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Form 504

U. S. COAST AND GEODETIC SURVEY

DEPARTMENT OF COMMERCE

DESCRIPTIVE REPORT

Type of Survey *Hydrographic*
Field No. *4256a & b* Office No. *4257*

LOCALITY

State *Alaska*
General locality *Icy Bay*
Locality

1922

CHIEF OF PARTY

H. B. Campbell

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Form 504
DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY

State: Alaska

11-5613

DESCRIPTIVE REPORT
4256 a+b
Hydro Sheets No. 4257

LOCALITY:
Icy Bay

1922

CHIEF OF PARTY:
H. B. Campbell

H Y D R O G R A P H I C R E P O R T

I C Y B A Y , A L A S K A .

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Launch "WILDCAT"

By H. B. Campbell, H. and G. E., in charge.

Preface to Hydrographic Report, Icy Bay.

In writing this report, as well as my other reports on Icy Bay, I have considered that locality as being a new section and as being practically unexplored as far as our work is concerned. I have tried to answer directly all questions which I could anticipate. In addition, since there is a very good chance that a developement of the oil fields may make this Bay of considerable importance, and since I could not foresee all the questions which your office may be asked, no doubt in many cases by people not at all acquainted with the country, I have included in these reports practically all I know of Icy Bay and the coast in general between Yakutat and Katalla. The result is, especially in this report, that what will be desired for immediate use is intermingled with a great deal of detailed information, some of which has no value at present. There is also some unavoidable overlapping of reports. I would therefore take the liberty of recommending that some one officer, as a part of the office work on these records, acquaint himself thoroughly with all reports on Icy Bay.

HYDROGRAPHIC REPORT.

Magnetic variation, mean of eight decliniatoire readings 30° 27'

The sounding in Icy Bay was done in accordance with instructions dated February 23rd, 1922.

The Launch "WILDCAT" was used for all sounding except on shoals where the depths were small enough to permit feeling with a hand lead from a skiff to advantage.

Plotting, angling and recording were done just forward of the wheelhouse on top of a large wooden tank built by the party for fresh water and ice. Sounding chains were located on the starboard side about twenty feet forward of the plotting table, where the leadsman and lead-line were always in sight of the recorder and plotter. Machine soundings were taken over the side abeam of the plotting table using a hand sounding machine, located just forward of the plotting table. A registering sheave which had been tested and found correct within the limits to which it could be read up to seventy five fathoms, was fitted into a framework just in front of the sounding machine where the man reeling in could read it without moving and where it could also be read by the recorder. The sounding wire ran from the machine over this registering sheave and then over a sheave attached to the head of a boat davit, from which the lead dropped over the side. No tube soundings were taken.

For hand lead sounding, No. 7 Silverlake sash cord and an 8 to 12 pound lead were used. For machine sounding stranded wire and a 15 pound lead were used.

The greater number of signals used for control were located by triangulation. Some plane table locations were used. All positions of the launch were determined by sextant angles. In a few cases offshore, signals were lost temporarily and the interval between positions is long. Where this is the case and the line has been retained, the course was as nearly as possible kept the same between positions.

For machine sounding the launch was stopped for every sounding. For hand lead work the launch was slowed down as much as possible and soundings taken as frequently as they could be at regular intervals. The "WILDCAT" was not satisfactory for this work. She is so heavy that even when she is run at a very slow speed it takes rather long to stop her. When hand lead sounding the speed could not be kept slow enough and still be dependable to enable me to take soundings closer than 100 meters in 9 to 10 fathoms of water.

Before deciding on a scheme the general character of the bottom was determined by a few lines run across the Bay and offshore. Also a

careful study of the moraine deposits on the beach was made. These heaps of moraine are very irregular and run in every direction. They are usually in the form of ridges and are frequently very steep on one or two sides. The directions in which the lines were run was considered the best for development of the bottom as well as for economy in running to and from the anchorage.

My instructions required that the work be done on a scale of 1:10000. This was inconvenient because of the excessive size of the sheets required. The work on the outer part of the bar could not be done on this scale so a 1:20000 was used.

For the work on boat sheet No. 1 ordinary tripod signals or whitewashed rocks were sufficient. On boat sheet No. 2 the sounding had to be carried offshore far enough so that in some cases some of the signals were below the horizon. For this offshore work the set \odot Tall, Δ Riou and Δ Dock were most used. Tall was built up to a good size and height by cloth banners. The signal at Δ Dock, besides the ordinary tripod signal about 20 feet high, had a rectangular addition about 14' x 20' made out of 2" x 4" pieces which was faced with white washed boards $\frac{1}{2}$ " x 6" x 14'. The bottom of this signal was about twenty feet above high water and it could be carried ten miles without difficulty. Our greatest difficulty with signals was with Δ Riou, which for much of the offshore work showed against the glacier. The tripod triangulation signal was added to and then faced with a target about 14' x 20' similar to the signal at station Dock. This was whitewashed and although prominent from some directions was often lost when showing against the glacier. This difficulty was partly overcome by building a framework beside the signal and facing this frame with a large tent fly about 12' x 20'. The tent flies used were discolored and were further distinguished by a diagonal marking of red signal cloth. This served the purpose but a forty foot tower signal would have been best, but I did not have the material. On some of the offshore work I took angles from the top of the house on the "WILDCAT".

Smooth sheets.

Projections are laid on the smooth sheets but are not inked as it is thought that there may be some slight shifting necessary when the three point position is adjusted. I did not have the data for projections for the boat sheets and on these the signals were plotted by distances.

When the smooth sheets were made no projections had been laid on the topographic sheets and it was necessary to allow for the shrinkage of the topographic sheets in transferring the stations. The triangulation stations were plotted first on the smooth sheets. The percentage of difference between the topographic sheets and the smooth hydrographic sheets was determined by scaling and comparing the distances between the triangulation stations on both sheets. The topographic stations were then plotted on the smooth sheets by swinging arcs with the beam compass from

the different triangulation stations. The distances used were the distances taken from the topographic sheets, a , plus the percent of difference times a . Arcs were swung from at least three triangulation stations to determine each topographic station and the station was plotted on the intersection of the arcs. Their intersections checked excellently. In some cases it was necessary to use a previously determined topographic station in place of the third triangulation station on account of the unfavorable location of the latter. The percentages of difference varied from .4 to 1.57 per cent. On different days the percentage varied on the same azimuth as much as .3 percent. The values used for the different distances were those determined from the triangulation stations in the immediate locality. The shore line and topographic features on the smooth sheets were put on by tracings.

Boat sheet No. 1.

Boat sheet No. 1 is on a scale of 1:10000 and covers practically all of Icy Bay. The strength of the hydrographic positions was greatly increased by laying out this sheet to include both sides of the Bay. It will be smooth plotted on two sheets, one for the Southern half and one for the Northern. The Northern smooth sheet will have practically nothing shown on it.

The work on this sheet was taken up in the order of its importance to anyone wishing to use the Bay either as a harbour or for commercial development.

The outside of the East spit or Riou spit is of sand and gravel beach and slopes gently downward. This spit is built out from a clay bluff which ends 340 meters East of O Tri. The spit is very low, being covered in places at the highest spring tides. On top of the spit is considerable drift wood which has been washed there by the storms. No large boulders were found on this spit. A detailed description of the spit and the shore line done on the topographic sheet is given in my topographic report on Sheet "A".

Riou sandspit has apparently been formed by the sea on the Southwestern edge of the flat or shelf left by the glacier on the East side of Icy Bay. It seems as though some heaps of moraine had been left along this edge for from 600 to 1200 meters off the end of the spit and in line with the direction of it we have a shoal area. This shoal is irregular in form, much like the moraine deposits ashore and three high spots were found with depths of about four fathoms. After developing this area with the Launch, the "WILDCAT" was anchored on one of the shoalest spots and all three of the high points were examined with a hand lead and skiff for several hours. Bearings on the launch and ranges were used and it is felt that this area is thoroughly covered. the least water found was $3\frac{1}{2}$ fathoms.

Inside Riou Bay the bottom was found to be even with gentle slopes except on the inside of the sand spit. On the inside of the spit the bank rises steeply from the bottom of the Bay to just outside the low water line and in places to the low water line. This is also true of the end of the spit and is of considerable importance. The top of the spit is very flat as a rule and a slight difference in the height of the high tide often makes considerable difference in the distance from the water line to deep water. At low water a ship could approach the low water line at the end of the spit very closely but the high water springs cover the end of the spit on some very high tides nearly as far back as \odot End. A ship would be in danger if the tide were very high should it approach the water line within two hundred meters which at low water would be a very reasonable distance for a ship to pass off the end of the spit. Inside Riou Bay the deeper water is found next the sand spit and in estimating the distance from the beach care must be taken to consider the height of tide.

The water inside Riou Bay is shoal, as shown by the soundings. The anchorage for vessels of any size will be just East of the end of the spit. Launches will find it advantageous to run further into the Bay where shoaler water and better holding bottom may be found.

The beach on the inside of Riou Bay is of hard and soft sand and gravel. South of the anchor buoy used by the "WILDCAT" the water continues very shoal on the Eastern side. On the West side a channel follows the line of the spit. At half tide a launch the size of the "WILDCAT" could get beyond the tide gauge in this channel. At the head of the Bay the beach bares well out and the water is very shoal.

