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INVESTIGATIONS OF GRAVITY AND ISOSTASY IN THE SOUTHERN CANADIAN CORDILLERA

BY

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Investigations of Gravity and Isostasy in the Southern Canadian Cordillera

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ABSTRACT: A regional gravity investigation of southern British Columbia and southwestern Alberta is described. The values of gravity are obtained from a network of closed circuits, subjected to a least squares solution, while the instrumental calibration is made with reference to stations established with the Cambridge pendulums. Maps of Bouguer and isostatic anomalies for the region are presented, and the compensation of the mountain systems is discussed. An Airy form of compensation appears reasonable, although certain features such as granitic batholiths show considerable isostatic anomalies. Detailed measurements over the Rocky Mountain Trench indicate a considerable thickness of lighter fill in some sections, but do not strongly suggest a major crustal dislocation beneath it.

INTRODUCTION

This paper deals with gravity measurements made throughout the Canadian Cordilleran region in western Alberta and southern British Columbia in July and August 1954, with a North American gravimeter (*see* Figure 1). It includes also a description of the calibration of the instrument against pendulum stations between Lethbridge and Whitehorse. The gravity results are presented in the form of maps, showing Bouguer anomalies, and Airy isostatic anomalies for those stations for which full reductions were made. To assist in the interpretation, a selection of rock samples for density measurements was taken in the field, and vertical force magnetometer observations were taken along certain key traverses.

Previous to the work described here regional gravity measurements of the Dominion Observatory west from the Rocky Mountain foothills in Alberta, were limited to about 100 determinations.* Approximately 25 of these are pendulum stations, observed between 1915 and 1926 with the Mendenhall pendulum apparatus (Miller, 1929). The remainder are gravimeter stations observed in 1952, along the Trans-Canada Highway between Calgary and Vancouver by J. A. Robinson and M. M. Fitzpatrick of the Dominion Observatory, with an Atlas portable gravimeter. All of the 1952 sites were re-occupied during the course of the present observations.

THE GRAVITY OBSERVATIONS

Since the aim of the present work was not only to provide regional gravity coverage of southern British Columbia, but also to provide reliable values at base stations for future work, considerable care was given to the planning of closed circuits in which to make the observations. The outline of these circuits is shown in Figure 2, where it will be seen that the work was projected westerly from a line between Edmonton and Lethbridge in Alberta, to Hope and Vancouver. Four closed circuits are included between the line in Alberta and Hope, and a pair of independent connections link Hope to Vancouver. The line between Edmonton and Lethbridge was included in the observations since it includes three stations, Edmonton, Red Deer and Lethbridge, at which observations had been made with the Cambridge pendulums (Garland 1955).

*313 stations were observed throughout the northern Cordillera in 1953 when a survey was made along the Alaska Highway between Edmonton, Alberta, and Fairbanks, Alaska. (Oldham, 1957.)

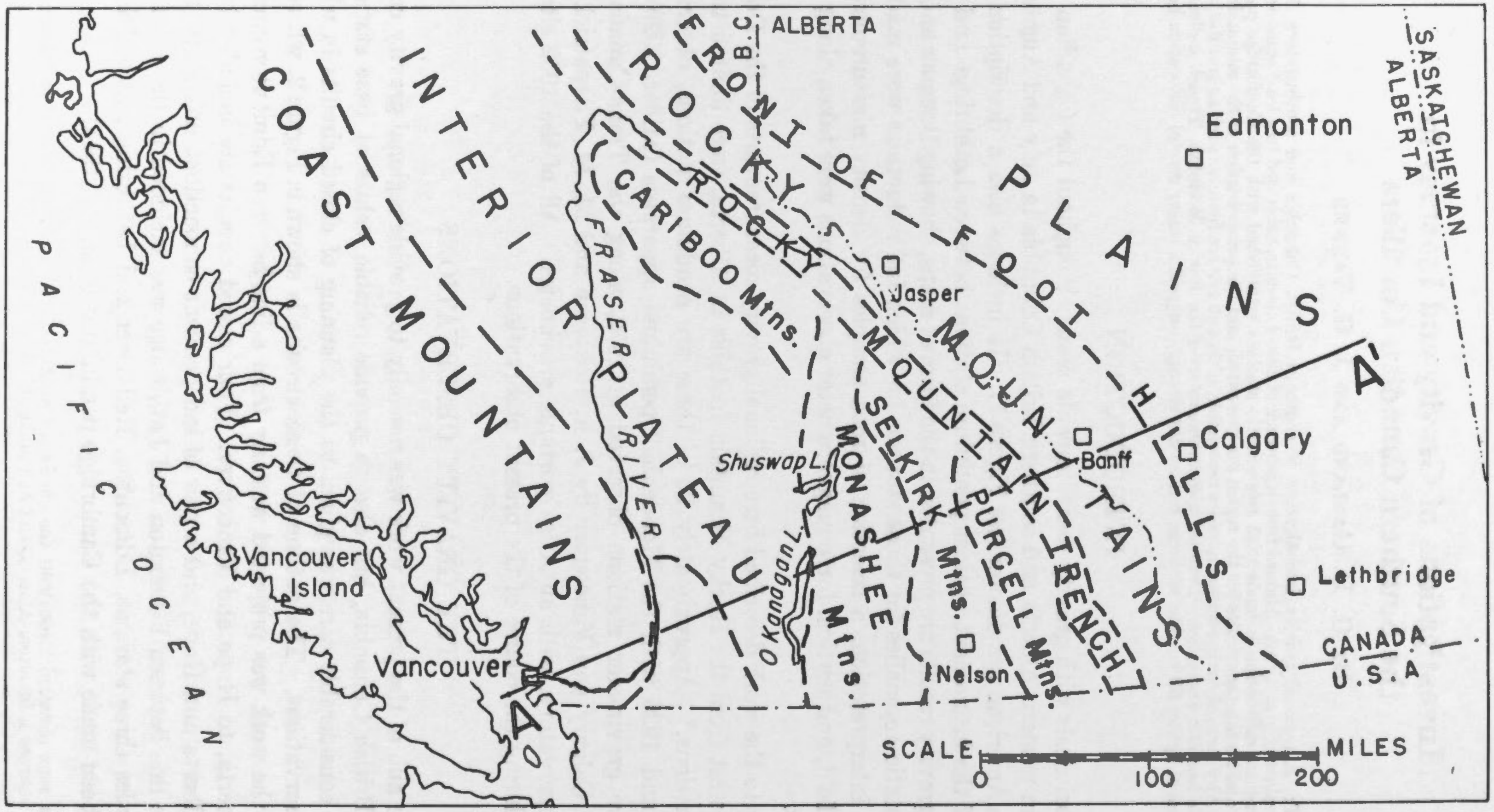


FIGURE 1. Location map showing the chief physiographic divisions of the Cordilleran region of southern Canada and general area of the gravity survey. A—A' is the line of section illustrated in Figures 4 and 5.

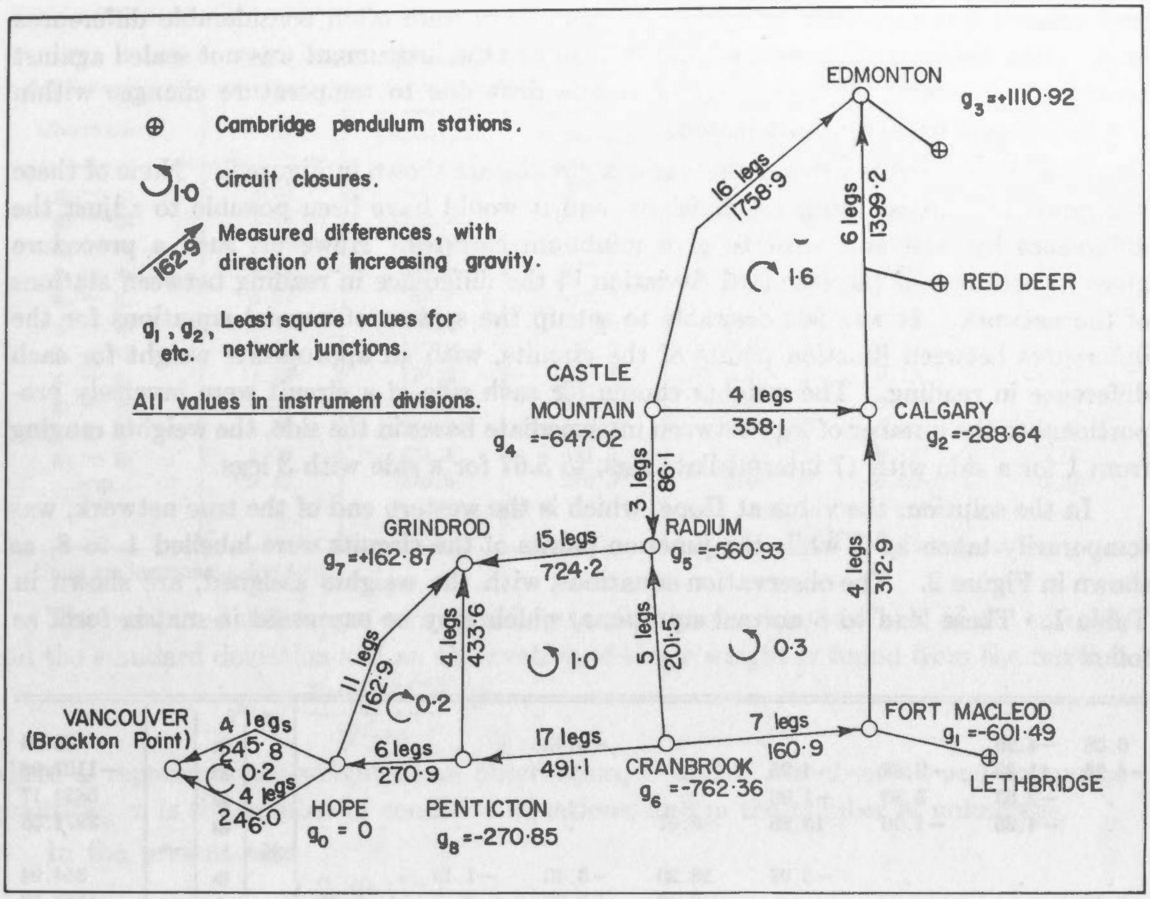


FIGURE 2. The primary gravity network, showing observed differences, closing errors and adjusted values.

All of the observations were made with a North American Gravimeter (No. 137), fitted with a long range geodetic dial. The scale constant of the instrument was known to be of the order of 0.242 milligal per division, but the final calibration was obtained from observations at pendulum stations, and are described below. The observations were carried forward around the circuits by the usual system of looping between intermediate bases, selected in such a way that repeat observations could by made within about one hour. In other words, if A and B are two such points, the measurements were made in the sequence A B A B, with the time between the two observations at either A or B being about one hour. Most of the intermediate bases were about 20 miles apart, and usually two or three stations could be observed on the final trip between them, without delaying the base readings. Differences in reading between bases were obtained by plotting the drift curve for each base, and measuring the distances between the curves corresponding to the times of the first reading at B and the second reading at A. In this method, the degree of parallelism between the drift lines at each base gives a measure of the behaviour of the instruments and of the reliability of the connection. For all of the present work the performance of the instrument was excellent. Out of 106 connections between base stations, 67 determinations had an uncertainty of less than 0.1 scale division, 38 had an uncertainty of 0.1 scale division, and one connection had an uncertainty of 0.2 scale division, all based on the parallelism, or lack of it, in the drift curves. This performance was especially gratifying because there were often considerable differences in elevation between adjacent base stations, and as the instrument was not sealed against changes in pressure, the possibility of erratic drift due to temperature changes within the instrument had been anticipated.

The closing errors around the various circuits are shown in Figure 2. None of these is serious, the largest being 1.6 divisions, and it would have been possible to adjust the differences by trial and error to give minimum closures. However, such a procedure gives no estimate of the standard deviation in the difference in reading between stations of the network. It was felt desirable to set up the system of normal equations for the differences between junction points of the circuits, with an appropriate weight for each difference in reading. The weights chosen for each side of a circuit were inversely proportional to the number of legs between intermediate bases in the side, the weights ranging from 1 for a side with 17 intermediate legs, to 5.67 for a side with 3 legs.

In the solution, the value at Hope, which is the western end of the true network, was temporarily taken as 0, while the junction points of the circuits were labelled 1 to 8, as shown in Figure 2. The observation equations, with the weights assigned, are shown in Table I. These lead to 8 normal equations, which may be expressed in matrix form as follows:

6.68	−4.25	.	.	.	−2.43	.	.		g_1		−938.84
−4.25	11.33	−2.83	−4.25	.	.	.	.		g_2		−1107.98
.	−2.83	3.89	−1.06	.	.	.	.		g_3		5824.17
.	−4.25	−1.06	10.98	−5.67	.	.	.		g_4		−3874.55
								×		=	
.	.	.	−5.67	10.20	−3.40	−1.13	.		g_5		354.94
−2.43	.	.	.	−3.40	6.83	.	−1.00		g_6		−1565.58
						6.93	−4.25		g_7		2913.65
.	.	.	.	−1.13	.						
.	.	.	.	.	.	−4.25	8.08		g_8		−1567.25

The inverse of the matrix, obtained by the method of Fox (1950), is

.951602	.851595	.828534	.766948	.691991	.714991	.246674	.218238
.851595	.943627	.910589	.822368	.714990	.690634	.249481	.216701
.828534	.910589	1.147107	.835153	.720298	.685020	.250131	.216347
.766948	.822368	.835153	.869278	.734457	.670019	.251858	.215399
.691991	.714990	.720298	.734457	.751702	.651766	.253965	.214248
.714991	.690634	.685020	.670019	.651766	.757592	.241766	.220929
.246674	.249481	.250131	.251858	.253965	.241766	.301232	.188367
.218238	.216701	.216347	.215399	.214248	.220929	.188367	.250185

The solution follows directly:

$g_1 = -\ 601.49 \pm 0.74$ scale divisions
$g_2 = -\ 288.64 \pm 0.74$ scale divisions
$g_3 = 1110.92 \pm 0.81$ scale divisions
$g_4 = -\ 647.02 \pm 0.71$ scale divisions
$g_5 = -\ 560.93 \pm 0.66$ scale divisions
$g_6 = -\ 762.36 \pm 0.66$ scale divisions
$g_7 = 162.87 \pm 0.41$ scale divisions
$g_8 = -\ 270.85 \pm 0.37$ scale divisions

TABLE I

OBSERVED AND ADJUSTED NETWORK DIFFERENCES

Observation	Weight	Observed Difference	Calculated Difference	O—C	$w(O-C)^2$	Standard Deviation
$g_2 - g_4$	4.25	358.1	358.4	−0.3	0.38	0.31
$g_3 - g_2$	2.83	1399.2	1399.6	−0.4	0.45	0.39
$g_3 - g_4$	1.06	1758.9	1757.9	1.0	1.06	0.45
$g_2 - g_1$	4.25	312.9	312.9	0.0	0.00	0.41
$g_5 - g_4$	5.67	86.1	86.1	0.0	0.00	0.31
$g_5 - g_6$	3.40	201.5	201.4	0.1	0.03	0.35
$g_1 - g_6$	2.43	160.9	160.9	0.0	0.00	0.41
$g_7 - g_5$	1.13	724.2	723.8	0.4	0.18	0.57
$g_7 - g_8$	4.25	433.6	433.7	−0.1	0.04	0.31
g_7	1.55	162.9	162.9	0.0	0.00	0.41
$g_8 - g_6$	1.00	491.1	491.5	−0.4	0.16	0.57
$-g_8$	2.83	270.9	270.9	0.0	0.00	0.37
					Sum 2.30	

Units are instrument divisions.

The computed differences corresponding to the observations of Table II are entered, and the standard deviation s of an observation of single weight is found from the relation

$$s^2 = \frac{\Sigma\omega(O-C)^2}{n-m}$$

where ω represents the weight of an observation, O and C are observed and computed quantities, n is the number of condition equations, and m the number of unknowns.

In the present case

$$s = \left(\frac{2.30}{12-8}\right)^{\frac{1}{2}} = 0.76 \text{ division.}$$

The standard deviations of the various unknowns, shown above, were determined, in the usual way, by dividing the quantity 0.76 by the square root of the appropriate term in the principal diagonal of the inverse matrix. For example, the standard deviation of g_1 is

$$\frac{0.76}{(0.952)^{\frac{1}{2}}} = 0.74 \text{ division.}$$

Similarly, the variance and standard deviation of differences, such as $g_2 - g_4$, were found from the relation Var $(g_2 - g_4)$ = Varg_2 + Var$g_4^{-2\,\mathrm{cov}\,(g_2g_4)}$ with the covariance being given by the term of the inverse matrix in the (2,4) position.

Thus, Var$(g_2 - g_4) = (0.94 + 0.87 - 2 \times 0.82)\ 0.76^2$ and the standard deviation of $(g_2 - g_4)$ is 0.31 division. The standard deviations for the other differences are shown in Table I. It is this ease of estimating the reliability of the adjusted values that makes the formal solution, especially by the matrix methods, worth the additional computation.

The solution which has been outlined above has yielded relative values, in instrument divisions, for the key points of the network from a line in Alberta to Hope. It will be observed from Figure 2 that the connection from Hope to Vancouver consists of a single "circuit" of two sides, with small closure, and no further adjustment can be done here. The solution has indicated adjustments, usually less than one division, between the key points, as shown in the O—C column in Table I. The adjusted values for intermediate bases were obtained by simply apportioning these quantities between the component legs of each side of a circuit. Before actual values of gravity for the base stations can be obtained, it will be necessary to discuss the calibration of the instrument.

CALIBRATION OF THE GRAVIMETER

Previous to the present series of observations, no reliable calibration for the instrument was available for the range in gravity of interest. The key network included the Cambridge pendulum stations Lethbridge, Red Deer and Edmonton, covering a range of about 400 milligals. To provide a more reliable calibration, observations were made at the pendulum stations Grande Prairie, Fort St. John, Watson Lake and Whitehorse, so that the range was extended to almost 1000 milligals. These observations were made by flying from Edmonton to Whitehorse and returning the next day, the intermediate stations being observed on both days. Instrumental drift appeared to be small and uniform during the flights, and the simple means of the differences in reading from Edmonton were taken for use in calibration.

In adopting weights to use with the pendulum and gravimeter observations for the least squares solution, consideration has been given to the standard deviations in each case. The mean standard deviation of a determination with the Cambridge pendulums has been estimated as 0.30 milligal (Garland 1955). However, the pendulum connection from Edmonton to Lethbridge showed a somewhat larger scatter than is normal among the results with the individual pendulums, and the standard deviation for this determination has been taken as 0.60 milligal. The gravimeter connections from Edmonton to Red Deer and Lethbridge are largely within the network which has been described above, and the standard deviations have been taken as 0.10 and 0.12 milligal respectively. In the case of the special gravimeter observations at pendulum stations north of Edmonton, there was less rigorous control on the drift of the instrument, and the standard deviation in each case was estimated to be 1 scale division, or 0.24 milligal. The weights finally chosen are closely proportional to the inverse squares of these standard deviations.

In column 4, the Observed Values refer for the first 6 entries to the pendulum values, and for the final 6 to gravimeter observations with the above trial scale constant.

Quantities relevant to the solution are shown in Table II. The trial values for differences in gravity (shown in column 5) are pendulum values, while the trial values of the scale constant of the gravimeter is 0.24200 milligal per division. The quantity K is the correction to this trial scale constant, therefore the trial value of K is zero. If we let x_w, x_{wl}, be the corrections to the trial differences from Edmonton to Whitehorse, Watson Lake and so on, the following normal equations are obtained:

$$
\begin{aligned}
41\, x_{WH} \quad & -14{,}528.75\, K = 1.25 \\
41\, x_{WL} \quad & -13{,}686.50\, K = 1.50 \\
41\, x_{SJ} \quad & -5{,}946.75\, K = -18.25 \\
41\, x_{GP} \quad & -3{,}750.00\, K = -10.00 \\
160\, x_{RD} \quad & 24{,}570.72\, K = -47.52 \\
104\, x_{L} \quad & 40{,}867.00\, K = -77.00
\end{aligned}
$$

$$
-14{,}528.75\, x_{WH} - 13{,}686.50\, x_{WL} - 5{,}946.75\, x_{SJ} - 3{,}750.00\, x_{GP} + 24{,}570.72\, x_{RD} + 40{,}867.00\, x_{L} + 38{,}806{,}866.61\, K = -35{,}282.43
$$

TABLE II

CALIBRATION OF GRAVIMETER AGAINST PENDULUM STATIONS

Quantity	Standard Deviation	Weight	Observed Value	Trial Value	O—T	Calculated Value	O—C	$w(O-C)^2$	X^2
$g_{WH} - g_E$	0.30	16	581.10	581.10	0	581.11	−0.01	0.0016	0.001
$g_{WL} - g_E$	0.30	16	547.40	547.40	0	547.42	−0.02	0.0064	0.004
$g_{ST} - g_E$	0.30	16	238.60	238.60	0	238.15	0.45	3.2400	2.25
$g_{GP} - g_E$	0.30	16	150.40	150.40	0	150.15	0.25	1.0000	0.69
$g_{RD} - g_E$	0.30	16	−170.30	−170.30	0	−170.59	0.29	1.3456	0.93
$g_L - g_E$	0.60	4	−407.90	−407.90	0	−408.62	0.72	2.0736	1.44
$g_{WH} - g_E - 581.15K$	0.24	25	581.15	581.10	0.05	581.14	0.01	0.0025	0.002
$g_{WL} - g_E - 547.46K$	0.24	25	547.46	547.40	0.06	547.45	0.01	0.0025	0.002
$g_{ST} - g_E - 237.87K$	0.24	25	237.87	238.60	−0.73	238.16	−0.29	2.1025	1.46
$g_{GP} - g_E - 150.00K$	0.24	25	150.00	150.40	−0.40	150.16	−0.16	0.6400	0.45
$g_{RD} - g_E$ 170.63K	0.10	144	−170.63	−170.30	−0.33	−170.60	−0.03	0.1296	0.09
$g_L - g_E$ 408.67K	0.12	100	−408.67	−407.90	−0.77	−408.64	−0.03	0.0900	0.06
				Units are in milligals.				10.6343	7.38

The correction to the trial scale constant, with its standard deviation, is $K = -0.000046 \pm 0.00051$ and the final scale constant is $0.24200\ (1-0.000046) = 0.24199 \pm 0.00012$ milligal per scale division. The solution yields the following values for the corrections to the various differences from Edmonton, together with their standard deviations:

$$x_W = 0.01 \pm 0.29 \text{ mgal.}$$

$$x_{WL} = 0.02 \pm 0.29 \text{ mgal.}$$

$$x_{SJ} = -0.45 \pm 0.23 \text{ mgal.}$$

$$x_{GP} = -0.25 \pm 0.23 \text{ mgal.}$$

$$x_{RD} = -0.29 \pm 0.14 \text{ mgal.}$$

$$x_L = -0.72 \pm 0.25 \text{ mgal.}$$

These values represent the differences between the pendulum results and the adjusted values of gravity at the six stations, and they appear to be satisfactorily small. Indeed, it is only at Fort St. John, Red Deer and Lethbridge that the corrections to the pendulums are significantly greater than the standard error of the adjustment. The corrections to the pendulum determinations at Red Deer and Lethbridge are of the same sign, suggesting that errors in a series of observations made in one tour from base are related. Such a situation could have been predicted, since all pendulum observations north of Edmonton depend on one set of base measurements, while those south of Edmonton depend on another.

The final column of Table II gives the contributions to the value of X^2 for the solution. The sum of the column, X^2, is 7.38 on 5 degrees of freedom.

VALUES OF GRAVITY AT BASE STATIONS

With the scale constant determined in the previous section, and the adjusted differences between bases in scale divisions, values of gravity at all of the base points were obtained, relative to the Cambridge pendulum value at Edmonton, 981.1691 cm. per sec.^{2}. The reliability of this value relative to Ottawa has been discussed previously (Garland 1955).

To assist in the location of base stations, sketches have been prepared, Figure 3, showing their position relative to the surroundings. The key points of the network, that is the junctions between circuits, whose values were directly obtained in the adjustment, and one or two other stations which will probably form the starting points for future work, are described here in somewhat more detail. These points have either been marked with a Dominion Observatory tablet set in concrete, or referenced to an existing monument.

Cranbrook: The mark is a standard tablet, stamped "#6 — 1954", set in the pavement surface of the lane at the rear of Cranbrook post office, 8 inches from the building wall. The station is 8 feet south of the mark, at the same elevation.

Radium Junction: The location is at Radium Junction, in the gore of land between Highways 97, 1B, and old 97, south of a cut-off between the old and new highways. A standard tablet, stamped "#5 — 1954", is set in concrete flush with the ground, 4 feet southeast of a large double spruce. The station is 8 feet south of this tablet, at the same elevation. There is also a topographical survey monument, No. 82K21, about 100 feet northeast of the station.

Penticton: The location is on the waterfront, on the extension of Martin St., which leads to the wharf. A British Columbia legal surveys tablet, set in concrete flush with the ground, was used as the reference mark. The station is 10 feet west of the tablet, at the same elevation.

Grindrod: The station is at the northern edge of a grass-covered gore of land in the intersection of highway 97 and the road through Grindrod to Sicamous. A standard tablet, stamped "#3—1954", is set in concrete, 10 feet north of the only utility pole in the gore, and the station is 10 feet north of the tablet, at the same elevation.

