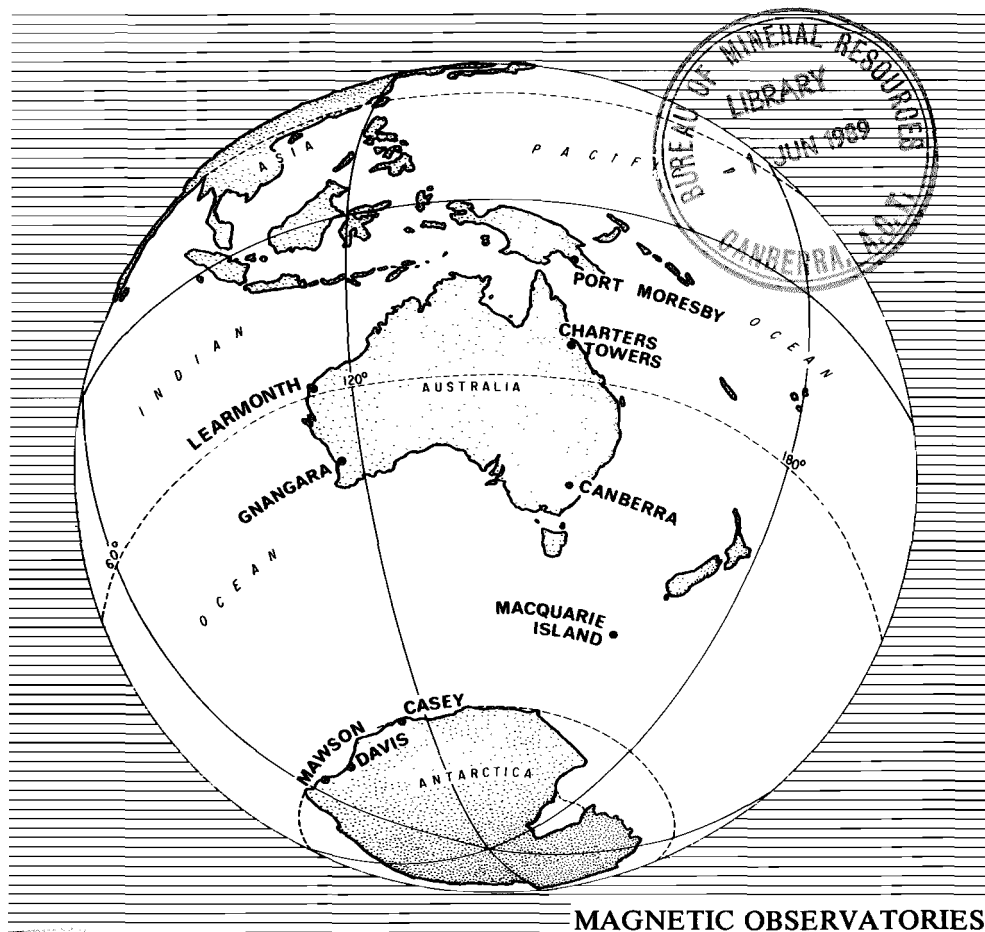


6-3



(NOTES ON THE
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GEOPHYSICAL
OBSERVATORY REPORT



MAGNETIC OBSERVATORIES

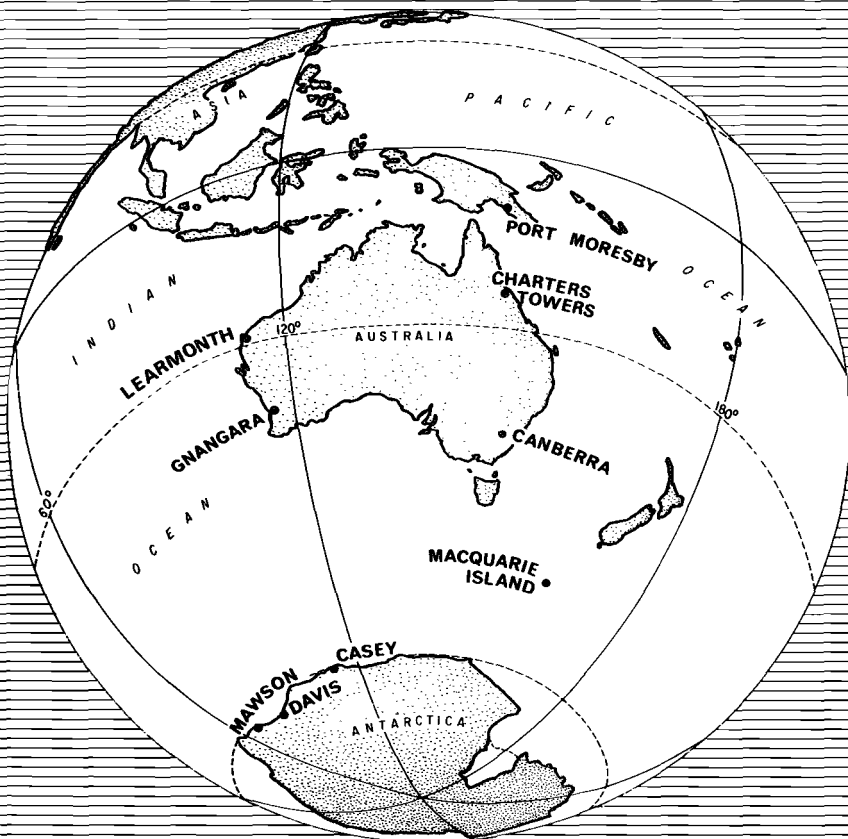
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VOLUME 36 No. 12
DECEMBER 1988

OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS



GEOPHYSICAL OBSERVATORY REPORT



MAGNETIC OBSERVATORIES

VOLUME 36 No. 12

DECEMBER 1988

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Resources:

Senator the Hon. Peter Cook

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**Published for the B.M.R.G. & G. by the
Australian Government Publishing Service**

ISSN 0433-5015

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CONTENTS

	Page
Contributing Observatories	4
K-Indices	5
Principal Magnetic Storms	9
Monthly Mean Values, Sudden Commencements and Other Rapid Variations	10
Summary of Monthly Mean Values 1988	11
Summary of all elements 1988	14

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The observers at Casey, Davis and Macquarie Island are officers of the Antarctic Division, The Department of the Arts, Sport, the Environment, Tourism and Territories. Their contributions are gratefully acknowledged. These observers and the Bureau of Mineral Resources' (BMR) geophysicist at Mawson are members of the Australian National Antarctic Research Expeditions (ANARE).

Data from the Port Moresby Geophysical Observatory are contributed by the Geological Survey of Papua New Guinea.