At \odot Rock a high water slough extends back into the flat. A small running stream of brackish water emerges here at low water. High tides flood a great deal of the flat and a considerable amount of water runs into the sloughs and creek beds which extend South of and beyond N. Base.

To the North of \odot Rock boulders are found off the beach. 107°, 1180 meters and 102°, 1250 meters (true) from Riou are two boulders which bare at low water. They were located by the plane table party, and no trace of them was found in sounding. Because of the depths and the likelihood of striking these or other boulders in this locality, the sounding inshore was done at high water and hydrographic checks on the positions of the boulders along this beach were not obtained. From the position of these two, boulders increase in number along this beach up to Moraine Island. From the Southern of the two boulders described above, Northward to the limit of the completed hydrography, about 2200 meters, a number of boulders were located by the plane table party. These lie offshore at varying distances up to about 450 meters. It is almost certain that there are other boulders within this distance from the beach and of course there may be more farther offshore. A few of these are of very good size, about ten feet in diameter, but most of them are smaller. A

small boat landing on this stretch of beach except at high water, especially if there is any sea running, should use care to avoid these. In sounding off here no soundings were obtained on boulders and the leadsman did not report any slips, such as might have been caused by the lead striking boulders.

Moraine Reef.

From 1 to $2\frac{1}{2}$ miles Northeast to North Northeast of the end of Riou spit is located a reef or series of shoals which are always covered but on which the seas break when much swell is running into the Bay. This reef is apparently an extension of the very irregular heaps of moraine that lie on the main shore at this point. I was unable to develop the reef or its limits but a number of cuts were taken to breakers on it by the plane table party and a few by the sounding party. Its limits are approximated on the boat sheet. This reef protects the anchorage in Riou Bay to a certain extent from the ice and somewhat from the sea caused by glacial winds. The chart should show this area as being foul.

A single line of soundings was run across this reef at high tide with a smooth sea. I do not believe that the soundings taken show the shoalest water that the launch crossed. Where this moraine is in heaps as it is on this reef the slopes are so steep that the closest kind of an examination is necessary to find the highest points and it is questionable if they could be found for certain with a hand lead. I would recommend that this line of soundings be not shown on the chart because their being there would indicate that there was a two fathom channel across this reef. There may be a two fathom channel across it but if so it is probably crooked and lined with boulders and gravel shoals. Fishermen going to the anchorage behind Moraine Island would be apt to cut across the reef rather than go through the ice farther offshore. The closest kind of a survey would be required to prove a channel here and then it should be dragged.

When a swell is coming into the Bay from the South it will usually break on this reef in some places at low water. If it is a storm swell there will be many breakers and it will lump up in other places. This kind of a sea will break quite heavily on the beach of Moraine Island and nearly as far as \odot Bow. Breakers on this reef are sometimes very hard to distinguish from icebergs.

A small boat can cross this reef when it is breaking in places by going between the breakers. It sometimes breaks hard enough on the beach between Δ Isle and \odot Bow to make landing with a small boat difficult and dangerous. Ordinarily during the Summer months landing there is very easy as much of the time there is no swell along here at all.

The passage South of Moraine Island is foul and bare at low water. There are some few places between the high and low water line where pools of water remain at low water. At high tide if there is any swell

running in here, care must be used in going through this channel with a small boat because there are boulders and the swell at some stages of the tide runs with enough force to carry a boat with it.

The Bay behind Moraine Island will be taken up under "Anchorages."

The Northwest corner of Moraine Island makes off a little. There is a sort of a short spit.

There is also a short spit off the end of the point on which Δ Black is located.

The Northeast arm of Icy Bay is considered to be that part of the Bay Northeast of Δ Black and Δ Bar. This part of the Bay is shoaler than the Southern part. Between Δ Black and Δ Bar is a sand bar which bares at extreme low water. This is sketched in on the smooth hydrographic sheet. The position given is approximate. I noted no other bars in this arm that bare, but there may be some. That the water here is generally shoal is proven by the way in which the icebergs ground and stay here. There are undoubtedly deep parts because some of this locality is clear of ice some of the time. The Northern half of this arm, and near the beach in the Southern and Eastern parts, are the places where the bergs most commonly ground. There are many large bergs from ten to twenty feet above the water found here. When the tide goes out they project still further above the water. They are in many places thick enough to prevent the passage of a small boat. Running among them with a small boat is dangerous for occasionally a corner of one will drop off and once in a while one will become topheavy as the tide leaves it and will capsize.

I mentioned in my topographic report of sheet "C" that there is an oil seepage to the East of Icy Bay. This was reported by Jack Dalton. The nature of the country is such that it is hardly to be expected that any drilling would be done in this locality at least for a long time. At present this Northeast arm has no value because of the ice. There are indications that this part of the glacier is dying and if it should finally cease to discharge ice even if there were no commercial development of the oil, it would probably be advisable to develop this arm as an anchorage. In that case an unusually close development would be necessary because the moraine behind the beach between Δ Black and the glacier is the most rugged and irregular found around Icy Bay and it is very likely that this is continued beneath the water.

Icebergs also strand around the bar on which Δ Bar is located, occasionally in such numbers as to obscure the bar.

To the West of the bar the face of the glacier apparently extends into deep water. Nothing was noted by the party on the "WILDCAT" to indicate any other bar forming along this face of ice. The ice varies in color from white to deep blue and there is practically no moraine notice-

able on it, except where the single line of medial moraine is found. The character of this medial moraine is not such as to incline one to think that it might be forming a bar. Most of this moraine is discolored ice rather than large quantities of rock and sand carried on the surface of the ice. There is no doubt much debris in the ice at this point but it would seem that this would be floated off down the Bay with the ice and be scattered as the bergs melted.

A close approach to this section of the glacier is often possible in many places but it is dangerous. At any time ice is liable to fall without warning in such quantities as to raise a swell sufficient to swamp a small boat at over half a mile from the face of the glacier. Our sixteen foot dinghy was caught on the beach by one of these swells, a little West of Δ Bear. The boat was hauled up behind the breakers but this swell from the ice lifted it and threw it down on the beach with sufficient force to stave in two or three planks and to bury in its planking pieces of gravel a quarter inch in diameter. The boat was partly filled with sand by this breaker.

The water at the mouth of Independence Creek is fairly shoal next the beach as indicated by the way the ice grounds, but a few hundred meters off the beach it is apparently deep for the bergs drift out of this little bight formed by the glacier.

The water outside the beach line between Independence Creek and Δ Goat deepens rapidly. I ran in close to the beach in a number of places along here with the "WILDCAT" and anchored while building signals. In most places there is a narrow flat of bottom outside the low water line with depths varying from 2 to about 6 fathoms and from fifty to a hundred meters wide, sometimes a little more but often less. There is just about room enough for a small launch to anchor and swing clear of the beach. In some places the bottom drops so steeply that there is not room outside the water line for a launch to anchor and swing clear of the breakers. Just outside the line of this narrow flat the bottom drops very steeply to the depths of the Bay. Just off this shore 48 fathoms are found.

There is usually a little sea breaking on this beach and often it becomes heavy enough to cause trouble in landing, especially when the beach is lined with pieces of small ice which must be avoided, as is often the case in this locality.

As Δ Goat is approached from the East I believe that this narrow strip of 2 to 6 fathom water just outside the beach becomes wider and I believe that off Δ Goat it may be several hundred meters wide. My reason for thinking this is that I have seen a few large icebergs apparently grounded in this locality as much as two to three hundred meters off the beach. These icebergs were about ten feet above the water and would probably ground in ten fathoms. The bottom on this shelf between Δ Bear and Δ Goat in the places where I anchored with the "WILDCAT" was usually of mud, probably glacial silt.

From Δ Goat to Δ Bluff the beach is rather concave from the water and near Δ Bluff is a small bight in which it appears some protection might be had from the Southerly seas. I did not approach the beach in this locality with the "WILDCAT" except near Δ Bluff. Judging from the bottom off Δ Bluff and Southeast of Δ Goat I believe that the bottom between Δ Bluff and Δ Goat in general slopes gradually from the beach for a few hundred meters and then drops abruptly to the flat forming the bottom of the Bay.

Δ Bluff is situated on Clay-Bluff Point which is twenty to twenty five feet above the water level and which would afford protection from Southerly wind to anything behind it. I considered this as being possibly one of the most favorable dock sites on the West side and investigated it with its suitability for such a purpose in mind. The water in the bight just North of Clay-Bluff Point is too shoal to permit the entrance of a vessel into the bight. Besides this the ice would prove troublesome, although there seems to be a current which keeps much of the ice away from here which might be expected to strand around the Point. I attempted to enter this bight with the "WILDCAT" but got soundings as shoal as two fathoms before getting inside and then gave up the attempt. I do not believe that this bight can be made use of at the present time for any purpose except landing gear from small boats or scows, and for that it would be necessary to first see that the bight was clear of ice. I will further discuss ice in this locality under the heading "Ice conditions" in this report.

Protection from a Southerly sea would also be obtained in this bight. A little way North of it the benefit of the shelter from Clay-Bluff Point is lost and a Southerly sea breaks on the beach as it does at Δ Goat and further North along the shore.

The beach between Clay-Bluff Point and Δ Bay is exposed to the full force of the seas entering the Bay from the South. The beach along here is of gently sloping sand and the seas sometimes break on it with considerable force. They do not break nearly as hard as they do on the outside beach, that is the beach on the outside coast on either side of the entrance to Icy Bay. The breakers are however frequently heavy enough to make landing difficult. Except in storms a skiff could nearly always have been landed along here this last Summer but difficulty might have been had, frequently, in getting off.