Hope: The gravity base is in the grounds of the C.P.R. station, 65 feet east of the southeast corner of the station building. A standard tablet, stamped "#1—1954", is set in concrete flush with the ground, 10 feet north of a fir tree. The station is 15 feet north of the tablet, at the same elevation.

Cache Creek: This point was marked because it would be the logical starting point for work along the Cariboo highway to northern British Columbia. The location is in the vicinity of the junction of highways 1 and 2, at the north side of a road leading west from highway 2 to a bridge over Bonivar Creek. A standard tablet, stamped "#2—1954", is set in concrete flush with the ground 7 feet south of the north fence line of the road, directly opposite the door of the Cache Creek Hotel. The station is 10 feet south of this mark, at the same elevation.

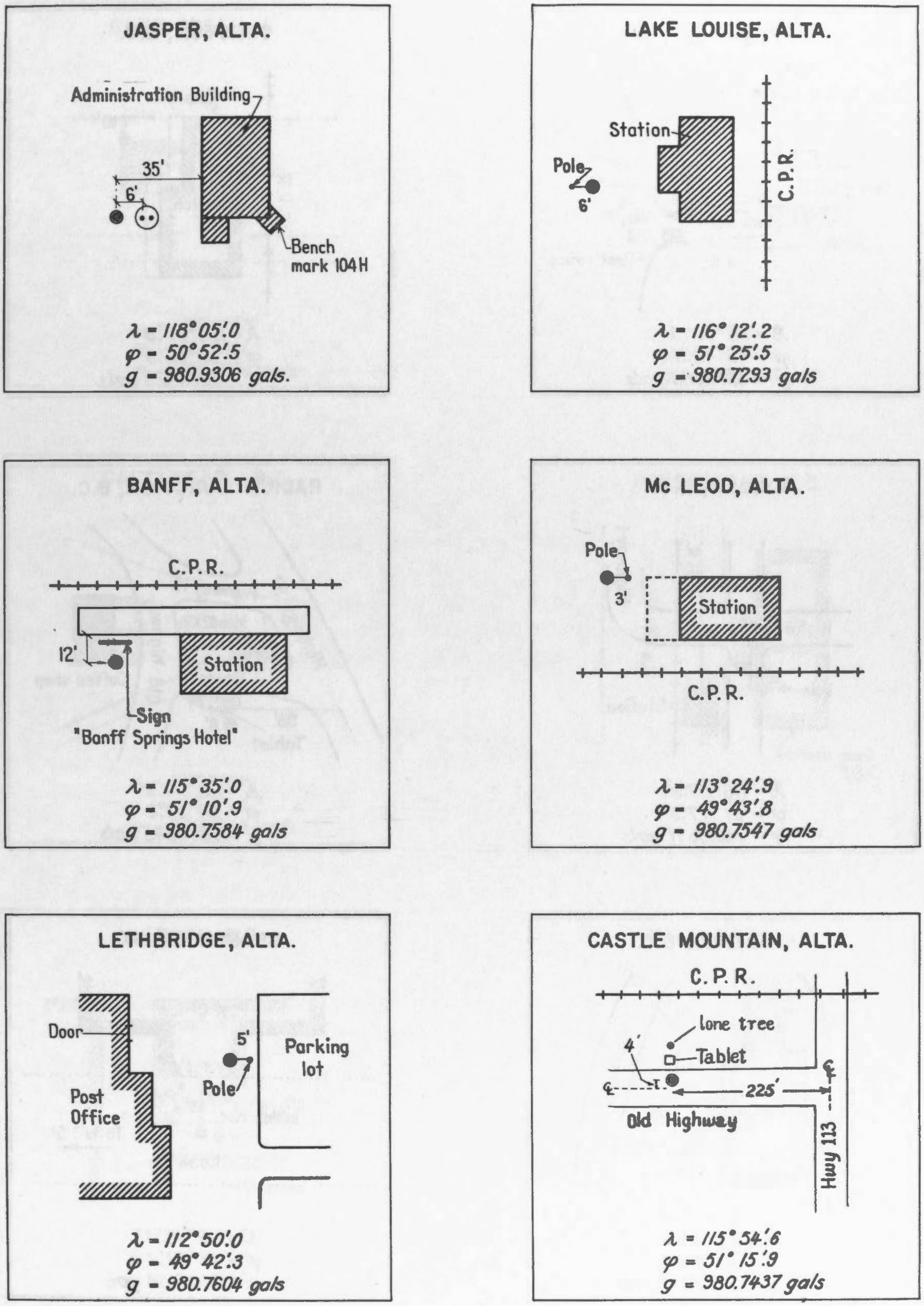


FIGURE 3a to g. Sketches showing locations of gravity bases. In each case, north is at the top. Scales are approximate, but are indicated by the distances given in each case.

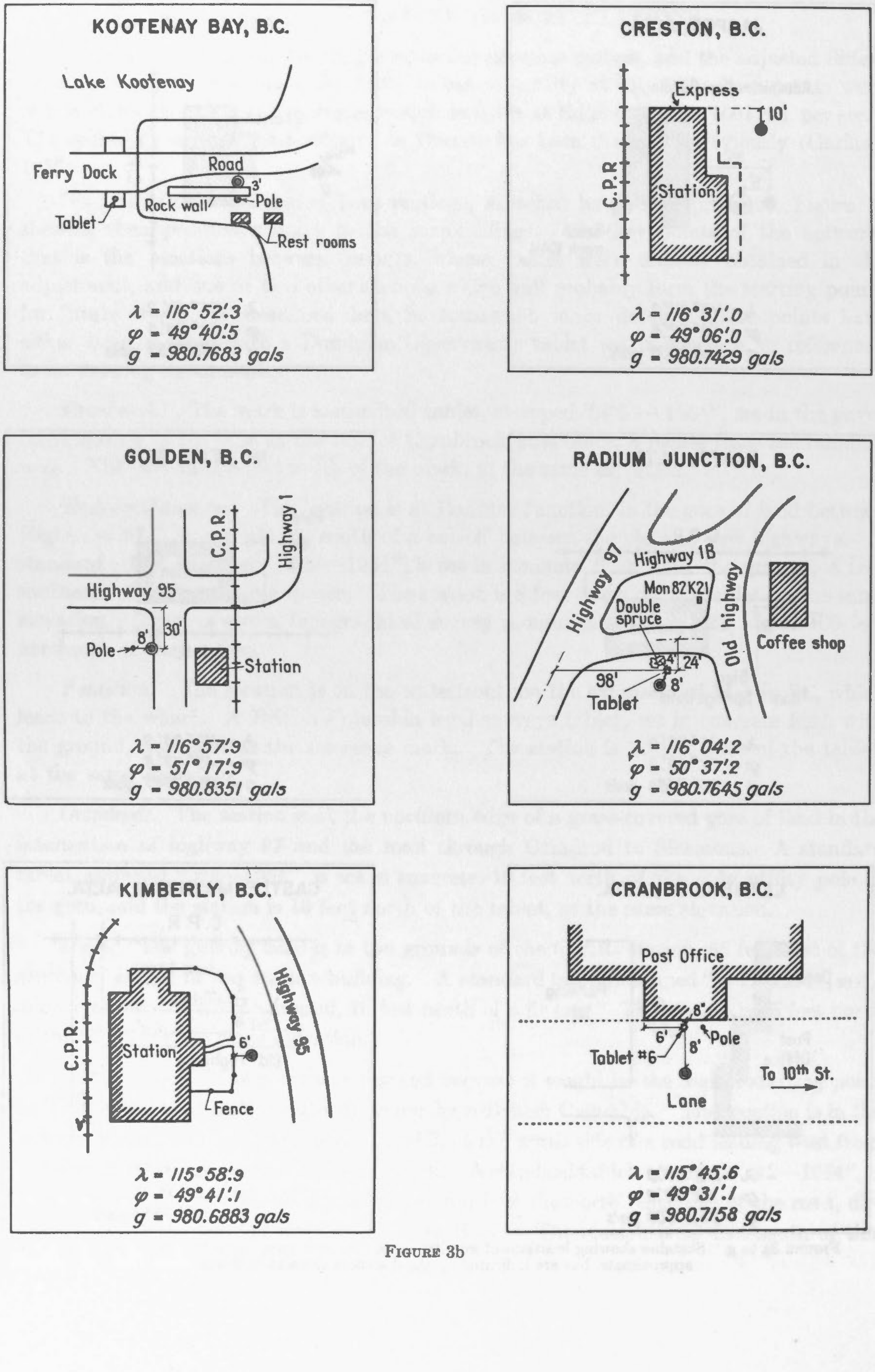

KOOTENAY BAY, B.C.
Lake Kootenay
Ferry Dock
Road
3'
Pole
Rock wall
Tablet
Rest rooms
λ = 116° 52'.3
φ = 49° 40'.5
g = 980.7683 gals
CRESTON, B.C.
Express
10'
C.P.R.
Station
λ = 116° 31'.0
φ = 49° 06'.0
g = 980.7429 gals
GOLDEN, B.C.
C.P.R.
Highway 1
Highway 95
30'
8'
Pole
Station
λ = 116° 57'.9
φ = 51° 17'.9
g = 980.8351 gals
RADIUM JUNCTION, B.C.
Highway 97
Highway 1B
Mon 82K21
Double spruce
Old highway
Coffee shop
83.4'
24'
98'
8'
Tablet
λ = 116° 04'.2
φ = 50° 37'.2
g = 980.7645 gals
KIMBERLY, B.C.
C.P.R.
Station
6'
Fence
Highway 95
λ = 115° 58'.9
φ = 49° 41'.1
g = 980.6883 gals
CRANBROOK, B.C.
Post Office
8'
6'
Pole
8'
Tablet #6
To 10th St.
Lane
λ = 115° 45'.6
φ = 49° 31'.1
g = 980.7158 gals

FIGURE 3b

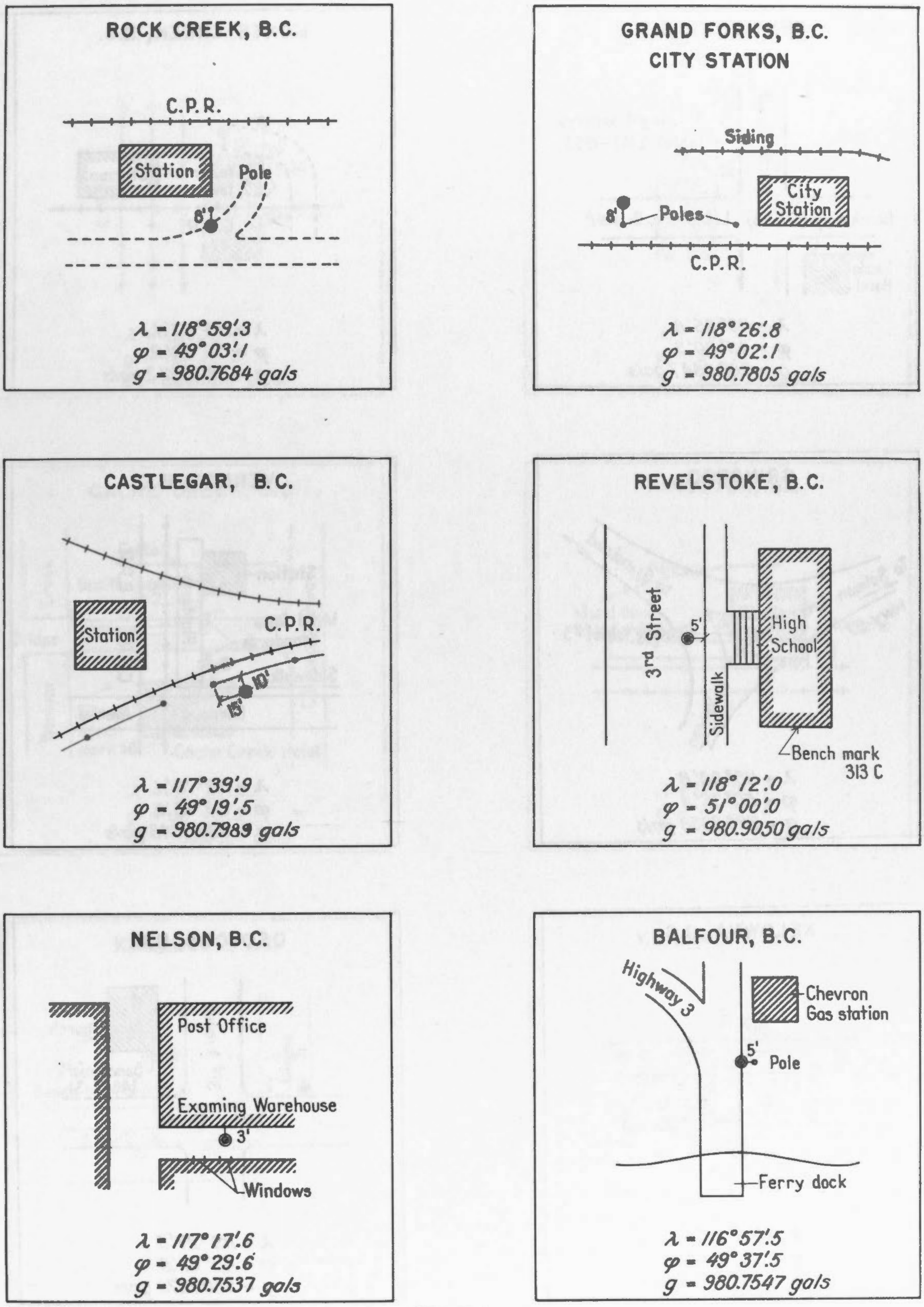

ROCK CREEK, B.C.
C.P.R.
Station
Pole
8'
λ = 118°59'.3
φ = 49°03'.1
g = 980.7684 gals
GRAND FORKS, B.C.
CITY STATION
Siding
City Station
8'
Poles
C.P.R.
λ = 118°26'.8
φ = 49°02'.1
g = 980.7805 gals
CASTLEGAR, B.C.
Station
C.P.R.
10'
15'
λ = 117°39'.9
φ = 49°19'.5
g = 980.7989 gals
REVELSTOKE, B.C.
3rd Street
5'
High School
Sidewalk
Bench mark
313 C
λ = 118°12'.0
φ = 51°00'.0
g = 980.9050 gals
NELSON, B.C.
Post Office
Examing Warehouse
3'
Windows
λ = 117°17'.6
φ = 49°29'.6
g = 980.7537 gals
BALFOUR, B.C.
Highway 3
Chevron Gas station
5'
Pole
Ferry dock
λ = 116°57'.5
φ = 49°37'.5
g = 980.7547 gals

FIGURE 3c

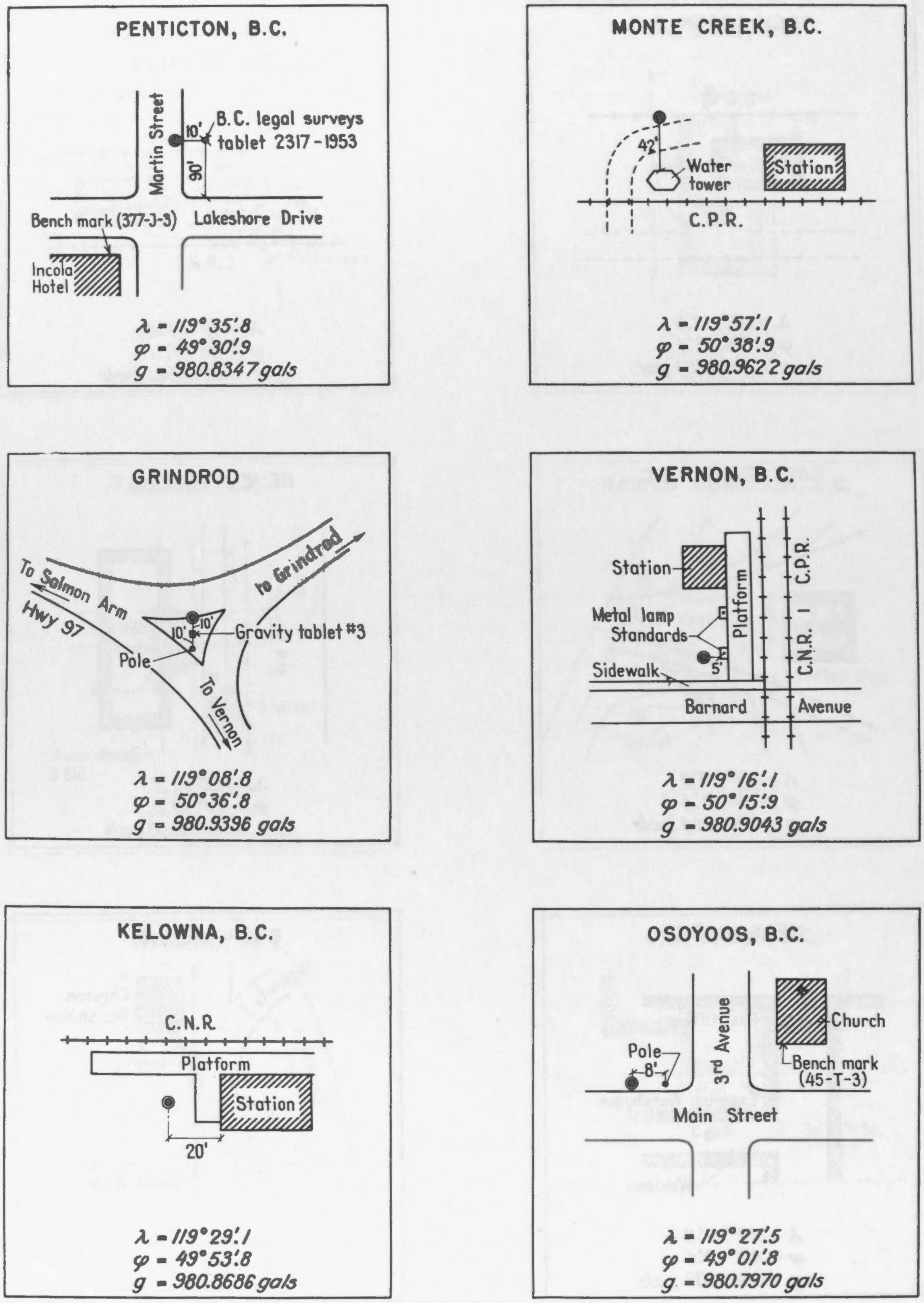

PENTICTON, B.C.
Martin Street
10'
B.C. legal surveys tablet 2317-1953
90'
Bench mark (377-J-3)
Lakeshore Drive
Incola Hotel
λ = 119° 35'.8
φ = 49° 30'.9
g = 980.8347 gals
MONTE CREEK, B.C.
42'
Water tower
Station
C.P.R.
λ = 119° 57'.1
φ = 50° 38'.9
g = 980.9622 gals
GRINDROD
To Salmon Arm
Hwy 97
to Grindrod
10'
10'
Gravity tablet #3
Pole
To Vernon
λ = 119° 08'.8
φ = 50° 36'.8
g = 980.9396 gals
VERNON, B.C.
Station
Platform
C.P.R.
Metal lamp Standards
C.N.R. I
5'
Sidewalk
Barnard
Avenue
λ = 119° 16'.1
φ = 50° 15'.9
g = 980.9043 gals
KELOWNA, B.C.
C.N.R.
Platform
Station
20'
λ = 119° 29'.1
φ = 49° 53'.8
g = 980.8686 gals
OSOYOOS, B.C.
3rd Avenue
Church
Pole
8'
Bench mark (45-T-3)
Main Street
λ = 119° 27'.5
φ = 49° 01'.8
g = 980.7970 gals

Figure 3d

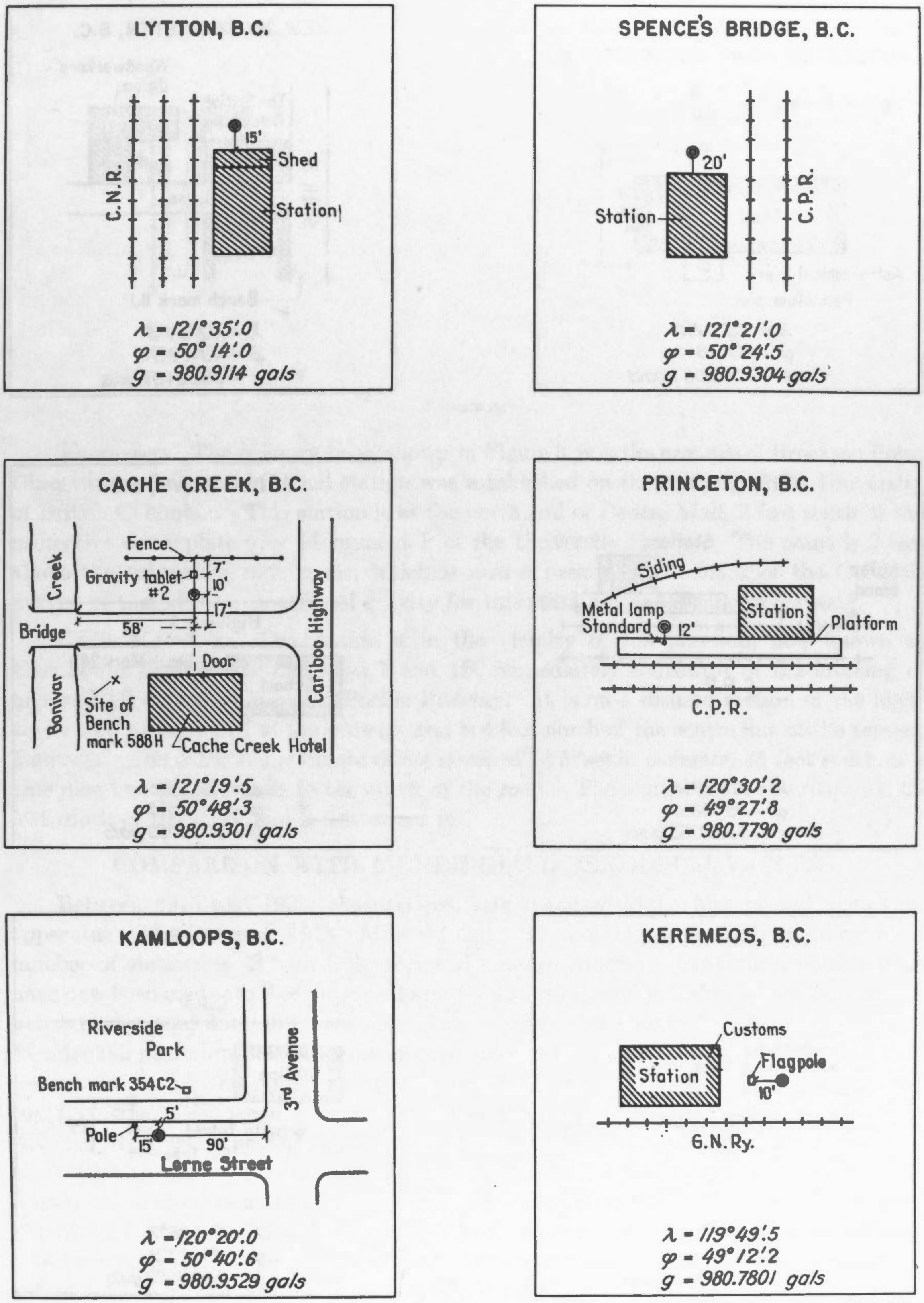

LYTTON, B.C.
C.N.R.
15'
Shed
Station
λ = 121°35'.0
φ = 50°14'.0
g = 980.9114 gals
SPENCE'S BRIDGE, B.C.
20'
Station
C.P.R.
λ = 121°21'.0
φ = 50°24'.5
g = 980.9304 gals
CACHE CREEK, B.C.
Fence
Creek
Gravity tablet #2
7'
10'
17'
58'
Bridge
Door
Bonivar
Site of Bench mark 588H
Cache Creek Hotel
Cariboo Highway
λ = 121°19'.5
φ = 50°48'.3
g = 980.9301 gals
PRINCETON, B.C.
Siding
Metal lamp Standard
12'
Station
Platform
C.P.R.
λ = 120°30'.2
φ = 49°27'.8
g = 980.7790 gals
KAMLOOPS, B.C.
Riverside Park
Bench mark 354C2
5'
Pole
15'
90'
3rd Avenue
Lorne Street
λ = 120°20'.0
φ = 50°40'.6
g = 980.9529 gals
KEREMEOS, B.C.
Customs
Station
Flagpole
10'
G.N.Ry.
λ = 119°49'.5
φ = 49°12'.2
g = 980.7801 gals

