COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/88

ALTIMETER TESTS, ROSEDALE AREA,

VICTORIA 1951

by

J.C. DOOLEY

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ILLUSTRATIONS

SUMMARY

Measurements of elevation were made with aircraft altimeters over a series of stations which had been previously surveyed with a spirit level. The object of the tests was to assess the accuracy of these instruments with a view to their use in gravity surveying. The leap-frog method was used. After distribution of cumulative errors around closed loops, the standard error of the elevations is about $\pm$ 9 ft. Part of this error is due to a systematic error that occurs when the altimeters change from rising to falling or vice versa. Field techniques are suggested for minimizing the errors.

1. INTRODUCTION

Tests were made near Rosedale, Victoria, to determine the accuracy with which levels of gravity stations could be measured using standard aviation altimeters, and to investigate methods of reducing the errors involved in an altimeter survey. The tests were made on gravity stations near Rosedale whose level had been determined by orthodox levelling. The altimeters were in two sets of three, and were used in the leap-frog method as described below. Corrections were applied for various factors, and the remaining errors and their probable causes are discussed. A field technique is outlined which should reduce the errors to a minimum.

The tests were made from 29th to 31st May 1951 by the author and J.H. van Son. The weather conditions were far from ideal for altimeter work. A strong westerly wind was blowing for most of the time, and rain fell intermittently.

2. FIELD TECHNIQUE

The instruments used were standard aviation altimeters. Two sets with three altimeters in each set were used, the average value of the three readings of a set being taken as the altimeter reading at a station. The dials of one set were marked at every 10 ft, while those of the other set were marked at every 20 ft. Estimates of readings were generally made to the nearest foot, but were not reliable to this accuracy. The instruments were subject to considerable friction and it was found advisable to tap them several times before taking a reading.

Measurements were made at 71 stations selected from those used in the Gippsland gravity survey. The levels of these stations were known, having been determined during the course of the gravity survey by the ordinary level-and-staff method. The locations of the stations are shown on Plate 1. They are at roughly half-mile intervals and form three closed loops, <u>viz.</u> the Rosedale-Gormandale loop (46 stations), the Rosedale-Willung loop (23 stations, 12 of which are common to the Rosedale-Gormandale loop) and 'The Holey Plain' loop (13 stations). The maximum elevation relief is about 650 ft.

The field technique used was based on the leap-frog method described by Stripling, Broding, and Wilhelm (1949). Fundamentally, the method involves determining the difference in level between two successive stations by taking altimeter readings simultaneously at the two stations. Two vehicles were used, each carrying one set of altimeters. The vehicles were fitted with radio transceivers so that the operators could communicate with each other to ensure simultaneity of readings. In working along a traverse, after reading at a pair of successive stations the rear vehicle would move two stations forward while the front one remained stationary; thus the rear vehicle would move to the forward station of the next pair of successive stations.

At roughly hourly intervals, both sets of altimeters were read simultaneously at the one station so that the drift between the readings of the two sets could be determined.

Readings of temperature and relative humidity were made simultaneously with the altimeter readings so that corrections for atmospheric conditions could be calculated.

3. CORRECTIONS APPLIED

Corrections were applied to the altimeter readings for drift in reading between the two sets of altimeters, and for temperature, humidity, and gravity. The misclosure errors were then distributed around the closed loops.

Brombacher (1944) gives a detailed discussion of the conditions under which altimeters are calibrated and the corrections that should be applied to their readings.

Drift correction

As mentioned above, readings were made of both sets of altimeters at the one station to check the drift. The difference between the average readings of the two sets of altimeters was plotted as a function of the time (Plate 2). Drift corrections at intermediate times were read off the graphs, and were applied to the average readings of one set of altimeters to make them comparable with the average readings of the other set.

Temperature correction

The temperature correction is given by Brombacher (1944, p. 287) as

$$H = Z\,t/T$$

where H = true difference in elevation between stations

Z = difference in altimeter readings

t = mean temperature of air column between the stations on the absolute scale

T = standard temperature for altimeter calibration, adopted as $288^{\circ}K$.

t was taken as the mean of the temperatures at the two stations. The temperature correction was less than three percent for the range of temperatures, about $10^{\circ}C$ to $24^{\circ}C$, but would be more for higher temperatures.

Humidity correction

The humidity correction which was adapted from the formulae given by Stripling _et al._ (1949), was

$$H = (1 + 0.6q)$$

where q = specific humidity, or the ratio of the density of the water vapour in the atmosphere to the density of the air/water-vapour mixture. The factor (1 + 0.6q) is plotted by Stripling _et al._ (1949, p.552) as a function of vapour pressure. To use this graph it is necessary to convert the relative humidity readings to actual vapour pressure. The humidity correction was never more than 0.5 percent, but could be over two percent under hot, moist conditions.

Gravity correction

Assuming a mean value of gravity of 979.97 cm/sec^2 for the area, a gravity correction of 0.06 percent was calculated. This correction is negligible compared with the errors that arise from other sources.

Horizontal pressure gradient correction

The mean horizontal pressure gradient for the area was determined from the meteorological charts issued by the Weather Bureau. This gradient was converted to a correction to the altimeter elevations, the amount of the correction being calculated from the positions of the stations in relation to the base station. The correction was less than 0.5 ft/mile with a maximum correction of 3 ft. This was probably less than the local pressure gradients caused by eddy currents, sudden wind gusts, and other erratic features.

Calculation of station elevations

Difference in station elevations were calculated from the drift-corrected altimeter readings. Assuming the true elevation for the first station, the altimeter elevations of the other stations were calculated successively from these differences. The true and altimeter elevations are listed in Columns A and B respectively of Tables 1, 2, and 3.