My two best men one day took a load of lumber in here in a sixteen foot flat bottom skiff. The wind in the Bay was Easternly, which meant Southeast offshore, and considerable sea was running. They got ashore allright but swamped in getting off but finally made it. The skiff was not very suitable for this kind of work. In storms a heavy surf might be expected here.

Off Δ Bay is a wide and very flat sand beach between high and

low water. The sea breaks on it very much as it does to the East of Δ Bay.

Along the beach to the South of Δ Bay as far as Δ Dock, the surf on the beach decreases, being greater at Δ Bay and less at Δ Dock. The beach along here is of gently sloping sand below the high water line. This gentle slope continues most of the way to about the nine fathom curve. An ordinary sea from the South or Southeast does not break hard enough along this section of beach to make landing difficult. An ordinary sea from either of these directions causes hardly any surf in the locality of Δ Hill or Δ Dock. A heavy swell from these directions causes some surf but not enough to prevent landing at these places. North of Δ Hill the effect of the sea from the South or Southeast would be greater. The surf would probably increase from Δ Hill to the North and be heaviest between Δ Bay and Δ Bluff.

Landing Gear on West Side.

As previously stated I found the surf from a South to Southeast outside swell to be less in the locality of Δ Dock and Δ Hill than elsewhere on the West side as far North as Δ Bluff. Landings North of Δ Bluff would be subject to continually changing ice conditions to too great an extent ordinarily but under some conditions might be made to advantage. I have also stated that a storm swell from the South or Southeast would not make landing in the locality between Δ Hill and Δ Dock impossible. While the storm was blowing landings would be impossible but the bar and West spit afford enough protection so that landing would be possible the next day after a storm. On September 24th we experienced a very heavy Easternly storm in Icy Bay. On the next day, just twenty four hours after the wind had been blowing sixty miles an hour, I ran to the locality of the cabin and found that I could land in my light skiff but might have gotten wet in getting off the beach. About three hours later I ran outside over the bar and a tremendous sea was running from the Southeast. I believe that the heaviest sea and the one that will cause the most damage at this point will be one from the East. During the storms, even though they are Southeast outside, there is evidence that the wind blows from the East off the glacier in Icy Bay. It has about a ten mile sweep and quite a heavy sea is raised. This is short and soon falls when the wind goes down. The ordinarily heavy wind from the glacier, with no unusual storm outside, frequently raised enough of a sea off Δ Hill to make it very uncomfortable for the "WILDCAT" when anchored there. Ordinarily this wind from the glacier during the Summer months does not raise enough sea to prevent landing but it frequently makes landing difficult at this point. During storms I do not believe that landing here would be possible because of this sea from the glacier wind. If it was desired to land gear here and there was some sea, probably the best way to do it would be to wait until high water and then run inside the entrance to Guyot Bay, where a landing could be made just Southwest of Δ Dock.

At extreme high water landing near Δ Hill will be right at the

face of the clay bluff and if there is any sea running it is liable to be wet work. At low water care must be taken to avoid the boulders which are scattered near the low water line. These are thick enough in some places to prevent a landing near low water if a sea is running. In most places they can be avoided. At the extreme low water line the beach is flatter and a very small swell will cause some surf. I landed off the cabin in July with about ten men in a sixteen foot dinghy with some surf, at extreme low water. We avoided the boulders and got into knee deep water and as we did not wish to beach the boat waded ashore.

Landing gear in Guyot Bay will be discussed under the next heading.

Guyot Bay.

The entrance into Guyot Bay is obstructed by a bar which extends entirely across the entrance. This has apparently been formed from the silt brought down by the streams discharging into Guyot Bay by the combined action of the currents, and of the seas from the East which break across this entrance.

This bar bares nearly all the way across on low water. Dr. Thomas shows this very well on topographic sheet "B". At low water ^{what channel} is left is occupied by a running stream a few feet deep. The bar is very flat on top and very little less than the height of the tide may be considered as the approximate depth to be found on it. Near high tide boats or launches may enter and unload gear if the sea is not too heavy. I have never seen it break way across on high tide but there is no doubt whatever that it does so when the sea is heavy enough. Once inside the bar there is a small area of water that is protected by the land. I did not take any soundings in Guyot Bay and do not know the depths. The best water will undoubtedly be found South of the end of the point of land on which Δ Dock is located. In this area the Northern beach at the foot of the bluff is quite gently sloped and this gentle slope extends below the low water line. The deeper water will be nearer the sand spit than the bluff. About two thirds of the way from the beach South of Δ Dock to the sand spit, I stuck a nine foot boat hook down at about half tide without striking bottom. As to whether they will be able to keep scows inside Guyot Bay at low water without beaching them I do not know. They could be beached if the water is not deep enough to float them for the beaches are excellent for this purpose. I did not take the "WILDCAT" into Guyot Bay. I tried to enter there on about a five or six foot tide one day with a smooth sea but I was unable to find a six foot channel so I couldn't go in. I believe enough sounding was done on this bar to show that it bares. The Northern side of the end of the West sand spit bares on low water about as indicated on the boat sheet. The zero soundings about 400 meters Northeast of \odot Root are on the low water line of the sand spit. All the description that is believed to be needed of the mud flats inside Guyot Bay is given in the descriptive report of Topographic sheet "B".

West Sand Spit.

The low water line off the end of the West sand spit was located with the plane table by C.M. Thomas on topographic sheet "B". There are two and three fathoms soundings shown on boat sheet No. 2 well off this. There is a great deal of silt brought down by the streams emptying into Guyot Bay. In the descriptive report of topographic sheet "B" I give evidence found that this sand spit has extended itself over a mile and a half since the present Icy Bay has been formed. By considering carefully the present spit and the low water line off its end and the shoal soundings off the end of it, I have come to the conclusion that this spit is still being built out and that its end is being curved offshore by the action of the currents. Mr. Asa Baldwin reported that in 1920 or 1921 he found a one and one quarter fathom channel into Guyot Bay at low water. The low water channel at present is not that deep. The soundings North and Northeast of the end of the sand spit indicate that there is a possibility that the bar across the channel into Guyot Bay is extending itself to the East into Icy Bay. The Southern or outside shore of the West sand spit slopes gently into the water and the seas break just outside the low water line. The breakers extend off the Eastern end of the sand spit for a considerable distance on the bar across the entrance to Icy Bay.

Docksites, etc.

I investigated the suitability of all parts of the West shore for this purpose. The oil fields lie to the West of Icy Bay and there is also considerable timber along the benches. If the oil fields are ever developed it would be necessary to make shipments from the West side.

Both ice conditions and the effect of the sea will have to be considered. The place that was most clear of ice and best protected from the sea on the West shore while I was in Icy Bay, lies near Δ Hill just inside the West spit. As to what ice conditions will be there in the Spring breakup I do not know, but I do not believe that there is a more favorable location for a dock site on the West side of Icy Bay.

Loading oil into scows inside Guyot Bay has been considered and is feasible, I believe. Another proposal is to load from a buoy in the locality of Δ Hill, by running a pipe line on lighters out from the beach and keeping this gear inside Guyot Bay when the weather is unfavorable. This is pretty cumbersome but probably might be done. Anyone considering the building of a dock inside the West sand spit should investigate the outside of the bar across the entrance to Guyot Bay to find out if it is extending itself, and ice conditions in the Spring.

I saw no sea in this locality that would affect a good dock, although the sea does sometimes get bad enough to make it inadvisable for a ship to lie alongside.

Shoals on Boat Sheet No. 1.

The shoal off the end of Riou spit, Moraine Reef, and the shoals in the Northwest arm have already been discussed on pages three, five and six.

Off the West shore about two miles North of the sand spit lies a shoal area extending about 1600 meters off the beach at O Edge. This area is not developed. The one hundred meter system of sounding lines indicates some three fathom water on this shoal. On the beach between O Funk and O Edge is some very rugged moraine and it seems very likely that this might be expected to continue on the shoal. For this reason I believe that there is very likely to be less water than found on this shoal and I would suggest that this area be marked on the chart "Shoal, not developed."

On the flat extending off the West shore for a mile or more on which 9 to 12 fathom water is found are occasional jumps of about one fathom. Those near the Southern part of the work, off Δ Hill, were developed, but nothing was found on them. There are two others marked on the boat sheet by blue circles which were not developed. These are located as follows:- one of $11\frac{1}{2}$ fathoms, 2750 meters, 74° and the other $9\frac{5}{6}$ fathoms, 2390 meters, 91° from O Funk; the angles being at O Funk to the right of a line to Δ Bay. These would have been developed if I had had an opportunity. I doubt very much if a close development would locate any shoaler water around these spots. They are I believe lumps of soft clay deposited by the ice. The bottom on this flat on the West side is generally hard. It is a hard stiff clay such as is found on the bluffs ashore. In taking soundings here the bottom would be hard for a number of soundings and then the lead would sink into soft clay, often burying itself deeply enough so that it took quite a pull to free it. These soundings on soft bottom were frequently a few feet shoaler than those on hard bottom. It is quite obvious that this hard surfaced flat in this locality has scattered on it small heaps of very soft glacial clay or silt, which have undoubtedly been deposited by icebergs, probably as they capsized on striking bottom. If these lumps were boulders or gravel moraine heaps such as are found ashore it would be indicated by the character of the bottom. The lead when brought up after striking one of these heaps was covered with very soft grey, and unusually fine mud, a typical glacial mud. No large boulders were found on this section of the West shore.