The terminology used in this report is that accepted by the International Association of Geomagnetism and Aeronomy (IAGA). The unit of field intensity is the nanoTesla (nT). All times are in Universal Time (UT).

# CONTRIBUTING OBSERVATORIES

| OBSERVATORY     | OBSERVER<br>IN CHARGE | GEOGRAPHIC |           | GEOMAGNETIC |        |
|-----------------|-----------------------|------------|-----------|-------------|--------|
|                 |                       | LAT.       | LONG.     | LAT.        | LONG.  |
| PORT MORESBY    | I.D.Ripper            | 9° 25'S    | 147° 09'E | -18.1°      | 219.8° |
| CHARTERS TOWERS | J.M.Millican          | 20° 05'S   | 146° 15'E | -28.7°      | 220.3° |
| LEARMONTH       | M.W.McMullan          | 22° 13'S   | 114° 06'E | -33.2°      | 185.5° |
| GNANGARA        | P.J.Gregson           | 31° 47'S   | 115° 57'E | -42.7°      | 188.0° |
| CANBERRA        | P.A.Hopgood           | 35° 19'S   | 149° 22'E | -43.3°      | 226.6° |
| MACQUARIE IS.   | M.J.Underwood         | 54° 30'S   | 158° 57'E | -60.4°      | 244.7° |
| MAWSON          | R. Hutchinson         | 67° 36'S   | 62° 53'E  | -73.2°      | 106.3° |
| DAVIS           | M. Craven             | 68° 35'S   | 77° 58'E  | -76.8°      | 124.0° |
| CASEY           | O. Holmwood           | 66° 17'S   | 110° 32'E | -77.3°      | 182.7° |

\* Geomagnetic co-ordinates based on the 1980 DGRF Geomagnetic North pole position of 78.8°N, 70.9°W

