W.A. No. ....

NAME Geol Rpt

SUBJECT ....

82FNE043 Bluebell

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M28-1506

GEOPHYSICAL REPORT
ON A
HYDROSONDE SURVEY
KOOTENAY LAKE, B.C.
May 1970

May 26-30 70

for
Cominco Limited

by
Kenting Earth Sciences
TORONTO
TELEX - 02-29505

CONTENTS

1. INTRODUCTION

1. Purpose

A HYDROSONDE survey was performed by Kenting Earth Sciences for Cominco Limited over a portion of Kootenay Lake, British Columbia. The purpose was to delineate bedrock with the hope of outlining a southward extension of the host rock of the Bluebell mine at Riondel, B.C.

This survey is a southern extension of a survey performed by Huntec Limited in 1966. For theoretical and geological aspects, reference is made to the report regarding that survey.

2. Survey Area

The survey area extended from line +48 00 to - 3200 covering an area of approximately 4.4 square miles.

3. Survey Vessel

The survey vessel, supplied by Cominco Limited, was a 41 foot wooden tug, "The Kokanee".

II. SURVEY

1. Dates of Survey

The field work commenced 26 May, 1970 and was completed 30 May, 1970.

2. Traverse Lines

The traverse lines were oriented approximately east-west. These lines extended from +4800 to -3200, referenced to mine co-ordinates. Lines +4800 to +2000, -400 and -2800 were run from shore to shore, the remaining lines from the east shore, to an approximate distance of 3,000 feet offshore. Line +7600 was run to correlate with the previous survey and line +5995 to correlate with D.D.H. 1363. Tie lines were also run to cut all east-west lines.

3. Survey Procedure

The survey procedure was the same as outlined in section II - 2 of the 1966 report, although different theodolite stations were used. Again, the theodolite parties were under the direction of Mr. H. Dixon of Cominco Limited.

III. DATA REDUCTION

The bedrock elevation map is produced from three maps; an unmigrated isopach map, a migrated isopach map, and a bottom elevation map. The procedure used is as follows.

1. Depth from lake bottom to bedrock was calculated using the time taken from the seismic records. This value was plotted at each fix and contoured to produce an unmigrated isopach map. Near shore sediment thicknesses are zero as the water depths are the depth to bedrock.

2. Sediment thickness at each fix was migrated to yield values which were used to contour a migrated isopach map.

3. Where bedrock formed lake bottom, i.e. near shore, water depth was calculated at each fix, plotted and contoured to produce unmigrated depth to bedrock. Profiles were drawn perpendicular to the contours, i.e. along dip. Circular wavefronts were drawn, having radii determined from unmigrated water depth values along the profiles. A line was drawn to envelope the wavefronts forming the migrated water depth profile. Elevation of the bedrock was read from the profile, plotted and contoured to form a portion of the bedrock elevation map.

4. Bottom elevations were calculated at fixes used in step 1), plotted and contoured to yield a bottom elevation map.

5. Step five yields the elevation of bedrock over the area detailed in step 1). When the elevation of the bottom and the thickness

of material between bottom and bedrock is known, subtraction of sediment thickness from bottom elevation yields bedrock elevations. To accomplish this, the bottom elevation map (step 4) was overlain on the migrated isopach (sediment thickness) map (step 2). Sediment thickness was subtracted from bottom elevation along each bottom elevation contour, plotted on the bedrock elevation map (step 3) and contoured to yield a complete bottom elevation map.

IV. INTERPRETATION

Throughout most of the survey area the bedrock horizon was quite well defined although in certain portions the bedrock was masked out for various reasons.

Above the intersection of the two dipping slopes, the actual bedrock horizon is masked by signals originating from reflections off the two slopes. Thus the centre portion of the bedrock elevation map has fewer contours because in this portion the first arrivals were reflections from the slopes and not from bedrock vertically below.

Another instance of masking occurs at diffraction points where the diffracted wave train hides the actual bedrock arrival. This phenonmenon in itself is not a great problem when one diffraction pattern occurs, but when two diffraction patterns occur, the bedrock arrivals are convolved with many reflections so that the definition between bedrock and the diffracting surfaces is extremenly difficult. This situation occurred on the east side of the survey area on lines -1200 to -3200. One diffracting surface follows tie line "B" and the second diffracting surface parallels it roughly eight hundred (800) feet to the east. Thus, between these two points on each record any definite outline of the bedrock is lost in the diffractions. There are several geological structures which could account for these diffracting patterns, but we shall concentrate only on the most likely structures.

Any structural feature must be evaluated bearing in mind that it occurs in a glacial valley. Thus the feature has been ice eroded. Since erosion acts differentially, the central portion of the feature must be softer than the two diffracting surfaces. This can occur when a "cap" rock or a sheared zone is present. A mechanism likely to produce these results would be ice eroding down a shear zone located midway between the diffracting surfaces. As the ice erodes vertically downward in the shear zone, it also erodes laterally to produce a "U" shaped valley. An analogy would be a river eroding downward and laterally to form a "V" shaped valley. There is another possibility which is more probable and is believed to be the best explanation.

According to Rice (1941), there are many dikes and sills within the Lardeau Series. Due to its homogeniety, a granitic sill or dike is much more resistant to erosion than a schist or gneiss. Thus it is concluded that the diffracting surfaces are due to the presence of either a dike or a sill or a combination of both. The thickness of the sill would be appreciable to produce a feature of this size. A sill or dike accounts for a deepening between diffracting surfaces due to the fact that the material between is less resistant to ice erosion.

The feature described above is delineated only in a detailed two-dimensional migration. In three dimensional migration of down-dip diffractions, the feature farther down-dip shows up as a flattened surface and not as a protrusion from a smooth bedrock profile. Thus below tie-line "B" between the lines mentioned above, bedrock could be at a considerably higher elevation and this could be outlined in a more detailed interpretation. It is unknown whether the western most feature is of any economic value, but this could be ascertained by drilling.

Another feature revealed by the records appears below tie-line "B" between +2000 and -400, its highest elevation being 1050 feet at fix 14.8 on line +800. It is broadest on line +800 measuring roughly twelve hundred (1200) feet and tapers in an approximately elliptical pattern to its extremities. This feature is believed to be a glacial remnant, composed of either clay or boulders or both, and may pose problems in drilling.

The ridge extending along tie-line "B" from +4800, south, to approximately +3600, is considered to be an extension of the host rock immediately to the north. Thus, due to the proximity to a known ore body, there is a strong possibility that the ridge does contain ore.

V. CONCLUSIONS

It is believed that the interpreted depths are within ten (10) percent of the actual depths. The error is probably a result of the following. The inaccuracies due to the velocity function increase with depth. The fact that three maps are used to produce the final map induces error. Migration may lead to as much as five (5) percent error and boat position adds perhaps another two (2) percent. The source receiver measurent will possibly add two (2) percent as the measurement was taken while the cable was under zero stress. Correlation with D.D.H. 1363 was accurate to within two (2) percent. This accuracy is well within geophysical limits, but should not be construed to apply to the entire survey area.

All these considerations, however, do not destroy the relative value of the contours which provide a picture of the bedrock surface.

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REPORT ON

HYDROSONDE SURVEY

KOOTENAY LAKE

RIONDEL, B.C.

for

COMINCO LIMITED

by

HUNTEC LIMITED

TORONTO, ONTARIO

APRIL, 1967

TABLE OF CONTENTS

ABSTRACT

The survey procedure and instrumentation are described.

The data reduction process is described and the outlines of the migration theory presented; for a more complete description see Reference 2.

The contours and profiles over Kootenay Lake show an over-deepened glacial valley to below sea level. The eastern bank follows the prevailing dip slope of about 40 degrees whereas the west bank, a strike slope, is considerably steeper and may be a vertical cliff in places. A dextral displacement occurs at Woodbury Point.

The tailings area is partially defined and isopachytes presented over the surveyed area.

I INTRODUCTION

1. Purpose

Huntec Limited of Toronto was commissioned by Cominco Limited to undertake a Hydrosonde survey over part of Kootenay Lake, British Columbia, the purpose of the survey being to determine bedrock surface beneath the lake, irrespective of depth. It was understood that the results of the survey would define the future limits of underground workings from the Bluebell Mine at Riondel.