The water in Icy Bay with the exception of the shoals referred to above and the boulders on the East side, is clear of shoals dangerous to navigation, so far as I know. Only the Southern part of the Bay is developed and a few other indications were found. These are located on or near a line from Δ Hill to just North of the end of Riou sand spit. They were developed as much as I considered advisable. Their location on this line may be considered as an indication that during its recession the face of the glacier stopped here for some time.

These indications are developed and clearly marked with colored pencil on the boat sheet and as nothing less than eleven fathoms was found they will not be further taken up here.

Another indication was found near the West spit, 2200 meters from O Root and 1420 meters from A Hill. This was developed but nothing was found on it which will reduce to less than nine fathoms.

On the East side, 1720 meters North by East, half East, magnetic, from the end of Riou sand spit, the Northern limit of the hydrography closely approaches Moraine Reef and a shoal indication is found. This may be considered the Southern limit of the Reef as just to the North of this point the sea lumps up in heavy weather. From this point to the end of the sand spit the bottom is lumpy in various places but it is believed that the development is sufficient.

Tides and Currents.

A report on the tides observed by the party has been submitted to your office with the tidal records. The readings from the gauge in Riou Bay are considered suitable for the reduction of all soundings. A series of simultaneous observations were made with a staff on the West side off the cabin and the differences were found to be very slight.

The currents inside Icy Bay are due to two causes, the tides and the streams discharging into the Bay.

The tidal currents are not very strong. The most of their apparent effect is on the ebb tide when they accelerate the currents from the streams. On flood tide in the Southern half of the Bay the strength of the flood current is decreased by the streams from the glacier. The tidal currents into or out of the Bay are of but little importance except as they affect ice conditions.

From beneath the glacier at least one large stream discharges into Icy Bay. This leaves the face of the glacier about three quarters of a statute mile straight out from its Western edge. Its effect is very noticeable near the face of the glacier, but did not appreciably affect sounding lines in the Southern part of the Bay. What I considered was probably a current effect was noted in running lines across the Bay near the Northern limit of the work about three statute miles from the end of Riou sand spit. This is in the locality of 15b sheet 1. On a number of lines I experienced a pronounced set to the South at about this distance off the East sand spit. No current observations were made in the area covered by this sheet.

At the entrance to Guyot Bay a strong current is found in or out of that bay, depending on the stage of the tide. This is about as strong as one man can row against successfully, probably about two knots.

When the streams are high probably the ebb current here is stronger. The effect of this current is felt for probably a mile and sometimes farther out into Icy Bay. From the locality of the entrance at A Dock the direction of this current radiates into Icy Bay, flowing directly to or away from the entrance to Guyot Bay depending on whether it be flood or ebb current.

Coastwise Current.

A current station was established on sheet 2 outside the line of the two spits where it was thought that the effect of a current running out of the Bay, if there was one, would be felt. This station was only occupied for eighteen hours and the wind and sea for most of this time were unfavorable for this work. It was blowing from the Northeast.

The current flowed to the West with varying strength and I believe this to be the prevailing direction of the coastwise current in this locality. When working on the bar it was nearly always necessary to allow for a Westernly set. Twice a strong set to the East was specially noted. One of these occasions was when the launch was anchored about one and a half miles Southeast of the end of the West spit late in June. The Eastern current was carefully estimated and was almost certainly flowing more than a knot.

I have tried to compare the times of my various runs to Yakutat and determine the current from the comparisons. The times taken varied greatly however and were often interrupted by slowing for soundings or on account of fog or the condition of the sea. It is apparent from them however that in June and the first of July the runs East and West took about the same amount of time. The runs made in August and September required more time to run to the East than to the West and the differences were enough to indicate a pronounced set to the West. The strongest set to the West that I noted was on September 25th just after a heavy Southeast storm, but the sea was very heavy and the bottom of the launch was foul so this is not very conclusive.

* *

Ice Conditions, including currents.

It is of special importance that it be remembered that my report on ice conditions is on what I saw from May 23rd to September 25th, 1922.

The character of the icebergs seen in Icy Bay varies greatly. Most of the ice is very small, apparently having been shattered by its fall to the water. Pieces of all sizes are found up to those projecting about twenty feet above the water, the larger of these having a horizontal cross section at the water line up to about 2000 square feet. There are but few of these larger bergs. The most ice is small or moderate size.

* * * As I have used the terms, small is ice of such size that a deep draft vessel would pay no attention to it, moderate sized ice is of such size that a deep draft vessel would slow down in passing through it if it could not be dodged, large bergs are of such size that a deep draft vessel would carefully avoid them.

The ice varies from white and blue to a very dirty color. I have seen some so dirty that when within about 100 feet of it I could not have said for certain that it was not a rock without using the binoculars.

During this season I saw no ice on the West side South of Δ Bay which would have endangered a dock or a vessel at anchor off the beach. Occasionally a few small pieces of ice stranded on this section of the beach but they were not of sufficient size to cause trouble to well built structures. Once in a while a moderately sized piece of ice would float into Guyot Bay.

From Δ Bay to within about a mile of Δ Bluff the same is true. I saw no large ice on or very near to the beach. Around Clay-Bluff Point and for about a mile to the Southwest of it as well as to the North, ice sometimes is quite thick. Around the point the ice on the beach is quite small but big pieces sometimes lay apparently as close to the beach as the depth of the water will permit. The bight inside of Clay-Bluff Point I have seen filled with small ice a number of times.

From Clay-Bluff Point North to the glacier, the beach is sometimes crowded with small ice and off the beach big bergs ten to fifteen feet above the water frequently strand. Sometimes even this section is clear. Usually a launch can work its way through this ice and a small boat can land if the sea is not too rough.

The Northern part of the Bay, that is the part North of a line between Δ Bluff and Δ Ridge, is frequently filled with ice floes. These are of mixed large and small pieces and of dirty and of clean ice, usually cleaner in the Western half than in the Eastern. This same section of the Bay is sometimes clear of ice apparently to the very face of the glacier. Through most of these floes a launch can usually pick its way, running full speed between floes and very slowly when in them.

The Northeast arm of the Bay, as has been previously stated, usually contains a great number of stranded bergs. Good sized bergs are common on or just off the beach as far South on the East side as the Southern end of Moraine Island. From here South apparently Moraine Reef and currents keep the heavier ice off the beach and only moderately sized pieces strand there.

As stated before the Northern part of the Bay is frequently filled with ice. This sometimes covers all the water but more often there are lanes between the floes. The tendency is for the ice to stream out toward the Southern part of the Bay in long quite narrow floes, as though it were being carried by currents and I believe this to be the case.

I never saw the ice in the Southern part of the Bay thick enough to prevent navigation. The places where ice is found most often in the Southern part of the Bay are as follows:

There seems to be a current which carries scattered bergs down the West side, passing just clear of Clay-Bluff Point by about half to three quarters of a mile and clearing the end of the West sand spit

by about a mile. There is not a steady stream of ice there but at almost any time if a launch were to run up this line to the Northeast from the locality of the West spit, an occasional piece of ice would be found possibly before Clay-Bluff Point was approached, but if not, then almost certainly in the locality of that point.

Another stream of ice frequently comes into the Southern part of the Bay in about the position of 15b. This is usually not such a thin stream as the other but more likely the forward edge of a good sized flow. The movement here seems to be slower and the ice does not come down as consistently as in the other place mentioned. I have never seen thick ice as far South as a line between the two sand spits even in this locality.

West and North of Moraine Reef is very often found a line of ice consisting of bergs of various sizes, through which a launch can usually pick its way to Moraine Island. This line sometimes lies like this for days at a time, more so during the latter half of this season than earlier in the season.

The high spring tides cause more ice movement on the East side than elsewhere. They apparently float a large number of bergs out of the Northeast arm and off Moraine Reef and the beach, that have been stranded, and the ebb current carries them down the East side to off the entrance to Riou Bay. As a rule they do not enter Riou Bay, but sometimes they do.

In the Southern part, that is the part of the Bay sounded, I have never seen any ice that would be a menace to navigation in the day-time.

I tried to find some connection between ice movements and the wind, but so far as I could find, there is none. After a Northeast and East wind lasting several days I have seen the West shore below Δ Bluff clear of ice. A continued North wind will sometimes drive a few pieces of ice into Riou Bay.

Ice Conditions in Riou Bay.

I have never seen ice in Riou Bay thick enough to menace a vessel anchored there. The high spring tides bring ice on this side down Icy Bay, but as a rule it passes outside the sand spit. Sometimes a few smaller bergs come into this Bay. The "WILDCAT" used the buoy in Riou Bay all season and only two or three times was she scraped by small bergs here. Twice during the season I saw quite thick ice come inside Riou Bay, including some moderate sized bergs but they could have been pushed off if they had come too close. A low fog sometimes hangs over a floe as it comes down past Riou spit.

Ice leaving Icy Bay.

I saw extremely little ice leave Icy Bay. I never saw any bergs outside the Bay. I saw a few drifting down the Bay which must have lasted

until they got outside but the current probably carried them to the West and quite likely they were badly broken up by the breakers off the West sand spit. I have heard a rumor that a number of years ago the beach was strewn with ice as far West as Yakataga one season. It was believed that this was the year in which the glacier is reported to have receded four miles. I did not see any icebergs stranded near the West spit as reported by the "SNOHOMISH." This might happen, but I did not see it.

