PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

The Earth's Magnetic Field in Southern Africa at the Epoch, 1 July 1930

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Phil. Trans. R. Soc. Lond. A 1947 **240**, 251-294
doi: 10.1098/rsta.1947.0003

THE EARTH'S MAGNETIC FIELD IN SOUTHERN AFRICA AT THE EPOCH, 1 JULY 1930

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(*Communicated by H. Spencer Jones, F.R.S.—Received* 16 *December* 1939)

This paper is an attempt to determine the earth's magnetic field in that part of Africa lying to the south of the Zambesi and Kunene Rivers, at the epoch 1930·50.

The data used are:

(1) Measurements made at about seven hundred stations by a number of previous workers, during the period 1900 to 1925, and already published.

(2) Observations at about fifty of these stations made by the present writer between 1928 and 1930. These have been used to determine the secular variation, and thus to deduce the 1930·50 values of the magnetic field at all the other stations.

The magnetic inclination is found to have changed in an almost linear manner, the maximum rate occurring in South-West Africa. The horizontal intensity has diminished at a gradually increasing rate, the maximum change being near Cape Town. The declination appears to have varied at a high rate until about 1928, and much more slowly since then. The greatest total changes are found near Durban.

The results are presented in the form suggested by Ljungdahl. Maps with highly smoothed isomagnetic lines are used to show the probable 'normal' values of three magnetic elements (declination, inclination, and horizontal intensity), i.e. the component of the field not due to local magnetic disturbance. At each point of actual observation is placed a symbol indicating to what extent the observed value differs from that obtained by interpolation between the isomagnetic lines.

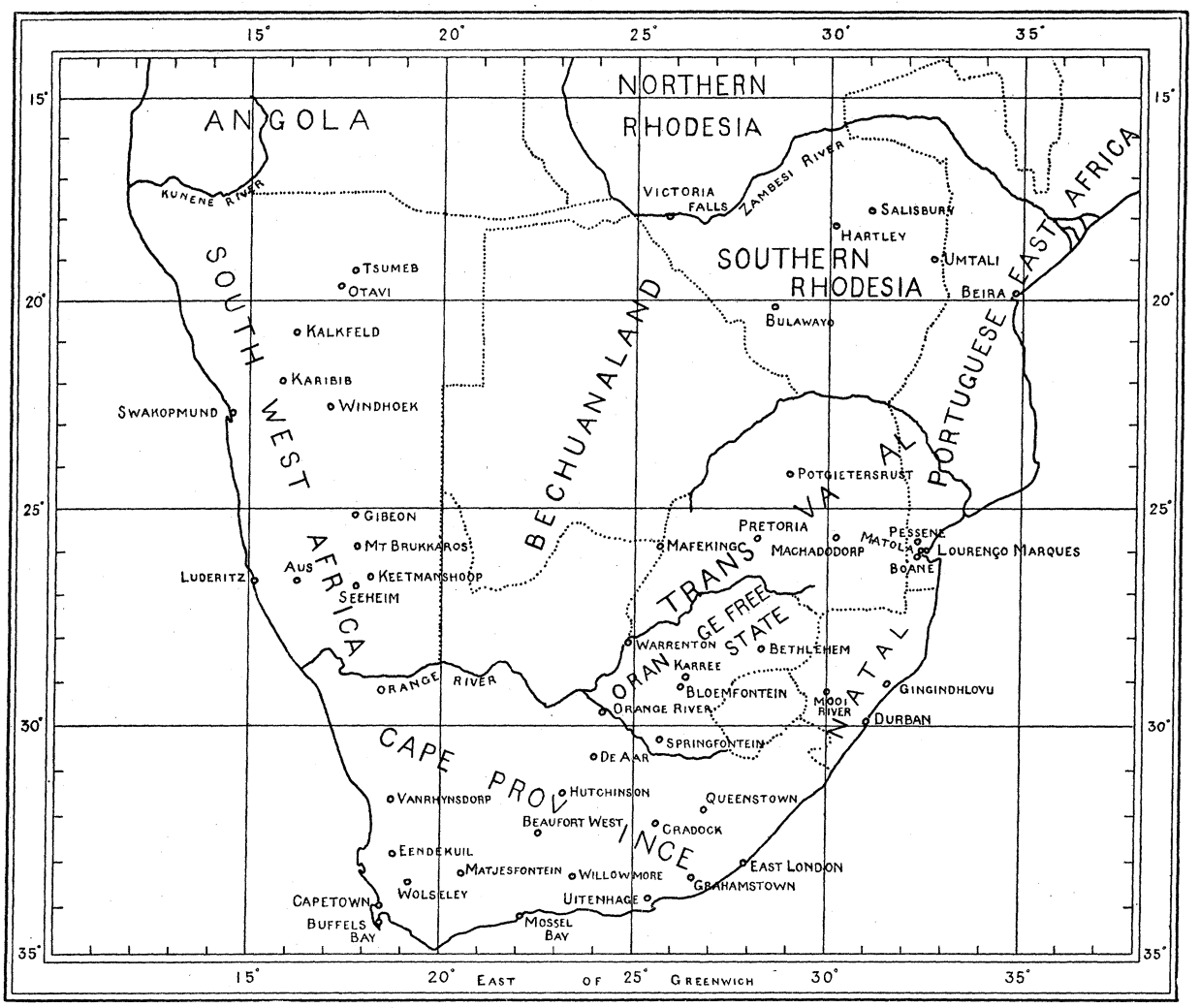
This paper describes an attempt to determine the earth's magnetic field in that part of Africa lying to the south of the Zambesi and Kunene Rivers, at the epoch 1930·50.

When this work was undertaken the magnetic information available about southern Africa was heterogeneous, and scattered through many different publications. Moreover, it referred to dates considerably earlier than the epoch chosen for the present survey. Up-to-date information was urgently required for marine and aerial navigation, and was also wanted by the survey departments of the Governments of the Union of South Africa, South-West Africa, and Southern Rhodesia.

As a complete resurvey was not possible at that time, it was decided to utilize the existing data. Observational work was therefore carried out with the chief object of determining the magnitude of the corrections that must be applied to the earlier observations to allow for the secular change that had occurred in the intervening time.

A programme of field work was commenced in 1927 with the aid of a grant from the South African Government Research Grant Board, and further grants and loan of apparatus from the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. A series of observing stations was reoccupied throughout the country, as shown in map 1, and measurements of three magnetic elements (declination, inclination, and horizontal intensity) were made. The comparison of these results with those obtained at the same

stations in earlier surveys has furnished a basis for computing the probable value of these elements at the epoch 1930·50 for the remainder of the earlier stations, as well as those reoccupied in the present survey.



MAP 1. Distribution of stations occupied in the present survey.

PREVIOUS MAGNETIC WORK UTILIZED

The first systematic magnetic survey of Southern Africa was made by Professor (now Sir Carruthers) Beattie and Professor J. T. Morrison, in the years 1898 to 1906 (Beattie 1909). 405 stations were occupied, south of the Zambesi and east of a line from Victoria Falls to Cape Town. Measurements of the declination (D), the inclination (I), and the horizontal intensity (H), were made with Kew magnetometers and dip-circles of the Dover pattern. A correction for diurnal variation was applied to the measurements of D, and the results for all three elements were reduced to epoch 1903·50, the necessary knowledge of secular change being obtained by reoccupying certain of the stations after an interval of several years. The positions of the isomagnetic lines at that epoch are shown on a series of maps. (No correction was made for differences between the instruments, nor to reduce the observations to standard values, but the results of intercomparisons of the instruments are

given, and also of comparisons with the instruments of the *Discovery* expedition of 1901, and those of Major Chaves in 1906. As Chaves's instruments were compared with the standard instruments at Val Joyeux observatory four months later this provided an indirect standardization of Beattie and Morrison's instruments.)

The magnetic elements at fifteen stations in Portuguese East Africa were measured by Chaves in 1906 (Chaves 1908).

Between 1907 and 1909 Beattie and Morrison occupied fifty-seven new stations in South Africa (chiefly in the north-west of Cape Province) and sixty-seven stations in South-West Africa. A correction to International Standard has been applied in the published results (Beattie & Morrison 1912), but none for diurnal variation.

Some of these results were reduced to epoch 1908·50 and shown on maps (Beattie 1914*b*).

During 1909 Beattie & Morrison extended their observations through East Africa to Egypt (Beattie 1914*a*).

From 1910 to 1912 Beattie occupied sixty-four new stations in western Transvaal, British Bechuanaland, and Bushmanland (Beattie 1914*b*). A number of reoccupations of earlier stations was also made, and these form the basis of a paper in which secular variation is illustrated graphically and geographically (Beattie 1915).

In the period 1913 to 15 Beattie occupied twenty-five further stations in South Africa, in places where the lack of information had made it difficult to draw isomagnetic lines (Beattie 1917).

Father Goetz occupied fourteen stations in Northern Rhodesia in 1914, and eleven stations in Southern Rhodesia in 1916 (Goetz 1920).

The values of D and I (but not of H) for all the foregoing stations south of latitude 14° S were reduced to epoch 1913·50 and published with maps showing the isogonal and isoclinal lines for that date (Beattie 1917).

In 1916 an observer from the Carnegie Institution of Washington reoccupied six stations in South Africa and six in South-West Africa, and in 1920 another of their observers occupied a series of twenty-seven stations from Victoria Falls to Beira, near the Zambesi (Brown 1921).

Fourteen stations in the neighbourhood of Lourenço Marques were occupied in 1925 by two lieutenants of the Portuguese navy (da Fonseca & Vaz 1925).

Beattie's list (1917) of the magnetic values at 653 stations for the epoch 1913·50 is the most extensive that has yet been published for southern Africa, but it has been found unsuitable as a basis for the present work. The omission of the values of H makes the magnetic information incomplete. Only three stations had been reoccupied in Rhodesia, and none in South-West Africa, so the correction for secular variation in these regions was liable to some doubt. (See Beattie 1917). Information now available shows that the allowance made for rate of change of I in South-West Africa was somewhat too small, giving rise to errors of about 10′, and the allowance made for D in Rhodesia was much too small, giving errors of more than a degree.) Also there is an unfortunately large number of errors of computation. (This may be seen by comparing values given for 1913·50 with the original observations; neighbouring stations frequently show large differences in the correction applied, and in some cases the observed value is given without correction.)

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It has therefore been decided to use the 1903·50 values as given in Beattie's *Report* (1909) for those stations occupied in that survey. For the north-west of Cape Province the values as reduced to epoch 1908·50 (Beattie 1914*b*) have been accepted. The results for South-West Africa (Beattie & Morrison 1912) have all been newly reduced to the same epoch, after applying a correction for diurnal variation based on that found in the present survey.

None of Father Goetz's stations have been reoccupied, and the link with his work (Goetz 1920) is based on a somewhat unsatisfactory interpolation.

Although no stations north of the Zambesi have been reoccupied during the present survey, use has been made of the results from a number of those stations slightly to the north of that river, to determine the general trend of the isomagnetic lines in that region. Reoccupation of one station at each end of the 1920 chain of Carnegie stations (Brown 1921) provides sufficient information for these to be utilized. A few earlier observations by Beattie & Morrison (1912) have also been used for the same purpose, an approximate rate of secular variation being provided by three reoccupations by the Carnegie Institution's observer in 1920 (Brown 1921).

Three stations occupied by Major Chaves (1908) and two occupied by the Portuguese observers (da Fonseca & Vaz 1925) have been reoccupied in the present survey, giving a satisfactory knowledge of the corrections to be applied in the neighbouring stations.

Instruments used

The magnetic and astronomical observations in this survey were all made with a combined Magnetometer—Earth-Inductor—Theodolite (no. 13), lent by the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

As a magnetometer this instrument is rather less accurate than one of the Kew pattern, but observations may be made much more rapidly. The inclination-inductor is both more rapid and more accurate than a Dover dip-circle.

Observations were usually carried out in a special tent with one eccentric pole. The tent first used was supplied by the Carnegie Institution; when this was worn out another was constructed, on the same lines, but somewhat larger. All the metal fittings were carefully tested to ensure their being non-magnetic. Provision was made for extra ropes to be attached to prevent the sides sagging inward in a high wind.

Two chronometers were carried, no. 1078 by Reid, and no. 58821 by Dent. The former had been used by Beattie throughout his work; the latter was purchased from the British Admiralty at the end of 1927. (The older instrument was used in the field, the newer one being left in a safe place at the hotel, and handled as little as possible.)

Method of observing

The routine usually followed was that laid down by the Carnegie Institution of Washington for their magnetic observers. This has been described in detail elsewhere (Bauer 1912; Hazard 1930). It comprises two complete determinations of each of the three magnetic elements (declination, inclination and horizontal intensity), together with the necessary sun observations for determining latitude, longitude, and true north.

To enable the stations to be accurately located on future occasions, theodolite readings were taken of the directions of prominent objects in the neighbourhood, and one or more photographs were usually taken from the tripod in the observing position. A stone beacon, cement marking block, or other indication was left to mark the exact site.

The order of making the observations varied, being usually dictated by the necessity of making sun observations when the sun was in a favourable position. Sometimes the programme of observations had to be curtailed; more often it was extended, additional observations (usually of declination) having been taken when time permitted.

At certain stations twice the usual number of observations was taken, an attempt being made to measure each of the elements at their daily maximum and minimum values, usually on two successive days. Observations were then usually made also at an auxiliary station about 1 km. away, to test for local magnetic disturbance, and to render possible an exact reoccupation at some future date even if the erection of magnetic buildings near one of the stations should render it useless.

Towards the end of the survey it became customary to test for local disturbance in the immediate neighbourhood of a proposed station before actually occupying it. The ordinary needle compass supplied for orientation of the inductor was used to indicate some distant object on the magnetic meridian. This was repeated at intervals of a few metres along the meridian through the proposed site. When the compass always indicated the same distant object as being on the meridian it was assumed that there was no serious local disturbance. (It was estimated that a deviation of one-tenth of a degree could be detected by this means. As no elaborate levelling was needed the determinations could each be carried out in about 2 min.)

Observations of diurnal variation

At certain of the stations occupied observations were made to determine the nature and extent of the diurnal variation of the three magnetic elements under investigation.

Observations of declination and horizontal intensity were made simultaneously three times each hour by measuring the deflexion of the short magnet at one single distance of the deflecting magnet, as described in the Carnegie Institution's *General directions for magnetic observations*. These readings were continued as nearly as possible from 6 a.m. until 6 p.m. (local mean time).

On other days observations of the inclination were made three times each hour throughout the day.

Later it was found more convenient to observe declination and horizontal intensity by timing the oscillations of the long magnet and observing the azimuth of its rest position.

Diurnal variation

There was no magnetic observatory in South Africa at the time when this survey was carried out, but a correction for diurnal variation has been applied to all the observations, based on the diurnal variation curves obtained at various stations with the field instruments.

These curves were examined for systematic variation (*a*) with season, and (*b*) with latitude. The summer and winter curves differed in a marked manner, but the variation

with latitude was found to be relatively unimportant. (None of the observations in the present survey was made during the equinoctial months.)

Mean curves for summer and winter were therefore made from the best of the curves for each of the elements D, H and I plotted as functions of the local mean time. (A separate mean curve was made for H in South-West Africa, where the diurnal amplitude at most of the stations occupied seemed to be considerably greater than at stations in South Africa.)

A magnetic observatory was established at the University of Cape Town in 1932, and curves of the mean diurnal variation at Cape Town are now available. Their difference from those used in the present work was not considered sufficient to make it necessary to revise the corrections already applied.

The curves actually used for these corrections are reproduced in figures 1 and 2, with the observatory curves (means for the quiet days of the corresponding season in 1933) superimposed on them for comparison.

Reduction of observations to 'mean for day'

As the diurnal variation curves obtained in the field all refer to less than 12 hr. out of the 24, they cannot be used without other information to compute the mean value for the day (i.e. the mean of the hourly means for the 24 hr.).

All the mean curves used show a maximum in the morning and a minimum in the afternoon, or vice versa. It was decided to define 'mean for day' as being the mean between the maximum and the minimum values on these curves. Curves obtained at the magnetic observatories of Cape Town, St Helena, Mauritius and Greenwich, show that the mean value defined in this way differs very slightly from that defined in the correct manner.

The correction for diurnal variation was therefore made thus: From each observed value of each of the magnetic elements was subtracted the diurnal variation corresponding to the local mean time of that observation, obtained by eye-reading from the above graphs. The mean of all these corrected values of any one element at a particular station was taken as the true mean value of that element at that station at the mean date of the observations, this date being reckoned to the nearest hundredth part of a year.

At those stations where a satisfactory diurnal variation curve was obtained capable of giving reliable 'absolute' values, the maximum and the minimum values from the smoothed-out curve have been included in taking the mean, instead of each of the individual observations. (This has the effect of giving the 'weight' of two ordinary corrected observations to the mean value of the smoothed-out curve. A larger weight was not given owing to the somewhat greater uncertainty of the rapidly taken observations, and the undesirability of giving undue importance to the values obtained on any one day when observations for more than one day were available.)

Summary of observations made in present survey

Table 1 contains a list of the stations occupied in the present survey, the date of occupation, and the mean value of each element at that date, after correcting for diurnal variation as described in the last paragraph. Angular values have been rounded to the nearest

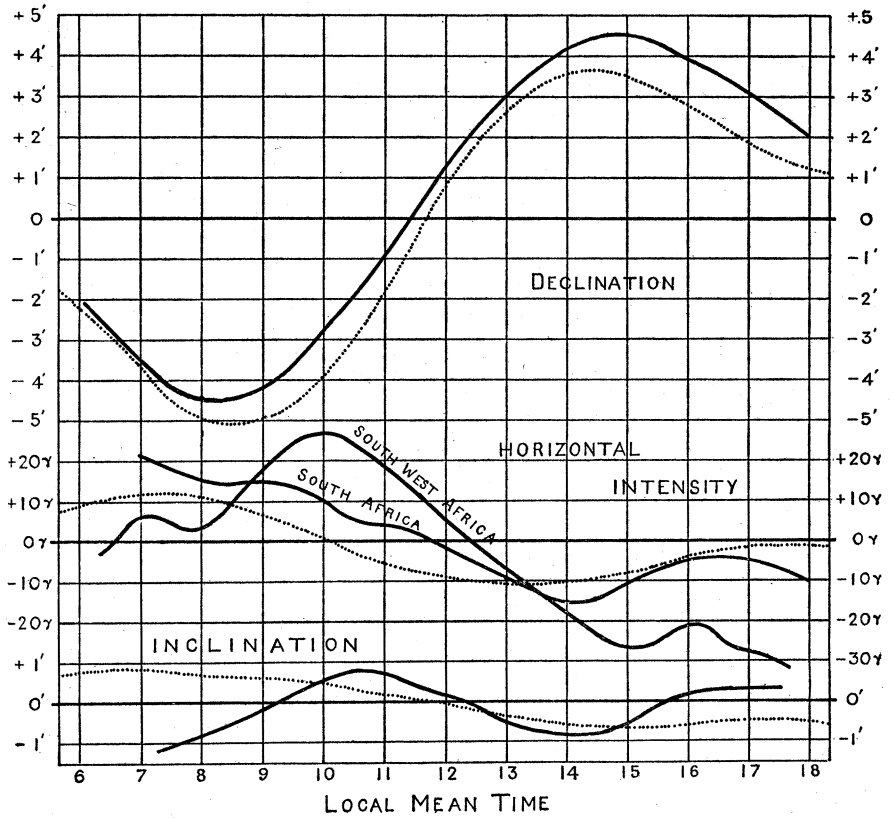

FIGURE 1. Mean diurnal variation curves—summer. The full lines are means of curves obtained in field observations. The dotted curves are the mean 'quiet day' curves at Cape Town Magnetic Observatory for January, February, November and December 1933. Negative values denote increase of westerly declination or of southerly inclination.

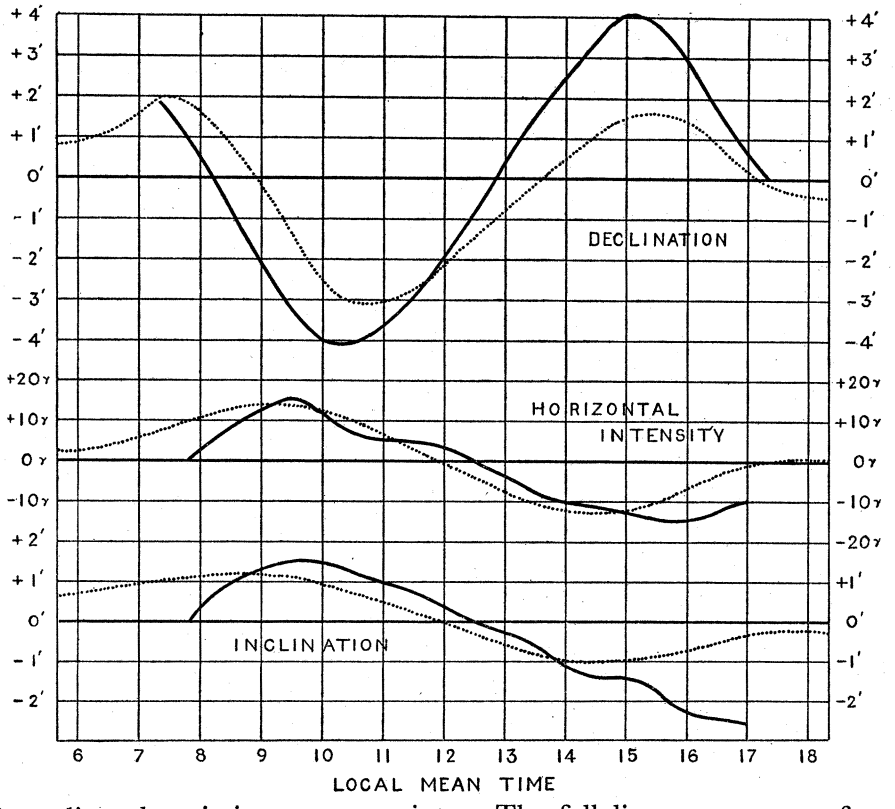

FIGURE 2. Mean diurnal variation curves—winter. The full lines are means of curves obtained in field observations. The dotted curves are the mean 'quiet day' curves at Cape Town Magnetic Observatory for May, June, July and August 1933. Negative values denote increase of westerly declination or of southerly dip.

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TABLE 1

number	station	date	position		observed values			values at epoch 1930·50		
			lat.	long.	D	I	H	D	I	H
			° ′	° ′	° ′	° ′		° ′	° ′	
43	Aus A	1929·13	26 40	16 16	22 20	58 32	17342	22 17	58 45	17188
44	Aus B	29·13	26 40	16 16	22 17	58 40	17274	22 14	58 53	17120
5	Beaufort West	28·02	32 21	22 36	22 45	62 46	15588	22 40	63 05	15278
59	Beira B	30·47	19 51	34 51	10 52	56 22	19460	10 52	56 22	19458
60	Beira C	30·47	19 50	34 51	10 42	56 21	19454	10 42	56 21	19452
25	Bethlehem A	1928·53	28 14	28 18	17 23	63 01	15945	17 19	63 14	15711
26	Bethlehem B	28·53	28 14	28 19	18 21	61 46	16554	18 17	61 59	16320
11	Bloemfontein	28·07	29 08	26 13	19 47	62 26	15918	19 42	62 43	15623
57	Boane	30·46	26 03	32 20	14 51	61 35	16658	14 51	61 35	16654
28	Buffel's Bay	28·85	34 18	18 27	24 38	62 47	15498	24 35	63 00	15290
46	Buffel's Bay (repeat)	1930·12	34 18	18 27	24 37	—	15324	24 36	—	15277
67	Bulawayo	30·52	20 09	28 36	13 06	56 19	19227	13 06	56 19	19229
1	Cape Town E	27·96	33 56	18 29	24 47	62 30	15668	24 42	62 51	15350
2	Cape Town F	27·95	33 56	18 29	24 46	62 32	15652	24 41	62 53	15333
18	Cradock	28·13	32 10	25 37	—	63 35	15403	—	63 51	15111
8	de Aar	1928·04	30 41	24 00	21 03	62 15	15852	20 58	62 33	15547
23	Durban (The Bluff)	28·50	29 53	31 03	17 57	63 32	15420	27 53	63 38	15185
16	East London A	28·11	33 00	27 56	21 10	64 10	15046	21 05	64 23	14757
17	East London B	28·12	33 00	27 56	21 08	63 59	15131	21 03	64 12	14843
47	Eendekuil	30·14	32 41	18 48	24 03	62 32	15540	24 02	62 35	15495
38	Gibeon	1929·07	25 07	17 45	21 08	58 13	17614	21 05	58 27	17459
27	Gingindhlovu	28·54	29 04	31 35	17 36	63 04	15824	17 32	63 14	15595
19	Grahamstown	28·14	33 20	26 32	21 53	64 16	15015	21 48	64 30	14726
65	Hartley A	30·51	18 09	30 10	11 37	54 28	20193	11 37	54 28	20194
66	Hartley B	30·52	18 10	30 10	11 37	54 25	20212	11 37	54 25	20214
6	Hutchinson A	1928·03	31 30	23 12	22 08	62 35	15730	22 03	62 53	15422
72	Hutchinson A (repeat)	30·57	31 30	23 12	22 01	62 27	15426	22 01	62 27	15634
7	Hutchinson B	28·03	31 30	23 12	22 10	62 34	15708	22 05	62 52	15400
31	Kalkfeld A	29·00	20 53	16 13	19 08	54 38	19246	19 05	54 51	19109
34	Kalkfeld B	29·03	20 54	16 12	20 21	55 02	19008	20 18	55 15	18873
37	Karibib	1929·06	21 56	15 51	20 10	55 20	18874	20 07	55 34	18738
12	Karree A	28·08	28 53	26 20	18 11	62 12	16054	18 06	62 29	15761
13	Karree B	28·09	28 53	26 21	18 04	62 18	15991	17 59	62 35	15699
41	Keetmanshoop	29·11	26 35	18 08	21 38	59 04	17215	21 35	59 17	17058
55	Lourenço Marques	30·46	25 58	32 36	18 08	—	17060	18 08	—	17056
42	Luderitzbucht	1929·12	26 39	15 09	22 53	58 20	17496	22 50	58 34	17344
54	Machadodorp	30·44	25 40	30 14	15 40	61 17	16568	15 40	61 17	16561
69	Mafeking	30·55	25 52	25 40	18 02	60 19	16790	18 02	60 19	16795
3	Matjesfontein A	28·00	33 15	20 35	24 05	62 52	15412	24 00	63 11	15099
50	Matjesfontein A (repeat)	30·42	33 15	20 35	24 00	63 29	15096	24 00	63 29	15086
74	Matjesfontein A (repeat)	1933·07	33 15	20 35	23 52	63 42	14846	—	—	—
4	Matjesfontein B	28·01	33 16	20 35	24 10	62 42	15416	24 05	63 01	15104
56	Matola	30·45	25 59	32 30	15 57	60 57	16903	15 57	60 57	16897
24	Mooi River	28·52	29 13	30 01	17 48	62 55	15707	17 44	63 06	15473
22	Mossel Bay	28·17	34 11	22 10	23 39	—	15280	23 34	—	14987
39	Mount Brukkaros A	1929·09	25 51	17 47	21 16	58 42	17442	21 13	58 56	17286
40	Mount Brukkaros B	29·10	25 51	17 48	21 15	58 39	17456	21 12	58 53	17300
9	Orange River A	28·05	29 40	24 12	20 36	62 13	15992	20 31	62 31	15691
71	Orange River A (repeat)	30·56	29 40	24 12	20 30	62 19	15681	20 30	62 19	15687
10	Orange River B	28·06	29 41	24 12	20 32	62 16	15994	20 27	62 34	15694

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TABLE I (*continued*)

number	station	date	position lat.	position long.	observed values D	observed values I	observed values H	values at epoch 1930·50 D	values at epoch 1930·50 I	values at epoch 1930·50 H
			° ′	° ′	° ′	° ′		° ′	° ′	
32	Otavi	1929·01	19 38	17 21	18 22	53 34	19741	18 19	53 47	19608
58	Pessene	30·46	25 41	32 20	15 20	61 32	16590	15 20	61 32	16586
51	Potgietersrust A	30·43	24 11	29 03	15 55	59 49	17334	15 55	59 49	17326
52	Potgietersrust B	30·43	24 11	29 01	15 33	59 54	17232	15 33	59 54	17224
53	Pretoria	30·44	25 45	28 10	16 50	61 04	16698	16 50	61 04	16691
15	Queenstown	1928·10	31 57	26 51	21 15	63 37	15358	21 10	63 52	15066
62	Salisbury A	30·50	17 50	31 03	9 00	—	19814	9 00	—	19814
63	Salisbury B	30·50	17 48	31 04	9 24	54 45	20010	9 24	54 45	20010
64	Salisbury C	30·50	17 50	31 04	10 57	54 04	20159	10 57	54 04	20159
45	Seeheim	29·13	26 48	17 47	22 03	59 28	17047	22 00	59 41	16891
14	Springfontein	1928·09	30 17	25 42	20 55	63 09	15529	20 50	63 26	15233
35	Swakopmund A	29·05	22 41	14 33	20 46	55 16	18846	20 43	55 30	18707
36	Swakopmund B	29·05	22 41	14 34	20 59	55 08	19026	20 56	55 22	18888
33	Tsumeb	29·01	19 14	17 43	18 09	53 07	19980	18 06	53 19	19849
20	Uitenhage	28·16	33 47	25 23	22 18	64 00	15102	22 13	64 15	14814
61	Umtali	1930·49	18 59	32 42	10 34	55 07	20147	10 34	55 07	20146
48	Vanrhynsdorp	30·14	31 38	18 44	23 51	—	15726	23 50	—	15681
68	Victoria Falls	30·54	17 56	25 52	13 12	54 16	20123	13 12	54 16	20126
70	Warrenton	30·56	28 07	24 52	19 50	62 02	16002	19 50	62 02	16008
21	Willowmore	28·16	33 18	23 28	23 03	63 46	15139	22 58	64 03	14847
29	Windhoek A	1928·98	22 33	17 04	20 04	56 03	18617	20 01	56 17	18467
30	Windhoek B	28·99	22 33	17 03	20 00	56 00	18612	19 57	56 14	18462
49	Wolseley A	30·15	33 26	19 12	24 21	62 47	15420	24 20	62 50	15375
75	Wolseley B	33·07	33 26	19 12	24 13	63 09	15093	—	—	—

minute of arc, but observations and computations were carried out to the nearest tenth of a minute (see p. 271).