The temperature, humidity, and gravity corrections were combined and are listed in Column C of Tables 1, 2, and 3. The horizontal pressure gradient corrections are listed in Column D. The corrected altimeter elevations (Column E) show the misclosure errors for the three loops. These were distributed (Column G) around the loops as would be done if the true station elevations were not known. The adjusted altimeter elevations are listed in Column H. The errors in the unadjusted and adjusted altimeter elevations are listed in Columns F and J respectively.

4. ERRORS AND THEIR CAUSES

Brombacher (1944) gives an excellent account of the possible sources of errors in altimeter readings. The errors to be discussed here are those that are most apparent from the behaviour of the altimeters during the tests.

The errors are summarized as follows:

Loop	No. of stations	Misclosure (ft)	Root mean square error (ft) Before distrib. of misclosure errors	After distrib.
Rosedale-Gormandale (R - G)	46	75	± 42	± 9
Rosedale-Willung (R - W)	23	2	± 9	± 9
'The Holey Plain' (HP)	13	33	± 21	± 6

The errors tend to accumulate positively in the direction of working along the traverse; this accounts for the large misclosure errors. The R-W loop is no exception to this in spite of the small misclosure error. The two arms of the loop were worked in the same direction from Station 1008 to Station 1043, giving errors of + 13 ft and + 15 ft for Station 1043, and therefore a residual misclosure of 2 ft. Thus it is better to express the errors as a combination of a cumulative error of so much per station, with an erratic r.m.s. error. On this basis we have, allowing for the reversal of direction in the R-W loop:

Loop	Cumulative error per station (ft)	Erratic r.m.s. error (ft)
R-G	1.6	$\pm$ 9
R-W	1.2	$\pm$ 9
HP	2.5	$\pm$ 6

If the R-W loop had been run completely in the one direction, presumably the errors would have accumulated around the loop giving a much larger misclosure. Distribution of the misclosure errors would then presumably reduce the erratic r.m.s. error substantially.

Plates 3, 4, and 5 were drawn so that the behaviour of the individual altimeters could be studied. The departure of an altimeter is defined as the difference between its reading and its true elevation. The departures for the six altimeters were calculated and were plotted as functions of time on each of the three days. The true elevations of each set were plotted at the bottom of the graph as a function of time.

The departures should show the diurnal variation in barometric pressure, together with any local pressure changes, combined with any changes of reading due to instrumental defects. A smooth curve following the general trend of one of the departure graphs should give the normal diurnal variation combined with any overall drift in instrument reading. Any abrupt pressure changes should affect all six instruments simultaneously.

There is a tendency for the six graphs to follow the same general course. However, many erratic variations occurred over short periods, and the graphs frequently cross and run in opposite directions at the same time. Much of this can only be accounted for by erratic instrument behaviour due to friction and perhaps to jolting and to general insensitiveness.

Two characteristics of the graphs are indicative of more or less systematic instrumental errors. The first is the tendency for the departures to change more while the instruments are being moved from one station to another than while they remain stationary. This effect is not universal, but occurs often enough to suggest that a certain amount of friction exists which tends to prevent the stationary altimeters from following small variations in pressure accurately. As the graphs generally indicate a rise in departures through the day, this effect could account for the positive accumulation of errors in the direction of traversing.

The other characteristic is a backlash or hysteresis effect, or a combination of the two. When one set of altimeters drops in elevation after rising for some time, the altimeter departures for that set rise, usually about 10 to 20 ft; similarly, when a set rises after having fallen for some time, the departures fall. In other words, when a reversal of the direction of change in pressure occurs, the altimeters do not fully follow the change but register a smaller change.

This effect could be due to either hysteresis or frictional effects. With hysteresis, the magnitude of the effect would depend on the magnitude of the pressure cycle; with a simple frictional effect, it should be independent of the magnitude of the pressure cycle. There is not enough information in the results to decide which of these two factors is the cause of this error. It may be a combination of the two. It will be referred to as reversal error.

Brombacher (1944, p.296) gives a table of hysteresis effects for the best altimeters for various pressure cycles. The reversal errors in the Rosedale tests are much greater than the errors shown in Brombacher's table. Whether the reversal error be due to hysteresis or friction, it is obvious that a better type of altimeter is essential for the accuracy of levelling required in most gravity surveys.

5. SUGGESTED METHODS FOR REDUCING ERRORS

One step to obtain greater accuracy of readings, is to use more-sensitive and more-accurate altimeters, preferably of the type especially made for surveying as described by Brombacher (op.cit.). Consideration should also be given to an instrument of the type described by Stripling et al. (1949).

Better results could also probably be obtained by choosing good weather for altimeter surveying. However, this may be awkward and expensive as long periods would be spent waiting for calm weather in some areas. The method should be capable of being used under a wide range of weather conditions, although field work should be abandoned under extremely bad weather conditions.

As regards field technique, the leap-frog method has the advantage over the base-altimeter method in that the two instruments are kept closer together, and are therefore more likely to be subject to the same local pressure fluctuations. Stripling et al. (1949) describe a further refinement in which a series of simultaneous readings is taken at each pair of stations. The operators compare readings by radio-telephone, and continue taking readings until the readings of both altimeters are steady or changing at the same rate. This technique was tried at Rosedale for a few stations, but it was realized that such changes were generally less than those the instruments were capable of reading reliably. This technique slowed the field work down to about half speed.

With the base-altimeter method, cumulative errors could hardly occur on the same scale as was found with the leap-frog method. It has been seen that these errors were reduced considerably by running closed loops and distributing the misclosure errors. However, the provision must be made that the loops are run consistently in the same direction (i.e. clockwise or anti-clockwise), and for preference they should be of such a size that they can be run in a fairly short time during which the barometric variations are more or less uniform.