## MAGNETOGRAPHS

| OBSERVATORY     | CODE | MAKE (TYPE/RES.) | ELEMENT/SCALE-VALUE |     |     |
|-----------------|------|------------------|---------------------|-----|-----|
| PORT MORESBY    | PMG  | La Cour (A)      | H/3                 | D/5 | Z/4 |
| CHARTERS TOWERS | CTA  | EDA/Elsec (D/1)  | X                   | Y   | Z   |
| LEARMONTH       | LRM  | EDA/Elsec (D/1)  | X                   | Y   | Z   |
| GNANGARA        | GNA  | Eschenhagen (A)  | H/3                 | D/7 | Z/6 |
| CANBERRA        | CNB  | Elsec (D/.1)     | D                   | I   | F   |
| MACQUARIE IS.   | MCQ  | PEM (D/.1)       | X                   | Y   | Z   |
| MAWSON          | MAW  | PEM (D/.1)       | X                   | Y   | Z   |

A = analogue, 20mm/hr, scale values in nT/mm

D/1 = digital, 1 minute readings, 1 nT resolution

D/.1 = digital, 1 minute readings, 0.1 nT resolution

PEM = BMR Photo-electronic magnetograph

## MAGNETOMETERS

Absolute data are based on observations made with QHM's, BMZ's, fluxgate-theodolites, declinometers, proton vector magnetometers and proton precession magnetometers.

Errors in preliminary values obtained from magnetograms are not likely to exceed 5 nT or 0.5 minutes of arc.

PORT MORESBY

**MAGNETIC K-INDICES - DECEMBER 1988**

Range for lower limit of K=9 is 300nT

| DAY | K-INDICES |   |   |   |   |   |   |   | K-SUM |
|-----|-----------|---|---|---|---|---|---|---|-------|
| 01  | 0         | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 10    |
| 02  | 2         | 2 | 4 | 3 | 3 | 3 | 3 | 2 | 22    |
| 03  | 2         | 2 | 2 | 2 | 2 | 4 | 4 | 3 | 21    |
| 04  | 2         | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 19    |
| 05  | 1         | 1 | 2 | 0 | 1 | 2 | 1 | 1 | 09    |
| 06  | 1         | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08    |
| 07  | 1         | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 10    |
| 08  | 1         | 1 | 2 | 2 | 2 | 3 | 1 | 1 | 13    |
| 09  | 1         | 1 | 1 | 0 | 1 | 2 | 1 | 3 | 10    |
| 10  | 3         | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 20    |
| 11  | 3         | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 27    |
| 12  | 2         | 5 | 3 | 2 | 3 | 3 | 3 | 3 | 24    |
| 13  | 3         | 3 | 4 | 4 | 3 | 3 | 4 | 3 | 27    |
| 14  | 2         | 3 | 1 | 1 | 3 | 3 | 4 | 4 | 21    |
| 15  | 2         | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 13    |
| 16  | 2         | 2 | 2 | 3 | 4 | 5 | 3 | 3 | 24    |
| 17  | 3         | 3 | 3 | 5 | 4 | 2 | 5 | 6 | 31    |
| 18  | 5         | 4 | 3 | 3 | 4 | 3 | 2 | 3 | 27    |
| 19  | 3         | 5 | 3 | 3 | 3 | 4 | 3 | 2 | 26    |
| 20  | 2         | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 16    |
| 21  | 2         | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 19    |
| 22  | 3         | 3 | 4 | 3 | 2 | 4 | 2 | 3 | 24    |
| 23  | 1         | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 09    |
| 24  | 1         | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 10    |
| 25  | 2         | 1 | 2 | 5 | 5 | 3 | 4 | 3 | 25    |
| 26  | 3         | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 27    |
| 27  | 3         | 3 | 3 | 4 | 3 | 3 | 2 | 1 | 22    |
| 28  | 2         | 2 | 2 | 3 | 3 | 2 | 4 | 2 | 20    |
| 29  | 3         | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 21    |
| 30  | 2         | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 17    |
| 31  | 1         | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 21    |

Mean of K-Sum is 19.1

**Frequency of K-Indices**

|     |   |    |    |    |    |   |   |   |   |   |   |
|-----|---|----|----|----|----|---|---|---|---|---|---|
| K : | 0 | 1  | 2  | 3  | 4  | 5 | 6 | 7 | 8 | 9 | - |
| f : | 3 | 55 | 75 | 82 | 24 | 8 | 1 | 0 | 0 | 0 | 0 |