Movement of Glacier.

When we arrived in Icy Bay on May 23rd the part of the glacier West of Δ Bar was discharging ice although it was not apparently as active as it became later in the season. The Northeast arm was entered on May 24th and the face of this part of the glacier was found to be generally of a dirty color and appeared to slope a little. Occasionally the fresh ice of a recent break could be seen, but in general it looked as though it were dying and melting at the face. About a month later the Northeast arm was entered again and nearly the entire face from Δ Bar to the Northeast corner showed that it had been discharging ice. The surface of the face was blue and white and streaked with much dirt. Undoubtedly this part of the glacier started discharging about the first of June. We did not measure the forward movement of the glacier. Either Tarr or Martin give the movement of the Guyot lobe as five to six inches a day during the Summer season. I believe this is a very conservative figure.

The extreme Western part is apparently the most active. During the months of July and August the glacier next the West shore, near Δ Bear, moved forward a distance of at least one hundred meters. I had a range on this corner of the ice between Δ Pyra and Δ S. Base and noted the changes a number of times. I did not compute them. During this period practically the whole face of the glacier was discharging ice. It did not seem to me that a continuous rain of several days increased the rate of discharge an appreciable amount. During September we had continual frosts at night and a little skim ice, and snow as low as three thousand feet. The glacier became more active, apparently from the action of the frost and, I believe, discharged more ice than it had for any equal length of time earlier in the season. The Western edge became very active and during September receded to approximately the same position it had occupied in May, possibly a little further in places. The icebergs came a little further South down the Bay at this time than they did earlier. The approximate ways in which the ice appeared in the Southern part of the Bay is shown by pencil notes on boat sheet number one.

It seems worthy of mention that very frequently during the season a vessel could have closely approached the face of the glacier without entering heavy ice. It seems to me that at nearly any time a ship could without damage, work its way close enough to get a good view of the face of the glacier.

It is reported that the Northern part of Icy Bay, approximately North of a line between Clay-Bluff Point and Moraine Island, freezes over in the Winter and that the Southern part does not freeze over. This was reported to me by one person and I was unable to verify it.

Anchorage.

There are three anchorages in Icy Bay, in Riou Bay, off the West shore inside the West spit, and behind Moraine Island.

Anchorage in Riou Bay is recommended magnetic East of the end of the sand spit about four to five hundred meters off the high water line of the spit. There is about six fathoms of water and the bottom is sandy. The sand is quite hard. It is possible that this sand is on top of a clay bottom as near the head of Riou Bay the bottom is formed by alternate strata of sand and mud or clay laying on top of one another. Anchorage may be had anywhere on the flat here, North of the position given and protection from the sea can be had. Larger vessels will probably anchor farther from the spit. This hard sand bottom continues over this flat. Small launches should run into Riou Bay and anchor in 3 to 4 fathoms mud bottom, near the sand spit. The protection from the sea from the ocean is believed to be ample. It is believed that in storms the wind in Icy Bay will be from the glacier. In Southeast storms probably it will be from the Malaspina about true East. A blow from the South, which I never saw occur here, would strike a vessel in this anchorage. I do not believe that the sea ever washes over Riou sand spit with sufficient force to trouble anything anchored behind it. Reasons for this are given in my report on topographic sheet "A". From an Easterly wind some protection would be afforded by the land to the East. A great deal of wind from true North blows into Riou Bay and this sometimes raised enough sea to make it uncomfortable on the "WILDCAT". This wind blew with a force up to five, Beaufort scale. I used a 350 pound patent anchor and fifteen fathoms of three quarter inch chain for the buoy and in blows ran out three four and one quarter inch lines. The launch frequently rode on one of these lines even in blows and we never parted a line or dragged anchor here.

By anchoring farther to the North on this bank probably more protection would be had from Moraine Reef, both from the Northerly sea and ice.

I do not believe that ice is to be feared here except on the highest spring tides. At other times I saw only small or moderately sized pieces coming into this Bay. The ice that comes into Riou Bay on spring tides could either be avoided or pushed clear. The largest bergs I ever saw in Riou Bay projected not more than five feet above the water but some were quite massive. The largest bergs I ever saw drifting by the entrance to Riou Bay did not exceed eight to ten feet in height above the water. The beach and shoal water near the main shore in this locality are to be avoided because of the boulders.

Anchorage on the West side is recommended 1000 meters, 1060 true from Δ Hill in between eight and nine fathoms of water, hard clay bottom. There are spots of soft clay near here. It is believed that here the maximum amount of protection from the West spit is obtained. In Southwest blows this anchorage should be valuable, if the wind blows from the Southwest in the Bay. In a storm in which the wind blows from the glacier a very heavy short sea will be found here and if a ship were to try to ride it out on this side I believe they should shift to a little farther offshore to about eleven fathoms of water and pay out plenty of chain.

The bottom in this locality is of hard clay with small spots of very soft clay or mud. Where the tide staff was located, just off the cabin, I was unable to get an extremely sharp pointed pile into the clay more than a few inches. Just East of the tide staff I was anchored in a heavy sea from the Northeast with the "WILDCAT", having out a 230 pound anchor and eight to ten fathoms of chain in about five fathoms of water. The launch brought up very sharply and before I could pay out more chain snapped the half inch chain off at the hawse pipe and opened up a number of links. I was watching a range very closely and the anchor did not drag at all. The bottom was hard. The bottom on all this flat on the West side, where it is hard clay as it usually is, I believe to be excellent holding bottom.

The anchorage behind Moraine Island I was unable to develop. Part of the time a floe of ice obstructs the entrance rather by laying across and outside it than by blocking it. A launch can usually be worked through this ice with care. I rode out the storm of September 24th where the anchor is shown. The wind blew at least 60 miles per hour, the hardest of it coming from magnetic East. We were anchored in 9 plus fathoms, mud bottom. Considerable protection is afforded from the wind by the high moraine. From a Westernly wind Moraine Island would protect this anchorage.

In my opinion it is important that an anchor in this position be shown on the chart. Many fishermen would find their way to it and a note in the Coast Pilot to the effect that it has not been developed would do away with that objection. It is the safest anchorage in Icy Bay and I consider it excellent. The very fact that it is shown would tend to do away with a prejudice that many of these fishermen have against Icy Bay at present because they do not know much about it but have heard that it is very windy. The low water line just East of the anchor shown is of importance for the bank drops very steeply outside it and it is an appreciable distance to the high water line.

On the boat sheet are shown a number of arrows with a note indicating the drift of the ice behind Moraine Island. Some very good sized pieces drift in here and apparently nearly always take the direction indicated. Undoubtedly this is caused by the current running out around the South end of Moraine Island. This is of importance and should be noted or shown for there is plenty of room and water for a boat to anchor between Moraine Island and the one next East from it. This would be directly

in the path of these stray bergs which travel through here with an appreciable speed.

Fresh water.

Fresh water cannot be readily obtained in any quantity at present in Icy Bay. The sources of supply are small streams or ponds. On the "WILDCAT" we melted ice.

At the head of Riou Bay, just South of Δ S. Base, is a small stream which may be used. I believe it dries up part of the season. It contains surface water from the flat. On the flat behind Riou Bay there are ponds near Δ Pyra from which poor fresh water may be obtained. Fresh water from running streams which drain the flat may also be obtained just South, magnetic, of Δ North Base. These sources are poor and the water is all surface water.

The stream at the head of the bight behind Moraine Island contains a very usable fresh water. It is the seepage from ponds in the moraine. It has to be dipped up and carried to boats. The best time to take water here is near high tide. The "WILDCAT" used this water.

In the Northeast arm is another small stream of similar nature to the last one mentioned. It is located just South of \odot Ann.

The water in some of the small streams that empty into Icy Bay on the West side in the Northern part of the Bay at the base of the Robinson Mountains can be used. The stream near Δ Goat has too much glacial silt for use without allowing it to settle. The amount of water in these streams varies with the season and if one wished to get water along here he would have to see for himself which of the streams was more suitable.

Just West of the cabin near Δ Hill on the West side a hole has been dug and a barrel sunk. This water is reported to be very good but of course the quantity obtainable would be small and it would have to be carried some distance.

Just North of the tent house, about one hundred meters, at the head of Guyot Bay, is a small running stream at which plenty of very good water may be obtained. It would have to be carried quite a long way even at high tide and then boated several miles to the vessel.

I have been informed that part of the time the water in Crystal Creek, just West of Icy Bay and which empties into Guyot Bay, is clear. The same party tells me that part of the time it contains silt in large quantities.

I do not know of any place in Icy Bay where good fresh water may be obtained conveniently in quantities. The small stream behind Moraine Island is probably the best and most convenient source of supply unless one has facilities for melting ice.

Boat Sheet No. 2.

Boat sheet No. 2 is on a 1:20000 scale. The sounding on it consists of the development of the channel over the bar and the development of the bottom inside the bar to connect with the sounding done on Boat Sheet No. 1. Some sounding was done outside the bar, enough it is believed to show that the bottom outside the bar slopes downward to the greater depths of the Gulf.

The sounding lines were run at 200 meter intervals in machine depths, over about twelve fathoms, and closer where needed for proper development. The depths under twelve fathoms were developed by 100 meter lines where I could run them and in places, such as on the bar in the channel, they are closer.