A secondary survey was also required over an old tailings dump.

2. Area

Kootenay Lake is elongate in a north-south direction, about 56 miles long, and with an average width of approximately 2.5 miles over most of its length: 2 miles at Riondel and the Bluebell Mine (approx. 49°46'N, 116°5'W).

The survey extended from Riondel (Mine Coordinate 7600N.7600E) to a point approximately 3 miles north with thirty-nine east-west oriented lines at a nominal separation of 400 ft., a total of approximately eighty line miles.

3. General Information

The equipment was mounted aboard the "Kokanee", a wooden tug under the supervision of Mr. Walter Tozer of Nelson Marine Services.

Two-way radios were provided by Huntec Limited for ship-to-shore communications; the shore party responsible for the surveying and navigation was under the direction of Mr. H. Dixon of Cominco Limited.

Mr. R.W. Hutchins and Mr. J.W. Prior of Huntec Limited were responsible for the operation of the Hydrosonde Mark 2A system and ancillary equipment, Mr. Prior later carrying out the data reduction and interpretation.

The field work was commenced on October 21st, 1966 and completed on October 30th, 1966.

II SURVEY

1. Traverse Lines

The survey was made over east-west oriented lines a nominal 400 ft. apart. Thirty-nine such lines were run from 7600N at the southern end of the area to 22800N at the northern end, the lines varying from 8550 ft. to 12,560 ft. in length. A tie line was run and positioned by dead reckoning from the west end of Line 22800N to the east end of Line 10400N.

The eastern halves of Lines 7400N, 7500N and 7600N were run as a separate survey to determine the position and extent of the old tailings dump.

An experimental line was run from the east end of Line 10400N at an azimuth of 275° over a known ore zone to determine if the equipment could detect the presence of ore within the bedrock.

Lines 6540N and 5955N were run over the locations of drill holes D.D.920 and D.D. 1363 respectively, in order to check the data reduction procedures.

2. Survey Procedure

The navigation control and survey were performed as an integrated procedure by shore-based parties provided by Cominco Limited under the direction of Mr. H. Dixon.

Survey points were located on the east bank opposite each traverse line, and at selected control stations on either bank (control stations G.S.C. 11 and H. 10); lines northwards to 12000N inclusive were controlled from G.S. 11 (16096. 66N. 1128.96E) and Line 12400N northwards from H. 10 (10469. 35N 7499.43E). The east bank party determined the azimuth of the traverse line and "talked the survey boat along the line. Simultaneously, at one minute intervals, bearings were taken on the boat and the seismic record marked. The intersections of these bearings were used to trace the path of the boat, and the seismic data was linearly interpolated between the points.

The results of the survey are presented in the form of coordinates and presented in Plan 1: the traverse line plot. The boat party noted the distance to the west bank from the first or last fix as appropriate, and this information is also incorporated in Plan 1.

The fixes were taken on the boat mast; the plotted point is the appropriate position for the centre of the source-receiver array, the traverse direction having been taken into consideration.

III INSTRUMENTATION

1. Hydrosonde Mark 2A

The Hydrosonde Mark 2A, the latest in a family of continuous underwater seismic profiling systems, was developed and manufactured by Huntec Limited.

The system consists of six parts:

a) Power supply
b) Pulse conversion unit
c) Air compressor
d) Bolt pneumatic source
e) Hydrophone array - "eel"
f) Receiver

a) Power supply

The power is supplied by a Briggs & Stratton engine driving a 115 volts 60 cycles 2.5 kw alternator.

b) Pulse conversion unit for pneumatic source

A trigger pulse is derived photoelectrically from the helix drum of the facsimile recorder, and, subject to control and processing by the control unit, is used to activate the pneumatic source at a predetermined firing rate. This pulse is used to activate the pulse conversion unit, which in turn triggers the Bolt pneumatic source.

c) Air compressor

A 30 H.P. Worthington gasoline engine is coupled to an air compressor capable of delivering up to 10 cu.in. of air at 2000 p.s.i. per second.

d) Bolt pneumatic source

The P.A.R. pneumatic source Model 600 is manufactured by Bolt Associates Inc., East Norwalk, Conn.

Throughout the present survey a 10 cu. in. chamber was used.

A pulse from the pulse conversion unit activates a solenoid within the Bolt source which releases the air pressure through a valve system.

e) Hydrophone array: "eel"

A single hydrophone, or an "eel", comprising 20 pressure sensitive MP-7 hydrophones at 1-foot intervals inside a plastic tube was used for the survey. The eel was towed in a zone outside the boat's wash in order to reduce turbulent noise.

f) Receiver

This unit incorporates a signal amplifier, adjustable bandpass filters, the facsimile-type recorder and the programming logic which controls the timing of the recording operation in relation to the firing pulse sent to the transmitter.

The hydrophone signals are passed through a low noise, low level pre-amplifier and fed into the variable bandpass filters. The twelve high frequency cut-off points are between 100-3027 cps. The ten low frequency cut-off points are between 20-1730 cps. The frequency response of the open filter is from 20 to 20,000 cps. Throughout the present survey, the filters were in the 101-628 cps range.

The band-limited signals are fed via a logarithmic gain control to a driver amplifier which in turn provides the input to the printing amplifier. The overall voltage gain of the signal processor is well over one million.

The helix of the 8 inch recorder is driven directly by a printed circuit D.C. motor phase-locked to a crystal oscillator through a hybrid digital servo system. The following record sweeps speeds are available: .0625; .125; .250; .500; 1.00 and 2.00 secs. full scale. The recording can be delayed by 1/2 full scale increments up to 18. The firing rate is variable from 3 per minute to 480 per minute.

The half wave rectified signals are recorded in the form of intensity shades on electro-sensitive paper.

The instrument is equipped with facilities to print scale and fiducial markers.

2. Radios

Small transceiver radios were used by the field parties whilst a Johnson 5 watt base radio was used on the boat.

3. Record Annotation

Every fiducial mark on the record was numbered to correlate with the survey; simultaneously a log was kept noting all data pertinent to the survey.

IV DATA REDUCTION

The process of data reduction converts the raw field profiles, which are vertically plotted as a function of reflection time, into fully migrated elevation contours of the bedrock; the major considerations in the processing operation are the choice of appropriate velocity-depth function and migration technique.

1. Velocity Function

The velocity of sound normally increases with depth in sediments such as are found in the lake; however, in this case no direct velocity measurements or drill hole sections through the unconsolidated sedimentary section were available. Such information would provide an absolute depth which could be used to correct the survey.

In the absence of definite velocity information, it was assumed for the purpose of converting the time profiles into depth profiles that the velocity within the lake sediments increased linearly with depth according to the following equation (Ref. 1):

$$Z = (V_o \sinh at)/a + V_o (\cosh at - 1)/a \qquad (1)$$

where Z = depth in feet

V_o = velocity in feet per second at zero feet depth

t = reflection time in seconds (one way)

a = equation constant

An alternative form of the same equation is as follows:

$$Z = R + D \qquad (2)$$

where

$$R = (V_o \sinh at)/a \qquad (3)$$

= radius of wave front circle at time t secs.

$$D = V_o(\cosh at - 1)/a \qquad (4)$$

= depth to centre of wave front circle at time t sec.

$$a = V_o/L \qquad (5)$$

where V_o = Velocity in feet per second at zero feet depth

L = scale length used in migration

Due to the lack of velocity information over the survey area a special technique was developed by the staff of Huntec Limited, whereby the average velocity could be computed for any particular two way reflection time from the diffraction patterns appearing on the records. Knowing the ditribution of average velocity against two way reflection time, it is possible to derive the appropriate velocity-depth function for the area. Figure 1 shows the plot of one way reflection time against average velocity for this survey. A velocity curve was selected after considering the reliability of each determination and the scatter of the plotted points.

Figure 2 shows a trial relationship between the average velocity, reflection time and total depth for this survey; the subsequent determinations used the lake bottom as datum and the constants are discussed later.