In the three final columns are shown the values of the three magnetic elements at the epoch 1930·50, the corrections for secular variation having been made as described in later paragraphs (see pp. 262, 265, 267).

The individual observations, and the corrections applied to them may be seen in the Library of the University of Cape Town (E. N. Grindley, Thesis for Ph.D., Appendix B).

Descriptions of the observing stations will be published in due course by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

SECULAR VARIATION

The nature of the secular variation of the three magnetic elements has been investigated by comparing the values observed during the present survey (corrected for diurnal variation) with the results of previous observations at the same stations.

Unfortunately, the descriptions of the stations of Beattie & Morrison were all somewhat vague, and exact reoccupation of the sites at which their observations were made has nowhere been possible. Seventeen of the stations occupied in the present survey are believed to have been within 30 m. of the original stations; in many of the remainder there is an uncertainty of several hundred metres, and in nine cases the new station may be more than a kilometre from the old one.

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The changes found in the values of the magnetic elements are therefore not entirely due to secular variation, but partly to a change in the position of the observer. Where local magnetic disturbance exists, the effect of this change of position may be considerable; in several cases it has been found that the change due to a shift of less than 1 km. was equal to that due to several years of secular variation (e.g. at Bethlehem A and B, Kalkfeld A and B, and Salisbury A and C).

The merits of each reoccupation might be considered individually, but it is probably safer to draw conclusions as to the presence of errors due to local disturbance by studying the closeness of the agreement of the secular variation curves with those of neighbouring stations.

Graphs have been drawn of the secular variation of the three magnetic elements at all the stations occupied in the present survey, the values for earlier dates being obtained from the sources listed on p. 274. A number of these graphs are reproduced in figures 3 to 5.

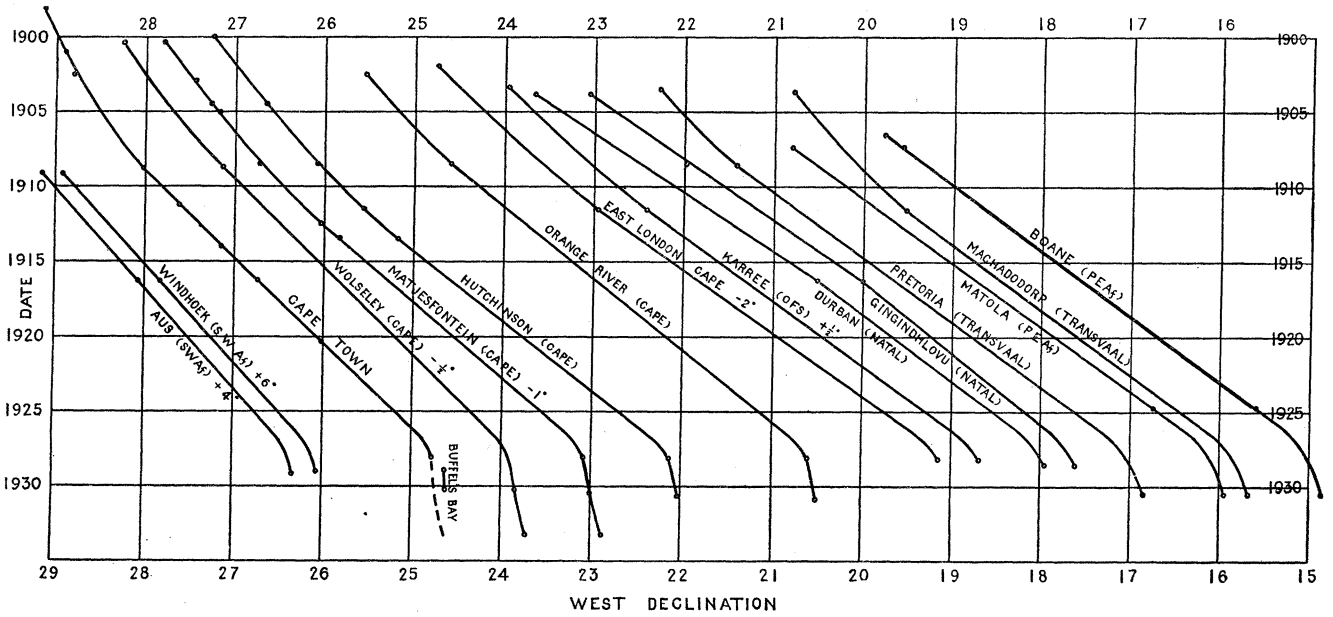

FIGURE 3. Secular variation of declination. The absolute values for some of the stations have been altered, to prevent confusion through curves overlapping.

When more stations than one have been occupied in any locality the observations from the one believed to be most nearly a reoccupation of the original station have generally been used in plotting the graphs. When neither was a close reoccupation the mean of the values at the two stations has usually been used. In a few cases the obvious existence of local disturbance in the closer reoccupation has led to the adoption of the values observed at the other station.

Declination

The secular variation of the declination at a number of representative stations is shown in figure 3.

The westerly declination is everywhere decreasing. At Cape Town, Matjesfontein, and Hutchinson, in the western half of Cape Province the rate accelerated from between 5′ and 8′ per annum at the beginning of the century to between 10′ and 14′ per annum in the second and third decades. After 1928·0 (the date of the first observations in the present survey) the rate is much lower—of the order of 2′ per annum.

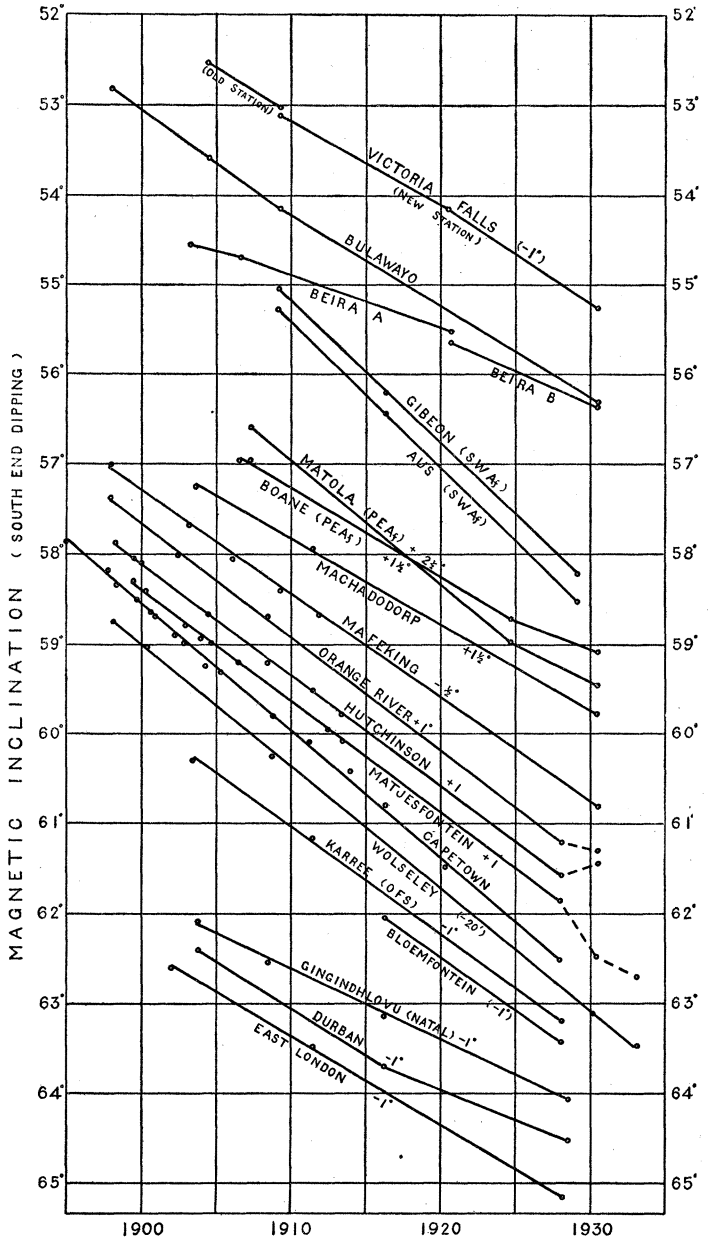

FIGURE 4. Secular variation of inclination. The absolute values for some of the stations have been altered, to prevent confusion through curves overlapping.

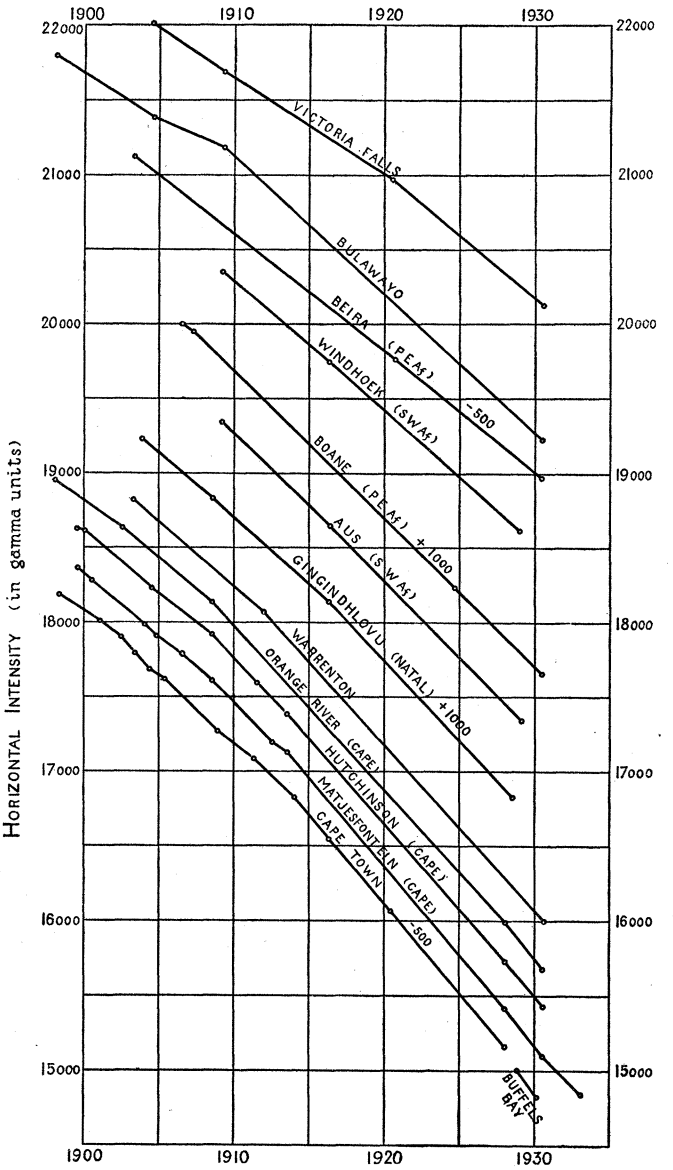

FIGURE 5. Secular variation of horizontal intensity. The absolute values for some of the stations have been altered, to prevent confusion through curves overlapping.

This reduced rate has been directly measured at four stations between 1928 and 1930. After correcting for diurnal variation the changes are:*

Buffel's Bay	1′·2 in 1·27 years,	or	1′·0 per annum
Matjesfontein	4′·2 in 2·42 years,	or	1′·7 per annum
Hutchinson	6′·2 in 2·54 years,	or	2′·4 per annum
Orange River	6′·6 in 2·51 years,	or	2′·6 per annum

* No correction has been made for seasonal variation, i.e. periodic annual changes. The records of the Cape Town Magnetic Observatory show that the seasonal changes are small, and differ considerably from year to year. The total changes shown above are unlikely to be in error by more than 1·0′. Corrected for seasonal variation on the basis of the mean monthly values at the Observatory during 1933 and 1934 the above rates of change become 0′·8, 1′·8, 2′·8 and 3′·0 per annum respectively.

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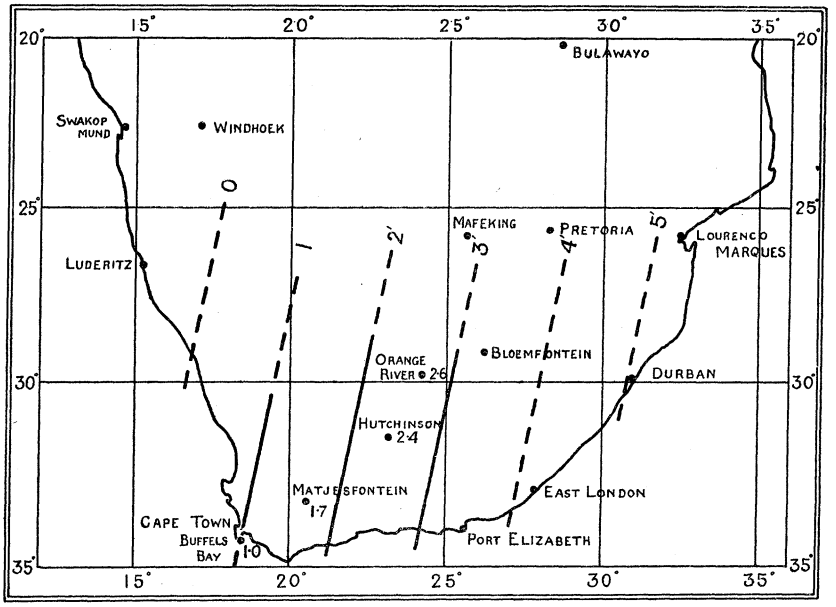
That this change in rate occurred rather abruptly, and not long prior to 1928, is indicated by the curves for Matola and Boane (Portuguese East Africa) for which the 1924 values are known.

Further evidence for this is furnished by the curves for Durban and Gingindhlovu (Natal) and five stations in South-West Africa (of which two are reproduced in figure 3). The 1916 value is known for each of these stations, and each curve shows a slower mean rate of change after 1916 than before. They may all be explained by assuming that the rate found between 1908 and 1916 was maintained until nearly 1928, after which it diminished to a very slow rate, as found at the stations in the Cape Province.

For correcting the results of the present survey to the epoch 1930·50 it was assumed that the secular rate was 2′ per annum for the whole area surveyed, for although the four direct determinations show a geographical regularity the differences involved are so small that this may easily be fortuitous. A possible arrangement of the isopors (lines of equal rate of change) for 1928 to 1930 is shown on map 2, from which one may estimate the probable error in assuming a uniform rate of 2′ per annum for all stations.



MAP 2. A possible arrangement of declination isopors, 1928–30. (Rate in minutes of arc per annum. Westerly declination decreasing.)

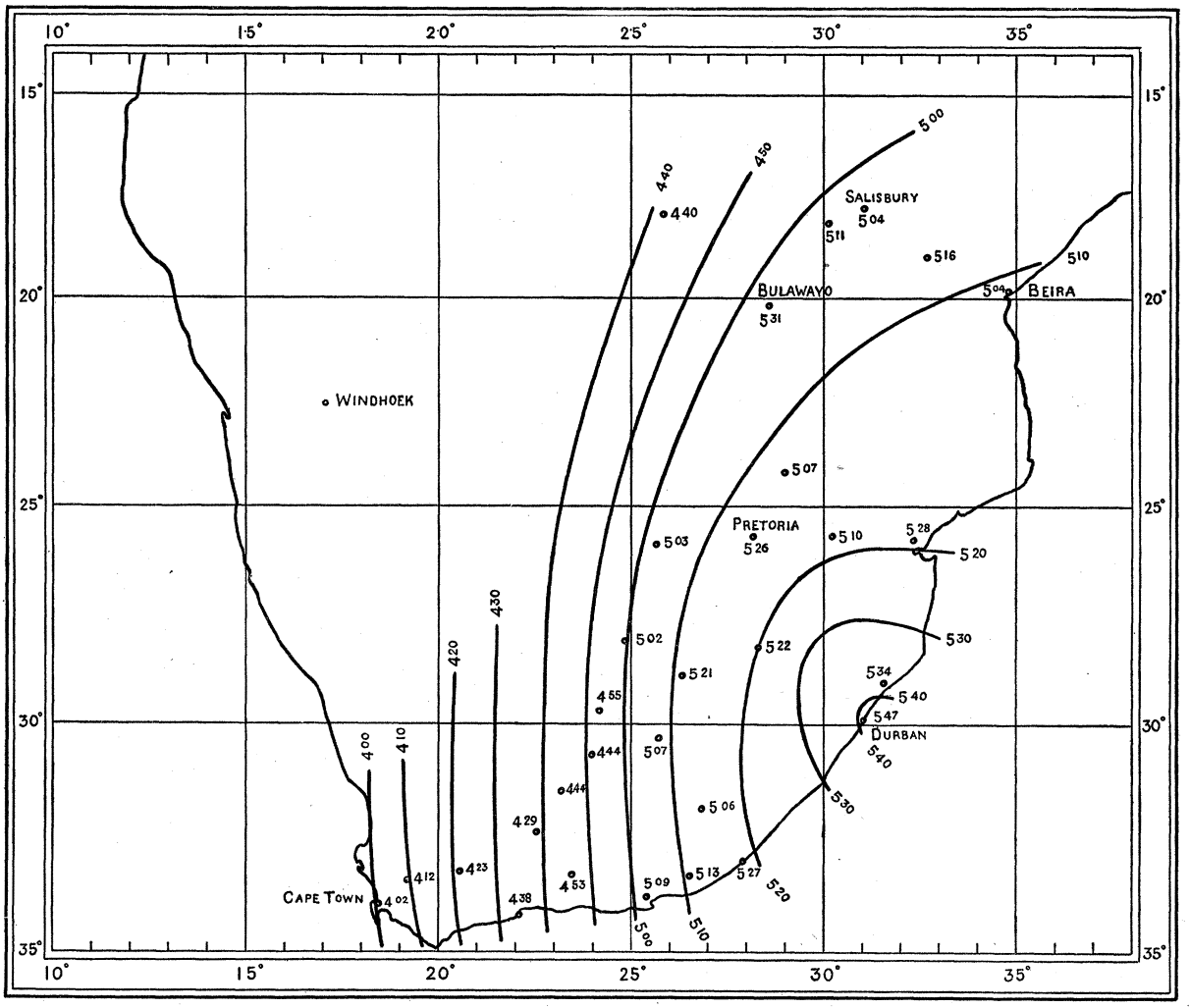
According to the map the correction of 5′ which was applied to all stations surveyed about 1928·0 should vary from $2\frac{1}{2}$′ (at Cape Town) to about 10′ (between Bloemfontein and East London). The correction for the Natal stations (occupied about 1928·5) should be 10′ instead of the 4′ actually applied. In South-West Africa the correction should be zero or negative instead of +3′. The difference for all other stations is so small as to be negligible.

Correction of other surveys to epoch 1930·50

The total change in declination between 1903·50 and 1930·50 has been plotted on map 3 for all those stations mentioned in Beattie's *Report* (1909) which have been reoccupied in the present survey, and lines of equal total change have been drawn. These represent the

observed changes to within 10′, except at Bulawayo (discrepancy 29′) and Pretoria (discrepancy 12′).

This map has been used for correcting to epoch 1930·50 all the remaining stations for which the 1903·50 value of the declination is given in the *Report*, the correction to be applied being read off by interpolation between the lines of equal total change.



MAP 3. Change of declination between epochs 1903·50 and 1930·50. The numerals show the total decrease in westerly declination observed between these two epochs, in degrees and minutes.

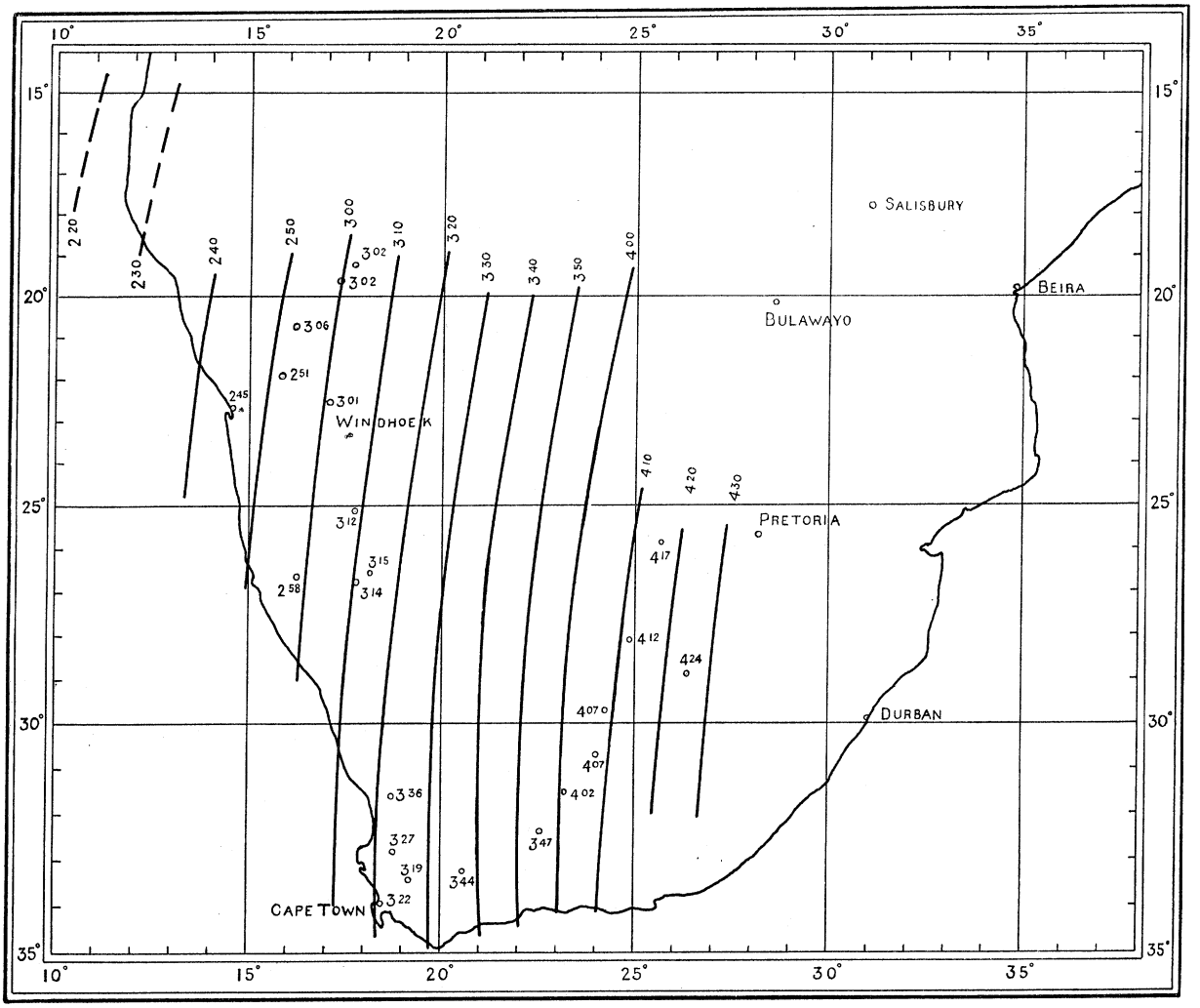
Stations for which the declination at 1908·50 is given by Beattie (1914*b*) have been similarly corrected to epoch 1930·50 by means of map 4, which shows lines of equal change between these two dates. Beattie and Morrison's observations for stations in South-West Africa (Beattie 1914*b*) have been corrected for diurnal variation, and reduced to epoch 1908·50 at the rate of 9′ per annum (taken from the secular variation curves for five stations there which were reoccupied in 1916 (Brown 1921).

Later observations in South Africa (Beattie 1917) have been reduced to epoch 1908·50 at rates given by the slope of the secular variation curves for neighbouring stations.

Father Goetz's observations of declination at stations in Rhodesia have been corrected for diurnal variation, then reduced to epoch 1914·50 at the rate of 14′ per annum found for

Bulawayo and Fort Usher. For the change between this epoch and 1930·50 a correction of 3° 00′ has been made (equal to that found at Bulawayo and Victoria Falls).

To determine the general trend of the isogonal lines to the north of the river Zambesi, use has been made of observations taken by Beattie and Morrison in 1909 and by F. Brown in 1920. To the former an arbitrary correction of 3° 30′ has been applied, and to the latter one of 1° 10′.



MAP 4. Change of declination between the epochs 1908·50 and 1930·50. The numerals show the total decrease in westerly declination observed between these two epochs, in degrees and minutes.

These corrections are based on the following data:

Four of the 1909 stations were reoccupied by Brown in 1920. The changes in declination observed were:

Victoria Falls	2° 30′	Mopea (Mapia)	2° 48′
Broken Hill	2° 13′	Chinde	2° 47′

Two of Brown's stations were reoccupied in the present survey. The changes in declination observed were:

Victoria Falls	1° 26′	Beira B	1° 00′

The observations of declination made by da Fonseca & Vaz (1925) at stations near Lourenço Marques in 1924 and 1925 have been corrected for diurnal variation on the basis of the Cape Town Observatory curves for the appropriate season of the year, and then reduced to epoch 1925·00 at the rate of 14′ per annum. A correction of 40′ was then made to reduce them to epoch 1930·50.

Earlier observations by Chaves (1908) and Metzner (in da Fonseca & Vaz 1925) in Portuguese East Africa were similarly reduced to epoch 1907·00 and a correction of 4° 51′ applied to reduce them to epoch 1930·50. (These corrections are based on the secular variation curves for Boane and Matola.)