The widely spaced lines run offshore at the first of the season indicated the location of the channel. The limited amount of work I was able to do on this sheet was nearly all done to develop this channel.

For the work on the bar in the channel only the best of weather was used. When the sea was rough enough to cause any uncertainty in reading the lead line I did not sound here.

Where the bar is developed the bottom is generally regular and even with gentle slopes. There are no large quick changes in depths. There are some small variations in depth which I was at first inclined to think were poor lead line readings. These were investigated and found to be due to a slightly irregular bottom. The bottom on top of the bar is of sand and gravel. This was probably left in heaps and mounds much in the same condition as that ashore. The fact that the top of the bar is level now I attribute to the combined effect of breakers, currents and icebergs.

The currents frequently, if not constantly, exceed one knot. The water near the bottom in eight fathom depths and less, must be frequently agitated by heavy seas sufficiently to disturb loose sand. The sand in suspension would naturally settle in the eddies over the holes or pockets between the moraine heaps.

All the evidence I can find, and much of it is indisputable, is to the effect that for years the face of the glacier discharged ice practically on the general coast line here. At that time the glacier must have been more active and probably discharged much more ice than at present. The large icebergs dragging and bumping across this bar in the heavy seas could have had but one effect. They must have leveled any pronounced irregularities in the bottom.

There can be no doubt but that the seas break all the way across this bar in the heaviest storms. They break all the way across Yakutat bar sixty miles to the East and the depths on that bar are greater than on the Icy Bay Bar.

I do not see how it is possible that any steep-to spots can remain on this bar after it has been subject to the combined effect of these agencies for no one knows how many years. The one exception is boulders. I do not believe there are boulders in the channel on this bar of sufficient size to be dangerous.

The largest boulder I saw in the locality of Icy Bay was between ten and twelve feet above the ground and was apparently lying on its flat side. If there were boulders of this size in the channel they would undoubtedly have kelp on them. Floating kelp is frequently seen here but I saw no live kelp. A careful lookout was always kept for kelp in this locality and pieces about which I was in doubt I investigated. One piece that appeared to be growing was not investigated for several days and was noted in the sounding record. It was searched for later and could not be found. Floating kelp could usually be seen for over 100 meters and I do not believe that a single piece grew in the channel over this bar during the past season.

I was outside, running over this bar a number of times when the sea was very heavy. On no occasion did I see as heavy a swell here as I saw on September 25th. This was about twenty seven hours after the wind had been blowing sixty miles an hour from approximately Southeast. The sea in the locality of Icy Bay was extremely heavy from the Southeast. Some of the larger seas were combing somewhat. The wind was nearly calm.

The "WILDCAT" ran out the center of the channel as closely as possible. I could not take fixes because my signals were blown down and it was too rough but I am confident that I was not far from the center of the channel. Several of us kept a careful lookout for breakers but saw none except those described on the boat sheet. The sea was so heavy that from the low elevation of the "WILDCAT" I could not see clearly and with certainty more than about two miles.

There are four inked notes, numbered with Roman numerals, on the 1:20000 boat sheet, which describe conditions on the East and West parts of the bar. No. II is the only one of these referring in particular to what I saw on September 25th. The sea was without doubt lumping up in the locality of that note and I wouldn't have cared to run through it with the "WILDCAT." I did not see it break there.

The area off the West spit where note No. I is found undoubtedly breaks at times depending on the condition of the sea and tide. Those acquainted with this locality before the survey was made inform me that their doubts about there being a channel into Icy Bay were caused by the fact that they could see breakers off the West spit apparently extending as far as they could see.

On the East side of the channel where note No. III is located there can be no doubt but that the sea breaks on low water before the swells reach the size of storm seas. Judging from the way it was lumping when I was in this locality I believe that the water shoals to nearly three fathoms.

From this point inshore towards Δ Pyra, approximately in the area covered by note No. IV there are breakers. They do not break in ordinary Summer weather but will break in the heavier Summer weather when the tide is low. It does not break in a constant line but from a position approximately two miles, magnetic West, from position IV, I have seen the sea lumping up in an unquestionable manner or breaking, from approximately the position of note III at various spots not widely separated, all the way to the beach in the direction of Δ Pyra.

A fisherman from Yakutat informed me that he had seen kelp in a position which I should judge from his description lies one half to one mile true South of Δ Pyra. I never saw any live kelp here or elsewhere around Icy Bay.

Between spots Nos. II and III is a channel over the bar into Icy Bay nearly three nautical miles in width which, both from the soundings taken and from the observations in extremely rough weather, I am practically certain is clear of dangers. Outside the bar I have never seen any indications of dangers although I have been South and East of the Southern extremity of the bar in very rough weather.

Sailing Directions.

I have never approached Icy Bay from the Westward on the water. For running coastwise undoubtedly the Robinson Mountains, which are not on the chart at present, would be of value. The fact that there is a range of mountains from two to five thousand feet high just North of the shore line should be indicated on the chart even if the positions of the peaks are not known.

In approaching Icy Bay from the Eastward a vessel should not approach the beach. I was informed by the Captain of the halibut boat "PIONEER", whom the Superintendent of the Yakutat cannery said was unusually reliable, that in heavy weather a vessel to be safe from breakers should be at least eight to ten miles off the beach between Yakutat and Icy Bay. It was his opinion that there are places where the sea breaks within this distance from the beach. I was also informed in Seattle in the Spring of 1922 by an ex-Captain of one of these fishing boats, who said he had fished the Yakutat banks for years, that there were many shoal places well off the beach in front of the Malaspina Glacier.

In making this run with the "WILDCAT" I usually kept between six and ten miles off this beach. In heavy weather I kept eight to ten miles off. I believe the sea is more regular and somewhat smoother and easier to ride ten miles off the beach than it is closer in, in this locality. At various times and in different places between Point Manby and Icy Bay I have thought that I saw the heavy swells lumping up between six and eight miles off the beach. I have run into Yakutat a number of times when the sea was lumping on the bar between Ocean Cape and Point Manby. In the locality of Sitkagi Bluffs I have run into very discolored

water six to eight miles off the beach. This was apparently from some stream from the Malaspina Glacier.

Launches from Yakutat are said to follow the beach to Icy Bay from Point Manby by running just a little outside the line of breakers in good weather.

It is very probable that there are other places besides Icy Bay where the Malaspina Glacier has extended out to sea as far as ^{it} formerly did at Icy Bay.

For these reasons I would recommend a note be put in the sailing directions advising all vessels to keep ten miles off the beach between Point Manby and Icy Bay until further surveys are made.

I did not closely approach the beach between Point Manby and Icy Bay but it was clearly visible on many of my runs past. It appears from offshore to be a gravel beach with many boulders. It is usually at least several hundred feet wide, and to the North of it lies for part of its length high bluffs and elsewhere wide flats on many of which are grass and trees.

The top of the Malaspina Glacier slopes gradually upward from its edge and it generally appears to be covered with moraine. One of the earlier explorers reported it first as a plateau and later discovered it to be a glacier. Occasionally a white streak of ice is seen.

A print is attached to my photographic report which shows the color of the glacier at the head of Icy Bay. From this can be obtained the limits of the clean white ice. It can be seen from this print that the Eastern part of the glacier might appear from offshore as being land rather than ice.

I would recommend that the chart show what part of the ice is white and what part is covered with moraine.

In approaching Icy Bay even if the peaks are clouded and St. Elias is not visible, the brilliant white of the Guyot lobe, or Western part of the Malaspina Glacier forms one of the best landfalls conceivable.

When seen from the Southeast the end of the Robinson mountain range apparently projects out into the white ice of the glacier a considerable distance. As a vessel runs to the West from a position Southeast of the West end of the glacier, the apparent distance which this ridge extends into the ice shortens. This effect will be noted by comparing prints Nos. 26, 15, 16 and 17.

To an observer approaching the entrance to Icy Bay from the West the end of this ridge would not be distinguishable until he had brought the West end of the glacier to bear approximately Northeast, when it would be nearly in line with the West tangent to the glacier's face.

Three different prominent points are available for use in running into Icy Bay on a bearing: the West edge of the face of the glacier, the point of the ridge described above, and the medial moraine at the face of the glacier about one and one half miles from its Western edge. All three can be readily distinguished for miles at sea. The end of the Robinson Mountain ridge is selected because of its greater elevation and because it is less liable to change than either of the others. Even if there were snow on it I believe that it could be identified without trouble.

From a position outside the bar the general appearance of the shore line and the moraine behind it is not distinctive. The moraine on the East side of Icy Bay appears as low land but nothing on it stands out sufficiently to be identified. From a low elevation in a position about ten miles East of the channel into Icy Bay and eight or ten miles offshore, the low, barren plain just West of the East Yahtse River might be mistaken for Icy Bay if no bearings were used.

To enter Icy Bay from a point outside the bar, bring the East end of the ridge of the Robinson Mountains which projects into the glacier, to bear $29\frac{1}{2}^{\circ}$ true. Then steer $29\frac{1}{2}^{\circ}$ true until the tangent to Point Riou is abeam, bearing $119\frac{1}{2}^{\circ}$ true. To go to the anchorage on the West side, change course at this point to $307\frac{1}{2}^{\circ}$ true. Steer $307\frac{1}{2}^{\circ}$ true for three nautical miles until the prominent pyramidal shaped hill just North of the cabin and about 700 meters North of the South end of the low bluff on the West side bears $284\frac{1}{2}^{\circ}$ true. Thence steer for this hill on course $284\frac{1}{2}^{\circ}$ true for 1.2 nautical miles and anchor in eight fathoms, hard or soft clay bottom, 800 meters off the high water line.

