COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1961 No. 10

REGIONAL MAGNETIC SURVEY OF QUEENSLAND AND NEW SOUTH WALES, 1960

by

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ABSTRACT

This Record describes a survey in which three elements of the earth's magnetic field were determined at 43 stations in Queensland and New South Wales. The survey was one of many surveys carried out in the Bureau's regional magnetic programme. The locations of magnetic stations and the measured values of the magnetic field are presented in tabular form.

1. INTRODUCTION

This Record describes a regional magnetic survey of Queensland and New South Wales conducted by the author between 26th July and 16th November 1960. It was one of many such surveys carried out in connection with the Bureau's regional magnetic programme, which includes the periodic publishing of maps showing present values and secular variations of the various elements of the earth's magnetic field.

Three magnetic elements (D, H, and Z) were measured at 43 stations. Of these, 19 were exact re-occupations of stations occupied in 1954, 1955 or 1956. At four of these re-occupation stations, the spread of buildings suggested that it might not be possible to re-occupy the station in future years. Therefore new stations were established in the vicinity. Station locations are shown in Plate 1. A road milage of more than 10,000 miles was covered; also, the author joined the Simpson Desert Helicopter Gravity Party for a short time and was able to reach two new magnetic stations by helicopter. Weather conditions were generally good and caused few delays. Delays of about one week each occurred at Brisbane (while the truck was being refitted), in the Simpson Desert (while the helicopter was unserviceable), and at Cunnamulla (while waiting for a replacement magnetometer).

2. EQUIPMENT

International panel van

A four-wheel-drive one-ton International truck with a van body designed for regional magnetic survey work was used. It gave little trouble, but had to be driven with care as even when only half loaded the rear springs were over-stressed. This was mainly due to the van body, which is well constructed, but is very heavy.

H.T.M. 570704

This Askania torsion magnetometer was used for measuring both the horizontal intensity and the magnetic meridian.

H and D are given by the following formulae :-

$$\log H = 9.33529 - \log \sin\phi + 0.000118\ (t-15^{\circ}C)$$

$$(\text{magnetic meridian}) = (\text{zero reading}) + 1^{\circ}\ 34.2'$$

Corrections to preliminary Toolangi Magnetic Standard for 1960 are :-

$$H = H(570704) + 0.00022H$$

$$D = D(570704) + 0^{\circ}\ 00'$$

H.T.M. 570704 was regularly compared in the field with Askania Declinometer 320, and no appreciable change in the correction to the zero reading was noted.

On 26th September the fibre broke and the instrument was replaced by Q.H.M. 306.

Q.H.M. 306

This torsion magnetometer was used from 4th October for measuring the horizontal intensity.

The formula for H is:

$$\log H = 9.26010 - \log \sin \phi + 0.000176t - 0.0004 \cos \phi$$

Comparisons during the survey with Declinometer 320 gave :

$$D(320) = D(306) + 2^{\circ}\ 39'$$

Correction to preliminary Toolangi Magnetic Standard for 1960 is:

$$H = H(306) + 0.00013H$$

This is the result of intercomparisons after return from the field.

B.M.Z. 221

This zero balance magnetometer was used throughout the survey for measuring the vertical intensity. Constants used are as given in the calibration table for the instrument. Intercomparisons with the preliminary Toolangi Magnetic Standard for 1960 gave :-

Before the survey (July) $Z = Z(221) - 6$ gammas

After the survey (Nov.) $Z = Z(221) - 5$ gammas

A correction of -6 gammas was adopted in the final reductions.

Askania declinometer 320

This fibre declinometer was used from 31st August for measuring the magnetic meridian. Intercomparisons with the preliminary Toolangi Magnetic Standard gave :-

$$D = D(320) + 0^{\circ}00'$$

The position of detorsion of the fibre was tested at regular intervals. At Parkes it was very difficult to obtain zero torsion; this may have been due to a static electricity charge on the glass torsion weight. Whilst reducing the field results the Coolabah and Coonamble D values as measured by declinometer 320 were found to be inconsistent with the Q.H.M. 306 values by about 16 minutes of arc. Also the Coonamble D value was anomalous with the 1957.5 value but the Q.H.M. value was not anomalous. Thus the D values measured by Q.H.M. 306 were used for these locations. It seems to be advisable to check detorsion of the fibre at each station, and this was done at all stations after Parkes.

