LIGHTHOUSE

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Cover

TRIPLE ISLAND LIGHT STATION
Triple Island, British Columbia
Graham Scholes

The Triple Island light station was one of the most difficult engineering projects the Department of Marine and Fisheries undertook. It required more than 3 years and several contractors before it was completed in 1920. The station was put into operation on or about January 1, 1921. Along with the light, a diaphone fog alarm was provided in the original structure. The physical structure of this isolated station has changed very little and is known to the keepers as the "The Rock" or "Little Alcatraz".

Triple Island
Image size 11" x 8"
Paper size 13 3/4" x 10 3/4"
Printed 11 colours

Triple Island Light
54° 18' N Lat.
130° 53' W Long.

The light was established as an aid to marine traffic traveling from the Inside Passage to Alaska and ocean ships bound for Prince Rupert.

Due to the severe weather when visiting this station on board the CCS Bartlett, I chose not to try and negotiate the leap from the surf boat to the slippery shore. The seas were heavy, so I spent the time sketching the station using binoculars to capture the reference material I required.

For more information, please contact Graham at:
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Editors' Note / Note des rédacteurs

We are very pleased that *Lighthouse* has been asked to play a prominent role in the 2004 Canadian Hydrographic Conference (CHC 2004) which will take place in Ottawa, Ontario, from May 24 to 27, 2004. Further details can be found on pages 43 and 51 in this edition of your journal. We look forward to being part of this historically significant conference as 2004 marks the 100th anniversary of the Canadian Hydrographic Service (CHS), although from 1904 to 1928 it was officially known as the Hydrographic Service of Canada. *Lighthouse* is proud to be part of this celebration and to honour the event we will publish a number of articles related to the history of the CHS in this edition, as well as in edition 65 which will be released, with the program, at the 2004 conference.

We, the editors of *Lighthouse*, look forward to this conference as it gives us a unique opportunity to talk directly to many members of our Association, (regular, international and corporate) advertisers, subscribers and others who are benefiting or could benefit from becoming part of our journal and/or the Association. We look forward to seeing you in Ottawa.

We are also very grateful for a new level of support for our journal that we will receive from the CHA. A proposal recommending a level of support was submitted to the National President in July and we are pleased that our submission was approved. In addition to a modest financial contribution, we are thankful for other commitments of support that the CHA will provide. It is important for us, as editors, and recipients of our journal, to be aware that the National office of the CHA recognizes that *Lighthouse* is an important and significant part of our organization. With this support and encouragement, we have some assurance that *Lighthouse* will remain healthy and we can continue to provide our readers with a journal that is displayed proudly on desks around the world.

We continue to welcome your letters and comments. Please do not hesitate to send us a note. Rake us over the coals if you feel we are not providing what you want as a journal – give us new directions if you believe we need them – or better still, provide an article for publication. We believe there are many exciting things happening in the Hydrographic community and that these activities should be made known to your colleagues around the world. Share your excitement and relevant information with all of us who are proud to be part of this rapidly evolving world of hydrography.

Earl Brown and Paola Travaglini

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Message from the National President
Mot du Président national

In my message in *Lighthouse* edition 63, I identified three main goals for CHA and a number of "hows" to help us reach those goals. The number one "how" was to foster Continuing Professional Development (CPD) through the delivery of conferences, workshops and educational courses. As of the time of this writing, we are very much involved in the number one "how", with final preparations underway for the ACLS-CHA Offshore Seminar, part of the CIG Geomatics 2004 pre-conference events in Calgary, Alberta. The joint ACLS-CHA committee responsible for organizing the seminar has also collaborated to prepare an extensive revision of *Offshore Management 1989*, a text by Capt. Proshanto. K. Mukherjee of the Canadian Hydrographic Service. The new document will serve as a study guide for candidates challenging the Canada Lands Surveyor Examination on Property Rights Systems on (Offshore) Canada Lands. The day after the seminar, CHA will be co-sponsoring the 2nd ACLS Offshore Consultation Workshop at which time a report on the UNB-FIG Meeting on Marine Cadastre will be presented.

What's great about these events is that we are involved both nationally and at the branch level with representation from Pacific, Prairie Schooner, Central and Ottawa branches.

With Canada's ratification of the United Nations Convention on the Law of the Sea (UNCLOS) on the horizon, it is our hope that these activities will help educate and hopefully prepare surveyors and other stakeholders in our inshore and offshore Canada lands for what may be in store in the near future.

Andrew Leyzack

CIG - Canadian Institute of Geomatics
ACLS - Association of Canada Lands Surveyors
UNB - University of New Brunswick
FIG - International Federation of Surveyors

Dans mon dernier message, j'ai identifier les 3 buts principaux pour ACH et un certain nombre de « comment » pour nous aider à atteindre ces buts. Le premier "comment" était pour favoriser le Développement Profesionnel Continue (DPC) lors de conférence, atelier de travail et formation. Au moment de cet écrit, nous sommes activement impliqué avec le « comment » numéro un, avec les préparations pour le colloque AATC-ACH traitant du territoire au large des côtes, durant ACSG géomatique 2004, à Calgary en Alberta. Ce comité conjoint AATC-ACH responsable pour l'organisation de ce colloque a aussi collaboré a une révision élaborer du rapport Offshore Management 1989 par le Capitaine Proshanto K. Mukherjee du Service hydrographique du Canada. Le nouveau document servira de guide d'étude pour les candidats se préparant aux examens du ATC traitant des droits territoriaux aux larges des terres canadienne. Le jour suivant le seminar, ACH sera le co-commanditaire du 2ième atelier consultatif AATC auquel un rapport sera présenté sur les rencontres UNB-FIG traitant de cadastre maritime.

Qui-a-t'il de spécial à propos de ces évènements? Nous sommes impliqués tant au niveau national et dans les différentes branches avec une réprésentation du Pacifique, Prairie Schooner, centre et Ottawa.

Avec la ratification par le Canada dans la convention des Nations Unies sur le droit de la mer (UNCLOS) à l'horizon nous espérons que ces activités vont aider à l'éducation et à la préparation des futurs appenteurs et des groupes d'intérêts dans la détermination des zones de rivages et aux larges des terres canadiennes.

Andrew Leyzack

ACSG - Association Canadienne des Sciences Géomatiques
AATC - Association des arpenteurs des terres du Canada
UNB - Université du Nouveau-Brunswick
FIG - Fédération Internationale des Géomètres

DID YOU KNOW . . .

DRINK TOAST SEATED

British naval officers have the privilege of remaining seated when drinking the toast "THE KING."

This is because when Charles the Second of England was rising to drink a toast while dining aboard a ship of the line, he bumped his head on one of the overhead beams.

The royal monarch took the accident in good part, laughing heartily with the rest of the guests; but he decreed that from that time on, officers drinking the royal toast could remain seated without incurring regal displeasure.

FIFTY YEARS LATER . . . WINNIPEGOSIS 1953

The Story of the Setting Up of a New Survey and the Introduction to Survey Work of a Would Be Hydrographer

By: Sidney van Dyck

I joined the Canadian Hydrographic Service (CHS), as field staff, in January 1953. For the first few months I was assigned to the Compilation Section under Ernie Leslie. I did not do or learn anything of great importance, but did get a feel of what hydrography was about.

Toward the end of March, or early April, I was assigned to a field establishment. This was a new field party which would start a survey of Lake Winnipegosis in Manitoba. Party chief was Paul Radakir who had considerable experience in field surveys. He had been in charge of other field surveys prior to this one. I was his only assistant. My background was university mathematics and physics. I had no field survey background or knowledge. I was, however, familiar with the theory and use of many types of instruments, none of them survey instruments. It would be up to Paul to make a useful hydrographic surveyor out of me.

I have very little recollection of the preparatory work that was done in Ottawa prior to departure for the field. Paul had all these matters in hand and, I suppose, he gave me things to do that he thought I could handle. He left for Winnipegosis about two weeks before I did in order to make all necessary local arrangements. These would include the hiring of seamen, and the arranging of accommodation and eating facilities for the two staff members. He was concerned about our launch, the 'Sandpiper', arriving there on time and modifying it for our needs. A jetty had to be built. Contact had to be established with local people that could be of help to us in our endeavors. These were all things in which I could not be of any real help to him.

When I arrived in Winnipegosis it was obvious that Paul had wasted no time. He now had a full survey establishment. There were six of us altogether.

First, there was Paul Radakir himself. He had been with the CHS for 22 years, since 1930. He was French Canadian and may have called Ottawa his home from early childhood. His task was to set up a viable survey party where none had been before. I was his one hydrographic assistant and I had no survey experience. I do believe Paul had convinced himself that I was capable of learning and that I was willing to do so. He had to make sure that all the hydrographic survey equipment would be there and operational. He found good and workable office space for us in the upstairs of a temporarily unused shed. Winnipegosis was a fishing village where it would not be too difficult to find a crew familiar with the waters of the shallow lake. He came up with a crew of four that could not have been better chosen. They were diverse and it seemed we had someone for every need and for every problem.

Secondly, there was myself. My distant background was Dutch. I was born in Winnipeg (maybe that is why I was drawn to the sea), spent my formative years from 11 to 21 in Germany and had made Ottawa my home. I was fully aware that where surveying was concerned I had to start at the beginning and my best way of learning was to listen to Paul and basically accept him as "GOD" in his position. With that relationship established, he was a wise, thorough and patient teacher. He explained things well and was always open to questions. He expected me to come to him with problems. This may be as good a place as any to mention that there was no compensation for overtime worked and no field bonus. I only say this because today, 50 years later, it would be unheard of.

The most senior member of the crew was Lloyd Burrill (or Burrell). He was a young grandfather with his own fishing business and was hired on as Quartermaster (maybe Coxswain). Then there was Numi Stephanson, of Icelandic origin, who could do almost everything and who would later assist me in survey work. Alex (or Alec) was of Ukrainian descent, capable of all things we required of him. Finally there was Charlie Denby. The youngest, and as good a go-fer as could be wished for.

There was no runabout or even a rowboat to supplement the 'Sandpiper'. It was not really a launch at all but an elderly small lifeboat converted for our needs. She had a sharp bow, but also a sharp stern. Propulsion was provided by one Evinrude outboard motor, our only motorized means of propulsion. With a sharp stern, brackets had to be installed on either side, near the stern, to attach the motor. If the launch started rolling the end of the outboard motor with the propeller would move up and down. Our outboard motor was provided with an extended shaft so that the propeller would not come out of the water. This extended shaft often caused problems which might have been prevented if the shaft had been sturdier. The shaft consisted of a simple extension with no extra bracing. One time, with a really bad failure, the whole motor had to be sent back to its maker in Ontario for repairs. Rules forbade sending it by express, only freight was allowed. This would have set our work back at least two weeks. I do not remember how Paul overcame this one. There was a further problem of what to do in case of a breakdown while on the lake. We had no radio to let anyone know if we were in trouble. The answer must have been considered and a set of oars had been included with the launch. These were used only once. After that Lloyd, our quartermaster, carried his own small outboard motor with him and we were saved from further rowing.

Crew members Alex, Charlie Denby, Numi Stephanson and Lloyd Burrill, with "launch" **Sandpiper**, *on Mosy River.*

To be used as a sounding launch a small housing had been installed in the launch. Inside that housing there was room for a small plotting table, a place to set down the sextants while plotting, and a space for the note keeper and his notes. Our echo-sounder, a Kelvin Hughes 21A wet paper model, was attached to the wall. There were batteries (under cover) to power the echo-sounder, and a charger for the batteries. This was all we had and we made the most of it. It was workable but with very few creature comforts.

Paul Radakir on launch **Sandpiper** *with station pointers and sextant.*

To begin the survey, the first job was to establish horizontal control. This involved the building of survey stations. These were used as control points for the shoreline and, most importantly, for fixing the positions of depth soundings. Depending on the purpose for which they were used and the distance they needed to be visible, there were a variety of station types. Most of them were built with two-by-fours and one-by-fours and white-washed for better visibility.

The main stations most commonly constructed and used for triangulation were tripod type stations, with a vertical mast over the centre of the station. The legs were either nailed to stakes driven into the ground or, if the ground was rocky, nailed to a platform weighted down by rocks to prevent them from moving. The mast had to be vertical and straight and was usually topped by a coloured flag. Flags of different colour were used to make it easier to identify the station from a distance. If the station was built over an existing, previously marked point, it was essential that the mast be precisely centred on that point. Experience was rapidly gained in doing this properly. The top of the tripod, the main portion of the station (or beacon) was enclosed with spaced one-by-fours for better visibility. It was also built in a manner that the surveyor could put up his transit theodolite inside the beacon to make all necessary observations for the triangulation network. The lumber used for all construction was coarse cut lumber. Coarse cut lumber was used because whitewash applied to it stayed in place and was not easily washed away.

At times a normal beacon would not be high enough to see over the top of an obstacle, such as a treed island, to a distant station to be observed. We were fortunate to have this problem only once. The answer was to build a survey tower. This type of tower really consists of two towers. The inner one was built strictly for the theodolite. The support of this instrument on a solid platform was essential for error-free observation. Again, the centre had to be precisely over an existing mark, or where we would leave a permanent marker. The outer tower was for the observer to move around and not disturb the theodolite when it was set up. In addition, a mast had to be erected over the centre of the fixed position on the ground. This mast could well have disturbed the solidity of the construction if it were attached to the inner tower. Yet it had to be precisely over the fixed position because the mast would be the target sighted on from other stations. As I recall, that tower took us two days to construct because we had no experience with towers.

When long distance visibility was not required a simpler station was constructed. This type was referred to as a 'flop'. It was called that because it was constructed to allow the mast to 'flop' over. The mast, as with other stations, was a two-by-four with a flag or cross pieces of boards at its top. The bottom was nailed to a base, held down by rocks or stakes driven into the ground. The mast was sitting about an inch or two above the station marker and was held upright by two supporting boards which could be detached from the mast and which then allowed the mast to 'flop'. These three types of stations were used for all our control work.

To position the launch while sounding it was necessary to establish additional sounding marks that also needed to be well and precisely positioned. The most common of these were referred to as white-washes. As the name implies, they were features that were smaller than most other stations and were given a coat of white-wash to make them visible in the sounding area. Most of the time they were large rocks. Lake Winnipegosis was in a flat country and rocks could not always be found where they would be useful. It was then left up to anyone's imagination on how to make selected points visible. The fanciest would be a small (three to four foot high) wooden pyramid. A slight problem in observing occurred at times when a 'white-wash' on shore turned out to be a pelican. Other sounding marks would be cross pieces of boards nailed to a free standing tree. Anything that would be visible was accepted. Prominent objects such as church spires, grain elevators, gables of prominent buildings and of course fixed navigation lights made excellent sounding marks. These were usually visible from a long way off and were easy to identify.

The next part of the job was to properly position all the survey stations and sounding marks. The method we employed was triangulation. For this, an established starting point was needed. Much earlier, during the survey of dominion lands, many control points had been established and some of them marked. These points had been marked by wooden pegs and were often made easier to find by doing something to draw attention to them such as a small cairn of stones nearby, or more wooden stakes arranged in a pattern about them. Some of these points were easy to find and others required much guesswork. Additionally, the positions (latitude and longitude) of these points, or at least most of them, had gone through a series of position adjustments and it was necessary to ensure that all positions we were going to use came from the

Sid van Dyck observing angles at a main triangulation station.

same adjustment. We were fortunate that a few points from later surveys, done by Topographic Survey, were available in the area. It was Paul's decision which ones we could or should use. Having decided which baseline we were going to use for our triangulation, we had an accepted fixed point and a fixed distance between two stations to start our work. We would establish the positions of all our control points by using a series of triangles based on our starting baseline. Other methods of establishing control, by traverse or trilateration, were not even considered. At that time there existed no practical distance measuring devices.

Our instrument for measuring angles, as required for triangulation, was a three foot-screw K & E (or similar) transit theodolite. Paul introduced me to this instrument, of which I had earlier only seen pictures on the drafting table in our office. He did a thorough job explaining all I needed to know at the beginning. After an hour or so he took me outside. There, on the side of our little river, he showed me how to set up the tripod, to centre it over a given point and to level the transit. He watched closely as I used first one circle and then the other. The method of reading the angles with an attached microscope on a vernier scale (which could be read to degrees, minutes and the nearest 10 seconds) was drilled into me. Then I was shown the method of note keeping. By lunch time these efforts were completed. After lunch my 'job' was to go to a nearby survey station and practice everything I had been shown in the morning. I spent four or five hours at that station and in the end felt quite comfortable with the procedures required. The few questions that arose were sorted out by Paul when I came back to the office. The same transit was later used to establish the level of the water level gauge from a topographic bench mark.

Once the observing started, Paul took part with some of the trickier situations but in general left the observing to me while he did the computation of the quadrilaterals and triangles in the office. Numi was a capable and conscientious note-keeper and a big help in spotting points that might be useful in controlling the sounding area.

It may here be of interest to mention the different accuracies that were used in observing the stations. For main triangulation the standard was two pointings on 'face left' and two on 'face right'. To establish the positions of white-washes we were normally content with one 'face left' and one 'face right'. Other sounding marks might be positioned with the sextant, as later were the sounding fixes. If for some reason a more accurate angle measurement was required it would be done by 'winding up' the angle. A sighting was made on the first (zero) station and then a sighting on the second station. This angle was recorded. By alternately using the lower and upper plates of the transit, the angle was wound up five times. The final reading would be five times the true angle and divided by five would give the true angle with greater precision than just one reading. This would in effect improve the reading accuracy that was otherwise restricted to 10 seconds. The reading of the first sighting would help to determine how many times the full circle of 360 degrees was included in the final reading. We observed for magnetic north at all main survey stations.

While this was going on, work was being done in the chartroom. Following is a quick description of the survey documents in normal use there.

Field sheets: A completed field sheet is the final product of a field survey. It displays all survey stations, sounding marks, prominent objects, lights, buoys, soundings and depth contours of the whole survey area. All this is drawn onto a sheet that has been prepared in the office prior to departure for the field. The projection, in our case a Polyconic projection, had been plotted, with regular latitudes and longitudes, onto a sheet constructed of linen backed heavy paper. This projection formed the basis of all the other plotting work. Unfortunately this linen backed paper was not very stable and distortion was expected. All latitude and longitude intersections were plotted in the office in as short a time as possible and preferably during a period of relative stable temperature and humidity conditions. Usually this was a morning's work and after checking that no mistakes had been made, was accepted as the final truth for all future work. The plotting was done using a brass diagonal scale which allowed setting of distances on the sheet to 1/1000 of an inch. The positions of all other work were then fitted into these intersections. All survey stations, for which latitude and longitude positions had been computed, were plotted within the grids, again with use of the diagonal scale, to the nearest 1/1000 of an inch. Sounding marks were often plotted using measured angles from the higher accuracy stations.

Boat boards, the sheets on which sounding fixes and other information was plotted on the launch, were a copy of the field sheet. This included all the survey stations, sounding marks and other pertinent information for the particular area in which work was being done at a given time. Boat boards were made on the clean backs of cancelled charts. These old charts were used because they were made of a high quality paper; paper, that in navigation on board ships and boats, would have to withstand hard use, even water spray and other abuse, without falling apart or distorting too much.

Transferring positions from the field sheet to the boat boards was done with the aid of blue tracing linen. This linen was reasonably stable and transparent enough to copy what was underneath it. The information was transferred with pinpricks to another sheet. To make these pinpricks more visible, 'kieling paper', a form of high quality carbon paper, was used. This would show up the pin prick or a scratch line as a well defined blue dot or a very fine blue line. The same tracing linen was used for collector sheets in the office. Sounding fixes and much other information was collected on these sheets before being transferred to the field sheet.

Sounding operations usually consisted of running lines of soundings. The echo sounder would give a continuous profile of depths along these lines. It was good practice to run these lines at right angles to the anticipated contours. As a rule this meant running lines at right angles to the shoreline. The pattern of lines was laid out in the office and the lines drawn on the boat board before the day's work. When sounding, one attempted to follow these predetermined lines as closely as possible. If too much space was left between the sounded lines a 'splitter' had to be run to fill in the space. Running sounding lines consisted of continuously 'fixing', i.e. determining and plotting the position of the launch on the boat board and giving the coxswain course corrections to keep the launch on line. Fixing the position of the launch was done by sextant angles. Two angles to three stations, in a proper pattern, would give three lines of position. The angles would be plotted using a clear plastic station pointer on which, with the help of verniers, the measured angles could be set close to the nearest minute. Taking a fix required the two angle takers to coordinate and observe the required angles simultaneously. When both angles were being tracked, the second angle taker would shout 'ready' then the first angle taker would shout 'fix'. At the same time, the operator of the echo sounder would press the 'fix' button on the echo sounder which would leave a mark on the sounding graph. The first angle would be read and called off. The first angle taker would set the angle on the station pointer then the second angle taker would record that angle in the sounding notes and give the second angle for the station pointer and record that angle also. The position would be plotted on the boat board. If necessary the course of the launch would be adjusted to stay on the line. Then stations to be used for the next fix were selected. This procedure, with a short break for lunch, carried on all day. Having left the wharf at 8 a.m. we would head for home to arrive there in time for dinner at about 6 30 p.m.

At dinner in the little restaurant, Paul and I would talk over the day's work and I would be told the plans for the following day. After a quiet meal it was back to the office to finish off the day's work. At this time Lloyd too would be down at the launch preparing it for the next day. He ensured that the 'Sandpiper' was gassed up, that the batteries for the sounding machine were charged and that the launch was secure for the night.