If it is impossible to run closed loops, then the stations should be re-run in the reverse direction, thus making in effect a 'loop' with two identical sides. In fact, a number of stations measured in the forwards and reverse directions should give greater accuracy than a closed loop, as two values are obtained for each station and these can be averaged. Table 4 is a calculation sheet for a fictitious loop of 16 stations with hypothetical readings to illustrate how reverse running will reduce some of the errors in an altimeter survey. The supposed true elevations are given and altimeter differences between the stations are calculated assuming a uniform cumulative error of 2 ft per station, and a uniform reversal error of 10 ft. The altimeter elevations and errors are worked out from these differences, firstly on the reading of the forward run around the closed loop, with misclosures distributed, and secondly on the mean of the readings from the forward and reverse runs. The following points are noticed :

(a) using one run only, the distribution of misclosure eliminates the cumulative errors,

(b) using the forward run only, when the traverse begins in an uphill direction, the reversal error of 10 ft occurs on all stations proceeding downhill, not on those proceeding uphill,

(c) using both runs, the misclosure is zero, and the cumulative errors are eliminated by averaging the forward and reverse differences,

(d) using both runs, half the reversal error occurs only at the summit of a hill (Station 3) or the trough of a valley (Station 7). Between Stations 10 and 11, the traverse is supposed to rise to 300 ft and then fall to 280 ft, and similarly for the valley between Stations 14 and 15. The results here indicate that, provided a station is below the summit or above the trough by a height greater than the reversal error, no error occurs,

(e) if the loop was run to close at Station 1, and run in reverse immediately, then Station 1 would effectively become a summit and its value would be in error by 5 ft, giving a misclosure of 5 ft. For this reason, the run shown repeats Station 1 and 2 before reversing. Thi misclosure at Station 1 is then zero.

In practice, ideal conditions such as the above grid would not occur. However, it is apparent that the errors are reduced by using both runs. Reverse runs mean twice as much field work, and it may be that the accuracy required for certain surveys is available without this. If one altimeter is to be read by the gravity-meter operator, then as gravity readings are sometimes repeated on the return run, it should be convenient to repeat the altimeter readings also.

6. CONCLUSIONS

It is suggested that the ideal method for obtaining accuracy with an altimeter survey is to run a group of stations by the leap-frog method, and then re-run them in reverse. The group should be of such a number that it can be run and re-run in a reasonably short time, say half a day. Ties between groups should overlap one station for preference, as possibly the value obtained for the last station of a group should be ignored. Where practicable, one or more groups of stations should form a closed loop, and misclosure errors should be distributed. Temperature and humidity readings should be taken with the altimeter readings, and horizontal pressure gradients should be calculated from the daily weather charts. However, many of the above corrections may be of little value unless the altimeters used are of a greater precision than the aviation altimeters used in the Rosedale tests.

7. REFERENCES

BROMBACHER, W.G.	1944	Altitude by measurement of air pressure and temperature. J. Wash. Acad. Sci. 34 (9), 277-299.
STRIPLING, A.A., BRODING, R.A. and WILHEIM, E.S.	1949	Elevation surveying by precision barometric means. Geophysics, 14 (4), 543-557.

TABLE 1

ROSEDALE - GORMANDALE LOOP.

Station	A True Elevation	B Altimeter Elevation	C Temp. & Hum. Corr.	D Horiz. Grad. Corr.	E=B+C+D Corrd. Altim. Elev.	F=E-A Errors	G Misclosure Adjustment	H=E+G Adj. Altim. Elev.	J=H-A Errors
1009	57	57	0	0	57	0	0	57	0
1008	66	66	0	0	66	0	0	66	0
1007	100	102	0	0	102	+ 2	0	102	+ 2
1006	108	108	0	0	108	0	0	108	0
1005	138	138	0	- 1	137	- 1	- 1	136	- 2
1036	163	161	0	- 1	160	- 3	- 1	159	- 4
1037	218	216	0	- 1	215	- 3	- 1	214	- 4
1038	281	275	0	- 1	274	- 7	- 1	273	- 8
1039	350	353	0	- 2	351	+ 1	- 2	349	- 1
1040	411	408	0	- 2	406	- 5	- 2	404	- 7
1041	418	427	0	- 2	425	+ 7	- 2	423	+ 5
1042	336	349	0	- 2	347	+ 11	- 2	345	+ 9
1043	353	370	0	- 2	368	+ 15	- 2	366	+ 13
1044	438	458	0	- 3	455	+ 17	- 4	450	+ 12
1045	420	440	0	- 3	437	+ 17	- 7	430	+ 10
1046	425	452	0	- 2	450	+ 25	- 9	441	+ 16
1047	442	463	0	- 2	461	+ 19	- 11	450	+ 8
1048	447	477	0	- 2	475	+ 28	- 13	462	+ 15
1049	419	446	0	- 2	444	+ 25	- 15	429	+ 10
1063	468	508	- 1	- 2	505	+ 37	- 17	488	+ 20
1064	478	499	- 1	- 3	495	+ 17	- 20	475	- 3
1065	532	573	- 1	- 3	569	+ 37	- 22	547	+ 15

TABLE 1 (contd.)

ROSEDALE - GORMANDALE LOOP.