Askania base circle 508813

This was used for H.T.M., Q.H.M., declinometer, and (up to 5th August) for the Askania midget theodolite.

Askania midget theodolite

This was used throughout the survey for sun observations. At most stations the true meridian, longitude, and latitude were observed. At some re-occupation stations the previous latitude was used if conditions prevented sun observations being made. At Hay River South B the true meridian, longitude, and latitude were determined from star observations by the surveyors W. Kennedy and M. Hickey of the Department of Interior.

Using the adapter for the Askania base circle, which did not fit well, it was extremely difficult to keep the theodolite level, and the results were not as good as those obtained while using a separate tripod. It is felt however that even using the same tripod studs, there may be a small error in centreing using different tripods for sun and magnetic observations.

Whilst observing the sun at elevations of more than 70 degrees much inconvenience was caused by the prismatic eyepiece. The sun filter has to be taken out of the eyepiece and held between two fingers in front of the eyepiece.

The midget theodolite is not really ideal, for the following reasons:-

(1) It is always difficult to keep level

(2) It is not highly accurate

(3) At times it is awkward to handle

(4) Elevation is limited to 70 degrees

Watts Z variometer

This magnetic balance was used throughout the survey to determine the extent of local irregularities in the magnetic field at the magnetic stations. It was rather old and not in perfect condition, but nevertheless gave a fair indication of local disturbances. An Askania or A.B.E.M. Z torsion magnetometer would have been better for this purpose.

Mercer Chronometer 21045

This marine chronometer mounted in gimbals was excellent and maintained a small and constant rate throughout the survey.

3. REDUCTION OF RESULTS

(a) All magnetic stations

The observed field values were reduced to mean field values using the following formulae :-

$$M_L = X_L + (D_T - D_L) - (Y - M_T)$$

where :

M_L = mean field value

X_L = observed field value

D_T = departure for diurnal variation at time of observation at latitude of Toolangi Observatory

D_L = departure for diurnal variation at time of observation at latitude of field station

Y = instantaneous value at Toolangi at time of observation

M_T = monthly mean value at Toolangi

of which D_T and D_L were obtained from Vestine et al. (1948),

Y was scaled from the Toolangi magnetograms,

M_T was obtained from the monthly mean tables for Toolangi.

The reduced values are shown in Table 1.

(b) Repeat stations

The secular change at each station was computed using the following formula :-

$$\text{secular change} = \frac{\text{Mean Field Value 1960 - Previous Value}}{\text{Time Interval in Years}}$$

The previous values have been corrected for transient fields by a method described in section 3(a) above. The results are shown in Table 2. As the previous values of Z had been derived from observations of H and I, they would not have been as accurate as those measured during the present survey. Therefore both previous and 1960 values in Table 2 have been rounded off to the nearest 10 gammas.

4. REFERENCE

VESTINE, E.H., LAPORTE, L., LANGE, I., COOPER, C., and HENDRIX, W.C.,	1948	Description of the Earth's main magnetic field and its secular change, 1905 - 1945. Publ. Carneg. Instn. 578.

REGIONAL SURVEY OF QUEENSLAND & N.S.W.

