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COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1953 N^o. 48

A REPORT ON THE CHANGE OF CORRECTION TO
INTERNATIONAL MAGNETIC STANDARD OF THE QUARTZ
HORIZONTAL MAGNETOMETERS OF THE GEOPHYSICAL
SECTION OF THE BUREAU OF MINERAL RESOURCES
DURING THE PERIOD MARCH 1951 TO JUNE 1952

by

R.E. ERVIN

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A Report on The Change of Correction to International Magnetic Standard of the Quartz Horizontal Magnetometers of the Geophysical Section of the Bureau of Mineral Resources during the Period March 1951 to June 1952.

During 1951 three separate sets of La Cour pattern Quartz Horizontal Magnetometers were received from the Danish Meteorological Institute. These instruments which are only semi-absolute, were calibrated at the Rude Skov Magnetic Observatory against the standard adopted by that observatory. As the Australian observatories are based on the International Magnetic Standard housed at Cheltenham near Washington, U.S.A., (hereinafter referred to as I.M.S.) it was decided to compare them against the Toolangi magnetometer as soon as possible after their arrival in Australia. Moreover, as the stability of the constants of these instruments depends on the torsion properties of a quartz fibre and on the magnetic moment of a magnet, regular comparisons should be made with an absolute magnetometer and the results used to control drift that might occur. The comparisons made immediately after the arrival of the instruments in Australia would thus constitute a starting point in the future control of the Q.H.Ms.

Two absolute magnetometers, namely D.T.M. C.I.W. Magnetometer No.18 and Askania pattern Magnetometer No.508813 were in service at Toolangi during the period in question but intercomparisons made between these instruments revealed that each gave the same value when corrected to I.M.S.

In March 1951, Q.H.Ms 172,173 & 174 and Q.H.Ms 177,178 & 179 were checked at Toolangi.

By a series of simultaneous observations using Station A (the magnetometer pier) in the absolute magnetic hut and Station C which is situated some feet outside the absolute hut, intercomparisons were made between Q.H.Ms 172 & 173, Q.H.Ms 172 & 174, Q.H.Ms 177 & 178, Q.H.Ms 177 & 179 and Q.H.Ms 172 & 177, the station difference being determined and applied.

Using the results from each Q.H.M. separately, mean base line values were computed for the H variometer of the La Cour magnetographs operating the the Toolangi Magnetic Observatory.

A series of H determinations were made with D.T.M. C.I.W. Magnetometer No.18 and the results were corrected to I.M.S. using a correction determined through a series of intercomparisons based on the International Comparison of Magnetic Standards of 1949 using Q.H.Ms.51,52 & 33. From these corrected results a mean H base line value was computed. By comparing this value with the base line values obtained with the Q.H.Ms, the correction to I.M.S. for each was determined as at that date. These corrections expressed as a decimal part of the horizontal intensity are shown in Appendix A.

Shortly after this series of intercomparisons Q.H.Ms 172,173 & 174 were despatched to Heard Island and Q.H.Ms 177,178 & 179 were despatched to Macquarie Island for regular use in the magnetic observatories at those Islands.

In November 1951, the third set of Q.H.Ms comprising Q.H.Ms. Nos. 187,188 & 189, was received and compared at Toolangi, the absolute magnetometer in regular use then being Askania pattern Magnetometer No.508813. This series of intercomparisons was made as before by determining H base line values for the magnetograms with each of the instruments, observations being made either on Station A or Station C, a station difference being applied to convert all readings to Station A. The correction to I.M.S. used for Askania Magnetometer No.508813 was based on intercomparisons with C.I.W. Magnetometer No.18. Corrections to I.M.S. for this set of Q.H.Ms were determined and are also shown in Appendix A.

During the relief of the Australian National Antarctic Research Expeditions at Heard and Macquarie Islands in February and April 1952 respectively, further series of intercomparisons with the Q.H.Ms were made with a view to checking the drift of the instruments.

To check Q.H.Ms Nos. 172, 173 & 174 which were on Heard Island, simultaneous observations were made between Q.H.M. 172 and Q.H.Ms 187, 188 & 189, using the corrections to I.M.S. recently determined at Toolangi for the latter instruments. A correction was thus determined for Q.H.M. 172, and by subsequently comparing this Q.H.M. with Q.H.Ms 173 & 174, corrections to I.M.S. as at February 1952 were obtained for the three instruments. (See Appendix A.)