Observations at three stations in Angola (Brown 1921) were reduced to epoch 1908·50 at the rate of 8′ per annum, then corrected to 1930·50 by means of map 4. This rate is the mean between those for Boma (to the north) and Swakopmund and Windhoek (to the south).

Inclination

Figure 4 shows the secular variation of the inclination at a number of stations. The variation is almost linear everywhere except in the neighbourhood of Durban and Lourenço Marques, where the secular rate appears to have decreased since 1916. That this decreased rate does not extend far west is shown by the graph for Bloemfontein since 1916; it is closely parallel to that for the neighbouring station of Karree, for which earlier values are known.

It is unfortunate that three of the four stations occupied twice in the present survey were reoccupied at a time when the inclination-inductor was not giving reliable results. The direct determinations of the secular rate between 1928 and 1930 are 3′, −2′ and −18′ per annum at Hutchinson, Orange River, and Matjesfontein respectively. This irregularity naturally throws some doubt on the accuracy of the other observations of inclination made during 1930.

It has been assumed that the secular variation is linear at all stations, and the secular rate has been determined for stations occupied in the present survey by dividing the difference between the new observations and those for an earlier date by the time (in years) between the observations.

These rates have been plotted on map 5. They show great geographical regularity, and the isopors drawn everywhere agree well with the observed values.

Reduction of the inclinations observed in this and earlier surveys to epoch 1930·50 has been made by applying a correction equal to the secular rate (found by interpolation between the isopors on map 5) multiplied by the appropriate number of years.

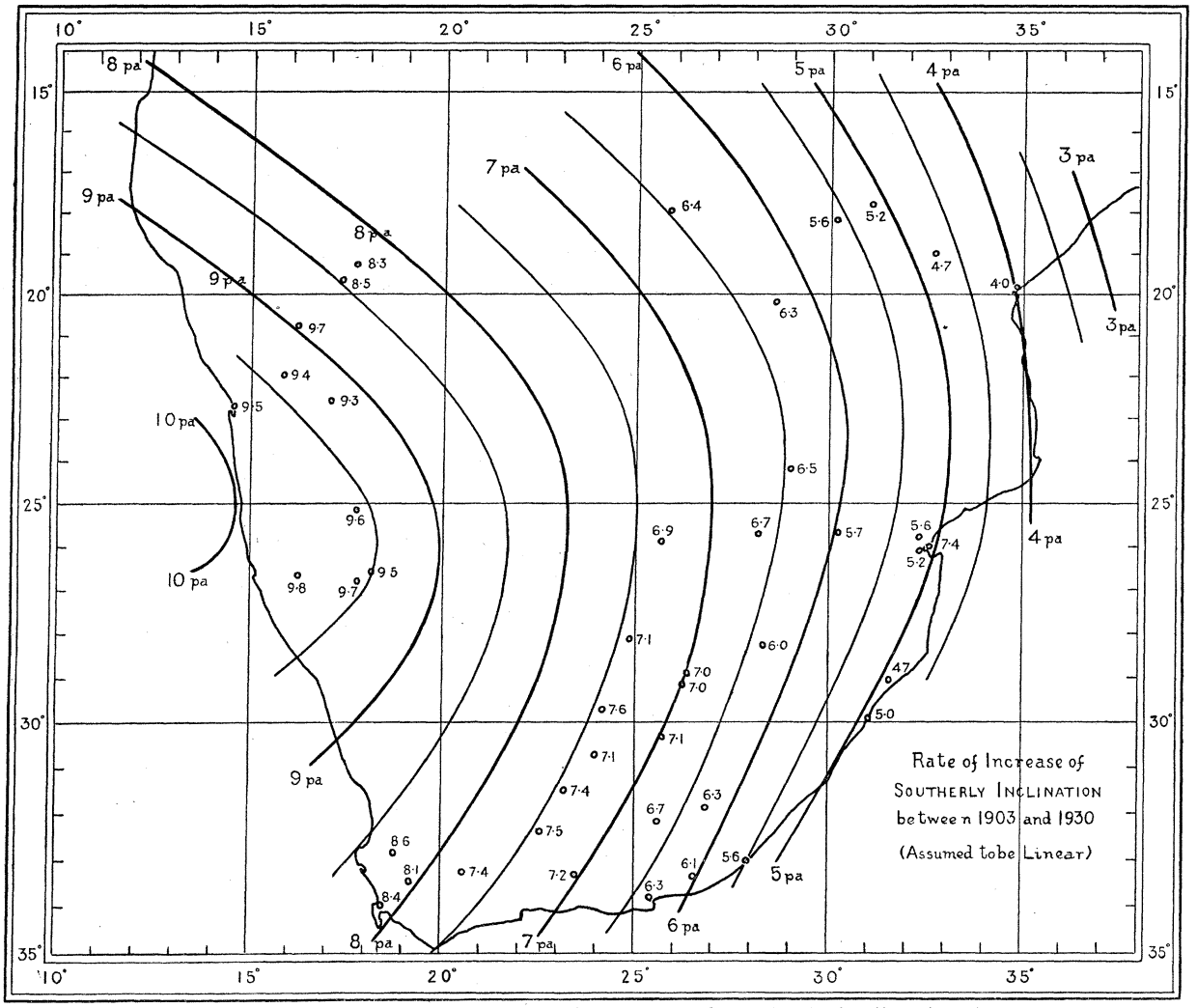
Horizontal intensity

At every station reoccupied in the present survey it is found that H has diminished at a very high rate—often more than 100γ units per year. ($10^5\gamma$ units = 1 gauss.) At those stations, 34 in all, where the value of H is known for two dates prior to the present survey, its rate of change in the second interval is everywhere greater than in the first, though the deviation from linearity is not very great.

An attempt was made to express the secular variation of H at these stations by an equation of the form

$$H = H_0 + At + Bt^2,$$

where t represents the date of the observation. The values obtained for the coefficient B showed little geographical regularity, but seemed to depend chiefly on the date at which the middle observation was taken (indicating that the deviation from linear would require terms of a higher order than Bt^2 to express it).



MAP 5. Inclination isopors, showing rate of increase of southerly inclination between 1903 and 1930, in minutes of arc per annum. (Rate assumed to be linear.)

This deviation was further investigated for stations at which the value of H was known for a number of dates, including the epochs 1903·50 and 1930·50. The stations selected were:

Matjesfontein A	Orange River A
Hutchinson A	Mafeking

From each of the observed values of H at these stations was subtracted the 'linear value' (i.e. what its value would have been if it had varied in a linear manner from 1903·50 to 1930·50). This difference was called the 'deviation'.

When this 'deviation' is plotted as a function of the date it is found that the values for all four stations can be fairly well represented by a single smooth curve, as shown in figure 6.

Up to 1913 the points are numerous; after that date a long gap exists, but the slope of the curve at the end is partly determined by three points for 1928·0.

It was decided to assume that the 'deviation' at all stations was given by this smooth curve. To determine the 'linear value' of H from any observed value, the 'deviation' at the date of observation must be subtracted. The 'linear rate of change' at any station is found by dividing the difference between the 'linear values' at any two dates by the difference between the dates. This 'linear rate' should be equal to the mean secular rate between 1903·50 and 1930·50. The actual secular rate at any date is found by adding the slope of the 'deviation curve' at that date to the 'linear rate' for the station concerned.

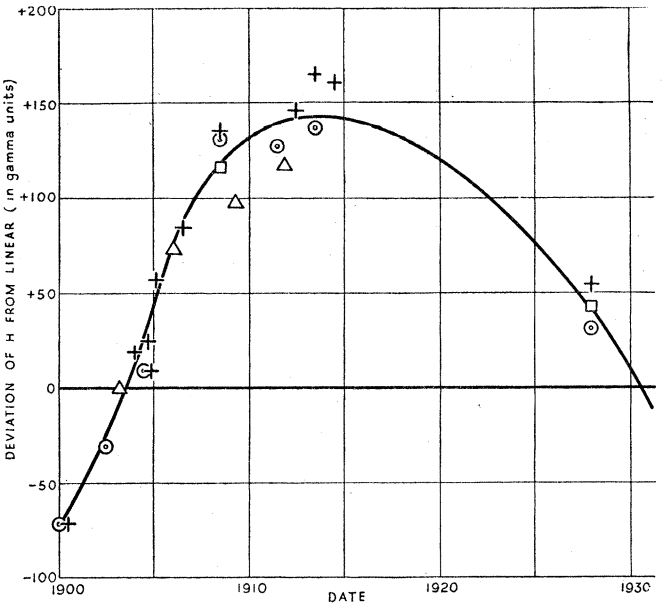


FIGURE 6. 'Deviation' of H from linear value, i.e. amount by which the observed value exceeds that found by linear interpolation between the values at the epochs 1903·50 and 1930·50. The data for the four stations Matjesfontein A, Orange River A, Hutchinson A and Mafeking are shown by separate symbols.

Map 6 shows the dependence of 'linear rate' on geographical position. For stations for which the 1903·50 value is given in Beattie's *Report* (1909) this has been computed between that value and the 'linear value' found in the present survey. For other stations the earliest available observation has been reduced to 'linear value' and the rate calculated between that and the linear value found in the present survey.

The lines of equal linear rate drawn on map 6 are in fairly good agreement with the observations. The worst misfits are:

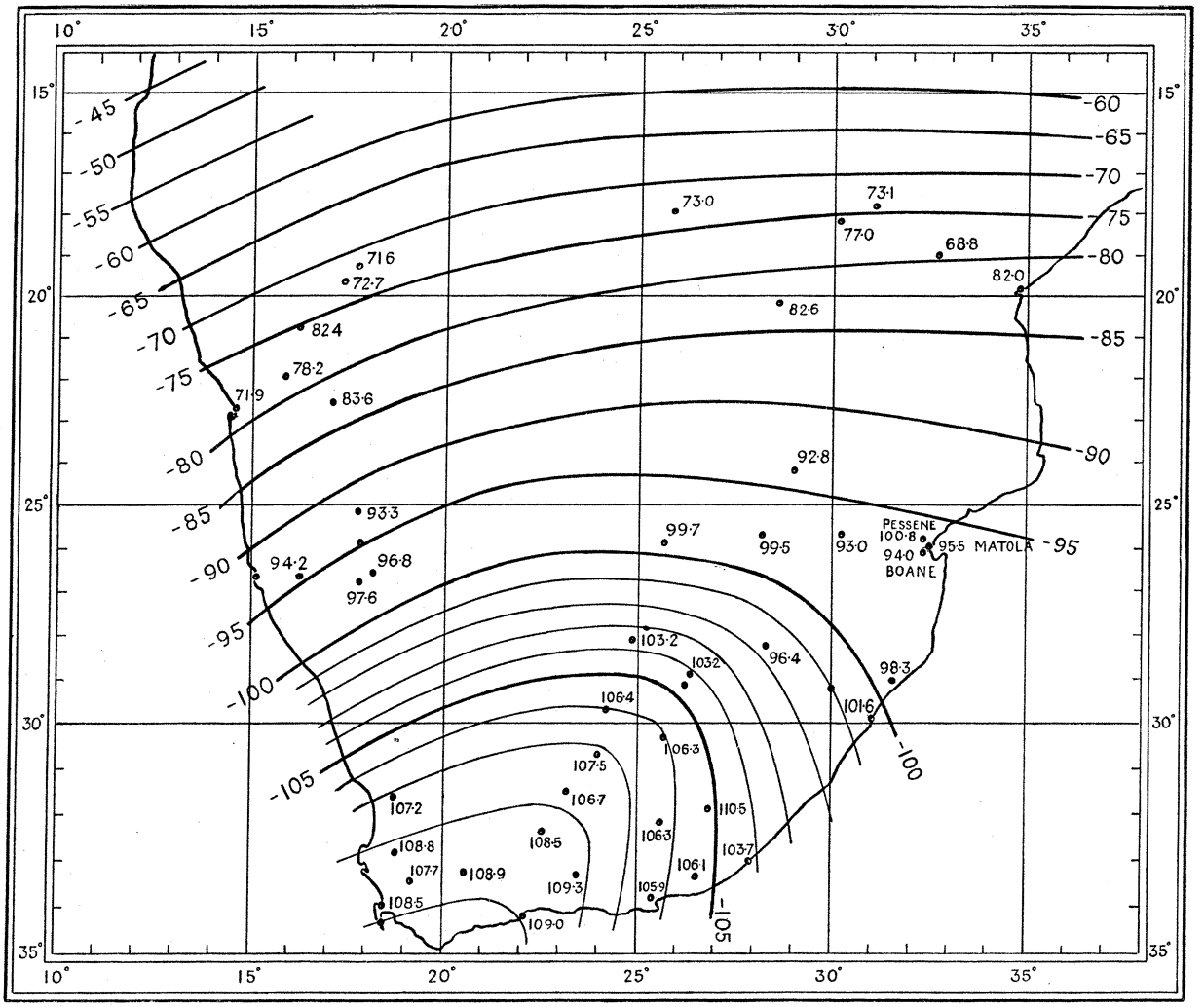
Umtali	Discrepancy 11γ per annum. Location of previous station unknown. Much local disturbance in district.
Kalkfeld Bethlehem Swakopmund	Discrepancy 7 or 8γ per annum. Local disturbance shown by differences between stations A and B in present survey.
Queenstown	Discrepancy of 5γ per annum. Location of previous station unknown.
Pessene Machadodorp	Discrepancy of 4 or 5γ per annum in spite of fairly accurate reoccupation of stations.

Correction to epoch 1930·50

All the results in the present survey have been reduced to 'linear value' as described above, and then corrected to 1930·50 at the 'linear rate' found for that station.

For the remainder of the stations in Beattie's *Report* the 1903·50 values have been corrected to 1930·50 at the 'linear rates' indicated by the isopors on map 6.

For other stations the observed value has been first reduced to linear, and then corrected to 1930·50 at the rate indicated by these isopors.



MAP 6. Horizontal intensity isopors, showing 'linear value' of rate of secular variation, i.e. mean rate between epochs 1903·50 and 1930·50, in γ units per annum. ($10^5\gamma$ units = 1 gauss.)

Observations for stations in South-West Africa were corrected for diurnal variation then reduced to epoch 1908·50 at a rate 10γ per annum less than that given by the 'linear rate' isopors, as the deviation curve has an upward slope of about 10γ per annum in this region. These values were then reduced to linear and corrected to epoch 1930·50 at the rate indicated by the isopors.

Examples of the methods used in reducing observations to the epoch 1930·50

The following examples illustrate the methods used in reducing the observed values of the magnetic elements to their probable value at the epoch 1930·50.

Angular values in the data used (latitude, longitude, declination and inclination) have been corrected to the nearest minute of arc.

Where possible the geographical co-ordinates have been confirmed from the 1:500,000 topographical maps of the Union of South Africa recently published by the Irrigation Department. When either the latitude or the longitude was found to be in error by more than 2′ the value scaled from the map has been substituted.

A. *Method used for stations in Beattie's Report* (1909)

Station: Graaf Reinet

Latitude 32° 17′ S. Confirmed from map
Longitude 24° 36′ E. Corrected from map to 24° 32′ E

Declination

Value given for 1903·50 ...	26° 58′ W
From map 3, change in D	4° 56′ E
Value deduced for 1930·50	22° 02′ W

Inclination

Value given for 1903·50 ...	60° 35′ S
From map 5, change in I (27 years at 6′·95 per annum)	3° 08′ S
Value deduced for 1930·50	63° 43′ S

Horizontal intensity

Value given for 1903·50 ...	17,931
From map 6, change in H (27 years at 107·2γ per annum)	−2,896
Value deduced for 1930·50	15,035

B. *Method used for stations in South Africa for which the* 1908·50 *values are given* (Beattie 1914*b*)

Station: Leeuw Kolk

Latitude 30° 25′ S. Confirmed from map
Longitude 21° 17′ E. Confirmed from map

Declination

Value given for 1908·50 ...	25° 54′ W
From map 4, change in D	3° 43′ E
Value deduced for 1930·50	22° 11′ W

Inclination

Value given for 1908·50 ...	59° 02′ S
From map 5, change in I (22 years at 8′·15 per annum)	2° 59′ S
Value deduced for 1930·50	62° 01′ S

Horizontal intensity

Value given for 1908·50 ...	18,219
Correction to 'linear value' (figure 6)	− 115
From map 6, 'linear change' in H (22 years at 106·6γ per annum)	−2,345
Value deduced for 1930·50	15,759

C. *Method used for stations in South-West Africa* (Beattie & Morrison 1912)

Station: GRÜNDOORN

Latitude 27° 26′ S. Confirmed from map
Longitude 18° 15′ E. Corrected from map to 18° 11′ E

Declination

Observed value, 1909·10	25° 10′ W
Correction for diurnal variation	1′ E
Correction to epoch 1908·50 (0·6 year at 9′ per annum)	5′ W
From map 5, change in D	3° 15′ E
Value deduced for 1930·50	21° 59′ W

Inclination

Observed value, 1909·10	56° 32′ S
Correction for diurnal variation	1′ N
Correction to epoch 1908·50 (map 5) (0·6 year at 9′·35 per annum)	6′ N
Correction to epoch 1930·50 (22 years at 9′·35 per annum)	3° 26′ S
Value deduced for 1930·50	59° 51′ S

Horizontal intensity

Observed value, 1909·10	18,836
Correction for diurnal variation	− 20
Correction to epoch 1908·50 (0·6 year at 89γ per annum)	53
Correction to 'linear value' (figure 6)	− 115
From map 6, 'linear change' in H (22 years at 99·4γ per annum)	−2,187
Value deduced for 1930·50	16,567

D. *Method used for stations in South Africa for which the* 1908·50 *values are not given* (Beattie 1917)

Station: JACOBSDAL

Latitude 29° 09′ S. Confirmed from map
Longitude 24° 46′ E. Confirmed from map

Declination

Observed value, 1914·51	23° 10′ W
Correction to epoch 1908·50 (6·01 years at 12′ per annum)	1° 12′ W
From map 5, change in D	4° 12′ E
Value deduced for 1930·50	20° 10′ W

Inclination

Observed value, 1914·51	60° 17′ S
From map 5, change in I (15·99 years at 7′·4 per annum)	1° 58′ S
Value deduced for 1930·50	62° 15′ S

Horizontal intensity

Observed value, 1914·51	17,599
Correction to 'linear value' (figure 6)	− 141
From map 6, 'linear change' in H (15·99 years at 105·2γ per annum)	−1,682
Value deduced for 1930·50	15,776

E. *Method used for Father Goetz's stations* (Goetz 1920)

Station: EMPANDENI

Latitude 20° 42′ S
Longitude 27° 53′ E } No map available for verifying these

Declination

Observed value, 1916·54	16° 31′ W
Correction for diurnal variation	0′
Correction to epoch 1914·50 (2·04 years at 14′ per annum)	29′ W
Correction to epoch 1930·50 (see p. 263)	3° 00′ E
Value deduced for 1930·50	14° 00′ W

Inclination and horizontal intensity

As in example D

F. *Method used for stations north of the Zambesi* (Beattie & Morrison 1912, Brown 1921)

Declination

For Beattie & Morrison's stations, occupied in 1909, a correction of 3° 50′ has been subtracted from the observed values of the westerly declination.

For Brown's stations, occupied in 1920, a correction of 1° 10′ has been subtracted (see p. 264).

Inclination and horizontal intensity

As in example D

G. *Method used for stations near Lourenço Marques* (da Fonseca & Vaz, 1925)

Station: Xefina Grande

Latitude 25° 55′ S
Longitude 32° 41′ E } No map available for verifying these

Declination

Observed value, 1924·76	15° 06′ W
Correction for diurnal variation (Cape Town Observatory curve for October)	6′ E
Correction to epoch 1925·00 (0·24 year at 14′ per annum)	3′ E
Correction to epoch 1930·50 (see p. 265)	40′ E
Value deduced for 1930·50	14° 17′ W

Inclination and horizontal intensity

As in example D

P. *Method used for stations occupied in the present survey*

Station: Gingindhlovu

Latitude 29° 04′ S. Corrected from map to 29° 02′ S
Longitude 31° 35′ E. Confirmed from map

Declination

Summary of observations

date	local mean time	observed value	diurnal variation	corrected value
13 July 1928	15^{h} 57^{m}	17° 31′·2 W	3′·0 E	17° 34′·2 W
14 July 1928	10 32	17 40·1	4·1 W	17 36·0
14 July 1928	12 38	17 40·0	0·6 W	17 39·4

Mean declination at 1928·54	17° 36′·5 W
Correction to epoch 1930·50 (1·96 years at 2′ per annum)	4′ E
Value deduced for 1930·50	17° 32′ W

Inclination

Summary of observations

date	local mean time	observed value	diurnal variation	corrected value
13 July 1928	13h 30m	63° 07′·0 S	0′·6 S	63° 06′·4 S
13 July 1928	13 52	63 06·2	0·8	63 05·4
14 July 1928	16 53	63 05·0	2·6	63 02·4
15 July 1928	9 18	(d.v. curve maximum)		62 59·9
15 July 1928	14 50	(d.v. curve minimum)		63 07·8

Mean inclination at 1928·54	63° 04′·4 S
Correction to epoch 1930·50 (map 5) (1·96 years at 4′·9 per annum) ...	9′·6 S
Value deduced for 1930·50	63° 14′ S

Horizontal intensity

Summary of observations

date	local mean time	observed value	diurnal variation	corrected value
13 July 1928	16h 25m	15808	−13	15821
14 July 1928	11 02	15834	+ 5	15829
14 July 1928	12 11	15823	+ 2	15821

Mean horizontal intensity at 1928·54	15,824
Correction to 'linear value'	− 34
Correction to epoch 1930·50 (map 6) (1·96 years at 99·5γ per annum) ...	−195
Value deduced for 1930·50	15,595

In table 2 (at the end of the paper) are collected the data for 729 stations occupied in the various magnetic surveys since 1900. The stations are listed and renumbered in alphabetical order. In column 3 is the number (if any) allotted to this station in the source from which the original data were obtained. This source is indicated by the numeral in column 4, and explained in the footnote to the table. The letter in this column indicates the method adopted in correcting the data to epoch 1930·50, as described in pp. 269–72. The latitude and longitude are next shown, and the next four columns give the original magnetic data used. The three final columns show the values of the three magnetic elements at the epoch 1930·50.

These corrected data have been used in the preparation of magnetic maps on which isomagnetic lines have been drawn.

Map 7 shows the positions of the stations in table 2, the stations being distinguished by the number allotted to them in that table. Maps 8, 9 and 10 show respectively the isomagnetic lines for declination, inclination, and horizontal intensity.

As suggested by Ljungdahl (1936, 1937), the observed values of these elements at each station are not shown on the maps; instead a symbol is used, indicating how closely the observed value at each station agrees with the value found by interpolation between the isomagnetic lines. These lines are highly smoothed, and arranged so that the spacings between them increase or decrease gradually. They are drawn sufficiently close together to justify linear interpolation between adjacent lines.

Thus the isomagnetic lines drawn make no attempt to conform to local magnetic disturbances, even when large anomalies are found at a number of neighbouring stations. For most purposes the lines are more useful if they indicate the average conditions. Even if this were not the case, the intervals between the points of observation on the present maps

are so large that even if the isomagnetic lines conformed exactly to every observed value, it is improbable that they would represent the true values of the elements at points where no observations are available any more accurately than the smoothed lines do. For the occurrence of anomalies is apparently accidental, as the term is understood in the theory of errors, and agreement of still unobserved values with any prearranged system of lines would be accidental also. Close representation of all the observed values does not improve the map as a means of estimating values at points where no observations have been made (McFarland 1930).

On the other hand, with a highly smoothed system of lines such as those on the present maps, the relation of the lines to observed and unobserved values can be expected to be about the same. The actual observations may be regarded as a random sample of all possible observations. Thus in the region within about 200 miles of Cape Town the symbols on maps 7, 8 and 9 show that nearly all the observations are in close agreement with the values indicated by the isomagnetic lines. It seems reasonable to suppose that at the majority of other places in this region the agreement would be equally good. On the other hand, to the north-west of Lourenço Marques considerable anomalies occur at a large proportion of the stations, and anomalies of the same order of magnitude would be liable to occur at other points in this region.

An isolated anomaly of unusual size shows the existence of a magnetic disturbance, but gives no indication of its form or extent. Its representation by a special symbol on the map serves as a warning that as one anomalous value has been found others are to be expected.

The main practical advantages of this type of magnetic map have been summarized by Ljungdahl (1936, 1937) as follows:

The map shows clearly to what extent the values given by the isomagnetic lines have been ascertained by observation, each observation being indicated by a symbol. Where no symbols are shown observations are lacking (as on a mariner's chart in parts without soundings).

Within the surveyed areas disturbed and undisturbed regions are clearly distinguished, and the average amplitudes of the irregularities may be estimated easily. The symbols at the points of observation are chosen so that by their magnitude they show at a glance the magnitude of the local disturbance at these points.

Within unsurveyed areas the most probable value of the magnetic element is given.

Even on small-scale charts most of the details of importance may be indicated.

It is possible to add values from new stations without altering the details already given.

When suitable data of secular variation is available, the epoch of the map may be changed by simply changing the position of the isomagnetic lines.

In concluding, I wish to express my thanks to the following:

The South African Government's Research Grant Board, for a grant covering about one-third of the expenses.

The Department of Terrestrial Magnetism of the Carnegie Institution of Washington, for grants covering the remainder of the expenses, and for the loan of most of the apparatus used.

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The Physics Department of the University of Cape Town, for the loan of further apparatus.

Professor Ogg, now Director of the Cape Town Magnetic Observatory, for much help and advice, and for supplying the Observatory data used in this paper.

Professor Schonland, Director of the Johannesburg Geo-Physical Laboratory, and the Astronomers Royal, the late Sir Frank Dyson, and Dr H. Spencer Jones, for much help, advice, and encouragement.

Mr J. P. T. Viljoen, for assistance in making some of the observations.

Thanks are also due to a large number of persons with whom the work brought me in contact at the various places visited, in particular Director Peres and Assistant-Director Soares of the Lourenço Marques Observatory. The large amount of friendly assistance received everywhere contributed greatly to the success of the survey.

References

Bauer, L. A. 1912 Land magnetic observations, **1**. *Publ. Carneg. Instn*, no. 175.

Beattie, J. C. 1909 *Report of a magnetic survey of South Africa*. London: Royal Society.

Beattie, J. C. 1914*a* *Trans. Roy. Soc. S. Afr.* **4**, 9.

Beattie, J. C. 1914*b* *Trans. Roy. Soc. S. Afr.* **4**, 57.

Beattie, J. C. 1915 *Trans. Roy. Soc. S. Afr.* **4**, 181.

Beattie, J. C. 1917 *Trans. Roy. Soc. S. Afr.* **5**, 669, 671.

Beattie, J. C. & Morrison, J. T. 1912 In Bauer, L. A., Land magnetic observations, **1**. *Publ. Carneg. Instn*, no. 175.

Brown, F. 1921 In Bauer, K. A. and others, Land magnetic observations, **4**. *Publ. Carneg. Instn*, no. 175.

Chaves 1908 *Bull. Inst. Océanogr. Monaco*, no. 123.

da Fonseca & Vaz 1925 *Valores dos elementos do Magnetismo Terrestre ne Provincia de Moçambique*. Lourenço Marques: Imprensa Nacional.

Goetz 1920 *Trans. Roy. Soc. S. Afr.* **8**, 297.

Grindley, E. N. Appendix B, Thesis for Ph.D. (unpublished).

Hazard, D. L. 1930 *U.S. Coast and Geodetic Survey Directions for Magnetic Measurements*. Washington, D.C.

Ljungdahl, G. S. 1936 *Terr. Magn. Atmos. Elect.* **41**, 101.

Ljungdahl, G. S. 1937 *Geogr. Ann., Stockh.*, **19**, 96.