My evening's work after a day of sounding was to first of all look after the echo sounder graph. This was a wet-paper sounder and the paper had to be rolled out to dry. In drying, the paper would turn dark and the echogram would later be hard to read. It was therefore necessary to pencil in the sounding profile while it could still be seen. That way it could be retrieved later when we had the chance to scale the soundings. Drying of the sounding paper resulted in shrinkage of the paper and the actual scaling would be done with a scale available for the reduced size of the paper. A leadline check for the correct depth had been made over a flat area at the beginning and end of the day. This was necessary to confirm the correctness of the echo sounder and the scale.

The next job was to check any doubtful sounding fixes on the boat board and either adjust, or if need be, discard them. Then the day's fixes would be transferred to the collector sheet. This was the same sheet used to transfer data from the field sheet to the boat board. All the sounding fixes and other pertinent information were transferred to the collector sheet. Because sounding lines could, and often did overlap, or cross each other, they were recorded with a different colour ink for every day of the week. Once that was finished it was easy to see exactly which areas had been sounded, where splitters of sounding lines were required and where the next day's soundings were to be run. The proposed sounding lines for the following day were then transferred to the boat board. If the same boat board was not suited for the next day a new one had to be made.

With all things being completed it was time to call it a day. This meant either heading for the hotel room to get rested up for the next day or maybe to stop off at the tavern for a quick beer. Winnipegosis was a small, rural town and the people very sociable. They would always welcome you to their table. In those days there was no place in Manitoba with a public bar that served anything other than beer. Men only were allowed in the tavern. If wives or other females were to accompany their men, they were left in a 'waiting room' next to the tavern. There was absolutely nothing for them to do other than sit and wait until their man was ready to leave. How much this added to a happy home life can be left to the imagination. In the tavern itself brawls, though rare, did occur. Generally the bartender would sort this out. If, however, it got out of hand, there was an RCMP detachment within half a block. The Mounties never had any difficulty in restoring order. Incidentally, the tavern was the reason for the existence of the hotel; the only reason it had its license. At times, going to bed early would not mean a quiet night. Sound carried only too well.

We had breakfast, as all meals, in the only restaurant in town. It too was in the hotel where we stayed. Paul and I usually had breakfast together and were always ready to get to the 'Sandpiper' in time for the day's work which was only a two minute to walk from the hotel. The breakfast was substantial and the service friendly. Paul always started off with a cigarette which resulted in a deep down cough; then we had a bit of chit-chat. Whenever I was going to be away for the day my lunch was brought to me and then we were ready. The owner of the restaurant was also the cook. She was a woman with two small children, a husband who had deserted her long ago, and a heart of gold. This poor woman held a job that required her to be there seven days a week and about 16 hours a day. It was not surprising that on the occasional weekend she would close the place for a well deserved change. She did however feel responsible for my food and always left me the key to the restaurant and kitchen. I could then go in and cook whatever I liked. Needless to say those were the worst meals of my stay in Winnipegosis.

On foul weather days we would not go out. This was the time to catch up with other office routines; one of which was scaling the sounding rolls. To do this the fixes were transferred to the field sheet and we could determine the number of soundings that were to be inserted between the fixes. Usually there were four to six soundings. The intervals were marked on the field sheet with proportional dividers. The same dividers were used to divide the distances between the fixes on the sounding graph. We were not in a tidal area and the water level of the lake did not change much in the course of one day. We applied the reduction to the soundings, as read from a water level staff, directly to the sounding graph and scaled the soundings 'reduced to lake level'. This saved an extra step later when inking the soundings onto the field sheet.

When the scaling of soundings was done but the working day was not yet over, Paul would introduce me to the computation of the triangulation network. The method of setting up the quadrilaterals and triangles to be used to best advantage was explained as were the computations on the available forms. All computations were done with seven-place logarithms. Adjustment of angles to fit trigonometric requirements was dealt with in detail. I had no problem with this routine as it followed strict mathematical principles. After triangle computations were completed, the best values were used to compute geodetic positions for all our survey stations. Again there were forms provided for these position computations. The necessary tables for values to be used in these forms were on hand. It was all rather interesting, even though I had no idea how the fixed values in the tables had been established. I had no problems learning how to use them. I did not, at this time, learn how to do an 'inverse solution', i.e. compute the distance and azimuth between two given stations. There was no form for this and Paul took this work upon himself. On days when there was nothing to prepare for the next day we closed down the shop in time for dinner.

Once the weather started turning bad and work on the lake became difficult, we finished up some small survey jobs that had been left for just this time. Paul had another look around to see if we had missed anything. Then it was time to pack up the survey and go home. Paul expected, rightly so, that he would return the following year. He sent me home after we had finished packing and shipping all our survey records to Ottawa. Paul stayed on for a short while to ensure that all survey equipment and gear, which could be stored for the following season, was properly stowed so that it would not suffer damage through the winter.

I was happy to head back home. My first season had been a good one. I had learned a lot and knew that I would want to carry on in this profession. I do not really remember the trip home. There certainly was nothing to do on the train but enjoy the scenery as much as possible when one's thoughts are already at home. Arriving back in Ottawa I took a few days off before reporting back to work. Hydrographic headquarters for all hydrographic personnel, with the exception of the West Coast, was in No.8 Temporary Building. This war-time building was on Carling Ave., a few minutes walk from Dow's Lake. Coming back there, it felt as though nothing had changed. The cafeteria was still in the same place, dispensing the same foods and being at times short of coffee spoons. What was new, were the stories that all the other hydrographers had to tell. They had been to all parts of the country and experienced many new things. I now understood more of what they were talking about but I also realized that there was still very much for me to learn.

This article may not be correct in every detail, but it is correct to the best of my memory. After all, this took place almost exactly 50 years ago and memory, as is well known, can be very selective. This does not however do away with the basic intent of accurately recording past occurrences.

Sidney van Dyck retired from the public service in 1988. Today he is very much involved with "Friends of Hydrography", a volunteer group, as part of CHA, preserving historical highlights of Canadian hydrography. Please visit Friends of Hydrography at *www.canfoh.org*

S-44 and Multibeam Echosounding

By: Stephen B. MacPhee, International Hydrographic Management Consulting (IHMC) Ltd.
Rob Hare, P. Eng, C.L.S., Canadian Hydrographic Service, Pacific Region

The purpose of this paper is to discuss the International Hydrographic Organization (IHO) S-44, 4th Edition (1998) Standard for Hydrographic Surveys and to suggest changes to make it more effective as an operational standard for multibeam echosounder (MBES) surveys and as a standard for the equipment manufacturers.

Background

Standards for Hydrographic Surveys – S-44

In late 1993, by Circular Letter 20, the International Hydrographic Bureau (IHB) requested Member States' participation in the rewrite of the 3rd Edition of S-44 (1987). The S-44 Working Group was formed and tasked with developing a standard that took into consideration the requirements of the end user (mariner) while also taking into account the current (1994) and future capabilities of hydrographic data acquisition technologies. The 4th Edition of S-44 (International Hydrographic Organization, 1998) was officially released in April 1998. In developing this edition, the principal aim was to specify minimum standards so that users could be confident that all data collected after this date was collected to a minimum defined accuracy in terms of depth and spatial uncertainty. It is understood that while the 4th Edition was published in 1998, much of the text was prepared in the 1994-95 period when there was much less operational experience with MBES surveys than is the case today.

As stated by one of the authors in an earlier publication (Hare, 2002), the 4th Edition of S-44 represents a quantum leap from earlier editions introducing for the first time the concept of multiple orders of survey to meet the needs of different end users. There was an attempt to remove the dependency on scale-based measures for quantifying horizontal accuracy and to consider the degradation in accuracy (and mariner risk) with increasing depth. There is the addition of requirements for seafloor coverage and target detection in the higher survey orders. Finally there was the requirement of hydrographic offices to provide realistic depth and position error estimates as sounding attributes. While fully acknowledging the strong effort put forth by the Working Group who prepared the 4th Edition, this paper is designed to stimulate interest in beginning work on a 5th Edition of S-44, particularly in the area of MBES surveys and target detection. Dave Wells and David Monahan have already provided a comprehensive review of S-44 as a hydrographic standard focusing on depth measurement uncertainty (Wells and Monahan, 2001).

Standards in a Number of Countries

During the time the 4th Edition of S-44 was being worked on and in the intervening period, a number of countries had been active in developing their own standards for hydrographic surveys. John Hughes Clarke discusses the work carried out by many of those countries up until 1999 in his paper prepared for Land Information New Zealand (LINZ) (Hughes Clarke, 1999). Two of the agencies that have provided considerable information are LINZ (LINZ, 2001) and National Ocean Service (NOS) of the National Oceanographic and Atmospheric Administration (NOAA). A summary of the standards provided by these two agencies is shown in Figure 2. In terms of being used as a standard, there is little difference between LINZ and the 4th Edition of S-44 with respect to the accuracy requirement. The one important difference, however, is that the LINZ specification is much clearer in specifying the requirements and closely links the accuracy requirements for single beam echosounder (SBES) and MBES surveys and also shows the differences.

The NOS standard (Office of Coast Survey, 2003) is also very clear and simple in its presentation. As written in the summary in Figure 2, the NOS standards for accuracy of measured depths apply to all methodologies whether by SBES, MBES, lead line or diver investigation. The specifications for MBES are very clear with one appreciable difference from the LINZ specification — swath width for full bottom coverage. The LINZ specification requires a swath coverage of 200% for MB Special and 100% for MB-1 and MB-2 whereas the NOS specification is for 100% coverage for beams meeting the accuracy criteria. A number of standards from other countries have been reviewed but for the most part the only differences are: higher accuracy is specified for Special Order surveys; variation in the number of strikes or pings required on targets in the along track direction and in the across track direction, and variations in the target specification. Most of the specifications reviewed are clear in terms of interpretation.

Table 1 from S-44, 4th Edition, 1998

ORDER	Special	1	2
Examples of Typical Areas	Harbours, berthing areas, and associated critical channels with minimum underkeel clearances	Harbours, harbour approaches, channels, recommended tracks and some coastal areas with depths up to 100 m	Areas not described in Special Order and Order 1, or areas up to 200 m water depth
Horizontal Accuracy (95% confidence level)	2 m	5 m + 5% of depth	20 m + 5% of depth
Depth Accuracy for reduced Depths (95% confidence level) (1)	a = 0.25 m b = 0.0075 m	a = 0.5 m b = 0.013 m	a = 1.0 m b = 0.023 m
100% Bottom Search	Compulsory (2)	Required in selected areas (2)	May be required in selected areas
System Detection Capability	Cubic features > 1 m	Cubic features > 2 m in depths up to 40 m; 10% of depth beyond 40 m (3)	Same as Order 1
Maximum Line Spacing (4)	Not applicable as 100% search compulsory	3 x average depth or 25 m, whichever is greater	3-4 x average depth or 200 m, whichever is greater

Figure 1. Summary of Minimum Standards for Hydrographic Surveys

(1) To calculate the error limits for depth accuracy the corresponding values a and b listed in Table 1 have to be introduced into the formula:

$$\pm\sqrt{a^2 + (b * d)^2}$$

with

- a — constant depth error, i.e. the sum of all constant errors
- b*d — depth dependent error, i.e. the sum of all depth dependent errors
- b — factor of depth dependent error
- d — depth

(2) For safety of navigation purposes, the use of an accurately specified mechanical sweep to guarantee a minimum safe clearance depth throughout an area may be considered sufficient for Special Order and Order 1 surveys.

(3) The value of 40 m has been chosen considering the maximum expected draught of vessels.

(4) The line spacing can be expanded if procedures for ensuring an adequate sounding density are used (see 3.4.2) [Author's Note: Section of S-44]

The rows of Table 1 are expressed as follows:

- Row 1 "Examples of Typical areas" gives examples of areas to which an order of survey might typically be applied.
- Row 2 "Horizontal Accuracy" lists positioning accuracies to be achieved to meet each order of survey.
- Row 3 "Depth Accuracy" specifies parameters to be used to calculate accuracies of reduced depths to be achieved to meet each order of survey.
- Row 4 "100% Bottom Search" specifies occasions when full bottom search should be conducted.
- Row 5 "System Detection capability" specifies the detection capabilities of systems used for bottom search.
- Row 6 "Maximum Line Spacing' is to be interpreted as
  - spacing of sounding lines for single beam sounders, and
  - distance between the outer limits of swaths for swath sounding systems.

Implementation Order and Agency	a	b	Allowable depth errors in metres at different depths at 95% confidence level				
			10	20	50	100	200
IHO Spec. Order	0.25	0.0075	0.26	0.29	0.45	0.79	1.52
IHO Order 1	0.5	0.013	0.52	0.56	0.82	1.39	2.65
IHO Order 2	1	0.023	1.03	1.1	1.52	2.51	4.71
IHO Order 3	1	0.023	1.03	1.1	1.52	2.51	4.71
LINZ SB SO*	0.25	0.0075					
LINZ MB S	1.0(LINZ SB SO)		0.26	0.29	0.45	0.79	1.52
LINZ MB-1	1.5(LINZ SB SO)		0.39	0.44	0.68	1.19	2.28
LINZ MB-2	2.0(LINZ SB SO)		0.52	0.58	0.9	1.58	3.04
LINZ MB-3	2.5(LINZ SB SO)		0.65	0.73	1.13	1.98	3.8
Overlap (that part of swath meeting accuracy standard), 200% swath to swath coverage for MB S, and 100% for MB-1, MB-2 and MB-3. Maximum distance for 3 along track and 3 across track strikes on target; 2.5% of depth for MB S, 5% of depth for MB-1, 10% of depth for MB-2 and 20% of depth for MB-3. Target specified, 1m for MB S, 2m for MB-1 and MB-2 and 8m for MB-3 in water depths less than 40m.-*(LINZ SB SO means LINZ Single Beam Special Order) Maximum distance for three strikes along and across track; 2.5% of depth for MB S, 5% of depth for MB-1, 10%of depth for MB-2 and 20% of depth for MB-3.							
NOS-NOAA	0.5	0.013	0.51	0.56	0.82	1.39	2.65
NOS specifications applies to SBES, MBES, lead line or diver. MBES total sounding error applicable to swath widths of at least two times water depth (45° on both sides of nadir) with the allowance of swath widths of greater than two time water depth if stated depth accuracy is met. Shoal detection requirement, 2m x2m, horizontally and 1m vertically in water depths of 40m or less. For depths greater than 40m, minimum size of detectable target, 10%of depth for horizontal and 5% for vertical. Specification on strikes is that 3.2 strikes required in distance of 3m or 10% of depth, whichever is less in the along track direction. For full bottom coverage, line spacing to be such that the portions of the swath meeting the accuracy and resolution requirements overlap.							

Figure 2. Comparisons of Allowable Depth Errors from S-44, LINZ and NOS

Multibeam Echosounder Surveying

MBES surveys are not new. The early systems were developed in the 1960s for military applications. One of the first systems to be installed on a research vessel was the SeaBeam System installed on N.O. JEAN CHARCOT in 1977. The early installations were deep sea bathymetric mapping systems with a small number of beams - sixteen 2.7° beams for the first SeaBeam system (Lurton, 2003, p.234). MBES systems for shallow-water mapping were introduced in the early 1990s. Modern systems may have over 500 formed beams, ensonify a swath of more than 7 times water depth and have sidescan sonar capability.

MBES systems have been used extensively in a production mode for ten years or more in a number of countries including Norway, Denmark, Canada, United States, Australia, New Zealand, Germany, France and others. There are many reports that testify to their accuracy and performance as a replacement for single beam systems to enhance data extraction and to reduce data gaps. Furthermore, equipment manufacturers have reported on various equipment trials and the accuracy of their multibeam systems.

While the MBES systems have demonstrated high quality with respect to meeting the IHO standards on depth accuracy, the same has not been true in the case of target detection. From field trials carried out to date, there have been problems in meeting the target detection criteria set out in S-44 (Kjersti et al, 2003) (Scibilia, 2003) particularly at speeds in excess of 5 Kn. One of the basic differences between the accuracy trials discussed earlier and the detection trials is that for the accuracy trials, much of the information is based on empirical models while these two sets of trials on target detection were carried out using actual targets in various water depths and vessel operating speeds. It is felt that, while many improvements are currently underway by the manufacturers to meet or exceed the criteria, one of the major issues is the type of target specified, i.e. a cubic target of one or two metres with no specification on the target material and a lack of clarity on how the standard is to be applied.

Issues With Respect to the S-44 Standard

Lack of Clarity

The specification lacks clarity for MBES surveys in a number of ways:[1]

- For Special Order Surveys, it is not clear whether it is intended that the $1m^3$ features be detectable to a depth of 40m or to a lesser depth.
- For Special Order Surveys, while it is stated that 100% search is necessary, it is unclear whether for MBES, this means to the limits of the swath coverage (100% coverage), to the limits of the beams meeting the depth accuracy standard or for a swath width providing 200% coverage (the outer extent of one swath is overlapped by the nadir beam of the subsequent swath, providing 100% redundancy in the overlapping area).
- For Order 1 surveys, a maximum line spacing of 3 x average depth or 25m, whichever is greater is stated. For MBES, it is stated that the maximum line spacing is to be interpreted as distance between outer limits of swaths for swath sounding systems (Figure1, Row 6). It would be more appropriate to specify in terms of coverage required, e.g., 100% coverage of beams meeting the depth criteria requirement or line spacing to provide 200% coverage or some other more definite criterion.

Target Selection for Measuring MBES Detection Capability

'In practical work, spheres make good reference targets for sonars when they can be used because their target strengths are relatively independent of orientation' (Urick, 1975, p.265). This statement was written years before the advent of shallow-water MBES systems. Nonetheless, because of the way in which the transmit and receive beam patterns in modern MBES systems are designed, it is equally applicable now. A cube is not considered to be an optimum target as it is highly directive in its response and depending upon the surface material will behave in different ways. An ideal target would be a target that would behave like a natural target behaves at different angles from the nadir. While natural targets ranging from mud to hard seabed to imbedded mines to sand waves to masts of shipwrecks present very different target signatures, it is felt that an important step would be made if cubic targets were replaced by spherical targets for determining MBES detection capability. Furthermore, it would be advisable to specify the targets in terms of acoustic impedance and other properties. As the physics of sound propagation at various frequencies is well known, it is also felt that consideration should be given to specifying a more manageable target size. In addition, the authors support a modelling approach that would examine target detection for varying size targets placed at different locations in the ensonified area over differing textures with some operational trials to verify the modelling.

Using MBES as the Sole Acquisition System

There is still some concern with respect to the use of MBES as the sole system for obtaining soundings. While a number of hydrographic offices have embraced MBES as a sole acquisition technology, many Hydrographic Offices have decided to operate SBES concurrently with MBES as a check on nadir soundings. In addition, sidescan sonar and magnetometers are towed and wrecks that are detected in depths less than 40m or some other specified depth are mechanically swept. Sector sonar search is also used by at least one Hydrographic Office. It is not considered necessary to operate a SBES system concurrently with an MBES system, but there is substantial merit in towing sidescan sonar as it is very effective in detecting anomalies that stand proud from the seabed. In the Introduction to S-44, it is stated that "Sidescan sonar equipment technology has also reached a high level of bottom obstacle detection and definition. Although at present, it is limited by the low speed (5-6 kn maximum) at which it can be operated." There have been many changes in sidescan sonar design over the past few years and the multi-pulse sidescan systems are capable of performing effectively at speeds up to 10kn or higher. S-44 specifies that "For wrecks and obstructions which may have less than 40m clearance above them and may be dangerous to normal surface navigation, the least depth over them should be determined either by high definition sonar examination or physical examination (diving). Mechanical sweeping may be used when guaranteeing a minimum safe clearance depth." It is suggested that the next edition endorse MBES as a stand alone bathymetry acquisition system but that sidescan sonar be towed to check for obstructions, especially when there are spaces between the sounding lines. Furthermore, while towed magnetometers are not mentioned in the 4th edition, their use should be encouraged when surveying in areas where there may be wrecks or mines. While MBES systems

[1] *One of the authors, R. Hare, a member of the S-44 Working Group, is fully aware of the intent of the group when the text was being prepared. The Lack of Clarity statements are, however, included to illustrate the difficulties that someone who wishes to use S-44 without benefit of being involved in the preparation process may encounter.*

are being endorsed as stand alone systems, it is fully recognized that for many years, SBES systems will also be used as stand alone systems on many surveys.

Estimating Periodicity of Resurveys

The 4th Edition of S-44 does not provide any guidance on the periodicity of resurveys in areas of unstable seafloor. In recent years, however, a considerable amount of research has been done on the use of Synthetic Aperture Radar (SAR) for monitoring changes in water depths over time and hence providing guidance on the time between resurveys. Under favourable meteorological and hydrodynamic conditions (moderate winds of 3 to 10 m/s and significant tidal currents of about 0.5 m/s), air or space borne SAR imagery shows features of the bottom topography of shallow seas in depths up to 30m (Hesselmans et al, 2000). The principle of this technology is the interaction between tidal flows and bottom topography resulting in modulations in the surface flow velocity. These modulations cause variations in the surface wave spectrum, which in turn cause modulations in the level of radar backscatter. The most important application of this system is seen to be in the field of depth monitoring along the coast and offshore sand banks and sand wave areas. Since these resurveys are time consuming and costly, every effort should be made to reduce their frequency while at the same time not compromising safety.

The Requirement for Bottom Samples

Much progress has been made in recent years in determining bottom texture acoustically and this is supported in S-44 (Para, 4.1, p.11). Obtaining bottom samples, particularly in deeper water is a time consuming operation and in water depths deeper than anchoring depths every attempt should be made to obtain seafloor information acoustically unless there is a specific requirement such as a military requirement to obtain samples. It is recognized, nevertheless, that some sampling is required to verify the information obtained acoustically.