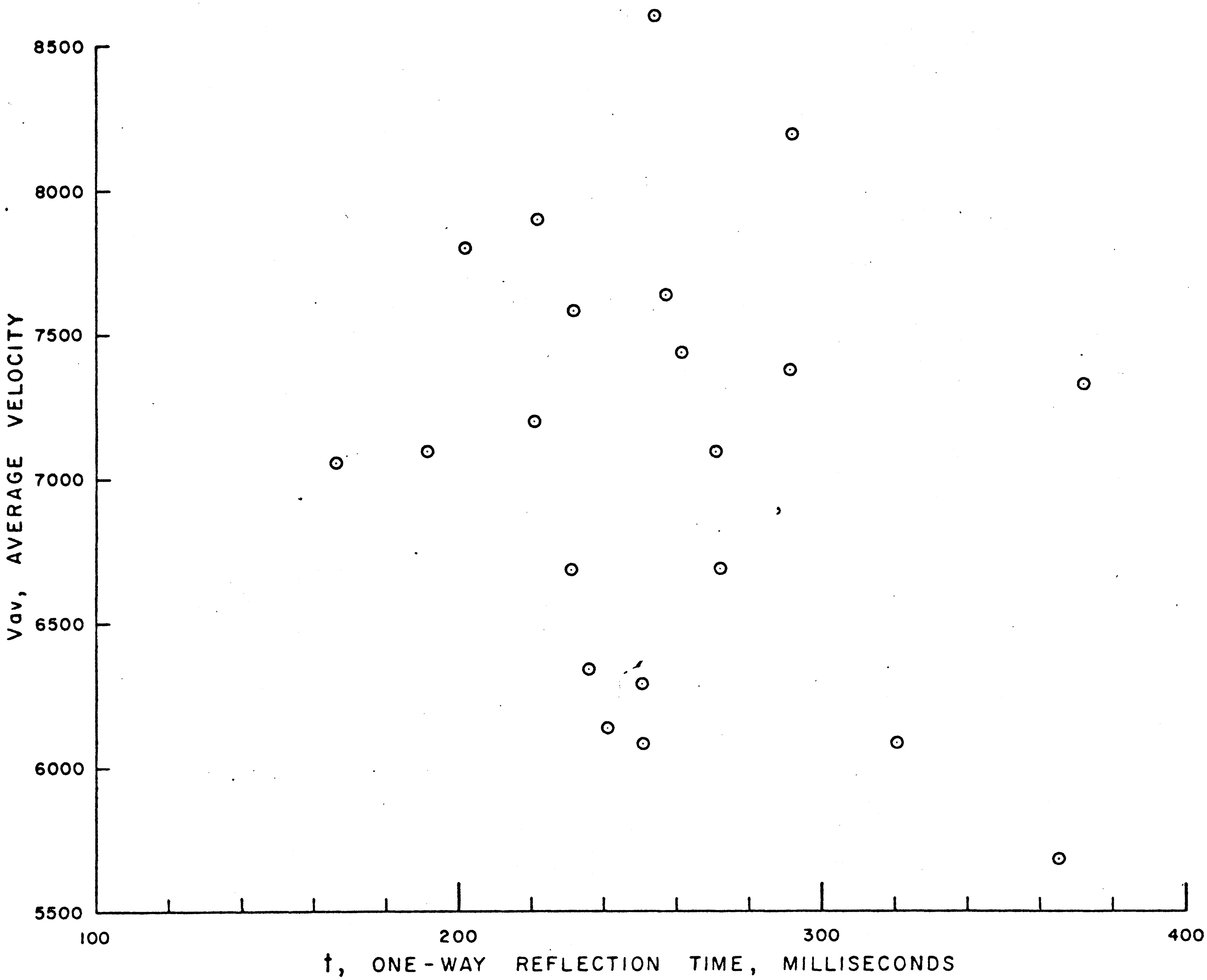

8500
8000
7500
7000
6500
6000
5500
Vav, AVERAGE VELOCITY
100
200
300
400
t, ONE-WAY REFLECTION TIME, MILLISECONDS

FIGURE 1

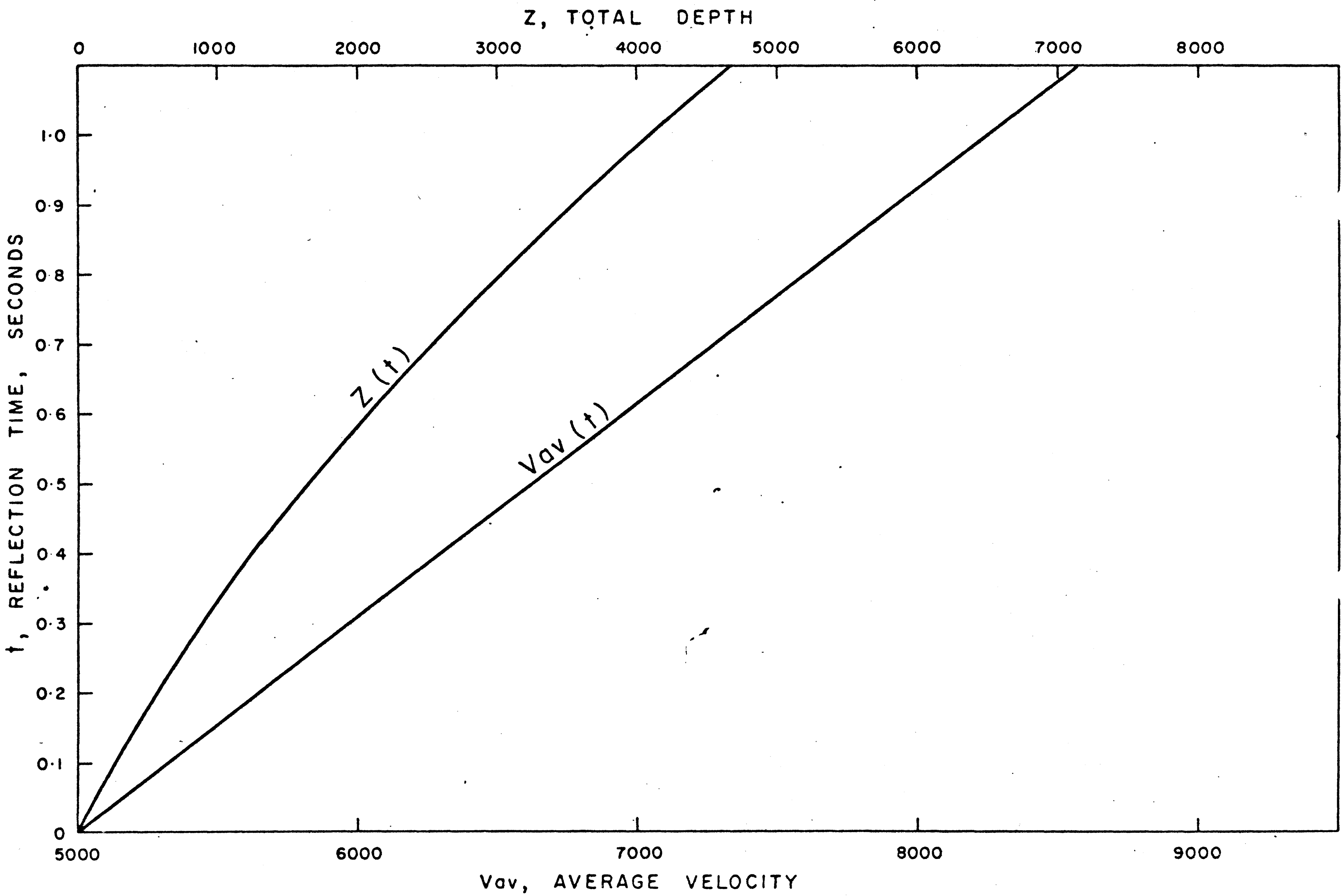

Z, TOTAL DEPTH
0
1000
2000
3000
4000
5000
6000
7000
8000
t, REFLECTION TIME, SECONDS
1·0
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0
Z (t)
Vav (t)
5000
6000
7000
8000
9000
Vav, AVERAGE VELOCITY

FIGURE 2

A histogram plot of average velocity produced two maxima, at 6200 ft/sec. and 7200 ft/sec. with an inclusive average over the total points of 7000 ft/sec.

The velocity of sound in the lake water was assumed to be a constant 5000 ft/sec.