McFarland, W. N. 1930 Construction of magnetic charts. *Terr. Magn. Atmos. Elect.* **35**, 78.

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PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

TABLE 2*

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
1	Abbasis	1	4 B	28 54	18 27	08·50	—	57 44	18592	—	61 03	16224
2	Abelsdam	1	1 A	27 37	26 22	03·50	23 38	59 02	18790	18 27	62 12	16035
3	Aberdeen C.P.	2	1 A	32 29	24 03	03·50	27 14	60 25	17991	22 23	63 37	15084
4	Aberdeen (Transvaal)	3	1 A	26 04	29 28	03·50	21 16	58 43	19217	15 58	61 30	16572
5	Aberdeen Road	4	1 A	32 44	24 18	03·50	27 06	60 21	18192	22 13	63 28	15290
6	Aberfeldy	5	1 A	25 46	28 34	03·50	22 14	58 04	19425	16 59	60 59	16781
7	Abiekwa Put	—	4 B	30 22	20 46	08·50	26 04	59 01	18202	22 26	62 03	15765
8	Adelaide	6	1 A	32 43	26 18	03·50	26 22	61 22	17743	21 12	64 12	14889
9	Aggennys	—	4 B	29 13	18 49	08·50	26 23	58 08	18328	23 01	61 25	15942
10	Albert Falls	7	1 A	29 26	30 26	03·50	23 46	60 55	18338	18 09	63 18	15620
11	Alexandersfontein	—	7 D	28 49	24 46	14·52	22 52	60 19	17665	19 52	62 17	15844
12	Alexandria	—	5 D	33 38	26 34	10·95	25 48	62 17	16931	21 50	64 14	14733
13	Alewynsfontein	—	4 B	30 27	18 36	08·50	26 24	58 42	18219	23 03	61 56	15787
14	Alicedale	8	1 A	33 19	26 05	03·50	27 27	61 36	17546	22 20	64 24	14688
15	Aliwal North	9	1 A	30 42	26 42	03·50	25 21	60 22	18205	20 08	63 20	15361
16	Alma	10	1 A	27 08	31 03	03·50	22 37	59 22	18857	17 10	61 50	16203
17	Amabele Junction	11	1 A	32 40	27 32	03·50	26 03	61 22	17815	20 47	64 00	14988
18	Amaranja	12	1 A	31 15	29 28	03·50	—	61 00	18073	—	63 22	15312
19	Amatongas	13	1 A	19 11	33 45	03·50	16 04	53 38	21839	10 55	55 36	19672
20	Ancuaze	—	10 F	16 48	34 34	20·68	10 01	52 30	21861	8 51	53 05	21074
21	Antelope Mine	—	8 E	21 02	28 26	16·58	16 37	55 32	20058	14 06	57 01	18732
22	Aris	—	3 C	22 45	17 08	09·24	—	53 09	20232	—	56 25	18317
23	Ashton	14	1 A	33 50	20 04	03·50	—	59 41	18135	—	63 10	15194
24	Assegai Bosch	15	1 A	33 57	24 20	03·50	27 33	—	17746	22 40	—	14846
25	Augsburg	—	4 B	32 10	18 53	08·50	27 26	59 13	18061	24 02	62 18	15578
26	Aus (C.P.)	8	4 B	29 13	17 48	08·50	26 17	57 32	18627	23 03	60 52	16260
27	Aus A (S.-W. Afr.)	—	P	26 40	16 16	29·13	22 20	58 32	17342	22 17	58 45	17188
28	Avontuur	16	1 A	33 44	23 10	03·50	27 49	60 42	17842	23 06	63 52	14918
29	Awasap	—	3 C	23 33	17 07	09·23	23 07	54 24	19821	20 09	57 44	17842
30	Ayrshire Mine	17	1 A	17 12	30 23	03·50	16 05	50 55	22805	11 05	53 18	20890

* See References: (1) Beattie (1909); (2) Chaves (1908); (3) Beattie & Morrison (1912); (4) Beattie (1914*b*); (5) Beattie (1914*a*); (6) Beattie (1915); (7) Beattie (1917, p. 669); (8) Goetz (1920); (9) Beattie (1917, p. 671); (10) Bauer (1912); (11) da Fonseca & Vaz (1925); P = present survey.

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
31	Balmoral	17*a*	1 A	25 51	28 58	03·50	22 07	58 10	19362	16 50	61 02	16720
32	Bamboo Creek	18	1 A	19 16	34 12	03·50	15 05	53 46	21930	9 54	55 40	19755
33	Bandar	—	10 F	16 38	34 10	20·68	11 23	52 06	21838	10 13	52 43	21056
34	Bankpan	19	1 A	26 18	29 35	03·50	—	59 43	18485	—	62 29	15729
35	Barber's Pan	—	5 D	26 36	25 35	09·78	22 41	—	—	18 40	—	—
36	Barberton	20	1 A	25 47	31 00	03·50	21 13	58 36	19287	15 54	61 09	16682
37	Barkly West	—	7 D	28 34	24 32	15·03	22 31	60 18	17643	19 39	62 14	15887
38	Barra do Limpopo	—	11 G	25 11	33 28	08·16	19 01	59 00	19281	14 21	60 47	17093
39	Barrington	21	1 A	33 55	22 52	03·50	26 38	60 08	18303	21 58	63 20	15378
40	Bashee	400	1 A	31 48	28 32	03·50	25 58	61 35	17786	20 35	64 01	14996
41	Battlefields	22	1 A	18 32	29 50	03·50	17 23	52 31	21872	12 21	55 05	19782
42	Bavaria	23	1 A	27 29	29 08	03·50	22 29	59 16	18843	17 06	62 02	16131
43	Baviaanskrantz	24	1 A	27 23	26 47	03·50	26 49	58 42	18903	21 36	61 49	16165
44	Beaconsfield	24*a*	1 A	28 45	24 47	03·50	—	58 40	—	—	62 00	—
45	Beaufort West	—	P	32 21	22 36	28·02	22 45	62 46	15588	22 40	63 05	15278
46	Beaulieu	12	4 B	26 14	24 14	08·50	22 32	57 40	19050	18 27	60 30	16734
47	Beira C	—	P	19 50	34 51	30·47	10 42	56 21	19454	10 42	56 21	19452
48	Bella Vista		11 G	26 20	32 40	24·93	14 54	61 19	17045	14 10	61 47	16431
49	Belleville	27	1 A	33 53	18 38	03·50	—	59 11	18262	—	62 50	15323
50	Berg River Mouth	28	1 A	32 46	18 10	03·50	28 18	58 29	18435	24 19	62 16	15517
51	Bethal	29	1 A	26 28	29 28	03·50	22 44	58 13	19416	17 25	61 00	16747
52	Bethany	30	1 A	29 37	26 00	03·50	24 50	59 42	18443	19 40	62 51	15601
53	Bethesda Road	31	1 A	31 55	24 44	03·50	26 21	60 29	18062	21 24	63 39	15168
54	Bethlehem A	—	P	28 14	28 18	28·53	17 23	63 01	15945	17 19	63 14	15711
55	Bethulie	33	1 A	30 30	25 59	03·50	25 30	59 51	18400	20 20	62 56	15540
56	Beukesfontein	14	4 B	32 55	19 43	08·50	27 55	59 56	17854	24 25	62 54	15354
57	Biesjespoort	34	1 A	31 44	23 12	03·50	26 02	59 38	18445	21 19	62 58	15532
58	Birthday	35	1 A	23 20	30 46	03·50	16 08	59 07	18566	10 54	61 47	16103
59	Blaauwbosch	36	1 A	30 29	22 05	03·50	26 34	58 52	18496	21 58	62 24	15605
60	Blaauwkrantz	37	1 A	33 57	23 37	03·50	27 44	60 58	17813	22 58	64 04	14895
61	Blaauwpoort	18	4 B	30 39	21 42	08·50	25 56	59 12	18137	22 09	62 08	15691
62	Blantyre	—	3 F	15 48	35 03	09·67	11 12	51 33	22998	7 22	52 41	21540
63	Bloemfontein	—	P	29 08	26 13	28·07	19 47	62 26	15918	19 42	62 43	15623
64	Bloemhof	—	7 D	27 38	25 37	15·04	22 03	59 50	17929	19 03	61 42	16203
65	Boane	—	P	26 03	32 20	30·46	14 51	61 35	16658	14 51	61 35	16654

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66	Boons	19	4 B	25 58	27 14	08·50	21 18	58 22	19025	16 48	60 54	16733
67	Boroma	—	10 F	16 03	33 27	20·65	10 20	51 15	22115	9 10	51 54	21354
68	Boschkopjes	39	1 A	23 12	29 59	03·50	19 51	56 49	19957	14 39	59 36	17497
69	Boschrand	40	1 A	27 46	27 12	03·50	23 39	59 03	18842	18 23	62 07	16091
70	Boshof	—	7 D	28 33	25 14	14·52	22 48	60 04	17758	19 45	62 01	15949
71	Boston	41	1 A	29 41	29 58	03·50	23 45	60 54	18242	18 11	63 21	15509
72	Botha's Berg	42	1 A	25 25	29 49	03·50	22 24	57 57	20347	17 07	60 43	17743
73	Brak River (C.P.)	21	4 B	31 16	19 30	08·50	26 52	58 55	18217	23 24	62 01	15750
74	Brak River (Transvaal)	43	1 A	22 52	29 15	03·50	19 32	55 56	20452	14 22	58 48	18010
75	Brandboontjes	44	1 A	23 28	30 16	03·50	19 52	56 40	20065	14 39	59 25	17586
76	Bredasdorp	45	1 A	34 32	20 03	03·50	28 39	59 56	18015	24 24	63 21	15063
77	Breekkerrie	46	1 A	30 07	21 35	03·50	27 03	58 21	18531	22 32	62 00	15660
78	Bretby	24	4 B	27 50	23 31	08·50	36 52	50 00	20564	32 50	55 52	18184
79	Britstown	47	1 A	30 35	23 30	03·50	26 29	59 06	18097	21 42	62 29	15206
80	Broken Hill	—	10 F	14 28	28 26	20·52	12 06	49 00	22908	10 57	49 53	22217
81	Bruwer's Farm	26	4 B	26 19	24 36	08·50	22 51	58 05	18985	18 43	60 53	16667
82	Bry Paal	27	4 B	29 10	20 28	08·50	25 48	58 17	18001	22 12	61 25	15596
83	Buchholzbrunn	—	3 C	26 41	17 07	09·13	24 17	55 24	19432	21 18	58 50	17267
84	Buckwheat	29	4 B	26 03	25 11	08·50	22 46	57 36	19080	18 34	60 20	16776
85	Buffel's Bay	—	P	34 19	18 28	28·85	24 38	62 47	15498	24 35	63 00	15290
86	Buffelsberg	48	1 A	23 37	30 01	03·50	20 55	57 11	19484	15 42	59 58	16996
87	Buffelshoek	49	1 A	23 07	29 00	03·50	20 07	57 05	19809	14 57	59 59	17346
88	Buffelsklip	50	1 A	33 32	22 52	03·50	27 47	60 38	17867	23 07	63 52	14937
89	Bulawayo	—	P	20 09	28 36	30·52	13 06	56 19	19227	13 06	56 19	19229
90	Bulshoek	30	4 B	31 59	18 47	08·50	27 15	59 02	18014	23 52	62 09	15535
91	Bult and Baatjes	52	1 A	26 08	30 16	03·50	—	59 12	19223	—	61 52	16591
92	Bultfontein	—	7 D	28 19	26 10	14·49	21 40	60 18	17802	18 29	62 12	16013
93	Bulwer	52*a*	1 A	29 48	29 46	03·50	24 22	—	18080	18 50	—	15338
94	Burghersdorp	53	1 A	31 00	26 18	03·50	25 42	60 18	18212	20 31	63 18	15357
95	Bushmanskop	54	1 A	32 21	22 14	03·50	27 17	59 41	18231	22 41	63 05	15309
96	Butterworth (road to)	55	1 A	32 21	28 04	03·50	25 51	61 20	17841	20 31	63 52	15033
97	Cachomba	—	10 F	15 39	31 55	20·63	10 38	50 27	22478	9 28	51 10	21735
98	Caledon River	56	1 A	30 19	26 42	03·50	25 44	60 23	18089	20 30	63 23	15251
99	Calitzdorp	57	1 A	33 32	21 41	03·50	28 18	60 19	17918	23 47	63 40	14980
100	Campbell	—	7 D	28 49	23 43	15·07	23 38	60 00	17689	20 53	61 58	15934
101	Camperdown	58	1 A	29 44	30 32	03·50	—	61 29	17833	—	63 48	15113
102	Cango	59	1 A	33 25	22 14	03·50	25 19	60 44	17780	20 44	64 02	14846
103	Cape Town E (Royal Observatory)	—	P	33 56	18 29	27·96	24 47	62 30	15668	24 42	62 51	15350
104	Captiva	—	10 F	15 44	31 14	20·62	11 25	50 57	22244	10 15	51 44	21496
105	Cathcart	61	1 A	32 18	27 09	03·50	—	61 46	17477	—	64 29	14644

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
106	Ceres	33	4 B	33 22	19 18	08·50	27 31	59 50	17846	24 05	62 48	15342
107	Chapakatika's Village	—	3 F	16 38	35 10	09·68	12 34	51 49	22588	8 44	53 00	21042
108	Charlestown	63	1 A	27 25	29 54	03·50	21 33	59 24	18861	16 06	62 03	16166
109	Chemba	—	10 F	17 11	34 55	20·69	10 10	52 26	21841	9 00	53 01	21029
110	Chicoa	—	10 F	15 36	32 21	20·64	10 45	50 18	22518	9 35	51 00	21781
111	Chinde	—	10 F	18 35	36 28	20·72	10 16	54 15	20858	9 06	54 47	19985
112	Chindio	—	10 F	17 42	35 17	20·70	10 18	53 02	21494	9 08	53 36	20663
113	Choma	—	3 F	16 49	26 48	09·32	16 06	50 29	22487	12 16	52 40	20904
114	Christiana	—	7 D	27 54	25 11	15·04	22 11	59 47	17865	19 14	61 41	16133
115	Clarkson	64	1 A	34 01	24 20	03·50	—	61 09	17800	—	64 07	14903
116	Coega	—	5 D	33 45	25 38	10·96	25 46	62 13	17024	21 56	64 15	14812
117	Coerney	65	1 A	33 28	25 44	03·50	27 18	61 30	17626	22 13	64 20	14762
118	Colenso	66	1 A	28 44	29 50	03·50	22 48	60 09	18548	17 16	62 43	15824
119	Colesberg	67	1 A	30 43	25 06	03·50	25 36	60 01	18183	20 26	63 12	15304
120	Connan's Farm	68	1 A	28 58	21 19	03·50	24 55	56 16	19602	20 27	60 02	16785
121	Cookhouse	69	1 A	32 44	25 48	03·50	26 43	61 14	17732	21 37	64 09	14868
122	Cotswold Hotel	70	1 A	30 40	29 53	03·50	24 23	61 28	17769	18 52	63 48	15022
123	Cradock	—	P	32 10	25 37	28·13	—	63 35	15403	—	63 51	15111
124	Cream of Tartar Fontein	72	1 A	22 35	29 01	03·50	19 42	55 44	20406	14 33	58 36	17982
125	Crocodile Pools	73	1 A	24 47	25 50	03·50	21 38	56 14	19995	16 36	59 31	17394
126	Dabai Gabis	—	3 C	28 18	18 40	09·08	25 14	57 11	18824	21 56	60 26	16500
127	Dabenoris	37	4 B	28 55	18 39	08·50	26 16	57 35	18638	22 56	60 54	16268
128	Dalton	74	1 A	29 20	30 37	03·50	—	61 24	17974	—	63 46	15261
129	Dambiesfontein	75	1 A	31 24	21 18	03·50	27 07	59 16	18355	22 39	62 51	15451
130	Daniel's Kuil	—	7 D	28 11	23 32	15·06	23 34	59 31	17897	20 51	61 31	16157
131	Dannhauser	76	1 A	28 01	30 03	03·50	22 30	59 44	18597	17 00	62 19	15893
132	Dargle Road	77	1 A	29 29	30 06	03·50	24 06	60 39	18468	18 31	63 06	15741
133	Darling	78	1 A	33 22	18 22	03·50	28 31	58 56	18351	24 30	62 39	15421
134	De Aar	—	P	30 41	24 00	28·04	21 03	62 15	15852	20 58	62 33	15547
135	Dealesville	—	7 D	28 42	25 44	14·49	22 48	60 45	17605	19 40	62 40	15793
136	De Doorns	80	1 A	33 29	19 40	03·50	—	59 20	18205	—	62 54	15267
137	Deelfontein	81	1 A	30 06	26 32	03·50	25 22	60 06	18243	20 10	63 08	15402
138	Deelfontein Farm	82	1 A	28 20	27 48	03·50	—	59 25	18706	—	62 22	15949
139	De Jager's Farm	83	1 A	28 16	28 58	03·50	23 04	59 34	18799	17 40	62 19	16067
140	De Kruis	—	3 D	32 36	18 44	07·03	26 12	59 13	18133	22 37	62 28	15506

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141	De Neus	—	5 D	29 11	19 39	12·99	25 04	58 42	18100	22 20	61 16	16146
142	Dewetsdorp	84	1 A	29 36	26 40	03·50	25 43	59 37	18528	20 30	62 41	15704
143	Dickdoorn	—	3 C	25 32	18 02	09·19	24 20	55 18	19447	21 20	58 40	17340
144	Dingle	45	1 B	27 49	22 59	08·50	23 35	58 09	18698	19 37	61 04	16322
145	Doorn Bosch	—	9 D	31 58	19 15	13·50	—	59 45	—	—	62 08	—
146	Doorn River	46	4 B	31 52	18 41	08·50	27 09	59 00	18110	23 47	62 07	15628
147	Douglas	—	7 D	29 02	23 47	15·08	23 30	60 09	17610	20 44	62 07	15850
148	Downes	47	4 B	31 28	19 57	08·50	27 00	—	18114	23 28	—	15640
149	Draaikraal	48	4 B	31 45	19 43	08·50	27 12	59 20	17959	23 42	62 23	15480
150	Draghoender	85	1 A	29 22	22 07	03·50	27 14	58 16	18723	22 39	60 54	15878
151	Drew	86	1 A	34 00	20 12	03·50	28 25	59 51	18130	24 06	63 19	15186
152	Driefontein	87	1 A	26 29	29 13	03·50	22 23	59 06	18788	17 04	61 55	16112
153	Driehoek	88	1 A	27 12	30 41	03·50	22 18	59 25	18898	16 51	61 57	16231
154	Drooge Grond	51	4 B	29 07	20 15	08·50	25 46	58 33	18338	22 13	61 43	15938
155	Durban (The Bluff)	—	P	29 52	31 03	28·50	17 57	63 32	15420	17 53	63 42	15185
156	East London A	—	P	33 00	27 56	28·11	21 10	64 10	15046	21 05	64 23	14757
157	Ebony	—	3 C	22 05	15 16	09·18	23 32	51 51	20888	20 49	55 13	19108
158	Eendekuil	—	P	32 41	18 48	30·14	24 03	62 32	15540	24 02	62 35	15495
159	Eenriet	53	4 B	29 11	17 50	08·50	26 21	57 23	18696	23 08	60 43	16330
160	Elandshoek	90	1 A	25 30	30 41	03·50	—	59 52	18867	—	62 29	16269
161	Elandskloof Farm	91	1 A	28 00	26 19	03·50	—	58 57	18830	—	62 07	16055
162	Elands Put	54	4 B	25 58	26 08	08·50	22 15	58 03	19061	17 55	60 42	16765
163	Elim	92	1 A	34 36	19 46	03·50	28 42	59 55	18065	24 29	63 22	15112
164	Ellerton	93	1 A	23 25	30 36	03·50	—	56 54	19819	—	59 36	17354
165	Elliot	94	1 A	31 20	27 51	03·50	24 55	61 05	17998	19 34	63 46	15189
166	Elsburg	95	1 A	26 15	28 11	03·50	22 29	58 26	19140	17 14	61 24	16460
167	Emmasheim	96	1 A	28 17	28 00	03·50	23 55	59 29	18697	18 36	62 22	15949
168	Empandeni	—	8 E	20 42	27 53	16·54	16 31	55 06	21044	14 00	56 37	18829
169	Epako	—	3 C	21 14	16 02	09·14	22 19	51 23	20787	19 33	54 37	19056
170	Erasmus	56	4 B	27 08	24 08	08·50	23 36	58 20	18822	19 30	61 10	16472
171	Erongo	—	3 C	21 42	15 53	09·15	22 50	51 45	20639	20 04	55 01	18840
172	Estcourt	97	1 A	29 01	29 54	03·50	23 17	60 12	18376	17 45	62 44	15550
173	Feira	—	10 F	15 37	30 25	20·60	11 51	50 25	22566	10 41	51 14	21822
174	Ferreira	98	1 A	29 12	26 11	03·50	24 47	59 31	18480	19 36	62 40	15656
175	Fish River	99	1 A	31 55	25 27	03·50	26 18	60 44	18018	21 14	63 47	15143
176	Flatlands	57	4 B	27 33	22 58	08·50	—	58 18	18579	—	61 14	16216
177	Fort Mangwe	—	8 E	20 43	28 03	16·54	16 24	55 04	20189	13 55	56 34	18874
178	Fort Usher	—	8 E	20 24	28 35	16·60	16 11	55 18	20271	13 40	56 45	18974
179	Forty-one mile Siding	100	1 A	17 43	30 33	03·50	15 55	51 47	22465	10 53	54 12	20470
180	Fountain Hall	101	1 A	29 16	29 59	03·50	23 20	60 20	18500	17 46	62 50	15772

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
181	Francistown	102	1 A	21 04	27 32	03·50	—	53 45	20380	—	56 43	18068
182	Francistown (South of)	102*a*	1 A	21 12	27 30	03·50	—	54 06	—	—	57 02	—
183	Fraserburg	103	1 A	31 55	21 31	03·50	27 33	59 16	18290	23 03	62 46	15374
184	Fraserburg Road	104	1 A	32 46	21 58	03·50	—	59 59	18251	—	63 22	15323
185	Gabis	—	3 C	28 08	18 36	09·08	25 30	57 00	18856	22 13	60 16	16540
186	Gamtoos River Bridge	105	1 A	33 55	25 02	03·50	27 25	61 14	17736	22 25	64 07	14856
187	Gansfontein	61	4 B	32 44	19 42	08·50	27 55	59 44	17923	24 25	62 43	15430
188	Gariganus	—	3 C	26 29	18 14	09·17	24 41	55 55	19321	21 33	59 17	17120
189	Garub	—	3 C	26 36	16 01	09·14	25 01	54 59	19434	22 11	58 29	17303
190	Gawachab	—	3 C	27 02	17 52	09·10	25 54	56 36	18985	22 45	59 58	16757
191	Gemboksfontein	107	1 A	31 23	22 58	03·50	27 47	59 27	18326	23 05	62 50	15420
192	Genesa	66	4 B	26 35	24 10	08·50	22 52	57 58	18829	18 46	60 48	16490
193	George	106	1 A	33 57	22 29	03·50	—	60 29	17970	—	63 43	15035
194	Gibeon	—	P	25 07	17 45	29·07	21 08	58 13	17614	21 05	58 27	17459
195	Gingindhlovu	—	P	29 02	31 35	28·54	17 36	63 04	15824	17 32	63 14	15595
196	Glenallen	109	1 A	29 39	22 36	03·50	48 00	41 53	23457	43 21	45 26	20597
197	Glencairn	305*a*	1 A	34 10	18 26	03·50	28 37	59 12	18252	24 36	62 50	15309
198	Glenconnor	110	1 A	33 25	25 10	03·50	27 29	61 19	17637	22 28	64 16	14757
199	Globe and Phoenix	111	1 A	18 56	29 48	03·50	16 54	52 44	21945	11 51	55 20	19820
200	Gobas	—	3 C	26 38	18 05	09·11	25 01	56 09	19210	21 54	59 31	17006
201	Goedgedacht	112	1 A	26 39	29 34	03·50	22 13	58 44	19138	16 52	61 39	16466
202	Gola	—	11 G	25 48	32 44	25·05	13 38	61 44	17379	12 55	62 11	16782
203	Gordon's Bay	113	1 A	34 10	18 53	03·50	—	59 24	18100	—	62 59	15157
204	Graaff Reinet	114	1 A	32 17	24 32	03·50	26 58	60 35	17931	22 02	63 43	15035
205	Grahamstown	—	P	33 20	26 32	28·14	21 53	64 16	15015	21 48	64 30	14726
206	Grange	116	1 A	29 38	30 23	03·50	—	61 06	18095	—	63 29	15371
207	Graskop	117	1 A	27 15	29 53	03·50	22 35	59 18	18865	17 10	61 58	16176
208	Grauwater	72	4 B	30 56	19 16	08·50	26 47	58 45	18245	23 21	61 53	15789
209	Greylingstad	118	1 A	26 45	28 46	03·50	22 24	58 57	18969	17 06	61 49	16271
210	Greytown	119	1 A	29 05	30 35	03·50	23 54	60 29	18690	18 18	62 53	15978
211	Griquatown	—	7 D	28 53	23 14	15·06	19 36	59 43	17555	16 54	61 44	15797
212	Grobler's Bridge	120	1 A	25 54	30 13	03·50	20 55	58 26	19310	15 36	61 07	16686
213	Groenkloof	121	1 A	29 28	27 11	03·50	24 31	59 57	18451	19 15	62 55	15647
214	Groenplaats	122	1 A	27 16	28 34	03·50	22 25	59 01	19076	17 06	61 53	16360
215	Grootfontein (Bechuanaland)	73	4 B	27 39	24 00	08·50	24 50	58 34	18514	20 44	61 24	16144