Considerations for Other Data Uses

In addition to the requirement for navigation charting, there are many other uses for bathymetric data. These include: marine scientific requirements in disciplines such as aquaculture research, renewable resource surveys, habitat ecology, geophysical and geological research, ocean climatology; defence requirements; search and rescue requirements; and the requirements of fishermen, ecotourists and those involved in investigating non-renewable resources in the offshore.

Suggestions for Changes to S-44

The main suggestions for changes to S-44 are as follows:

- Ensure that the information provided is clear and easy to interpret. For example, in the 4th Edition to meet the Special Order it is unclear whether the 1m³ objects must be detectable to a depth of 40m or some lesser depth. Furthermore, the line spacing for MBES surveys should be more clearly stated.
- Update the information on sidescan sonar by stating that with multi-pulse sidescan, the maximum speed restriction is raised.
- Pay more attention to 'other users' of bathymetric information. It is particularly important that stress be placed on saving raw data including backscatter information whenever possible.
- Prior to producing another edition of S-44, ensure that information on the target detection standard is more detailed and that demonstration trials are carried out on representative targets that approximate natural conditions to ensure that the standard is achievable and meets the requirements.
- Provide the information in enough detail so that manufacturers can carry out a set of trials and publish results to demonstrate that their equipment is congruent with the standard.
- Provide guidance on use of analytical techniques and systems such as SAR to estimate the periodicity of resurveys.

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About the Authors...

Stephen B. MacPhee has many years of experience in marine science and hydrography in the government and in the private sector. He is currently a partner in a consulting firm, International Hydrographic Management Consulting (IHMC) Ltd. and over the past five years has been involved in the review of hydrographic programs, on Marine Electronic Highway studies and on underwater acoustics studies in a number of countries.

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DID YOU KNOW . . .

THE NORTH POLE

The North Pole is not owned by any country. The Pole is the earth's northernmost geographic point, located at the northern end of the earth's axis. It lies in the Arctic Ocean, more than 7,200 kilometres north of Ellesmere Island, at a point where the ocean is 4,087 metres deep and usually covered with drifting pack ice.

A spokesperson for the legal branch of the federal Department of External Affairs in Ottawa said that no country has ever attempted to prove legal ownership of the area around the North Pole. "States have particularly defined rights and no state has rights at that point. No one has ever tried to lay claim to the pole," he said.

FIG

Go F.I.G.ure

by Andrew Leyzack

International Federation of Surveyors (FIG) Annual General Assembly and Working Week April , 2003

The International Federation of Surveyors (FIG) is a UN-recognised, non-government organization (NGO) comprised of ten technical Commissions representing various surveying disciplines and activities. Commission 4, in particular, strives to represent the interests of hydrographic surveyors from every discipline through participation within their respective national surveying and/or national hydrographic associations. Commission 4 through FIG has formal relations with the International Hydrographic Organisation (IHO) and the International Cartographic Association (ICA).

In Canada, hydrographic interests are represented internationally by two streams: one, by way of the International Hydrographic Organisation (IHO), an intergovernmental organisation (IGO), whose interests are governed by the hydrographic offices of its member states and whose activities are primarily directed towards nautical charting; two, by way of FIG Commission 4, whose interests are governed by hydrographers in private sector, government and academia. FIG Commission 4 activities focus on the development of professional standards to assist hydrographers in the provision of their services and similarly good practice guidelines developed for and by the hydrographic community. As with the other FIG commissions, Commission 4 disseminates information relevant to the profession through participation in international meetings, conferences committees and working group publications.

Working Week 2003 was a forum for the Commissions to hold working group meetings, workshops and to communicate their activities through technical and poster sessions. The event was jointly hosted by the International Federation of Surveyors and member associations l'Ordre des Géomètres-Experts and l'Association Française de Topographie.

In participating at this event, I served two roles, one as a Canadian delegate to the General Assembly and the other as an officer in Commission 4.

General Assembly

More than 100 countries are represented in FIG by national associations, affiliates, corporate and academic members. At this year's General Assembly, 50 out of 88 member associations participated and as the Canadian National Delegate to Commission 4, I was temporarily called upon to represent Canada's interests until the Canadian National Chair from the Canadian Institute of Geomatics (CIG), Mr. Ken Allred, joined in during the second half of the session. In a UN-like setting we participated in a democratic process of voting on Federation issues. We were seated (in alphabetic order by country) between delegates from Cameroon and the People's Republic of China.

Working Week

The commissions prepare and conduct the programme for FIG's international congresses, held every four years, and annual working weeks, held in the intervening years. Working weeks combine meetings of FIG's administrative bodies with technical conferences organised by the commissions and the host member associations and as such provide the opportunity for commissions to implement and develop their work group programmes.

As a Commission 4 officer, tasked with administration and communications, I orchestrated an exhibit which focused on the activities of Commission 4's work groups. I also organised and recorded meetings held by the Commission and its working groups.

Federation under FIG – Potential Benefits to CHA

FIG, now 125 years old, and its traditional relationship with the International Hydrographic Organisation have, over the years, published many documents prescribing standards and best practice significant to Canadian Hydrography. For example, FIG/IHO/ICA accreditation of training programs has set the standards of competence for hydrographic surveyors and cartographers at many Canadian colleges and universities.

Should we join, the Canadian Hydrographic Association would benefit from direct input to and feedback from the activities of FIG Commission 4 and other commissions whose work is significant to hydrography. In particular, some of Commission 4's activities are carried out jointly with Commission 1 (Professional Practice), Commission 5 (Positioning and Measurement) and Commission 7 (Cadastre and Land Management). The topics of a common Vertical Reference Frame and Coastal Zone Management are not only on the forefront of international hydrography but are significant to Canadian hydrography and as indicated above are being lead by Canadian institutions. A current example is the recent University of New Brunswick (UNB)-FIG Meeting on Marine Cadastre Issues.

For information on the specific objectives of Commission 4 and its working groups, look up Commission 4 under : *www.FIG.net*

Lighthouse puzzler

By

Beth Weller

	Untethered boat	No helicopter fuel	Engine blew away	Chart blew away	Bernard	Bruce	Stacey	Tim	Spring	Summer	Fall	Winter
Atlantic Branch												
Pacific Branch												
Central Branch												
Section du Québec												
Spring												
Summer												
Fall												
Winter												
Bernard												
Bruce												
Stacey												
Tim												

Lighthouse Puzzler # 24

Four CHA members relaxing after the National AGM last year were recalling embarrassing situations from their earlier careers. Thinking about it during a particularly interesting technical session the next day, can you figure out whose team watched their untethered boat drift away in Halifax harbour and what time of year it was?

(Mark an "O" in the boxes for a yes and an "X" for a no. Each column and row will end up with one O and three Xs. Write the answers in the table as you figure them out.)

1. It was not winter when the team from Vancouver left their helicopter fuel at their base camp.
2. It was in the spring when Bruce's team went up the St. Clair River.
3. Stacey's team was back home by Labour Day.
4. Tim and Bernard are from neighbouring Regions.
5. Bernard's team spent three sub-zero hours waiting to be found after their chart blew away.

Solution to Puzzler #23

The person scraping the oars is a woman (clue 2) and is not Julia (also clue 2) so must be Terese. The person from New Zealand is a man (clue 3) and is not Andrew (clue 1) so must be John, and Julia must be the person picking oakum.

Terese, scraping the oars, must be the student from Ottawa, so, by elimination, Julia is the cartographer from Grimsby. Filling in the rest of the blanks gives us the rest of the story.

Rosie of the Chatham Bar, Monaco

By: Steve Ritchie (Rear Admiral, Ret.)

Rosie with her parents - April 1962

Eugene Bernard fought in the Italian army during World War I. A bemedalled veteran, he went to live in the Principality of Monaco after the War and got married. He opened a bar on rue Caroline and later moved to the Azure Bar near the entrance to the Exotic Gardens which had been created by Prince Albert I of Monaco.

Yet again Eugene moved to open the London Bar near the Hermitage Hotel. During Word War II Monaco was occupied first by Italian troops and then the Germans. The London Bar was closed by the War's end and Eugene had lost everything.

However, by 1946 he was back on his feet again to open a bar on the Avenue de Monte Carlo (now Avenue d'Ostende) just above the International Hydrographic Bureau which had been built on the quay in 1929.

A number of British naval vessels were still based in Malta and a flotilla of these, having their home base in Chatham in the south of England, visited Monaco. The sailors received a great welcome in the new Bar which was attuned exactly to their needs; thus did the Chatham Bar get its name.

In 1950 Eugene's daughter Rosie, leaving school, helped her father in the Bar for the summer season, but never left.

The railway used to rumble past the back of the Bar, but in 1969 it was diverted underground leaving the track to be transformed as a carriageway. To allow access to this new road Eugene was informed that his Bar was to be demolished, a blow which hastened his death.

By now the Chatham Bar had become a popular venue for visiting sailors, rally and grand prix drivers and their mechanics in season; the walls were adorned with ships badges, sporting car number plates and associated graffiti giving the place a unique character.

Leading figures in the motor racing world, including Graham Hill who had won the Monaco Grand Prix 5 times, and Stirling Moss, together with the Commander-in-Chief of the U.S. Mediterranean Fleet wrote to Prince Rainier pointing out that the demise of the Chatham Bar would leave many thirsty seamen and motor sports competitors wandering the streets in search of sustenance.

As Hydrographer of the Navy I wrote to the Prince championing the cause of hydrographers, for at conference times it had become the habit for delegates to meet in the Chatham Bar where, it was said with some truth, that difficult decisions on the floor of the Conference were often sorted out!

Both the Prince and Princess Grace took notice of our entreaties and the Government was directed to provide new premises for the Bar which were found about one hundred metres further up the Avenue d'Ostende.

Rosie was now on her own as patronne of the new Bar and she brought her unique personality, and her love of people, both old and young, which soon raised the ambience to that experienced at the old Bar; whilst the ever changing décor of ships badges and motor racing paraphernalia continued as before.

Chatham Bar, August 1988

Association was about to build a replica of the Admiralty launch which Joseph Bouchette had used to make the first survey of Toronto Harbour; *Surveyor* was to be used to demonstrate how the original survey had been made, 200 years earlier, during the 1993 Hydrographic Conference in Toronto. Would I, asked Earl, be prepared to give a running commentary on this occasion? In my genial mood this seemed a great idea; little did I know until I arrived in Toronto for the Conference that I was to be dressed up as an admiral of the period, with a pair of pantaloons particularly hard to find!

The walls were soon so covered that I remember one night when a Russian admiral stood on the shoulders of his chief-of-staff to write his autograph on the ceiling!

Many a hydrographer will recall his particular night of merriment within the Chatham Bar. One of my memories was during the 1967 Conference when Admiral Baptiste brought his Brazilian survey ship to Monaco. I was one of five admirals in the Bar that night, jumping up to samba music being hammered out on empty beer drums by a party of Brazilian sailors. Two of my junior officers were to meet me that night in the Bar, but on hearing the rumpus they thought there was trouble within and passed by on the other side.

One night in Rosie's during the 1992 Conference I was informed by Earl Brown, now the editor of 'Lighthouse', that the Canadian Hydrographic

In December 1971 a young man named Jean Louis who had been working at the Chaumier at the top of the town dropped into Rosie's for a coffee; Rosie suggested that he should stay and help her. His hobby, when he could afford it, was parachuting whilst he was wedded to his guitar.

Adam Kerr, Steve Ritchie and David Haslam in Chatham Bar, May 1992

There never appeared to be a closing time at Rosie's if things were going well. Sometimes Jean Louis would be playing his guitar long into the night.

In 1973 Rosie and Jean Louis married and they ran the Bar together for another 23 years. He died tragically of cancer in 1996 shortly before, for a second time, the Bar was to be demolished, this time to permit an extension to a major heart hospital.

Once again the Government was generous in Rosie's support finding for her a small boutique on rue Comte Felix Gastaldi in Monaco Ville, high on the Rocher.

Rosie in her boutique in Monaco Ville.

There you will find her, with her old guard dog from the Chatham Bar, selling decorative wall mountings from Italy, cards and souvenirs. Right next to her little shop is a restaurant with outside tables where you can lunch while chatting to Rosie about the great days and nights in the Chatham Bar.

About the Author...

Rear Admiral Steve Ritchie joined the Royal Navy Surveying Service as sub-lieutenant in 1936. He served with the 8th.Army in North Africa & Italy ; and as First Lieutenant of HMS Scott from D Day onwards charted the harbour at Arromanches as it was built. He commanded four HM surveying ships,was the Hydrographer of the Navy 1966-71, and President of the International Hydrographic Bureau in Monaco 1972-82. He is an Honorary Life Member of the Canadian Hydrographic Association.

Hydrographic Lidar Processing Moves into the Next Dimension

By Karen Francis and Paul LaRocque, Optech Incorporated, Toronto, Canada
Lindsay Gee and Mark Paton, Interactive Visualization Systems, Fredericton, Canada

Lidar hydrography has been in use world-wide since the mid-1980s, with current systems proving to have unique capabilities, particularly in shallow, hazardous and remote areas. The systems have also demonstrated their flexibility and mobility to respond rapidly to evolving requirements in both the coastal management and defense scenarios. As a result, the Lidar systems have found application across a wide variety of coastal mapping including navigation hazard identification, nautical charting, storm damage assessment, beach nourishment and design, navigation channel inspections and erosion monitoring.

As the technology has evolved the data rates have increased and algorithms are being developed to extract more information from the data. The airborne platform allows the use of a number of sensors to build on the efficiency of the Lidar system and its general mobility. This can include the addition of a digital still or video camera, a topographic Lidar and a multispectral scanner.

To complement the higher volumes and variety of data there has been a parallel evolution of the approaches to processing, driven particularly by the massive amounts of data from shallow-water multibeam systems. The original line by line based systems that required the inspection of every data observation are a thing of the past and cannot be supported with current data rates and resources. The whole data workflow of acquisition and processing is being automated and based on an area approach. However, this approach requires suitable tools to ensure that the automatic processes are validated and to guarantee the quality of the final products meets the required standards.

An effective area based approach needs to satisfy three important elements: a data structure designed for area processing; rigorous automated filtering techniques; and the integration of these capabilities within an intuitive and efficient 3D area based view of the data that allows rapid and accurate analysis as well as validation of the automated processing. The data structure must allow direct access from the area view to the full-resolution data stored in its native format, and occasionally during the validation this may require access to the Lidar waveform. Quality Control must be implemented throughout the workflow from planning flight lines through to automated processing and area based filtering to produce the accepted products. The 3D area based analysis and editing tools must be directly integrated with the unique Lidar processes from flight line planning and management to detailed Lidar point investigation and manipulation. The 3D application provides the benefit in a single interface of allowing integration and processing of all the acquired and other available data such as chart, aerial photograph and existing topographic and bathymetric models.

This paper describes the development of the latest generation Ground Control System (GCS) software for the SHOALS-1000 Airborne Lidar Hydrography (ALH) system. One unit has recently been delivered to the Japan Coast Guard and a second system with integrated 10 kHz topographic capability is scheduled for delivery to the US Naval Oceanographic Office this summer.

Introduction

Airborne Lidar hydrography (ALH) has developed into a mature technology that is used world-wide for a variety of applications, and provides a unique capability and rapid coverage in shallow coastal waters. The surveys by the existing systems have covered the world from clear tropical waters to the Arctic and Sub-Antarctic. The surveys have been undertaken for the update of nautical charts, maintenance of navigational channels, rapid environmental assessment in support of amphibious operations, emergency response, coral reef mapping and fisheries management.

The existing second generation ALH systems, developed in the 1980's have continued to evolve during the last decade. The volume of data and rate of acquisition initially challenged available computer technology and the traditional hydrographic approach to processing these data. However, with recent rapid advancements in high resolution mutlibeam sonar systems and computer hardware there has been a shift in the approach to data processing. The processing workflow is moving from the traditional highly manual intensive line based approach to an automatic area based methodology. This requires suitable new software tools to ensure that the automatic processes are validated and the quality of the final product meets the required standards.

A new SHOALS-1000 system was recently delivered to the Japan Coast Guard and another is under development for the US Naval Oceanographic Office (NAVOCEANO) through their partnership in the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX). These systems will provide not only the latest laser technology and sensors, but a fully integrated processing system with rigorous automated filtering and an intuitive 3D area based module for validation and quality control.

The paper describes the background to the development and modules of the new SHOALS-1000 Ground Control System.

Background and Development of ALH Systems

The first report in open literature of the possible use of airborne Lidar in the marine environment comes from University of Syracuse in 1969. [1] In the early 1970's much of the research focused on experimental profiling ALH-type systems by NASA and the US Navy. [2],[3] In Canada, the Canada Centre for Remote Sensing joined with Optech in profiling efforts, while in the Australia the Defence Weapons Research Establishment (WRE) working with the Royal Australian Navy (RAN) developed a profiling system called WRELADS-1 which underwent trials in 1976/77. [4],[5]

The next step in the evolution resulted in a joint effort by NASA, NOAA and the US Navy producing a scanning Airborne Oceanographic Lidar (AOL). [6] This work led to further development in the US, Australia, Canada and Sweden.

Further development of these airborne systems in the late 1970's and early 1980's led to the world's first operational ALH system - LARSEN-500. Since then a number of operational ALH systems have been manufactured, and all have contributed to revolutionizing the mapping of the shallow coastal zone.

The success of these experimental systems confirmed the feasibility of the technology and the benefits over conventional hydrographic surveying methods for conducting near shore shallow water surveys; faster with higher coverage rate, lower cost per unit area, flexible and mobile. Although ALH has these distinct advantages in the very shallow waters it has proved to be an excellent complement to ship borne multibeam sonar.

The new SHOALS-1000 is the most recently manufactured ALH system (see Figure 1) and consists of:

- Sensor Subsystem (SS)
- Ground Control Subsystem (GCS)
- SystemControl and Data Acquiistion Subsystem (SCADA)
- Aircraft Positioning (AP) Subsystem

Figure 1. SHOALS-1000 Airborne components

SHOALS-1000 was developed as a strategic tool for commercial surveying applications with an emphasis on increased performance and decreased size/weight/power consumption over the previous SHOALS-400. Additionally, the SHOALS-1000 has an integrated 10 kHz topographic capability providing more accurate and higher density land/on shore elevation information. When integrated with IHO Order I depth information, this results in an extremely powerful coastal zone mapping tool.

Background and Evolution of ALH Processing

Traditional processing and presentation of hydrographic data was developed hundreds of years ago in the days of lead line and plot sheets. Advances in echo sounding during the Second World War saw the adoption of this technique for the mapping of the seafloor. However the general processing of the data remained the same, with the product of the surveys being a hard copy plot that was derived from a much denser sampling of the seabed. The decimation of the data along the profile was dependent on the scale of the plot and distance between ship track lines were generally defined by the type of survey and depth of water.

The early stages of this method were almost entirely manual and the quality control (QC) was ongoing as the soundings were compiled on the plot sheet and correlated with adjacent and cross lines of soundings. The advances of computer technology allowed for automation, but the final product of the survey remained essentially the same, except it was now drawn as a computer generated plotted product. The focus of the manual requirements concentrated on the quality control of the automated process, both in the line by line review of the digitization of individual profile lines and the compiled plot sheets. The hydrographic surveys for nautical charting were based on obtaining shoal biased soundings, and the line based review ensured that decimated data honored the shallow soundings in the data. Techniques in the latter stage of QC included coloring plotted sounding by depth, contouring, and static plots of 3D models.

The initial deep water multibeam sonar systems introduced in the early 1970's had a small number of beams and limited swath width and relatively slow pulse repetition rates. [7] They did not present too many difficulties for the automated single beam approach to processing, and fundamentally, at least for the hydrographic surveys, the final product was still the decimated and shoal biased set of soundings based on a plotted chart scale. The ALH systems generally also required the operators to go back and view the Lidar to validate depths extracted. As multibeam, and swath mapping systems such as the ALH systems, moved into shallow water, the data volumes increased significantly with many more beams and wider swath widths. However, until recently the approach to processing these data had not progressed with the systems, and it remained a labor intensive process based on the operators attempting to review all data and constrained to the chart scale of the final plotted product.

The Australian Hydrographic Service (AHS) Laser Airborne Depth Sounder (LADS) was based on technology designed in the late 1980's and was accepted into service in 1993. Since then it has surveyed Australian waters at an average rate of about 10,000 square kilometers per annum. This coverage is approximately the same area as surveyed by all the AHS survey ships combined. [8] However, the structure of the processing systems was based on the decimation of the data to approximately 30 meter spacing during the line based processing and the only area based view where comparison was made between lines was via the hard copy sounding plot. As with most of the earlier generation ALH systems, review and decisions on the quality of the data often required the operators to review the individual waveforms of the Lidar. This resulted in a bottleneck in the processing when it was necessary to review any anomalies. Furthermore, less than 1% of the data was finally approved for use in updating the nautical chart product.

The AHS recognized that a suitable independent QC application based on a 3D visualization tool would improve both the efficiency and accuracy of the process and allow the processing of all the secondary data, and not just those soundings that made it onto the hard copy plot sheet. Therefore, the basis of the process focused on the density of the data from the sensor and not the chart scale at the end of the process. To improve the efficiency of the process it was essential that after any anomalies were identified, it was possible to directly access the underlying XYZ and attributes of each data point. This was satisfied using a unique sounding class in the Interactive Visualization Systems' Fledermaus software. This data structure provided the benefit of a dynamic gridded surface to rapidly identify anomalies and features, combined with direct access to each selected point for review and edit with an audit trail of changes (Figure 2). Because all data for the region was loaded into memory there was a restriction to the volume that could be defined for each region.