The parameters of Equation (1) chosen for this survey were:

$$V_o = 6000 \text{ ft/sec.}$$

$$a = 1.2$$

By using these values for the parameters in Equation (1) the reflection time profiles were transposed to a plan of depth to bedrock beneath water surface, due allowance being made in the transposition process for the depth of the water. Two plans were made of the depth contours: one for each bank; the two banks were separated for ease of operation. The situation pertaining at Kootenay Lake is demonstrated in Fig. 3 which shows how a complex record with a crossover is obtained towards the centre of the profile when the bedrock surface exceeds a certain limiting concavity i.e. two surfaces having equal reflection times.

The sets of depth contours for each bank are then the basis for the migration procedure.

2. Migration Procedure

The hydrosonde record is a two dimensional section in which the total reflection time is vertically plotted beneath the array centre. This

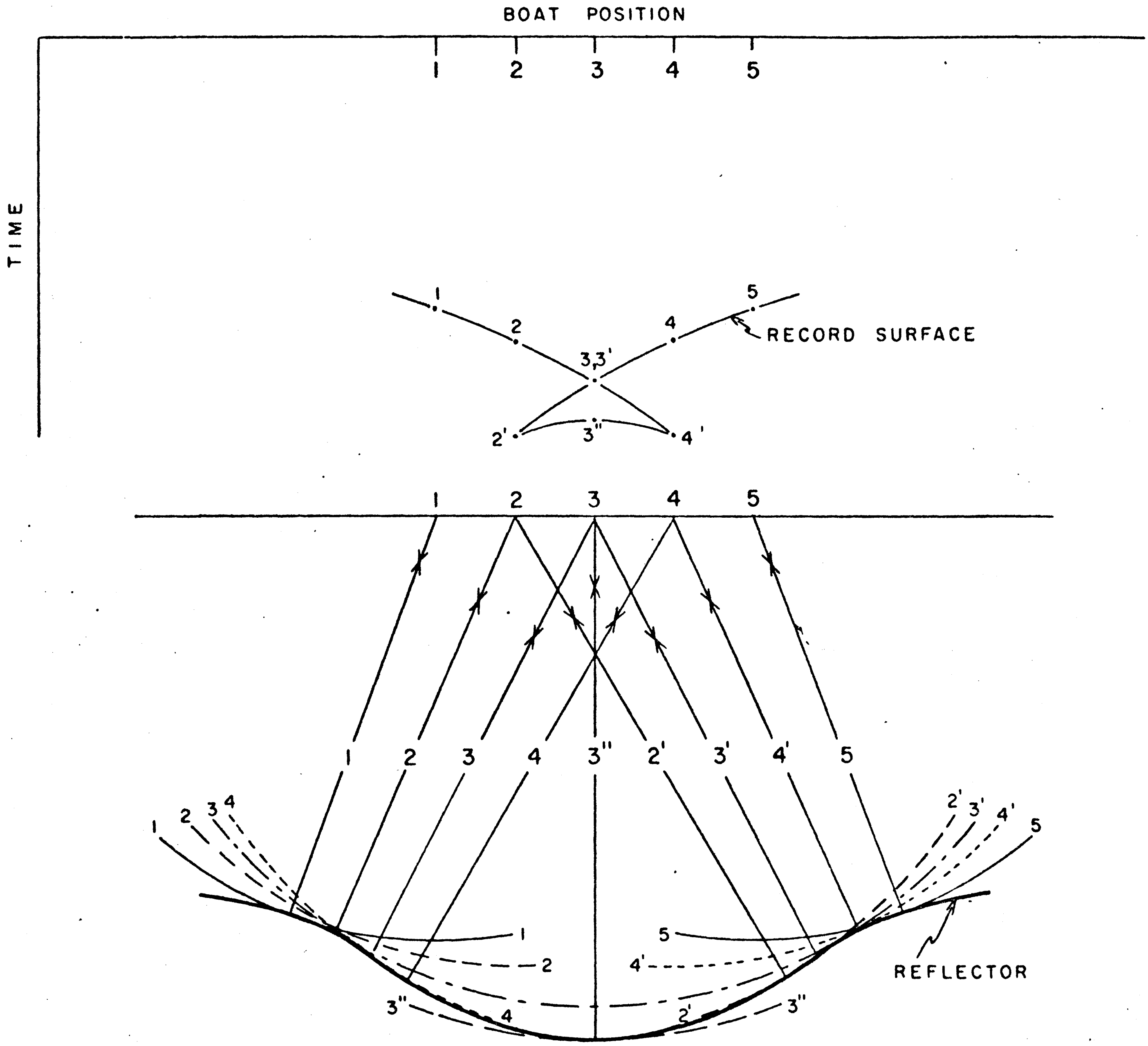


FIGURE 3. A surface of equal reflection time is a surface of maximum available concavity.

point has no other significance than that of being one point determining a surface of equal reflection times, this surface being tangential to the actual reflector at some point in space. "Migration", therefore, is the procedure of determining the true three dimensional reflecting surface from a surface determined by a number of vertically plotted points. Only in the case when the vertical section through transmitter and receiver lies in the direction of maximum dip of the reflector, can migration be carried out in the same vertical plane as the vertical plotting.

Hagedoorn (Ref. 2) developed the concept of curves of maximum convexity, whereby the process of migration is performed by determining the surface of equal reflection times, or surfaces of concavity, belonging to each vertically plotted point. Fig. 3 gives an example of the surface of maximum concavity. The inverse case, the surface of maximum convexity, can be summarized as the apparent horizon formed by vertically plotting the reflection times from one reflecting point (Fig. 4).

Three-dimensional migration of a vertically plotted point can be reduced to a two-dimensional migration in the vertical plane in the direction of maximum dip, i.e. in the direction normal to the contours. The migration is performed therefore by centering a family of surfaces of equal reflection times (depths) or wave fronts at the vertical through a vertically plotted point and moving a family of surfaces of maximum convexity to the best tangential fit to the vertically plotted horizon; the migrated point is then determined by following the surface of maximum convexity to the axis of the family of surfaces of maximum convexity.

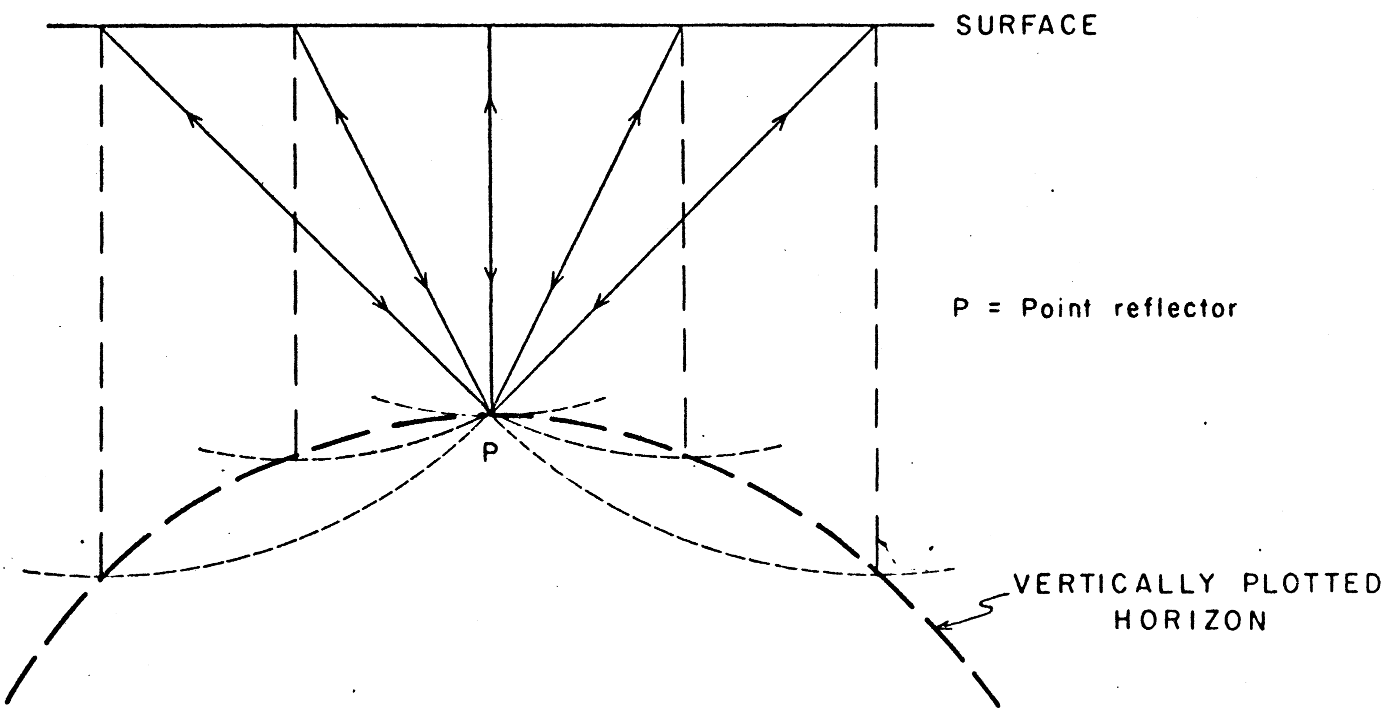


FIGURE 4. A vertically plotted horizon from one reflecting point is a surface of maximum obtainable convexity.