Station	A True Elevat-ion	B Altimeter Elevation	C Temp. & Hum. Corr.	D Horiz. Grad. Corr.	E=B+C+D Corrd. Altim. Elev.	F=E-A Errors	G Misclosure Adjustment	H=E+G Adj. Altim. Elev.	J=H-A Errors
1066	561	583	- 1	- 3	579	+ 18	- 24	555	- 6
1067	501	538	- 1	- 3	534	+ 33	- 26	508	+ 7
1068	457	493	- 2	- 3	488	+ 31	- 28	460	+ 3
1069	464	498	- 2	- 3	493	+ 29	- 30	463	- 1
1070	540	566	- 2	- 2	562	+ 22	- 32	530	- 10
1071	640	665	- 2	- 2	661	+ 21	- 34	627	- 13
1072	674	697	- 2	- 2	693	+ 19	- 36	657	- 17
1077	602	638	- 2	- 2	634	+ 32	- 38	596	- 6
1078	464	502	- 3	- 2	497	+ 33	- 40	457	- 7
364	305	357	- 4	- 1	352	+ 47	- 42	310	+ 5
365	246	299	- 5	- 1	293	+ 47	- 44	249	+ 3
366	233	291	- 5	- 1	285	+ 52	- 46	239	+ 6
367	206	264	- 5	- 1	258	+ 52	- 48	210	+ 4
1034	185	249	- 5	- 1	243	+ 58	- 50	193	+ 8
1030	172	231	- 5	0	226	+ 54	- 52	174	+ 2
1031	150	216	- 5	0	211	+ 61	- 54	157	+ 7
1024	134	206	- 6	0	200	+ 66	- 56	144	+ 10
1025	127	199	- 6	0	193	+ 66	- 59	134	+ 7
1026	113	187	- 6	0	181	+ 68	- 61	120	+ 7
1013	120	195	- 6	0	189	+ 69	- 63	126	+ 6
1012	113	191	- 6	0	185	+ 72	- 65	120	+ 7

TABLE 1 (contd.)

ROSEDALE - GORMANDALE LOOP

Station	A True Elevation	B Altimeter Elevation	C Temp. & Hum. Corr.	D Horiz. Grad. Corr.	E=B+C+D Corrd. Altim. Elev.	F=E-A Errors	G Misclosure Adjustment	H=E+G Adj. Altim. Elev.	J=H-A Errors
1011	97	182	- 6	0	176	+ 79	- 67	109	+ 12
1010	67	150	- 7	0	143	+ 76	- 69	74	+ 7
1000	59	141	- 7	0	134	+ 75	- 71	63	+ 4
1009	57	137	- 7	0	130	+ 73	- 73	57	0

TABLE 2

ROSEDALE - WILLUNG LOOP

Station	A True Elevation	B Altimeter Elevation	C Temp. & Hum. Corr.	D Horiz. Grad. Corr.	E=B+C+D Corrd. Altim. Elev.	F=E-A Errors	G Misclosure Adjustment	H=E+G Adj. Altim.Elev.	J=H-A Errors
1008	66	66	0	0	66	0	0	66	0
1362	104	107	0	0	107	+ 3	0	107	+ 3
1375	126	131	0	0	131	+ 5	0	131	+ 5
1376	148	153	+ 1	- 1	153	+ 5	0	153	+ 5
1377	183	181	+ 1	- 1	181	- 2	0	181	- 2
1378	298	299	+ 2	- 1	300	+ 2	0	300	+ 2
1427	703	715	+ 9	- 2	722	+ 19	0	722	+ 19
1426	602	610	+ 7	- 2	615	+ 13	0	615	+ 13
1425	426	436	+ 5	- 2	439	+ 13	0	439	+ 13
1424	401	408	+ 5	- 2	411	+ 10	0	411	+ 10
1422	316	327	+ 4	- 2	329	+ 13	0	329	+ 13
1423	339	354	+ 5	- 2	357	+ 18	0	357	+ 18
1043	353	363	+ 5	- 2	366	+ 13	0	366	+ 13

TABLE 3

'THE HOLEY PLAIN' LOOP

Station	A True Elevation	B Altimeter Elevation	C Temp. & Hum.Corr.	D Horiz. Grad. Corr.	E=B+C+D Corrd. Altim. Elev.	F=E-A Errors	G Misclosure Adjustment	H=E+G Adj. Altim.Elev.	J=H-A Errors
1342	35	35	0	0	35	0	0	35	0
1374	34	23	0	0	23	- 11	- 3	20	- 14
1373	38	46	0	0	46	+ 8	- 5	41	+ 3
1372	36	36	0	0	36	0	- 8	28	- 8
1371	37	53	0	0	53	+ 16	- 10	43	+ 6
1370	39	49	0	0	49	+ 10	- 13	36	- 3
1369	44	54	0	0	54	+ 10	- 15	39	- 5
1336	58	71	+ 1	0	72	+ 14	- 18	54	- 4
1337	56	72	+ 1	0	73	+ 17	- 20	53	- 3
1338	47	77	+ 1	0	78	+ 31	- 23	55	+ 8
1339	48	74	+ 1	0	75	+ 27	- 25	50	+ 2
1340	49	80	+ 1	0	81	+ 32	- 28	53	+ 4
1341	49	79	+ 1	0	80	+ 31	- 30	50	+ 1
1342	35	67	+ 1	0	68	+ 33	- 33	35	0

TABLE 4

FICTITIOUS SET OF READINGS TO ILLUSTRATE METHODS OF ELIMINATING ERRORS

			Altimeter difference			Results of forward run only				Results Using Mean	
Station	True Elev.	Elev. Diff.	Forward Run	Reverse Run	Mean	Altim. Elev.	Misclosure Adjustment	Adj. Altim. Elev.	Error	Altim. Elev.	Error
1	200					200	0	200	0	200	0
		+ 50	+ 52	- 48	+ 50						
2	250					252	- 2	250	0	250	0
		+ 50	+ 52	- 38	+ 45						
3	300					304	- 4	300	0	295	- 5
		- 50	- 38	+ 52	- 45						
4	250					266	- 6	260	+ 10	250	0
		- 50	- 48	+ 52	- 50						
5	200					218	- 8	210	+ 10	200	0
		- 50	- 48	+ 52	- 50						
6	150					170	- 10	160	+ 10	150	0
		- 50	-48	+ 42	- 45						
7	100					122	- 12	110	+ 10	105	+ 5
		+ 50	+ 42	- 48	+ 45						
8	150					164	- 14	150	0	150	0
		+ 50	+ 52	- 48	+ 50						
9	200					216	- 16	200	0	200	0
		+ 50	+ 52	- 48	+ 50						

TABLE 4 (Cont.)