Figure 2. LADS QC Tool - Australian Hydrographic Service

Over recent years the US Naval Oceanographic Office (NAVOCEANO) has been updating survey vessels and launches to include the latest generation of high-resolution multibeam sonar systems. Similar to many ocean mapping organizations, NAVOCEANO is faced with massive amounts of data that must be validated before inclusion in various products. They recognized that the line-by-line processing approach would no longer meet the requirements and developed a unique data structure (PFM) and area based editor (ABE), that included a direct interface to target files and imagery. They also identified the need to integrate this with a commercial off the shelf (COTS) 3D visualization and analysis software. A Cooperative Research and Development Agreement (CRADA) was established in 2000 to integrate the NAVOCEANO PFM data structure and ABE functionality into the IVS Fledermaus 3D visualization software. The PFM structure was integrated into Fledermaus replacing the sounding class structure with a disk based storage that removed the data volume constraint of the previous format. [9]

The NAVOCEANO surveys are extensive and utilize a number and variety of platforms, and the PFM data structure is required to support simultaneous processing of data from various types of multibeam and single beam sonars. Therefore the data structure was designed to allow flexibility and evolution with new sensors and native data formats. NAVOCEANO is also a partner with the US Army Corps of Engineers (USACE) and NOAA in the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX), and undertakes surveys with the SHOALS system in conjunction with the ship surveys. The PFM structure initially supported multibeam or single-beam data stored in Generic Sensor Format (GSF), and SHOALS Lidar data in the Optech "out" file format was added to support the multi-sensor surveys. The structure has subsequently been updated to a number of other formats including the AHS Hydrographic Transfer Format (HTF) that is now used with LADS data.

During surveys in Saipan in 2000 and 2001, SHOALS was integrated with the conventional survey assets of the USNS SUMNER and her hydrographic survey launches. This enabled each platform to operate in its optimum depth environment, consequently maximizing efficiency. The data was also combined in the NAVOCEANO PFM structure and processed with the ABE. Figure 3 illustrates the Fledermaus application with part of the Saipan PFM data loaded. The main visualization window shows the gridded 3D surface, and a selected seabed feature. Individual soundings are shown in the 3D editor and the PFM structure provides an index back to the individual waveforms files, shown in the window to the top left of the figure.

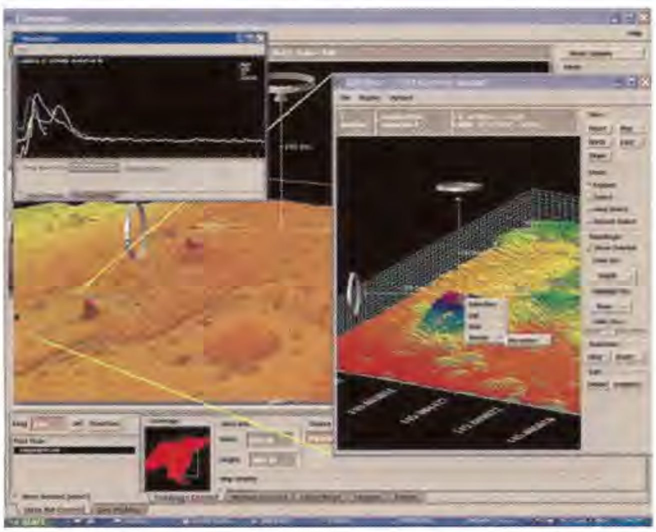

Figure 3. US Naval Oceanographic Office survey data - Saipan

SHOALS-1000 Ground Control System

The SHOALS-1000 Ground Control System (GCS) software is a 2nd generation integrated software suite developed to support the SHOALS-1000 airborne data acquisition system. The development objectives for this next generation software product were aimed at the commercial need for a streamlined, user friendly, Lidar mapping tool that provided an integrated solution for the planning, processing, cleaning, 3D visualization and output of a seamless hydrographic and topographic dataset.

This software product is built on the experience gained from almost a decade of SHOALS-400 operations, expertise from leading industry specialists in 3D visualization, and expertise from leading industry specialists in the manufacture of airborne Lidar systems for mapping both land and water. The functional overview of the GCS is shown in Fig. 4 and the three primary modules in the GCS software suite are :

- MAPS – Management and Planning Software,
- DAViS – Download, Automated Processing and Visualization Software, and
- STARS – Statistical Tracking and Reporting Software.

The main interface to the GCS is the gateway to all ground based functions. It allows the operator to plan survey missions, process, view in 3D, and clean airborne Lidar data and manage entire project data sets. Additionally it provides a means of generating the necessary statistical reports pertaining to the project, missions and flight lines as well as detailed technical reports pertaining to the airborne system at a subsystem level.

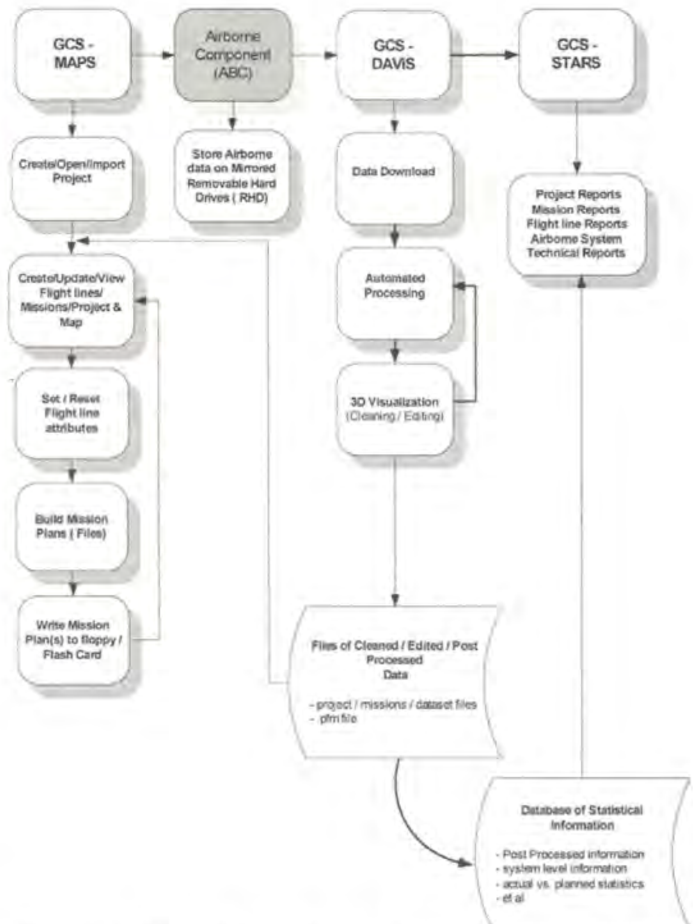

Figure 4. Ground Control System functional overview


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Email: mail@kleinsonar .com

MAPS - Management and Planning Software

The MAPS module is an integrated survey management and planning tool that provides the following basic capabilities:

- tools to quickly and efficiently generate complete project survey plans consisting of flight lines and some customizable flight lines attributes
- tools that facilitate project planning and budgeting
- tools to create/update/maintain a survey project and associated mission plans
- tools to define and/or import tide information
- tools to unload x,y,z and meta data

Initially the operator establishes a project map using either the world shoreline database, included with MAPS, or by digitizing features from imported project maps. Supported file formats are Geotif, JPG, BSB, BMP, TIF, DNC and ENC. Once the survey area and necessary map features are defined the user can interactively add hydrographic and/or topographic flight lines to the map using various options such as 'add line', 'add rectangle' and 'add polygon'. As the user adds flight lines, MAPS tracks the total number of lines, the total time-on-line and total distance-on-line (Figure 5).

Figure 5. MAPS Flightline Window

To prepare a mission plan, the operator graphically picks flight lines to allocate to the active mission plan. When the desired number of flight lines have been allocated to a given mission the operator saves this mission plan file. This file is then transferred to either floppy or Compact Flash Card and uploaded to the airborne system.

The mission planning file consists primarily of the mission map and allocated flight lines, user defined survey parameters such as water clarity and water type along with several airborne hardware parameters that are used to establish airborne system settings for data collection (Figure 6).

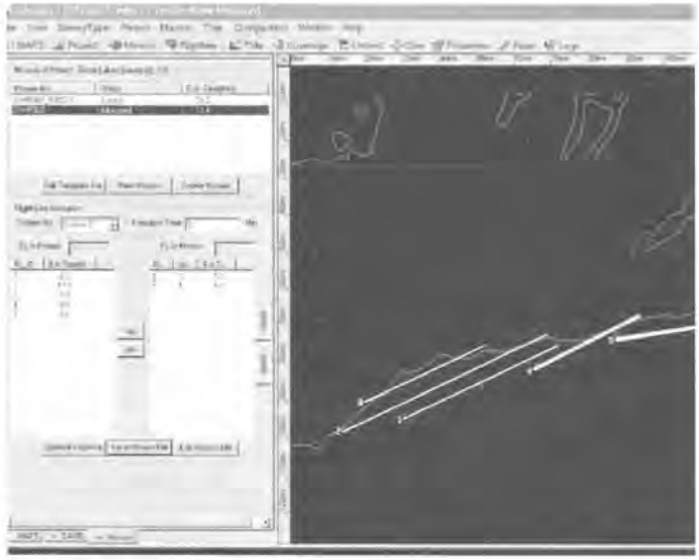

Figure 6. MAPS Mission Window

Following the initial project planning, MAPS serves as a powerful survey project management tool by visually providing up-to-date project, mission and flight line status information to the operator.

As airborne collected data is downloaded, auto-processed, cleaned and edited via the GCS DAViS module, flight line and mission status information is synchronized with the MAPS database. This provides the operator with accurate mission and flight line QC information for the entire project enabling them to make adjustments to subsequent missions immediately. At any stage of the project, MAPS provides a color coded display of the status of every flight line planned in the GCS including those planned by the airborne system. Flight lines are color coded in one of three possible states: 'planned' (green), 'allocated' to mission (yellow) or 'downloaded and auto-processed' (blue). This allows the operator to instantly ascertain the project status at a detailed level. Up-to-date total project area coverage views in several formats are made available to the operator via MAPS including color coding by: depths, depth confidence, and coverage. Additionally, MAPS displays data 'holidays' and 'hazards' determined via spatial processing and data editing in DAViS.

DAViS – Download and Automated Processing

DAViS consists of three primary phases:

- downloading phase,
- automated processing phase, and
- operator interactive data editing/cleaning phase with Fledermaus.

At the point of downloading, hydrographic and topographic data is parsed into separate files for subsequent processing into latitude, longitude, depth/elevation and other supporting data. Following data downloading and automated processing, Fledermaus can be launched to accomplish manual editing and cleaning of the data. This process dynamically updates SHOALS data accordingly when modification/editing occurs to the data points shown in the 3D editor.

Prior to the above phases, DAViS provides a means of previewing the removable hard drive contents, once inserted, via the Airborne Drive Preview. This provides the user with a list of missions, number of lines in each mission, when the data for each mission was acquired, the status of the mission – new or already downloaded, and the associated project name for each mission.

SHOALS raw sensor data collected by the airborne system is stored on mirrored removable hard drives along with mission planning information and mission log information. Mission planning information, based on the original MAPS Mission Planning file, is read from floppy or Compact Flash Card by the airborne system and then written to the removable hard drive. Information modified by the airborne operator during a mission is always recorded to removable hard drive for subsequent synchronization with the MAPS database. The mission information consists of the following:

- flight lines that were created on the ground as well as lines that were modified and/or added by the in-flight operator,
- hardware settings for each line established on the ground by operator and then perhaps modified during flight by the in-flight operator, and
- hydrographer settings for each line established on the ground by operator and if modified during flight by the in-flight operator.

Mission Log information is acquired/entered throughout the planning and acquisition stages. This log is automatically created during the downloading of a mission, and there is a single Mission Log associated with each mission. The purpose of the Mission Log is to provide the operator with general mission details along with some specific flight line information. Mission details consist of information such as collection date, survey area, airborne operator, water clarity, air temperature etc. along with a separate display of airborne alert messages. The source of this information varies depending on the field; some fields are entered by operator

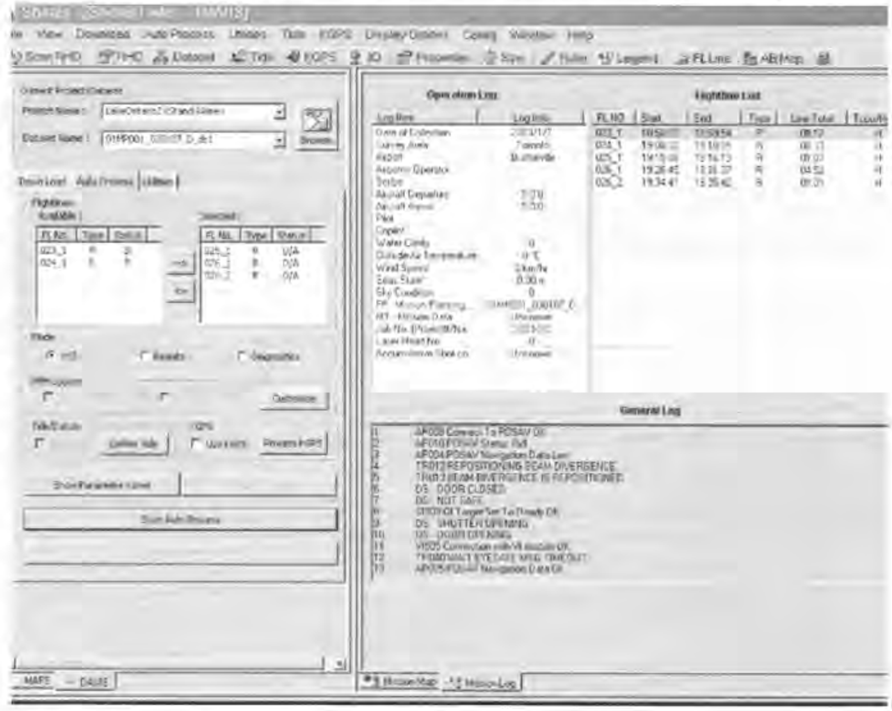

Figure 7. DAViS Mission Log

on the ground prior to flight, some are entered in the air during flight by the airborne operator, and some are sourced from the airborne system. Flight line details are all sourced from the airborne system and they include: flight line #, start time, end time, total time on line and line type. Prior to downloading any data from the removable hard drive, the operator can view this information. This can be of particular use when an operator is looking to download and process a specific line from a specific mission only i.e. a calibration line or a refly line. See Figure 7 for an example of a DAViS mission log.

Raw sensor data consists of data collected by the airborne sensors – both hydrographic and topographic - as follows:

- a time stamped record for each hydrographic sounding including all hardware readings and waveforms,
- a record for each topographic data point,
- POS/AV data consisting of both INS and GPS type data,
- image data collected by the digital still camera, and
- airborne alert messages.

Once the operator has selected a mission for downloading, they can then select all or a subset of flight lines to download. Whatever is selected constitutes a dataset which has an associated file recognized throughout DAViS. During download all errors and warnings are displayed and logged.

As well data is boundary and range checked with warning and error messages being logged for subsequent review and retrieval.

Though the survey map will display all flight lines associated with the mission, downloaded flight lines are distinguishable from those that are not downloaded in a single session. This enables the operator to maintain a visual inventory on what has been downloaded and what still remains on the removable hard drive. After lines are downloaded, the operator can then select all or a subset of flight lines in the dataset for auto-processing. During the auto-processing, a coverage map display is progressively updated according to one of the following coloring schemes as selected by the operator: color-coded by depth/ elevation, color-coded by confidence, color-coded for coverage only.

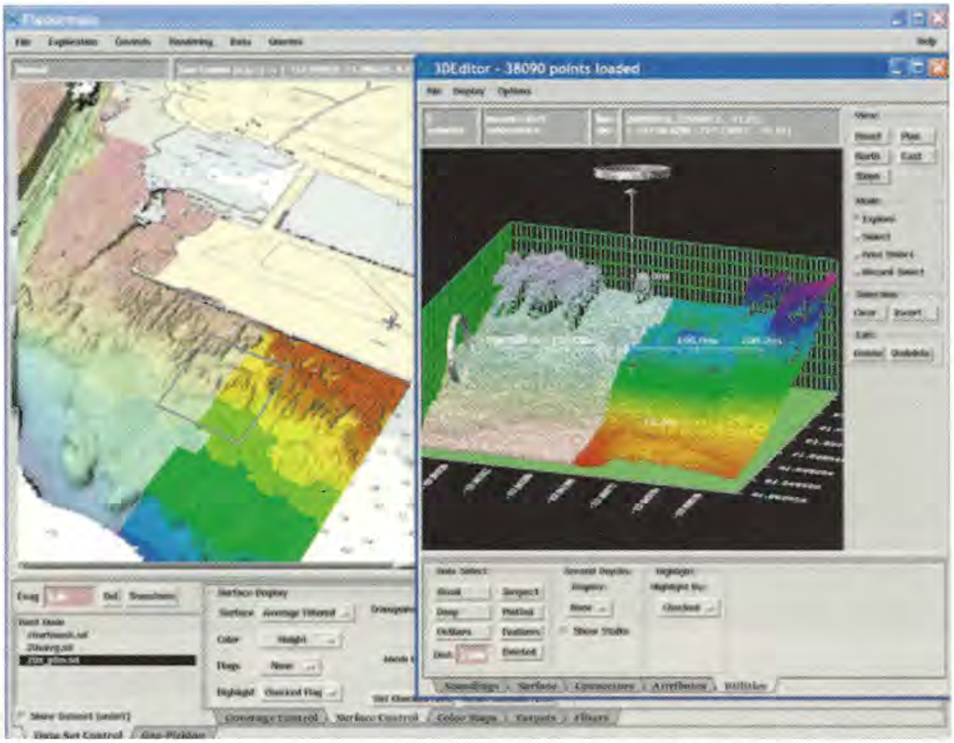

Figure 8. Honolulu and approaches to Pearl Harbor – SHOALS-400 survey and NOAA chart

Significant improvements have been made to the auto-processing algorithms that have resulted in a substantial reduction in operator intervention. In the past, the processing of SHOALS Lidar data required the input of the user for a variety of environmental parameters. For example, the user previously had to enter details of the water clarity, salinity, the logic for the bottom detection (whether first or strongest pulse), expected wave height and the threshold for bottom detection. The latter was influenced by the amount of background light and hence was highly variable over a survey. In the SHOALS-1000 GCS, most of these parameters have been automated. For example, the wave heights are sampled during Download and the measured values are used for the processing. The thresholds for bottom detection are measured for every shot and applied. The only environmental parameters requiring user input are the water salinity and the water clarity. Whether the water is fresh or salty affects only deep water and has little effect in depth less than 20 meters.

In addition to the automation of the environmental parameters, a new part of the algorithm searches for spatial anomalies in the data. These consist of holidays or gaps, comparisons between overlapping data, and also possible hazards. Once auto-processing is complete, the operator can then launch Fledermaus for cleaning, editing, and 3D viewing.

DAViS –3D Visualization

One of the major enhancements to the SHOALS-1000 GCS suite was the addition of a 3D visualization, cleaning and editing capability. This was achieved by integrating a 3rd party COTS product, Fledermaus, in a manner that provided the data processor with a means of viewing and inspecting individual Lidar points along with associated point information from the native file. This combined with the ability to view the corresponding Lidar waveform and the associated digital image makes this a fast and efficient visual analysis and editing tool.

The large amounts of data that the SHOALS-1000 system produces, provides a significant challenge to process automatically and establish that the data acquired meets the requirements of the survey. The inherent density of the data provides the opportunity to use an integrated 3D visualization application, allowing operators to maximize the value of the data and improve the efficiency of the overall process. By presenting the data in a natural and intuitive display that allows the presentation of multiple data sets from various sensors, the data can be interpreted more rapidly and accurately. [7] Figure 8 illustrates the simple integration of multiple components without compromise to the quantitative aspects of the data with a SHOALS-400 survey adjacent to Honolulu airport and the approaches to Pearl Harbor and a geo-referenced image of the NOAA chart. A section of the survey data has been

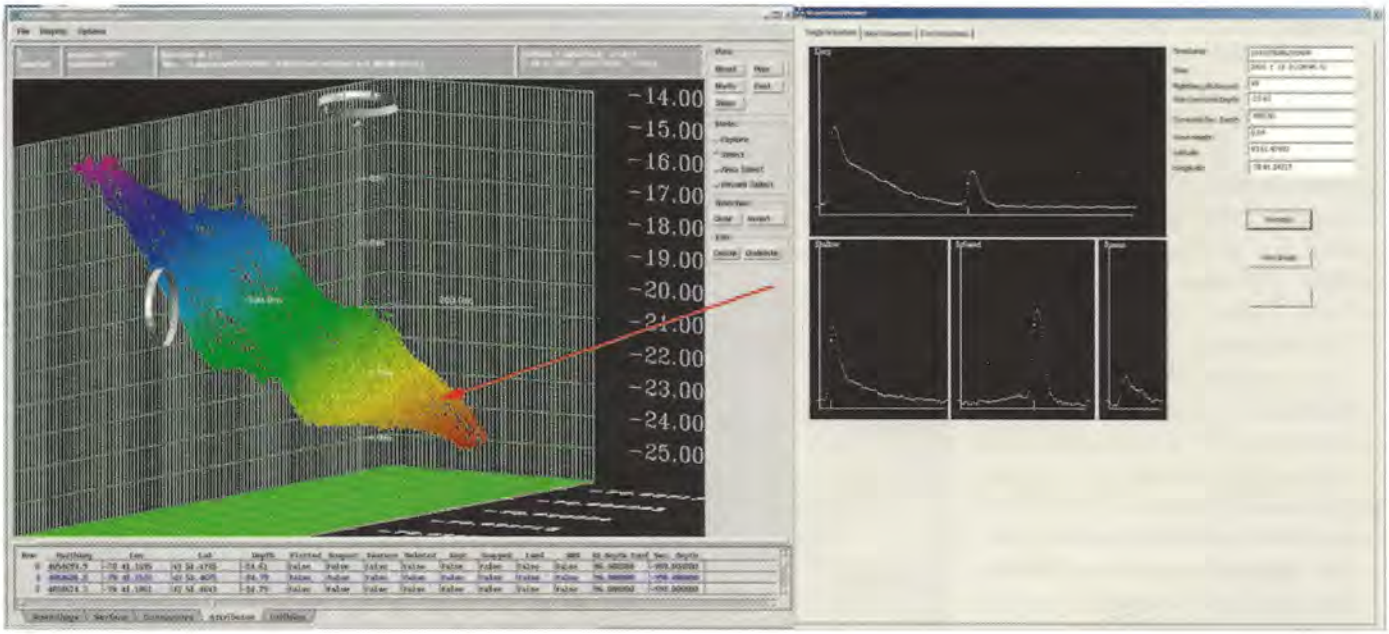

Figure 9. SHOALS-1000 3D Editor and single wave viewer - Lake Ontario

selected in the main surface display and the valid data points from the selection are shown in the sub-window. The pastel shade of the data on the left hand side of each window indicates that these data have been checked. The areas with the primary coloring have yet to be reviewed.