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216	Grootfontein (C.P.)	123	1 A	33 08	21 15	03·50	28 16	60 02	18044	23 49	63 28	15112
217	Groot Riet	75	4 B	29 18	20 46	08·50	25 36	58 27	18402	21 58	61 34	15986
218	Groot Rosynbosch	76	4 B	29 05	18 54	08·50	25 58	57 43	18689	22 36	61 00	16309
219	Grundoorn	—	3 C	27 26	18 11	09·10	25 10	56 32	18836	21 59	59 51	16567
220	Gwaai	124	1 A	19 18	27 42	03·50	18 17	52 27	21749	13 21	55 17	19623
221	Gwelo	125	1 A	19 28	29 47	03·50	17 57	54 23	22034	12 53	57 01	19859
222	Hamaan's Kraal	126	1 A	25 24	28 17	03·50	22 06	57 30	19710	16 52	60 28	17088
223	Hamburg	78	4 B	27 01	24 16	08·50	23 20	58 25	18772	19 13	61 15	16427
224	Hankey	127	1 A	33 52	24 53	03·50	27 23	61 13	17773	22 25	64 09	14888
225	Haribes	—	3 C	24 35	17 33	09·21	24 02	54 39	19671	21 01	58 01	17595
226	Harrisburg	80	4 B	27 09	26 24	08·50	22 18	58 54	18666	17 55	61 30	16324
227	Hartebeestfontein	81	4 B	26 46	26 26	08·50	22 22	58 45	18699	17 59	61 11	16370
228	Hartley A	—	P	18 10	30 10	30·51	11 37	54 28	20193	11 37	54 28	20194
229	Hector Spruit	129	1 A	25 26	31 40	03·50	20 35	58 10	19673	15 16	60 38	17091
230	Heidelberg	130	1 A	34 05	20 58	03·50	28 22	60 07	18041	23 58	63 27	15094
231	Heilbron	131	1 A	27 18	27 58	03·50	23 18	58 51	18998	18 02	61 48	16274
232	Helvetia	132	1 A	29 52	26 33	03·50	25 16	59 59	18336	20 04	63 02	15500
233	Henkriesfontein	82	4 B	28 57	18 08	08·50	26 24	57 24	18734	23 08	60 44	16367
234	Hermanus	133	1 A	34 25	19 14	03·50	28 46	59 38	18138	24 38	63 09	15188
235	Hermon	134	1 A	33 27	18 58	03·50	28 30	59 05	18309	24 23	62 44	15375
236	Hex River	85	4 B	32 27	18 57	08·50	27 26	59 12	18046	24 02	62 16	15558
237	Highlands	135	1 A	27 12	31 20	03·50	21 53	59 56	18742	16 25	62 21	16092
238	Hlabisa	136	1 A	28 12	32 18	03·50	22 09	60 54	18261	16 35	63 05	15602
239	Hluti	137	1 A	27 12	31 35	03·50	21 45	59 44	18760	16 17	62 06	16117
240	Hoetjes Bay	138	1 A	33 00	17 57	03·50	28 27	58 35	18407	24 30	62 23	15486
241	Hoezar West	87	4 B	30 07	20 27	08·50	26 08	58 40	18314	22 33	61 45	15882
242	Holfontein	139	1 A	29 15	27 24	03·50	24 38	59 50	18502	19 22	62 48	15710
243	Hollerivier	88	4 B	31 22	19 32	08·50	27 03	59 20	17995	23 35	62 25	15525
244	Holoog	—	3 C	27 24	17 57	09·10	25 26	56 23	19033	22 14	59 44	16762
245	Honey Nest Kloof	140	1 A	29 12	24 33	03·50	25 36	59 02	18623	20 39	62 22	15778
246	Honing Spruit	141	1 A	27 27	27 25	03·50	23 15	58 42	19005	18 00	61 44	16269
247	Hopefield	142	1 A	33 04	18 21	03·50	28 22	58 46	18348	24 21	62 31	15424
248	Howhoek	143	1 A	34 13	19 09	03·50	28 38	59 32	18128	24 30	63 05	15182
249	Howmoed	—	5 D	29 19	19 33	12·96	25 23	58 47	18071	22 30	61 21	16109
250	Huguenot	144	1 A	33 44	19 00	03·50	28 30	59 14	18286	24 23	62 51	15347
251	Humansdorp	145	1 A	34 02	24 45	03·50	26 58	61 16	17702	22 01	64 11	14815
252	Hutchinson A	—	P	31 30	23 12	28·03	22 08	62 35	15730	22 03	62 53	15422
253	Ibisi Bridge	147	1 A	30 24	29 54	03·50	24 27	61 02	18170	18 55	63 24	15427
254	Idutywa	148	1 A	32 01	28 20	03·50	25 56	61 44	17559	20 34	63 16	14759
255	Igusi	149	1 A	19 41	28 06	03·50	17 19	53 01	21633	12 19	55 50	19450

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
256	Illovo River	150	1 A	30 06	30 51	03·50	23 49	61 19	18001	18 10	63 32	15282
257	Imvani	151	1 A	32 02	27 05	03·50	26 04	61 28	17781	20 49	64 14	14949
258	Indowani	152	1 A	29 58	29 27	03·50	24 14	61 00	18074	18 44	63 32	15324
259	Indwe	153	1 A	31 28	27 21	03·50	25 32	60 56	18186	20 16	63 43	15361
260	Inhaca	—	11 G	25 58	32 59	07·39	18 53	59 54	21651	14 05	61 47	19339
261	Inhaca	—	11 G	26 00	32 56	25·14	13 42	61 33	16862	13 04	61 59	16285
262	Inhambane (2nd Sta.)	—	2	23 49	35 22	06·55	17 17	58 14	19691	12 32	59 47	17430
263	Inoculation	154	1 A	20 50	27 38	03·50	19 12	54 00	21121	14 11	56 56	18831
264	Inyantue	155	1 A	18 32	26 42	03·50	18 27	51 09	22341	13 39	54 02	20286
265	Jacobsdal	—	7 D	29 09	24 46	14·51	23 10	60 17	17599	20 10	62 15	15776
266	Jagersfontein	—	7 D	29 45	25 25	14·50	23 01	61 00	17373	19 54	62 54	15546
267	Jakalswater	—	3 C	22 36	15 20	09·10	23 24	52 27	20354	20 31	55 51	18511
268	Jim Farm	—	8 E	20 54	28 08	16·55	16 58	55 31	19837	14 29	57 01	18516
269	Kaalfontein	156	1 A	26 02	28 16	03·50	—	58 13	19459	—	61 11	16794
270	Kaalkop Farm	157	1 A	27 47	28 58	03·50	22 55	59 27	18770	17 32	62 14	16048
271	Kaapmuiden	158	1 A	25 32	31 19	03·50	20 58	58 29	19310	15 39	61 00	16721
272	Kachikadza's Village	—	3 F	17 06	35 19	09·69	12 55	51 58	22520	9 05	53 09	20923
273	Kadebis	96	4 B	26 17	24 25	08·50	—	57 44	19124	—	60 33	16806
274	Kafue	—	10 F	15 47	28 12	20·55	12 51	50 40	22237	11 41	51 38	21484
275	Kalkbank	159	1 A	23 32	29 22	03·50	20 09	56 22	20283	14 57	59 13	17798
276	Kalkfeld A	—	P	20 53	16 12	29·00	19 08	54 38	19246	19 05	54 51	19109
277	Kalomo	—	3 F	17 02	26 22	09·31	16 10	51 09	22194	12 20	53 21	20588
278	Kaloombies	160	1 A	22 39	29 14	03·50	20 02	56 35	20150	14 52	59 26	17724
279	Kamabies	97	4 B	30 02	18 29	08·50	26 00	58 41	18187	22 40	61 56	15775
280	Karibib	—	P	21 56	15 51	29·06	20 10	55 20	18874	20 07	55 34	18738
281	Karmoe	98	4 B	31 44	19 18	08·50	27 13	58 36	18083	23 46	61 41	15607
282	Karree A	—	P	28 53	26 21	28·08	18 11	62 12	16054	18 06	62 29	15761
283	Karreebosch	100	4 B	31 34	19 54	08·50	27 15	59 24	18017	23 44	62 27	15541
284	Katembora Rapids	—	8 E	17 49	25 22	14·57	16 48	51 40	21487	13 49	53 25	20193
285	Kathoek	162	1 A	34 23	20 16	03·50	28 37	60 03	18012	24 19	63 27	15062
286	Keeley's Farm	102	4 B	26 09	24 44	08·50	23 18	57 30	19357	19 08	60 17	17045
287	Keetmanshoop	—	P	26 35	18 08	29·11	21 38	59 04	17215	21 35	59 17	17058
288	Kenhardt	163	1 A	29 21	21 09	03·50	26 22	58 01	18925	21 49	61 47	16090
289	Kenilworth	163*a*	1 A	28 42	24 46	03·50	—	57 39	—	—	60 59	—
290	Kenkelbosch	—	5 D	33 30	25 52	10·96	25 40	62 09	16952	21 48	64 11	14750

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291	Khamis	—	3 C	27 52	18 38	09·09	25 26	56 56	18893	22 10	60 12	16590
292	Khan Copper Mine	—	3 C	22 30	15 00	09·09	22 41	52 40	20020	20 01	56 06	18235
293	Khosis	106	4 B	27 53	23 16	08·50	24 22	57 55	18828	20 22	60 49	16448
294	Kilometer 233	—	3 C	21 55	16 05	09·15	22 54	—	20400	20 06	—	18608
295	Kilometer 275	—	3 C	21 53	16 35	09·16	22 49	52 22	20529	19 59	55 38	18681
296	Kimberley	164	1 A	28 44	24 46	03·50	—	58 48	18727	—	62 08	15902
297	King William's Town	165	1 A	32 52	27 25	03·50	26 19	61 39	17726	21 04	64 16	14902
298	Klaarstroom	166	1 A	33 20	22 32	03·50	27 56	60 28	17906	23 18	63 45	14976
299	Klein Boetsap	—	7 D	27 59	24 27	15·05	25 00	59 44	17813	22 10	61 41	16075
300	Klerksdorp	167	1 A	26 52	26 40	03·50	23 42	58 12	19123	18 32	61 22	16400
301	Kliparani	109	4 B	25 59	25 22	08·50	22 34	57 49	19122	18 20	60 32	16822
302	Klipfontein (C.P.)	168	1 A	30 42	22 24	03·50	23 06	59 16	18340	18 28	62 46	15448
303	Klipfontein (Namaqualand)	111	4 B	29 13	17 40	08·50	26 10	57 36	18656	22 58	60 57	16291
304	Klipplaat	170	1 A	33 02	24 20	03·50	27 27	61 11	17745	22 33	64 16	14845
305	Knysna	171	1 A	34 02	23 03	03·50	27 53	60 51	17840	23 11	64 00	14914
306	Koffyfontein	—	7 D	29 25	25 01	14·51	23 30	60 22	17653	20 28	62 18	15827
307	Kokstad	172	1 A	30 33	29 25	03·50	24 40	61 12	18016	19 11	63 40	15259
308	Komati Poort	173	1 A	25 26	31 57	03·50	—	59 45	18869	—	62 10	16289
309	Komgha	174	1 A	32 34	27 54	03·50	26 12	61 35	17782	20 54	64 08	14968
310	Komgha (East of)	398	1 A	32 32	27 59	03·50	26 07	61 33	17730	20 48	64 05	14919
311	Koopmansfontein	—	7 D	28 14	24 03	15·05	22 52	59 41	17836	20 04	60 59	16094
312	Koppeskraal	112	4 B	31 04	19 28	08·50	26 49	58 45	18258	23 21	61 52	15796
313	Korab	—	3 C	19 27	17 28	09·13	21 08	50 32	21325	18 16	53 33	19675
314	Korrobib	—	3 C	25 52	18 10	09·18	24 43	55 32	19395	21 33	58 56	17232
315	Koster	114	4 B	25 52	26 54	08·50	21 29	58 14	19004	17 02	60 48	16713
316	Kraal	175	1 A	26 35	28 26	03·50	22 06	58 39	19068	16 48	61 34	16373
317	Krantz Kloof	176	1 A	29 48	30 50	03·50	23 32	61 21	18001	17 52	63 36	15287
318	Krantz Kop	177	1 A	30 49	20 45	03·50	26 55	58 27	18677	22 32	62 09	15789
319	Kromm River	178	1 A	27 19	28 19	03·50	24 06	58 56	18940	18 48	61 50	16220
320	Krugers	179	1 A	29 56	25 50	03·50	25 00	59 52	18490	19 52	63 01	15635
321	Kruispad	180	1 A	32 57	20 33	03·50	28 10	59 46	18146	23 49	63 18	15218
322	Kubas	—	3 C	22 16	15 35	09·10	23 06	52 12	20468	20 21	55 34	18645
323	Kuibis	—	3 C	26 41	16 51	09·13	24 32	55 31	19384	21 32	58 59	17197
324	Kumnabis River	—	3 C	26 00	18 19	09·18	24 48	55 42	19386	21 40	59 03	17218
325	Kuruman	119	4 B	27 28	23 25	08·50	24 12	58 23	18625	20 11	61 17	16265
326	Kwambonambi	181	1 A	28 36	32 05	03·50	22 58	60 38	18454	17 23	62 47	15788
327	Kweekfontein	120	4 B	29 30	18 02	08·50	26 22	57 39	18573	23 07	60 58	16191
328	Kye Charp River	—	3 C	25 42	18 04	09·19	24 32	55 26	19431	21 24	58 48	17270
329	Laat River	182	1 A	29 38	21 19	03·50	26 26	58 13	18793	21 58	61 57	15943
330	Ladismith	183	1 A	33 29	21 17	03·50	28 15	60 06	17974	23 47	63 30	15036

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position		original values				values at epoch 1930·50		
				lat.	long.	date 1900+	D	I	H	D	I	H
				° ′	° ′		° ′	° ′	γ	° ′	° ′	γ
331	L'Agulhas	184	1 A	34 50	20 00	03·50	28 41	60 05	17970	24 27	63 28	15015
332	Laingsburg	185	1 A	33 12	20 52	03·50	28 17	59 56	18022	23 53	63 24	15090
333	Lake Banagher	186	1 A	26 22	30 19	03·50	21 39	58 55	19056	16 17	61 33	16413
334	Langlaagte	187	1 A	26 12	28 01	03·50	23 05	58 56	18907	17 50	61 55	16229
335	Lealui	—	8 E	15 15	23 10	14·51	15 46	48 14	22838	12 46	49 58	21722
336	Leeuwenfontein	126	4 B	33 17	19 30	08·50	27 56	59 50	17846	24 28	62 47	15344
337	Leeuwkolk	127	4 B	30 25	21 17	08·50	25 54	59 02	18219	22 11	62 01	15759
338	Leeuwriet	128	4 B	31 28	19 20	08·50	27 06	59 11	18075	23 39	62 17	15600
339	Letjesbosch	188	1 A	32 34	22 18	03·50	—	59 39	18346	—	63 01	15421
340	Levveskolk	129	4 B	29 39	19 50	08·50	25 36	58 33	18283	22 06	61 44	15864
341	Libode	189	1 A	31 32	29 02	03·50	25 13	61 31	18006	19 48	63 57	15230
342	Lichtenburg	131	4 B	26 10	26 11	08·50	22 23	58 22	18887	18 02	61 05	16575
343	Limpopo (North of)	378	1 A	22 07	29 10	03·50	20 00	55 52	20291	14 52	58 42	17804
344	Livangwe	—	3 F	15 32	35 02	09·66	10 53	49 58	23475	7 03	51 05	22045
345	Livingstone	—	10 F	17 51	25 52	20·54	14 44	52 50	21054	13 34	53 54	20212
346	Liwali	—	8 E	16 20	23 17	14·53	16 16	49 49	22259	13 16	51 36	21070
347	Lobatsi	190	1 A	25 11	25 43	03·50	22 28	57 00	19542	17 26	60 18	16917
348	Lochard	191	1 A	19 55	29 03	03·50	18 17	53 34	21506	13 14	56 18	19296
349	Loriesfontein	132	4 B	30 57	19 26	08·50	26 47	58 48	18295	23 19	61 56	15836
350	Lourenço Marques (Observatory)	—	P	25 58	32 36	30·46	18 08	—	17060	18 08	—	17056
351	Lourenço Marques (Ponta Vermelha)	—	11 G	25 58	32 36	24·68	17 38	60 57	17510	16 49	61 27	16869
352	Louw Zyn Kolk	133	4 B	30 17	21 00	08·50	25 47	59 09	18150	22 07	62 11	15712
353	Luckhoff	—	7 D	29 46	24 47	14·51	23 41	60 26	17552	20 40	62 23	15723
354	Luderitzbucht	—	P	26 39	15 09	29·12	22 53	58 20	17496	22 50	58 34	17344
355	Lydenburg	192	1 A	25 06	30 26	03·50	20 54	58 05	19483	15 37	60 45	16903
356	Mabuli River	—	8 E	20 49	28 29	16·58	16 29	55 05	20509	13 59	56 33	19191
357	Machadodorp	—	P	25 40	30 14	30·44	15 40	61 17	16568	15 40	61 17	16561
358	Macheke	193	1 A	18 08	31 55	03·50	16 15	52 09	22424	11 10	54 24	20374
359	Mafeking	—	P	25 52	25 40	30·55	18 02	60 19	16790	18 02	60 19	16795
360	Magalapye	196	1 A	23 04	26 50	03·50	20 24	55 34	20496	15 22	58 43	18126
361	Magaliesberg	135	4 B	26 00	27 33	08·50	21 22	58 28	18989	16 52	60 58	16700
362	Magnet Heights	197	1 A	24 45	29 58	03·50	19 45	57 59	19272	14 29	60 44	16707
363	Magonda Island	—	8 E	17 30	24 40	14·56	16 17	51 15	21711	13 18	53 00	20449
364	Makwiro Siding	198	1 A	17 57	30 25	03·50	16 34	51 36	22447	11 32	54 03	20422
365	Malagas	199	1 A	34 18	20 36	03·50	28 41	60 05	18066	24 20	63 28	15117

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366	Malenje Siding	200	1 A	18 55	32 15	03·50	16 07	53 03	22040	11 00	55 15	19900
367	Malinde	201	1 A	18 41	26 56	03·50	18 02	51 50	21859	13 12	54 42	19786
368	Malmesbury	202	1 A	33 28	18 43	03·50	28 29	59 06	18220	24 25	62 47	15287
369	Mandegos	203	1 A	19 07	33 32	03·50	15 58	53 26	21930	10 49	55 27	19763
370	Manhica	—	11 G	25 24	32 49	07·33	18 16	59 36	19031	13 30	61 34	16728
371	Maotas	—	11 G	25 55	32 38	25·30	18 29	60 30	17880	17 56	60 58	17311
372	Mapani Loep	204	1 A	22 18	29 10	03·50	19 04	55 48	20532	13 56	58 39	18133
373	Mapia	—	3 F	18 03	35 46	09·70	13 21	53 24	22033	9 31	54 35	20354
374	Maquassi	137	4 B	27 20	25 59	08·50	23 09	58 58	18750	18 49	61 41	16395
375	Mara	205	1 A	23 05	29 25	03·50	—	57 16	20181	—	60 07	17723
376	Marandellas	206	1 A	18 11	31 33	03·50	15 55	52 55	22211	10 50	55 12	20156
377	Marca da Catembe	—	11 G	26 00	32 34	24 75	17 26	61 32	17174	16 38	62 01	16543
378	Maribogo	207	1 A	26 25	25 12	03·50	23 35	57 18	19366	18 34	60 38	16657
379	Markson's Hotel	139	4 B	25 35	26 32	08·50	21 42	57 52	19193	17 21	60 31	16918
380	Marokwen	140	4 B	26 08	23 44	08·50	22 48	57 15	19208	18 47	60 07	16893
381	Marula	—	8 E	20 28	28 05	16·53	16 24	54 53	20127	13 51	56 22	18825
382	Mashamba	—	10 F	15 45	32 53	20·64	10 46	50 32	22530	9 36	51 12	21782
383	Matetsi	208	1 A	18 12	26 02	03·50	17 58	51 41	21696	13 15	54 36	19686
384	Matjesfontein A	—	P	33 15	20 35	28·00	24 05	62 52	15412	24 00	63 11	15099
385	Matola (Concessao Lingham)	—	P	25 57	32 30	30·45	15 57	60 57	16903	15 57	60 57	16897
386	Matola	—	2 G	25 48	32 26	06·58	20 37	59 19	18874	15 37	61 23	16498
387	Matopos	—	8 E	20 26	28 42	05·36	18 31	54 17	—	13 20	56 54	—
388	Maxixe	—	2 G	23 49	35 21	06·55	17 15	58 20	19679	12 30	59 53	17418
389	Mbosa	—	10 F	15 55	28 40	20·57	12 18	50 31	22272	11 08	51 26	21510
390	Mburuma	—	10 F	15 36	29 40	20·58	12 00	50 10	22530	10 48	51 02	21787
391	Meintjes' Farm	142	4 B	26 04	25 02	08·50	22 34	57 59	18968	18 22	60 44	16660
392	Merriman	271	1 A	31 13	23 38	03·50	27 12	59 54	18231	22 24	63 13	15328
393	Meyerton	210	1 A	26 33	28 01	03·50	22 42	58 30	19148	17 26	61 28	16449
394	Middelburg (C.P.)	211	1 A	34 00	24 09	03·50	27 44	61 02	17779	22 53	64 03	14875
395	Middelburg (Transvaal)	391	1 A	25 48	29 36	03·50	21 10	58 30	19228	15 52	61 18	16594
396	Middlepost	212	1 A	31 54	20 14	03·50	27 29	58 50	18455	23 10	62 30	15548
397	Middleton	213	1 A	32 58	25 48	03·50	26 56	61 22	17742	21 50	64 15	14880
398	Mill River	214	1 A	33 36	22 55	03·50	—	60 38	17839	—	63 50	14911
399	Miller Siding	215	1 A	33 05	23 55	03·50	27 31	61 00	17794	22 42	64 09	14880
400	Miller's Point	216	1 A	34 14	18 28	03·50	28 41	59 17	18259	24 41	62 54	15310
401	Misgund	217	1 A	33 46	23 30	03·50	27 53	60 49	17825	23 08	63 57	14904
402	Mission Station	218	1 A	23 13	30 27	03·50	19 32	57 06	19910	14 19	59 48	17453
403	Modderfontein	146	4 B	32 37	18 59	08·50	27 30	59 20	17971	24 06	62 23	15480
404	Modder River	147	4 B	29 03	24 45	08·50	21 42	59 31	18387	17 31	62 17	15963
405	Modder Spruit	219	1 A	28 29	29 53	03·50	23 10	60 00	18560	17 39	62 35	15843

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
406	Molteno	220	1 A	31 24	26 21	03·50	25 58	60 36	—	20 47	63 33	—
407	Mooi River	—	P	29 13	30 01	28·52	17 48	62 55	15707	17 44	63 06	15473
408	Mopeia	—	10 F	18 00	35 42	20·72	10 33	53 48	21230	9 23	54 21	20390
409	Morambala Mountain	—	3 F	17 30	35 23	09·70	13 23	52 27	22404	9 33	53 39	20766
410	Mossamedes	—	10 D	15 10	12 09	16·40	18 50	45 25	22376	—	—	—
411	Mossel Bay	—	P	34 11	22 08	28·17	23 39	—	15280	23 34	—	14987
412	Mount Ayliff (East of)	222	1 A	30 48	29 32	03·50	24 33	61 16	17890	19 04	63 41	15134
413	Mount Ayliff (S.E. of)	402	1 A	31 01	29 30	03·50	24 18	61 07	17973	18 50	63 29	15214
414	Mount Ayliff (West of)	403	1 A	30 50	29 16	03·50	24 14	61 18	17953	18 46	63 46	15189
415	Mount Brukkaros B	—	P	25 51	17 48	29·10	21 15	58 39	17456	21 12	58 53	17300
416	Mount Frere	223	1 A	30 54	28 59	03·50	24 34	61 02	18067	19 08	63 33	15296
417	Mount Moreland	224	1 A	29 38	31 05	03·50	23 12	61 20	18064	17 32	63 34	15356
418	Movene	224*a*	1 A	25 34	32 07	03·50	17 42	59 06	19573	12 23	61 29	16990
419	Mpezi	—	3 F	15 04	34 57	09·64	12 23	49 32	23686	8 33	50 44	22298
420	M'Phatele's Location	225	1 A	24 20	29 41	03·50	20 59	59 12	19535	15 45	62 00	16997
421	Mpunzi	—	3 F	14 23	34 14	09·64	11 47	48 24	23930	7 57	49 32	22601
422	Mukwanga Island	—	8 E	16 58	23 56	14·54	16 48	50 26	21931	13 49	52 13	20702
423	Mulunguske	—	3 F	14 16	28 31	09·35	14 06	47 35	23832	10 16	49 27	22494
424	Mundale	—	8 E	15 45	23 11	14·52	15 37	49 22	22762	12 37	51 06	21616
425	Muona	—	3 F	16 25	35 06	09·68	12 55	51 22	22835	9 05	52 32	21309
426	Murraysburg	148	4 B	31 56	23 43	08·50	25 41	60 46	17598	21 36	63 26	15113
427	Naauwpoort	226	1 A	31 11	24 55	03·50	26 02	60 02	18166	21 02	63 13	15280
428	Nabitsaus	—	3 C	22 58	17 12	09·23	23 14	53 21	20160	20 16	56 38	18226
429	Naboomspruit	227	1 A	24 31	28 43	03·50	21 03	57 05	19889	15 51	60 01	17327
430	Nalisa	—	8 E	17 23	24 19	14·54	16 34	51 18	21652	13 35	53 05	20395
431	Nalola	—	8 E	15 32	23 07	14·52	16 08	48 35	22706	13 08	50 19	21576
432	Namies	149	4 B	29 18	19 12	08·50	26 17	57 47	18586	22 52	61 02	16195
433	Nanibes	150	4 B	29 51	20 05	08·50	25 46	58 57	18124	22 14	62 05	15696
434	Ncheu	—	3 F	14 49	34 38	09·65	12 10	49 06	23630	8 20	50 13	21264
435	Nelspoort	228	1 A	32 08	23 01	03·50	27 35	60 18	17795	22 53	63 38	14877
436	Nelspruit	229	1 A	25 28	30 58	03·50	21 00	58 28	19290	15 42	61 03	16700
437	Newcastle (Natal)	230	1 A	27 45	29 58	03·50	22 33	59 39	18845	17 04	62 16	16144
438	Newcastle (Transvaal)	231	1 A	26 32	30 27	03·50	21 58	58 57	18982	16 35	61 34	16336
439	Ngambwe Rapids	—	8 E	17 16	24 09	14·55	17 00	50 49	21840	14 01	52 36	20583
440	Niekerk's Hope	—	7 D	29 20	22 50	15·07	24 52	57 52	19588	22 13	59 53	17824

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441	Nieuwefontein	152	4 B	30 36	18 41	08·50	26 31	58 00	18609	23 09	61 12	16171
442	Nooitgedacht	232	1 A	25 38	30 31	03·50	19 01	57 22	19204	13 43	60 00	16598
443	Norval's Poort	233	1 A	30 39	25 27	03·50	—	59 50	18320	—	62 59	15448
444	'Nqutu Road	234	1 A	28 05	30 26	03·50	—	60 13	18584	—	62 44	15886
445	Ntowa	—	3 F	17 56	35 33	09·70	13 25	52 54	22209	9 35	54 07	20538
446	Nylstroom	235	1 A	24 42	28 26	03·50	21 12	57 29	19843	16 00	60 26	17269
447	Okahanja	—	3 C	21 59	16 55	09·16	22 45	52 30	20489	19 49	55 44	18627
448	Okaputa	—	3 C	20 07	16 58	09·12	21 36	51 11	21057	18 44	54 17	19338
449	Olinda	—	2	18 02	36 56	06·61	13 12	53 12	22185	8 43	54 28	20180
450	Omaruru	—	3 C	21 25	15 57	09·14	22 08	51 42	20721	19 24	54 58	18940
451	O'okiep	153	4 B	29 36	17 53	08·50	26 28	57 29	18696	23 13	60 48	16313
452	Oorlogskloof	154	4 B	31 31	19 27	08·50	27 19	59 09	18050	23 52	62 14	15577
453	Orange River A	—	P	29 41	24 12	28·05	20 36	62 13	15992	20 31	62 31	15691
454	Orjida	236	1 A	33 26	23 19	03·50	27 49	60 45	17836	23 05	63 56	14914
455	Otavi	—	P	19 38	17 21	29·01	18 22	53 34	19741	18 19	53 47	19608
456	Otjihavera	—	3 C	22 19	17 04	09·16	22 51	—	20441	19 55	—	18573
457	Otjiwarongo	—	3 C	20 28	16 40	09·13	21 47	51 28	20732	18 56	54 36	18987
458	Ottoshoop	156	4 B	25 45	25 57	08·50	22 06	57 52	19076	17 48	60 32	16788
459	Oudemuur	237	1 A	31 06	20 19	03·50	27 19	58 42	18549	23 00	62 25	15657
460	Oudtshoorn	238	1 A	33 35	22 12	03·50	28 11	60 24	17944	23 36	63 42	15009
461	Ougrabies	158	4 B	29 16	18 32	08·50	26 17	57 43	18539	22 57	61 01	16156
462	Ove River	—	8 E	20 41	28 31	16·58	16 16	55 14	20188	13 43	56 42	18875
463	Paardeberg	—	7 D	29 00	25 04	14·51	23 14	60 19	17668	20 11	62 16	15847
464	Paarde Vlei	239	1 A	30 36	21 54	03·50	27 01	58 44	18588	22 28	62 19	15699
465	Paarl	240	1 A	33 45	18 57	03·50	—	59 14	—	—	62 51	—
466	Palapye	241	1 A	22 30	27 07	03·50	20 33	55 08	20639	15 31	58 13	18214
467	Pampoenpoort	242	1 A	31 04	22 39	03·50	26 48	59 19	18324	22 08	62 45	15424
468	Panhame	—	10 F	15 37	30 40	20·62	11 29	50 40	22375	10 19	51 27	21636
469	Papekuil	161	4 B	32 29	19 40	08·50	27 31	—	18026	24 01	—	15533
470	Paswedza	—	3 F	15 17	34 58	09·64	12 33	49 50	23487	8 43	50 57	22082
471	Payne's Farm	243	1 A	30 37	29 48	03·50	24 37	61 34	17826	19 07	63 57	15076
472	Pella	162	4 B	29 02	19 08	08·50	26 29	57 49	18600	25 05	61 05	16216
473	Pemba	—	3 F	16 31	27 16	09·30	16 05	50 04	22717	12 15	52 11	21161
474	Pessene	—	P	25 41	32 20	30·46	15 20	61 32	16590	15 20	61 32	16586
475	Petrus	—	7 D	29 07	25 24	14·52	23 02	60 19	17624	19 56	62 14	15803
476	Pienaar's River	245	1 A	25 13	28 19	03·50	23 22	57 49	19729	18 09	60 47	17121
477	Pietersburg	246	1 A	23 54	29 27	03·50	20 12	56 57	19855	15 00	59 47	17344
478	Piet Potgietersrust	—	P	24 11	29 01	30·43	15 55	59 49	17334	15 55	59 49	17326
479	Piet Retief	248	1 A	27 00	30 48	03·50	22 14	59 33	18831	16 48	62 05	16174
480	Pilgrim's Rest	249	1 A	24 57	30 45	03·50	20 59	57 50	19612	15 42	60 29	17044