TABLE 1

STATION LOCATIONS AND MAGNETIC VALUES

South Lat.	East Long.	Station	Date 1960	MEAN FIELD VALUE Based on prelim. 1960 Toolangi Standard					
				D		H		Z	
				° '	Inst.	Gammas	Inst.	Gammas	Inst.
20° 43'	143° 08'	Richmond*	23. 8	6 14	704	32791	704	39256	BMZ221
21 09	149 11	Mackay*	19. 8	8 03	..	32501	..	38854	..
22 17	137 57	Tobermory	9. 9	5 38	..	31903	..	42110	..
22 55	138 48	Glenormiston	10. 9	5 02	320	31339	..	42470	..
..	..	..	11. 9	5 03	320	-		-	
23 26	144 15	Longreach*	25. 8	7 05	704	31230	..	42378	..
23 31	148 10	Emerald*	17. 8	8 03	704	31182	..	41972	..
23 47	138 52	Duck Point W.H.	14. 9	5 46	320	30878	..	43695	..
23 51	137 16	Lake Carolina	31. 8	5 22	320	30777	..	43626	..
24 22	139 29	Bedourie*	15. 9	6 12	320	30256	..	44193	..
24 30	150 34	Thangool	15. 8	8 49	704	30863	..	42424	..
24 45	137 43	Hay River Sth A	2. 9	5 47	..	30258	..	44689	..
..	..	Hay River Sth B	6. 9	5 40	..	30259	..	44668	..
24 51	143 04	Jundah	17. 9	7 04	320	30419	..	44282	..
24 55	151 05	Monto*	14. 8	9 00	704	30652	..	43292	..
25 25	142 39	Windorah*	16. 9	7 00	320	30124	..	45035	..
26 34	148 48	Roma A*	22. 9	8 41	..	29852	..	45296	..
26 34	148 48	Roma B	22. 9	8 41	..	29803	..	45297	..
27 48	142 36	Noccundra	6.10	7 22	..	28645	306	47725	..
28 00	143 49	Thargomindah*	5.10	7 46	..	28629	..	47714	..
28 04	148 36	St. George A	25. 9	8 30	..	28978	704	47042	..
..	..	St. George B	26. 9	8 28	..	-		47067	..
28 04	145 42	Cunnamulla*	4.10	8 04	..	28641	306	47604	..
29 04	152 02	Tenterfield* ≠	5. 8	10 19	704	28544	704	47452	..
29 55	151 09	Tingha ≠	4. 8	10 19	..	28901	..	48379	..
30 57	148 24	Coonamble A*	4.11	9 51	306	27055	306	50336	..
..	..	Coonamble B	3.11	9 50	306	27051	..	50354	..
30 58	141 48	Sandy Ck. Bore	11.10	7 27	320	26638	..	51173	..
31 02	146 41	Coolabah	1.11	9 08	306	26870	..	50370	..
31 30	145 49	Cobar A*	28.10	8 57	320	26601	..	50994	..
31 32	145 48	Cobar B ≠	29.10	9 04	..	26565	..	51045	..
31 31	143 23	Wilcannia C*	14.10	8 20	..	26380	..	51353	..
..	..	Wilcannia D	14.10	8 18	..	26391	..	51370	..
32 03	146 19	Nymagee	27.10	9 16	..	26292	..	51449	..
32 45	151 34	E. Maitland*	2. 8	11 08	704	26279	704	51422	..
32 48	142 22	Tolarno	12.10	8 20	320	25450	306	52745	..
33 05	146 28	Euabalong	25.10	9 28	..	25622	..	52459	..
33 09	148 14	Parkes*	8.11	10 36	..	25722	..	52187	..
33 23	147 59	Forbes	7.11	10 46	..	25440	..	52391	..
33 42	149 35	Rockley ≠	10.11	10 13	..	25288	..	52230	..
34 30	144 51	Hay*	17.10	9 17	..	24565	..	53951	..
34 46	149 44	Goulburn*	29. 7	10 56	704	24777	704	53272	..
35 14	146 42	Lockhart	19.10	10 15	320	24329	306	54343	..
35 40	147 20	Holbrook*	20.10	10 24	..	24039	306	54695	..

* denotes exact re-occupation, other stations are new stations.