The integration of the Fledermaus software in the SHOALS-1000 GCS processing system provides a natural and logical progression from the LADS QC tool, through the NAVOCEANO ABE, and use with SHOALS-400, to the SHOALS-1000 GCS. The LADS QC tool utilized an exported file and was limited by a previous generation of computer architecture and a proprietary data format that did not allow access to the processing database and waveform data. The initial implementation of the ABE added the existing SHOALS-400 "out" file format to the PFM structure, allowing the full generic editing capabilities of the ABE and direct access and viewing of the waveform. Integration of the PFM and ABE functionality with the Fledermaus software extended these capabilities to an interactive and intuitive 3D display. The next stage with SHOALS-1000 GCS provides a direct integration of the Fledermaus application as part of the DAVis module. This allows validation and QC of the survey from a natural and intuitive display and interface to all the Lidar specific functionality. Figure 9 shows the integration of 3D Editor and wave viewer and Figure 10 shows the display of SHOALS-1000 second depths in the 3D editor. In addition, it will retain the full capabilities of the existing software to integrate data from various sensors (bathymetric Lidar, topographic Lidar, multibeam and singe beam sonars, digital imagery and vector data.

A number of shared memory blocks were added to Fledermaus to facilitate functional integration of the software with the Optech modules of the SHOALS-1000 GCS. These memory blocks are all related to PFM objects at different stages of processing. These shared memory definitions include structures for the initialization and loading of PFM data structures, and working with the soundings in the 3D Editor. In addition to the shared memory structures which facilitate the transfer of status and data it also supports the launching of applications from the primary Fledermaus application and the 3D Editor. A simple configuration allows the user to specify the applications to launch and the various command line and shared memory control parameters. The programs can be defined for generic data or specifically for particular data types. The configuration file for each program allows the specification of the name that will appear in the popup menu, name of the program to run, a short cut key combination, and any options that may included when the program is run. For applications that use the shared memory, flags control can be set to define how the programs are run, what parts and when shared memory is updated. Figure 11 shows an example of the SHOALS-1000 GCS applications that can be initiated from the 3D Editor using this additional functionality.

STARS – Statistical Tracking and Reporting Software

The STARS module is a report generator that provides survey personnel with up-to-date project survey status information. As well it provides an up-to-date history on airborne system maintenance and repair at the subsystem

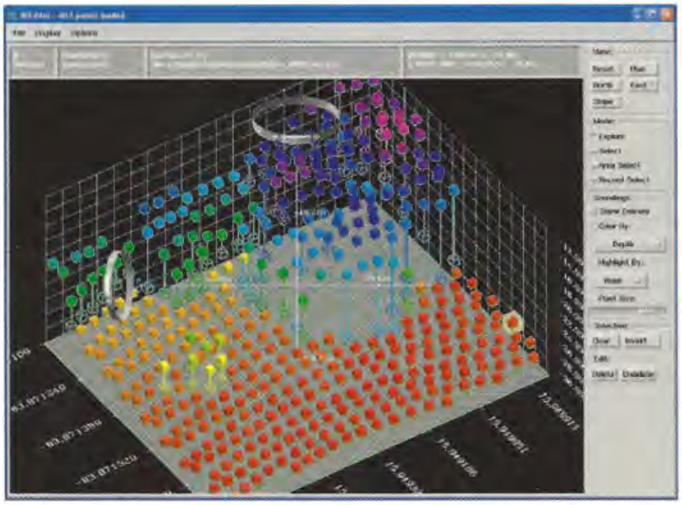

Figure 10. Second depths displayed in 3D Editor

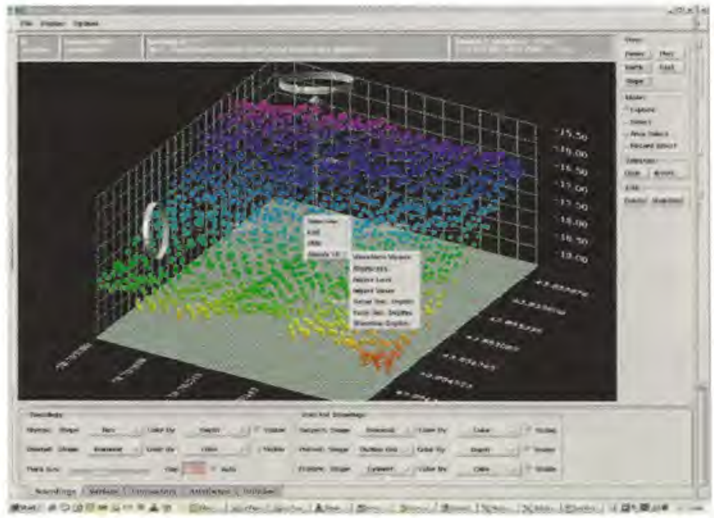

Figure 11. SHOALS-1000 processes that can be initiated from 3D Editor

level. All information is stored in a Microsoft Access database. Reports can be generated using the customized report formats that come with the GCS software or via an offline report writing utility offering greater flexibility to a knowledgeable MS Access user.

Project survey status reports are divided into four levels: Administrative, Daily Operations, Client and Manufacturer reports.

- Administrative reports consist of information that enables management to asses the overall status of a current project by providing such information as planned vs. actual production time, planned vs. actual square mileage, refly time, estimated time to complete, etc. These reports assist management in controlling and managing costs and resources.
- Daily Operations reports provide detailed mission and flight line level information necessary for the field crew to assess project status. It reports on various planned vs. actual parameters which can then be used to optimize subsequent mission and flight line plans. As well, Daily Operations reports provide a means of tracking automated processing tasks and tracking data processor activities in the GCS. These reports could be viewed as tracking 'What Happened When' and 'Who Did What When' thus providing traceability and process Quality Control.
- Client reports provide feedback to a client on their project. This can be in the form of a text report on area-coverage-to-date combined with meta data as well as a graphical output illustrating data coverage and data quality thus far.
- Manufacturer reports provide detailed technical information that aids the manufacturer in performing system and subsystem level diagnostics.

These reports when combined with the powerful features of the MAPS module provide the field crew with an integrated, closed loop method of planning and managing a total survey.

Future Development of ALH Processing

The development of ALH systems has been driven by a number of governments (US, Australia and Sweden) to meet specific requirements for nautical charting and surveying of ports and harbors. It is also likely that these governments will provide the primary impetus for the agenda of ongoing development of ALH. [10], [11] A significant element of the development will be related to integrating more sensors in the airborne platform and maximizing the information from the total package of these sensors.

The SHOALS-1000 GCS that has evolved from the earlier Lidar processing systems, has resulted in a change in the overall process that is well suited to the higher data volumes and variety of data types produced by a single platform. Importantly this has been based on an automatic processing paradigm in place of the traditional line based process, although access back to the individual data points, attributes and waveforms remains. The automatic processing has been tightly integrated with 3D visualization to provide an intuitive and efficient validation and QC module. This development builds on the PFM data structure from NAVOCEANO, and its efficiency and design allows easy incorporation of other data formats and development. [12] The challenge will be to continue to improve on the automatic processing, and to improve the overall workflow efficiency and accuracy.

The overall design of the SHOALS-1000 GCS allows the easy incorporation of developments such as the Combined

Uncertainty and Bathymetry Estimator (CUBE) program [13] and work on the "Navigation Surface" both being developed at the Center for Coastal and Ocean Mapping/NOAA UNH Joint Hydrographic Center (CCOM/JHC) at the University of New Hampshire [14]. Research at CCOM/JHC has shown that a significant improvement in the speed and objectivity of hydrographic data processing are possible and that the use of a Digital Terrain Model for charting has significant benefits. [13] The preliminary integration of the CUBE module in Fledermaus has demonstrated a significant improvement over the filtering of multibeam sonar data with that of the ABE in

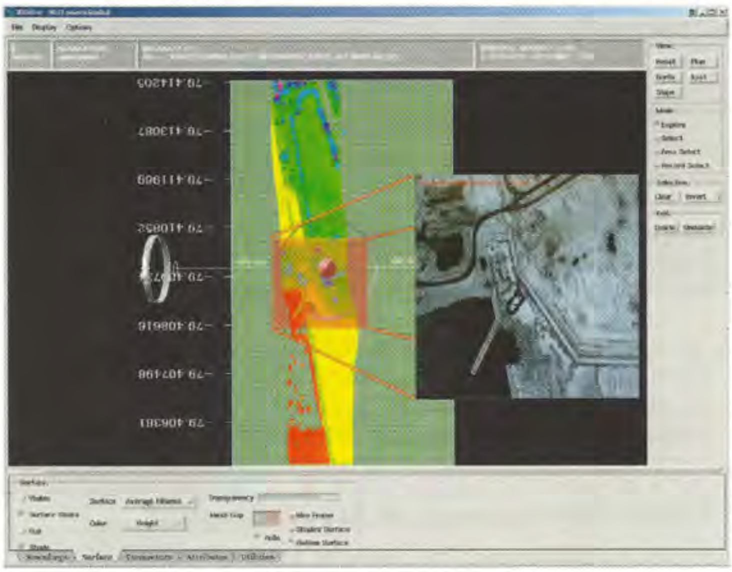

Figure 12. SHOALS-1000 3D Editor and digital image – Toronto

the Fledermaus software. It is planned to extend this to the SHOALS data with the development of an error model describing the SHOALS data similar to the model developed for the Canadian Hydrographic Service multibeam and sweep systems. [15]

Obtaining a seamless dataset measured from the near shore through to the back of the beach and defining the shoreline is being driven by the requirements for both the coastal zone management and military rapid environmental assessment. The SHOALS-1000 has additional capability with the topographic Lidar and digital still imagery (Figures 12 and 13) and should aid the land/water interface definition. In addition, recent advancements with the SHOALS-400 land/water discriminator algorithm show promise for using ALH to accurately and reliably define this boundary interface. [16] As a follow on to this work, efforts will focus on validating the new algorithm after which it will be automated and integrated into the processing of the SHOALS-1000 GCS. The SHOALS-1000 system also records more data for the surface channels than the SHOALS-400 for every shot. It is expected this extra information will further enhance the land water discrimination.

The processing of imagery or backscatter from multibeam sonar data has been undertaken with varying levels of success for many years. The resultant processed imagery provides an additional value to the data, and extends the use of the data and derived information to other disciplines. Characterization of the seabed from the Lidar waveform has not been fully exploited in airborne ALH, partly due to the physical difficulties, but also by focused use for hydrographic surveying where the primary importance is the identification of hazards to navigation from the bathymetry. Independent research at CCOM/JHC [17] and Cornell University [18] presented at the 3rd Annual Airborne Hydrography Workshop showed significant promise for characterization of the seabed and will undoubtedly extend the application of the SHOALS system. This will particularly apply in the coastal zone where multi-disciplinary surveys and research teams require access to more than the seabed depth model. The data structure and objects in the Fledermaus software support the analysis of this type of data from multibeam and sidescan sonar and the addition of the Lidar defined seabed characterization is a logical and straight forward extension.

Conclusion

ALH systems have evolved into a mature technology with unique capabilities for mapping the shallow and hazardous areas of the coastal zone. The systems demonstrated rapid coverage, flexibility and mobility has seen their use in a number of applications including nautical charting, navigation channel inspection, rapid environmental assessment, emergency response and coral reef mapping.

Data rates have increased as the new generation of sensors have been developed and additional sensors, such as topographic Lidar, have been added to the airborne platform. An even bigger increase in data volumes has occurred with ship borne multibeam sonar, and they have reached a level where the

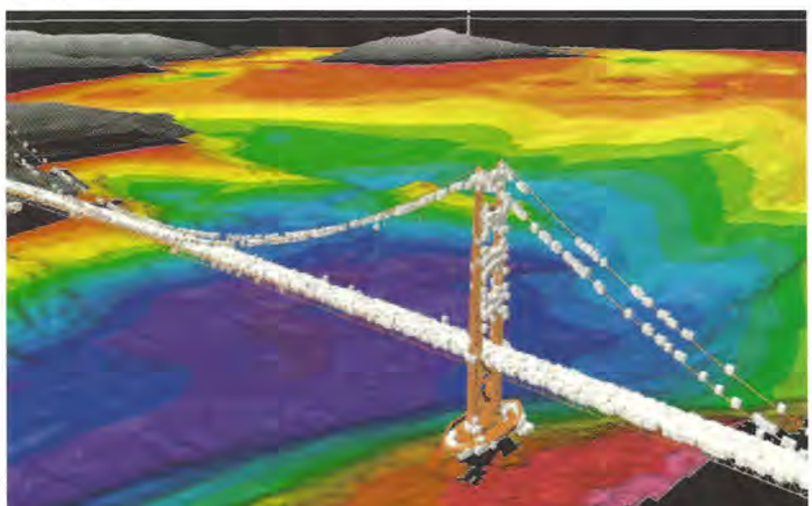

Figure 13. USGS DTM of San Francisco Bay, NOAA ALTM data and bridge model

traditional line based approach to processing has been replaced with an automated area based processing. Significant advancement has also been made with the auto-processing algorithms for the extraction of the depth information from the Lidar data. The combination of these two improvements, associated with a tightly integrate 3D visualization, analysis and editing capability has resulted in improved efficiency and accuracy for the processing of ALH data.

Future improvements to the processing, including improved automated area processing, incorporating new algorithms for the land/water interface, seabed characterizing from Lidar and the fusion of other data, in parallel with sensor development will no doubt continue to widen the use of ALH in the near shore coastal zone.

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About the Authors...

Karen Francis has been involved in software design, development, field testing and management of both realtime airborne data acquisition systems and ground-based data processing systems for over 17 years. She graduated in 1984 from Sir Sandford Fleming College with a diploma in Geographical Information Systems Technology. She currently manages Optech's SHOALS-1000 Ground Control System software development.

Dr. Paul LaRocque, a member of Optech's Marine Survey Division, is an experienced Project Manager who has been deeply involved in the technical development of Optech's lidar bathymeter systems. He is currently the Technical Program Manager for Optech's new SHOALS-1000 programs.

Lindsay Gee is the general manager of Interactive Visualization Systems and has over 20 years experience with hydrographic and ocean mapping surveys.

In recent years, after realizing that the earth is not flat, his work has been concentrated on the application of interactive 3D visualization to the field of ocean mapping and hydrographic surveying. He is a member of the Institution of Surveyors, Australia and The Hydrographic Society and holds a bachelor of surveying science from the University of New South Wales.

Let There Be Light

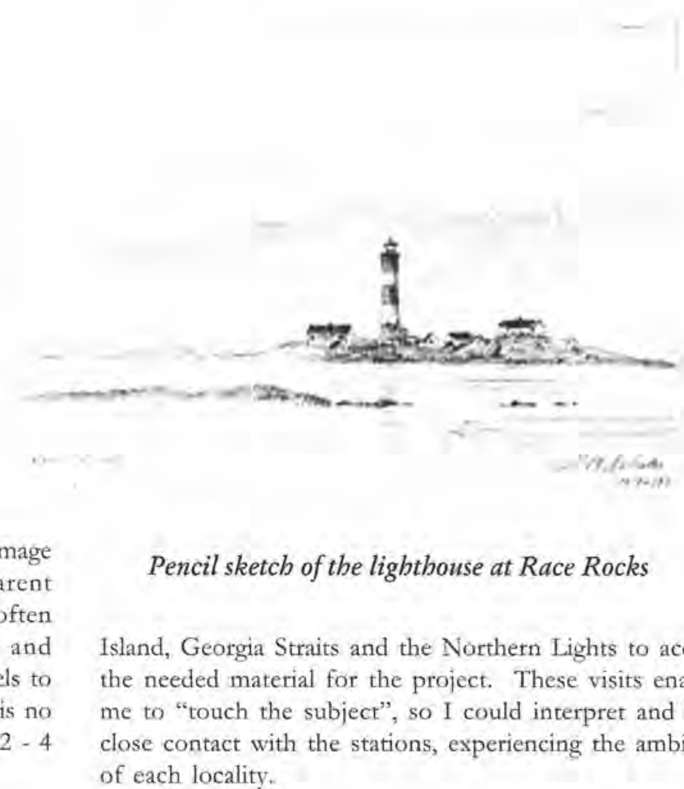
By: Graham A. Scholes

The light came on for me in 1994 when the thought struck me that there were a number of coastal subjects in British Columbia that have never be interpreted and created into a series of images. The Lighthouses would never be seen by most people, as there are no roads enabling access. The only people these icons are available to are the Canadian Coast Guard seamen and a few pleasure craft boaters. Even for the pleasure crafters, the accessibility is very difficult as none of the stations have docks. The method of visiting all the lights on the West coast of Vancouver Island is to have very small craft that could be beached and then climb the cliffs to keepers' residences. The Canadian Coast Guard achieves this with their fibre glass surf boats. This craft is nudged against the rocks and the seamen jump off of the bow onto the shore, which at low tide is extremely slippery with seaweed and wet rocks. Even at high tide, the task requires agility and timing to jump at the opportune time as the surf boat bobs and bounces against the rocks due to the waves and swells of the Pacific Ocean. Accessing the lights on the Inside Straights of Vancouver Island is less hazardous, but nevertheless, difficult for a person not in good physical condition.

This project started at age 60, when I attended summer school to learn the art of Moka Hanga, coloured woodblock printmaking, in the traditional technique founded in mid 1700's by the Japanese. I soon realized that I had found a new medium to work in, as it is relatively similar to image making with watercolours, because of the transparent quality and requirements of the pigments. I have often said that the difference between watercolours and woodblock prints is that I traded my brushes for chisels to create my images. The major distinction is taht there is no instant gratification with woodblocks, because it takes 2 - 4 months to achieve a print.

I had the opportunity to visit Race Rocks Lighthouse and it was there that I saw the light, so to speak. As the tour boat approached the station, I said to Marnie, my wife, "You know what? I am going to create a series of woodblock prints of all the lighthouses of British Columbia". At that time I had no idea how many stations there were or how I would access them in order to acquire my reference material. I recognized that the remoteness of them was such that a personal motor boat was out of the question. I had a friend, who offered to fly me to and around stations on the Southern tip of Vancouver Island to snap pictures. After the first pass, it was obvious to me that this was not going to give me the hands-on and personal involvement required to capture the ambiance and character of each location.

Making arrangements with the Canadian Coast Guard, I was able to visit all the lighthouses in British Columbia, enabling the completion of the series, "Let There Be Light". Three trips were required to the west coast of Vancouver Island, Georgia Straits and the Northern Lights to acquire the needed material for the project. These visits enabled me to "touch the subject", so I could interpret and have close contact with the stations, experiencing the ambience of each locality.



Pencil sketch of the lighthouse at Race Rocks

This was my path to destiny and a series of prints that by all reports is being looked upon as a worthy contribution to the Canadian Art scene. The project has been an "8 hours a day, 8 days a week, for 8 years" venture. I have been on a trip that can be best described as light fantastic, creating a body of work from 228 hand carved plates for 37 subjects, requiring over 25,000 hand inked and burnished sheets of handmade Japanese Hosho paper.

To learn about the method of creating a woodblock print, visit my web site *www.woodblock.info* and click on "How are Woodblock prints made?" You can also see all the British Columbia light stations.

Race Rocks

Image size 14 1/2" x 8 1/2"
Paper size 16 3/4" x 10 3/4"
Printed 14 colours

Race Rocks Light was one of the first stations to be operative, starting up on Dec 26th 1860. It warned the mariners of the rocks and shoals in Juan de Fuca Straits near Victoria. Granite from Scotland, used to construct the tower, was brought over in a ship as ballast. A mechanical fog bell came from England in 1865 and because of finances was not installed until 1870. A steam fog whistle (1881), a diaphone alarm (1909) and an Airchime system (1978) were to follow.

The Island is now an ecological reserve operated by Lester B. Pearson College of the Pacific.

Race Rocks Lighthouse
48° 18' N Lat.
123° 32' W Long

Estevan Point
Image size 17" x 9 1/4"
Paper size 21 3/4" x 12 3/4"
Printed 25 colours

First Nations oral history maintains that Estevan Point was the meeting grounds between natives (the Hesquiat band) and the European Explorers (from the Spanish vessel "Santiago") in British Columbia. A temporary gas light was established at Hole-in-the-Wall in December 1907, at the southwest extremity of this point and replaced by the present concrete light tower in 1909. A wireless telegraph station was put into operation in 1908 and expanded during World War II.