As there was no suitable Q.H.M. available for checking Q.H.Ms 177, 178 & 179 on Macquarie Island intercomparisons between these three Q.H.Ms were made in April 1952 by means of simultaneous observations. Q.H.M. 179 was then brought back to Toolangi where it was compared in June 1952. The results of the intercomparisons with Q.H.M. 179 were used to determine the corrections for Q.H.Ms 177 & 178 and consequently for the whole set. (See Appendix A.).

In June 1952 Q.H.M. 189 was again checked at Toolangi as before and its correction to I.M.S. redetermined. (see Appendix A.).

The several corrections determined for each Q.H.M. are grouped in Appendix B to illustrate the drift of each instrument with time. It can be seen that in most cases the drift has been small and in high latitudes like those of Heard and Macquarie Island where the horizontal intensity is relatively low, this drift, in terms of gammas, would be of little importance. However, the notable exception was Q.H.M. 179 which in little over a year changed its correction at Toolangi by 6 gammas. This is noteworthy because of the rather large negative increase in the correction to I.M.S. for this Q.H.M., presumably due to a change in the rigidity of its quartz suspension.

The results of this investigation illustrate the necessity for regular checks on the Q.H.Ms when these instruments are used in a semi absolute capacity such as for base line control in a magnetic observatory. It is possible that the drift of these instruments may decrease with time but at this stage insufficient evidence is available to draw a worth while conclusion in this regard.

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23/3/53.

APPENDIX A.

Corrections to International Magnetic Standard for
Q.H.Ms 172,173,174 Q.H.Ms 177,178,179 and Q.H.Ms
187,188,189. Determined at Toolangi Magnetic
Observatory

| Date | Q.H.M. | Correction to I.M.S. (gammas) | H at time of intercomparison (gauss) | Correction expressed as a decimal of H (gammas) |
|---|--------|-------------------------------------|--|---|
| March 1951 | 172 | -11.2 | 0.228 | -0.00049 H |
| " " | 173 | - 8.7 | 0.228 | -0.00038 H |
| " " | 174 | - 9.2 | 0.228 | -0.00040 H |
| " " | 177 | -11.9 | 0.228 | -0.00052 H |
| " " | 178 | - 9.4 | 0.228 | -0.00041 H |
| " " | 179 | - 8.2 | 0.228 | -0.00036 H |
| Nov. " | 187 | - 7.8 | 0.228 | -0.00034 H |
| " " | 188 | - 1.9 | 0.228 | -0.00008 H |
| " " | 189 | - 4.9 | 0.228 | -0.00021 H |
| Feby. 1952 | 172 | - 7.1 | 0.184 | -0.00039 H |
| " " | 173 | - 6.3 | 0.184 | -0.00034 H |
| " " | 174 | - 8.8 | 0.184 | -0.00048 H |
| April " | 177 | - 6.9 | 0.136 | -0.00051 H |
| " " | 178 | - 4.9 | 0.136 | -0.00036 H |
| " " | 179 | - 7.9 | 0.136 | -0.00059 H |
| (The April value for Q.H.M.179 was obtained by interpolation) | | | | |
| June " | 179 | -14.1 | 0.228 | -0.00062 H |
| " " | 189 | - 4.5 | 0.228 | -0.00020 H |

APPENDIX B.

Corrections to International Magnetic Standard determined for Q.H.Ms 172,173 & 174, Q.H.Ms 177,178 & 179 and Q.H.Ms 187,188 & 189. Determined at Toolangi Magnetic Observatory.

| Q.H.M. | Date | Correction to I.M.S. | Correction in gammas where H is 0.228 gauss |
|--------|------------|---------------------------|--|
| 172 | March 1951 | -0.00049 H | -11.2 |
| | Feby. 1952 | -0.00039 H | - 8.9 |
| 173 | March 1951 | -0.00038 H | - 8.7 |
| | Feby. 1952 | -0.00034 H | - 7.8 |
| 174 | March 1951 | -0.00040 H | - 9.2 |
| | Feby. 1952 | -0.00048 H | -11.0 |
| 177 | March 1951 | -0.00052 H | -11.9 |
| | April 1952 | -0.00051 H | -11.6 |
| 178 | March 1951 | -0.00041 H | - 9.4 |
| | April 1952 | -0.00036 H | - 8.2 |
| 179 | March 1951 | -0.00036 H | - 8.2 |
| | April 1952 | -0.00059 H (interpolated) | (-13.5) |
| | June 1952 | -0.00062 H | -14.1 |
| 187 | Nov. 1951 | -0.00034 H | - 7.8 |
| 188 | Nov. 1951 | -0.00008 H | - 1.9 |
| 189 | Nov. 1951 | -0.00021 H | - 4.9 |
| | June 1952 | -0.00020 H | - 4.5 |