FIGURE 3e

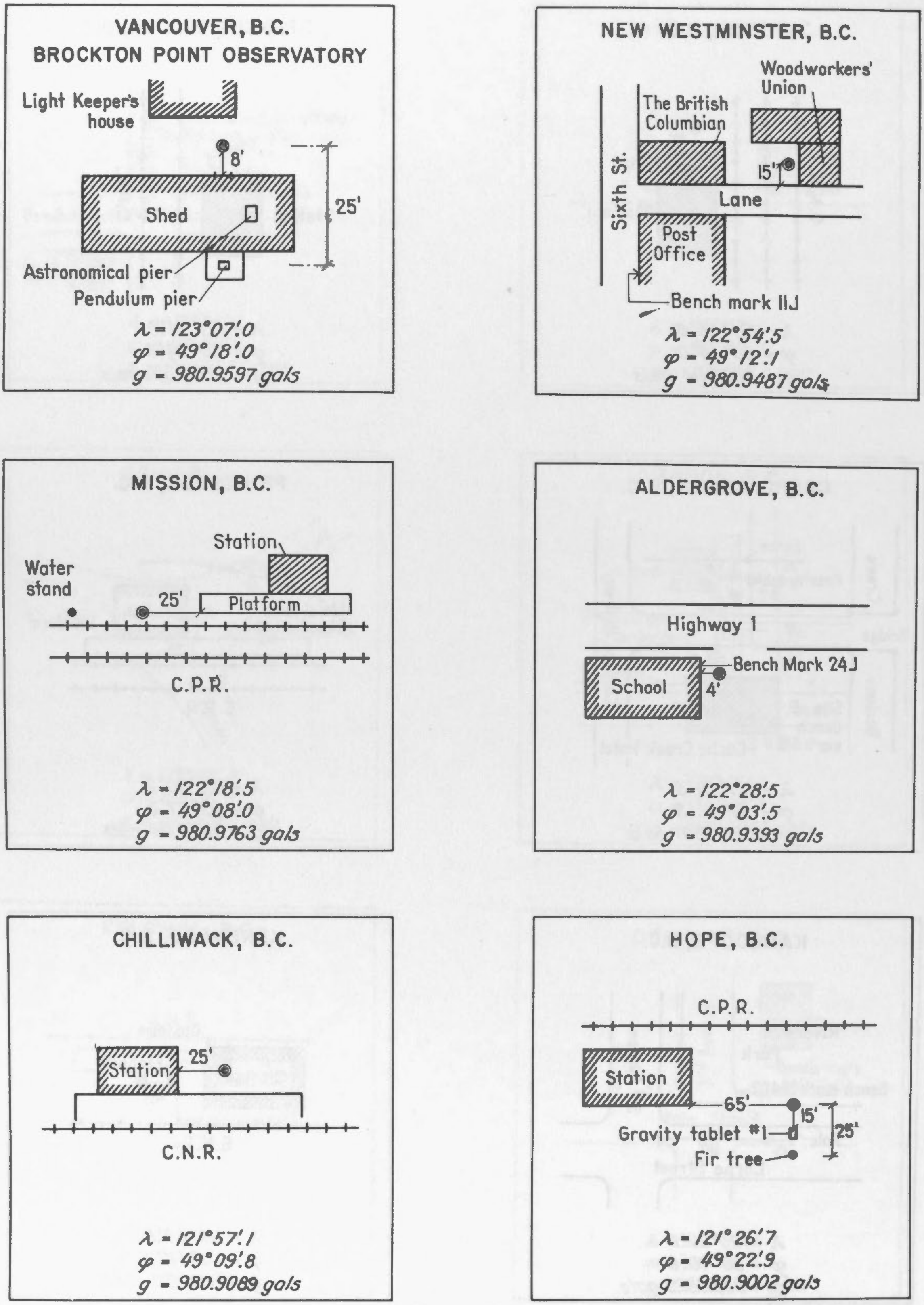
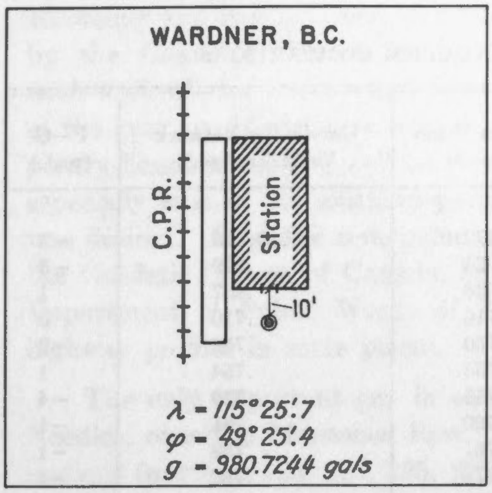

VANCOUVER, B.C.
BROCKTON POINT OBSERVATORY
Light Keeper's house
8'
25'
Shed
Astronomical pier
Pendulum pier
λ = 123°07'.0
φ = 49°18'.0
g = 980.9597 gals
NEW WESTMINSTER, B.C.
Woodworkers' Union
The British Columbian
Sixth St.
15'
Lane
Post Office
Bench mark 11J
λ = 122°54'.5
φ = 49°12'.1
g = 980.9487 gals
MISSION, B.C.
Station
Water stand
25'
Platform
C.P.R.
λ = 122°18'.5
φ = 49°08'.0
g = 980.9763 gals
ALDERGROVE, B.C.
Highway 1
Bench Mark 24J
School
4'
λ = 122°28'.5
φ = 49°03'.5
g = 980.9393 gals
CHILLIWACK, B.C.
Station
25'
C.N.R.
λ = 121°57'.1
φ = 49°09'.8
g = 980.9089 gals
HOPE, B.C.
C.P.R.
Station
65'
15'
25'
Gravity tablet #1
Fir tree
λ = 121°26'.7
φ = 49°22'.9
g = 980.9002 gals

FIGURE 3f



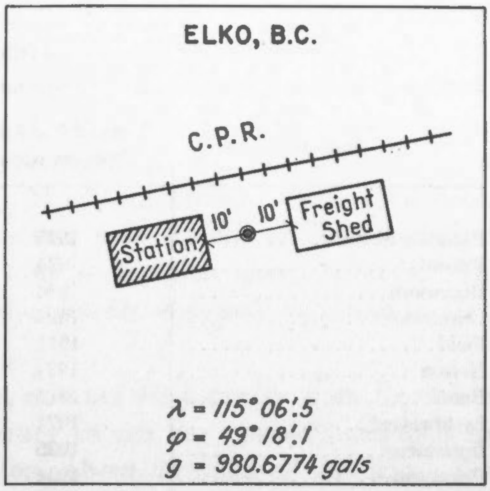


FIGURE 3g

Vancouver: The primary base, shown in Figure 3, is in the grounds of Brockton Point Observatory, but an additional station was established on the campus of the University of British Columbia. This station is at the north end of Centre Mall, 2 feet south of the protective cover plate over Monument P of the University Survey. The point is 2 feet above the subsurface monument, which is also a precise bench mark of the Geodetic Survey of Canada. The value of gravity for this station is 980.9366 cm. per sec.[2].

Castle Mountain: The station is in the vicinity of the junction, now known as Eisenhower Junction, of highways 1 and 1B, immediately southwest of the crossing of highway 1B over the Canadian Pacific Railway. It is on a disused section of the highway which runs parallel to the railway, and is 4 feet north of the centre line of the present highway. The mark is a standard tablet stamped" #6"set in concrete, $3\frac{1}{4}$ feet south of a lone pine tree which stands to the north of the road. The station is on the roadway, 25 feet south of the mark and 2 feet above it.

COMPARISON WITH MENDENHALL PENDULUM VALUES

Between 1915 and 1925, observations were made with the Mendenhall pendulum apparatus (MacDiarmid 1918, Miller 1929), of the Dominion Observatory at a number of stations in British Columbia and western Alberta. Gravimeter observations have now been made at all of these that are still accessible, and in Table III the comparison between the pendulum and network values is made. It should be explained that the Mendenhall pendulum stations were in most cases in the basements of buildings, and that the gravimeter observations were usually made just outside these buildings, when they could be identified, some 5 or 6 feet above the pendulum sites. Previous experience with the Mendenhall pendulum values had shown that errors of several milligals could be expected, and since these stations were not being used for calibration, the time was not usually taken to make an exact relocation of the observation site. The summary of mean differences by years in Table III confirms that an error of between two and three milligals is to be expected in the pendulum values. The errors appear to be consistently negative, except for the pendulum observations made in 1924, which are quite well centred about the network values.

TABLE III

GRAVIMETER AND MENDENHALL PENDULUM COMPARISONS

Station	Date of Pendulum Observation	Pendulum Value (cm/sec.²)	Gravimeter Network Value (cm/sec.²)	P—G (mgl.)
Paradise Mine*	1925	980.472	980.475	−3
Phoenix*	1924	.624	.629	−5
Blairmore	1924	.638	.637	1
Cranbrook	1924	.716	.716	0
Field	1915	.750	.752	−2
Nelson	1924	.755	.754	1
Banff	1915	.755	.759	−4
Lethbridge*	1921	.760	.761	−1
Invermere	1925	.767	.768	−1
Princeton	1924	.778	.782	−4
Calgary	1915	.825	.832	−7
Vernon	1925	.906	.905	1
Revelstoke	1915	.905	.907	−2
Jasper	1924	.932	.931	1
Kamloops	1915	.949	.951	−2
Vancouver	1915	.952	.954	−2
Vancouver	1926	.951	.960	−9
Red Deer	1925	.995	.999	−4
Edson	1924	981.106	981.100	6
Edmonton*	1924	.173	.169	4

*Gravimeter values refer to precise location of pendulum pier.

Means of Differences	With regard to sign (mgal.)	Without regard to sign (mgal.)
1915 stations	−3.1	3.1
1924	0.3	2.5
1925	−1.8	2.3
1926	−9.0	9.0
all	−1.6	3.0

REDUCTION OF OBSERVATIONS

The principal facts for all stations are set out in the appendix, in much the same way as in other recent Dominion Observatory publications. Stations are named according to town, railway station or river crossing, and listed with latitude, longitude, elevation, observed gravity and various types of anomaly. The positions of stations have been scaled from maps of the largest scale available in each case. In many cases these were 1 or 2 miles to 1 inch, but a few stations are located in areas where only 4 mile or even 8 mile to 1 inch mapping is available. Because of the relatively large differences in height involved through the area, the obtaining of reliable elevations for the stations was a considerable problem. In other areas, aneroid barometers have been used, with results accurate to perhaps 5 feet, but the differences of height in the mountains, and the variable pattern of atmospheric pressure conditions, make their use undesirable in this case. Fortunately, sufficient control was obtained from various sources to make it unnecessary to use aneroid barometers except for a very few cases. Along the valleys of the Columbia, Kootenay and Kettle rivers, and their tributaries, use was made of elevations supplied by the Columbia Rivers Survey of the Legal Surveys of this Department. The field work of this Survey had been done in the years immediately preceding the season of the gravity observations, and it was possible to locate many gravity stations at temporary bench marks, as well as permanent monuments, of this organization. This was especially true in the southern part of the Rocky Mountain Trench, where good detail was desired. Over the remainder of the area, stations were located at bench marks of the Geodetic Survey of Canada, or at points of known elevation along railways. The Department of Public Works of British Columbia kindly supplied information from highway profiles in some places.

The only important gap in elevation control was on the highway from Vernon to Needles, over the Monashee Pass. It was necessary to use the aneroid barometer for stations (numbers 223, 224, 225, 227, and 228) along about 60 miles of this line. Fortunately, weather conditions were quite stable at the time these observations were made, and the barometer readings, taken twice at each station, appear quite reliable.

The free air and simple Bouguer anomalies shown in the tables are based on the International Formula for gravity at sea level, with a crustal density of 2.67 grams per cubic centimetre adopted for the Bouguer correction. The designation of the Bouguer anomalies as "simple" is to indicate that no terrain correction has been made.

In a mountainous region such as southern British Columbia, it is of course essential that any detailed interpretation be based on anomalies which are corrected for the topographic effect. It was thought to be worth while also to compute isostatic anomalies on at least one hypothesis, to indicate the degree of compensation existing. The method of computation adopted was that of Bullard (1936), in which the simple Bouguer anomaly is the starting point, and corrections for irregularities of topography, curvature of the earth's surface, and compensation, are applied to it. Mean elevations were read from maps for each of the Hayford zones surrounding a station, out to the limit of zone O, which has an outer radius of 166 kilometres. The topographic correction for each zone depends on the difference in height between that zone and the station. These corrections are conveniently tabulated by Swick (1942), as is the curvature correction, which is a simple function of station height.

The hypothesis of compensation adopted for computing the isostatic anomalies was the Airy-Heiskanen type, with a depth of compensation of 40 kilometres for regions at sea level. This was chosen because that depth is fairly close to the depth of the Mohorovičić discontinuity as determined seismologically by Hodgson (1953) in Northern Ontario, 36 kilometres, and by Milne for the vicinity of Victoria, 33 kilometres (Hodgson, J. H. 1954). The identification of the Mohorovičić discontinuity with the level of compensation is probably as sound a preliminary hypothesis as can be found, and it is felt that the Airy anomalies calculated for the single depth of 40 kilometres will be as useful as any in the interpretation. It is realized that certain recent seismic determinations of the depth of the Mohorovičić discontinuity in mountainous regions are not in accord with this picture of compensation (Tuve and Tatel 1955), but this will be discussed later. To return to the actual computations, the effects of compensation for each zone surrounding a station, to the limits of zone O, were obtained from the tables of Heiskanen

(1938). For the remainder of the earth's crust, beyond the limits of zone O from any station, it is more convenient to estimate the combined effect of topography and compensation. This quantity varies rather slowly from place to place, and it had already been calculated for about 25 Mendenhall pendulum stations in the area by Miller and Hughson (1936). Their calculations of it were plotted on a map which could be contoured smoothly at intervals of one milligal. This map was then used to interpolate the correction at any station at which it was desired.

The greatest labour involved was undoubtedly the estimation of heights of the compartments out of zone O. Contoured topographic maps on a sufficiently large scale were not available for many stations, and a compromise was necessary. Full reductions were therefore made for about one-third of the total number of stations, distributed as uniformly as possible over the area, and for all stations in the region of the Rocky Mountain Trench from Radium south (see Maps 1 and 2). In general, stations were chosen for which maps on a scale of 1 or 2 miles to 1 inch, with contour intervals of less than 100 feet, were available to the limit of zone K (18.8 kilometres) from the station. Compartments in the L, M, and N zones were read on maps of scale 8 miles to 1 inch with contour intervals of 1,000 feet, and elevations in zone O were estimated from 1:1,000,000 charts. It is still possible that the effects of terrain very close to the station have been underestimated by this method, although personal judgment, and the recollection of the local conditions surrounding stations, were used in making the selections.

Some of the stations for which reductions were made coincided with stations of Miller and Hughson, in their study referred to above. It was found that their estimates of height in mountainous regions were consistently high, and the effect of compensation therefore consistently too large. This was traced to the map available at the time of their work, on a scale of 100 miles to 1 inch, which showed large areas of uniformly high elevations. The newer 8 mile maps, based on aerial photographs show that such areas are composed of peaks and valleys, for which the average height is much less than was formerly indicated. Consequently, the isostatic anomalies now tabulated are less in absolute value (by as much as 10 milligals) than those published by Miller and Hughson for the same stations. The point is mentioned here because the same situation may exist in other mountainous regions where corrections were based on small-scale, generalized maps. It is difficult to estimate the error to be expected in the final anomalies in the present case, but it is believed that the total corrections for topography and compensation have been computed to an accuracy of about one milligal. In the case of stations within a particular region, such as the Trench area, the correction for local terrain, which is the important factor in studying the relative values of anomalies over structures of limited extent, is probably a good deal more reliable than this. The magnitude of the terrain correction involved throughout the area studied is indicated by the following distribution table:

		No. of Stations
Terrain Correction	0 – 1 mgal.	20
	1 – 5 mgal.	104
	5 –10 mgal.	50
	10 + mgal.	29

INTERPRETATION OF THE REGIONAL GRAVITY FIELD

The results of the observations and computations described above for the complete area, are presented in the form of two contour maps. Except in the area of the Rocky Mountain Trench where station density is too great to indicate on this scale, the locations of all stations are shown. Anomalies corresponding to the actual stations are not shown on this map, because it is based largely on the simple Bouguer anomalies, uncorrected for topography. It was felt desirable to construct one map making use of all stations, in order to show most clearly the trend of the anomaly features, and, as explained before, full corrections were made for only one-third of the stations. The application of the topographic correction would not significantly change the form of the 10 milligal contours on this map, although the absolute value of all anomalies would be one or more milligals greater. The second map shows the position of stations for which corrections for topography and compensation were made, with the Airy isostatic anomaly at each station, and contours at 10 milligal intervals. These maps portray the gravitational field over a belt about 600 miles wide across the southern Canadian Cordillera, giving more detail than has been available in these mountains, or for that matter, in most of the North American Cordillera. The distribution of stations, especially those for which full corrections are available, is still such that only for fairly major structures within the belt can an interpretation be attempted.

A preliminary examination of the contour maps shows Bouguer anomalies ranging from -20 to -210 milligals, as might be expected in a mountainous area, with isostatic anomalies between 26 and -27 milligals. One feature of the contours that may be unexpected is their tendency to cut across the mountain structures, which trend northerly or northwesterly across the western part of the map area. In contrast, the contours in the vicinity of the International Boundary strike almost east-west. There is therefore not a simple relation between the gravity field and the distribution of heights, and some outline of the structural history of the region will be required before an interpretation is suggested.

GENERAL DESCRIPTION OF THE AREA

The area under consideration extends from the plains region, east of the foothills through the Rocky Mountains and the western Cordilleran mountains to the shores of the Strait of Georgia, which separates Vancouver Island from the mainland. Thus, while the western limit of the area is at sea level, it is still some 100 miles from the edge of the continent, if the latter is taken as the western shore of Vancouver Island.

The geological structure is markedly different in the eastern and western divisions of the mountains. The true Rocky Mountains, which form the eastern division, lie between the foothills and a line which closely follows, or coincides with, the Rocky Mountain Trench, a feature which will be described in more detail later. These mountains are marked by the almost complete absence of igneous rock, in contrast to the western ranges. They consist of late Precambrian, Palaeozoic and Mesozoic sedimentary rocks, mountain-built during Tertiary time largely through thrust faulting. Many of these faults dip to the west but Evans (1933) and North and Henderson (1954a) have given examples of uplift by wedge action between east- and west-dipping thrusts. The Precambrian rocks within the area considered are exposed along anticlinal structures within the main range of the Rockies, along the headwaters of the Bow River, and near Jasper. Peak elevations within the southern Rocky Mountains are in many places over 10,000 feet.

The western Cordilleran division in southern British Columbia includes from east to west, a series of mountains, the Purcell, Selkirk and Monashee Mountains, a portion of the extensive Interior Plateau, and a part of the Coast Mountains (see Figure 1). Within the Purcell and Selkirk Mountains, in southeastern British Columbia, is found the very thick belt series of late Precambrian rocks, the Purcell and Windermere. Associated with the Purcell sedimentary rocks, which are believed to be over 40,000 feet thick, are numerous basic sills and dykes. The sedimentary rocks are mainly quartzite and argillite. Overlying these is the Windermere system, containing over 20,000 feet of sedimentary rock. Thus the total thickness of late Precambrian sediments in the region is very great, and their deposition must almost certainly have been accompanied by major crustal flexure to produce geosynclinal conditions.

West of the area of Precambrian rocks, large areas are occupied by batholithic intrusive masses, of Jurassic or Cretaceous age. The rocks, known as the Coast intrusions, are of variable composition, but the average type is probably a granodiorite. The largest exposure, which forms the core of the Coast Mountains, lies to the north of the area under study, but batholiths of apparently related rocks occur to the west of Okanagan Lake, and in the vicinity of Nelson. These and other exposures are indicated on the Bouguer and isostatic anomaly maps. The rocks intruded by the Coast batholiths consist of sedimentary and volcanic rocks ranging in age from Carboniferous to Lower Cretaceous. In some areas, including a belt lying to the east of Okanagan Lake and extending to the north of Shuswap Lake, the rocks are metamorphosed and granitized to such an extent that their original nature and age is doubtful. These rocks were originally believed to be Precambrian (the Shuswap series) because of their high degree of metamorphism, but this correlation is now admitted to be uncertain. In part these rocks underly the physiographic division known as the Interior Plateau, where the average elevation is some 4,000 feet above sea level. In the Coast range to the west, and the Selkirk Mountains to the east, peaks range in height up to 12,000 feet.

Deposits of Tertiary age, including volcanic flows, occur in the western part of the area, especially in, and west of, the Okanagan valley. The volcanic rocks reach a few thousand feet in thickness in some places. These formations obscure the older structure, as does the cover of glacial and recent unconsolidated material, which is especially heavy in some of the river valleys.

The western mountains were apparently formed during the time of emplacement of the Coast batholithic rocks, in Jurassic or early Cretaceous time. During the Tertiary period, considerable vulcanism occurred, and many of the older formations are concealed by flows of this age. It was during Tertiary time also, that the Rocky Mountains to the east were formed (Warren 1938), so that these are younger than the western ranges.

Looking at the mountain structure in a still broader way, the Coast range forms one of the primary volcanic arcs of a chain down western North America (Wilson 1954), while the Rocky Mountains form one of the secondary arcs. The latter are characterized by the absence of volcanic rocks, and by thick series of normal sediments. In this classification, the Interior Plateau becomes the Zwischengebirge or median land between the primary and secondary arcs. It is noteworthy also that Wilson defines two topographic lineaments, radiating from the junction of primary arcs near the International Boundary. One of these is marked by the Fraser valley, the other strikes southeasterly into Montana, and is called the Montana or Olympic-Wallowa (Raisz 1945) lineament. Scheidegger (1953) has put forth an explanation for such lineaments radiating from junctions, on the basis of material in the mantle moving along neighbouring arcs.

The foregoing outline of the area under study is very much generalized and abbreviated, but the investigation that can be made over most of the area is generalized also. Further descriptions of geological structures will be given when particular features of the anomaly maps are dealt with.

ROCK DENSITIES

The results of density measurements on samples collected from the area under study are given in Table IV. In many cases it is difficult to know whether or not a measurement is representative of a formation or lithologic unit as a whole, because of variations both stratigraphically and areally within these units. However, certain general conclusions can be drawn. The mean density of the Lower Purcell sedimentary rocks is 2.74 gms. per cc., but these rocks are interbedded with the Purcell extrusives, and intruded by the Purcell intrusives, so that a section of Lower Purcell may well have a density close to 2.80 gms. per cc. The samples from the Windermere series average 2.71 gms. per cc., from the Palaeozoic rocks of the Rocky Mountains 2.73 gms. per cc., and from the Mesozoic sedimentary and volcanic rocks 2.77 gms. per cc. It would appear, therefore, that the average crustal density in the region, exclusive of the granitic rocks, is close to 2.74 gms. per cc. The latter appear to be definitely less dense than the formations by which they are surrounded, as the mean density of the Nelson or Coast "granites" is 2.63 gms. per cc. There is a variation in density among samples even from the same locality, as might be expected in view of the gradation in rock type from granite through granodiorite. In general, the coarser-grained phases of the granitic rocks have the lower densities. These phases would correspond to the "red granodiorite" of Rice (1947), which occupies the major portion of the Osprey Lake body west of the Okanagan trench. Rice describes also a "grey granodiorite" which occurs near the southern margin of the same body, and which corresponds to the denser samples. His analyses for the two types are as follows:

Assumed Mineral Density		Red Granodiorite (Osprey Lake)	Grey Granodiorite
2.65	Quartz	20.2%	21.8%
2.67	Plagioclase	47.6	59.8
2.57	Potash Feldspar	25.1	4.4
3.00	Ferromagnesian and accessory minerals	7.1	14.0
	Per cent An of Plagioclase	*27*	*30*
	Theoretical density	2.66	2.71

Rice remarks that the grey granodiorite "may be the result of widespread granitization with little introduction of molten magmatic material". The fact that the theoretical density of this phase is close to the mean measured density of the older rocks would support this suggestion. The lower density of the coarse-grained red phase appears to result from a real difference in composition, specifically a decreased ferromagnesian and increased potash feldspar content.

As working values for density differences, we may take 0.10 gm. per cc. as the density deficiency of the main bodies of granite, and 0.05 gms. per cc. as the density excess of sections of Lower Purcell rocks containing basic extrusive and intrusive types. Both of these figures are relative to a "normal" density of about 2.73 gms. per cc. for the other rock types. The relatively low density (2.26 gms. per cc.) of samples of primary gypsum from the Kootenay valley is also noteworthy, and reference will be made to this when more local effects are discussed.