On June 20th 1942, a Japanese submarine allegedly shelled the station for an hour without doing any damage. This attack, the first on Canadian soil since 1812, helped swing the Parliamentary vote for Mackenzie King's Mobilization Act (Conscription). The nature and perpetrator of the attack remains a point of historical contention.

Estevan Point Lighthouse
49° 22' 05" N Lat.
126° 32' 22" W Long.

Cape Mudge was erected on September 16th 1898. The present reinforced concrete tower was built in 1915. The name is a result of Captain Vancouver rechristening the Cape in memory of Zachary Mudge, his first lieutenant on the ship "Victory". The station is located on Quadra Island opposite Campbell River on Vancouver Island and was needed to meet the needs of Klondike traffic moving through the racing tides of Discovery Pass.

The day, like so many days in late fall, was gray, one of those go-nowhere-nothing gray days. After spending a few hours absorbing the essence of the lighthouse, looking at it from all directions, the day was beginning to wane when the setting sun poked through causing a glow to the scene. Deciding the best angle for my image required me to create a morning sunrise and the wisps of mist casting their magic.

Cape Mudge Light
Image size 24" x 12"
Paper size:
27 3/4" x 15 1/2"
Printed 20 colours

Entrance Island is located in the Georgia Straits near Nanaimo Harbour and Departure Bay. It was put into operation on June 8th 1876 with a wooden tower that lasted until 1939. The combined tower/dwelling was replaced in 1971 with the present concrete tower. This was an important light for the once coal vessels, and now for BC Ferries and the heavy pleasure boat traffic.

This is one of the few images where I maintained reality of the actual scene. All of the lighthouse images I create have accurately depicted the buildings and nearby surrounding, as I decided it was important to record the stations from a historical point of view. However, in many cases, the backgrounds and the foregrounds belong to me and I have used creative license to embellish and interpret the ambience of each locality.

Entrance Island
Image size 18" x 9 1/2"
Paper size 21 3/4" x 13"
Printed 14 colours

About the Author/Artist...

Artist's Statement

Art melds the eye's image and the mind's interpretation.

Emotions and one's-self should be an integral part of creating a visual statement.

Art should stimulate a dialogue.

Graham A. Scholes, born in Toronto, Dec 28th, 1933, resides in Sidney B.C. and is one of Canada's renowned artist/author/educators with a reputation for his watercolours, woodblock prints and figurative drawings. He is internationally known as a result of the book, "Watercolor and How", published by Watson-Guptill, New York. His philosophy is that an artist must take risks with his work, always strive for higher skill plateaus, and continually develop an original concept.

His woodblock prints have been accepted by public galleries and museums such as: Art Gallery of Greater Victoria, Maltwood Gallery - University of Victoria, Dawson Creek Art Gallery, Pentiction Art Gallery, MacLaren Art Centre, Maritime Museum, and Steward Hall Art Gallery.

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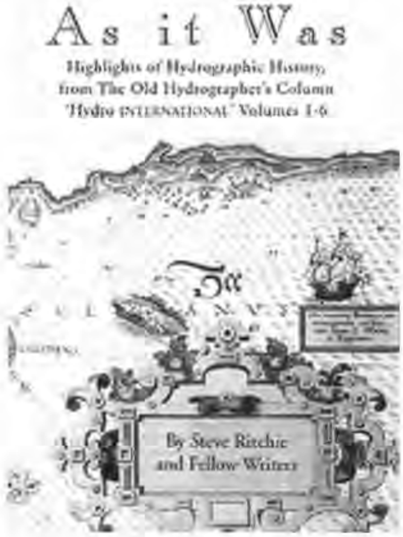

As it Was: Highlights of Hydrographic History

Written by Admiral Steve Ritchie RN (Ret'd) and fellow writers.

Review contributed to *Lighthouse*
by Sam Weller

Published by GITC bv, Lemmer, The Netherlands 2003
ISBN: 90-806205-5-6

This collection of 48 *Old Hydrographer* columns from the journal *Hydro International* is a fascinating series of stories on charts and charting around the world, beginning with a description of Greek sailing directions called "periploi", penned between 95 A.D. and 130 A.D. The story continues up to the use of electronic aids such as Decca in the 1940s, the Tellurometer in the 1950s, and underwater trilateration in the 1960s. Most of the articles have magnificent illustrations of original documents, giving us a glimpse of live history.

As a mariner, a hydrographer and a sailing directions compiler, I was particularly interested to read that sailing directions is indeed the senior partner in navigation as those Greek periploi predate the earliest recorded mention of charts by some 1,200 years. Each early mariner jealously guarded his own personal sailing directions throughout his career, and our modern charts have their roots in the sketches the mariner drew in his own notebook. An interesting aside here is that the reason the master was boss is that he was the only one who knew where they were and thus the only one that could get the ship back home.

One of the articles is a fascinating account by CHA Member Nick Emerson of the seven voyages in the early 1400s of the Chinese seaman and explorer Zheng He, also known as Sanbao. The article ends with an interesting thought: was this Sinbad?

The tales of charts include a 13th Century Mediterranean portolan, the 1513 chart of Piri Reis, and the more formal charts of the 18th Century that would even now be quite familiar to our older colleagues. One article tells of the Dutch mariner Lucas Janszoon Waghenaer, who published in 1583 what were probably the first charts produced by a mariner for other mariners; for over 100 years these were the best charts available. The next article mentions that the Dutch made an interesting point 100 years later, during the Second Dutch War, using those same charts to sail their warships into the Thames and Mersey estuaries. This prompted Samuel Pepys, of diary fame, to persuad King Charles II that it might be a good idea to carry out their own surveys of British coasts and harbours and to produce a set of British charts. Thus was the naval officer Greenvile Collins appointed as the first Hydrographer to the King, though another of the articles points out that the French, thirty years later, were the first to actually set up a national Hydrographic Office.

Greenvile Collins' work resulted in 1693 in an atlas of 47 charts and 26 pages of sailing directions, along with tide tables and coastal views. That same year, France published the *Neptune François*, thought by Samuel Pepys to be a finer product. The French authorities, incidentally, were not very happy about the reluctance of their officers to purchase their *Neptune François* and devised a brilliant plan to ensure that each officer bought one. (Keep quiet about this ploy, though, lest our budget-conscious employers hear about it.)

Particularly interesting to CHA members is the article on Joseph Bouchette and his survey of Toronto Harbour in 1792 and the building by CHA's Central Branch of their replica Admiralty launch *Surveyor*. There is a fine colour photograph of the launch in action in Toronto Harbour on the inaugural re-enactment survey of Toronto Harbour; this was a highlight of the Canadian Hydrographic Conference there in June 1993, complete with colour commentary by the redoubtable Admiral Ritchie himself, garbed in appropriate period attire. This article is followed by the story of Henry Bayfield and Phillip Collins, who worked out of Penetanguishene on the Great Lakes Survey in the 1820s. In the fullness of time, this became the forerunner of the Canadian Hydrographic Service.

The story of surveying the Rajang River in Borneo in 1947 was of particular interest to me as I was on a ship anchored at that same bend in the river in 1958 on my first trip as a cadet with the Ben Line; we were at anchor there for ten days loading three thousand tons of sawn timber. There were no aids to navigation at the time so each evening one of us cadets would go out in a small boat to set up oil lamps at three locations at the edge of the jungle for the night watch to use for anchor bearings, then we'd go back in the morning to retrieve the lamps and get them ready for the next night. I well remember watching for those red ants and have vivid memories of interesting movements in the nearby jungle.

All in all, this is a wonderful book, worthy of a near-to-hand place on every hydrographer's bookshelf. I really look forward to the publication of a second collection of such articles.

The History of GEBCO 1903-2003

The 100-year story of the General Bathymetric Chart of the Oceans

Written and edited by Jacqueline Carpine-Lancre, Robert Fisher, Brian Harper, Peter Hunter, Merion Jones, Adam Kerr, Anthony Laughton, Steve Ritchie, Desmond Scott, and Maya Whitmarsh with contributions from many other hands.

Review contributed to *Lighthouse*
by Stephen B. MacPhee

Published by GITC bv, Lemmer,
The Netherlands 2003 ISBN: 90-806205-4-8

This is indeed a unique book and a necessary addition to the library of anyone who has an interest in the history of ocean mapping. It is well researched, covers the material in considerable detail and is well presented. In the Introduction, individual initiatives during the 18th and 19th century to map the oceans are mentioned but there was not really any financial backing until April 1903 when His Serene Highness Prince Albert I of Monaco offered to organize and finance the production of an ocean mapping series to be designated as 'La Carte générale bathymetric des océans' (the General Bathymetric Chart of the Oceans): GEBCO.

In Chapter 1, Admiral Ritchie discusses the pre-GEBCO history of deep-sea sounding and early attempts to obtaining geographic coordinates leading to the invention of the chronometer. He discusses the leadline soundings required for the various North Atlantic cable routes and later for cable routes world-wide as well as the methods and equipment used for obtaining soundings and sediment samples. It is interesting to note the strong influence the telegraph companies had on hydrography at this time (1850-1870) and how their requirements contributed to the change from rope to wire sounding and to the invention of the Lucas sounding machine which became the instrument of choice for the next fifty years.

In Chapter 2, Jacqueline Carpine-Lancre explains the origin and early history of GEBCO. She discusses the early International Geographic Congresses and the fact that it was not until the 6th Congress held in London in 1895 that a session was devoted to Oceanography with nomenclature and terminology as topic areas. In the 1899 Congress held in Berlin, there were three Oceanology sessions with considerable debate on nomenclature for submarine features resulting in the formation of a Commission on Sub-oceanic Nomenclature. The writer provides an excellent well referenced discussion leading up to the publication of the 1st Edition of GEBCO and to the presentation of all 24 sheets to the *Académie des sciences de Paris* on 11 January, 1904. Interestingly, while this was initially believed to be a major scientific success, many imperfections were noted after the printing was completed and the projected was somewhat discredited.

The inauguration of the *Muséé océanographique* in Monaco in 1910 provided an opportunity to have formal dialogue with the oceanographic scholars on a 2nd Edition. This edition met with many delays and was brought to a total halt with the outbreak of war in August, 1914. Prince Albert died in 1922 but left in his will funds and instructions for completing the 2nd Edition. It was completed in 1931 but was a financial failure with only 148 complete sets being sold. In 1921, the International Hydrographic Bureau (IHB) was formed in Monaco and in 1929, at the first Extraordinary International Hydrographic Conference, a decision was made that the IHB would keep GEBCO up to date.

In Chapter 3, Adam Kerr provides details on the 3rd and 4th Editions. In 1928, with three sheets of the 2nd Edition still to be completed, the process to produce a 3rd Edition began. This edition was compiled by staff of the IHB and production was delayed due to the Second World War and a lack of funds. During the period while the 3rd Edition was being prepared, acoustic sounding was introduced and the amount of new data consequently increased. The first sheet of the 3rd Edition was published in 1935 and the edition was declared finished in 1955 although six polar sheets were not published at the time. Three were published later and the other three were never published. This edition was considered to be out of date at the time of publication and was not a huge success.

In a 1953 paper to the International Joint Commission on Oceanography, the IHB President talked about how difficult it was for the IHB to present bathymetry in a form that would truly satisfy the various scientists who they hoped would use the charts. Subsequently in 1957, at the General Assembly of the International Association of Physical Oceanography, a committee was formed on the General Bathymetric Chart of the Oceans. In 1958, a meeting was convened at the IHB to discus co-operation in the production of future editions. After many discussions among the various scientific unions and debates among Member States of the International Hydrographic Organization (IHO), in April 1965 an agreement was signed between the French *Institut Géographique national* and the *service hydrographique de la marine* as one party and IHB as the second party concerning publication of the 4th Edition. Work started but there were a number of problems and only six sheets were published.

In 1960 the Intergovernmental Oceanographic Commission (IOC) of UNESCO was founded and the exchange of bathymetric data was one of the issues of interest. From its founding, IOC's main scientific advisory body was the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU). IOC turned to SCOR for advice and SCOR formed a working group that was chaired by Dr. A.S. Laughton who in Chapter 5 discusses the working group on Morphological Mapping of the Ocean floor. It was clear at this time that oceanographers were not satisfied with the GEBCO sheets as they were out of date and did not reflect current thinking on seafloor processes. As a result of meetings and discussions, an IOC/IHO Guiding Committee on GEBCO was established. This was to be the Guiding Committee for the Fifth Edition of GEBCO.

In Chapter 6, Desmond Scott discusses A Change of Direction for the 5th Edition. The first session of the IOC/IHO Guiding Committee was convened in 1974 and the first task of this meeting was to finalize the specifications for the 5th Edition. As work was well under way in a number of scientific areas on regional ocean mapping, the first sheet of the 5th Edition was available for publication in early 1975. This first sheet (Sheet 5.05 of the northern Indian Ocean and the Mediterranean Sea) was widely distributed and became the model on which the remaining sheets of the series were based. Compilers for the 5th Edition came from marine scientific establishments worldwide with considerable collaboration among scientists from different countries. All 18 sheets of the 5th Edition were drafted and printed by the Canadian Hydrographic Service and were first displayed as a complete set at the XIIth International Hydrographic Conference in Monaco in 1982. A World Sheet was subsequently published in 1984.

In Chapter 7, Dr. Robert Fisher provides a summary of the work of the GEBCO Sub-committee on Geographical names and Nomenclature of Ocean Bottom Features. One result of this sub-committee's work is the IHO-IOC Gazetteer currently available in paper and digital form. During the preparation of the 5th Edition, it became clear that a digitised dataset was needed in addition to the paper chart series and in 1994, the British Oceanographic Data Centre (BODC), after considerable effort over ten years, released the GEBCO Digital Atlas (GDA) on a CD-ROM. In the final chapter of the book, Dr. Meirion Jones discusses the process leading to the GDA and notes that since 1994, the bathymetry of about one-third of the world's oceans has been revised and submitted to BODC for updating the Atlas.

On a personal note, I have little knowledge of the first four editions of GEBCO but seek information from the 5th Edition on a regular basis in my work. While earlier editions did not meet with full satisfaction, I think it can be said that GEBCO is now designed to meet the needs of those for whom they it was intended, that is those persons with a professional or private interest in ocean science, and this book provides an important chronology of this significant work.

SOUNDINGS ...

"Soundings" is a regular feature of Lighthouse. It is named in recognition of a newsletter named "Soundings" that was produced by the Dominion Hydrographer's Office many years ago. It is intended to stimulate thought and discussion within the hydrographic community. We invite your comments.

"Register the Sale of Each Chart"

This edition of *Soundings* suggests that Hydrographic and/or chart distribution offices may benefit from some means of maintaining a link of communication with those that purchase charts. I suspect this topic has been discussed many, many times over the years, but I believe there still may be a concern within the charting community.

As I understand it, the procedure in many chart distribution centres or chart dealers, is to sell a chart and record the sale, perhaps for inventory purposes. The customer may or may not subscribe to Notice to Mariners. The salesperson may or may not make any attempt to convince the chart buyer to register for Notice to Mariners.

In many cases, particularly with recreational boaters, those who buy a chart do not know or care about Notice to Mariners. I also suspect that of those recreational boaters who do receive Notice to Mariners, many toss them aside immediately because there is too much information or the particular notice lacks information about the chart of interest.

I suggest there is a better way of getting information to those who acquire hydrographic charts.

The proposal is to register the sale of each chart, with the buyer's name and address recorded. This is not a complex task. Then when a notice affects a particular chart, the buyer can be notified. With this registration system, the chart owner knows that each communication from the chart distribution centre is important: It affects his chart!

With a registration system, the chart owner can also be made aware when a new edition of his particular chart is published. At present this is a concern as many boaters operate with out-of-date charts, primarily because they do not know a new chart or new edition of their area of interest has been produced.

The answer is to register the sale of each chart and personalize the distribution of Notice to Mariners. For those chart distribution centres that do maintain a registration system, or have tried it and rejected it for one reason or another, we would be pleased to hear of your experiences.

P.S. This article contains a lot of generalization and paints many boaters with the same brush. That is not the intent. There are many boaters who are very responsible, have full understanding and without fail maintain their charts with Notice to Mariners. However, it is known that many do not, and a good registration system by hydrographic offices can make it much easier for all.

I am also aware that, through the Notice to Mariners system of the Canadian Coast Guard, an individual can register a chart and receive a weekly notice, for that particular chart, through the e-mail systems. This is an excellent system but does not resolve all concerns.

Your comments are invited.

Earl Brown,
Hydrographer (retired)

DID YOU KNOW . . .

CRUISERS

The word cruiser is derived from the Mediterranean word CRUSAL, meaning "fast".

THE CANADIAN HYDROGRAPHIC ASSOCIATION AWARD
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(est. 1992 / établier en 1992)

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5. The award application will be submitted to the Administrator of Canadian Hydrographic Association Award Program by June 30 each year and to the address in item 11 below.

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2. La bourse s'adresse seulement aux étudiants qui seront à leur deuxième année d'étude dans un programme menant à un diplôme collégial ou de premier cycle universitaire conforme aux sujets de base. Le candidat doit soumettre une copie de son relevé de notes de sa première année avec sa demande. Les notes doivent être supérieures à la moyenne et avoir une moyenne inconditionnelle supérieure à 70 %.

3. La bourse sera remise au candidat qui, de bonne foi, peut démontrer ses besoins financiers et qui respecte les performances académiques exigées ci-haut.

4. Le candidat devra écrire un court texte, d'une manière claire et concise, démontrant ses besoins financiers sur le formulaire de la demande ou, si nécessaire, sur une lettre jointe. Une grande importance est accordée à cet aspect de la demande.

5. La demande doit être soumise à l'administrateur du programme de la bourse de l'Association canadienne d'hydrographie au plus tard le 30 juin de chaque année à l'adresse mentionnée à l'article 11 ci-bas.

6. La valeur de la bourse est de 2000 $. Il n'y a qu'une seule bourse remise à chaque année civile.

7. Le récipiendaire recevra un certificat spécial de l'Association canadienne d'hydrographie, dûment encadré . Il recevra aussi un médaillon à l'effigie de l'Association canadienne d'hydrographie et son nom sera ajouté sur la plaque des gagnants. Une photo de la plaque gravée sera postée au gagnant avec un chèque de 2000 $ au cours de la deuxième semaine de juillet.

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4719 Amblewood Drive, Victoria, BC V8Y 2S2
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University of New Brunswick (UNB)
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On September 15th and 16th, 2003 the Land and Coastal Studies Group, Department of Geodesy and Geomatics Engineering, UNB, in conjunction with FIG Working Group 4.3 hosted a "Meeting on Marine Cadastre Issues". The meeting was held at the Wu Centre, UNB in the city of Fredericton, New Brunswick. The meeting provided an excellent opportunity for international stakeholders and experts to share their perspectives and to learn about international initiatives relating to the marine cadastre.

The event was sponsored by the UNB, Terradigm (Canada), The Royal Institute of Chartered Surveyors, Geomatics Faculty (UK), The Canadian Institute of Geomatics, FIG, The Association of New Brunswick Land Surveyors and the Canadian Hydrographic Association. Delegates attended from Austrialia, Canada, USA, the Netherlands, Malaysia and Trinidad and Tobago.

Papers and presentations covered country status and initiative with regard to the implementation of marine cadastres, as well as related technical, institutional and conceptual issues.

For more information, please visit:
http://gge.unb.ca/Research/LandStudies/MarineCadastre/marine cadastre 2003.html

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C & C Technologies (C & C), an international hydrographic surveying company, headquartered in Lafayette, Louisiana, has approximately 170 employees and four offices worldwide.

As of January 2003, eighty percent of C & C's revenues were derived from survey work for the oil and gas industry and the other twenty percent are derived from US government contracts. The oil industry work includes high-resolution marine geophysics for hazard studies and pipeline route surveys, rig and barge positioning, acoustic positioning for ROV's, as well as satellite navigation services. The company has separate offshore oil industry survey departments for geophysical work, marine construction, and navigation.

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visit C & C's Website at *www.cctechnol.com*

C & C Technologies Participates with The History Channel's "Deep Sea Detective" Series

In the fall of 2003, C & C Technologies, Inc., in conjunction with the NOAA Office of Ocean Exploration, the PAST Foundation and the History Channel, will conduct an archeological expedition to the wreck site of the German U-166 submarine in the Gulf of Mexico. The purpose of the expedition is to collect archaeological data and examine the biologic communities on the U-166 site to better understand what happened on July 30, 1942. The scientists will research how the vessel, built to destroy, is now providing life to colonies of undersea creatures. As part of this documentation, a series of educational internet web casts are planned that will provide viewers with a live view of the wreck site 5,000 feet beneath the waters of the Gulf of Mexico. The expedition, along with others, will be aired as part of the History Channel's "Deep Sea Detectives" series.

The German U-boat 166 was attacked and sunk by the U.S. Navy Patrol Craft 566 in July 1942. As the only U-boat lost in the Gulf of Mexico, the U-166 represents a unique piece of America's and Louisiana's Maritime History. The submarine was discovered and identified by members of C & C Technologies 50 miles southeast of New Orleans, Louisiana, in January 2001. The initial discovery was made by C & C while performing a deep-water pipeline survey for BP and Shell International Exploration & Production, Inc. in the vicinity of the reported location of the *Robert E. Lee*.

This survey was conducted using C & C's HUGIN 3000 (High Precision Untethered Geosurvey and Inspection System). The HUGIN 3000 was the world's first commercially operated Autonomous Underwater Vehicle (AUV) capable of surveying to 3000 meters water depth. The HUGIN utilizes a state-of-the-art multibeam bathymetry and imagery system, a dual frequency chirp side scan sonar, chirp sub-bottom profiler and a inertial navigation system. The leading edge instrumentation, coupled with the acoustic tracking system, make the HUGIN one of the most powerful and cost effective commercial survey packages operating in the world.