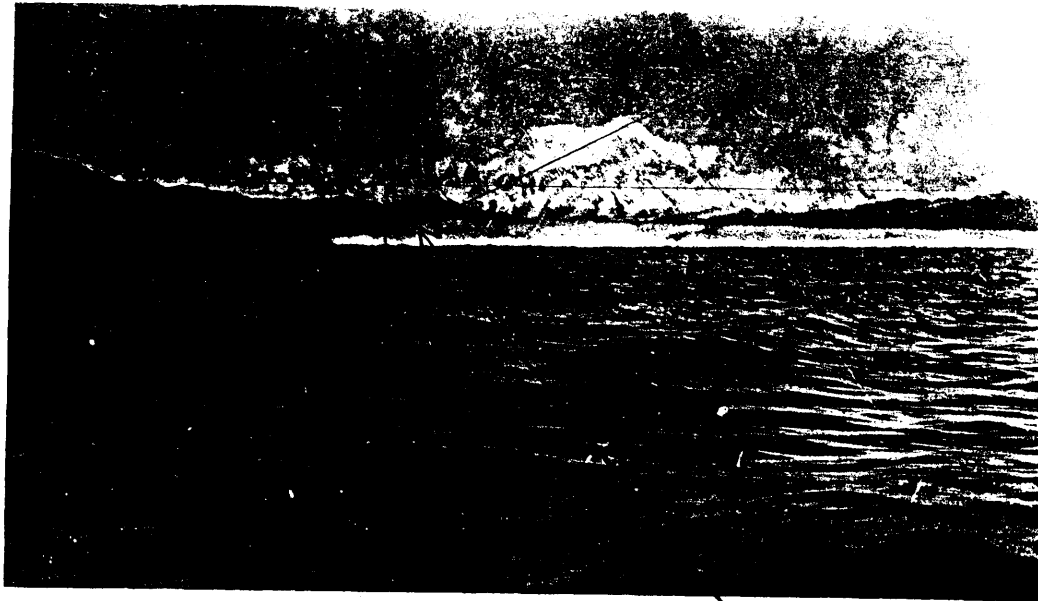
From this position to go to the anchorage in Riou Bay steer $284\frac{1}{2}^{\circ}$ true and clear the end of Riou sand spit by 300 meters. When the tangent to the Eastern side of Riou sand spit is abeam, steer 144° true for 450 meters and anchor in six fathoms, sandy bottom.

To go direct to the anchorage in Riou Bay, continue on the course $29\frac{1}{2}^{\circ}$ true until Pt. Riou bears $139\frac{1}{2}^{\circ}$ true, then change course to $284\frac{1}{2}^{\circ}$ true and clear the end of Riou sand spit by three hundred meters. Then proceed to the anchorage in Riou Bay as before.

Pt. Riou is a clay bluff about fifteen feet high and will appear as the extremity of the land on all bearings given to it except at low water when at its foot will be a sloping sand beach which will cause no confusion. The hill on the West side used is the one on which Δ Hill is located. It is very prominent on the bearing used and appears as the most prominent part of this point of land showing against the sea or sky. Sailing directions given should recommend that the stage of the tide be considered in passing the end of Riou sand spit because the end of this spit is so flat. The elevation of Δ Hill may be obtained from the level record for tidal bench marks.

That there may be no confusion a print showing the end of the Robinson Mountain range to be used is attached hereto. This picture was

taken from the direction of the bearing recommended and closely shows the relative appearance of the edge of the glacier, the end of the ridge and the medial moraine. It does not show the relation exactly between the end of the ridge and the mountains in the background. These mountains in the St. Elias ridge are usually obscured by clouds.



*Bearing point is
tip of this ridge where
arrow points.*

A plan on the chart showing the end of the Robinson ridge and the glacier as they appear from the direction of the bearing would be of great value to any navigator without local knowledge. The peaks in the background should either be omitted or put on in such a way as to make it clear that it is not a range that is being recommended. If St. Elias were shown its appearance relative to the end of the medial moraine might be misleading at different distances offshore. The end of the ridge recommended usually appears more distinctive than is indicated in this print. The ice is a brilliant white and the ridge for a long distance from its end is barren rock, probably shale or sand-stone. From a high bridge I believe considerable ice would be visible over the end of the ridge.

Sailing lines as recommended are laid out on the boat sheets. Because of the method by which these boat sheets were made and because of distortion, slight changes in courses and bearings may be necessary. The entering course, $29\frac{1}{2}^{\circ}$ should be shifted slightly on the smooth sheet so it will lie on sounding lines.

The only sailing line run was that from the West side to Riou Bay and on account of the time available, no bottom soundings were taken

on that. The other sailing lines would have been run but my signals blew down and it was not feasible to rebuild them. The sailing line over the bar crosses the bar about where I always ran across it in entering or leaving Icy Bay.

On low tides there is sometimes enough current out of Icy Bay to cause a moderate swell to lump up in the channel recommended between the two spits. It also does this in the channel over the bar sometimes when the sea is not very heavy. I have noted in the sounding records small tide rips and current lines in the channel on the bar.

Weather.

The weather in Icy Bay during the season of 1922 has been referred to in a number of my reports. It does not seem necessary to go into detail about it here. From May 23rd until early in July the weather was generally very good. The wind was variable and some fog was blown into the Bay from the West.

In July, August and September we had much wind from the glacier blowing from the first quadrant and nearly always bringing rain. On clear days a haze or light fog sometimes formed over the lagoon West of Icy Bay and over Guyot Bay.

It is reported by those having local knowledge that a wind off the glacier often blows toward the South inshore when the wind well offshore is either calm or blowing from the South. We frequently had Eastern wind from the glacier and North to Northeast in Riou Bay when the swell indicated that it was blowing from South or Southeast offshore.

I consider the information given in my report on "Conditions in Icy Bay from September, 1922, to January, 1923" to be very reliable. Reference to this should be made for information regarding weather, ice and conditions in general during this period.

Respectfully submitted,

Feb. 26, 1923.

H. B. Campbell

H. B. Campbell,

E. and G. Engineer.

HYDROGRAPHIC STATISTICS, SHEET NO. 1

ICY BAY, ALASKA.

Date, 1922.	Letter	Volume	Positions	Soundings	Miles statute.	Vessels.
June 26	A	1	50	107 ...	11.0	"WILDCAT"
" 27	B	1	82	156 ...	15.8	"
" 28	C	1	37	75 ...	7.0	"
" 29	D	1	9	24 ...	1.6	"
July 12	E	1	11	31 ...	1.3	"
" 14	F	1	70	285 ...	14.0	"
" 18	G	1	59	203 ...	11.0	"
August 2	H	2	42	139 ...	9.0	"
" 4	J	2	116	425 ...	18.4	"
" 5	K	2	16	33 ...	3.0	"
" 7	L	2	65	236 ...	10.5	"
" 9	M	2	152	435 ...	25.0	"
" 10	N	3	84	233 ...	17.5	"
" 11	P	3	140	432	26.0	"
" 14	Q	3	155	610 ...	30.5	"
" 15	R	3	33	67 ...	4.0	"
" 15	R	4	76	304 ...	11.5	"
" 16	S	4	95	267 ...	16.0	"
" 18	T	4	40	77 ...	8.0	"
" 19	U	4	41	75 ...	8.5	"
" 28	V	4	83	205 ...	13.6	"
" 30	W	5	4	7 ...	.8	"
" 31	X	5	57	105 ...	10.5	"
Sept. 1	Y	5	73	248 ...	9.5	"
" 4	Z	5	155	390 ...	24.4	"
" 8	AA	5	13	23 ...	2.7	"
" 14	BB	6	79	200 ...	16.5	"
" 18	CC	6	4	4 ...	-	"
" 25	DD	6	31	108 ...	7.0	"
Total			1872	5504	334.6	

HYDROGRAPHIC STATISTICS, SHEET NO. 2

ICY BAY, ALASKA.

Date, 1922.		Letter	Volume	Positions	Soundings	Miles statute	Vessels
June	28	..... A	..... 1	.... 20	..... 76	... 8.6	"WILDCAT"
"	29	..... B	..... 1	.... 41	..... 222	... 15.6	"
July	12	..... C	..... 1	.... 52	..... 184	... 11.8	"
"	14	..... D	..... 1	.... 53	..... 198	... 13.3	"
"	18	..... E	..... 1	.... 44	..... 153	... 9.5	"
"	19	..... F	..... 1	.... 87	..... 317	... 19.0	"
"	20	..... G	..... 2	.... 175	..... 623	... 36.4	"
"	21	..... H	..... 2	.... 138	..... 389	... 25.6	"
"	22	..... J	..... 2	.... 163	..... 499	... 32.3	"
August	1	..... K	..... 3	.... 151	..... 454	... 30.0	"
"	2	..... L	..... 3	.... 16	..... 73	... 3.0	"
"	28	..... M	..... 3	.... 21	..... 47	... 4.0	"
Sept.	1	..... N	..... 3	.... 59	..... 116	... 10.5	"
"	2	..... P	..... 3	.... 70	..... 129	... 11.8	"
"	5	..... Q	..... 3	.... 53	..... 102	... 8.5	"
"	5	..... Q	..... 4	.... 8	..... 23	... 2.0	"
"	11	..... R	..... 4	.... 120	..... 288	... 21.5	"
"	15	..... S	..... 4	.... 95	..... 218	... 17.0	"
"	16	..... T	..... 4	.... 94	..... 323	... 22.5	"
Total	.....	.....	.....	1460	4434	302.9	

C.I.C.