THE REGIONAL GRAVITY FIELD

The main feature of the Bouguer anomaly map is, of course, the minimum, reaching −200 milligals, centred over the interior ranges. To the east, over the plains, the level of Bouguer anomaly rises to about −50 milligals, and similar values occur on the coast near Vancouver. A negative Bouguer anomaly of this order is to be expected over mountain ranges if compensation is present; the immediate question is the nature of the mass deficiency. Two general hypotheses are possible, involving either density variations within the crust beneath the mountains, or variations in the thickness of the crust itself. The fact that the minimum is most intense over the Selkirk and Purcell mountains in the vicinity of granitic batholiths, together with the measured density deficiency of the granite, and the association of negative anomalies with granites in many other areas (Bott 1953), might suggest an interpretation of the entire negative anomaly in terms of a concentration of granite within the crust. If we suppose the "normal" continental crust to consist of material of density 2.73 gm. per cc. (with compressional and transverse elastic wave velocities appropriate to the crust), then a prism of granite of density 2.63 gm. per cc., extending to the base of the crust, would produce a negative anomaly of 150 milligals, if the prism had a horizontal extent more than a few times its thickness. In other words, the major relief of the Bouguer gravity field could be explained in this way, without the assumption of variations in crustal thickness. The surface exposures of the Coast granites cover a very considerable area, as a glance at the geological map of Canada will show, and the above interpretation would not involve a vertical dimension out of proportion to the horizontal extent of the bodies. Furthermore, the findings of Tuve and Tatel (1955) on the thickness of the crust as measured seismologically, have suggested that in some mountain regions the Mohorovičić discontinuity is not depressed as would be expected on an Airy type of compensation. However, there appear to be two reasons why this interpretation is less attractive than one involving variations in crustal thickness. If we consider the form of an anomaly profile taken across the mountain structure, as shown in Figure 4 (see also Figure 1), the gradual decrease into the minimum on the east side is apparent. On the assumption that the main anomaly is due to a large concentration of granite, this would suggest that the eastern boundary of the granite dips easterly (the computed curve shown on the profile is for a dip of 7°), from the most easterly surface exposure. A principal characteristic of the Coast type intrusions in the southern Canadian Cordillera is the abrupt termination of

TABLE IV

DENSITIES OF ROCK SAMPLES

Age	Rock Type or Formation	Locality	Density gm/cc.	Mean gm/cc.
Precambrian	Lower Purcell:			
	argillaceous quartzite	St. Mary River	2.69	
	chlorite schist	Wildhorse River	2.74	2.74 (Lower Purcell sedimentary rocks)
	quartzite	Luster River	2.84	
	slate	Luster River	2.68	
	amygdaloidal lava	Skookumchuck	2.84	
	Upper Purcell:			
	altered lava	Findlay Creek	2.47	
	quartzite	Paradise Mine	2.63	
	slate	Paradise Mine	2.64	
	Hector:			
	slate and conglomerate	Lake Louise	2.74	
	Windermere:			
	chlorite schist	Lardeau River	2.95	
	quartzite	Lardeau River	2.61	
	conglomerate	Horsethief Creek	2.64	2.71
	schist	Horsethief Creek	2.77	
	slate	Lake Windermere	2.69	
Precambrian or younger	Shuswap complex:			
	gneiss	Revelstoke	2.82	
Cambrian	quartzite	Jasper	2.69	
	slate	Jasper	2.80	2.73 (Rocky Mountain Palaeozoic samples)
	quartzite	Sunwapta Pass	2.83	
	Cathedral: limestone	Kicking Horse Pass	2.71	
	Eldor: limestone	Kicking Horse Pass	2.74	
Devonian	limestone	Rocky Mountain foothills	2.68	
	gypsum	Kootenay River	2.26	
Mississippian	Banff: shaly limestone	Rocky Mountain foothills	2.66	
Carboniferous	sheared basic volcanic	Vernon	2.67	
Triassic	basic volcanic	Nicola Lake	2.95	2.77 (Mesozoic volcanic and sedimentary rocks)
	basic volcanic	Princeton	2.82	
Lower Cretaceous	Agglomerate	Spence's Bridge	2.70	
	andesite	Spence's Bridge	2.74	
	conglomerate	Nicola River	2.66	
Jurassic or Cretaceous	Nelson granite:			
		Slocan Lake	2.62	
		Slocan Lake	2.54	
		Slocan Lake	2.72	
		Lower Arrow Lake	2.68	2.63 (Nelson and Coast type granitic rocks)
		Granby River	2.53	
	Coast intrusives:			
	gneissic granite	Yale	2.59	
	granite	Osprey Lake	2.65	
	porphyritic granite	Osprey Lake	2.68	
	granite	Shuswap Lake	2.63	
Tertiary	sandstone	Kettle Valley	2.43	
	shale	Kettle Valley	2.40	
	lava	Kamloops	2.18	

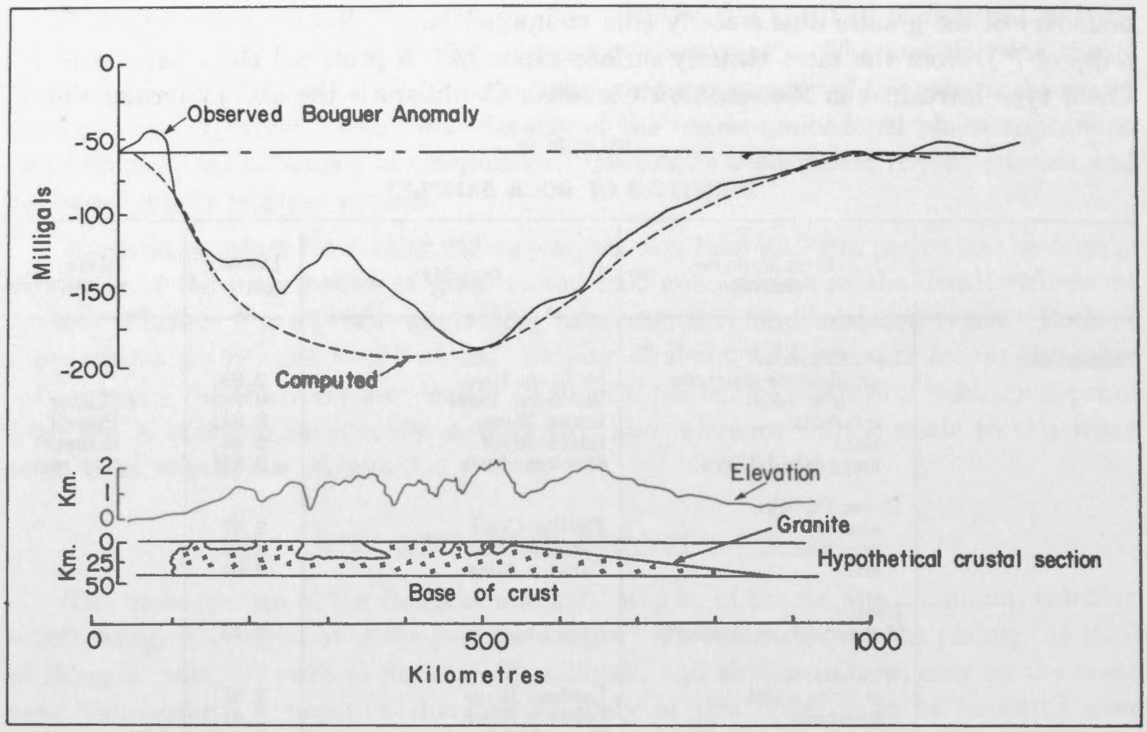


FIGURE 4. Bouguer anomaly profile across the southern Canadian Cordilleras. The cross-section indicates the form of a low-density body within the crust which would account for the main mass deficiency. The hypothetical body is extended in strike, with a sloping eastern boundary and steep western boundary.

exposures at the eastern boundary of the Purcell mountains. No exposures are known in the Rocky Mountains or east of them, yet the structure shown in Figure 4 places granite at a fairly moderate depth beneath the Rocky Mountains. It will be seen from the profile that regions of older rock between the Nelson, Okanagan, and Coast batholiths, with which are associated higher values of Bouguer anomaly, are, on this interpretation, in the forms of roof pendants, underlain by granite. At the extreme westerly end of the profile, the contact of the granite with normal crustal rocks would have to be steeply dipping.

The second objection to the above interpretation is of a more general nature: the origin of such a large volume of rock consistently less dense than the crust as a whole is difficult to explain. If the prism of lighter granite is assumed to result from a separation of the lighter minerals of the crust, it is not apparent where the heavier fraction could be, since it is necessary to have the granite extending to the base of the crust. However, it would be possible to argue that the original base of the crust had been depressed during mountain building, and that the denser fraction of a differentiated section of crust filled the lower portion of the downfold.

Because of the horizontal extent of the area, the positive and negative attractions of the heavy and light fractions cancel, and the negative anomaly must be largely explained by the crustal thickening. Hence we are led to the second form of interpretation, involving distortions at the base of the crust.

It is to be noted that seismological observations might indicate the top of the denser fraction to be the Mohorovičić discontinuity, if the boundary was sufficiently sharp, as has been suggested by van Bemmelen (1952). If this were so, it could reconcile the findings of Tuve and Tatel in certain mountainous areas with the notion of root formation and compensation.

On the other hand we may begin the interpretation with the assumption that the base of the crust has been warped in accordance with an Airy form of compensation. We then attribute the larger part of the negative Bouguer anomaly to this warping, and only the much smaller isostatic anomalies are to be explained in terms of anomalous densities, or departures from the Airy crust. Until more specific information is available on the depth of the Mohorovičić discontinuity in the area, it seems reasonable to proceed with the interpretation on this hypothesis. It will be seen from the isostatic anomaly map that the areas of granite are characterized by negative anomalies reaching about 30 milligals. These could be explained by assuming the granite extends to depth beneath the surface outcrops, to about 7 kilometres, or one-fifth of the thickness of the crust. Such an interpretation is shown in Figure 5 (see also Figure 1), where it will be seen that the amount of granite involved is very much less than in the previous interpretation. However, because of the width of the exposures of granite (up to 100 kilometres), there remains the difficulty of accounting for the anomalies if any form of differentiation, or increasing density with depth, is assumed. For example, consider a prism of original crust (density 2.73) of 100 kilometres width and considerable length, to separate by some process into

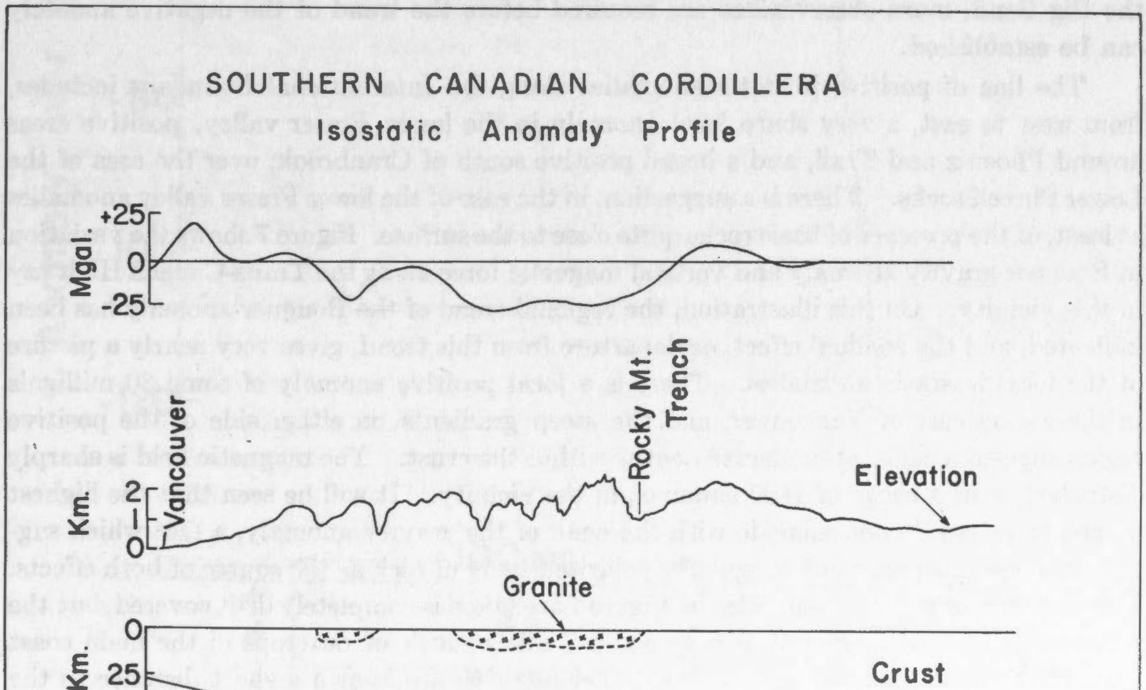


FIGURE 5. Isostatic anomaly profile across the southern Canadian Cordillera. The cross-section indicates the thickening of the Airy crust beneath the elevated regions and the form of granitic batholiths which would account for the negative isostatic anomalies.

an upper, granitic portion of density 2.63, and a lower, basic portion. Because of the width of the prism relative to its vertical dimension, the positive attraction of the lower fraction very greatly diminishes the negative anomaly due to the upper portion. The variation of resultant anomaly with thickness of prism is shown in Figure 6, and from this we find that a negative anomaly of greater amplitude than 20 milligals implies a further depression of the base of the crust, beneath that required for compensation, to accommodate the denser fraction. Since the anomalies observed over the batholiths of the interior mountains reach −30 milligals, it would appear that either there is such a depression, or the lighter granitic rocks in these ranges have been formed by some process independent of the settling of the denser constituents.

On the second form of interpretation the granite is assumed to underly chiefly the areas of surface outcrop, or other areas of negative isostatic anomaly, in contrast to the first hypothesis where it would be assumed to underly all the region of abnormally negative Bouguer anomaly, concealed by abundant roof pendants. In the second case, therefore, the area underlain by granite must be interrupted rather abruptly along the International Boundary, where the anomaly contours trend east-west and the isostatic anomaly rises sharply to positive values. The area of granite development appears to swing from the Coast batholith southeasterly through the Nelson batholith, then northerly under the Selkirk and Purcell mountains toward the Big Bend of the Columbia River. North of the Big Bend, more observations are required before the trend of the negative anomaly can be established.

The line of positive isostatic anomalies along the International Boundary includes, from west to east, a very sharp local anomaly in the lower Fraser valley, positive areas around Phoenix and Trail, and a broad positive south of Cranbrook, over the area of the Lower Purcell rocks. There is a suggestion, in the case of the lower Fraser valley anomalies at least, of the presence of basic rocks quite close to the surface. Figure 7 shows the variation in Bouguer gravity anomaly and vertical magnetic force along the Trans-Canada Highway in this vicinity. On this illustration, the regional trend of the Bouguer anomaly has been indicated, and the residual effect, or departure from this trend, gives very nearly a picture of the local isostatic anomalies. There is a local positive anomaly of some 30 milligals in the region east of Vancouver, and the steep gradients on either side of the positive region suggest a cause at moderate depths within the crust. The magnetic field is sharply disturbed, over a range of 1400 gammas, in the vicinity. It will be seen that the highest magnetic values do not coincide with the peak of the gravity anomaly, a fact which suggests a dense, magnetic but irregularly polarized body of rock as the source of both effects. The area across which the profiles of Figure 7 are taken is completely drift covered, but the remarkable feature is that it is only some 5 miles south of outcrops of the main coast batholith. Basic rocks of Cretaceous or Tertiary age are known a short distance to the south on Mount Sumas, and it is supposed that a body of basic rock reaching practically to the bedrock surface, is responsible for the anomaly. Similarly, bodies of basic or ultrabasic rock, mostly of Mesozoic age, in the region between Phoenix and Rossland, suggest a concentration of basic rock in the crust as a cause of the positive iosstatic anomalies in this region. In other words, the nature of the crust is assumed to change rather abruptly from granitic to basic as the International Boundary is approached, giving rise to the pattern of anomaly contours cutting across the mountain structure.

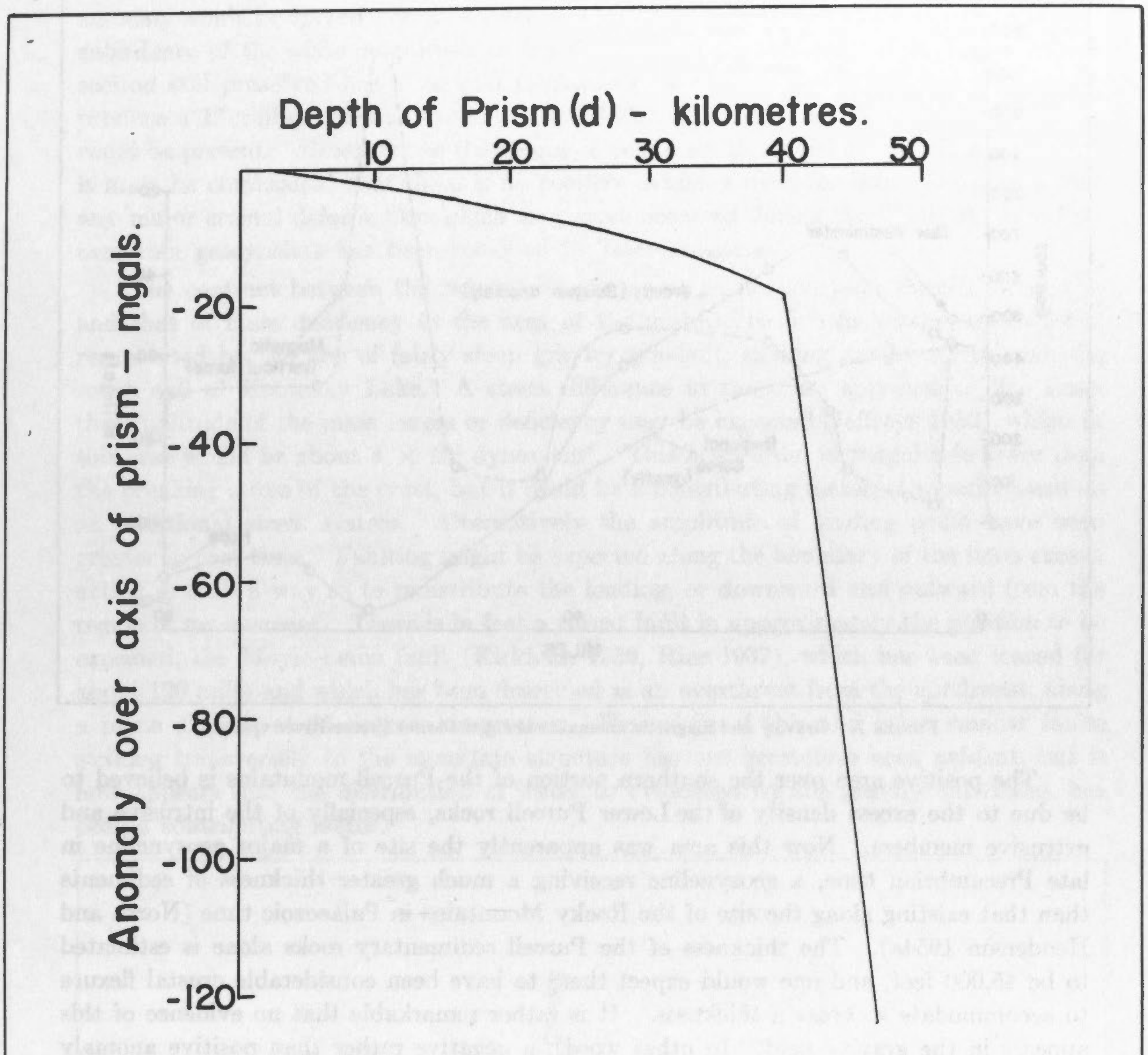


Figure 6. Calculated anomaly to be observed over a differentiated prism of rock within the crust. The original density of the prism is taken to be that of the crust, while the densities after separation are as indicated.

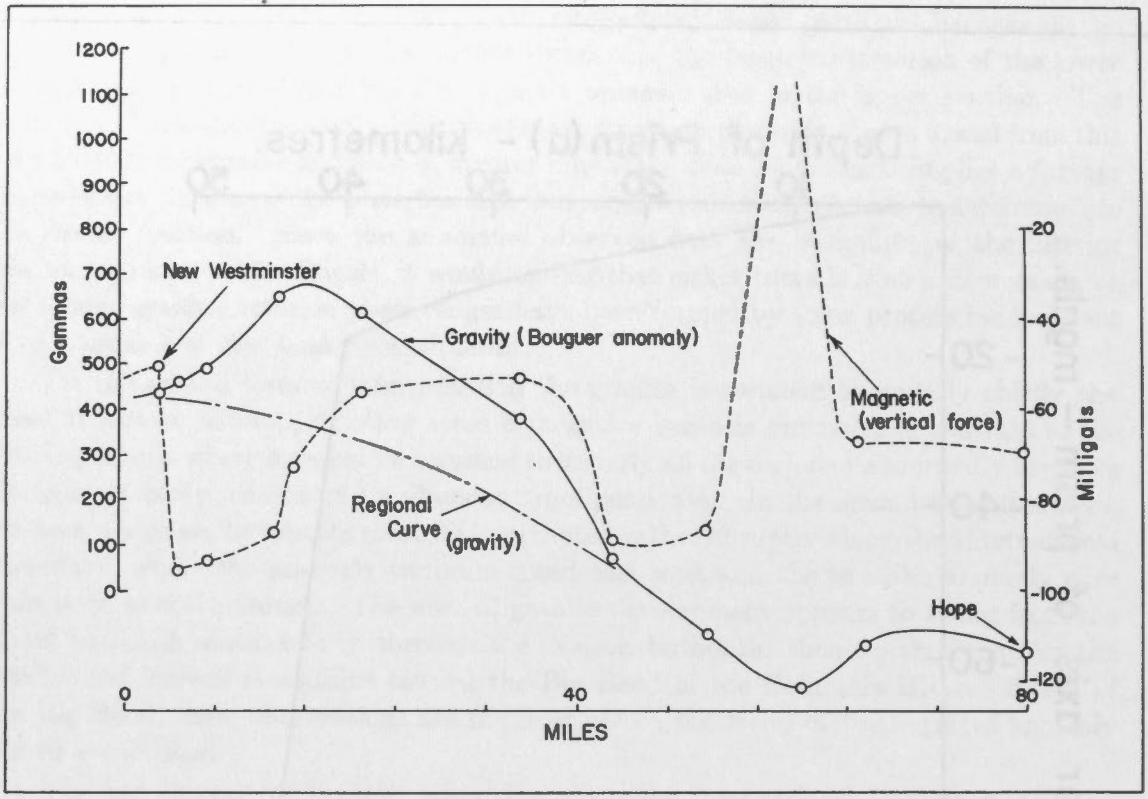


FIGURE 7. Gravity and magnetic anomalies along the lower Fraser River valley.

The positive area over the southern portion of the Purcell mountains is believed to be due to the excess density of the Lower Purcell rocks, especially of the intrusive and extrusive members. Now this area was apparently the site of a major geosyncline in late Precambrian time, a geosyncline receiving a much greater thickness of sediments than that existing along the site of the Rocky Mountains in Palaeozoic time (North and Henderson 1954a). The thickness of the Purcell sedimentary rocks alone is estimated to be 45,000 feet, and one would expect there to have been considerable crustal flexure to accommodate so great a thickness. It is rather remarkable that no evidence of this appears in the gravity field. In other words, a negative rather than positive anomaly might have been predicted over the area, and while the positive attraction of the denser Purcell rocks may be obscuring some such effect, it is possible to place limits on the amount of crustal thickening present. The argument is similar to that used in the case of the origin of granite by differentiation, and depends on the horizontal extent of the region covered by the positive anomaly. The latter in this case is about 80 miles in any direction, and within this area the isostatic anomaly rises to about 17 milligals. The average density of the Lower Purcell rocks has been estimated in the preceding section to be 2.80 gms. per cc., or 0.07 gms. per cc. greater than the normal crust, based on the proportion of basic flows and sills present in the section. Thus, each kilometre thickness of Lower Purcell would contribute about 2.9 milligals to the positive anomaly. On the other hand, subsidence at the base of the Airy crust, over a circle of 80 mile diameter, would contribute a negative anomaly approaching 20 milligals per kilometre of subsidence, for a density contrast of 0.5 gm. per cc. at the base of the crust, and of course this negative anomaly would be spread over a broader area. It is apparent that there cannot be crustal subsidence of the same magnitude as the thickness of the section. If the Lower Purcell section still preserved has a vertical thickness greater than the 19,000 feet required to produce a 17-milligal anomaly then a crust thicker than that required for compensation could be present. However the thickening is not likely to exceed 3 or 4 kilometres, and it must be emphasized that there is no positive evidence even for this. It appears that any major crustal deformation which may have occurred during the life of the late Precambrian geosyncline has been removed by later orogenies.

The contract between the region of excess mass in the southern Purcell mountains and that of mass deficiency in the area of the granitic batholiths to the northwest is represented by the line of fairly steep gravity gradient, striking northeasterly from the south end of Kootenay Lake. A stress difference in the crust approaching 2/e times the amplitude of the mass excess or deficiency may be expected (Jeffreys 1952), which in this case would be about 4×10^7 dynes/cm². This is an order of magnitude lower than the breaking stress of the crust, but it could be a contributing factor, if superimposed on an additional stress system. Alternatively the amplitude of loading could have been greater in past time. Faulting might be expected along the boundary of the mass excess, acting in such a way as to redistribute the loading, or downward and outward from the region of mass excess. There is in fact a thrust fault in approximately the position to be expected, the Moyie-Lenia fault (Kirkham 1930, Rice 1937), which has been traced for about 120 miles and which has been described as an overthrust from the northwest, along a plane dipping at 45 degrees or greater. The origin of this and other smaller faults striking transversely to the mountain structure has not heretofore been evident, but it now appears that the distribution of loads, as evidenced by the gravity anomalies, has been a contributing factor.