For more information on C & C's Technologies' services please contact:
Jay Northcutt at: (337) 261-0660
For further information, visit C&C's Website at *http://www.cctechnol.com* or E-mail: info@cctechnol.com.

Kongsberg Simrad - ConCat

The new folding workboat is a joint project between Neptun Workboats (part of Hesnes Neptun Gruppen) and Kongsberg Simrad. Together, they will provide the market with a completely new survey concept. The ConCat vessel consists of a foldable catamaran housed in a specially designed 40 feet container, hich also includes an office.

In Horten, the catamaran will be fitted with survey equipment from Kongsberg Simrad and bridge equipment from Simrad. Kongsberg Simrad will install an EM 3000 dual multibeam echo sounder, and an EA 400 single beam echo sounder with 38 and 200 kHz transducers as well as a 120 kHz sidelooking transducer. For position reference, a Seatex Seapath 200 reference and navigation system is added, as well as sensors for sound velocity sensor, motion etc.

The ConCat is based on a well proven workboat design, and includes the unique MB Folding Mechanism (MBFM). The catamaran is built in FRP sandwich, and it has a total deck area of approximately 35 m2.

Main specifications:

Length: 9.4 m	Width: 3.7 m
Draft: 0.5 m	Weight: 4.8 tons
Speed: 18 knots	Payload: 4 tons

Main engine: 2 x STEYR 164 turbo diesel marine
Gearbox: Hurt HSW450D
Water jets: Alamarin 230

ConCat will make a North American debut in the spring of 2004.

For further information please contact
Nick Burchill,
Survey and UVI Sales, Dartmouth, NS. (902) 468-2268
Email: Burchill@kongsberg-simrad.ns.ca

ANNOUNCEMENTS / ANNONCES

The editors of Lighthouse realize that the number of events and happenings associated with the world of hydrography over a given period could make for a rather exhaustive listing. In presenting the following listing of announcements we are focusing on the activities of organisations and individuals who are either directly or indirectly affiliated with the Canadian Hydrographic Association...

NEW CHA WEBSITE UP AND RUNNING

Please bookmark *www.hydrography.ca*

MANDALY to NORSEMAN – Book by T.D.W. McCulloch

CHA's Tom McCulloch has published his memoirs in a book entitled "Mandalay to Norseman" available from Trafford Publishing, Victoria, British Columbia [it will be reviewed in the next edition of *Lighthouse*]. It tells of a misspent youth in Scotland and at sea before arriving in Canada in 1948. Tom informs us that the sequel which is yet to be written will feature his time with the CHS and CHA. For more information contact the bookstore at bookstore@trafford.com or visit *www.trafford.com*

CHA NATIONAL AGM

This year's National AGM was held on October 15 at the Fairmont Palliser Hotel, Calgary. Following the business meeting and dinner, members and guests were entertained by speaker Gordon Guenette and his presentation on Raising the Kursk. Minutes of the National AGM will be posted to the CHA website *www.hydrography.ca*

MELAHA2004 - The Arab Institute of Navigation, bi-annual Conference on Navigation in Channels and Restricted Waters, - Call for Papers

Dr. Ahmed El-Rabbany, a member of Central Branch CHA, is the Secretary General for this conference and would like to extend an invitation to our members to submit an abstract.

The conference topics are as follows:

1. Global Navigation Satellite Systems (GNSS): Present and future developments
2. Space- and ground-based augmentation systems
3. Multi-sensor integrated navigation systems
4. Receiver technology
5. Applications in maritime VTS, pilotage and ship berthing
6. Applications in multi-modal transport operations and container monitoring
7. General applications on navigation in restricted waters
8. Applications in aviation traffic systems
9. Application in surveying and mapping
10. Hydrographic surveying and data management
11. Electronic navigational charts

The conference is to be held at the El Salam hotel in Cairo, Egypt, **April 13-15, 2004**. The conference will focus on the recent and future developments in the general area of navigation. As part of the event, an industry exhibition will run in parallel to the conference. The exhibition will offer a unique marketing opportunity to companies and agents in the navigation business. The deadline for abstracts is November 15, 2003 and may be submitted to Dr. El-Rabbany at rabbany@ryerson.ca or to the Arab Institute of Navigation, ain@asst.edu. The deadline for full papers will be 1 February, 2004.

For more information,
please contact the Arab Institute of Navigation at
+203 5509624 or by fax +203 5509686 or visit
www.ainonline.org

HYDRO 2003 - The 4th Australasian Hydrographic Symposium

To be held in Christchurch from **24-26 November**, HYDRO 2003 will be the fourth Australasian hydrographic symposium and is being organized by the Australasian Hydrographic Society's New Zealand region. The last symposium was in Perth five years ago and was enjoyed by about 150 attendees and exhibitors.

In other words it's a great opportunity to come and either display your products or meet like minded professionals.

Surveying Extremes is the main theme of proceedings for HYDRO 2003, planning for which is well underway. So far, around 24 individual papers are scheduled on topics covering Offshore Development, Data Management (UNCLOS etc), Environmental, Navigation and Technical Innovation. The organizers are keen to hear from people wanting to present a paper.

There will be 18 exhibitors' booths and many of them are already booked. There are booths left so please visit the website below to get the details.

It is likely that two hydrographic survey vessels from the NZ and Australian Navy will be coming to the local port – Lytellton – for this symposium.

Also try and convince your partner to travel with you. There is a Partner's programme organized for the Symposium. The South Island of New Zealand is a scenic location.

For more information visit
www.hydrographicsociety.org.nz

MULTIBEAM SONAR Training Course (United States) -

The (US) National Oceanic and Atmospheric Administration (NOAA) and The Hydrographic Society of America (THSOA) host the 32nd, Coastal Multibeam Training Course.

Presented by The University of New Brunswick Ocean Mapping Group and the University of New Hampshire Center for Coastal and Ocean Mapping, this course will be held in Seattle, **December 1-6, 2003** at the NOAA Western Regional Center. This world recognized course aims to prepare and train experienced hydrographers in the use of multibeam sonar systems.

For more information visit *www.thsoa.org*

MULTIBEAM SONAR Training Course / Cours de formation en SONARS MULTIFAISCEAUX

The United States/Canada Hydrographic Commission Coastal Multibeam Sonar training course will take place in Ottawa-Gatineau from **17 to 22 May, 2004**. This training is regarded as one of the best sources for multibeam sonar training in the world. The course will precede CHC 2004. For more information visit www.chc2004.com or E-mail info@chc2004.com.

Le cours de formation de la Commission hydrographique US/Canada de Sonars cotiers multifaisceaux se tiendra du **17 au 22 mai, 2004** à Gatineau-Ottawa. Ce cours est l'un des meilleurs au monde en cette matière.

Pour de plus amples renseignements, visitée :
www.chc2004.com ou courriel info@chc2004.com.

CHC 2004 – A Canadian Celebration of Hydrography: Foundation for the future

Plan to attend the **Canadian Hydrographic Conference in Ottawa, 24 to 27 May, 2004**, to help us celebrate 100 years of hydrographic achievements (1904 – 2004) while looking forward to and exciting future. CHC 2004 will be co-hosted by the CHA Ottawa Branch, the Canadian Hydrographic Service and the Canadian Nautical Research Society (CNRS).

The program will provide an outstanding opportunity to revisit the pioneering spirit and achievements of early hydrographers, while building upon those accomplishments to look at the future of the profession. Sessions and exhibitions will take place at the Westin Hotel in downtown Ottawa.

The co-hosts invite anyone interested to contact the CHC 2004 Planning Committee to inquire about sponsorship opportunities.

For more information contact:
The Canadian Hydrographic Conference 2004,
300-615 Booth Street, Ottawa, Ontario, Canada K1A 0E6,
www.chc2004.com or E-mail info@chc2004.com.

CHC 2004 –Hommage canadien à l'Hydrographie : La Fondation pour l'Avenir

Participez à la **Conference hydrographique du Canada qui se tiendra à Ottawa, 17 au 22 mai, 2004**. Joignez-vous à la célébration du Centenaire de l'hydrographie canadienne, (1904 – 2004) tout en étudiant le future de l'hydrographie. Hotes de la CHC 2004: L'Association hydrographique canadienne section du Ottawa, le Service hydrographique du Canada et la Société canadienne pour la recherche nautique (CNRS).

Le programme donnera l'extraordinaire possibilité de reprendre contact avec l'esprit pionnier et les exploits des premiers hydrographs, tout en offrant un regard sur l'avenir de la profession. Toutes les sessions et exposition se tiendront a l'hotel Westin dans le centre-ville d'Ottawa.

Les organisateurs invitent tous les commanditaires à contacter le Comité de planification de la CHC 2004 pour étudier les possibilités de commandites.

Pour de plus amples renseignements, veuillez communiquer avec:

Conférence hydrographique du Canada 2004,
300-615, rue Booth, Ottawa (Ontario) K1A 0E6 Canada,
www.chc2004.com ou courriel info@chc2004.com.

INTERNATIONAL FEDERATION OF SURVEYORS (FIG) WORKING WEEK 2004

To be held in Athens this **22-27 May, 2004**
Commission IV (Hydrography) CALL FOR PAPERS
Topics include Coastal Zone Management, Hydrography and Charting and Hydrography in support of Construction and Dredging.
Abstracts are to be submitted to the FIG office, email: fig@fig.net by 30 November, 2003.
The deadline for full papers will be 15 February, 2004
For more information please visit: www.fig2004.gr and the FIG web site *www.fig.net*

ISPRS 2004 INTERNATIONAL SOCIETY FOR PHOTOGRAMMETRY AND REMOTE SENSING, GEO-IMAGERY BRIDGING CONTINENTS

The 20th Congress of ISPRS will be held in Istanbul, July 12-23, 2004 and will bring together more than 2000 people representing more than 120 countries.

For the first time in the history of the ISPRS there will be sessions organized by student attendees, and the organizers of this Congress are placing a great emphasis on these sessions, offering two awards for Best Paper and three for Best Poster in the Youth Forum.

The Organizing Committee has announced the availability of a limited number of grants and fellowships to provide financial support for deserving attendees from developing countries. Deadline for these applications is December 31, 2003.

About ISPRS

The International Society for Photogrammetry and Remote Sensing is a non-governmental organization devoted to the development of international cooperation for the advancement of knowledge, research, development, education and training in the photogrammetric, remote sensing and spatial information sciences, their integration and applications, to contribute to the well-being of humanity and the sustainability of the environment. The Society operates without any discrimination on grounds of race, religion, nationality, or political philosophy.

For additional information about the XXth ISPRS Congress, visit the Congress website at *www.isprs2004-istanbul.com*.

For information about ISPRS, visit *www.isprs.org*.

Congratulations! CHA Award Winner Matthew H. Bigney

B.M. Lusk, Manager, CHA Award Program

The Canadian Hydrographic Association award for 2003 is presented to Matthew H. Bigney, from Fall River Nova Scotia, who is entering second year Geomatics and Geodesy Engineering at the University of New Brunswick this fall. He recently graduated from the Centre of Geographic Sciences after completing his two-year program. As his letter of reference states "Matthew was one of the top students in the Geomatics Engineering Technology program here at the Centre of Geographic Sciences. Not only was he at or near the top in terms of marks but also hew was also always keen to clearly understand how and why things worked, and not simply strive for high marks." A cheque for $2000 was given to Matthew; a framed certificate and the medallion was also be presented. His name will also be inscribed on the Award's perpetual plaque. The Canadian Hydrographic Association congratulates the award's 10th winner and the first from the University of New Brunswick.

Dear Canadian Hydrographic Association,

Thank you for selecting me for your Award. Receiving it has been a great honour. The certificate and medallion will be proudly displayed in my home and one day, in my office. The 2000 dollars I have received will really help me pay for the coming semester's expenses.

The generosity of this award is greatly appreciated. It will allow me to focus on my schoolwork as opposed to my finances.

I hope you continue to provide this help to students in the future. Thank you again.

Sincerely,
Matt Bigney
Student

Charles M. "Chuck" Leadman

29 Dec 1917 - 19 July 2003

Members or the Canadian Hydrographic Service heard with regret of the passing away of Chuck in the Ottawa Hospital at age 85. He was predeceased by his wife Dorothy. He is survived by his children Tony and Larry, his two granddaughters and one great-grand daughter.

Chuck will always be remembered for the dedication to accurate work, his straight forward approach to almost everything in life but mostly for his irreverence of modern society. He balanced this with a subtle sense of humour that never left him.

He was a second generation hydrographer. His father, Heaman L. Leadman was the hydrographer who finally put the deadly Superior Shoal, on Lake Superior, on the chart and ended his career as Superintendent of Hydrography.

In about 1950 Chuck graduated from the University of New Brunswick with a degree in forestry. He then joined Topographic Surveys where he stayed for two years before joining the Canadian Hydrographic Service.

His career in the CHS, from about 1953 to 1975, saw him deal with a wide variety of surveys. First he was assistant on arctic surveys with D'Arcy Charles on board the Algerine. That was followed by time on the Acadia off Newfoundland under C.H. Martin and D. LeLievre. Further shoreparty work with G. Lowe and L. Hunter kept him working in Newfoundland a little longer.

When he became Hydrographer-in-Charge of surveys he spent much time in Prince Edward Island, Lake Winnipeg, the St. Lawrence Seaway survey and Lake of the Woods among other assignments. One of the more interesting hightlights must have been the responsibility for safety of navigation around the Montreal Expo 1967 site.

Office projects he was involved with were the writing of the CHS Survey Manual as well as Sailing Directions for the Richeleau River and the Trent Canal System. Toward the end of his career he joined Staff Training in Ottawa.

Chuck had resisted moving to Burlington with his family when Central Region was relocated there. For the sake of a few years he did not want to cut ties with Ottawa and instead spent the working week in Burlington and the week-ends at home with his family.

In Ottawa he lived with his family in the house he had inherited from his father in 1966. He was an ardent Ottawa football fan. In W.W.II he had been a bombardier with the RCAF and maintained his interests in aviation by frequent walks near the airport, watching the coming and going of air traffic, and following the annual air shows.

Pacific Region

Nautical Publications, Pacific Region Update

The Nautical Publications division in CHS Pacific is busy working on a variety of projects. We are moving forward with our Risk Area Approach to charting, defining the charts we will maintain, and adding them to our production plans. We are also working on the completion of projects that were started under the PI2 and Loran C funding received in recent years.

We have been striving to release ENC products at the same time as paper products, after hearing this is a concern from our users. We have been tracking this as a performance measure and can happily report that the two are finally in alignment for recent projects and updates completed. This certainly will be well received by the users of these products.

Our division has recently completed and released a major New Edition of chart 3419, Esquimalt Harbour, the home of the Navy on the west coast. It utilized Multibeam data, which gives the Navy a high degree of confidence in the area. New Chart 3938 is in the final stages of production. It is another in the series of charts in the central coast of BC in a popular recreational area. Another New Chart, 3412, Victoria Harbour, is also nearing completion. It is anticipated to be released this fiscal year.

The rotation of new Multidisciplinary Hydrographers continues. They all participated in the recent CHS Data Transformation course, and scored very well. Brian Port continues his exchange assignment in Quebec and apparently can now speak French. Al Schofield recently completed Management Development I as well as a diploma course in supervision from a local college.

Over the past couple of years we have suffered numerous ergonomic related injuries as a result of using old drafting furniture in a computer world. We were able to secure funding through a building upgrade/maintenance project to correct this continuing problem of an unhealthy worksite. We have worked with a designer and have recently ordered new workstations for the entire division. We hope they will arrive for Christmas.

Acoustic Seabed Classification Surveys in Pacific Region

By Jim Galloway

CHS Pacific has been collecting both mutibeam backscatter and single beam raw echoes as a routine part of our survey operations for a number of years. These data provide us with an overview of the seafloor geology and habitat, which is useful for charting purposes, habitat health, and stock assessment—since many benthic communities are keyed to particular bottom types. In order to make processing of the significant quantities of recorded acoustic data efficient, the Sonar Systems group in CHS Pacific has been conducting single beam surveys to establish an "acoustic classification standard catalog". This catalog can be applied to classify regional surveys of the seafloor using our Knudsen 320M sounders and Quester Tangent's software product "IMPACT". To date, we have established 43 reference sites in depths from 15m to 350m near IOS, Sidney, and Victoria. These areas define a suite of unique bottom types over a range of depths suitable for calibration of the classification systems, both single beam and multibeam.

We want to identify sites that are non-complex to provide us with suitable calibration areas. The procedure is to perform a mini survey for a small area of 400m x 400m with 50m line spacing at 38 kHz and 200 kHz simultaneously, then perform an unsupervised classification with IMPACT to determine how coherent the region actually is. We then take a number of grabs to confirm the composition of the bottom material and we record video at the same time to ensure we are collecting a representative sample of the seafloor. Next, we tow our video camera on transects through the survey area to confirm the transtition zones and to get a feel what the distribution of surficial bottom material really is. Finally, we conduct a supervised calibration over those specific sites for which we have excellent knowledge of the geology and biogenic properties. This supervised classification then forms the basis for the standard catalog. The focus has been on single beam operations to date, but these reference sites can be used for multibeam classification calibrations also.

Central and Arctic Region

Goderich Marine Heritage Festival Opening Ceremonies CHS/CHA Presentation

By Mike Bennett

CHS attended the North American Safe Boating Week media kickoff day. This year the Canadian Safe Boating Council hosted event was held at Little Lake Park, Peterborough on May 17. This is the first time that the Canadian portion of the event was held outside of Toronto. Peterborough proved to be an excellent venue and there was a good turnout by the public including a group of school children from grades 4 and 5. The children and the many politicians including the local MP, MPP, Mayor and Councillors provided the pickings for much humourous material from Co-host Luba Goy. Luba is an excellent spokeswoman for boating safety and the children were a good target audience. CHS sponsored and exhibited with many other organizations and the children along with the adults were interested in the charts of the area and the CHS fridge magnets and tattoos proved to be a popular item, especially with the kids. CHS renewed its sponsorship for the 2003 Labatt WaterWise Boat Pro Program and on May 20 the Boat Pro Team, Tara Ross and Ryan Hartwell had a sponsor orientation visit at the CHS office in Burlington. The Boat Pro team had a very busy summer promoting boating safety across Ontario. During the month of August CHS exhibited at the Orilla and Port Credit In-Water Boat Shows and Nautical Data International shared our booth at both events. An exhibit was also provided for a Deputy Minister's visit in Sarnia on July 18. CHS partnered with NDI to celebrate NDI's 10th anniversary by hosting a cocktail reception on the Tall Ship Caledonia in Toronto Harbour for clients, business partners and other marine industry representatives. The Canadian Hydrographic Association did double duty at two events by representing the Heritage Launch Surveyor and staffing the CHS exhibit on an opportunity basis at the Tall Ships Festival in Sarnia and at the Goderich Marine Heritage Festival. CHS attended the Canadian Safe Boating Council Symposium in Montreal, September 25 to 28.

Data Acquisition Division

Tides and Water Levels

Annual inspections and equipment upgrades were competed at the permanent gauging stations on the Great Lakes and upper St. Lawrence River.

Arctic Gauging Project

Run jointly with the CHS, Natural Resources Canada (NRCan) and Environment Canada (EC), the Arctic Gauging Program is a four year project to establish a network of gauging stations in the Arctic to monitor sea level change. This project is funded through the Canadian Climate Action Fund, administered by EC. The project is now into its third year.

This past summer, Ron Solvason along with Neil Sutherland and Ron Woolley from Pacific Region CHS traveled to the Arctic Gauging station at Alert, NU, to perform the annual servicing. A couple of weeks prior to the visit, ice overturned the underwater measuring orifice. The orifice was righted and the equipment was brought back into operation. Additional work was performed to ensure that this won't happen next year. Ron, along with Neil Sutherland and Denny Sinnott from Pacific Region CHS traveled to Tuktoyaktuk, NT to re-establish the permanent gauging station at that site. On this trip they were accompanied by J.C. Lavergne from NRCan who setup the GPS equipment at the Tuktoyaktuk station. Ron, Neil and Denny then traveled to Holman, NT to service the gauging station installed last year. This station has now been in operation for over a year and continues to operate well. Staff from Atlantic Region CHS serviced the Arctic Gauging station at Nain, NL. In September, Ron along with Carol Robinson Central and Arctic Region CHS and J.C. Lavergne NRCan traveled to Qikiqtarjuaq, NU to install the final gauging station in the project. Delays in the arrival of the sealift with all of the equipment meant that this installation will be postponed until next year.

Revisory Surveys

Field operations began this spring on Charts 1512 and 1513 of the Rideau Canal with the focus on positioning of buoys and day beacons and controlling the many insets on the charts. A few days were spent on Chart 2017 at Kingston where lights were positioned and the ferry channel into Barrett Bay on Wolfe Island was sounded to investigate the grounding incident in 2002. A review of Chart 2026, Lake Scugog on the Trent-Severn Waterway was completed along with positioning of daymarks, towers, and several shoreline points to assist with the shift to NAD83. On Lake Muskoka Chart 6021, one light, two towers and several shoreline points were positioned to confirm the NAD83 shift. On Chart 6022, Lakes Rousseau and Joseph, two lights, two towers and several shoreline points were positioned. The area of the Segwun grounding in 2002 was checked and the reported rock was found and positioned. The survey returned later in the season to investigate a recent grounding of the Segwun on another rock. The next stop was Britt on Georgian Bay. Reported rocks were found on Charts 2202-3, 2203-2, 2293 and 2204-2 and shoreline points were positioned. Five daymark ranges and one daymark on 2204-1 were surveyed. The Byng Inlet range was positioned and the Parry Sound CCG helicopter was used to position the rebuilt Wigwam Point light on Lake Nipissing. The new sector light at Penetang was surveyed. The survey end on Lake Erie with checks on Charts 2121, 2122 and 2123. Soundings and shoreline points were collected in Port Stanley, Port Burwell, Leamington, Kingsville, Scudder, Wheatley and Erieau. A small Field Sheet of the West Dock ferry terminal on Pelee Island was completed, including sounding, shoreline and shoal exams. Thirteen lights, a daymark, 7 towers and 5 silos were positioned. Numerous charted towers and "PA" silos were checked. A sidescan search for the reported wreck hit by the Algolake in December 1995 was successful. A wreck was located just north of the ship track.