The family of surfaces of equal reflection times (depths), or wave front chart, is drawn graphically according to the velocity function desired. Hagedoorn presents wave front charts derived from the velocity function

$$V_Z / V_o = 1 + Z/L \tag{6}$$

where V_Z = velocity in ft/sec. at depth Z ft.

V_o = velocity in ft/sec. at 0 ft.

Z = depth in ft.

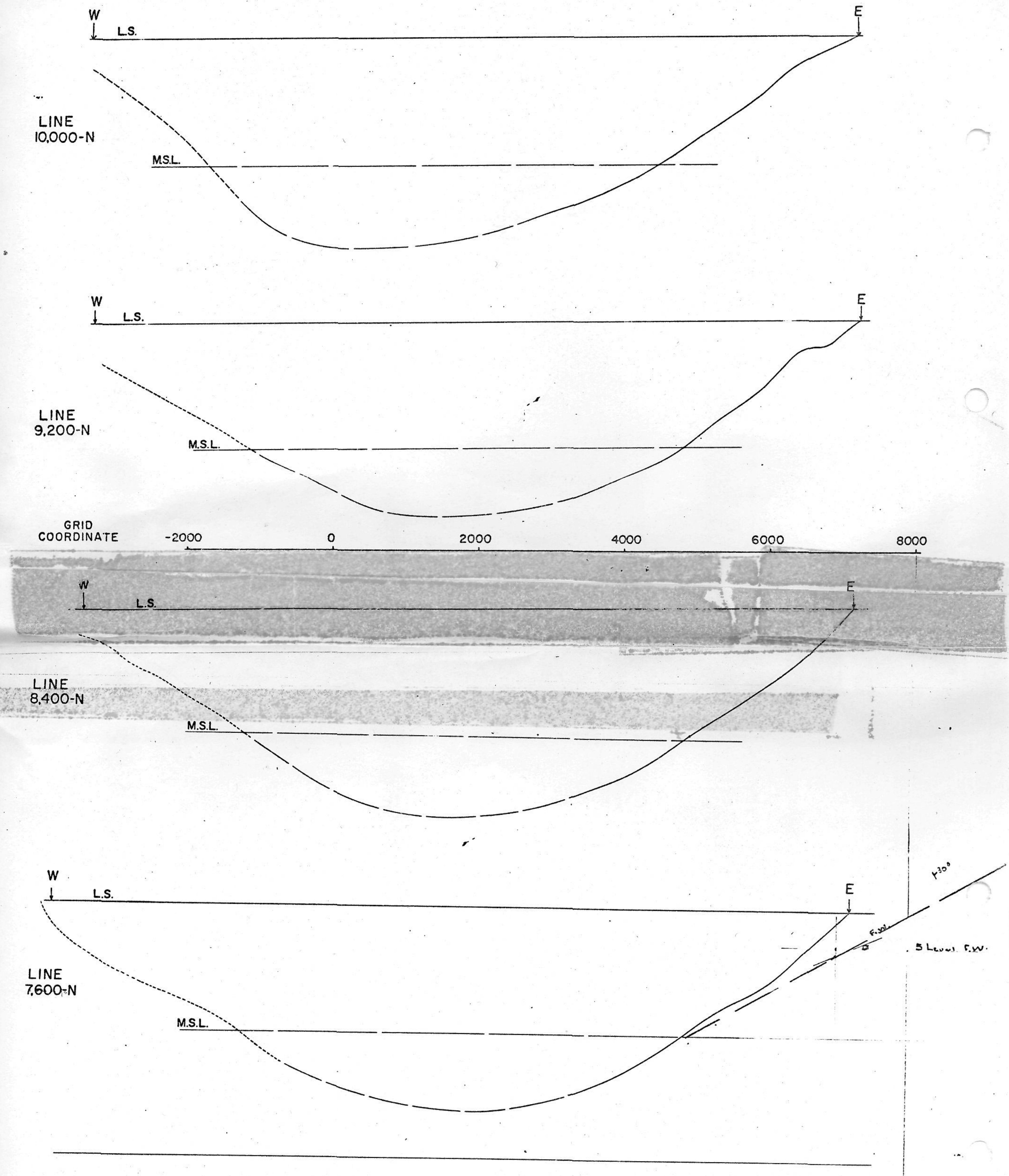
L = equation constant.

This equation is equivalent to Equation 1 in that succeeding wave fronts are circles of increasing radius with increasing depth to the centre point.

Hagedoorn also presents the procedure for constructing the chart of curves of maximum convexity from the appropriate wave front chart.

The sets of depth contours for each bank are then migrated using the wave front chart and the maximum convexity chart.

Several profiles (Figures 5 to 9 inclusive) were constructed after the migration process was completed to ensure that the two banks met at depth, and also that the banks below the lake bottom and above lake bottom respectively match up. The information from plan and profile was coordinated to produce a plan (1) of bedrock elevation contours with respect to sea level.



BEDROCK PROFILES

.75" = 1000'

1" = 1333'