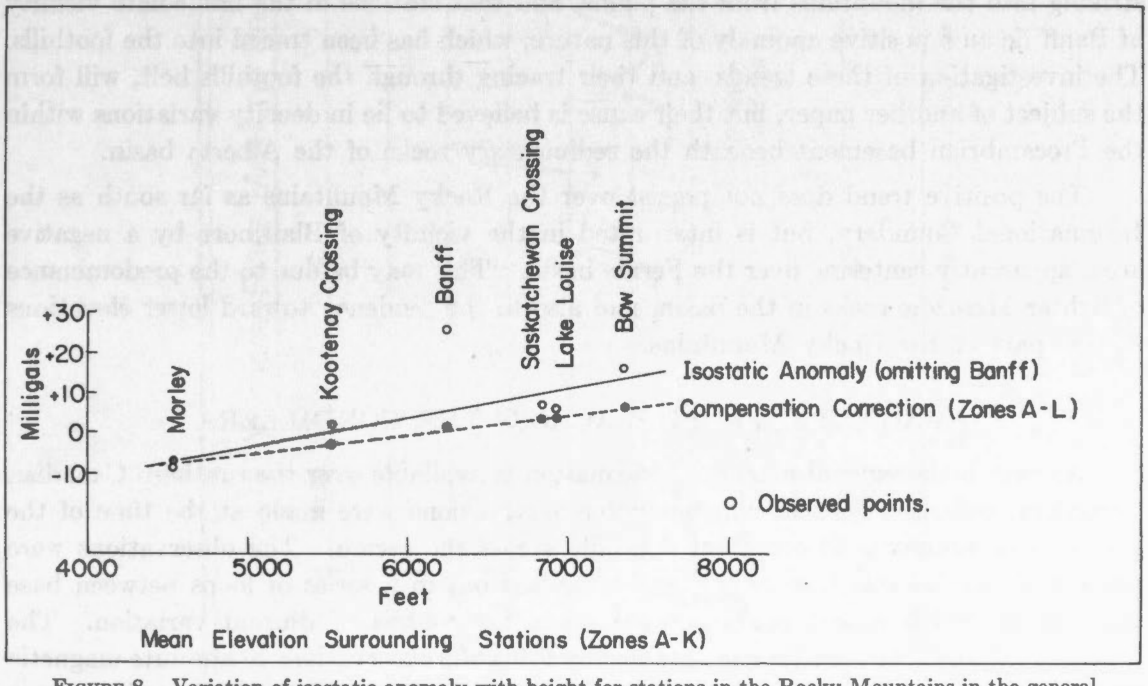


FIGURE 8. Variation of isostatic anomaly with height for stations in the Rocky Mountains in the general vicinity of Banff.

The pattern of anomalies over the Rocky Mountains themselves is interesting. These mountains, although of a comparable elevation to the interior mountains to the west, lie on the eastern shoulder of the main area of highly negative anomaly, and it is not surprising that the isostatic anomalies over them show a tendency toward positive values. The positive trend is most pronounced in the vicinity of Banff, and suggests an incomplete compensation of the topography in the region. The relation between isostatic anomaly and the mean height of the topography surrounding a station (taken to the limit of zone K, or to 18.8 kilometers) is shown in Figure 8, for six stations in this section of the Rocky Mountains. The isostatic anomaly increases in a general way with height, the major part of the increase being provided by the correction added for compensation out to zone L, or to 28.8 kilometres from each station. This suggests that the topography above about 4,500 feet, in this portion of the Rocky Mountains, is not completely compensated. In other words, it would appear that the crust having adjusted itself at the time the Coast and interior ranges were formed, did not suffer further major distortion when the Rocky Mountains were built by overthrusting or wedge-faulting of the sedimentary rocks. Otherwise, it would be difficult to reconcile the tendency toward positive isostatic anomalies, suggesting a crust thinner than that called for by Airy compensation, with the very large estimates of crustal shortening that have been based on geological evidence. For example, North and Henderson (1954a), estimate 100 miles or 50 per cent of the original width as the shortening across the Rocky Mountains and the Trench, a figure which must almost certainly apply to a relatively thin surface layer, and not to the crust as a whole.

Referring again to Figure 8, it will be seen that the anomaly at Banff lies very much above the line through the other points. Hence this station must be affected by some factor in addition to the apparent under-compensation. We believe there are anomaly trends striking into the mountains from the plains, and that stations in the immediate vicinity of Banff lie on a positive anomaly of this nature, which has been traced into the foothills. The investigation of these trends, and their tracing through the foothills belt, will form the subject of another paper, but their cause is believed to lie in density variations within the Precambrian basement beneath the sedimentary rocks of the Alberta basin.

The positive trend does not persist over the Rocky Mountains as far south as the International Boundary, but is interrupted in the vicinity of Blairmore by a negative area, apparently centering over the Fernie basin. This may be due to the predominance of lighter Mesozoic rocks in the basin, and also to the tendency toward lower elevations in this part of the Rocky Mountains.

MAGNETIC PROFILE ACROSS THE CORDILLERA

As very little regional magnetic information is available over the southern Canadian Cordillera, sufficient vertical magnetometer ovservations were made at the time of the gravity measurements to construct a profile across the region. The observations were made with an Askania instrument, and were laid out in a series of loops between base stations, at which repeat readings were made for control of diurnal variation. The absolute datum for the profile was obtained by tying the observations to absolute magnetic stations at Fort McLeod, Cranbrook and Midway. In Figure 9, the profile is shown pro-

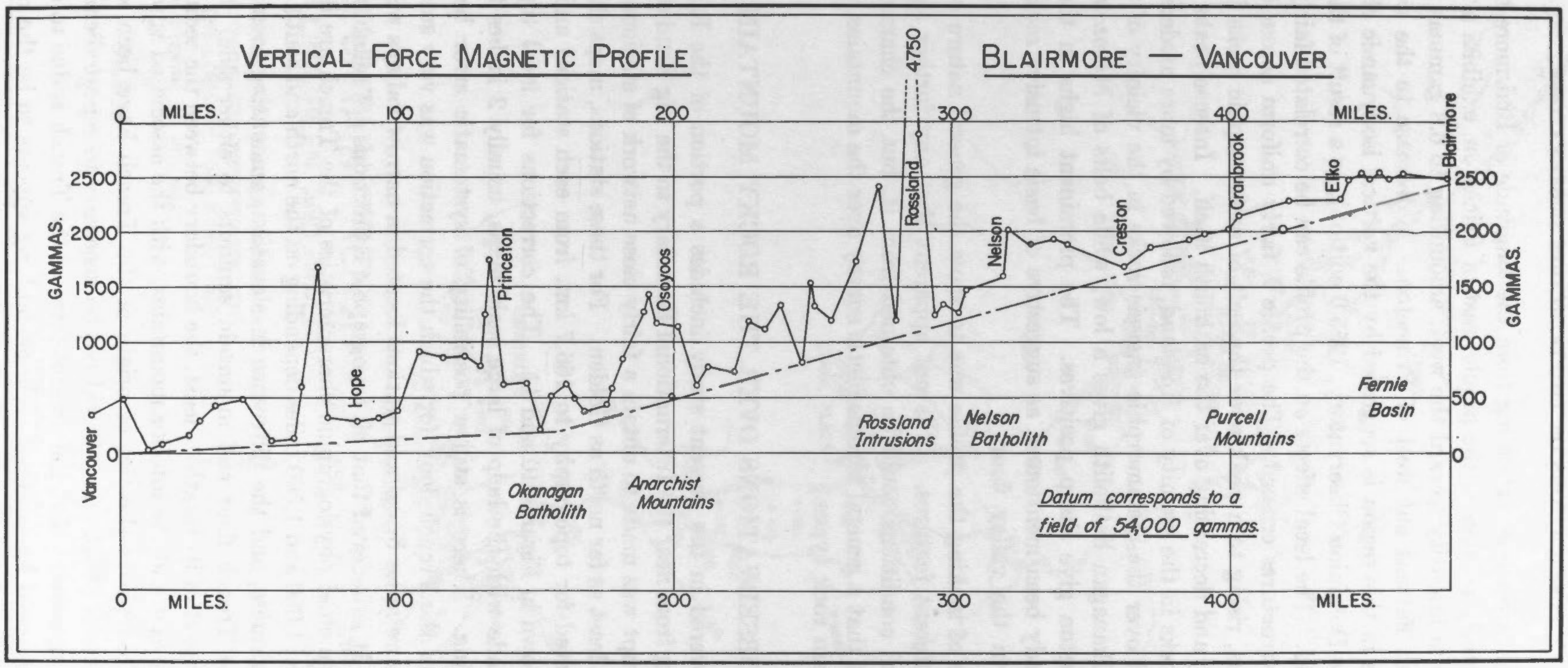


FIGURE 9. Vertical force magnetic profile from Blairmore, Alberta, to Vancouver, B.C.

jected onto an east-west line, extending from the longitude of Blairmore to that of Vancouver. The easterly portion of the profile, east of Princeton, exhibits a rather uniform regional decrease in intensity toward the west, amounting to 6.8 gammas per mile, while the regional effect flattens out west of Princeton. A decrease to the west of about 7 gammas per mile in this region is suggested by the vertical isodynamic chart of Canada (published by the Dominion Observatory, 1955.0 edition), as a result of the configuration of the earth's field. The local effects on the profile can be correlated fairly well with the main geological structures crossed. The profile is fairly uniform across the Rocky and Purcell mountains, rising to a peak over the belt of metamorphic rocks just east of the Nelson batholith, and decreasing over the batholith itself. Intense peaks occur over the basic intrusive rocks in the vicinity of Rossland, followed by more moderate values until a high is reached over the metamorphic gneissic rocks in the vicinity of Osoyoos. The interior of the Okanagan batholith gives a low, while belts of Mesozoic and Tertiary lavas near Princeton give sharp positives. The prominent highs in the lower Fraser valley have already been mentioned, as suggestive of basic intrusive rock lying beneath the overburden in the valley floor.

The purpose of making the profile was to show the general nature of the magnetic field over the different features. It is not apparent that any further significant information on crustal conditions could be obtained from it, but the characteristics of the profile do suggest that a general aeromagnetic survey over the mountains would be useful in outlining certain rock types.

GRAVITY OBSERVATIONS OVER THE ROCKY MOUNTAIN TRENCH

The area covered in the present study includes a portion of the Rocky Mountain Trench, extending from near the International Boundary to the Big Bend of the Columbia River. An attempt was made to obtain a fairly close network of stations in the vicinity of the Trench, at least as far north as Golden. For these stations, maps showing Bouguer anomalies (corrected for topography to 166.7 km. from each station) and Airy isostatic anomalies are shown in Figures 10 and 11. The corrections for local topography were practically all made with the help of large scale maps, usually 2 inches to 1 mile, with detailed contouring. There is still a possibility of systematic error between stations near the middle of the Trench floor, for which the correction was very small (the Trench being 4 to 8 or more miles broad and stations located in narrow valleys within the ranges on either side). It is believed that all topographic corrections are reliable to better than one milligal. The chief physiographic characteristics of the Trench are its great length, estimated between 1,000 and 1,500 miles depending on the north and south limits adopted, its relative straightness, and the difference in elevation, amounting to several thousand feet, between the Trench floor and mountain summits to either side. Structurally, it forms, for a large part of its length at least, the boundary between the sedimentary Rocky Mountains to the east and the interior mountains, with the associated igneous intrusives, to the west. The various theories of origin of the Trench have been summarized by North and Henderson (1954b) and it will not be necessary to repeat them in detail here. There is general agreement that the present form of the Trench is due to erosion along a zone or zones weakened by faulting. Thrust faulting appears to be the most important

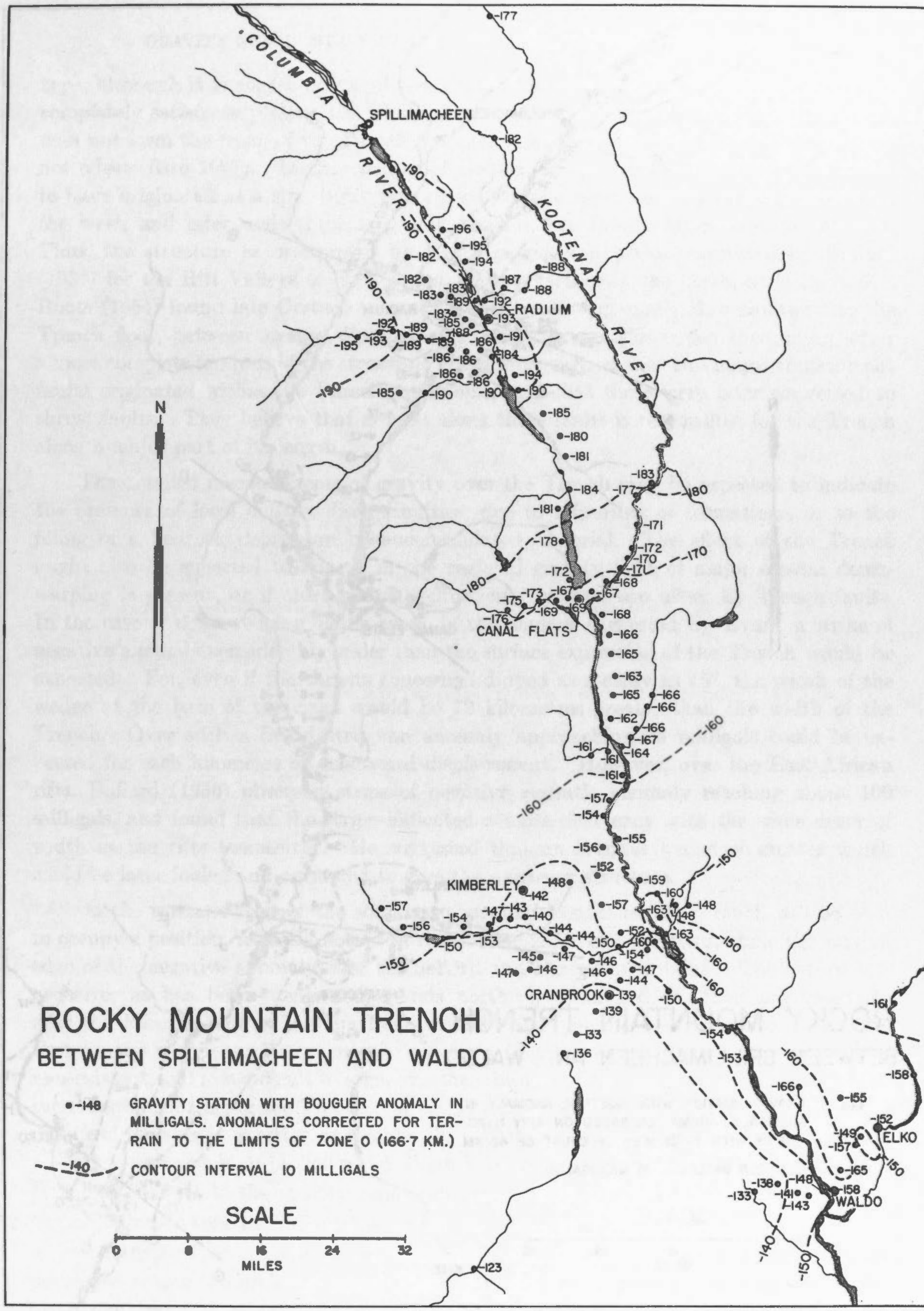


Figure 10. Bouguer anomalies observed over the southern portion of the Rocky Mountain Trench in Canada.

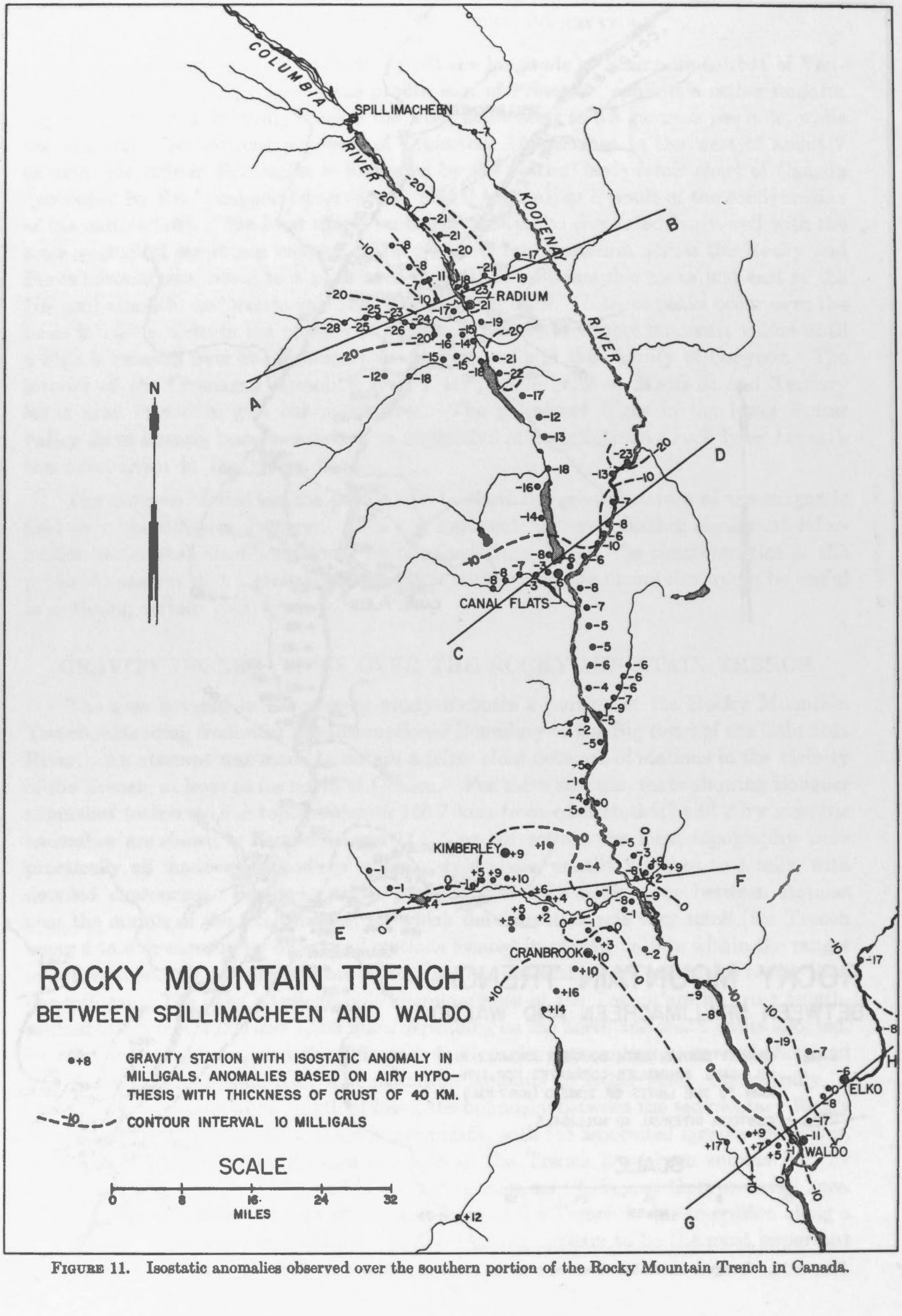


Figure 11. Isostatic anomalies observed over the southern portion of the Rocky Mountain Trench in Canada.

type, although it is characteristic of the Trench that no one structural interpretation is completely satisfactory along the whole length. Thus, south of Canal Flat, the Trench does not form the front of the Purcell mountains, and structures on either side of it are not offset (Rice 1937). In the vicinity of Golden, Evans (1932) considered the Trench to have originated as a structurally depressed area between westerly dipping thrusts on the west, and later underthrusts dipping beneath the Rocky Mountains to the east. Thus, the structure as interpreted by Evans is not unlike that suggested by Bullard (1936) for the Rift Valleys of East Africa. Much farther to the north, at latitude 57°, Roots (1954) found late Cretaceous or Paleocene rocks apparently downfaulted into the Trench floor, between steeply dipping faults. North and Henderson themselves, after a most complete analysis of the structural conditions, suggest that two major transcurrent faults originated within the Purcell mountains, and that these were later converted to thrust faults. They believe that erosion along these faults is responsible for the Trench along a major part of its length.

The detailed measurements of gravity over the Trench may be expected to indicate the presence of local density discontinuities, due to infaulting of formations, or to the filling of a bedrock depression by unconsolidated material. The effect of the Trench might also be expected to appear in the regional gravity field, if major crustal downwarping is present, or if older anomaly-producing features are offset by Trench faults. In the case of downwedging of the crust, in the manner suggested by Evans a strike of negative anomaly considerably wider than the surface expression of the Trench would be expected. For, even if the thrusts concerned dipped as steeply as 45°, the width of the wedge at the base of the crust would be 72 kilometres greater than the width of the Trench. Over such a broad strip, an anomaly approaching 20 milligals could be expected for each kilometre of downward displacement. However, over the East African rifts, Bullard (1936) observed strips of negative isostatic anomaly reaching about 100 milligals, and found that the strips indicated a mass deficiency with the same order of width as the rifts themselves. He suggested that an original wedge of greater width could be later folded and crumpled to give the narrower structure.

On the isostatic map of the southern Canadian Cordillera, the Trench will be seen to occupy a position, from the source of the Columbia River northward, along the eastern edge of the negative anomaly over the Selkirk and Purcell mountains. The axis of this negative, as has been mentioned, trends northerly from Nelson, then northwesterly near the Purcell front to the Big Bend of the Columbia and beyond. The problem is that control within the Purcell mountains north of Spillimacheen (Figure 11) is practically non-existent, and it is difficult to argue whether the axis of the negative anomaly is within the mountains or along the Trench. A single station, shown on the isostatic map in the middle of the area in question, with anomaly -10 milligals, is actually a pendulum station (Glacier) observed in 1915, for which there is no modern check on the observed value. It is felt that while the gravity minimum appears to follow the Trench toward Boat Encampment (where the isostatic anomaly is -32 milligals), the cause of the anomaly is that suggested before, the density deficiency in exposed or concealed granitic rocks developed within the interior mountains. In this regard, a gravity and magnetic profile along the Trench, between Golden and Boat Encampment (Figure 12 and also Map 1 and

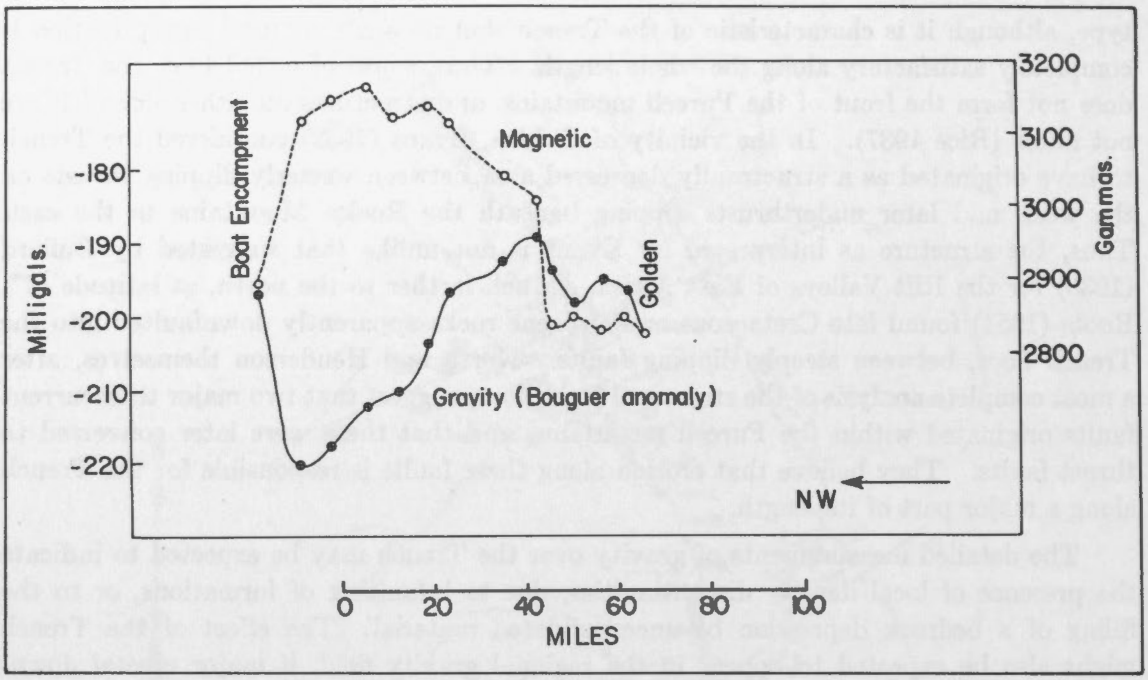


FIGURE 12. Gravity and magnetic profiles along the Rocky Mountain Trench between Golden and Boat Encampment. The latter station is at the northern extremity of the Big Bend of the Columbia River.

2) is illuminating. The Bouguer gravity anomaly shows a relief of 30 milligals, reaching a minimum just south of Boat Encampment. The relief in this profile, taken along the strike of the Trench, is not suggestive of a crustal structure elongated in the Trench direction, and the gravity gradients indicate density differences close to the surface. Furthermore, the magnetic profile indicates a positive anomaly of some 300 gammas over the region of negative gravity. Now the interior of the larger granitic batholiths have been seen to be fairly non-magnetic, but the zones of mixed and metamorphosed rocks around the edges of the batholiths can be highly magnetic, as evidenced by the eastern edge of the Nelson batholith on the main magnetic traverse (Figure 9). It is concluded that a fairly small batholith of the Coast intrusion family underlies the area very close to the Purcell front, in the vicinity of the Big Bend. As will be seen on the map, no intrusions are mapped in this area, although small exposures are known a short distance to the west. On this interpretation, there remains no strong suggestion of downwedging along the Trench, although the possibility is by no means eliminated.