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position		original values				values at epoch 1930·50		
				lat.	long.	date 1900+	D	I	H	D	I	H
				° ′	° ′		° ′	° ′	γ	° ′	° ′	γ
481	Piquetberg	250	1 A	32 55	18 43	03·50	28 11	58 56	18340	24 06	62 40	15419
482	Pivaan's Poort	251	1 A	27 34	30 28	03·50	22 39	59 43	18796	17 10	62 16	16113
483	Plaatklip	164	4 B	30 48	19 06	08·50	26 50	58 36	18300	23 25	61 46	15860
484	Platrand	252	1 A	27 06	29 29	03·50	22 36	59 12	18907	17 13	61 56	16214
485	Plettenberg Bay	253	1 A	34 02	23 21	03·50	27 48	60 55	17812	23 04	64 02	14891
486	Plumtree	254	1 A	20 30	27 55	03·50	—	53 47	21219	—	56 40	18964
487	Pofadder	165	4 B	29 07	19 24	08·50	26 24	58 13	18471	22 57	61 28	16080
488	Pokwani	255	1 A	24 54	29 46	03·50	21 18	57 41	19753	16 03	60 28	17179
489	Ponta Macuti	—	10 F	19 51	34 53	20·75	11 58	55 41	20268	10 48	56 20	19353
490	Ponta Maone	—	11 G	26 01	32 36	24·89	17 23	61 21	17273	16 38	61 49	16656
491	Ponta das Tres Marias	—	11 G	26 07	32 40	25·08	16 56	62 27	16690	16 14	62 54	16094
492	Port Alexander	—	10 D	15 48	11 49	15·20	15 57	46 16	22230	—	—	—
493	Port Alfred	256	1 A	33 36	26 54	03·50	26 55	61 42	17595	21 43	64 20	14757
494	Port Beaufort	257	1 A	34 24	20 49	03·50	28 27	60 12	17990	24 04	63 33	15040
495	Port Elizabeth	258	1 A	33 58	25 37	03·50	27 39	61 35	17640	22 35	64 23	14775
496	Port Herald	—	3 F	16 55	35 17	09·69	—	—	22631	—	—	21056
497	Porto Henrique	—	11 G	26 14	32 26	24·81	15 39	61 25	16991	14 56	61 54	16362
498	Port Nolloth	167	4 B	29 16	16 51	08·50	26 48	57 07	18749	23 42	60 30	16397
499	Port Shepstone	259	1 A	30 44	30 27	03·50	24 16	61 53	17801	18 42	63 07	15068
500	Port St Johns	260	1 A	31 38	29 33	03·50	25 18	62 02	17547	19 51	64 19	14785
501	Postmasburg	—	7 D	28 21	23 04	15·06	22 56	59 04	18237	20 15	61 06	16495
502	Potchefstroom	261	1 A	26 43	27 05	03·50	23 00	58 22	19079	17 48	61 28	16364
503	Potfontein	262	1 A	30 12	24 07	03·50	25 38	59 21	18433	20 46	62 41	15552
504	Praia da Catembe	—	11 G	25 58	32 34	24·72	17 16	61 02	17429	16 27	61 31	16793
505	Pretoria	—	P	25 45	28 12	30·44	16 50	61 04	16698	16 50	61 04	16691
506	Prince Albert	264	1 A	33 13	22 03	03·50	28 04	60 20	—	23 30	63 40	—
507	Prince Albert Road	265	1 A	32 59	21 42	03·50	27 51	60 14	18010	23 20	63 38	15080
508	Quaggasfontein	170	4 B	29 59	20 42	08·50	26 05	58 52	17833	22 28	61 57	15400
509	Queenstown	—	P	31 54	26 52	28·10	21 15	63 37	15358	21 10	63 52	15066
510	Quelimane (1st Sta.)	—	2	17 52	36 52	06·60	13 10	53 00	22376	8 40	54 16	20395
511	Rahman's Drift	171	4 B	28 53	18 20	08·50	26 22	57 39	18572	23 04	60 59	16206
512	Randfontein	267	1 A	26 11	27 42	03·50	22 46	58 19	19151	17 33	61 21	16470
513	Rateldraai	268	1 A	28 46	21 18	03·50	24 54	57 46	19194	20 27	61 33	16389
514	Rateldrift	269	1 A	31 32	20 18	03·50	27 32	58 50	18439	23 12	62 31	15538
515	Rehoboth	—	3 C	23 20	17 04	09·23	23 20	53 47	20100	20 21	57 06	18142

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516	Revué	283	1 A	18 59	33 03	03·50	16 06	—	21995	10 58	—	19845
517	Richmond (C.P.)	174	4 B	31 26	23 56	08·50	25 27	60 54	17609	21 21	63 34	15130
518	Richmond (Natal)	270	1 A	29 52	30 16	03·50	—	61 05	18091	—	63 27	15363
519	Richtofen	—	3 C	22 38	14 42	09·08	23 38	51 50	20639	20 58	55 18	18843
520	Rietfontein	175	4 B	29 52	18 12	08·50	26 47	58 23	18180	23 30	61 40	15780
521	Rietkuil Farm	272	1 A	30 14	29 22	03·50	24 12	61 05	17978	18 43	63 36	15223
522	Rietpoort	273	1 A	31 04	20 55	03·50	26 54	58 54	18523	22 29	62 33	15628
523	Rietvlei (C.P.)	275	1 A	33 32	22 29	03·50	27 59	60 29	—	23 21	63 45	—
524	Rietvlei (Transvaal)	274	1 A	24 35	30 40	03·50	20 24	57 30	19793	15 08	60 10	17245
525	Riversdale	276	1 A	34 05	21 16	03·50	28 17	60 11	17997	23 50	63 31	15050
526	Rivierplaats	277	1 A	32 08	20 24	03·50	27 17	58 49	18456	22 56	62 26	15542
527	Rivierplaats	179	4 B	31 30	19 41	08·50	27 00	58 56	18311	23 30	62 00	15838
528	Roadside	278	1 A	30 44	20 26	03·50	26 52	58 18	18734	22 32	62 02	15852
529	Robertson	279	1 A	33 49	19 53	03·50	28 24	59 41	18145	24 09	63 11	15204
530	Rodekrantz	280	1 A	24 38	30 35	03·50	20 53	57 43	19734	15 36	60 24	17182
531	Roodekloof	182	4 B	25 50	27 14	08·50	21 26	58 14	19035	17 00	60 46	16750
532	Roodepoort	281	1 A	30 13	23 12	03·50	25 14	57 58	18534	20 28	61 23	15654
533	Rooidam	282	1 A	29 54	23 00	03·50	25 00	58 40	18657	20 16	62 08	15789
534	Rooidraai	—	5 D	26 21	27 08	09·18	22 08	—	—	17 48	—	—
535	Rooiputs	284	1 A	29 17	21 39	03·50	27 00	58 16	18545	22 29	61 58	15710
536	Rooival	285	1 A	32 12	21 58	03·50	27 19	59 27	18274	22 46	62 53	15354
537	Rosmead Junction	286	1 A	31 30	25 07	03·50	26 14	60 21	18170	21 12	63 28	15290
538	Rotkuppe	—	3 C	26 43	15 23	09·15	24 57	55 14	19617	22 08	58 44	17481
539	Rouxville	287	1 A	30 32	26 47	03·50	25 07	60 12	18286	19 53	63 10	15348
540	Rumsey's Farm	188	4 B	26 24	24 03	08·50	22 46	58 02	19240	18 42	60 52	16920
541	Rusapi	288	1 A	18 32	32 08	03·50	16 03	52 35	22179	10 57	54 47	20086
542	Rustenburg	189	4 B	25 40	27 15	08·50	21 02	58 12	19038	16 33	60 44	16762
543	Rustplaats	289	1 A	24 51	30 38	03·50	20 53	57 50	19639	15 36	60 30	17074
544	Ruystersbosch	290	1 A	33 56	22 02	03·50	28 00	60 19	18004	23 27	63 36	15064
545	Rystkuil	190	4 B	32 39	22 54	08·50	26 06	60 28	17772	22 08	63 10	15277
546	Sabie River	291	1 A	25 06	30 45	03·50	21 04	58 17	19694	15 47	60 55	17116
547	Sabies	191	4 B	29 17	17 46	08·50	—	57 35	—	—	60 55	—
548	Salisbury C	—	P	17 50	31 04	30·50	10 57	54 04	20159	10 57	54 04	20159
549	Sandflats	—	5 C	33 20	25 57	10·97	25 48	62 18	16942	21 56	64 20	14740
550	Sandverhaar	—	3 C	26 50	17 24	09·12	25 15	55 57	19159	22 12	59 21	16962
551	Saratoga	—	7 D	29 18	24 00	15·08	23 26	60 16	17564	20 38	62 12	15800
552	Saxony	293	1 A	28 44	27 47	03·50	24 12	59 47	18562	18 54	62 42	15793
553	Schietfontein	294	1 A	32 42	20 47	03·50	27 52	59 32	18314	23 29	63 04	15390
554	Schikhoek	295	1 A	27 25	30 34	03·50	23 16	59 48	18656	17 48	62 21	15980
555	Schmidt's Drift	—	7 D	28 42	24 04	15·07	23 05	60 06	17672	20 17	62 03	15918

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position lat. ° ′	position long. ° ′	original values date 1900+	original values D ° ′	original values I ° ′	original values H γ	values at epoch 1930·50 D ° ′	values at epoch 1930·50 I ° ′	values at epoch 1930·50 H γ
556	Schoemanshoek	296	1 A	25 28	30 21	03·50	21 09	58 30	19293	15 51	61 10	16694
557	Schuilplaats	297	1 A	26 54	29 47	03·50	22 16	59 08	18922	16 53	61 50	16245
558	Schulenburg	194	4 B	26 26	25 58	08·50	22 22	58 28	18834	18 03	61 08	16512
559	Schuurkraal	195	4 B	31 57	19 46	08·50	26 59	59 16	18027	23 29	62 18	15546
560	Schweiser Reneke	—	7 D	27 11	25 19	15·04	21 33	59 34	17899	18 37	61 28	16189
561	Secocoeni's Stad	298	1 A	24 28	29 52	03·50	19 18	56 27	20070	14 03	59 13	17523
562	Seeheim	—	P	26 48	17 48	29·13	22 03	59 28	17047	22 00	59 41	16891
563	Selosi	—	8 E	20 11	28 10	16·52	16 23	54 57	20375	13 51	56 25	19087
564	Senanga	—	8 E	16 02	23 15	14·49	15 51	49 57	21877	12 51	51 43	20705
565	Sendlingsgrab	—	3 C	23 58	17 18	09·22	23 52	54 09	19882	20 52	57 30	17870
566	Seruli	299	1 A	21 56	27 19	03·50	20 26	54 56	20658	15 24	57 58	18281
567	Sesheke	—	8 E	17 30	24 52	14·45	16 35	51 08	21808	13 34	52 54	20528
568	Sesskameelboom	—	3 C	24 53	17 42	09·21	24 07	54 45	19659	21 03	58 07	17549
569	Shakals Kuppe	—	3 C	26 38	16 35	09·13	24 30	55 46	19350	21 35	59 12	17202
570	Shangani	300	1 A	19 46	29 24	03·50	18 38	54 41	22431	13 35	57 23	20251
571	Shapanga	—	10 F	15 51	29 07	20·57	12 14	50 27	22296	11 04	51 21	21539
572	Shashi	301	1 A	21 23	27 27	03·50	19 29	57 00	21195	14 28	59 59	18863
573	Shela River	302	1 A	26 51	30 43	03·50	21 44	59 10	18896	16 19	61 43	16244
574	Shoshong Road	303	1 A	23 35	26 34	03·50	21 54	56 40	19750	16 52	59 51	17245
575	Signal Hill	304	1 A	33 55	18 24	03·50	28 50	59 07	18271	24 49	62 47	15333
576	Simonstown	305	1 A	34 12	18 26	03·50	28 42	59 16	18209	24 41	62 54	15266
577	Sioma	—	8 E	16 40	23 35	14·54	16 07	49 48	22090	13 08	51 35	20878
578	Sir Lowry's Pass	306	1 A	34 07	18 55	03·50	28 58	59 25	18108	24 52	63 00	15164
579	Smaldeel	307	1 A	28 24	26 44	03·50	24 21	59 07	18680	19 08	62 13	15896
580	Spelonken	169	1 A	23 06	30 10	03·50	19 31	56 21	20344	14 18	59 06	17889
581	Spitzkop	—	3 C	26 25	18 28	09·17	24 54	55 54	19300	21 41	59 16	17091
582	Spitzkopje	308	1 A	25 18	30 49	03·50	20 36	58 48	19224	15 18	61 24	16640
583	Springfontein	—	P	30 17	25 42	28·09	20 55	63 09	15529	20 50	63 26	15233
584	Springs	310	1 A	26 15	28 27	03·50	22 20	58 22	19116	17 03	61 17	16443
585	Stanford	311	1 A	34 26	19 27	03·50	28 43	59 41	18127	24 33	63 11	15177
586	Stanger	312	1 A	29 21	31 18	03·50	22 59	61 16	18011	17 20	63 31	15311
587	Steenkampspoort	313	1 A	32 06	21 44	03·50	27 23	59 24	18335	22 51	62 52	15417
588	Stellenbosch	314	1 A	33 56	18 51	03·50	28 45	59 20	18192	24 40	62 57	15250
589	Sterkstroom	315	1 A	31 34	26 33	03·50	25 58	60 49	18095	20 46	63 43	15246
590	Steynsburg	316	1 A	31 18	25 48	03·50	26 06	60 15	18258	20 59	63 18	15391

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591	Still Bay	317	1 A	34 23	21 26	03·50	28 22	60 18	17967	23 54	63 36	15019
592	Stompiesfontein	205	4 B	32 14	19 41	08·50	27 13	59 22	18103	23 43	62 23	15617
593	Stormberg Junction	318	1 A	31 18	26 16	03·50	25 58	—	18138	20 48	—	15282
594	Storms River	319	1 A	33 58	23 53	03·50	27 42	61 01	17790	22 53	64 04	14880
595	Strandfontein	320	1 A	34 05	18 32	03·50	28 52	59 14	—	24 50	62 52	—
596	Sutherland	321	1 A	32 24	20 39	03·50	27 31	59 16	18495	23 08	62 50	15576
597	Swakopmund B	—	P	22 41	14 34	29·05	20 59	55 08	19026	20 56	55 22	18888
598	Swanswani	209	4 B	27 47	23 50	08·50	23 44	58 34	18512	19 45	61 21	16155
599	Swellendam	322	1 A	34 02	20 27	03·50	28 25	59 53	18107	24 05	63 19	15162
600	Taungs	323	1 A	27 35	24 45	03·50	24 05	58 22	18887	19 06	61 55	16120
601	Tete	—	10 F	16 09	33 35	20·66	10 22	51 11	22230	9 12	51 50	21464
602	Thaba'Nchu	324	1 A	29 13	26 51	03·50	24 27	59 37	18548	19 14	62 40	15740
603	Thirtyfirst	336	1 A	25 41	29 38	03·50	22 01	58 25	19197	16 43	61 12	16576
604	Tiger Bay	—	10 D	16 35	11 44	15·19	20 08	46 39	22062	—	—	—
605	Tinfontein	325	1 A	30 24	26 55	03·50	24 45	60 33	18077	19 31	63 30	15243
606	Toise River	326	1 A	32 27	27 24	03·50	26 28	61 47	17559	21 12	64 26	14734
607	Touws River	327	1 A	33 21	20 02	03·50	28 50	59 32	18151	24 33	63 05	15218
608	Trekkopje	—	3 C	22 17	15 07	09·18	21 15	53 31	19871	18 35	56 54	18080
609	Tsawisis	—	3 C	27 28	18 03	09·10	25 12	56 32	18974	22 02	59 51	16705
610	Tschaukaib	—	3 C	26 35	15 41	09·15	25 13	55 07	19372	22 24	58 36	17250
611	Tsolo	328	1 A	31 18	28 46	03·50	24 50	60 57	18002	19 25	63 29	15220
612	Tsumeb	—	P	19 14	17 43	29·01	18 09	53 07	19980	18 06	53 19	19849
613	Tsumis	—	3 C	23 43	17 11	09·22	23 47	53 58	19882	20 49	57 18	17890
614	Tugela	329	1 A	29 12	31 25	03·50	—	61 09	18139	—	63 22	15445
615	Tulbagh Road	330	1 A	33 19	19 06	03·50	28 29	59 02	18313	24 21	62 41	15381
616	Tweepoort	331	1 A	26 37	30 43	03·50	22 03	58 51	19260	16 40	61 25	16616
617	Twee Rivieren	332	1 A	33 50	23 56	03·50	27 40	60 59	17783	22 51	64 03	14873
618	Twelfelhoek	333	1 A	27 27	29 22	03·50	22 01	59 29	18796	16 38	62 14	16090
619	Tygerfontein	334	1 A	34 10	21 33	03·50	28 13	60 18	17967	23 43	63 36	15021
620	Tygerkloof Drift	335	1 A	28 09	28 35	03·50	22 57	59 22	18836	17 35	62 11	16097
621	Ugie (on road to)	405	1 A	31 08	28 26	03·50	25 07	61 12	17971	19 44	63 48	15181
622	Uitenhage	—	P	33 47	25 24	28·16	22 18	64 00	15102	22 13	64 15	14814
623	Uitkyk	338	1 A	25 50	29 25	03·50	21 24	58 10	19456	16 06	60 58	16821
624	Uitspan Farm	339	1 A	31 41	21 27	03·50	27 38	59 34	18157	23 08	63 06	15248
625	Umgwezi River Mouth	—	8 E	17 39	25 06	14·58	16 21	51 30	21597	13 22	53 14	20315
626	Umgwezi (above)	—	8 E	17 36	25 04	14·44	16 40	—	21681	13 37	—	20392
627	Umhlatuzi	340	1 A	28 52	31 54	03·50	22 29	60 38	18602	16 52	62 48	15925
628	Umhlengana Pass	341	1 A	31 36	29 18	03·50	25 10	61 50	17787	19 44	64 10	15020
629	Umtali	—	P	18 59	32 42	30·49	10 34	55 07	20147	10 34	55 07	20146
630	Umtata	343	1 A	31 36	28 47	03·50	25 12	61 35	17879	19 48	64 04	15096

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TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position		original values				values at epoch 1930·50		
				lat.	long.	date 1900+	D	I	H	D	I	H
				° ′	° ′		° ′	° ′	γ	° ′	° ′	γ
631	Umtwalumi	344	1 A	30 30	30 38	03·50	—	61 45	17735	—	63 59	15008
632	Umzinto	345	1 A	30 19	30 39	03·50	23 40	61 22	18102	18 03	63 36	15377
633	Underberg Hotel	346	1 A	29 48	29 30	03·50	24 39	61 02	18068	19 08	63 34	15321
634	Upington	347	1 A	28 28	21 15	03·50	27 04	57 42	19183	22 46	61 30	16393
635	Usakos	—	3 C	22 00	15 35	09·17	23 00	52 17	20449	20 20	55 38	18647
636	Usib Poort	—	3 C	23 07	17 07	09·24	23 15	53 12	20270	20 17	56 30	18324
637	Utrecht (West of)	348	1 A	27 40	30 12	03·50	22 41	59 34	18780	17 12	62 09	16087
638	Vaalgras	—	3 C	26 05	18 34	09·18	24 42	55 56	19339	21 31	59 17	17133
639	Van Reenen	349	1 A	28 22	29 24	03·50	23 05	—	18596	17 37	—	15872
640	Van Rhyn's Dorp	—	P	31 37	18 44	30·14	23 51	—	15726	23 50	—	15681
641	Van Wyk's Farm	350	1 A	33 49	21 12	03·50	28 11	60 03	18025	23 44	63 25	15083
642	Van Wyk's Vlei	351	1 A	30 22	21 50	03·50	27 05	58 47	18461	22 32	62 23	15581
643	Ventersdorp	—	5 D	26 20	26 50	09·22	22 21	—	—	18 05	—	—
644	Victoria Falls	—	P	17 57	25 51	30·54	13 12	54 16	20123	13 12	54 16	20126
645	Vila Luisa	—	11 F	25 44	32 41	24·71	13 22	61 25	17386	12 34	61 55	16750
646	Villiersdorp	353	1 A	34 00	19 18	03·50	28 38	59 31	18118	24 28	63 05	15175
647	Virginia	354	1 A	28 08	26 55	03·50	24 06	59 02	18749	18 53	62 08	15981
648	Vlaklaagte	355	1 A	26 51	29 05	03·50	22 23	58 54	19059	17 03	61 43	16367
649	Vogelvlei	356	1 A	29 08	27 31	03·50	24 05	60 00	18422	18 48	62 57	15638
650	Vondeling	357	1 A	33 20	23 04	03·50	27 46	60 34	17858	23 04	63 47	14933
651	Vredefort	358	1 A	27 01	27 23	03·50	22 36	57 37	19276	17 23	60 40	16554
652	Vredefort Road	359	1 A	27 07	27 41	03·50	—	59 04	17948	—	62 04	15226
653	Vryburg	360	1 A	26 57	24 43	03·50	22 58	58 02	19179	18 00	61 26	16444
654	Wakkerstroom	361	1 A	27 22	30 09	03·50	22 27	59 24	18874	17 00	62 01	16191
655	Wankie	362	1 A	18 22	26 28	03·50	16 06	51 06	22192	11 20	53 59	20157
656	Warmbad (Waterberg)	363	1 A	24 53	28 20	03·50	21 21	57 11	19691	16 09	60 09	17105
657	Warmbad (Zoutspanberg)	364	1 A	22 25	29 12	03·50	21 17	57 17	19223	16 08	60 08	16816
658	Warrenton	—	P	28 07	24 52	30·56	19 50	62 02	16002	19 50	62 02	16008
659	Waschbank	366	1 A	28 19	30 06	03·50	23 16	59 59	18608	17 44	62 32	15900
660	Waterworks	367	1 A	29 10	26 32	03·50	24 30	59 37	18500	19 18	62 44	15686
661	Welverdiend	368	1 A	26 23	27 17	03·50	23 00	58 44	18985	17 48	61 49	16285
662	Wepener	369	1 A	29 44	27 02	03·50	25 23	60 10	18303	20 08	63 09	15487
663	Wessels	224	4 B	27 24	23 40	08·50	23 33	58 24	18779	19 30	61 16	16421
664	White Water	—	8 E	20 32	28 20	16·59	16 20	55 19	20112	13 50	56 47	18815
665	Willems River	225	4 B	31 21	19 69	08·50	27 10	59 02	18000	23 45	62 10	15532

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666	Williston	370	1 A	31 20	20 55	03·50	26 40	59 03	18451	22 15	62 41	15551
667	Willowmore	—	P	33 18	23 28	28·16	23 03	63 46	15139	22 58	64 03	14847
668	Winburg	372	1 A	28 31	27 01	03·50	24 13	59 17	18646	18 59	62 21	15866
669	Windhoek (C.P.)	227	4 B	31 44	18 38	08·50	27 20	58 50	18151	23 58	61 58	15680
670	Windhoek A. (S.-W. Afr.)	—	P	22 33	17 04	28·98	20 04	56 03	18617	20 01	56 17	18467
671	Winkeldrift	373	1 A	27 08	27 06	03·50	24 15	58 44	18988	19 03	61 50	16258
672	Witklip	374	1 A	23 16	29 10	03·50	21 58	56 31	19958	16 47	59 23	17494
673	Witmoss	375	1 A	32 33	25 45	03·50	26 27	61 15	17852	21 22	64 13	14986
674	Witwater	—	7 D	28 58	23 00	15·06	24 07	61 09	16906	21 28	63 11	15141
675	Wolseley	—	P	33 26	19 12	30·15	24 21	62 47	15420	24 20	62 50	15375
676	Wolvefontein	376	1 A	33 18	24 49	03·50	—	61 19	17600	—	64 19	14712
677	Wolvehoek	377	1 A	26 55	27 50	03·50	23 01	58 36	19040	17 46	61 36	16326
678	Wonderfontein	379	1 A	25 48	29 53	03·50	23 35	58 00	19847	18 17	60 44	17223
679	Woodville	380	1 A	33 56	22 41	03·50	27 57	60 37	17881	23 18	63 49	14948
680	Worcester	381	1 A	33 39	19 27	03·50	28 34	59 24	18199	24 22	62 59	15260
681	Wortel	229	4 B	29 02	18 49	08·50	26 20	57 42	18676	22 58	61 00	16296
682	Xefina Grande	—	11 G	25 55	32 41	24·76	15 06	61 38	17498	14 17	62 07	16866
683	Zak Rivier	382	1 A	30 29	20 31	03·50	27 01	58 17	18707	22 40	62 02	15832
684	Zand Gat	231	4 B	29 11	19 43	08·50	25 43	58 04	18575	22 14	61 17	16178
685	Zand Put	232	4 B	30 06	20 49	08·50	26 02	59 01	18153	22 24	62 03	15720
686	Zand Rivier	383	1 A	23 04	29 34	03·50	21 13	56 21	20234	16 02	59 10	17781
687	Zeekoe Gat	384	1 A	33 03	22 31	03·50	27 57	60 38	17639	23 19	63 56	14711
688	Zeerust	234	4 B	25 32	26 04	08·50	22 57	57 52	18999	18 38	60 32	16724
689	Zimba	—	3 F	17 19	26 09	09·33	16 51	50 36	22262	13 02	52 49	20644
690	Zonder Huis	235	4 B	29 40	20 54	08·50	26 01	58 43	18283	22 22	61 45	15853
691	Zoutpan	236	4 B	26 49	24 13	08·50	23 21	—	18889	19 15	—	16553
692	Zoutpansdrift	237	4 B	33 10	19 43	08·50	27 46	60 04	—	24 16	63 01	—
693	Zuurbrak	385	1 A	34 00	20 39	03·50	28 20	59 59	18092	23 58	63 24	15148
694	Zuurfontein	386	1 A	32 51	18 34	03·50	28 17	58 44	18426	24 14	62 29	15506
695	Zuurpoort	387	1 A	32 03	24 08	03·50	26 53	60 23	18072	22 01	63 35	15169
696	Zwaartkopje	241	4 B	29 29	19 39	08·50	25 59	58 14	18519	22 30	61 26	16110
697	Between Pietersburg and Birthday	388	1 A	23 43	29 44	03·50	20 48	56 35	20114	15 35	59 23	17616
698	Between Pietersburg and Chunie's Poort	389	1 A	24 08	29 28	03·50	20 24	56 55	19908	15 11	59 45	17375
699	Between Pokwani and Middelburg	390	1 A	25 10	29 45	03·50	21 34	58 14	19557	16 18	61 01	16964
700	Between Kasper's Nek and Pilgrim's Rest	392	1 A	24 47	30 42	03·50	—	58 09	19547	—	60 49	16990