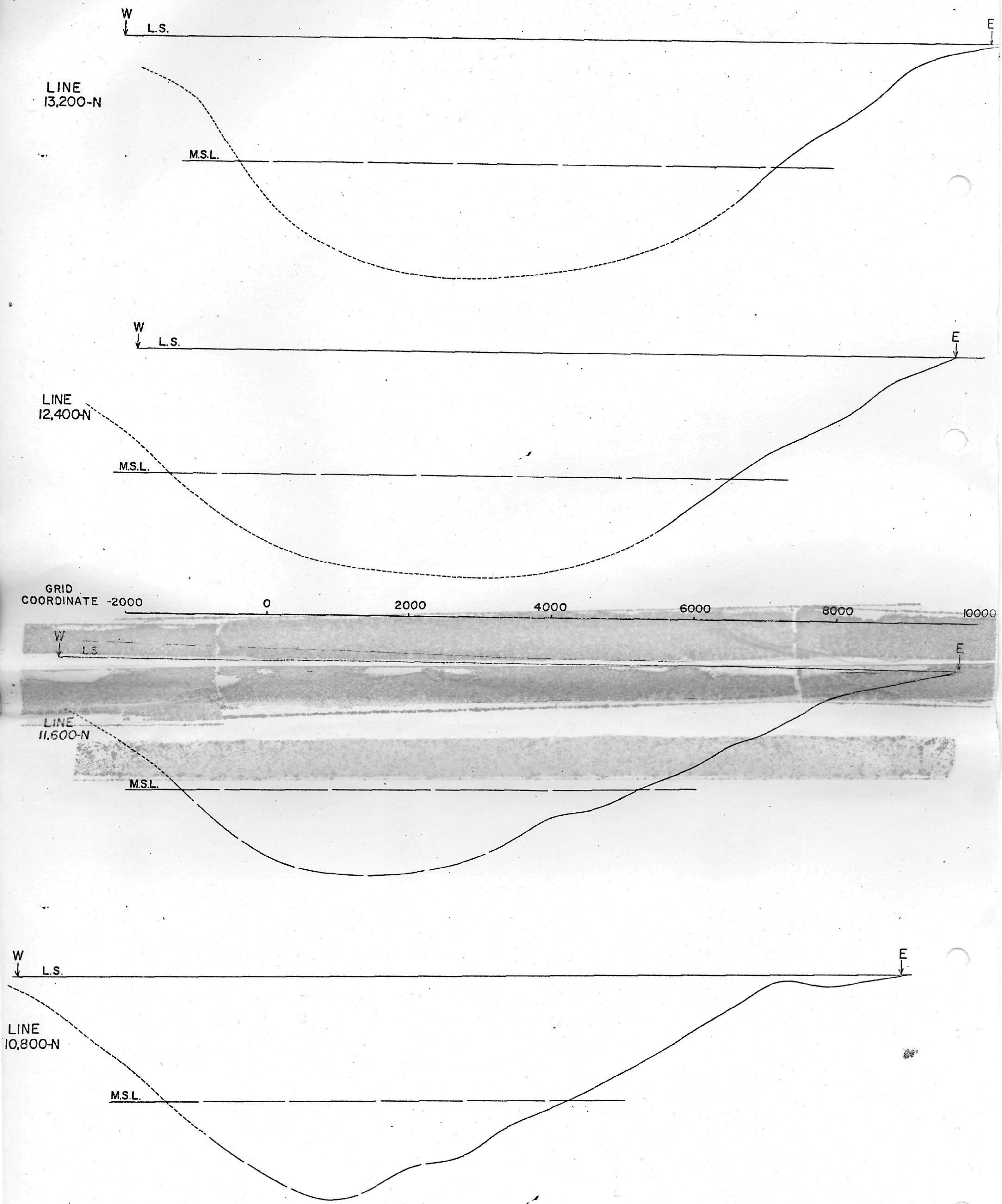
0 1000 2000 FT

HORIZONTAL AND VERTICAL SCALE

LEGEND

W↓	WEST BANK	L.S	LAKE SURFACE	———	BEDROCK SURFACE
E↓	EAST BANK	M.S.L.	MEAN SEA LEVEL	— — —	INTERPOLATED BEDROCK SURFACE

FIGURE 5



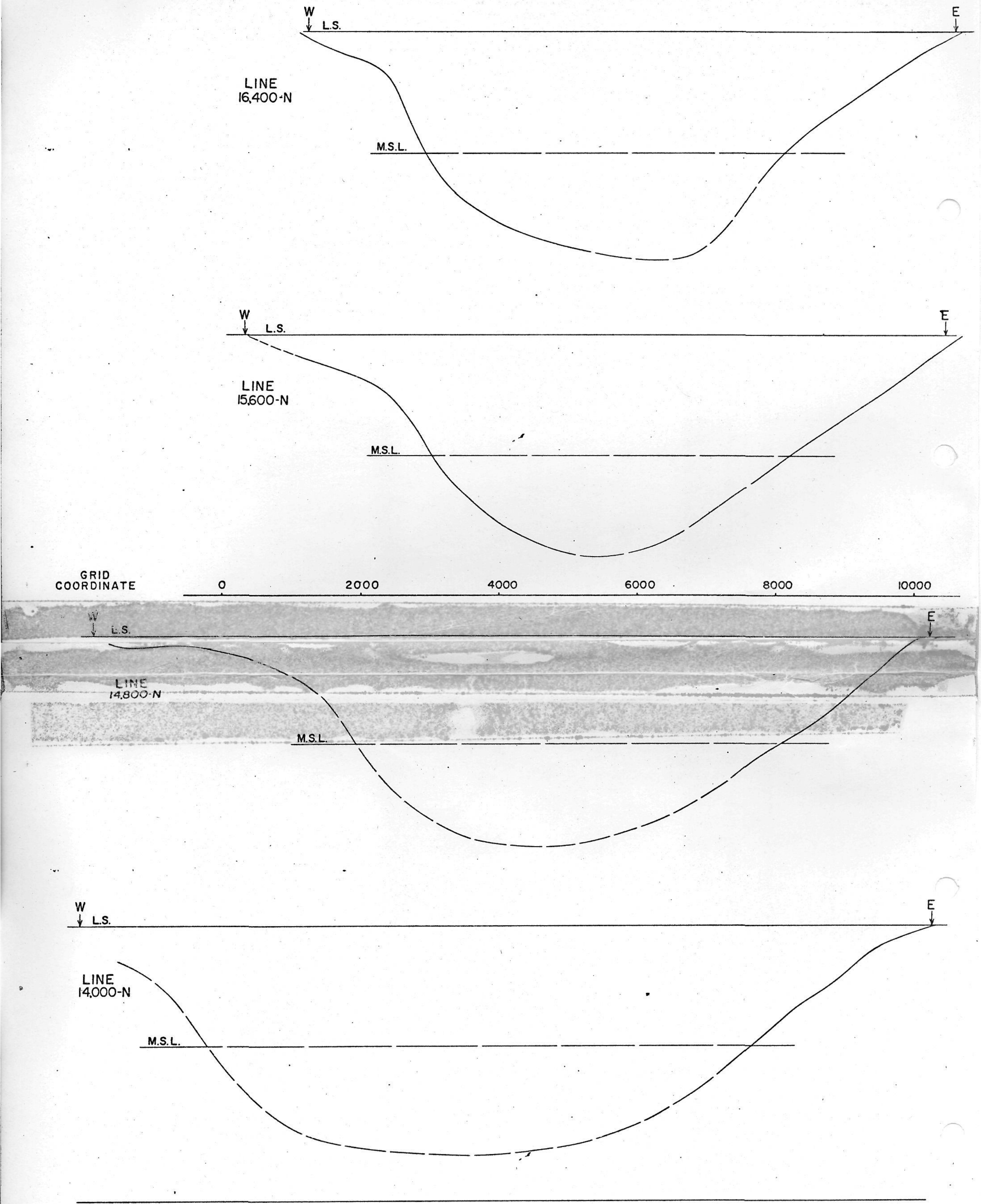
BEDROCK PROFILES

0 1000 2000 FT

HORIZONTAL AND VERTICAL SCALE

LEGEND

W↓ WEST BANK	L.S. LAKE SURFACE	——— BEDROCK SURFACE
E↓ EAST BANK	M.S.L. MEAN SEA LEVEL	— — — INTERPOLATED BEDROCK SURFACE
		- - - - - ESTIMATED BEDROCK SURFACE