704 = H.T.M. 570704 ≠ Station locally disturbed

306 = Q.H.M. 306

320 = Declinometer 320

TABLE 2

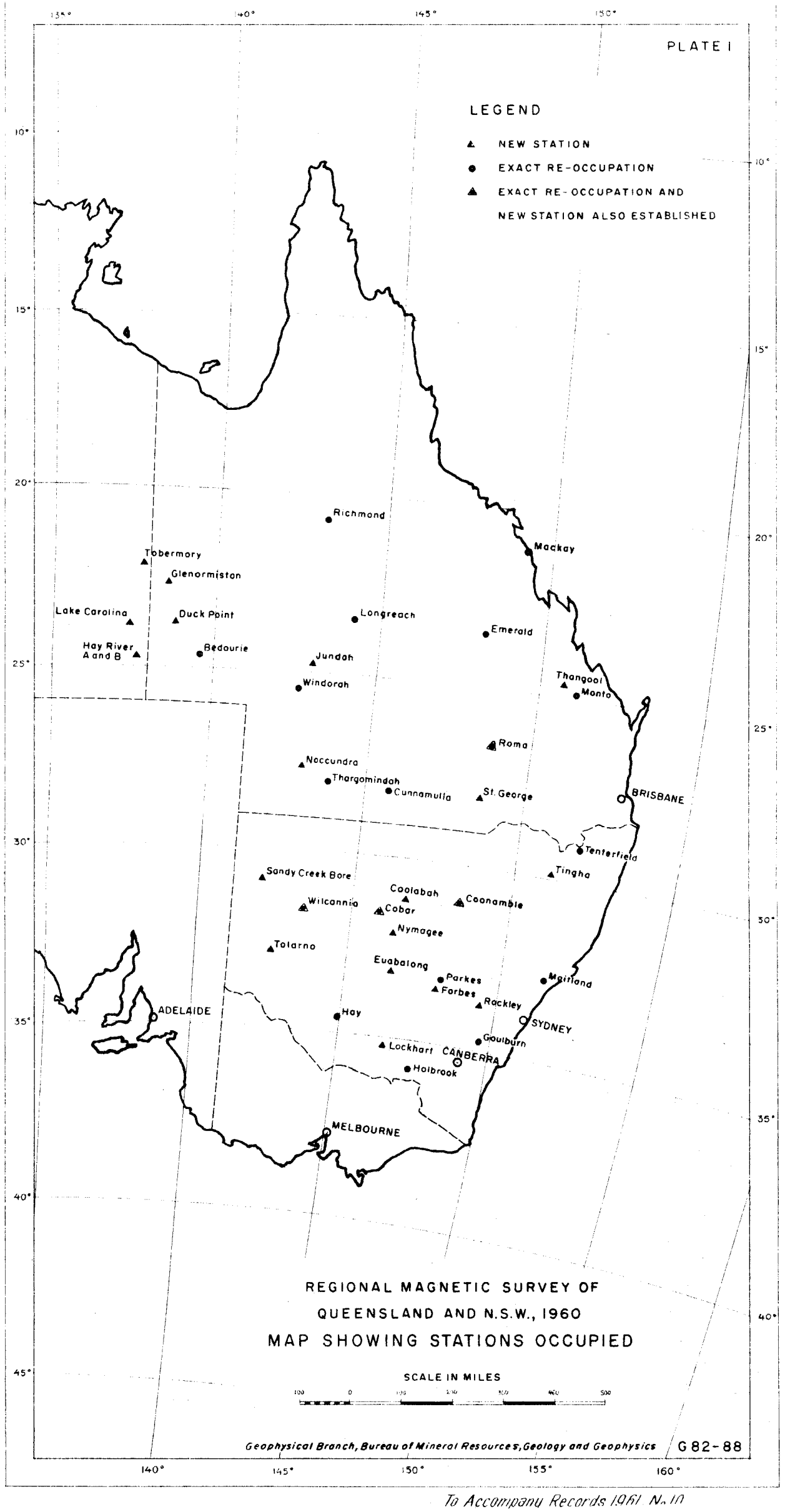
SECULAR VARIATIONS OF REPEAT STATIONS

QUEENSLAND & N...T.