COPY TO FIELD RECORDS:

April 9, 1923.

Division of Hydrography and Topography:

Division of Charts:

Tide reducers are approved in
6 volumes of sounding records for

HYDROGRAPHIC SHEET 4256

Locality: Icy Bay, Alaska

Chief of Party: H. B. Campbell, in 1922

Plane of reference is Mean lower low water, reading
4.2 ft. on tide-staff at Rion Bay, Icy Bay.
auto. gauge

For reduction of soundings, condition of records satisfactory
except as checked below:

1. Locality and sublocality of survey omitted.
2. Month and day of month omitted.
3. Time meridian not given at beginning of day's work.
4. Time (whether A.M. or P.M.) not given at beginning of day's work.
5. Soundings (whether in feet or fathoms) not clearly shown in record.
6. Leadline correction entered in wrong column.
7. Field reductions entered in "Office" column.
8. Location of tide gauge not given at beginning of each day's work.
9. Leadline corrections not clearly stated.
10. Kind of sounding tube used not stated.
11. Sounding tube No. entered in column of "Soundings" instead of "Remarks".
12. Legibility of record could be improved.
13. Remarks.



Chief, Division of Tides and Currents.

April 11, 1923.

Division of Hydrography and Topography:

Division of Charts:

Tide reducers are approved in
volumes of sounding records for

HYDROGRAPHIC SHEET 4257


Locality: Icy Bay, Alaska

Chief of Party: H. B. Campbell in 1922

Plane of reference is mean lower low water, reading
4.2 ft. on tide staff at Rion Bay, Icy Bay.
auto. gauge

For reduction of soundings, condition of records satisfactory
except as checked below:

1. Locality and sublocality of survey omitted.
2. Month and day of month omitted.
3. Time meridian not given at beginning of day's work.
4. Time (whether A.M. or P.M.) not given at beginning of day's work.
5. Soundings (whether in feet or fathoms) not clearly shown in record.
6. Leadline correction entered in wrong column.
7. Field reductions entered in "Office" column.
8. Location of tide gauge not given at beginning of each day's work.
9. Leadline corrections not clearly stated.
10. Kind of sounding tube used not stated.
11. Sounding tube No. entered in column of "Soundings" instead of "Remarks".
12. Legibility of record could be improved.
13. Remarks.


Chief, Division of Tides and Currents.

Verification of Hydrographic Sheets 4256 a+b

Jay Bay.

There was no difficulty encountered in verifying and inkning this sheet. The plotting was excellent, so good in fact that one almost felt free to accept the plotted positions without checking. The soundings too were well plotted and time intervals strictly observed.

The records were well kept, notes having been made where necessary. Considering the difficulty and hazards of the work any criticism on the part of the draftsman would be sheer folly. Some of the peculiar shapes of the curves are doubtless due to the dropping of fractions over 9 fathoms.

A. L. Shalvort

Hyd. Sheet No. 4257

- No noteworthy features were developed by the
- verification of this work.

The character of the work done on the sheet was good and the records well kept.

Some of the irregularities in the ten fathom curve are due to the dropping of fractions over nine fathoms

R. L. Johnston.

ADDRESS THE DIRECTOR
U. S. COAST AND GEODETIC SURVEY

AND REFER TO No. 4-DRM

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
WASHINGTON

August 30, 1923.

SECTION OF FIELD RECORDS

Report on Hydrographic Sheet No. 4257

Icy Bay - Alaska

Surveyed in 1922

Instructions dated February 23, 1922

Chief of Party, H. B. Campbell.

Surveyed by H. B. Campbell.

Protracted by D. E. Whelan, Jr., W. O. Manchester.

Soundings plotted by F. M. Albert.

Verified and Inked by R. L. Johnston.

1. The records conform to the requirements of the General Instructions except that the boats head by compass should have been recorded in degrees instead of points according to paragraph 294 of the General Instructions for field work. Also the sounding volumes should have contained an index of signals determined. (See Paragraph 296, G. I.) Otherwise the records were good, and the recording of W. G. McDonald is worthy of special mention.
2. The plan and character of development fulfill the requirements of the General Instructions.
3. The plan and extent of development satisfy the specific instructions.
4. The sounding line crossings are adequate.
5. The information was sufficient for drawing the usual depth curves within the limits of the work. The irregularity in the 10-fathom curve is due partly to the dropping of fractions and partly to the slight irregularity in the bottom as mentioned in the Chief of Party's Descriptive Report.

6. The protracting was finished by the field party but the soundings were plotted in the office.
7. There are no sheets adjacent to this sheet except the one to the north which was done the same season and the junction between the two is adequate.
8. No further work is required on this sheet insofar as the channel or bar is concerned. However, if work is done in this locality in the future it would be advisable to fill in the gap between the 10 and 20 fathom curves on the east side of the bay and also better develop the 10 fathom curve on the western side of the bay.

It is very probable that the kelp shown on top of the bar is floating kelp and not live kelp. (See Descriptive Report, p. 22)

9. Considering the great difficulty of the work and the handicap of the poor equipment, the survey is considered excellent and the Chief of Party is to be highly commended for his perseverance in the execution of the work.
10. Reviewed by A. L. Shalowitz, August, 1923.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY

WASHINGTON

September 11, 1923.

SECTION OF FIELD RECORDS

Report on Hydrographic Sheets 4256^a and ^b.

Icy Bay, Alaska

Surveyed in 1922

Instructions dated February 23, 1922.

Chief of Party, H. B. Campbell.

Surveyed by H. B. Campbell.

Protracted by W. O. Manchester.

Soundings plotted by J. D. Torrey and R. L. Johnston.

Verified and inked by A. L. Shalowitz and F. M. Albert.

1. The records conform to the requirements of the General Instructions. The descriptive report was unusually comprehensive.
2. The plan and character of development fulfill the requirements of the General Instructions.
3. The plan and extent of development satisfy the specific instructions. The surveyed area does not extend closer than 4 miles to Guyot Glacier, only three or four lines of soundings having been carried nearer to the glacier. As the descriptive report states that navigation in this area is unsafe there will probably be no need to carry the survey further up the bay unless there is a considerable recession of the glacier.
4. The sounding line crossings are adequate.
5. The information is sufficient for drawing the usual depth curves.
6. The protracting was done by the field party, but the plotting of soundings was done in the office.
7. The junction with the adjoining sheet is satisfactory.

H. 4256^a and ^b - 2.

8. No further surveying is required within the limits of the sheet.
9. The character and scope of the surveying are excellent. In view of the difficult circumstances under which it was done, it must be considered a most commendable piece of work. The field drafting is excellent.
10. Reviewed by E. P. Ellis, September, 1923.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY

HYDROGRAPHIC TITLE SHEET

The finished Hydrographic Sheet is to be accompanied by the following title sheet, filled in as completely as possible, when the sheet is forwarded to the Office.

U. S. Coast and Geodetic Survey
Register No. 4256 a+b

State . Territory of Alaska
General locality
Locality . . Icy Bay
Chief of party . . . H. B. Campbell
Surveyed by H. B. Campbell
Date of survey . . . June - September, 1922.
Scale 1 - 10,000.
Soundings in Not plotted.
Plane of reference . LLW (3.6 ft., computed by W.O.M.) . . .
Protracted by W.O.M. . . Soundings in pencil by
Inked by Verified by
Records accompanying sheet (check those forwarded):
Des. report, _____ Tide books, _____ Marigrams, 1 Boat sheets,
5 Sounding books, _____ Wire-drag books, _____ Photographs.
Data from other sources affecting sheet

Remarks:

Descriptive report, tide books, marigrams and season's report have been forwarded to Washington, D.C.
This sheet, Hydrographic Sheet No. I, consists of two smooth sheets, which together correspond to the one boat sheet.

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY

HYDROGRAPHIC TITLE SHEET

The finished Hydrographic Sheet is to be accompanied by the following title sheet, filled in as completely as possible, when the sheet is forwarded to the Office.

U. S. Coast and Geodetic Survey.

Register No. 4257

State . Territory of Alaska

General locality . Icy Bay

Locality Icy Bay Entrance

Chief of party . H. B. Campbell

Surveyed by . . H. B. Campbell

Date of survey . . June - September, 1922.

Scale 1. - 20,000.

Soundings in Not plotted.

Plane of reference . . LLW. (3.6 ft., computed by W.O.M.). .

Protracted by ^{D.E.W. Jr. & W.O. Manchester} Soundings in pencil by J.M. Albert

Inked by R.L. Johnston. Verified by R.L. Johnston . .

Records accompanying sheet (check those forwarded):

Des. report, _____ Tide books, _____ Marigrams, 1 _____ Boat sheets,

4 _____ Sounding books, _____ Wire-drag books, _____ Photographs.

Data from other sources affecting sheet

Remarks:

Descriptive report, tide books, marigrams and season's report have been forwarded to Washington, D.C.