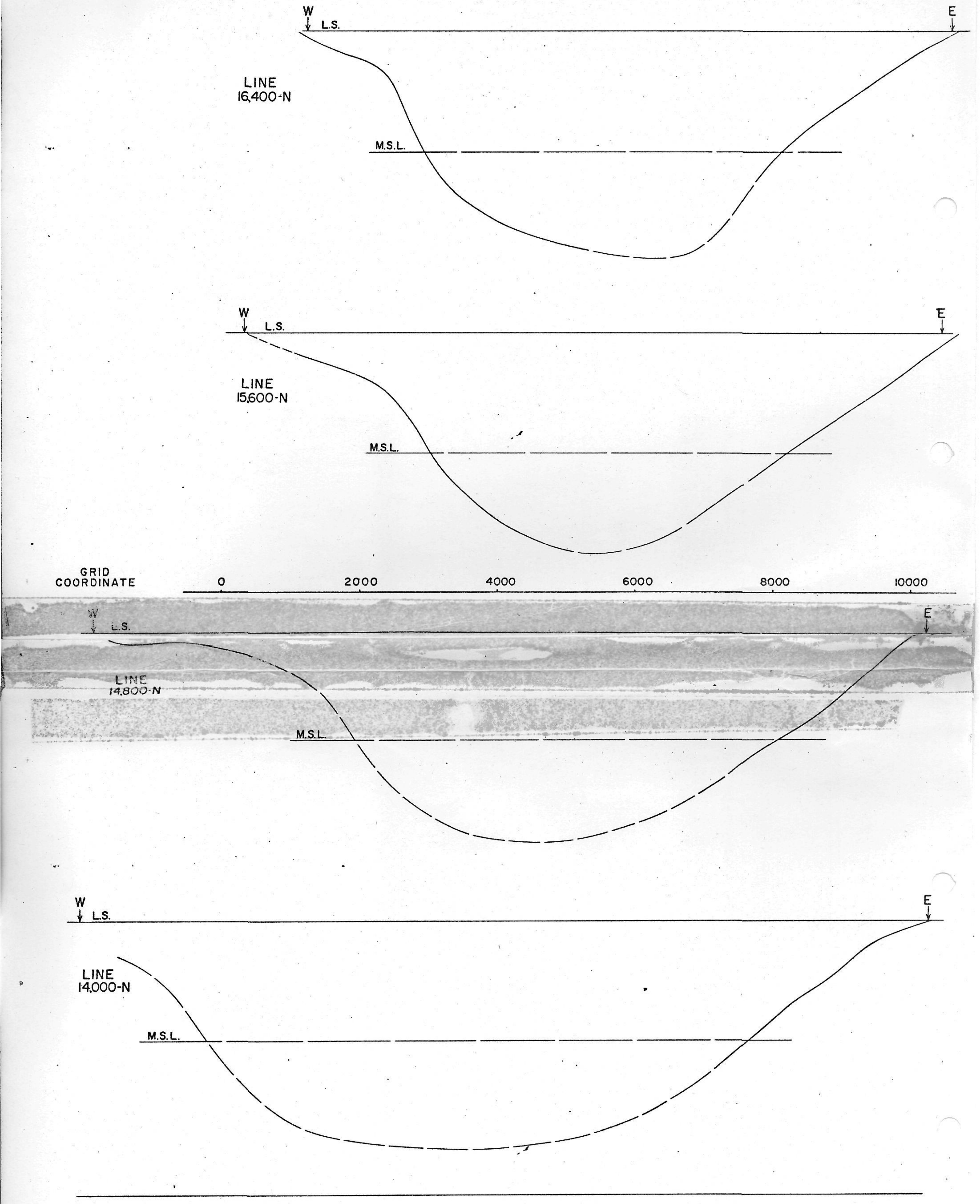
BEDROCK PROFILES

0 1000 2000 FT

HORIZONTAL AND VERTICAL SCALE

LEGEND

W	WEST BANK	L.S	LAKE SURFACE	————	BEDROCK SURFACE
E	EAST BANK	M.S.L.	MEAN SEA LEVEL	—— ——	INTERPOLATED BEDROCK SURFACE
				- - - - -	ESTIMATED BEDROCK SURFACE



BEDROCK PROFILES

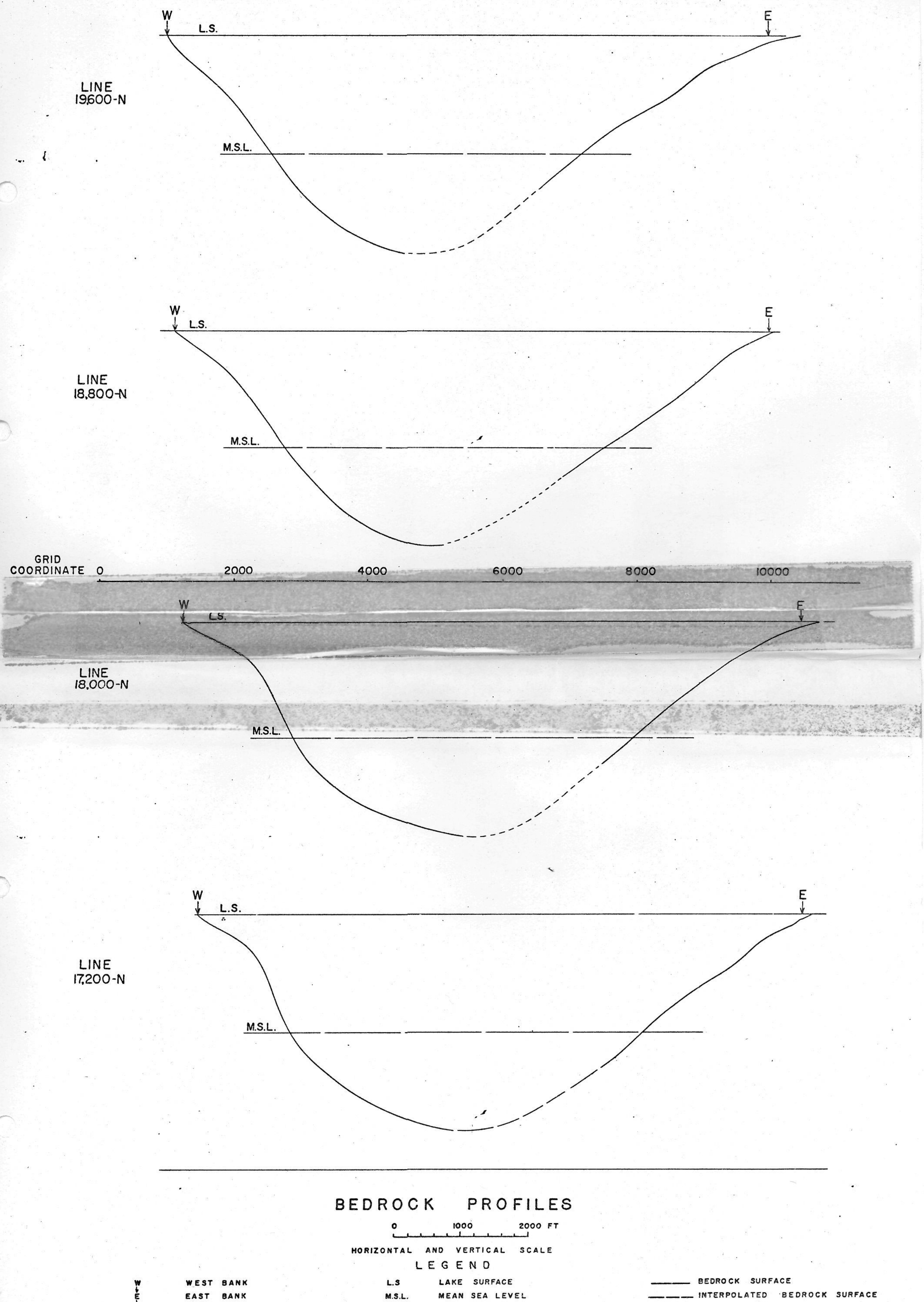
0 1000 2000 FT

HORIZONTAL AND VERTICAL SCALE

LEGEND

W↓ WEST BANK	L.S LAKE SURFACE	———	BEDROCK SURFACE
E↓ EAST BANK	M.S.L. MEAN SEA LEVEL	— — —	INTERPOLATED BEDROCK SURFACE
		- - - -	ESTIMATED BEDROCK SURFACE