FICTITIOUS SET OF READINGS TO ILLUSTRATE METHODS OF ELIMINATING ERRORS

			Altimeter difference			Results of forward run only				Results using mean	
Station	True Elev.	Elev. Diff.	Forward Run	Reverse Run	Mean	Altim. Elev.	Misclosure Adjustment	Adj. Altim. Elev.	Error	Altim. Elev.	Error
10	250					268	- 18	250	0	250	0
		(+ 50)	(+ 52)	(- 40)							
	(300)	+ 30	+ 42	- 18	+ 30						
		(- 20)	(- 10)	(+ 22)							
11	280					310	- 20	290	+ 10	280	0
		- 40	- 38	+ 42	- 40						
12	240					272	- 22	250	+ 10	240	0
		- 40	- 38	+ 42	- 40						
13	200					234	- 24	210	+ 10	200	0
		- 50	- 48	+ 52	- 50						
14	150					186	- 26	160	+ 10	150	0
		(- 50)	(- 48)	(+ 40)							
	(100)	- 30	- 38	+ 22	- 30						
		(+ 20)	(+ 10)	(- 18)							
15	120					148	- 28	120	0	120	0
		+ 40	+ 42	- 38	+ 40						
16	160					190	- 30	160	0	160	0
		+ 40	+ 42	- 38	+ 40						

TABLE 4 (Cont.)

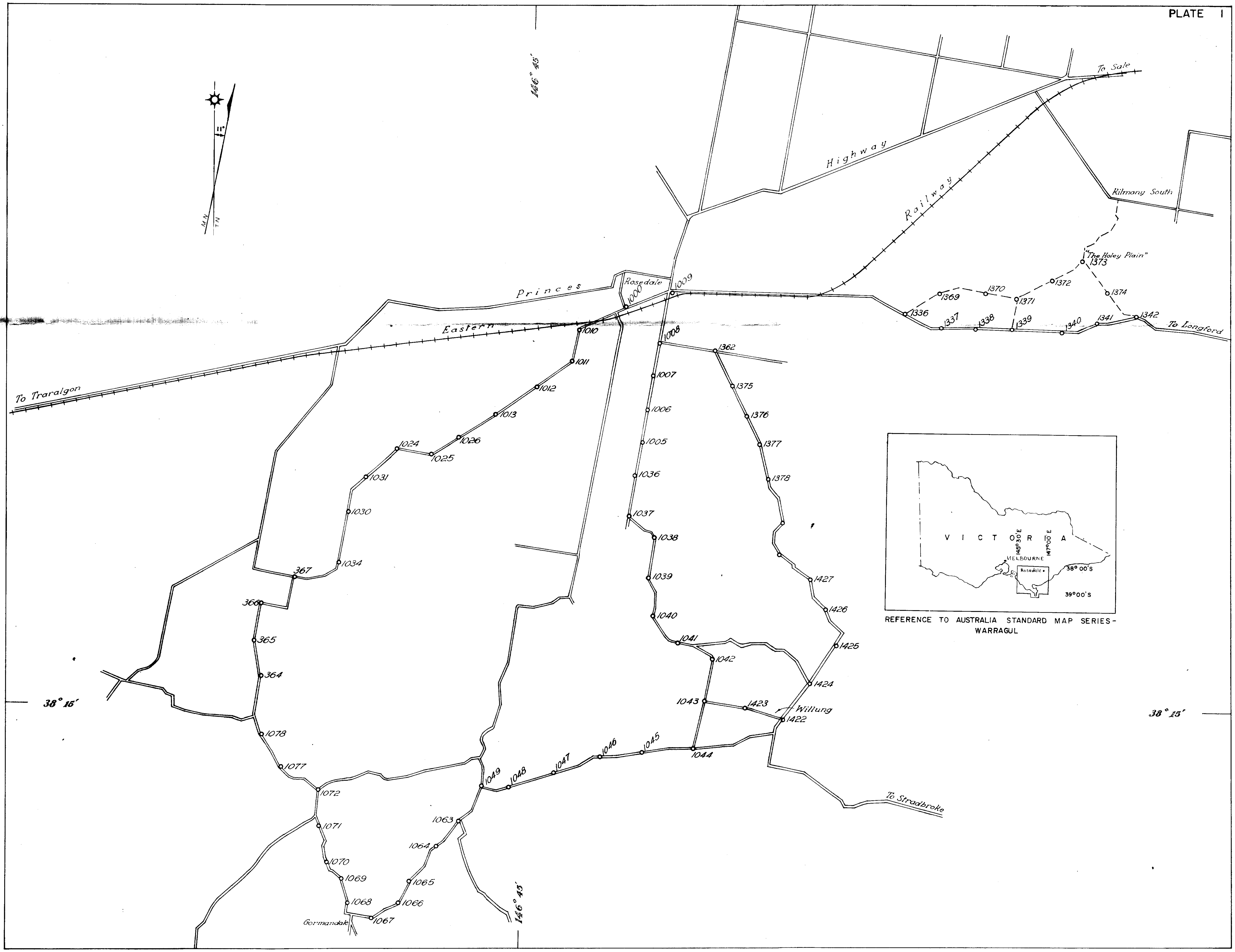
FICTITIOUS SET OF READINGS TO ILLUSTRATE METHODS OF ELIMINATING ERRORS

			Altimeter difference			Results of forward run only				Results using mean	
Station	True Elev.	Elev. Diff.	Forward Run	Reverse Run	Mean	Altim. Eliv.	Misclosure Adjustment	Adj. Altim. Elev.	Error	Altim. Elev.	Error
1	200					232	-32	200	0	200	0
		+ 50	+ 52	- 38	+ 45						
2	(250)					284				245	

Figures in brackets apply if intermediate station was occupied between 10 and 11 or 14 and 15.