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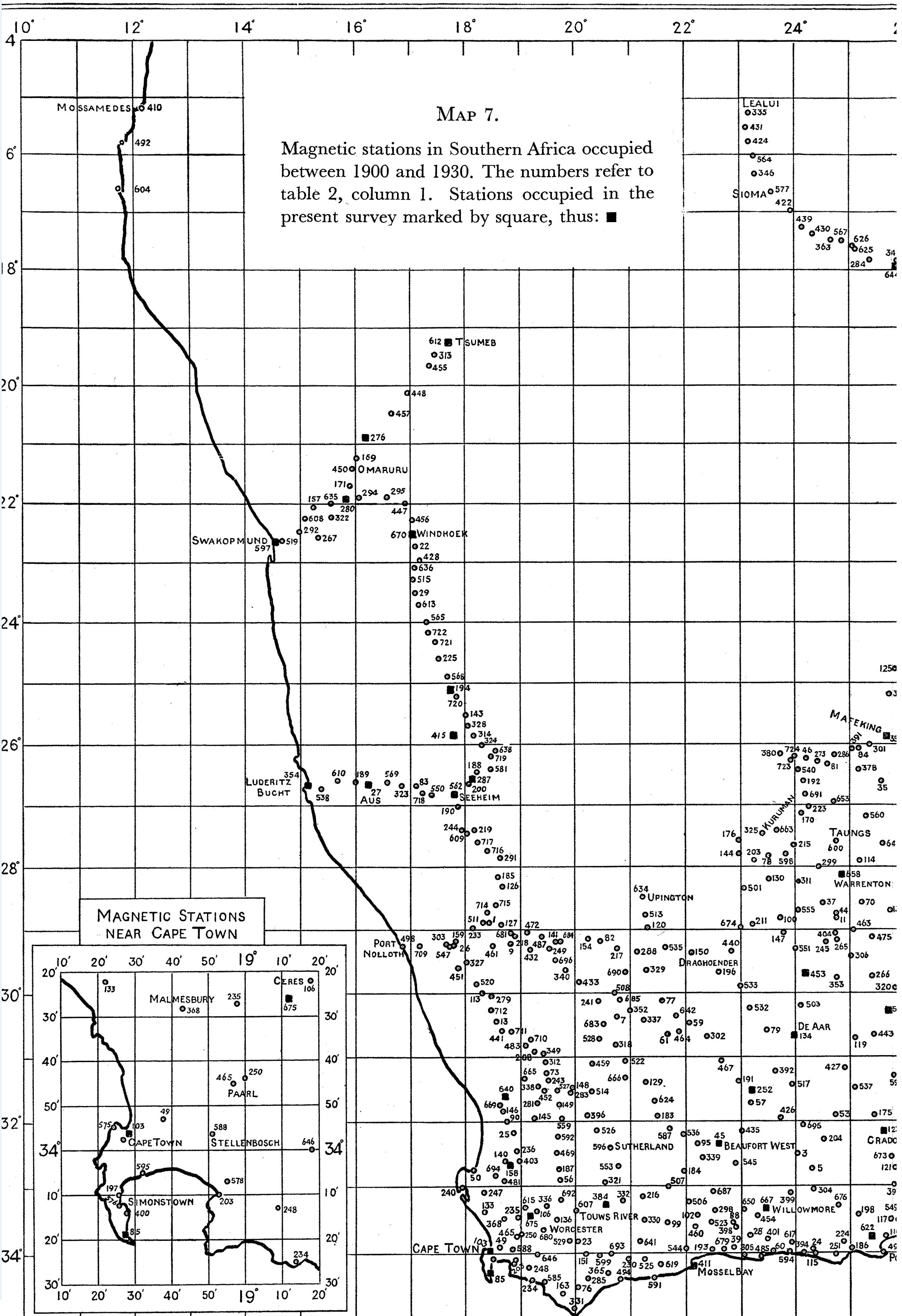
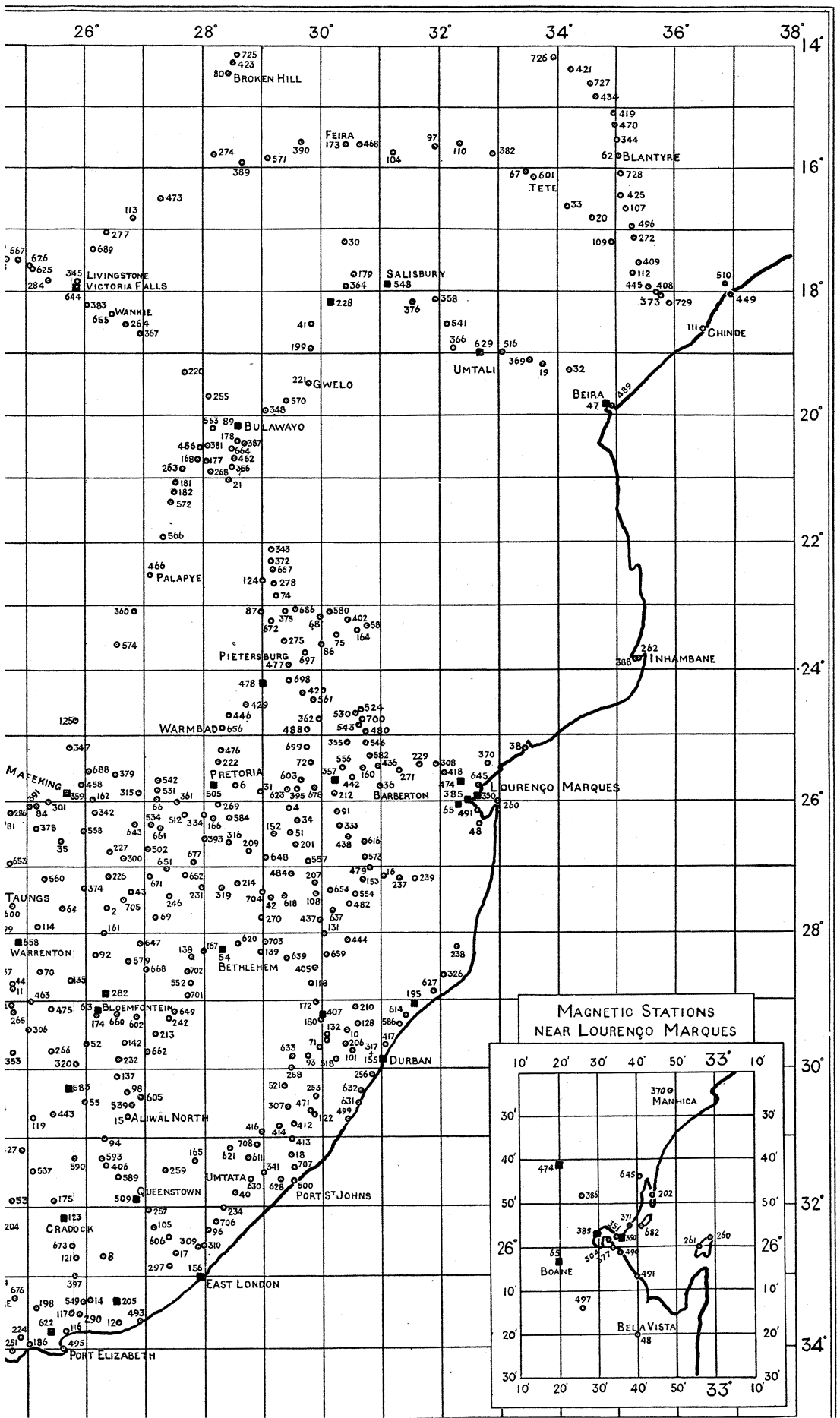
TABLE 2 (*continued*)

number	station	old number	source and method of correcting	position		original values				values at epoch 1930·50		
				lat. ° ′	long. ° ′	date 1900+	D ° ′	I ° ′	H γ	D ° ′	I ° ′	H γ
701	Between Ladybrand and Ficksburg	393	1 A	28 55	27 44	03·50	24 06	59 54	18476	18 48	62 48	15703
702	Between Ficksburg and Senekal	394	1 A	28 32	27 42	03·50	23 58	59 32	18697	18 41	62 29	15933
703	Between Harrismith and Vrede	395	1 A	28 07	29 03	03·50	22 58	59 39	18634	17 33	62 24	15907
704	J.C.B. 396	—	1 A	27 23	29 00	03·50	22 32	59 08	18892	17 11	61 56	16182
705	J.C.B. 397	—	1 A	27 30	26 38	03·50	—	58 58	18777	—	62 07	16027
706	Between Butterworth and Idutywa	399	1 A	32 13	28 12	03·50	25 57	61 19	17803	20 36	63 51	14997
707	Between Port St John's and Mount Ayliff	401	1 A	31 26	29 32	03·50	—	61 02	18449	—	63 21	15687
708	Between Mount Frere and Qumbu	404	1 A	31 06	28 54	03·50	—	61 19	17793	—	63 50	15017
709	J.T.M. 26	242	4 B	29 16	17 11	08·50	26 29	57 20	18718	23 20	60 43	16360
710	J.C.B. 26	243	4 B	30 44	19 12	08·50	26 30	58 44	18347	23 04	61 54	15895
711	J.C.B. 27	244	4 B	30 36	18 51	08·50	26 33	—	18286	23 10	—	15846
712	J.C.B. 30	245	4 B	30 16	18 28	08·50	26 48	58 12	18393	23 25	61 25	15963
713	J.C.B. 32	246	4 B	29 59	18 19	08·50	26 13	—	—	22 55	—	—
714	J.C.B. 48	—	3 C	28 44	18 25	09·07	25 53	58 37	18376	22 36	61 51	16044
715	J.C.B. 49	—	3 C	28 35	18 33	09·07	25 58	57 20	18743	22 40	61 34	16409
716	J.C.B. 53	—	3 C	27 45	18 24	09·09	25 11	56 46	18903	21 57	60 03	16617
717	J.C.B. 54	—	3 C	27 35	18 15	09·09	25 16	56 41	18909	22 01	60 01	16626
718	J.C.B. 62	—	3 C	26 48	17 14	09·12	24 28	55 24	19441	21 28	58 49	17267
719	J.C.B. 73	—	3 C	26 12	18 29	09·17	24 46	56 05	19258	21 35	59 26	17059
720	J.C.B. 79	—	3 C	25 14	17 52	09·20	24 19	55 08	19538	21 14	58 30	17410
721	J.C.B. 83	—	3 C	24 18	17 30	09·22	24 00	54 38	19734	20 57	57 59	17685
722	J.C.B. 84	—	3 C	24 09	17 22	09·22	23 29	54 30	19734	20 29	57 51	17716
723	A.	254	4 B	26 15	23 57	08·50	23 05	57 25	19195	19 02	60 15	16875
724	B.	255	4 B	26 12	24 01	08·50	23 01	57 36	19162	18 58	60 27	16847
725	J.T.M. 36	—	3 F	14 08	28 35	09·36	14 04	47 27	23852	10 14	49 17	22544
726	J.T.M. 111	—	3 F	14 11	33 57	09·64	11 55	48 16	24011	8 05	49 23	22704
727	J.T.M. 113	—	3 F	14 36	34 33	09·64	12 04	48 52	23842	8 14	49 59	22495
728	J.T.M. 119	—	3 F	16 03	35 05	09·68	—	—	22979	—	—	21498
729	J.T.M. 127	—	3 F	18 11	35 54	09·71	13 24	53 38	21921	9 34	54 49	20233



Map 7. Magnetic stations in Southern Africa occupied between 1900 and 1930. The numbers refer to table 2, column 1. Stations occupied in the present survey marked by square, thus: ■



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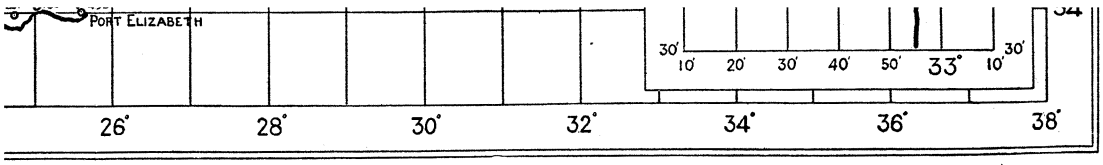

(*Facing p.* 294)

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

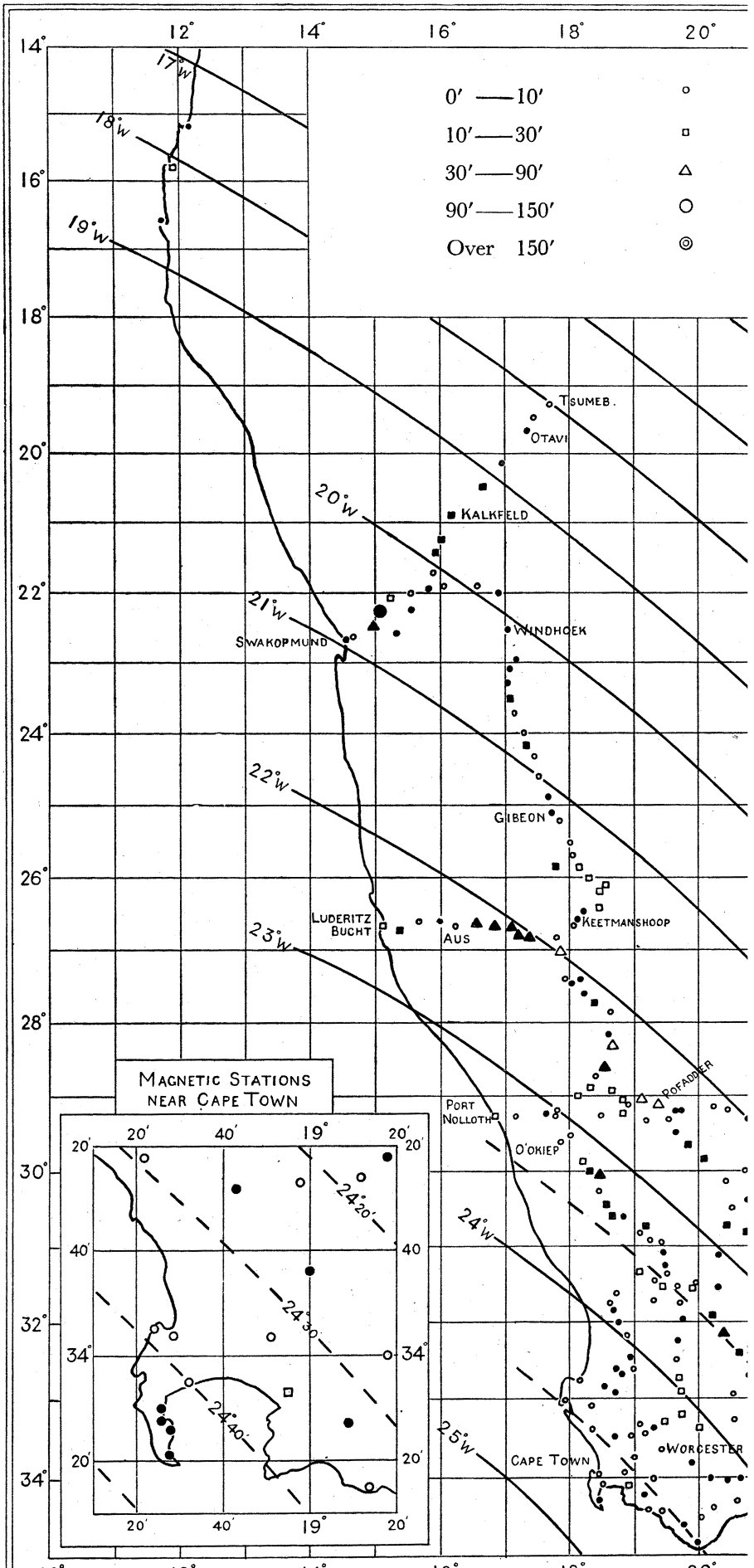

Fig. 8. Isogonal lines (lines of
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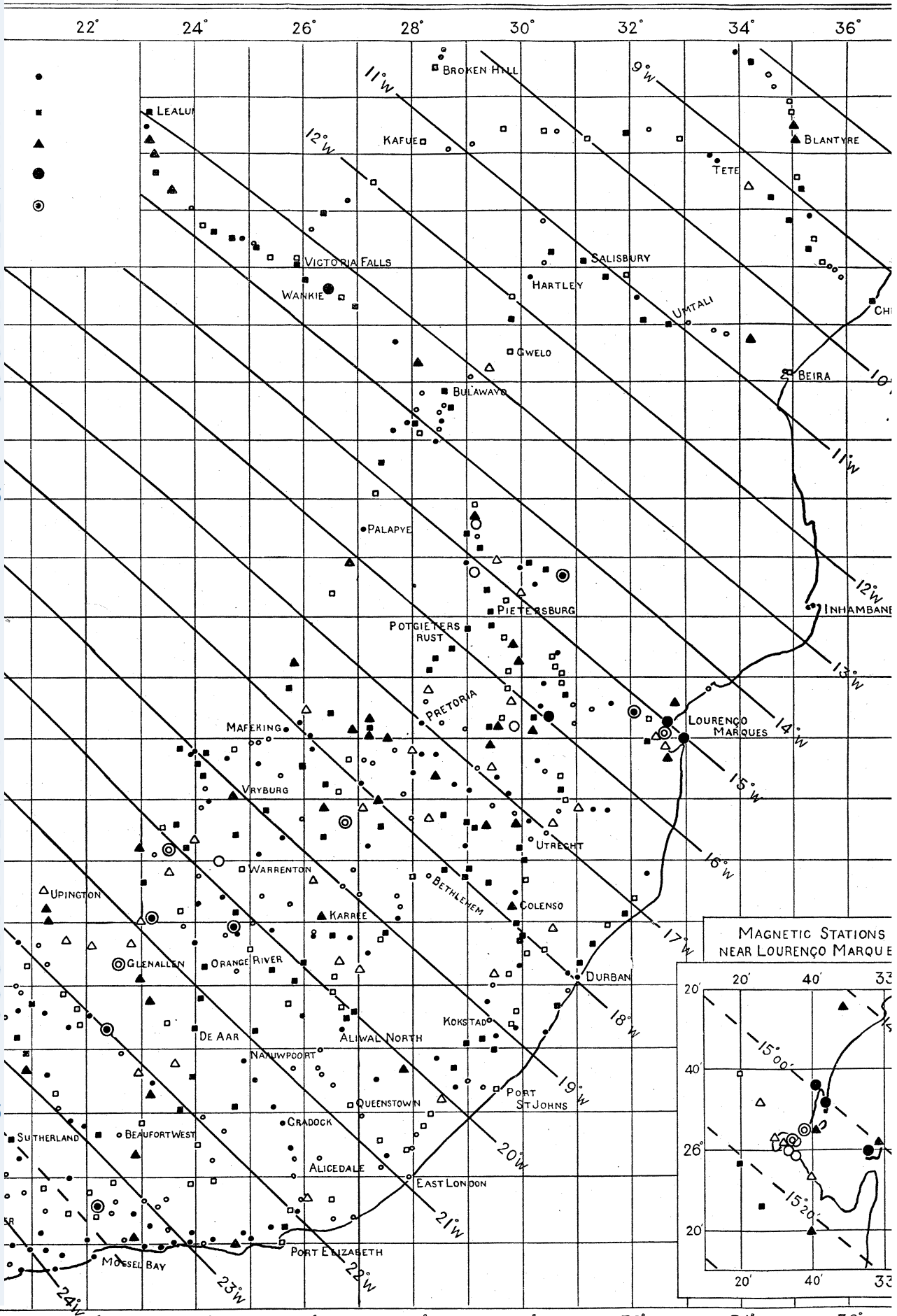

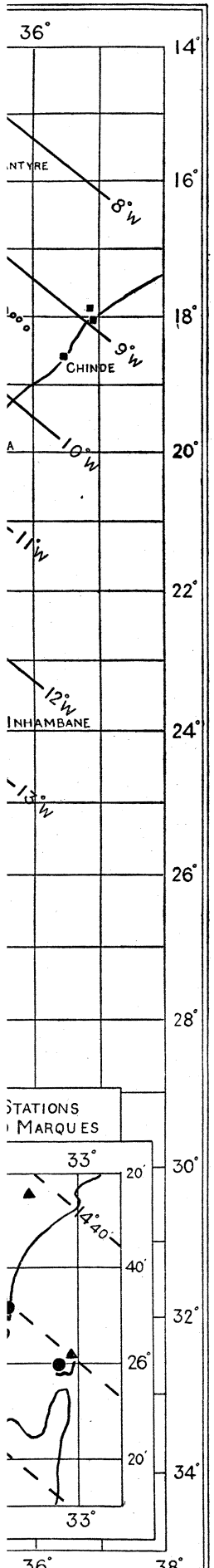

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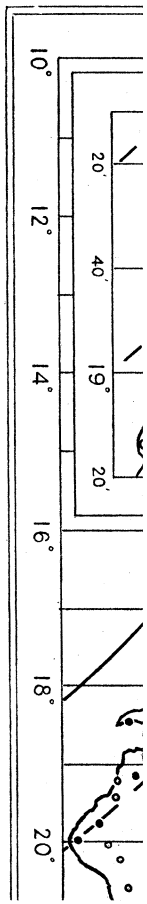

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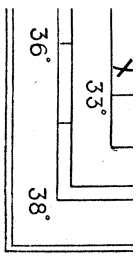

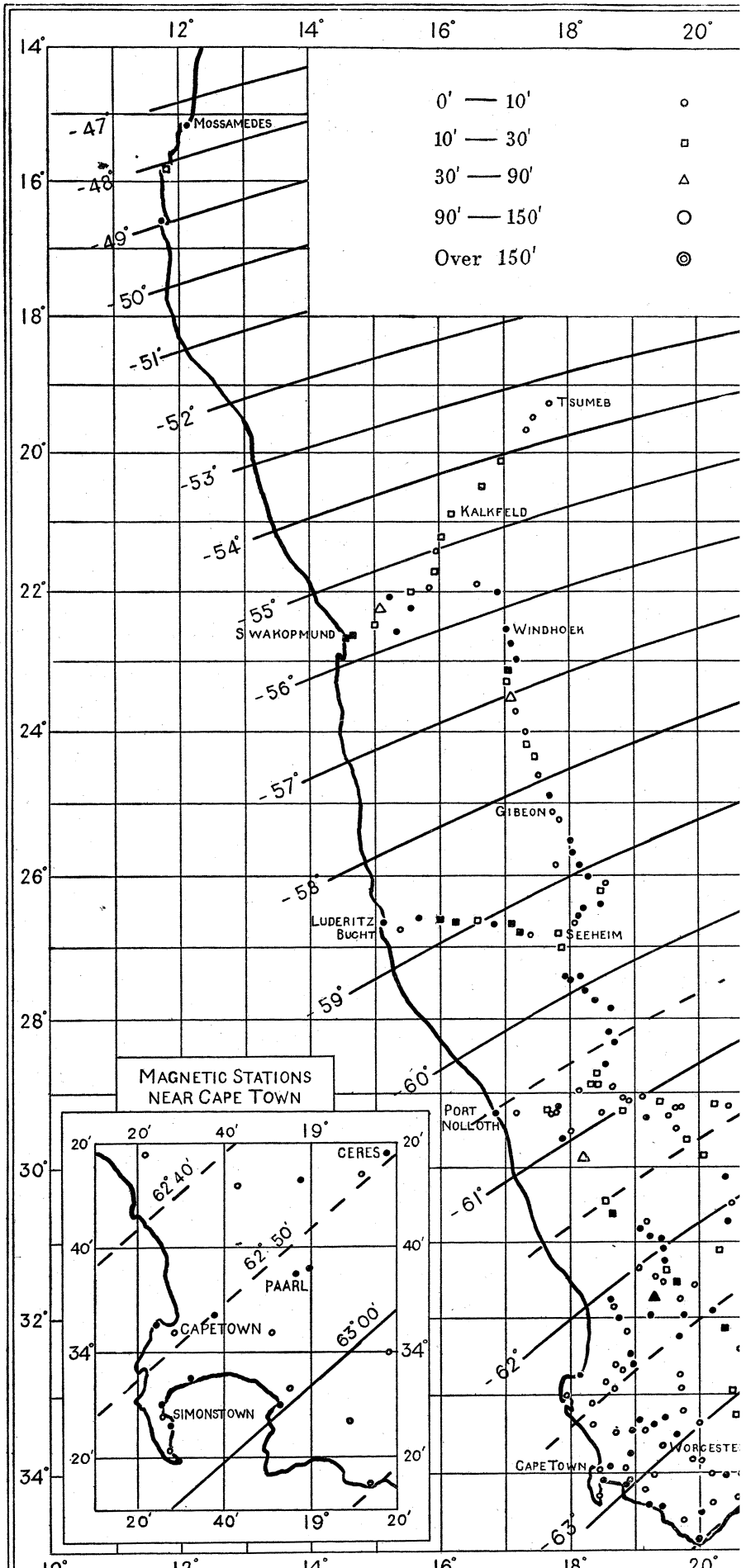

P 9. Isoclinal lines (lines of
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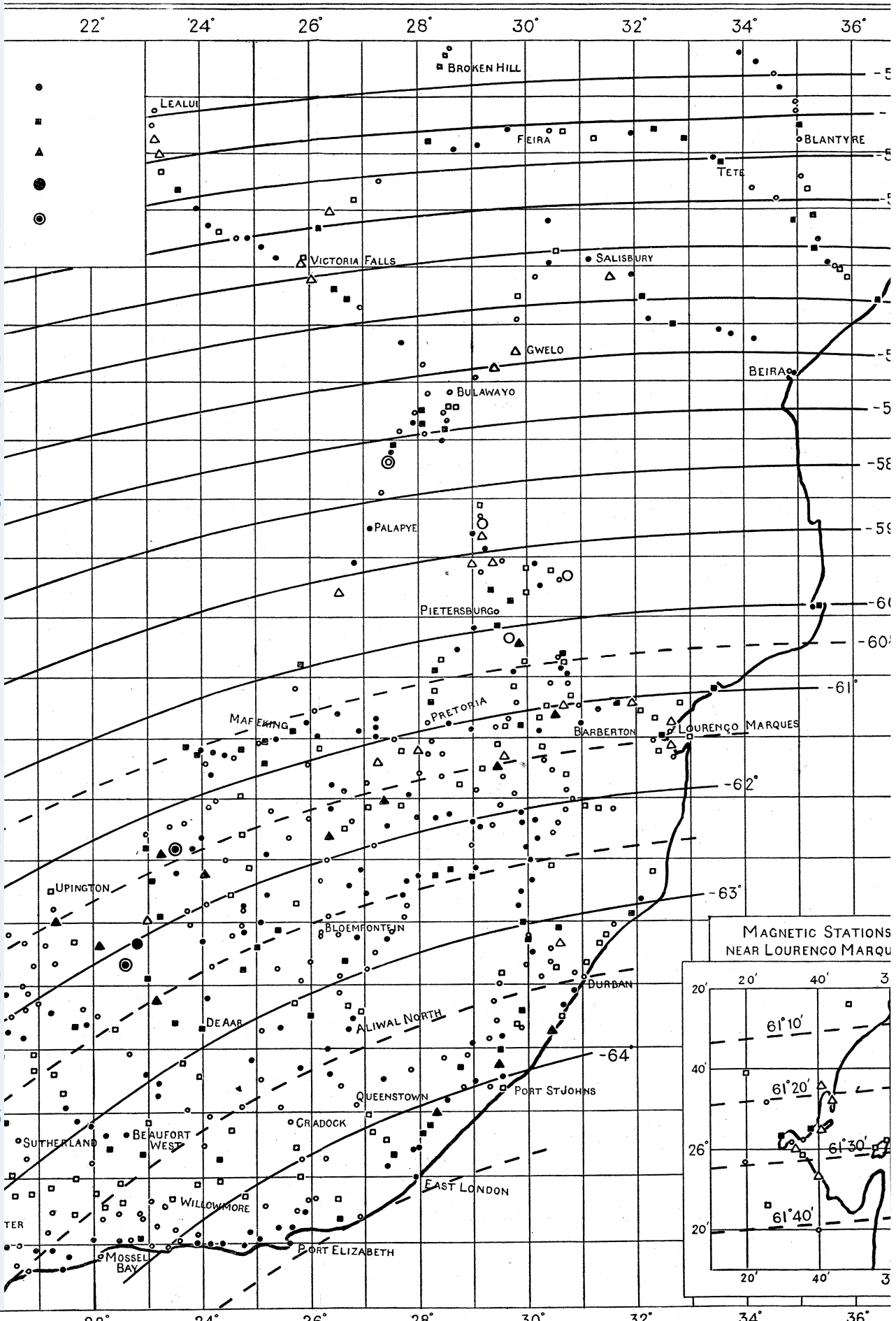