FIGURE 7



BEDROCK PROFILES

0 1000 2000 FT

HORIZONTAL AND VERTICAL SCALE

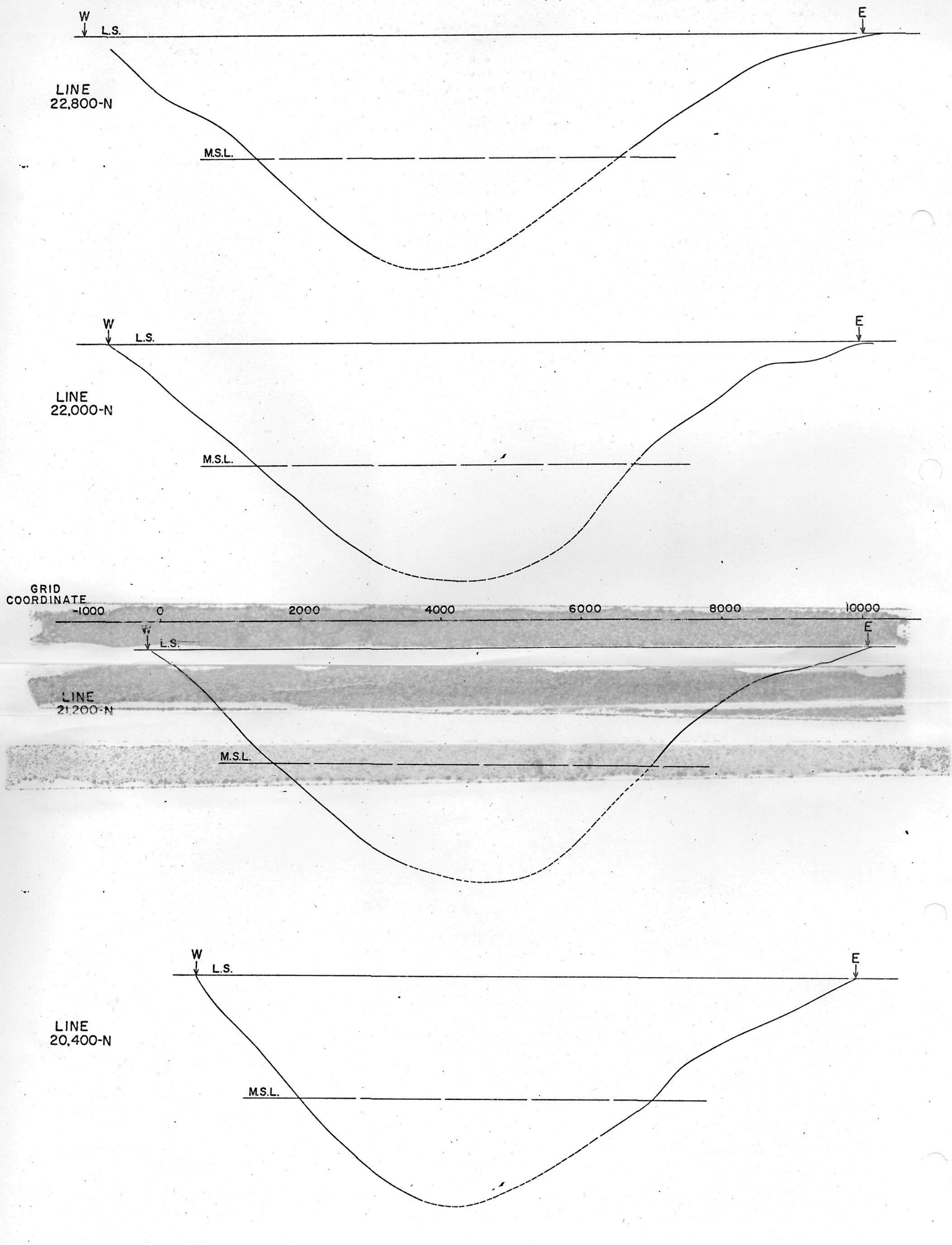
LEGEND

W↓ WEST BANK
E↓ EAST BANK

L.S LAKE SURFACE
M.S.L. MEAN SEA LEVEL

——— BEDROCK SURFACE
— — — INTERPOLATED BEDROCK SURFACE
- - - - - ESTIMATED BEDROCK SURFACE

FIGURE 8



BEDROCK PROFILES

0 1000 2000 FT

HORIZONTAL AND VERTICAL SCALE

LEGEND

W↓ WEST BANK	L.S. LAKE SURFACE	——— BEDROCK SURFACE
E↓ EAST BANK	M.S.L. MEAN SEA LEVEL	— — — INTERPOLATED BEDROCK SURFACE
		------- ESTIMATED BEDROCK SURFACE

FIGURE 9

3. Borehole Checks

The migrated sections agreed exactly with borehole DD 1363, but there remained a small discrepancy over borehole DD 920; the discrepancy could be due to any one of a number of causes, but is not considered serious.

V INTERPRETATION

1. Kootenay Lake

a) Regional Setting.

Kootenay Lake lies on the generally acknowledged boundary between two major physiographic regions: the Selkirk Mountains to the west and the Purcell Mountains to the east. Holland (Ref. 3) refers to the valley: ".....which extends southwards from the Rocky Mountain Trench and contains the Beaver River, Duncan River, Duncan Lake, and Kootenay River," alternatively, Schofield (4) refers to the Kootenay Valley as the Purcell Trench. The mountains on either side of the Kootenay Valley comprise a number of individual ranges which at Nelson trend northward, and to the north trend northwestward to form a curve convex to the east which is the local topographic expression of the Kootenay Arc, a major structure of the underlying bedrock.

The Purcell trench is carved in a series of sedimentary rocks ranging in age from Beltian to Carboniferous, intruded by masses of granodiorite. The general dip of the rocks is 40-45 degrees towards the centre of the arc, so that at Riondel the rocks dip almost due west. The granite masses, the eastern fringe of the West Kootenay-Nelson batholith, have had little effect in the general strike of the sedimentary series, therefore the conclusion is reached that the Purcell Trench is carved into the terrain without reference to the structure (4).

b) Structure.

Daly (reported in 4) considered the Purcell Trench to be a fault bounded graben structure, but several researchers investigating the theory have found no evidence of major faulting. The generally accepted theory (4, 5) is that in the early Tertiary the Selkirk mountains were uplifted; the effect of the uplift was to raise the old land surface to its present height with the result that the streams which meandered over the old surface were rejuvenated. These streams bore no relation to the underlying structure, hence the rejuvenated valleys bore no relation to structure. During the ice ages the pre-existing valleys were modified to their present form (5); though the Kootenay Lake is overdeepened, there is no evidence of it being a moraine dammed lake. There is evidence of glacial overdeepening elsewhere inland in British Columbia, but only in the coastal fiords is it reported to be in excess of 2000 ft (3).

c) Profiles and Plans.

The presented profiles are derived from the bedrock elevation plan. They show that in general the east bank of Kootenay Lake follows essentially the prevailing geological dip slope of 40-45 degrees; this slope can invariably be followed to depth on the hydrosonde records.

The west bank is the strike slope and is considerably steeper than the east bank; this can be seen clearly on the profiles from north of Woodbury Point. To the south of Woodbury Point the west bank gave a complex record. The outwash fan of Woodbury Creek had a strong masking effect; this is considered to be due to the high boulder content which the creek had dumped on the bottom, the boulders being an excellent reflector hence minimizing the proportion of transmitted energy. The lateral extent of this masking effect is shown on the bedrock elevation plan. The second complicating factor is that the bank is considerably steeper: almost a vertical cliff, and under these conditions very little or no reflection will occur.

The contours and profiles for the west bank south of Woodbury Point represent an interpolated bank which may in reality be considerably steeper; this bank is shown by broken contour and profile lines.

The contour plan reveals a dextral displacement of the valley at Woodbury Point on the west bank and at "North Bay" on the east bank. This sharp turn and resultant steep slope have tested the migration procedure almost to its limit, therefore any work in the vicinity of this inflection should thoroughly pre check the contouring in order to establish the extent of any errors.

d) Conclusions.

The Hydrosonde survey shows the Kootenay Lake to be a considerably overdeepened glacial valley which follows the line of a pre-Early Tertiary uplift river course; the river course was not controlled to any great extent by the underlying geological structure. The overdeepening is of the same order of magnitude as the coastal fiords.

2. Tailings Area

Several traverses were made with the express purpose of determining the extent and depth of the old tailings dump. A re-examination of records from an earlier survey shows that they did not have satisfactory definition of the bottom of the dump; the present survey determined the cross-section profile along a restricted number of lines which, whilst not giving complete information, do give an indication of the probable volume and hence the tonnage of the dump. The profiles are shown on Plan 3 for lines 7400N, 7500N, and 7600N; Line 7500N was repeated at different vertical scales, and over a slightly different track. The position of the bank shown on the profiles is the estimated migrated position; it will be appreciated that the predominantly horizontal bottom requires little, if any, migration whereas the steep bank, for accuracy, must be fully migrated. Any useful information available on the old records has been incorporated wherever possible, and the track recovery for the early survey has been estimated from the available plans.

The isopachyte map, Plan 2, shows the isopachytes of the tailings area surveyed.

On the basis of the profiles and isopachyte plan the conclusion is reached that Line 7400N is over the approximate centre of the tailings dump.

The dense tailings, when dumped, would probably roll down the bank somewhat after the manner of a turbidity current, and settle as a fan over the unconsolidated lake sediments; the tailings would then settle into the lake sediments due to the effects of differential compaction.

VI ACKNOWLEDGEMENTS

The crew of Huntec Limited wish to express their gratitude to the management and staff, particularly the survey crews, for their hospitality and cooperation while at Riondel, British Columbia.

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April, 1967

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