For more detailed study, isostatic anomaly profiles are shown in Figure 13. Of these, the first two, taken in the vicinity of Radium and Canal Flat, cross the Trench where it is along the Purcell front, and where cover on the floor is generally thin. In this region, outcrops of either Purcell or Rocky Mountain type rocks occur in the Trench floor, depending on the exact location of the Purcell front. Both types have densities averaging close to 2.73 gms. per cc. The profiles at Marysville and Elko are in the area where the Trench lies completely within the Purcell mountains, where it is considerably broader than in the first two cases, and where cover on the Trench floor may be of considerable thickness. The Radium profile exhibits a decrease toward the west, where the contact of a granitic batholith is approached, and a narrow negative over the section

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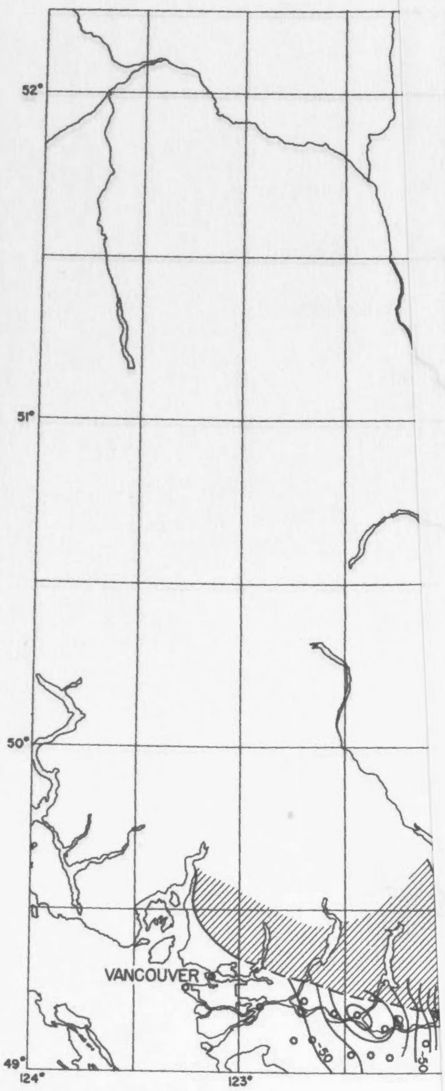

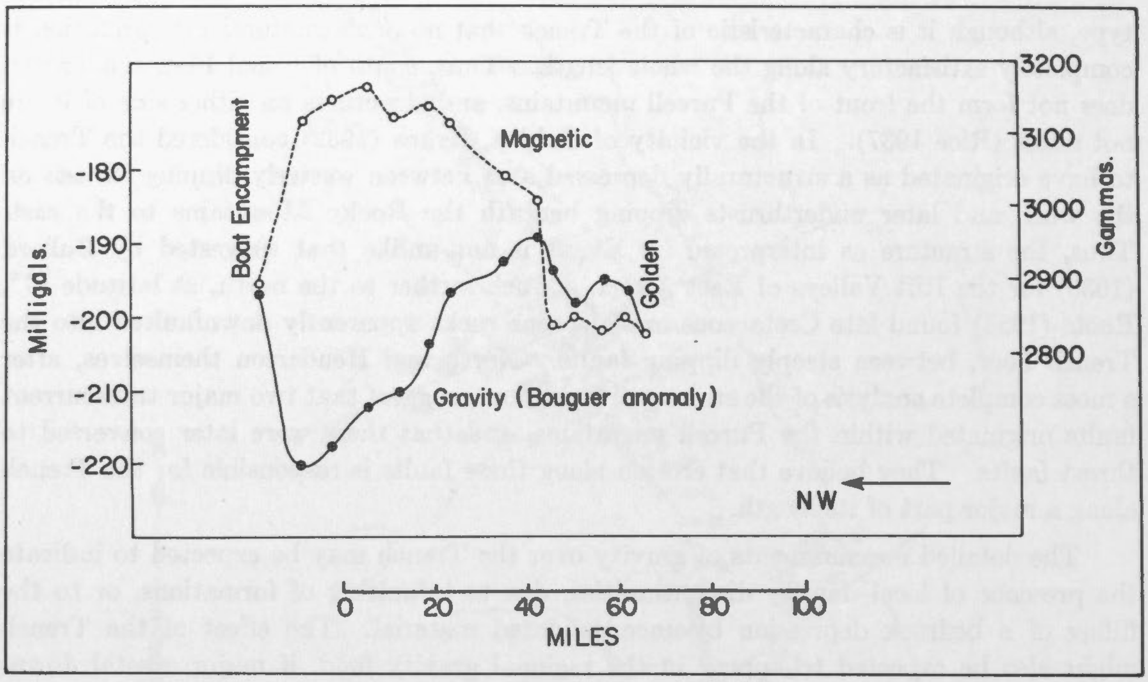

Figure 12. Gravity and magnetic profiles along the Rocky Mountain Trench between Golden and Boat Encampment. The latter station is at the northern extremity of the Big Bend of the Columbia River.

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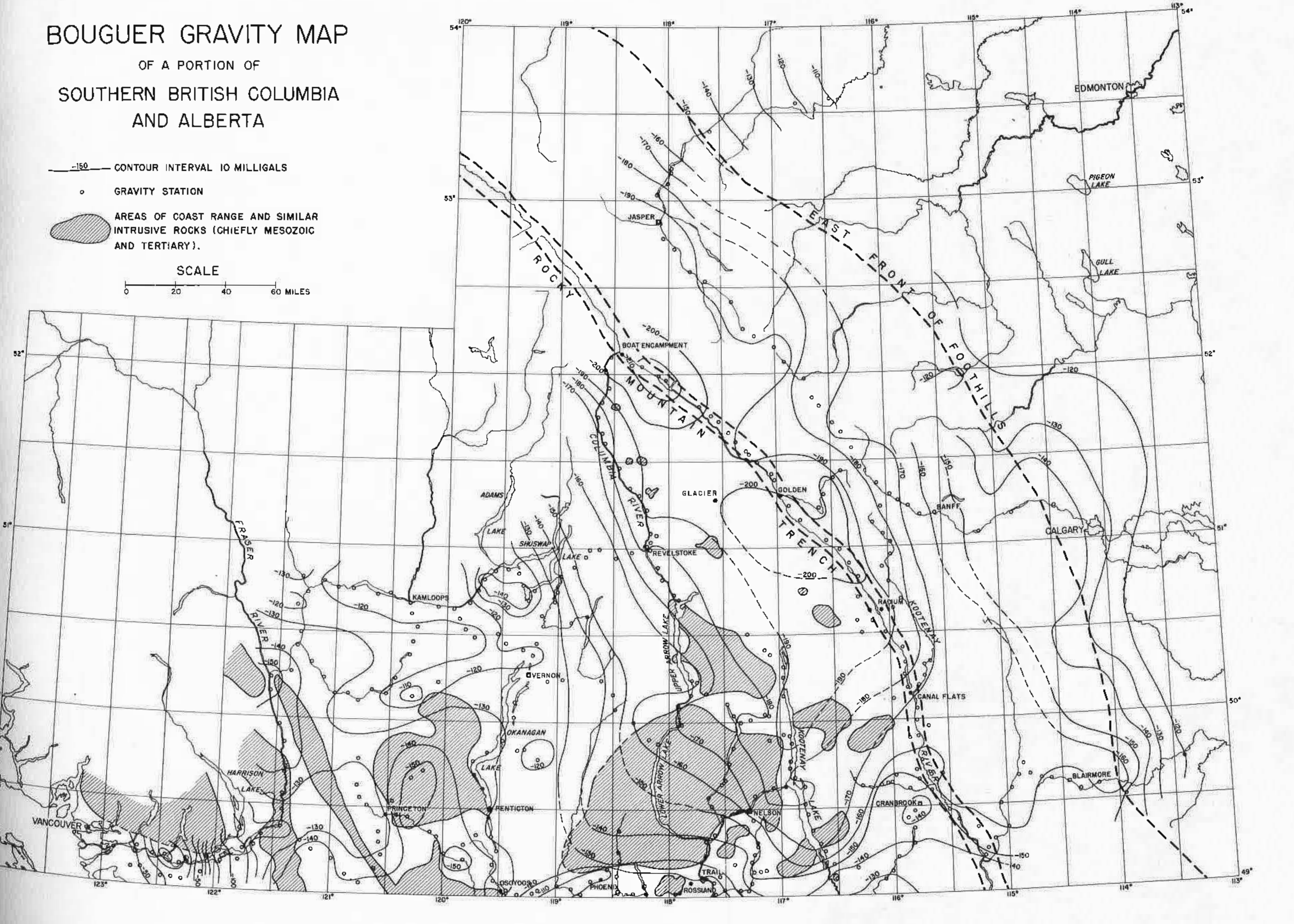
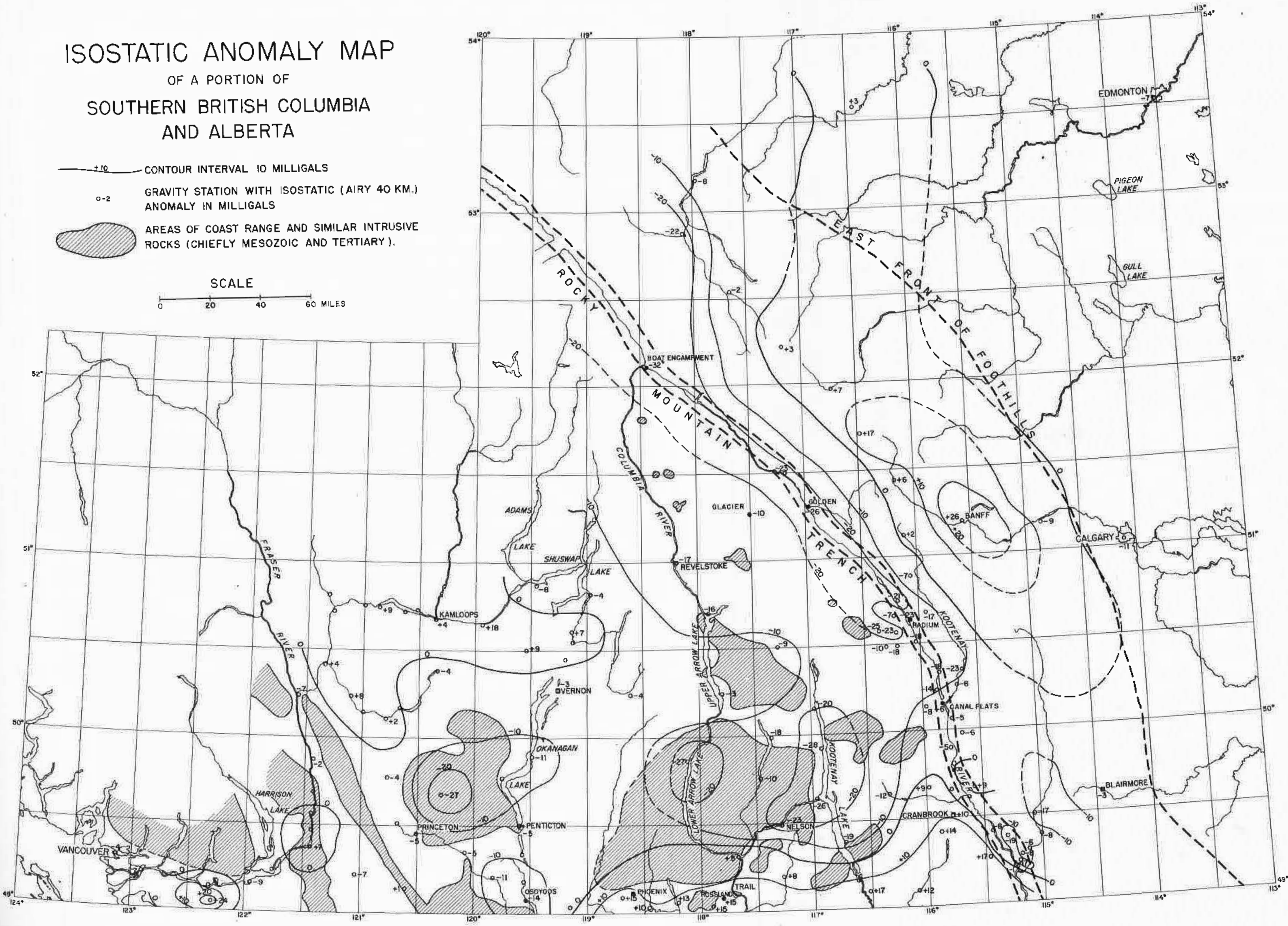
BOUGUER GRAVITY MAP

OF A PORTION OF

SOUTHERN BRITISH COLUMBIA AND ALBERTA





ISOSTATIC ANOMALY MAP
OF A PORTION OF
SOUTHERN BRITISH COLUMBIA
AND ALBERTA
+10 CONTOUR INTERVAL 10 MILLIGALS
o-2 GRAVITY STATION WITH ISOSTATIC (AIRY 40 KM.) ANOMALY IN MILLIGALS
AREAS OF COAST RANGE AND SIMILAR INTRUSIVE ROCKS (CHIEFLY MESOZOIC AND TERTIARY).
SCALE
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EDMONTON
PIGEON LAKE
GULL LAKE
EAST FRONT OF FOOTHILLS
ROCKY MOUNTAIN TRENCH
BOAT ENCAMPMENT
COLUMBIA RIVER
GLACIER
GOLDEN
BANFF
CALGARY
REVELSTOKE
RADIUM
KOOTENAY
ADAMS LAKE
SHUSWAP LAKE
FRASER RIVER
KAMLOOPS
VERNON
UPPER ARROW LAKE
LOWER ARROW LAKE
KOOTENAY LAKE
CANAL FLATS
KOOTENAY RIVER
BLAIRMORE
OKANAGAN LAKE
HARRISON LAKE
VANCOUVER
PRINCETON
PENTICTON
OSOYOOS
PHOENIX
ROSSLAND
TRAIL
NELSON
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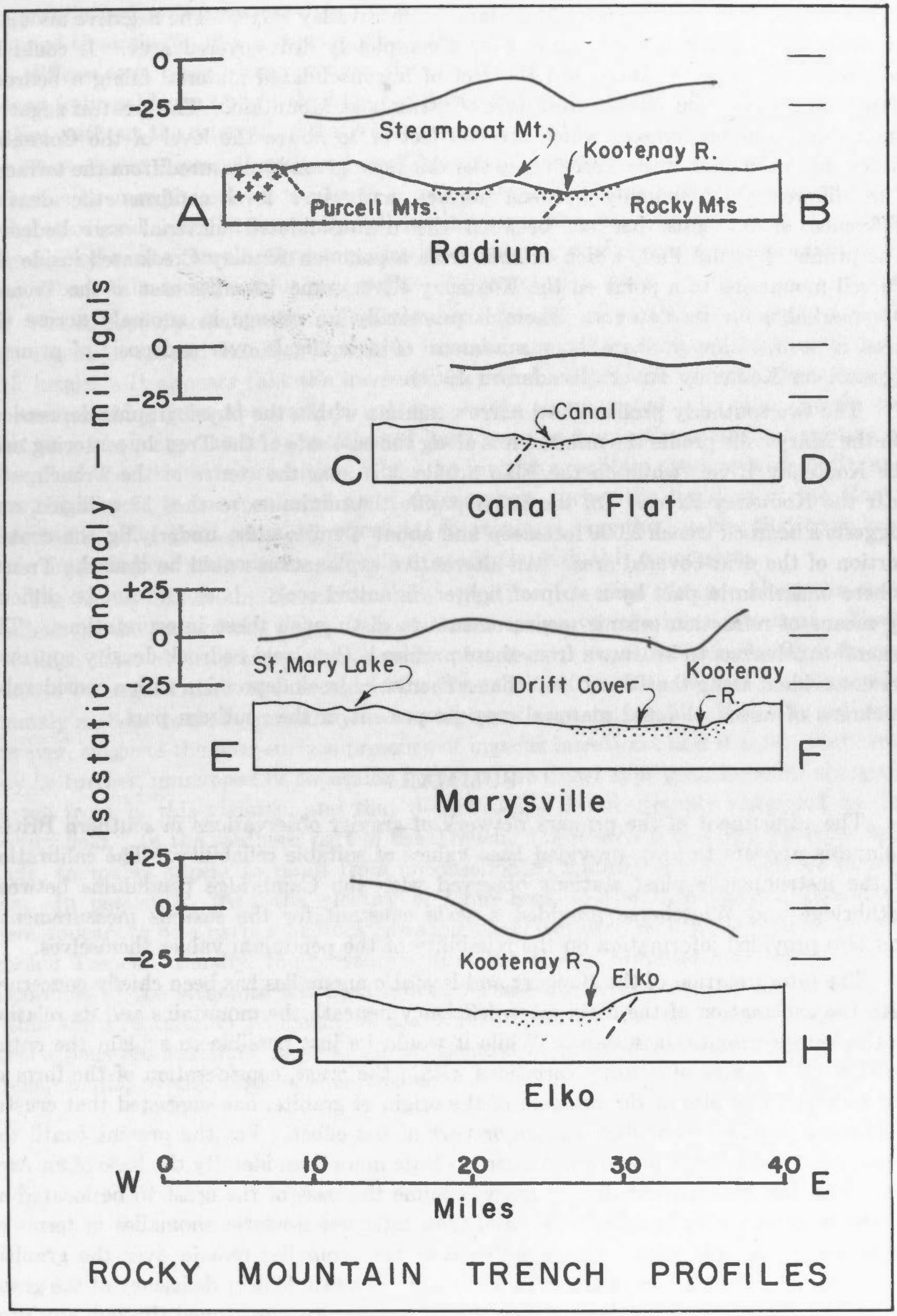

FIGURE 13. Isostatic anomaly profiles across the Rocky Mountain Trench. The locations of the profiles are shown in Figure 10.

of the Trench east of Steamboat Mountain, an intravalley ridge. The negative anomaly amounts to 16 milligals, and occurs over a completely drift-covered area. It could be accounted for by a thickness of 1,800 feet of unconsolidated material filling a bedrock trench on the east, but not the west, side of Steamboat Mountain. The greatest negative anomalies occur on terraces which are 300 feet or so above the level of the Columbia River cut in the floor of the Trench, and the thickness given is measured from the terraces. The difference in anomaly between terrace and river level confirms the density difference of 0.7 gms. per cc. between the unconsolidated material and bedrock. The profile at Canal Flat, which extends from a point on Findlay Creek well inside the Purcell mountains to a point on the Kootenay River some 10 miles east of the Trench, is remarkable for its flatness. There is practically no change in anomaly across the Trench itself, although there is a minimum of 4 milligals over a deposit of primary gypsum on Kootenay River (Henderson 1954).

The two southerly profiles show narrow minima within the physiographic depression. On the Marysville profile the minimum is along the east side of the Trench, centering near the Kootenay River, while on the Elko profile it is near the centre of the Trench, still near the Kootenay River. On the latter profile the minimum reaches 17 milligals, and suggests a bedrock trench 2,000 feet deep and about 4 miles wide, underlying the central portion of the drift-covered area. An alternative explanation would be that the Trench is here underlain in part by a strip of lighter, infaulted rock. It should not be difficult by means of refraction seismic measurements to distinguish these interpretations. The general conclusions to be drawn from these profiles is that local bedrock density contrasts are not evident along the Trench, but that a narrow bedrock depression with a considerable thickness of unconsolidated material may be present in the southern part.

SUMMARY

The adjustment of the primary network of gravity observations in southern British Columbia appears to have provided base values of suitable reliability. The calibration of the instrument against stations observed with the Cambridge pendulums between Lethbridge and Whitehorse provided a scale constant for the seasons measurements, and also provided information on the reliability of the pendulum values themselves.

The interpretation of the Bouguer and isostatic anomalies has been chiefly concerned with the explanation of the main mass deficiency beneath the mountains and its relation to the known granitic intrusions. While it would be just possible to explain the entire deficiency by means of density variations within the crust, consideration of the form of the anomaly, and also of the problem of the origin of granite, has suggested that crustal thickening probably contributes a major part of the effect. For the present (until the actual form of the crust is known) we can do little more than identify the base of an Airy crust with the Mohorovičić discontinuity, assume the base of the crust to be located at depths in accord with compensation, and then interpret isostatic anomalies in terms of departures from this state. Considerable isostatic anomalies remain over the granitic batholiths, but these are explainable in terms of the known density deficiency of the granitic rocks. However, it has been shown that if the granite was formed through any process of settling of denser constituents, there must be additional crustal thickening beneath

the granite bodies to accommodate the denser fraction. Otherwise, the granite must be assumed to originate by a process in which the denser constituents are removed laterally. The difference in composition between the granitic rocks and the older formations would appear to be evidence against the hypothesis that the lower density arises from recrystallization without the removal of material.

The area of Lower Purcell sedimentation is characterized by a positive anomaly. This has been explained on the basis of relatively dense basic extrusive and intrusive rocks associated with the Lower Purcell formations. The important point is that there does not appear to remain any suggestion of a major crustal downwarp that might have been expected under this great geosyncline of Precambrian time.

The Rocky Mountains themselves are characterized, at least in the area of considerable elevation around Banff, by positive isostatic anomalies, showing some correlation with height. It appears that the increased elevation, which was brought about largely by overthrusting from the west, is not completely compensated. In other words, the crust as a whole appears to have adjusted itself more or less to the conditions existing at the end of the Laramide revolution, when the interior mountain systems were built, and does not appear to have suffered great deformation during the building of the Rocky Mountains. The great estimates of crustal shortening across the Rockies that have been made on geological grounds are difficult to reconcile with this conclusion.

The Rocky Mountain Trench occupies a position for some distance along the steep gradient on the east of the negative isostatic anomaly over the interior ranges. North of Golden most of the gravity stations were of necessity located within the Trench, and it could be argued that in this region the Trench itself is characterized by a negative anomaly such as would be caused by downwedging of a crustal block. Magnetic evidence, however, suggests the near-surface presence of ingeous intrusions, and it is felt that there may be further, unmapped or concealed bodies of the Coast type granitic rocks along the Purcell front in this vicinity, and that downwedging is not strongly suggested by the gravity field. In the southern part of the Trench, where several detailed traverses were made, anomalies appear to result from unconsolidated material filling a bedrock depression. In particular, from the vicinity of Cranbrook to the International Boundary, there appears to be a narrow bedrock rift some 2,000 feet deep within the broader physiographic Trench. Finally, the presence within the Rocky Mountains of certain trends discordant to the structure has been noted. These are believed to be due to features within the Precambrian basement, and a fruitful problem for the future, when more observations are available, may be the verification of transcurrent movement along the Trench faults, by the offset of such trends.