Misclosure 32 ft
r.m.s. error ± 7 ft

Misclosure 0 ft
r.m.s. error ± 1.7 ft



SCALE IN MILES

1 0 1 2 3 4 5

LOCATION OF GRAVITY
STATIONS USED IN ALTIMETER TESTS

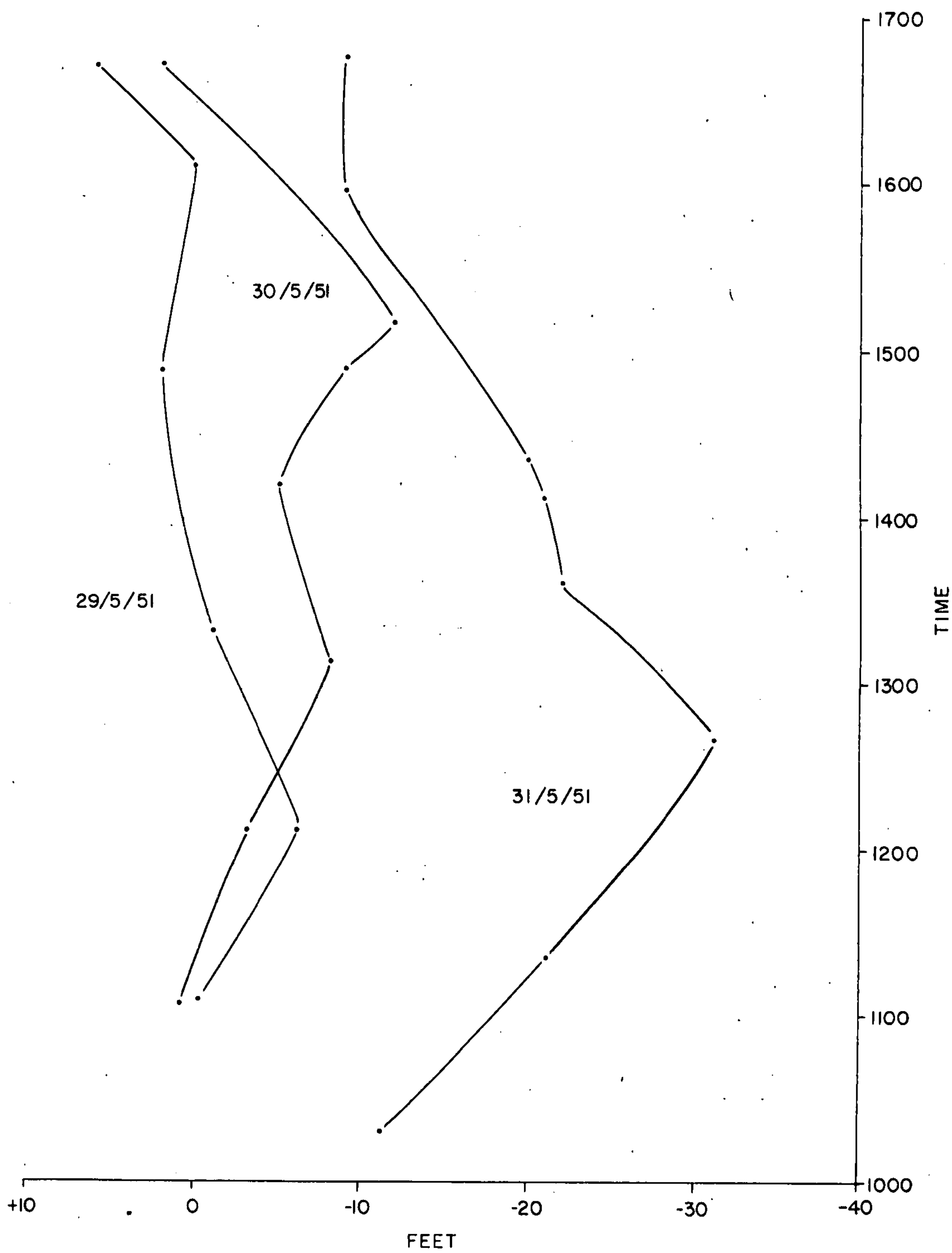
ROSEDALE AREA, VICTORIA

To accompany Record No 1963/88

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

J55/B2-26

PLATE 2

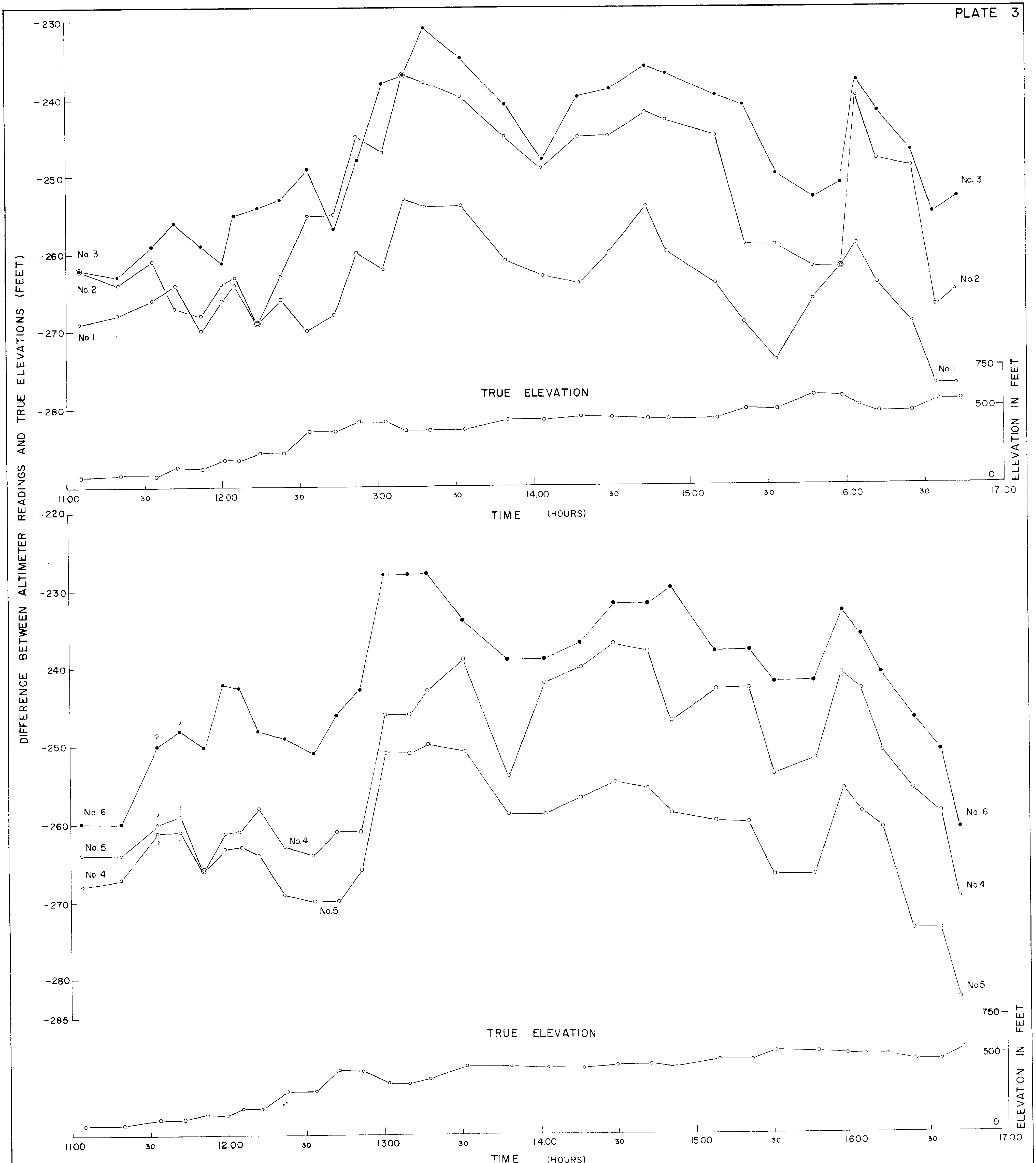