Based on preliminary Toolangi Standards for 1960

Lat. South	Long. East	Station	Date 1960	Date prev. obs.	Time int. years	DECLINATION				HORIZONTAL INTENSITY in gammas				VERTICAL INTENSITY in gammas			
						Mean Field Value	Prev. Value	Change	Change per Annum	Mean Field Value	Prev. Value	Change	Change per Annum	Mean Field Value	Prev. Value	Change	Change per Annum
° '	° '					° '	° '	'	'								
20 43	143 08	Richmond	23-8	18. 8.56	4.0	6 14	6 02	12	+ 3.0	32791	32860	- 69	- 17	-39260	-39250	- 10	- 2
21 09	149 11	Mackay	19-8	28. 6.56	4.1	8 03	7 57	6	1.5	32501	32605	-104	- 25	38850	38900	+ 50	+12
23 26	144 15	Longreach	25-8	8. 9.56	4.0	7 05	6 56	9	2.2	31230	31370	-140	- 37	42380	42360	- 20	- 5
23 31	148 10	Emerald	17-8	21.10.54	5.8	8 03	7 53	10	1.8	31182	31320	-138	- 24	41970	42000	+ 30	+ 5
24 22	139 29	Bedourie	15-9	17. 9.56	4.0	6 12	6 04	8	2.0	30256	30318	- 62	- 16	44190	44120	- 70	-18
24 55	151 05	Monto	14-8	8.11.54	5.8	9 00	8 57	3	+ 0.5	30652	30820	-168	- 29	43290	43330	+ 40	+ 7
25 25	142 39	Windorah	16-9	21. 9.56	4.0	7 00	7 02	- 2	- 0.5	30124	30190	- 66	- 16	45040	45030	- 10	- 2
26 34	148 48	Roma	22-9	27. 9.54	6.0	8 41	8 31	10	+ 1.7	29852	29960	-108	- 18	45300	45300	0	0
28 00	143 49	Thargomindah	5-10	12.11.55	4.9	7 46	7 30	16	3.3	28629	28780	-151	- 31	47710	47650	- 60	-12
28 04	145 42	Cunnamulla	4-10	16. 9.54	6.0	8 04	7 53	11	1.8	28641	28800	-159	- 26	47600	47580	- 20	- 3
29 04	152 02	Tenterfield	5-8	3. 9.54	5.9	10 19	10 05	14	2.4	28544	28705	-161	- 27	47450	47520	+ 70	+12
30 57	148 24	Coonamble	3-11	20.10.55	5.0	9 51	9 40	11	2.2	27055	27230	-175	- 35	50340	50320	- 20	- 4
31 30	145 49	Cobar	28-10	27.10.55	5.0	8 57	8 48	9	1.8	26601	26730	-129	- 26	50990	51030	+ 40	+ 8
31 31	143 23	Wilcannia	14-10	30. 4.55	5.5	8 20	8 05	15	2.7	26380	26540	-160	- 29	51350	51380	+ 30	+ 6
32 45	151 34	E. Maitland	3-8	23. 8.54	6.0	11 08	10 52	16	2.7	26279	26405	-126	- 21	51420	51370	- 50	- 8
33 09	148 14	Parkes	8-11	31. 3.55	5.6	10 36	10 20	16	2.9	25722	25835	-113	- 20	52190	52180	- 10	- 2
24 30	144 51	Hay	17-10	18. 4.55	5.5	9 17	9 02	15	2.7	24565	24695	-130	- 24	53950	53910	- 40	- 7
34 46	149 44	Goulburn	29-7	7. 5.55	5.3	10 56	10 44	12	2.3	24777	24870	- 93	- 18	53270	53280	+ 10	+ 2
35 40	147 20	Holbrook	20-10	18. 5.54	6.5	10 24	10 06	18	+ 2.5	24039	24185	-146	- 22	54700	54730	+ 30	+ 5

PLATE I



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MAP SHOWING STATIONS OCCUPIED

SCALE IN MILES

100 0 100 200 300 400 500

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 82-88

To Accompany Records 1961 No. 10