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APPENDIX

PRINCIPAL FACTS FOR GRAVITY STATIONS

No.	Station	Longitude	Latitude	Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		° ′	° ′	feet							(Airy—40 km.)
1	Lethbridge.................	112 50.0	49 42.3	2,977	980.7604	−0.0122	−0.1136				
2	Macleod....................	113 24.9	49 43.8	3,116	.7547	− .0069	− .1130				
3	Pincher....................	113 57.0	49 31.0	3,771	.6623	− .0186	− .1470				
4	Blairmore..................	114 25.5	49 36.1	4,235	.6366	− .0084	− .1526	.0031	−.0014	.1479	−.0030
5	Natal......................	114 51.1	49 42.9	3,782	.6605	− .0372	− .1660				
6	Sentinel...................	114 34.4	49 37.5	4,444	.6203	− .0071	− .1585				
7	Crow's Nest................	114 41.1	49 37.7	4,451	.6249	− .0022	− .1537				
8	....	114 45.8	49 39.5	4,039	.6440	− .0245	− .1621				
9	Fernie.....................	115 03.3	49 30.2	3,310	.6726	− .0505	− .1632	.0034	−.0012	.1439	−.0171
10	Olson......................	114 54.2	49 39.1	3,535	.6693	− .0460	− .1664				
11	Howser.....................	114 57.5	49 35.2	3,453	.6682	− .0489	− .1665				
12	Elko.......................	115 06.5	49 18.1	3,088	.6774	− .0486	− .1537	.0026	−.0011	.1459	−.0064
13	Wardner....................	115 25.7	49 25.4	2,489	.7244	− .0688	− .1536	.0018	−.0010	.1451	−.0077
14	Cranbrook..................	115 45.6	49 31.1	3,011	.7158	− .0368	− .1393	.0010	−.0011	.1490	−.0096
15	Moyie......................	115 50.1	49 17.4	3,052	.6959	− .0324	− .1364				
16	Peavine Creek..............	115 49.4	49 22.1	3,051	.6986	− .0368	− .1407				
17	Yahk.......................	116 05.7	49 05.0	2,823	.7005	− .0309	− .1270	.0051	−.0011	.1351	.0121
18	Tochty.....................	115 59.3	49 12.2	2,970	.6904	− .0378	− .1390				
19	Ryan.......................	116 01.1	49 08.8	2,904	.6969	− .0325	− .1315				
20	Creston....................	116 31.0	49 06.0	1,987	.7429	− .0686	− .1363	.0032	−.0008	.1355	.0016
21	McConnell..................	116 20.1	49 09.4	2,441	.7182	− .0557	− .1388				
22	Sanca......................	116 43.6	49 22.6	1,819	.7358	− .1162	− .1782	.0132	−.0008	.1466	0.0192
23	Wynndel....................	116 33.1	49 10.7	1,850	.7480	− .0889	− .1519				
24	Sirdar.....................	116 37.2	49 14.9	1,807	.7335	− .1022	− .1638				
25	Kuskanook..................	116 39.5	49 17.9	1,773	.7306	− .1188	− .1792				
26	Kootenay Bay...............	116 52.3	49 40.5	1,763	.7683	− .1157	− .1757				
27	Boswell....................	116 45.8	49 27.6	1,770	.7470	− .1171	− .1774				
28	Lafrance Creek.............	116 46.9	49 31.5	1,780	.7543	− .1147	− .1753				
29	Gray Creek.................	116 47.3	49 37.4	1,781	.7516	− .1261	− .1867				
30	Balfour....................	116 57.5	49 37.5	1,763	.7547	− .1249	− .1849	.0115	−.0007	.1476	− .0265
31	Nelson.....................	117 17.6	49 29.6	1,823	.7537	− .1084	− .1705	.0103	−.0008	.1384	− .0226
32	....	117 15.5	49 29.1	2,885	.7019	− .0596	− .1579				
33	....	117 14.5	49 19.4	2,551	.7232	− .0552	− .1421				

34	Ymir	117	12.8	49	16.9	2,390	.7236	− .0663	− .1477				
35	Boulder Mill	117	14.3	49	14.4	2,272	.7379	− .0593	− .1367				
36	Salmo	117	16.8	49	11.8	2,176	.7388	− .0635	− .1376	.0087	− .0009	.1364	.0066
37	Sheep Creek Bridge	117	15.4	49	08.5	2,192	.7341	− .0619	− .1366				
38		117	11.4	49	08.4	2,650	.6928	− .0599	− .1502				
39	Sheep Creek	117	08.8	49	08.8	3,116	.6651	− .0444	− .1505				
40		117	16.3	49	04.7	2,061	.7412	− .0614	− .1316				
41	Nelway	117	18.3	49	00.1	2,559	.7108	− .0291	− .1253				
42		117	23.1	49	02.0	1,745	.7585	− .0698	− .1292				
43		117	30.4	49	02.2	1,891	.7656	− .0492	− .1136				
44		117	35.9	49	00.4	1,793	.7760	− .0453	− .1064				
45		117	37.1	49	05.0	1,352	.7921	− .0776	− .1237				
46	Fruitvale	117	32.5	49	06.9	1,979	.7646	− .0490	− .1165				
47	Parks	117	30.2	49	09.9	2,089	.7559	− .0519	− .1231				
48	Meadows	117	23.6	49	11.1	2,319	.7295	− .0584	− .1374				
49	Ainsworth	116	54.5	49	44.2	1,798	.7531	− .1331	− .1943				
50	Woodbury Creek	116	54.4	49	46.5	1,799	.7536	− .1360	− .1973				
51	Mirror Lake	116	54.0	49	52.6	1,772	.7667	− .1333	− .1947				
52	Kaslo	116	54.4	49	54.8	1,768	.7703	− .1345	− .1946	.0111	− .0007	.1564	− .0278
53	Lardeau	116	57.2	50	08.8	1,763	.7899	− .1361	− .1961	.0201	− .0007	.1566	− .0201
54	Marblehead	116	57.7	50	14.8	1,807	.8073	− .1234	− .1850				
55	Howser	116	58.8	50	18.5	1,859	.8126	− .1188	− .1822				
56	Goldhill	117	04.8	50	23.1	2,048	.8070	− .1134	− .1831				
57	Gerrard	117	17.3	50	30.8	2,350	.7933	− .1110	− .1900	.0196	− .0009	.1622	− .0091
58		117	07.9	50	25.0	2,160	.8031	− .1094	− .1831				
59	Shutty Creek	116	53.9	49	57.9	1,762	.7643	− .1457	− .2057				
60	Bear Creek	117	07.0	50	02.5	3,016	.7184	− .0803	− .1830				
61	Retallack	117	08.5	50	04.0	3,344	.7064	− .0637	− .1776				
62	Three Forks	117	17.4	50	01.9	2,591	.7436	− .0942	− .1824				
63	Denver Canyon	117	21.7	49	59.9	2,095	.7721	− .1095	− .1809	.0106	− .0008	.1527	− .0184
64	Roseberry	117	24.9	50	02.5	1,788	.7940	− .1202	− .1811				
65	Brouse	117	45.0	50	14.0	1,953	.8273	− .0885	− .1550				
66	Nakusp	117	48.0	50	14.3	1,478	.8536	− .1074	− .1577	.0061	− .0007	.1497	− .0026
67		117	47.9	50	09.2	1,415	.8361	− .1232	− .1714				
68	East Arrow Park	117	55.6	50	05.4	1,422	.8353	− .1176	− .1661				
69	Burton	117	53.8	49	59.5	1,406	.8206	− .1253	− .1731				
70	Summit Lake	117	39.0	50	09.1	2,494	.7726	− .0851	− .1701				
71		117	27.5	50	05.2	1,890	.8004	− .1082	− .1726				
72		116	58.7	49	55.8	2,276	.7447	− .1138	− .1912				
73	Cork Mine	117	04.4	49	54.5	3,405	.6735	− .0768	− .1928				
74		117	05.1	49	36.7	1,790	.7526	− .1232	− .1842				

PRINCIPAL FACTS FOR GRAVITY STATIONS—*Continued*

No.	Station	Longitude	Latitude	Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		° ′	° ′	feet							(Airy—40 km.)
75	....	117 13.8	49 34.3	1,766	980.7437	−0.1309	−0.1910				
76	Castlegar..................	117 39.9	49 19.5	1,435	.7989	− .0847	− .1336	.0075	− .0006	.1312	.0045
77	Taghum....................	117 23.6	49 29.8	1,757	.7681	− .1005	− .1604				
78	South Slocan...............	117 31.5	49 27.1	1,625	.7909	− .0861	− .1415				
79	Slocan Park................	117 36.9	49 31.1	1,600	.7901	− .0952	− .1497				
80	Vallican....................	117 38.9	49 33.5	1,641	.7871	− .0979	− .1538				
81	Winlaw.....................	117 34.1	49 37.2	1,714	.7847	− .0990	− .1574				
82	Slocan......................	117 28.1	49 48.1	1,764	.7850	− .1103	− .1704	.0142	− .0007	.1473	− .0096
83	Enterprise Landing..........	117 25.5	49 51.7	2,010	.7693	− .1080	− .1765				
84	Perry's.....................	117 30.1	49 40.1	1,722	.7793	− .1079	− .1666				
85	Thrum's....................	117 34.9	49 21.3	1,506	.7871	− .0924	− .1437				
86	Rossland...................	117 47.8	49 04.7	3,385	.6839	.0058	− .1095				
87	Blueberry Creek............	117 39.7	49 14.8	1,568	.7844	− .0796	− .1330				
88	Hanna......................	117 44.7	49 07.7	1,479	.7845	− .0772	− .1278				
89	Rossland...................	117 47.9	49 04.8	3,465	.6786	.0081	− .1101	.0024	− .0012	.1240	.0151
90	Big Sheep Creek............	117 56.8	49 00.9	2,238	.7362	− .0441	− .1203				
91	Summit.....................	117 53.9	49 01.8	4,594	.6037	.0437	− .1128	.0055	− .0014	.1236	.0149
92	Cascade....................	118 12.4	49 01.1	1,581	.7857	− .0567	− .1105				
93	Grand Forks................	118 26.8	49 02.1	1,685	.7805	− .0536	− .0110	.0036	− .0007	.1179	.0098
94	Gilpin......................	118 18.7	49 00.8	1,672	.7779	− .0554	− .1124				
95	Fife........................	118 12.2	49 04.0	1,968	.7642	− .0461	− .1131	.0055	− .0009	.1224	.0129
96	Troutdale..................	118 28.0	49 06.9	1,763	.7743	− .0597	− .1197				
97	Stanwell...................	118 25.9	49 12.1	1,852	.7662	− .0671	− .1302				
98	Archibald..................	118 27.2	49 15.1	1,903	.7225	− .0705	− .1353				
99	Burrell Creek..............	118 27.2	49 22.2	2,094	.7564	− .0691	− .1405				
100	Greenwood.................	118 40.6	49 06.0	2,457	.7388	− .0284	− .1122	.0040	− .0009	.1235	.0144
101	Eholt......................	118 32.3	49 09.5	3,087	.7106	− .0027	− .1079				
102	Jewel Lake.................	118 37.3	49 09.9	3,711	.6739	.0187	− .1077				
103	Phoenix....................	118 36.3	49 05.8	4,529	.6286	.0565	− .0978				
104	Rock Creek.................	118 59.3	49 03.1	1,982	.7684	− .0393	− .1068				
105	Midway.....................	118 47.1	49 00.9	1,906	.7632	− .0483	− .1132				
106	Kettle River Crossing.......	118 52.5	49 02.6	1,936	.7682	− .0430	− .1089				
107	Osoyoos....................	119 27.5	49 01.8	952	.7970	− .1055	− .1380				

108	Bridesville.................	119	09.4	49	02.1	3,373	.6794	.0041	− .1108				
109	Summit (Anarchist).........	119	11.9	49	00.9	4,049	.6398	.0298	− .1081				
110	....	119	20.0	49	00.5	3,714	.6523	.0114	− .1151				
111	....	119	25.8	49	01.6	1,004	.7942	− .1032	− .1374				
112	Okanagan Falls.............	119	34.5	49	20.8	1,119	.8258	− .0893	− .1275				
113	....	119	33.5	49	06.0	927	.8017	− .1095	− .1411	.0076	− .0004	.1198	− .0141
114	Oliver......................	119	33.2	49	11.5	971	.8091	− .1062	− .1393				
115	....	119	32.1	49	15.0	1,077	.8173	− .0932	− .1299				
116	Penticton..................	119	35.8	49	30.9	1,128	.8347	− .0947	− .1331	.0049	− .0006	.1239	− .0049
117	Skaha......................	119	36.4	49	27.0	1,115	.8279	− .0969	− .1349				
118	....	119	40.8	49	22.1	2,215	.7558	− .0583	− .1337				
119	Cedar Creek................	119	49.4	49	17.9	1,782	.7663	− .0823	− .1462				
120	Keremeos...................	119	49.5	49	12.2	1,355	.7801	− .1000	− .1462	.0106	− .0006	.1254	− .0108
121	Hedley.....................	120	04.4	49	20.9	1,716	.7726	− .0866	− .1450	.0138	− .0007	.1271	− .0048
122	....	119	55.2	49	13.2	1,430	.7624	− .1122	− .1609				
123	....	119	59.9	49	14.5	1,547	.7627	− .1029	− .1556				
124	Princeton..................	120	30.2	49	27.8	2,098	.7790	− .0547	− .1260	.0024	− .0008	.1238	− .0006
125	....	120	12.2	49	23.4	1,807	.7681	− .0862	− .1478				
126	....	120	18.7	49	26.6	1,895	.7634	− .0875	− .1520				
127	....	120	24.7	49	27.6	1,987	.7688	− .0749	− .1426				
128	Bonnevrier Creek...........	120	37.5	49	08.6	3,383	.6655	− .0186	− .1338	.0059	− .0012	.1297	.0008
129	Whipsaw Creek.............	120	34.1	49	21.9	2,686	.7493	− .0201	− .1116				
130	....	120	34.2	49	18.9	3,949	.6685	.0222	− .1123				
131	Sunday Summit............	120	33.3	49	14.0	4,126	.6361	.0139	− .1266				
132	Skagit Creek..............	121	00.6	49	12.9	2,524	.7077	− .0636	− .1496	.0215	− .0010	.1223	− .0068
133	....	120	44.1	49	04.1	3,710	.6283	− .0183	− .1447				
134	Allison Pass...............	120	51.7	49	06.9	4,400	.6037	.0178	− .1321				
135	Hope (CNR)...............	121	25.9	49	22.2	157	.8929	− .1148	− .1202				
136	Nineteen Mile Creek........	121	09.5	49	14.2	2,100	.7332	− .0799	− .1514				
137	11 Mile Creek.............	121	16.7	49	19.3	1,876	.7796	− .0622	− .1261				
138	Hope (CPR)...............	121	26.7	49	22.9	137	.9002	− .1105	− .1152	.0096	− .0002	.1126	.0068
139	Chilliwack................	121	57.1	49	09.8	32	.9089	− .0922	− .0933	.0018	− .0000	.0821	− .0092
140	Laidlaw...................	121	36.9	49	19.9	90	.9024	− .1083	− .1114				
141	Cheam View..............	121	40.3	49	16.8	100	.8864	− .1187	− .1221				
142	Rosedale..................	121	48.3	49	10.7	47	.8929	− .1081	− .1097				
143	Aldergrove................	122	28.5	49	03.5	336	.9393	− .0238	− .0352				
144	....	122	07.4	49	05.4	15	.9346	− .0615	− .0620	.0000	− .0002	.0594	.0240
145	Abbotsford................	122	17.1	49	03.0	88	.9502	− .0354	− .0384				
146	....	122	22.9	49	03.5	304	.9444	− .0217	− .0321				
147	New Westminster..........	122	54.4	49	12.1	64	.9487	− .0528	− .0550				
148	Langley Prairie............	122	39.2	49	06.2	38	.9458	− .0493	− .0506				

PRINCIPAL FACTS FOR GRAVITY STATIONS—*Continued*

No.	Station	Longitude	Latitude	Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		° ′	° ′	feet							(Airy—40 km.)
149	Cloverdale	122 44.0	49 06.2	13	980.9447	−0.0528	−0.0532				
150	Vancouver, Brockton Point	123 07.0	49 18.0	34	.9597	− .0534	− .0546	.0008	− .0000	.0496	−.0042
151	Coquitlam	122 48.0	49 17.2	34	.9610	− .0509	− .0521				
152	Vancouver (UBC)	123 15.4	49 16.2	285	.9366	− .0502	− .0599				
153	Mission	122 18.5	49 08.0	27	.9763	− .0226	− .0235				
154	Pitt Meadows	122 41.3	49 13.6	23	.9534	− .0541	− .0549				
155	Albion	122 33.2	49 11.0	28	.9639	− .0393	− .0402				
156	Ruskin	122 25.7	49 10.4	33	.9837	− .0181	− .0192				
157	Agassiz	121 46.0	49 14.4	59	.8977	− .1076	− .1097				
158	Deroche	122 04.3	49 11.2	50	.9440	− .0574	− .0591				
159	Spuzzum	121 24.7	49 41.4	398	.8877	− .1260	− .1395				
160	Choate	121 25.7	49 28.4	212	.8961	− .1158	− .1230				
161	Yale	121 25.9	49 33.8	221	.8934	− .1256	− .1331				
162	Boston Bar	121 26.7	49 51.9	453	.8960	− .1281	− .1435	.0177	− .0002	.1233	− .0025
163	Chapman's	121 25.2	49 43.0	358	.8859	− .1339	− .1461				
164	Lytton	121 35.0	50 14.0	566	.9114	− .1349	− .1541	.0161	− .0002	.1313	− .0068
165	Boothroyd	121 28.1	49 57.1	571	.8987	− .1221	− .1415				
166	Cisco	121 34.7	50 08.9	604	.8966	− .1386	− .1592				
167	Spence's Bridge	121 21.0	50 24.5	774	.9304	− .1119	− .1383	.0159	− .0003	.1262	.0035
168		121 23.6	50 16.5	677	.9211	− .1185	− .1416				
169	Drynock	121 23.5	50 20.5	755	.9195	− .1186	− .1443				
170	Cache Creek	121 19.5	50 48.3	1,498	.9301	− .0793	− .1303				
171	Martel	121 18.3	50 28.5	818	.9394	− .1048	− .1326				
172		121 20.9	50 39.0	1,530	.9257	− .0670	− .1191				
173	Ashcroft	121 16.5	50 43.6	993	.9635	− .0863	− .1201	.0065	− .0005	.1232	.0091
174	Savona	120 50.5	50 45.0	1,163	.9607	− .0752	− .1148				
175	McAbee	121 07.9	50 46.8	1,033	.9672	− .0836	− .1188				
176	Walhachin	120 59.3	50 45.2	1,257	.9548	− .0726	− .1154				
177	Kamloops	120 20.0	50 40.6	1,150	.9529	− .0776	− .1168	.0030	− .0005	.1177	.0034
178	Cherry Creek	120 38.4	50 43.1	1,142	.9610	− .0741	− .1130				
179	Tranquille	120 31.0	50 43.3	1,184	.9571	− .0743	− .1147				
180	Kamloops (CPR)	120 19.0	50 40.2	1,161	.9507	− .0782	− .1177				
181		120 19.0	50 36.8	2,656	.8678	− .0157	− .1061				

182	....	120	15.5	50	32.7	2,321	.8658	− .0431	− .1221				
183	....	120	17.4	50	26.8	2,374	.8365	− .0587	− .1396				
184	....	120	27.3	50	14.4	2,053	.8503	− .0563	− .1262				
185	....	120	32.1	50	09.1	2,048	.8497	− .0500	− .1197				
186	Nicola..................	120	40.1	50	09.8	2,048	.8472	− .0525	− .1232				
187	Merritt..................	120	47.2	50	06.5	1,954	.8423	− .0623	− .1289	.0028	− .0008	.1288	.0019
188	Coyle..................	120	52.8	50	08.8	1,875	.8426	− .0728	− .1367				
189	Canford..................	121	00.0	50	08.2	1,727	.8618	− .0667	− .1255				
190	Dot..................	121	06.0	50	13.8	1,463	.8787	− .0829	− .1326	.0101	− .0006	.1311	.0079
191	Clapperton..................	121	12.8	50	19.8	1,139	.9062	− .0949	− .1337				
192	Chapperon Lake............	120	03.5	50	13.3	3,051	.7965	− .0150	− .1189				
193	Douglas Lake..............	120	17.1	50	08.4	2,633	.8239	− .0196	− .1093				
194	Thallia..................	120	45.6	49	46.4	2,859	.7550	− .0347	− .1321	.0037	− .0011	.1251	− .0044
195	Manning..................	120	47.1	49	38.7	2,630	.7615	− .0383	− .1279				
196	Tulameen..................	120	45.5	49	32.6	2,557	.7680	− .0295	− .1166				
197	Coalmont..................	120	41.6	49	30.7	2,442	.7709	− .0346	− .1178				
198	Osprey Lake..............	120	11.1	49	43.1	3,601	.6813	− .0337	− .1563				
199	Jellicoe..................	120	16.9	49	40.4	3,357	.6922	− .0417	− .1560	.0045	− .0012	.1255	− .0272
200	Jura..................	120	27.0	49	32.6	3,041	.7222	− .0298	− .1333				
201	Stump Lake..............	120	19.8	50	22.8	2,473	.8367	− .0432	− .1274	.0020	− .0010	.1220	− .0044
202	Monte Creek..............	119	57.1	50	38.9	1,154	.9622	− .0657	− .1051	.0053	− .0005	.1177	.0174
203	Campbell Creek............	120	04.8	50	39.6	1,151	.9484	− .0808	− .1200				
204	Sorrento..................	119	28.1	50	52.5	1,366	.9449	− .0830	− .1295	.0031	− .0006	.1189	− .0081
205	Pritchard..................	119	48.9	50	41.1	1,151	.9613	− .0699	− .1091				
206	B.M. 344C..............	119	45.0	50	45.4	1,140	.9336	− .1051	− .1439				
207	Chase..................	119	41.7	50	49.0	1,184	.9316	− .1083	− .1487				
208	Squilax..................	119	35.4	50	51.7	1,299	.9388	− .0942	− .1385				
209	Salmon Arm..............	119	16.8	50	42.1	1,159	.9307	− .1013	− .1408				
210	....	119	22.5	50	51.1	1,498	.9350	− .0784	− .1294				
211	Tappen..................	119	20.0	50	46.9	1,159	.9333	− .1059	− .1448				
212	Grindrod..................	119	08.8	50	36.8	1,210	.9396	− .0799	− .1211	.0031	− .0006	.1255	.0069
213	Canoe..................	119	13.4	50	45.1	1,150	.9435	− .0938	− .1330				
214	....	119	12.4	50	39.9	1,700	.9091	− .0690	− .1269				
215	Vernon..................	119	16.1	50	15.9	1,251	.9043	− .0804	− .1230	.0024	− .0006	.1177	− .0035
216	Sweetsbridge..............	119	28.8	50	27.1	1,748	.8919	− .0627	− .1222				
217	Falkland..................	119	33.2	50	30.0	1,921	.8913	− .0511	− .1165	.0080	− .0008	.1185	.0092
218	Westwold..................	119	45.0	50	28.7	2,070	.8668	− .0599	− .1304				
219	Monte Lake..............	119	50.7	50	31.5	2,280	.8696	− .0413	− .1190				
220	Ducks Meadow............	119	53.9	50	34.7	2,141	.8892	− .0396	− .1124				
221	O'Keefe..................	119	19.1	50	24.2	1,553	.9007	− .0678	− .1207				
222	Lumby..................	118	57.5	50	15.0	1,624	.8771	− .0711	− .1265				

PRINCIPAL FACTS FOR GRAVITY STATIONS—*Continued*

No.	Station	Longitude		Latitude		Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		°	′	°	′	feet							(Airy—40 km.)
223	Pass Creek.................	118	30.5	50	09.8	2,880	980.7777	−0.0447	−0.1428				
224	Kettle River...............	118	28.9	50	04.8	3,854	.7067	− .0166	− .1479				
225	Inonaklin River............	118	20.5	50	00.0	3,557	.7050	− .0390	− .1602				
226	Needles....................	118	05.5	49	52.0	1,423	.8204	− .1125	− .1610	.0059	− .0006	.1283	− .0274
227	....	118	11.2	49	55.2	1,606	.8098	− .1107	− .1654				
228	Cherryville................	118	36.0	50	14.6	1,780	.8585	− .0745	− .1351	.0043	− .0007	.1274	− .0041
229	Lavington..................	119	06.0	50	14.1	1,719	.8703	− .0677	− .1263				
230	Vernon.....................	119	16.1	50	15.9	1,244	.9050	− .0804	− .1228				
231	Kelowna....................	119	29.1	49	53.8	1,131	.8686	− .0839	− .1330	.0025	− .0004	.1200	− .0109
232	Oyama......................	119	22.5	50	06.7	1,291	.8863	− .0810	− .1249				
233	Winfield...................	119	23.9	50	01.3	1,400	.8691	− .0798	− .1275				
234	Rutland....................	119	24.0	49	55.0	1,330	.8645	− .0817	− .1270				
235	Peachland..................	119	44.5	49	46.7	1,129	.8529	− .1000	− .1385				
236	Westbank...................	119	37.2	49	50.1	1,129	.8623	− .0955	− .1340				
237	Greata.....................	119	44.7	49	42.3	1,130	.8469	− .0993	− .1378				
238	Summerland.................	119	39.5	49	36.5	1,129	.8421	− .0956	− .1341				
239	Klo Creek..................	119	21.8	49	49.3	1,847	.8314	− .0579	− .1208				
240	....	119	16.4	49	50.1	2,934	.7705	− .0175	− .1174				
241	McCulloch..................	119	10.9	49	46.9	4,130	.6938	.0229	− .1178				
242	Larkin.....................	119	14.1	50	22.3	1,306	.9158	− .0732	− .1176				
243	Armstrong..................	119	11.3	50	27.0	1,177	.9256	− .0823	− .1226				
244	Enderby....................	119	08.0	50	33.3	1,160	.9347	− .0841	− .1238				
245	....	118	53.4	50	34.1	1,230	.9215	− .0919	− .1340				
246	Mable Lake.................	118	44.0	50	36.1	1,307	.9109	− .0983	− .1430				
247	Sicamous...................	118	59.5	50	50.3	1,155	.9464	− .0979	− .1374	.0066	− .0006	.1273	− .0041
248	....	119	03.1	50	40.9	1,177	.9388	− .0895	− .1298				
249	....	119	01.5	50	45.1	1,151	.9470	− .0900	− .1294				
250	Taft.......................	118	35.9	50	59.5	1,281	.9283	− .1178	− .1616				
251	Cambie.....................	118	52.2	50	53.5	1,175	.9383	− .1091	− .1491				
252	....	118	46.1	50	56.7	1,212	.9347	− .1140	− .1553				
253	Craigellachie..............	118	43.2	50	58.5	1,226	.9390	− .1111	− .1528				
254	Revelstoke.................	118	12.0	51	00.0	1,496	.9050	− .1216	− .1725	.0087	− .0007	.1477	− .0168
255	....	118	29.0	50	56.5	1,666	.9037	− .1019	− .1586				