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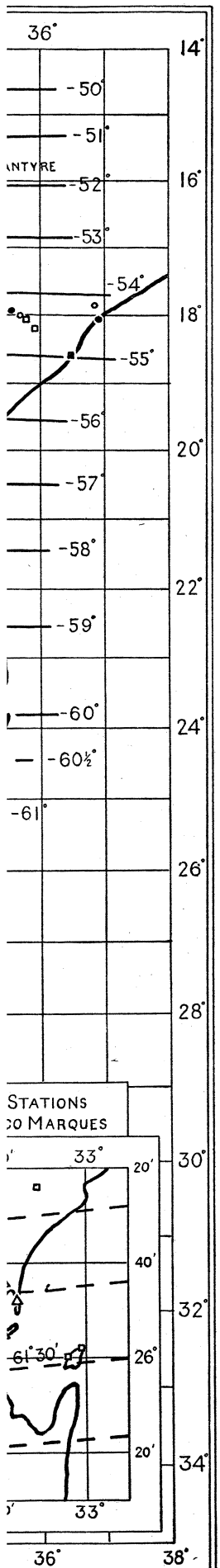

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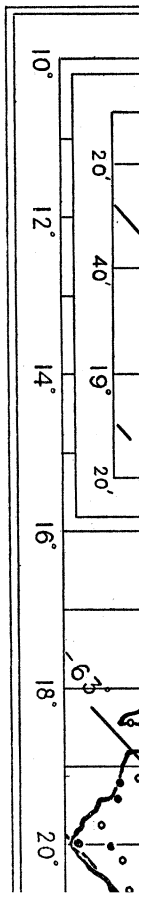

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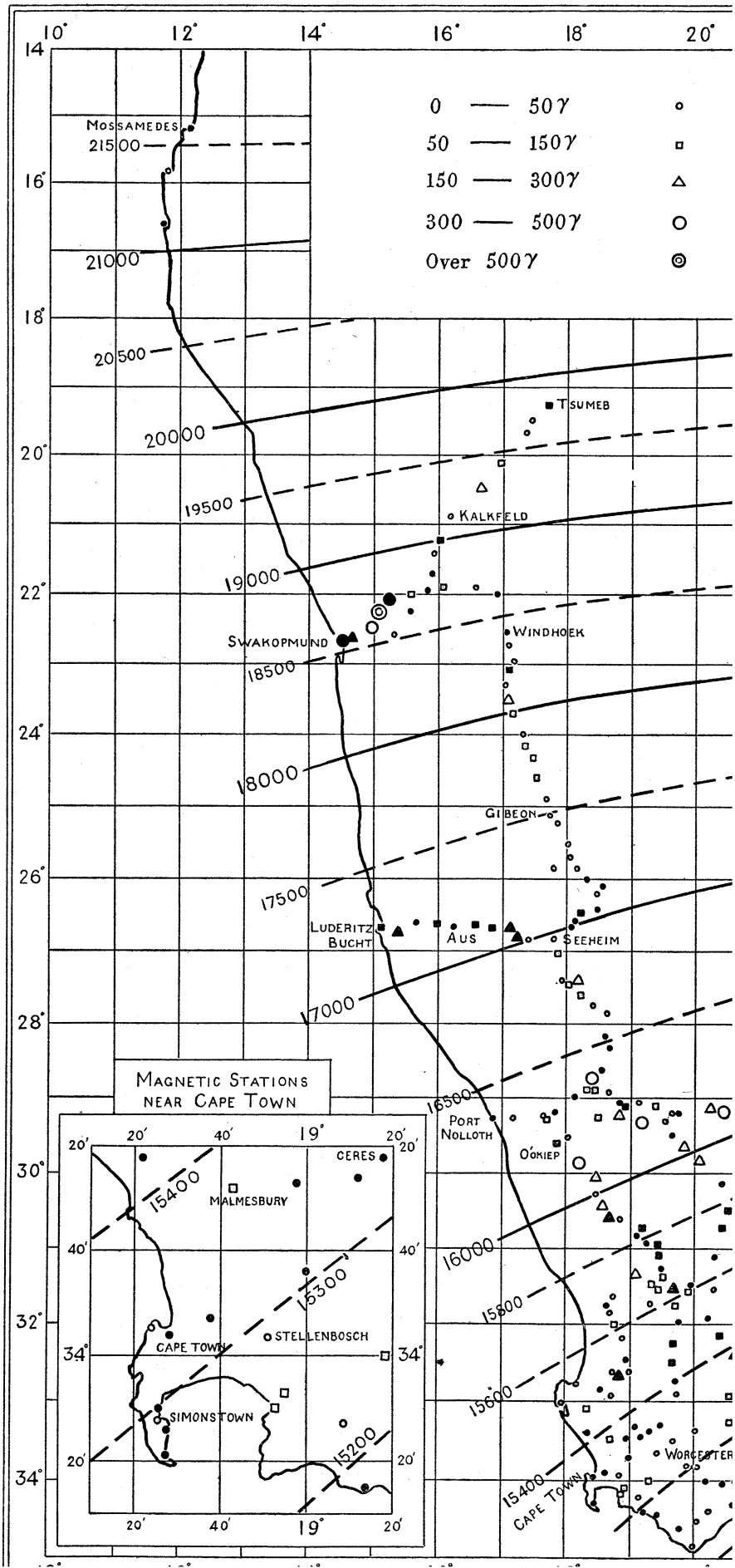

AP 10. Lines of equal hori-
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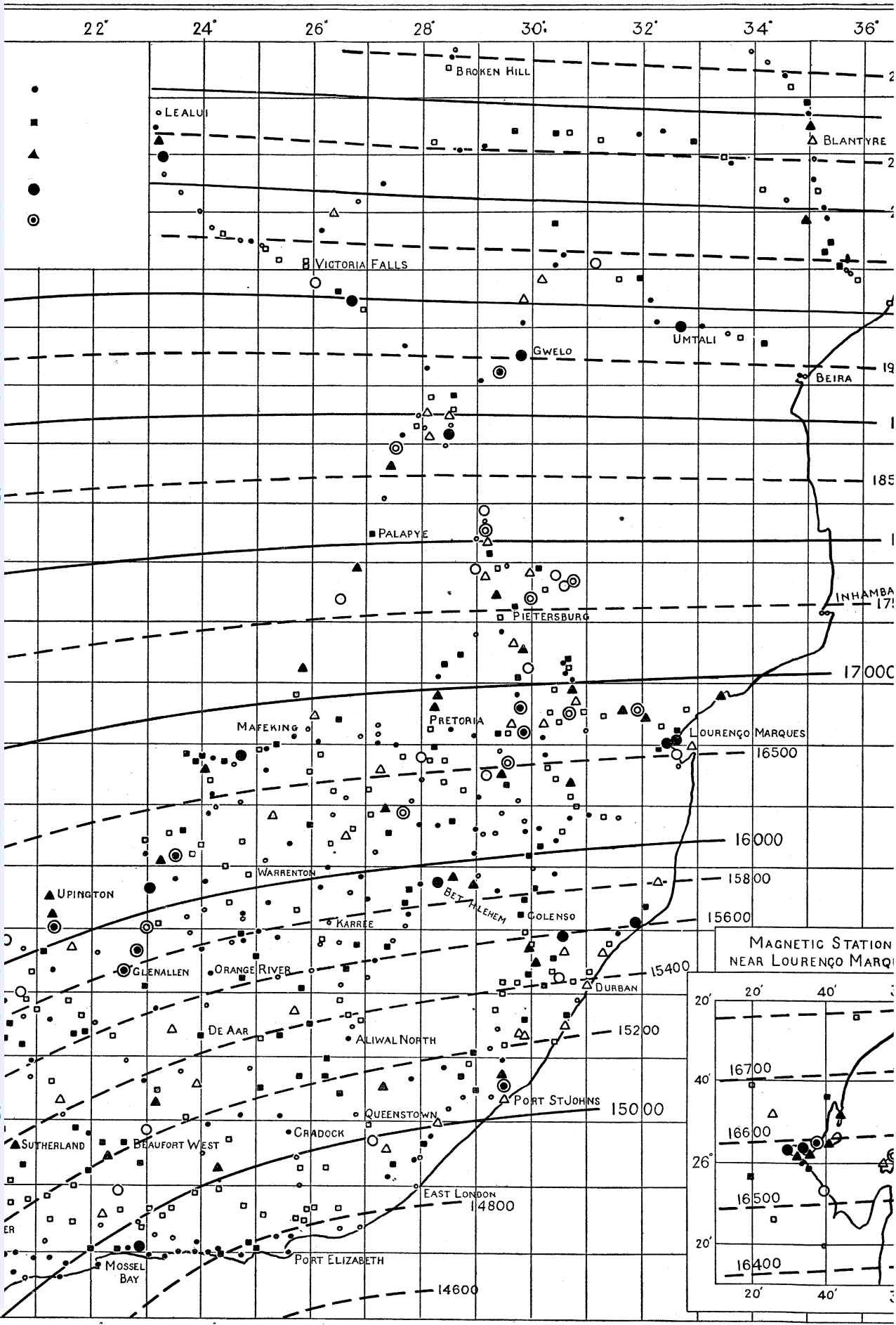

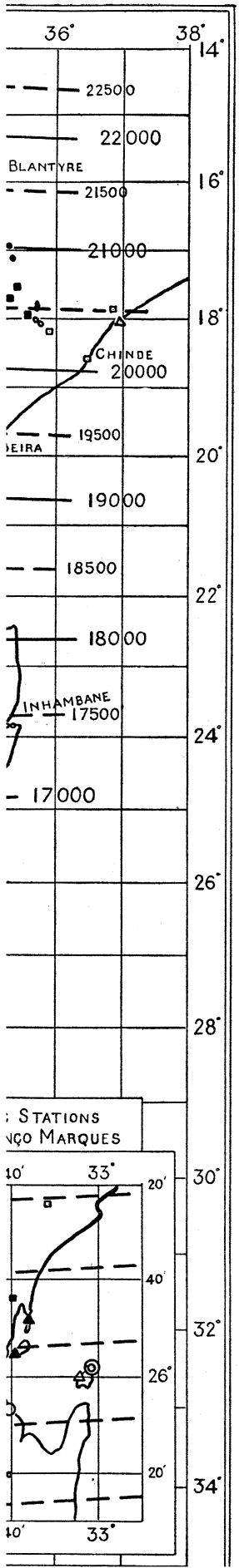

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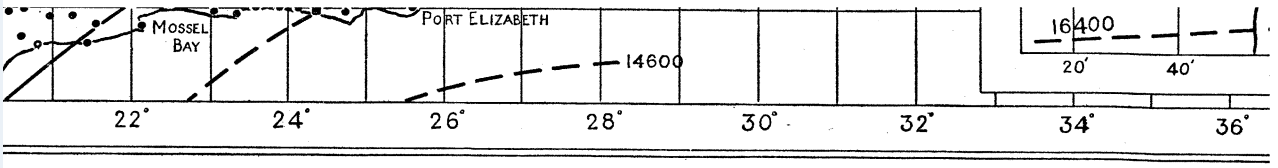

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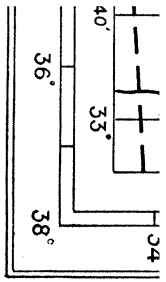
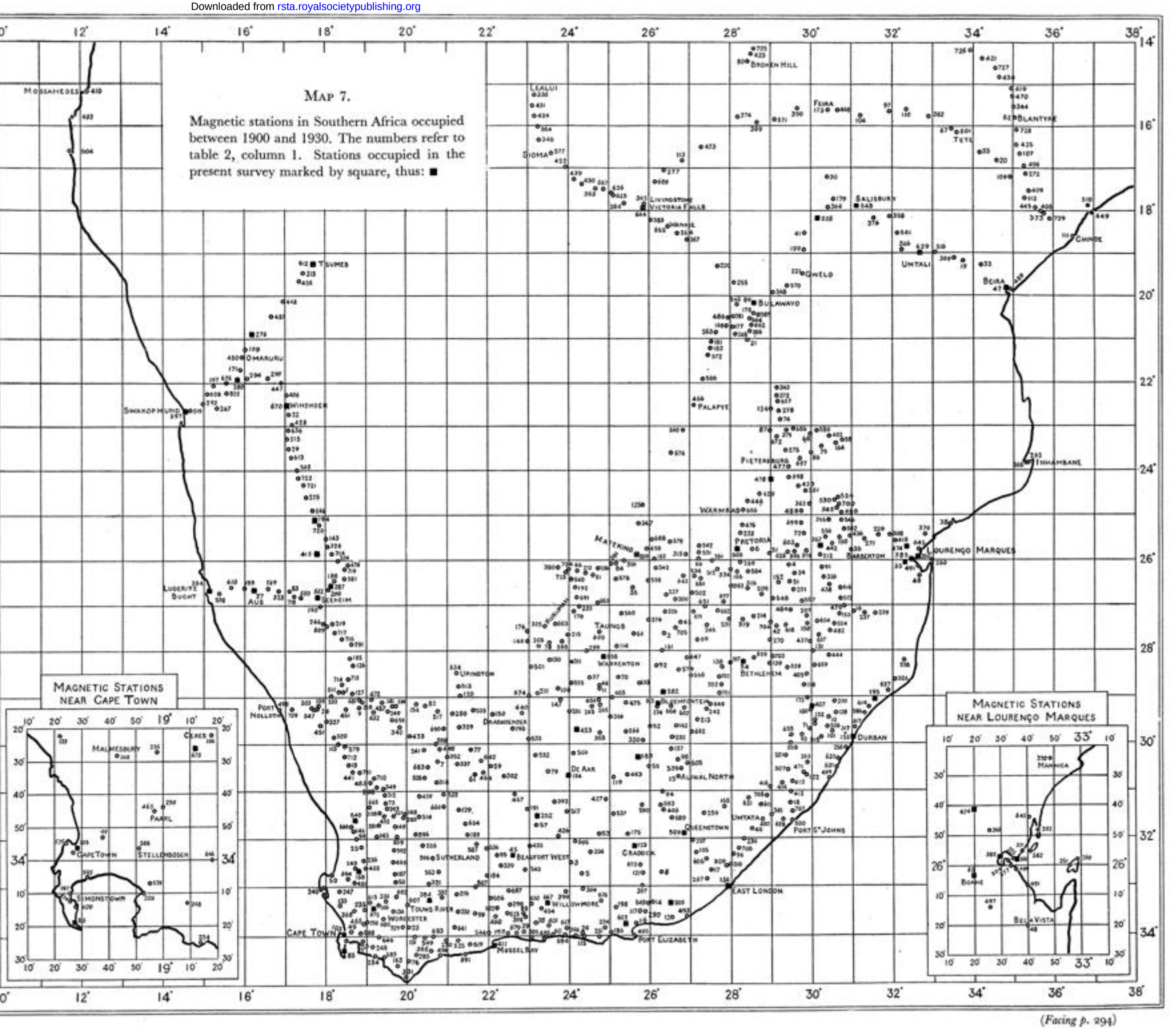


Map 7.

Magnetic stations in Southern Africa occupied between 1900 and 1930. The numbers refer to table 2, column 1. Stations occupied in the present survey marked by square, thus: ■



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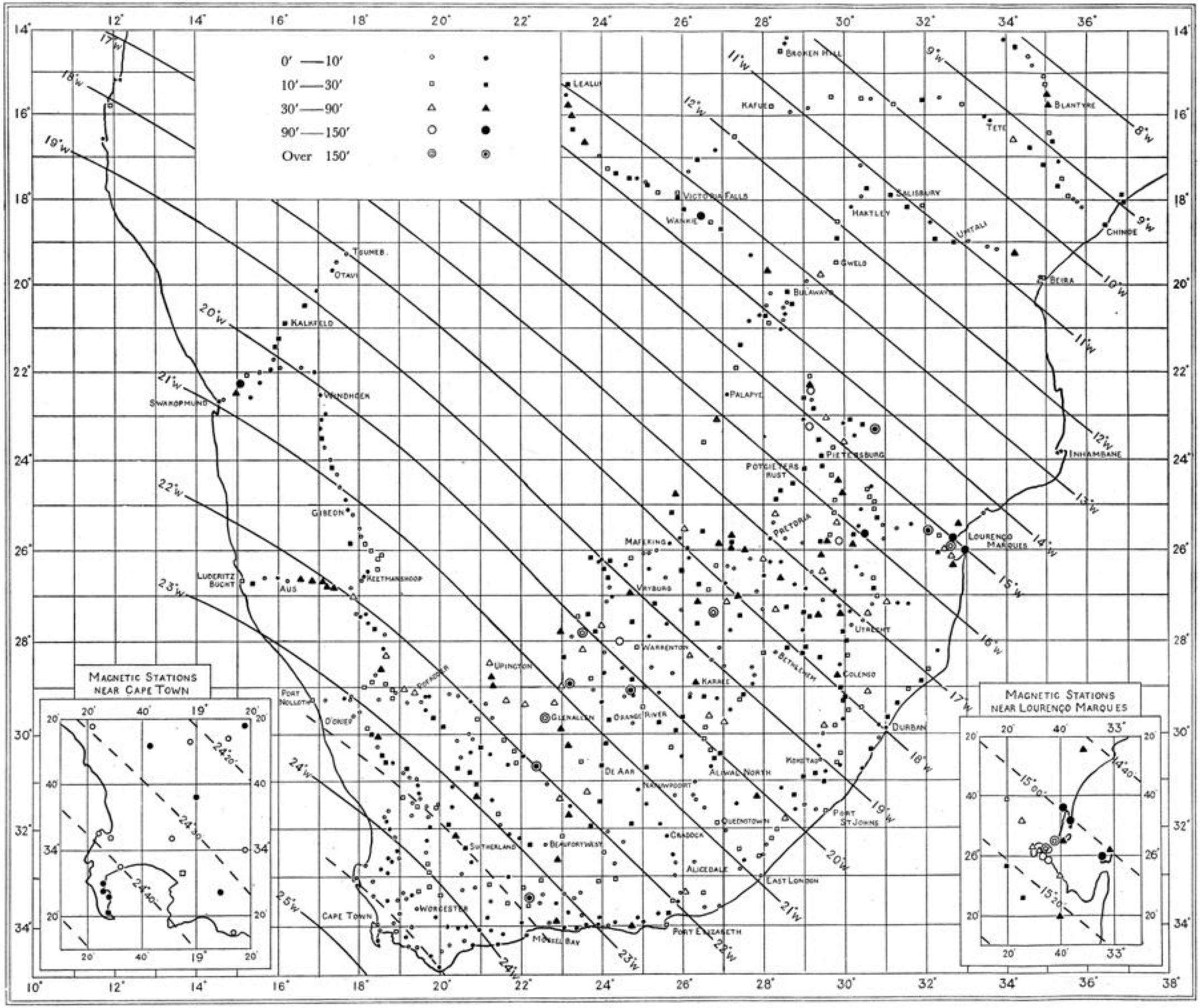

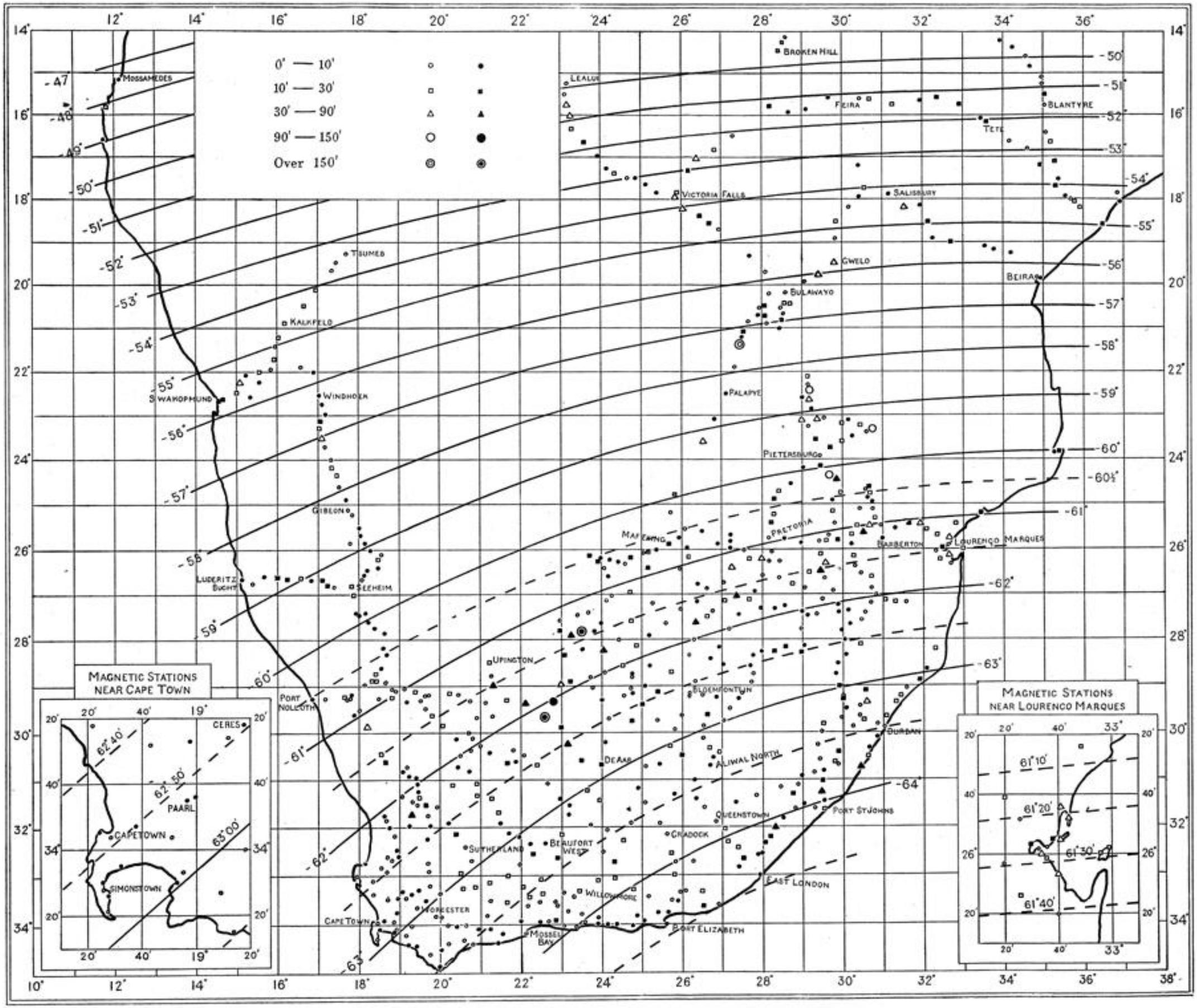

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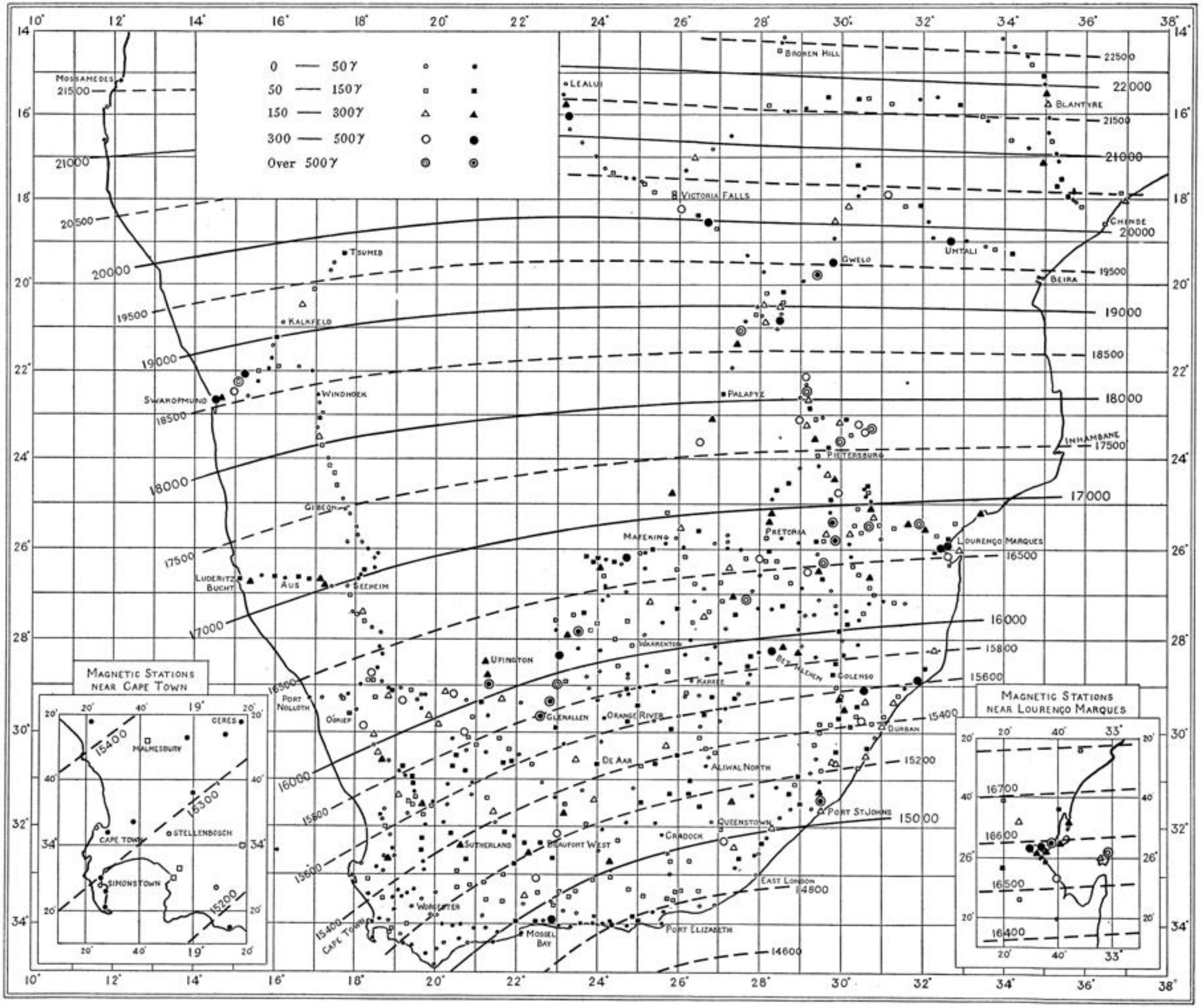

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