Multibeam Surveys

At the request of Petro-Canada, their wharfs at Bronte and Clarkson on Lake Ontario were sounded by the multibeam launch Merlin. The Owen Sound Transportation Company requested a survey of the approaches to wharf used by the ferry in South Baymouth on Lake Huron. The area was previously sounded in the 1950's and the chart is off datum. A multibeam survey was completed and the shoreline was positions to correct the chart and to verify the S57 ENC file.

Western Arctic Survey

The 2003 Nahidik program was probably the most complex integrated Federal/Industry oceanographic/science/hydrographic program conducted to date in the Beaufort Sea. The survey ran from August 4 to September 21. Despite the difficult Arctic ice and weather conditions, all program participants and stakeholders met their objectives. In addition to acquiring regional bathymetric data (track lines) CHS conducted detailed surveys of Workboat Passage and Tuktoyaktuk Harbour and two abandoned artificial islands. The project completed three main objectives for the 2003 season. The first phase was a DFO Freshwater Institute/Canadian Museum of Nature/Geological Survey program that collected water column and seabed samples and acoustic profile data for assessing the Beaufort Sea ecosystem in relation to the identification of marine protected areas. The second objective was the testing of survey acoustic systems and the impact on marine mammals, conducted by LGL/Jasco LTD. Testing resulted in the approval for the survey to proceed, with the requirement of a 150m and 50m equipment shutdown zones for whales and seals, respectively, around the survey vessel. The third objective was the charting/mapping of the seabed with emphasize on seabed scouring by ice keels, abandoned artificial island stability and shallow gas hazards. Peter Harrison, former Deputy Minister of NRCan and DFO and presently Senior Research Fellow, Oceans, at NRC spent 3 days onboard the Nahidik. Dr. Harrison spent time learning every aspect of the science/hydrographic program – partnerships, links with the private sector, difficulties in working in a harsh environment and law-of-the sea issues. CHS staff departed for Burlington on September 24th and 26th. The CCGS Nahidik departed for Tuktoyaktuk on September 27th for winter lay up.

As the Nahidik field program came to a close, the CCGS Amundsen entered the Western Arctic to commence its equally complex, multidisciplinary science program. Jason Bartlett joined the ship in Quebec City on September 6 to help with the setup the new EM300 multibeam system and to collect multibeam data during the transit north and through the northwest passage. Jason will return in mid-October and the ship will over-winter in Franklin Bay.

Eastern Arctic Surveys

The survey party arrived in Iqaluit, Nunavut on August 10th and joined the CCGS Henry Larsen. Over the next few days they outfitted the ship, readied the launches and tested equipment. During the testing phase some survey lines were collected by the launches and horizontal position calibrations were done using the backpack system and the NRCan ePing CDGPS receivers. The installation and testing went very smoothly. The Larsen proceeded to Pangnirtung and survey work and calibrations began immediately. The portable Anderra tide gauge was deployed. The area adjacent to the community and beach landing was surveyed at 25 metre line spacing (1:5,000 scale). The area from the top of Chart 7105 to the mouth of the fiord was surveyed at 50 metre line spacing (1:10,000 scale). Several days of hydrographic work was done at Pond Inlet, resulting in enough sounding and shoreline data for 1:5,000 field sheets of the entire settlement/beach landing area and the approaches. While at the Nanisivik dock some data was collected to later verify the accuracy of datum shifts to the ENC CA573250 for chart 7512. A survey of Clyde Inlet was completed and all of the shoreline was flown. The northern portion of the inlet was sounded at a scale of 1:5,000 and the southern portion at 1 :10,000. Some soundings were done in Koojesse Inlet of Iqaluit. The outstanding survey work at Lake Harbour (Kimmirut) was competed and the survey party returned home on October 6.

Nautical Publications Division

Charts

Ten New Edition charts were published this past spring and summer in the region as follows: Arctic (7121, 7125, 7127, 7646), Hudson Strait (5316, 5455, 5464), Port of Thunder Bay (2314), Trent-Severn (2024), and Lake of the Woods (6218). Fifty-five charts were bilingualized, datum issues resolved and standard symbology used for charts in the Arctic. These charts will be published over the course of the year. In addition, 153 Notices to Mariners were published for critical changes to charts in both southern and Arctic waters.

Work progressed on the New Charts of Lake Timiskaming (1556), Georgian Bay (2242), Hudson Bay (5630), and the Arctic (7736, 7790-7792).

Electronic Navigational Charts

Five ENCs and sixteen S57 updates were released. A large scale ENC of Thunder Bay Harbour based on multibeam data began and is currently being reviewed prior to release.

Sailing Directions

Nine Notices to Mariners were drafted for Sailing Directions. Work began on a New Edition of sailing directions for *Hudson Bay and Hudson Strait ARC 401*.

100 YEARS AGO . . .

The Chart of Lake Winnipeg, "Red River to Berens River", was the first hydrographic chart to be surveyed, compiled, printed and published in Canada. The year was 1903.

The following notes are from Mike Meehan's text of the history of the Canadian Hydrographic Service. Thanks to David Gray, CHS, Ottawa, for extracting this information.

THE SURVEY OF LAKE WINNIPEG, 1901-03. The First Inland Water Survey Beyond the Great Lakes

Back in 1898 two lighthouses were constructed on Lake Winnipeg by the Department of Marine and Fisheries; one at Gull Harbour on Big Island, and the other some 34 miles to the northward on the eastern extremity of Black Bear Island. These lights were built according to the Chief Engineer "to accommodate the increasing steamboat traffic on Lake Winnipeg". The steamer channels between these lighthouses were located in the narrowest sector of Lake Winnipeg, an area where lake traffic was most concentrated and the waters uncharted. On June 17th; therefore, Mr. Stewart having placed Mr. Anderson in charge of the BAYFIELD, journeyed to Lake Winnipeg to undertake the first Canadian hydrographic survey of inland waters beyond the Great Lakes.

At Selkirk, Manitoba, the steam-tug FRANK BURTON was chartered from the Northwest Navigation Co. Ltd. for the season at a cost of $3,387.16. Sailing Master was Capt. C.P. Paulsen; and Chief Engineer, Mr. C. Walderson. Assistants with Mr. Stewart were Mr. R.E. Tyrwhitt of the BAYFIELD

for one month; and seasonal employee Mr. Walter Young for three and a half months. Activities were centred in the southern portion of the lake between Red River and Big Island where several lines of track soundings were run; and in the narrow channels from Gull Harbour and Berens River the waters were closely sounded.

In his annual report to the Deputy Minister the Chief Engineer wrote, "to save delay and expense the map of the lake issued by the Geological Survey (1899) is being used as a basis for a new chart." This was the first official occasion when results from a Canadian survey were not forwarded to the Admiralty for engraving and publishing.

In 1902, First and Second Assistants Messrs. F. Anderson and R.E. Tyrwhitt replaced Mr. Stewart, and extended his work on the previous season northwards. Capt. Paulsen was again Sailing Master of the FRANK BURTON; and Mr. Walderson, Chief Engineer. The chartered agreement with the Northwest Navigation Company extended from May 20th to October 16th; at a cost of $2,451.61. This season the eastern shore of the lake was closely examined; the channels into Berens and Big Black Rivers developed; and George, Little George and Sandy islands located and investigated.

FIRST CANADIAN CHART FROM CANADIAN SURVEYS, 1903

Before the season of navigation opened on Lake Winnipeg, in February 1903 a chart for the Southern Portion of Lake Winnipeg was printed in Ottawa for the Department of Marine and Fisheries. It was a coloured photo-lithographic sheet, drawn by Mr. F. Anderson, to a scale of 4 statute miles to the inch. This was the first Canadian chart from Canadian surveys. Later the Chief Engineer reported "the demand for this chart has been exceedingly small".
Note: An original copy of this Lake Winnipeg chart can be seen at the Map Division, Public Archives and National Library, Ottawa.

In 1903, Messrs. Anderson and Tyrwhitt returned to Lake Winnipeg to further develop its northern portion. This season Capt. Paulsen of the FRANK BURTON was replaced by Capt. A. Vance; and Mr. A. Vrooman of the BAYFIELD replaced Mr. Walderson as Chief Engineer. Special investigations were carried out in several small harbours at Spider's Islands, Warren's Landing (entrance to the Nelson River) and Selkirk Island. Most of these narrow, crooked channels with none too deep entrances, were carefully sounded and marked with range beacons. In his annual report, the Chief Engineer commented "the open part of the Lake has now been pretty thoroughly gone over, so that there is not much necessity for continuing the work at present." Despite this statement, another full season was necessary to bring the first survey of Lake Winnipeg to a temporary close.

Canadian Hydrographic Association NEWS
Association canadienne d'hydrographie NOUVELLES

OTTAWA BRANCH

The Ottawa Branch was happy to host a luncheon for our CHA members and the visiting director's from all the regions, here for a national director's meeting. Dave Monahan, the director of Ocean Mapping, discussed his recent trip up North for a cruise in celebration of the Northwest Passage Centenary. Between 1903 and 1906, Roald Amundsen became the first to navigate the northwest passage when he made his trip aboard the Gjoa. Dave Monahan had the unique experience of being one of only two Canadians on board for this centenary cruise. As chief science officer, he's been coordinating efforts with our American counterparts to use this great opportunity to collect Multibeam data during the voyage with minimal interference to the surrounding environment. Although ice kept them from some areas that he would have liked to explore, he believes they collected much valuable data.

Stacey Turcotte, current Vice President for the Ottawa branch of CHA, was married May 9th, 2003 to Kevin Kirkpatrick. Stacey has been working for CHS since 1998 in chart corrections, Notices to mariners and chart production.

CHS Atlantic region is winding down work on the PI2 project. With less than a dozen charts remaining to be processed through headquarters, Ottawa is preparing for charts from the other regional offices. The completion of the Atlantic charts will represent a major milestone for the CHS PI2 project.

Member news from Vantage Point International Inc.

Vantage Point International Inc. Develops Technology to Exploit RADARSAT Imagery in Shoreline Data Acquisition

In conjunction with its partners, Vantage Point International Inc (VPI) has developed technology and expertise that uses data from the Canadian RADARSAT radar remote sensing satellite in order to position and extract shoreline worldwide.

The project is funded by the Canadian Space Agency, the Canadian Hydrographic Service, the Atlantic Geoscience Centre, and National Defence, with technical assistance from the Canada Centre for Remote Sensing (NRCan). Vantage Point International has also made significant investments in this technology, which has application to chart update, topographic map update, and global shoreline mapping.

The technology allows shoreline data acquisition at very low cost over large areas, and is best suited to remote shorelines which are expensive to access using traditional survey techniques. Shoreline extraction at 1:50,000 scale can be achieved at a cost as low as $10 per kilometre of shoreline.

The data can be applied to correction of charts for horizontal datum errors, using the radar imagery to "rubber sheet" existing charts to a common reference. Furthermore, small rocks can be mapped in support of delineating the limits of national control over coastal waters.

The technology has proven to be superior to techniques based on LANDSAT for most applications, and the data is available and low-cost.

CENTRAL BRANCH

Central Branch participates in Port Hope 210 Anniversary celebrations June 6-8, 2003.

By Brian Power

On the weekend of June 6th,7th and 8th 2003, DFO employees with the Canadian Hydrographic Service (CHS) and members in the Canadian Hydrographic Association (CHA) were invited to participate in the municipality of Port Hope's 210 year anniversary celebration.

To celebrate this event, the town organized a 1793 re-enactment of the arrival (by ship) of the first families to settle at Port Hope, Ontario. Twenty-four descendents of the original families were contacted and invited to participate in the re-enactment. Dressed in period costume, they boarded the Brigantine *Pathfinder* in Cobourg to be transported to Port Hope. The CHA's circa 1793, Admiralty Launch *Surveyor*, and her crew of eight playing the role of Provincial Marines were responsible for conveying the families from the STV (Sail Training Vessel) *Pathfinder* to the shore of Port Hope located at what then was called Smith's Creek on Lake Ontario.

There were about 4,000 people crowded along the shore to watch *Pathfinder* sail out of the fog, drop anchor and have the *Surveyor* row to shore. The celebrations included public sailing cruises aboard , *Pathfinder* and her sister ship *Playfair* an afternoon picnic and evening concert. *Surveyor's* crew were camped out in canvas tents on a small section of the public park situated in the center of town and the public were invited to visit the camp and meet with the crew who were present to interpret the life in the 1790's.

Coincidentally, it was 10 years ago to the day that the CHA first launched *Surveyor* in Toronto Harbour and re-enacted the first Hydrographic Survey performed by Joseph Bouchette, and it was Joseph Bouchette who as an officer in the Provincial Marine who captained the armed Schooner Mississauga which brought the first settlers to Port Hope 210 years ago.

Central Branch participates in welcoming HMCS *Haida* to her new home.

From a DFO *Oceans* article by Mina Foroutan

A piece of Canadian history sailed into Hamilton Harbour on August 30th when Canada's most decorated warship, the HMCS *Haida* made its way to its new home.

Only one of two Royal Canadian Navy Second World War ships still in existence, the HMCS *Haida* has spent the last 30 years at Toronto's Ontario Place as a tourist attraction. After some much needed restorations fit for a ship of this class, the HMCS *Haida* marked its sixtieth anniversary by making the voyage to Hamilton. As the ship entered the mouth of the harbour, members of CHA's Central Branch were present onboard their Admiralty launch *Surveyor* to pro-vide a hardy sailor's salute in true maritime tradition. The journey ended at Pier 9, the lo-cation of the HMCS *Star Naval Reserve Unit* in Hamilton Harbour where it will be made into a naval museum set to open the summer of 2004.

Admiralty launch **Surveyor** *member Brian Power greets the Haida into The Harbour.*

The HMCS *Haida* is the third Canadian ship commissioned as a tribal class destroyer, after the HMCS *Iroquois* and *Athabaskan*. It joined the Second World War in 1943 under its first commanding officer Commander Harry DeWolf. Having sunk 11 enemy vessels including 4 destroyers and a u-boat, it would eventually be a part of 10th Destroyer Flotilla and member of fleet that would eventually support the Normandy invasion.

Rates Tarifs

POSITIONING / EMPLACEMENTS

The acceptance and positioning of advertising material is under the sole jurisdiction of the publisher.

L'approbation et l'emplacement de l'annonce sont à la discrétion de l'éditeur.

DIGITAL REQUIREMENTS
EXIGENCES NUMÉRIQUES

Advertising material must be supplied by the closing dates as digital Tiff 600dpi files. Proofs should be furnished with all ads.

Single-page inserts will be charged at a full-page body rate. Material must be supplied by the client. Page size must conform to the single page insert trim size (below).

L'annonce publicitaire doit être fournie aux dates de tombée. Les épreuves devraient être fournies avec tous les suppléments.

Les insertions d'une page seront chargées au tarif d'une pleine page. Le matériel devra être fourni par le client.

PUBLICATION SIZE
DIMENSIONS DE LA PUBLICITÉ

Publication Trim Size/ Dimension de la revue:	8.5"	x	11.0"
Live Copy Area/ Encart libre:	7.0"	x	10.0"
Bleed Size/ Publicité à fond perdu:	8.75"	x	11.5"
Single Page Insert Trim Size/ Insertion d'une page:	8.25"	x	10.75"
Standard Ad Sizes/ Grandeurs standards des suppléments:			
Full Page/ Pleine page:	7.0"	x	10.0"
1/2 Page/ Demie-page:	6.875"	x	4.75"
or/ ou:	3.375"	x	9.75"

PRINTING / IMPRESSION

Offset screened at 133 lines per inch.
Internégatif tramé à 133 lignes au pouce.

CLOSING DATES / DATES DE TOMBÉE

LIGHTHOUSE is published twice yearly, in Spring and Fall. The closing dates are March 15th and September 15th respectively.

LIGHTHOUSE est publiée deux fois par année, au printemps et à l'automne. Les dates de tombée sont le 15 mars et le 15 septembre respectivement.

RATES / TARIFS

All rates are quoted in Canadian Funds. Corporate Members receive a 10% discount.

Tous les tarifs sont en devises canadiennes. Les membres corporatifs ont droit à un rabais de 10%.

	B & W/ N & B	Colour/Couleur Four/Quatre
Outside Back Cover *Couverture arrière*	NA/SO	$1,025
Inside Cover *Couverture intérieure*	NA/SO	$825
Body, Full Page *Pleine page*	$475	$675
Half Page *Demie-page*	$300	$475
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Advertisers will be protected at their contract rates for the term of their contracts up to one year. Cancellations are not accepted after closing date.

Les tarifs sont assurés aux termes des contrats publicitaires jusqu'à concurrence d'un an. Les annulations ne sont pas acceptées après la date de tombée.

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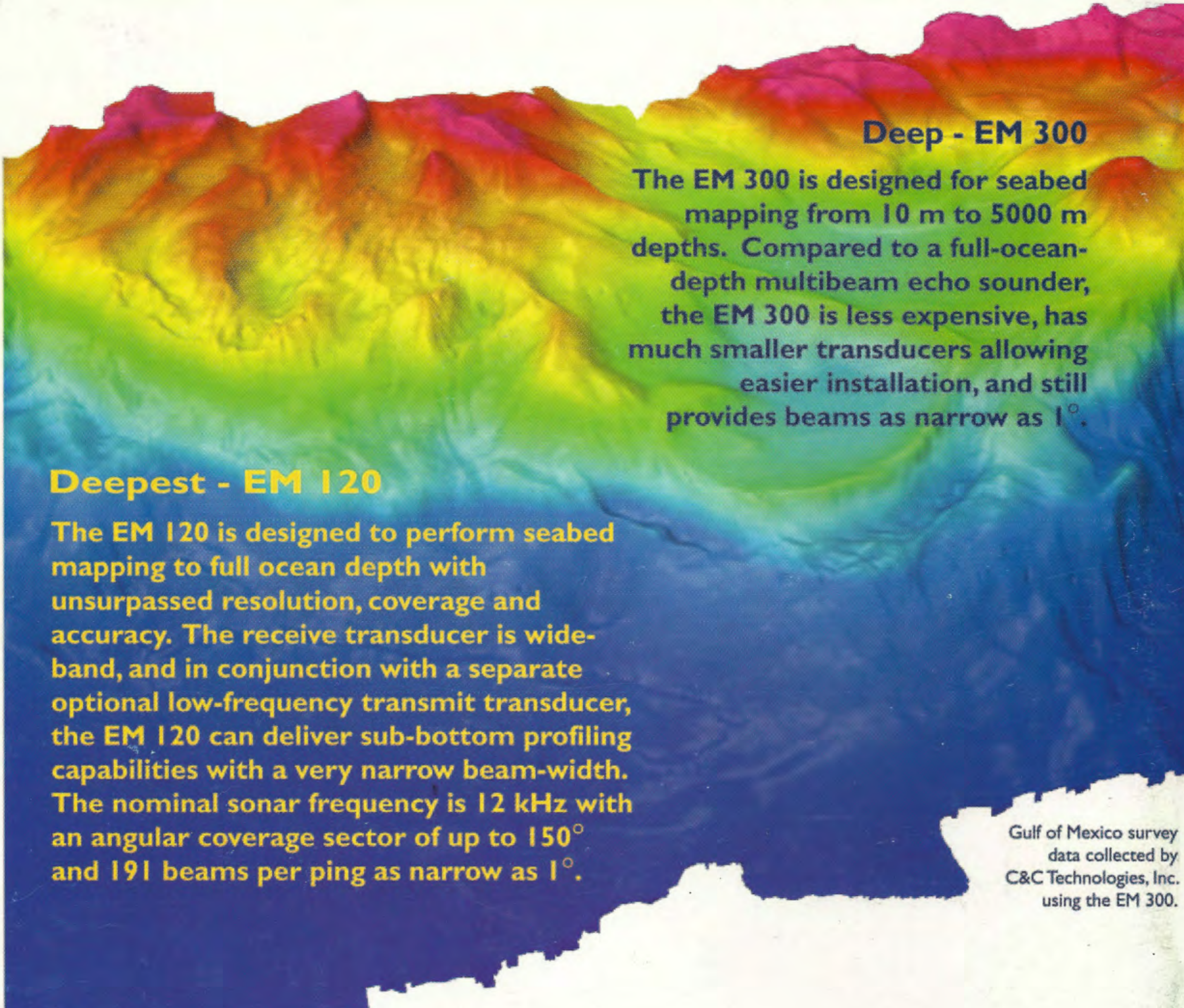
HINTS TO AUTHORS

LIGHTHOUSE publishes material covering all aspects of hydrography. Authors submitting manuscripts should bear the following points in mind:

1. Submit a hardcopy complete with graphics including tables, figures, graphs and photos.
2. Submit digital files, one with text only and a separate file for each graphic (tables, figures, photos, graphs) in its original form or in .tif format (600 DPI). Photos may be submitted separately to be scanned. These may be submitted via E-mail or on CD ROM to the Editor.
3. Papers should be in either English or French and will be published without translation.
4. An abstract, information about the author(s) and contact information should be included.



Gulf of Mexico survey data collected by C&C Technologies, Inc. using the EM 300.