256	....	118	21.5	50	58.1	1,842	.8718	– .1197	– .1825				
257	Greenslide................	118	06.1	50	53.0	1,485	.8853	– .1319	– .1827				
258	....	118	04.0	50	49.1	1,422	.8906	– .1271	– .1756				
259	Sidmouth.................	117	57.5	50	44.1	1,410	.8849	– .1265	– .1745				
260	Arrowhead................	117	54.8	50	42.3	1,407	.8781	– .1309	– .1788	.0188	– .0006	.1442	– .0164
261	Revelstoke................	118	11.1	50	59.9	1,496	.9067	– .1201	– .1710				
262	....	118	11.0	51	01.0	3,929	.7609	– .0383	– .1722				
263	Mt. Revelstoke............	118	08.4	51	03.1	6,230	.6103	.0243	– .1879				
264	Carnes Creek..............	118	22.3	51	17.6	1,705	.9053	– .1278	– .1859				
265	Silvertip Falls.............	118	09.9	51	04.9	1,623	.8904	.1316	– .1869				
266	Laforme Creek............	118	11.9	51	13.0	1,813	.8859	– .1311	– .1919				
267	Downie Creek.............	118	27.8	51	27.5	1,628	.9281	– .1269	– .1823				
268	Mars Creek................	118	22.6	51	20.6	1,641	.9129	– .1344	– .1863				
269	Goldstream................	118	36.8	51	39.0	1,806	.9491	– .1059	– .1674				
270	....	118	35.0	51	35.3	1,910	.9208	– .1189	– .1876				
271	Birch Creek...............	118	33.3	51	55.3	1,910	.9438	– .1253	– .1904				
272	Nickel Creek..............	118	38.5	51	44.8	2,002	.9414	– .1036	– .1718				
273	Bigmouth Creek...........	118	36.1	51	50.1	1,860	.9528	– .1132	– .1766				
274	Boat Encampment..........	118	26.1	52	06.9	1,950	.9518	– .1306	– .1970	.0065	– .0008	.1593	– .0320
275	Mica Creek................	118	33.7	52	00.8	1,862	.9487	– .1328	– .1962				
276	Potlach Creek..............	118	32.0	52	06.1	1,932	.9476	– .1353	– .2011				
277	Kinbasket..................	118	01.7	51	57.6	2,214	.9070	– .1369	– .2124				
278	Cummins Creek............	118	13.2	52	02.3	2,187	.9071	– .1461	– .2206				
279	Tsar Creek................	118	04.5	51	59.1	2,252	.9019	– .1409	– .2176				
280	Bush River................	117	36.2	51	45.7	2,378	.8952	– .1158	– .1968				
281	Boulder Creek.............	117	52.8	51	52.5	2,265	.8983	– .1332	– .2104				
282	Big Foster Creek...........	117	42.1	51	48.1	2,335	.8936	– .1242	– .2037				
283	Bluewater Creek...........	117	14.1	51	32.0	2,625	.8630	– .1045	– .1939				
284	....	117	26.5	51	39.2	3,232	.8388	– .0824	– .1925				
285	....	117	18.0	51	33.2	3,065	.8430	– .0719	– .1893				
286	Golden....................	116	57.9	51	17.9	2,580	.8351	– .1162	– .2041	.0069	– .0010	.1725	– .0257
287	Donald....................	117	09.9	51	29.2	2,581	.8573	– .1105	– .1984	.0069	– .0010	.1703	– .0232
288	Blaeberry River...........	117	03.3	51	25.7	2,571	.8560	– .1076	– .1951				
289	Moberly...................	117	01.1	51	23.0	2,554	.8519	– .1092	– .1962				
290	Parson....................	116	35.5	51	04.2	2,587	.8087	– .1216	– .2097				
291	Nicholson.................	116	54.2	51	14.5	2,581	.8295	– .1166	– .2045				
292	McMurdo..................	116	46.1	51	08.5	2,583	.8152	– .1219	– .2100				
293	Brisco.....................	116	16.9	50	49.9	2,601	.7870	– .1209	– .2095				
294	Harrogate.................	116	27.5	50	59.0	2,591	.8000	– .1224	– .2006				
295	Spillimacheen.............	116	22.0	50	54.5	2,601	.7917	– .1230	– .2116				
296	Invermere.................	116	01.2	50	30.2	2,710	.7679	– .1006	– .1929	.0042	– .0010	.1712	– .0185

PRINCIPAL FACTS FOR GRAVITY STATIONS—*Continued*

No.	Station	Longitude	Latitude	Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		° ′	° ′	feet							(Airy—40 km.)
297	Radium Junction...........	116 04.2	50 37.2	2,875	980.7645	−0.0990	−0.1969	.0059	− .0011	.1687	− .0234
298	Kindersley Creek..........	116 10.3	50 44.2	2,689	.7816	− .1096	− .2012	.0065	− .0010	.1751	− .0206
299	....	116 08.1	50 42.8	2,881	.7695	− .1015	− .1996	.0059	− .0011	.1735	− .0213
300	....	116 06.9	50 41.1	2,687	.7788	− .1080	− .1995	.0069	− .0010	.1731	− .0205
301	....	116 04.9	50 39.2	2,904	.7651	− .0986	− .1974				
302	Radium Station............	116 05.6	50 37.5	2,621	.7839	− .1040	− .1933	.0057	− .0010	.1709	− .0177
303	....	116 03.0	50 36.0	3,199	.7442	− .0870	− .1960	.0042	− .0012	.1720	− .0210
304	....	116 01.8	50 34.1	2,887	.7605	− .0972	− .1956	.0053	− .0010	.1722	−0.0191
305	....	116 00.3	50 32.0	2,918	.7539	− .0977	− .1971	.0027	− .0011	.1692	− .0263
306	....	115 59.9	50 30.9	2,855	.7561	− .0999	− .1971	.0042	− .0011	.1728	− .0212
307	....	116 22.9	50 33.8	3,599	.6979	− .0924	− .2150	.0212	− .0013	.1673	− .0278
308	....	116 19.7	50 34.3	3,553	.7094	− .0860	− .2070	.0153	− .0013	.1678	− .0252
309	....	116 17.6	50 34.2	3,526	.7140	− .0837	− .2038	.0132	− .0013	.1673	− .0246
310	....	116 15.6	50 33.9	3,537	.7188	− .0775	− .1980	.0106	− .0013	.1659	− .0228
311	....	116 14.0	50 33.7	3,480	.7242	− .0772	− .1957	.0077	− .0013	.1631	− .0262
312	....	116 12.2	50 33.5	3,469	.7265	− .0756	− .1938	.0060	− .0012	.1651	− .0239
313	....	116 09.8	50 33.0	3,464	.7315	− .0703	− .1883	.0032	− .0012	.1655	− .0202
314	....	116 06.8	50 32.4	3,126	.7514	− .0813	− .1877	.0031	− .0012	.1702	− .0156
315	....	116 05.4	50 32.8	2,934	.7634	− .0879	− .1879	.0032	− .0011	.1703	− .0155
316	Wilmer....................	116 03.4	50 32.0	2,863	.7677	− .0891	− .1866	.0037	− .0011	.1702	− .0138
317	....	116 04.6	50 34.0	2,850	.7692	− .0918	− .1889	.0034	− .0011	.1720	− .0146
318	....	116 06.0	50 35.0	2,827	.7707	− .0940	− .1903	.0034	− .0011	.1705	− .0171
319	....	116 07.0	50 35.4	3,006	.7635	− .0850	− .1873	.0031	− .0011	.1718	− .0135
320	....	116 08.9	50 36.3	3,265	.7523	− .0732	− .1844	.0028	− .0012	.1725	− .0103
321	....	116 10.4	50 37.2	3,225	.7553	− .0753	− .1851	.0035	− .0012	.1725	− .0103
322	....	116 13.4	50 39.5	3,280	.7539	− .0750	− .1867	.0061	− .0012	.1743	− .0075
323	....	116 16.1	50 41.5	3,389	.7489	− .0724	− .1879	.0069	− .0012	.1743	− .0079
324	....	116 09.5	50 38.1	3,840	.7205	− .0527	− .1844	.0027	− .0014	.1722	− .0109
325	....	116 10.0	50 39.8	4,425	.6862	− .0354	− .1861				
326	Paradise Mine.............	116 19.8	50 28.3	7,470	.4751	− .0569	− .1975	.0137	− .0017	.1732	− .0123
327	....	116 12.6	50 28.5	3,615	.6959	− .0852	− .2083	.0195	− .0012	.1716	− .0184
328	....	116 07.9	50 30.0	3,438	.7259	− .0738	− .1909	.0056	− .0012	.1716	− .0149
329	....	116 05.2	50 30.6	3,094	.7506	− .0824	− .1878	.0033	− .0011	.1707	− .0149

330	....	116	02.6	50	31.2	2,644	.7775	− .0987	− .1888	.0044	− .0010	.1690	− .0164
331	Canal Flats................	115	50.1	50	09.1	2,666	.7601	− .0814	− .1722	.0039	− .0010	.1628	− .0065
332	....	115	59.0	50	28.5	2,770	.7618	− .0988	− .1931	.0039	− .0010	.1685	− .0217
333	....	115	55.3	50	26.2	2,868	.7566	− .0912	− .1889	.0045	− .0011	.1681	− .0174
334	....	115	52.9	50	24.5	3,132	.7423	− .0782	− .1849	.0058	− .0012	.1683	− .0120
335	....	115	52.2	50	22.5	2,840	.7565	− .0885	− .1852	.0050	− .0011	.1683	− .0130
336	....	115	51.8	50	19.4	2,653	.7601	− .0980	− .1883	.0053	− .0010	.1663	− .0178
337	....	115	53.2	50	17.3	2,818	.7519	− .0875	− .1835	.0039	− .0011	.1642	− .0165
338	....	115	52.4	50	14.4	2,829	.7497	− .0843	− .1807	.0042	− .0011	.1631	− .0145
339	....	115	51.5	50	10.8	2,800	.7529	− .0784	− .1738	.0031	− .0011	.1640	− .0078
340	....	116	00.6	50	07.6	3,522	.6998	− .0589	− .1789	.0042	− .0012	.1676	− .0083
341	....	115	58.6	50	08.0	3,530	.7012	− .0574	− .1776	.0039	− .0012	.1665	− .0084
342	....	115	55.9	50	08.6	3,305	.7136	− .0670	− .1795	.0082	− .0012	.1651	− .0075
343	....	115	53.4	50	08.5	3,270	.7224	− .0614	− .1728	.0050	− .0012	.1652	− .0038
344	....	115	51.4	50	08.7	3,210	.7303	− .0595	− .1688	.0031	− .0012	.1639	− .0030
345	....	115	39.1	50	19.8	3,077	.7333	− .0855	− .1903	.0084	− .0011	.1603	− .0227
346	....	115	41.5	50	18.7	3,019	.7392	− .0834	− .1863	.0099	− .0011	.1648	− .0127
347	....	115	41.6	50	15.9	2,852	.7508	− .0833	− .1805	.0104	− .0011	.1641	− .0071
348	....	115	41.7	50	14.4	2,793	.7490	− .0884	− .1835	.0123	− .0011	.1639	− .0084
349	....	115	42.4	50	12.8	2,810	.7521	− .0813	− .1770	.0083	− .0011	.1636	− .0062
350	....	115	43.8	50	11.6	2,748	.7543	− .0831	− .1767	.0062	− .0010	.1612	− .0103
351	....	115	46.1	50	10.3	3,045	.7392	− .0684	− .1721	.0049	− .0011	.1625	− .0058
352	Canal Flats Village..........	115	48.2	50	09.2	2,679	.7599	− .0775	− .1688	.0025	− .0010	.1615	− .0058
353	Skookumchuck.............	115	44.1	49	54.7	2,563	.7512	− .0786	− .1659	.0026	− .0010	.1588	− .0055
354	....	115	46.4	50	07.2	2,737	.7550	− .0770	− .1702	.0036	− .0010	.1593	− .0083
355	....	115	45.5	50	05.4	2,889	.7465	− .0685	− .1669	.0017	− .0011	.1593	− .0070
356	....	115	45.3	50	03.4	2,923	.7426	− .0662	− .1657	.0015	− .0011	.1599	− .0054
357	....	115	45.1	50	01.5	2,899	.7431	− .0651	− .1639	.0015	− .0011	.1583	− .0052
358	....	115	45.4	49	59.6	2,883	.7399	− .0671	− .1653	.0015	− .0011	.1584	− .0065
359	....	115	45.5	49	57.4	2,820	.7427	− .0669	− .1630	.0019	− .0011	.1586	− .0036
360	....	115	48.9	49	54.0	2,874	.7362	− .0633	− .1612	.0015	− .0011	.1572	− .0036
361	....	115	47.3	49	54.0	2,792	.7418	− .0654	− .1605	.0016	− .0011	.1575	− .0025
362	....	115	46.0	49	54.5	2,620	.7494	− .0748	− .1640	.0026	− .0010	.1571	− .0043
363	....	115	44.9	49	54.3	2,657	.7496	− .0708	− .1613	.0024	− .0010	.1563	− .0036
364	....	115	39.9	49	59.5	2,980	.7324	− .0654	− .1669	.0023	− .0011	.1600	− .0057
365	....	115	40.5	49	58.5	2,929	.7332	− .0679	− .1677	.0026	− .0011	.1602	− .0060
366	....	115	40.2	49	57.6	2,886	.7353	− .0684	− .1667	.0027	− .0011	.1592	− .0059
367	....	115	41.6	49	56.3	2,835	.7349	− .0717	− .1683	.0030	− .0011	.1596	− .0068
368	....	115	42.7	49	55.8	2,820	.7350	− .0722	− .1683	.0022	− .0011	.1579	− .0093
369	....	115	44.1	49	55.5	2,800	.7395	− .0692	− .1646	.0020	− .0011	.1584	− .0053
370	Kimberly..................	115	58.9	49	41.1	3,661	.6883	− .0184	− .1431	.0020	− .0013	.1512	.0088

PRINCIPAL FACTS FOR GRAVITY STATIONS—*Continued*

No.	Station	Longitude	Latitude	Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		° ′	° ′	feet							(Airy—40 km.)
371	....	115 43.5	49 52.1	2,578	980.7496	−0.0749	−0.1627	.0027	− .0010	.1553	− .0052
372	....	115 45.0	49 49.8	2,553	.7528	− .0708	− .1577	.0020	− .0010	.1518	− .0049
373	....	115 46.2	49 48.2	2,539	.7536	− .0689	− .1554	.0022	− .0010	.1528	− .0014
374	....	115 46.8	49 45.4	2,885	.7280	− .0577	− .1560	.0012	− .0011	.1513	− .0049
375	....	115 47.7	49 42.4	2,911	.7264	− .0524	− .1515	.0007	− .0011	.1513	− .0006
376	....	115 51.6	49 41.9	3,222	.7112	− .0376	− .1474	.0005	− .0012	.1487	.0006
377	....	115 45.9	49 33.3	2,966	.7155	− .0446	− .1456	.0005	− .0011	.1453	− .0009
378	....	115 48.1	49 34.3	3,010	.7139	− .0436	− .1461	.0008	− .0011	.1461	− .0003
379	....	115 51.7	49 36.2	2,902	.7255	− .0449	− .1438	.0010	− .0011	.1473	.0034
380	....	115 54.2	49 36.9	3,061	.7174	− .0392	− .1434	.0007	− .0011	.1497	.0059
381	Marysville.................	115 57.6	49 38.2	3,100	.7194	− .0354	− .1410	.0017	− .0011	.1506	.0102
382	St. Mary Lake..............	116 10.1	49 36.5	3,201	.6916	− .0512	− .1602	.0116	− .0012	.1539	.0041
383	....	116 16.0	49 37.4	3,217	.6816	− .0610	− .1706	.0160	− .0012	.1548	− .0010
384	....	116 19.0	49 39.1	3,290	.6815	− .0568	− .1689	.0130	− .0012	.1553	− .0013
385	....	116 06.6	49 37.4	3,132	.6949	− .0555	− .1624	.0099	− .0012	.1533	− .0004
386	....	116 03.4	49 37.7	3,142	.6995	− .0507	− .1577	.0060	− .0012	.1515	− .0014
387	....	116 01.7	49 38.1	3,077	.7109	− .0460	− .1508	.0051	− .0011	.1515	.0047
388	....	116 00.1	49 38.1	3,158	.7114	− .0379	− .1454	.0037	− .0012	.1520	.0091
389	....	115 52.3	49 35.2	3,018	.7138	− .0442	− .1470	.0012	− .0011	.1485	.0016
390	....	115 55.9	49 34.6	3,049	.7115	− .0427	− .1466	.0024	− .0011	.1499	.0046
391	....	115 57.5	49 33.5	3,203	.6984	− .0397	− .1488	.0038	− .0012	.1515	.0053
392	....	115 55.5	49 34.9	3,915	.6577	− .0165	− .1495	.0037	− .0013	.1546	.0075
393	....	115 12.6	49 14.1	2,623	.6884	− .0754	− .1647	.0009	− .0010	.1476	− .0172
394	....	115 13.2	49 11.6	2,399	.7040	− .0770	− .1588	.0015	− .0009	.1476	− .0106
395	....	115 14.2	49 12.1	2,406	.7139	− .0673	− .1492	.0016	− .0009	.1479	− .0006
396	....	115 16.8	49 11.9	2,845	.6942	− .0454	− .1423	.0007	− .0011	.1477	.0050
397	....	115 18.3	49 12.2	3,062	.6834	− .0362	− .1405	.0005	− .0011	.1469	.0064
398	....	115 21.3	49 13.1	3,350	.6703	− .0236	− .1377	.0009	− .0012	.1471	.0091
399	Gold Creek.................	115 25.0	49 12.4	3,228	.6812	− .0231	− .1330	.0016	− .0012	.1497	.0171
400	....	115 10.9	49 16.5	2,720	.6934	− .0649	− .1575	.0011	− .0010	.1494	− .0080
401	....	115 09.0	49 17.5	2,880	.6937	− .0510	− .1491	.0013	− .0010	.1485	− .0005
402	....	115 04.1	49 18.0	3,046	.6734	− .0564	− .1601				
403	Morrissey..................	115 00.8	49 23.3	3,139	.6707	− .0582	− .1652	.0079	− .0012	.1505	− .0080

404	Galloway	115	12.2	49	21.2	2,849	.6946	− .0584	− .1555	.0019	− .0011	.1473	− .0074
405	Jaffray	115	18.1	49	22.2	2,702	.6945	− .0738	− .1659	.0010	− .0010	.1471	− .0188
406	Tokay	115	28.1	49	28.0	2,585	.7210	− .0670	− .1551	.0019	− .0010	.1454	− .0088
407	Ramport	115	37.0	49	31.5	2,686	.7242	− .0595	− .1510	.0021	− .0010	.1474	− .0025
408	Eagen	115	42.7	49	33.5	2,930	.7164	− .0474	− .1472	.0012	− .0011	.1468	− .0003
409		115	44.2	49	32.4	2,952	.7172	− .0428	− .1434	.0008	− .0011	.1465	.0028
410	Lumberton	115	52.1	49	25.3	3,236	.6955	− .0273	− .1375	.0023	− .0012	.1501	.0137
411	Fassifern	115	50·9	49	27.2	3,261	.7011	− .0222	− .1332	.0015	− .0012	.1488	.0159
412		115	47.9	49	29.9	3,056	.7114	− .0352	− .1393	.0018	− .0011	.1482	.0096
413		115	40.2	49	35.3	2,770	.7214	− .0601	− .1545	.0011	− .0010	.1532	− .0012
414		115	39.3	49	36.1	2,731	.7186	− .0678	− .1608	.0015	− .0010	.1525	− .0077
415	Fort Steele	115	37.7	49	36.7	2,522	.7285	− .0785	− .1644	.0026	− .0010	.1541	− .0087
416		115	36.9	49	37.1	2,714	.7189	− .0706	− .1631	.0026	− .0010	.1539	− .0076
417		115	36.0	49	39.7	3,107	.7099	− .0466	− .1524	.0054	− .0011	.1567	.0086
418		115	34.2	49	39.7	3,185	.7015	− .0476	− .1561	.0093	− .0012	.1567	.0087
419		115	36.9	49	39.3	2,816	.7223	− .0609	− .1568	.0040	− .0011	.1558	.0019
420		115	38.0	49	38.3	2,750	.7163	− .0716	− .1553	.0030	− .0010	.1548	− .0085
421		115	38.3	49	40.4	2,797	.7197	− .0668	− .1621	.0034	− .0011	− .1570	− .0028
422		115	41.3	49	41.9	2,544	.7371	− .0755	− .1622	.0037	− .0010	.1543	− .0052
423	Wasa	115	47.0	49	45.7	2,536	.7492	− .0699	− .1562	.0024	− .0010	.1551	.0003
424		115	47.0	49	39.7	2,863	.7204	− .0590	− .1565	.0006	− .0011	.1533	− .0037
425		115	44.0	49	37.0	2,781	.7258	− .0572	− .1519	.0008	− .0010	.1507	− .0014
426		115	45.1	49	35.4	2,646	.7335	− .0598	− .1499	.0013	− .0010	.1494	− .0002
427	Lake Louise	116	12·2	51	25.5	5,051	.7293	− .0007	− .1727	.0046	− .0015	.1755	.0059
428	Great Divide	116	18.2	51	27.1	5,330	.7067	+ .0005	− .1810				
429	Field	116	30.1	51	23.7	4,074	.7526	− .0666	− .2054				
430		116	34.9	51	17.9	3,697	.7649	− .0814	− .2073				
431	Yoho	116	25.5	51	25.7	4,759	.7212	− .0366	− .1987				
432	Banff	115	35.0	51	10.9	4,537	.7584	.0017	− .1529	.0046	− .0014	.1751	.0254
433	Castle Mountain	115	54.6	51	15.9	4,693	.7437	− .0059	− .1657				
434	Sawback	115	42.1	51	10.1	4,547	.7465	− .0081	− .1630				
435	Massive	115	47.3	51	13.2	4,594	.7492	− .0056	− .1621				
436	Hawk Creek	116	03.6	51	04.9	4,390	.7266	− .0352	− .1847	.0095	− .0014	.1780	.0014
437	Continental Divide	116	02.9	51	13.6	5,386	.6883	.0074	− .1760				
438		116	07.6	51	07.7	4,699	.7097	− .0272	− .1873				
439	Kootenay River	116	02.6	50	53.0	3,845	.7416	− .0538	− .1848	.0036	− .0013	.1750	− .0075
440		115	58.7	51	01.5	4,150	.7369	− .0423	− .1837				
441		115	58.4	50	56.5	4,128	.7256	− .0485	− .1891				
442		115	59.9	50	47.7	3,740	.7312	− .0664	− .1938				
443		115	53.8	50	42.1	3,916	.7165	− .0562	− .1895				
444		115	56.1	50	40.6	4,853	.6528	− .0294	− .1947	.0085	− .0015	.1710	− .0167

PRINCIPAL FACTS FOR GRAVITY STATIONS—*Continued*

No.	Station	Longitude	Latitude	Elevation	Observed Gravity	Free Air Anomaly	Bouguer Anomaly	Terrain	Curvature	T + C (A to 1)	Isostatic
		° ′	° ′	feet							(Airy—40 km.)
445	....	115 58.3	50 38.8	4,102	980.6903	–0.0602	–0.1999	.0133	– .0014	.1693	– .0187
446	....	116 01.4	50 38.2	3,483	.7215	– .0863	– .2049	.0187	– .0012	.1659	– .0215
447	Kananaskis................	115 07.2	51 05.3	4,231	.7755	– .0018	– .1459				
448	Cochrane..................	114 28.8	51 12.5	3,759	.8136	– .0187	– .1468				
449	Eldon.....................	116 02.6	51 21.5	4,827	.7334	– .0116	– .1761				
450	Temple....................	116 06.0	51 22.4	4,920	.7313	– .0063	– .1739				
451	Bow Pass..................	116 30.0	51 43.5	6,645	.6652	.0592	– .1671	.0052	– .0017	.1803	.0167
452	....	116 17.7	51 33.0	5,975	.6854	.0315	– .1720				
453	....	116 22.6	51 38.6	6,268	.6821	.0474	– .1661				
454	Saskatchewan River.........	116 41.7	51 58.1	4,563	.8005	– .0233	– .1787	.0070	– .0014	.1801	.0070
455	....	116 34.3	51 47.0	5,688	.7200	.0191	– .1746				
456	....	116 39.6	51 51.8	5,464	.7382	.0086	– .1775				
457	....	116 54.5	52 04.3	4,715	.7806	– .0378	– .1984				
458	....	116 49.5	52 00.2	4,706	.7928	– .0202	– .1805				
459	Gatehouse..................	117 12.3	52 12.9	6,583	.6967	.0415	– .1827	.0087	– .0017	.1788	.0031
460	Big Hill Creek..............	117 01.8	52 09.9	5,112	.7688	– .0206	– .1947				
461	Sunwapta Falls..............	117 38.2	52 31.9	4,564	.8447	– .0280	– .1835	.0068	– .0014	.1763	– .0018
462	....	117 20.3	52 20.4	5,161	.7856	– .0148	– .1899				
463	....	117 26.7	52 26.8	5,051	.8064	– .0133	– .1853				
464	Jasper.....................	118 05.0	52 52.5	3,483	.9306	– .0738	– .1924	.0046	– .0012	.1668	– .0222
465	....	117 48.2	52 41.2	4,026	.8799	– .0570	– .1941				
466	Leach Lake................	117 54.1	52 46.6	4,070	.8893	– .0515	– .1901				
467	Astoria River...............	118 01.9	52 46.8	4,009	.8958	– .0510	– .1876				
468	Rock Cut..................	117 57.5	53 10.5	3,267	.9961	– .0544	– .1657	.0050	– .0012	.1538	– .0081
469	Hinton.....................	117 35.2	53 24.3	3,327	981.0323	– .0324	– .1457				
470	Galloway..................	116 52.1	53 32.4	3,270	.0715	– .0103	– .1217				
471	Edson.....................	116 25.3	53 34.9	3,042	.0997	– .0071	– .1107	– .0001	– .0011	.1148	.0029
472	Edmonton..................	113 31.0	53 31.6	2,202	.1691	– .0121	– .0871	.0001	– .0009	.0798	– .0069
473	Calgary (Library)...........	114 04.2	51 02.5	3,439	980.8304	– .0187	– .1358	.0000	– .0012	.1266	– .0104
474	Morley (1952)..............	114 51.2	51 09.6	4,078	.7951	– .0028	– .1417	.0004	– .0013	.1518	.0092