DIFFERENCE BETWEEN MEAN READINGS OF

ALTIMETER SETS IN FEET

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS J55/B2-27

To accompany Record Nº 1963/88

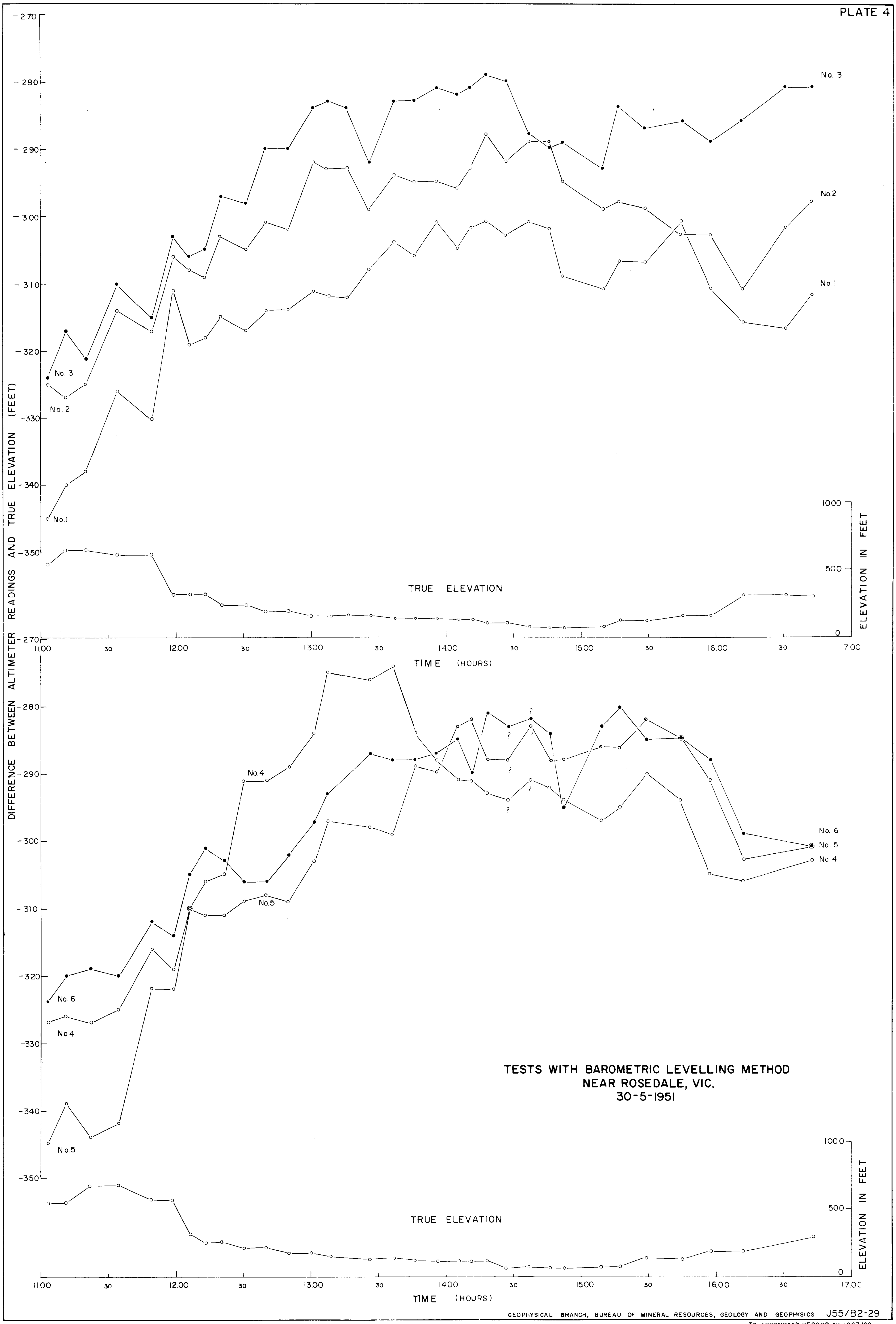


TESTS WITH BAROMETRIC LEVELLING METHOD
NEAR ROSEDALE, VIC.
29-5-1951

J55/B2-28

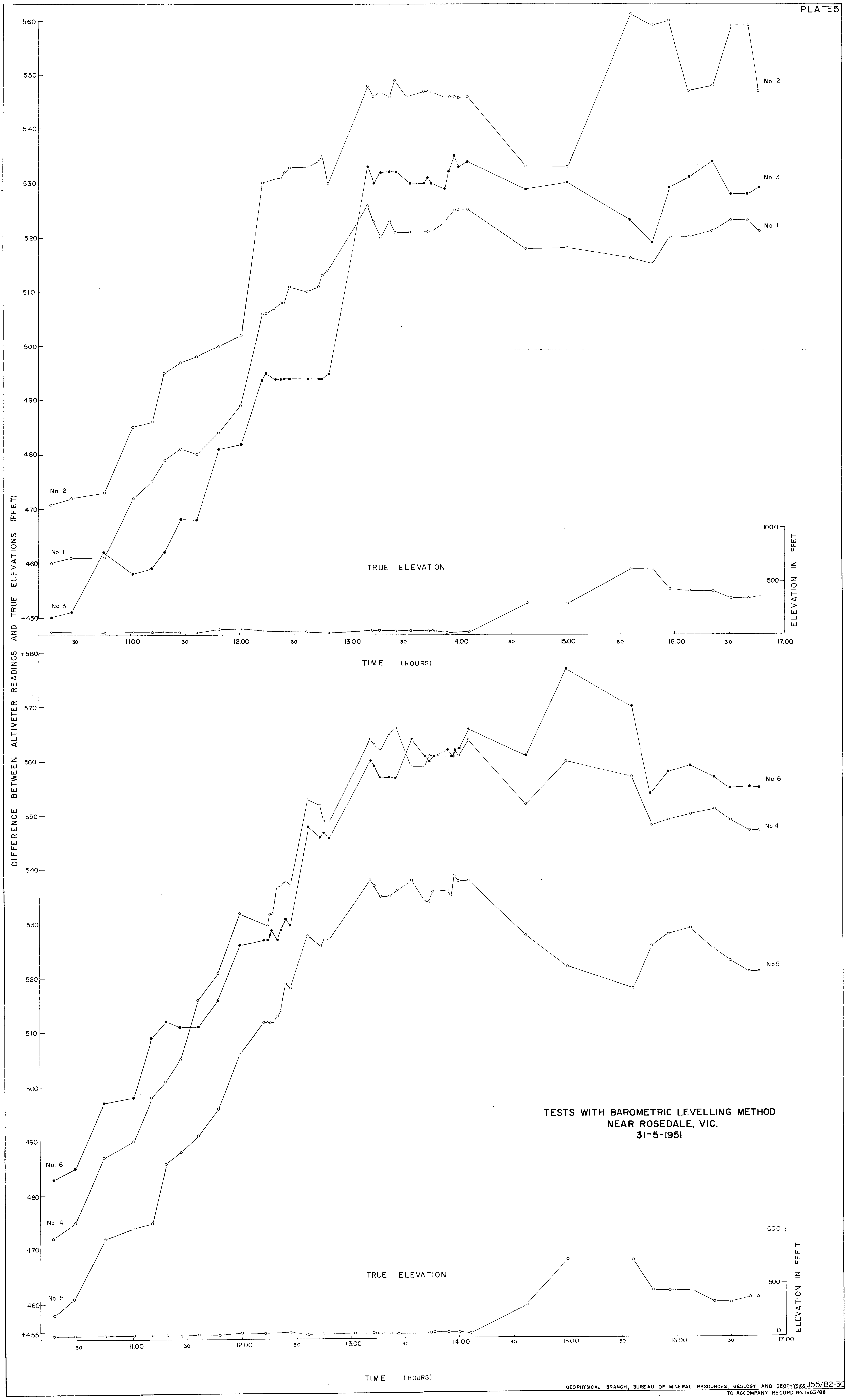
GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
TO ACCOMPANY RECORD No. 1963/88

ROSEDALE VICTORIA 1951 BAROMETRIC LEVELLING



ROSEDALE VICTORIA 1951, BAROMETRIC LEVELLING

PLATE 5



TESTS WITH BAROMETRIC LEVELLING METHOD
NEAR ROSEDALE, VIC.
31-5-1951

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS J55/B2-30
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ROSEDALE VICTORIA 1951, BAROMETRIC LEVELLING