GNANGARA

**MAGNETIC K-INDICES - DECEMBER 1988**

Range for lower limit of K=9 is 450nT

| DAY | K-INDICES |   |   |   |   |   |   |   | K-SUM |
|-----|-----------|---|---|---|---|---|---|---|-------|
| 01  | 0         | 0 | 1 | 1 | 2 | 0 | 1 | 2 | 07    |
| 02  | 1         | 1 | 4 | 3 | 4 | 4 | 2 | 3 | 22    |
| 03  | 3         | 2 | 3 | 3 | 3 | 4 | 4 | 3 | 25    |
| 04  | 3         | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 17    |
| 05  | 1         | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 08    |
| 06  | 1         | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 05    |
| 07  | 1         | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 06    |
| 08  | 1         | 0 | 0 | 2 | 1 | 3 | 0 | 1 | 08    |
| 09  | 1         | 1 | 2 | 0 | 1 | 1 | 1 | 3 | 10    |
| 10  | 2         | 2 | 2 | 3 | 2 | 1 | 0 | 1 | 13    |
| 11  | 2         | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 26    |
| 12  | 4         | 5 | 2 | 2 | 2 | 3 | 2 | 2 | 22    |
| 13  | 2         | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 30    |
| 14  | 2         | 1 | 1 | 2 | 3 | 4 | 5 | 4 | 22    |
| 15  | 3         | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 16    |
| 16  | 2         | 2 | 2 | 4 | 5 | 5 | 5 | 4 | 29    |
| 17  | 3         | 3 | 3 | 4 | 5 | 2 | 5 | 6 | 31    |
| 18  | 4         | 3 | 3 | 4 | 4 | 3 | 3 | 4 | 28    |
| 19  | 4         | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 28    |
| 20  | 2         | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 16    |
| 21  | 2         | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 19    |
| 22  | 4         | 3 | 5 | 3 | 1 | 3 | 3 | 2 | 24    |
| 23  | 2         | 2 | 1 | 2 | 0 | 0 | 2 | 1 | 10    |
| 24  | 1         | 1 | 2 | 0 | 2 | 1 | 1 | 2 | 10    |
| 25  | 2         | 1 | 3 | 5 | 4 | 5 | 5 | 3 | 28    |
| 26  | 4         | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 30    |
| 27  | 3         | 3 | 3 | 4 | 3 | 3 | 2 | 2 | 23    |
| 28  | 3         | 2 | 3 | 4 | 3 | 3 | 4 | 3 | 25    |
| 29  | 3         | 3 | 3 | 3 | 4 | 2 | 2 | 2 | 22    |
| 30  | 2         | 2 | 1 | 3 | 3 | 2 | 3 | 2 | 18    |
| 31  | 1         | 2 | 4 | 2 | 3 | 3 | 3 | 3 | 21    |

**Mean of K-Sum is 19.3**

**Frequency of K-Indices**

|            |    |    |    |    |    |    |   |   |   |   |   |
|------------|----|----|----|----|----|----|---|---|---|---|---|
| <b>K :</b> | 0  | 1  | 2  | 3  | 4  | 5  | 6 | 7 | 8 | 9 | - |
| <b>f :</b> | 17 | 50 | 62 | 64 | 43 | 11 | 1 | 0 | 0 | 0 | 0 |

CANBERRA

**MAGNETIC K-INDICES - DECEMBER 1988**

Range for lower limit of K=9 is 450nT

| DAY | K-INDICES |   |   |   |   |   |   |   | K-SUM |
|-----|-----------|---|---|---|---|---|---|---|-------|
| 01  | 0         | 1 | 1 | 1 | 2 | 0 | 0 | 1 | 06    |
| 02  | 1         | 2 | 4 | 3 | 4 | 4 | 3 | 2 | 23    |
| 03  | 2         | 1 | 2 | 2 | 2 | 3 | 4 | 2 | 18    |
| 04  | 2         | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 15    |
| 05  | 0         | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 08    |
| 06  | 0         | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07    |
| 07  | 1         | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 06    |
| 08  | 1         | 1 | 0 | 1 | 1 | 3 | 1 | 1 | 09    |
| 09  | 1         | 1 | 1 | 0 | 1 | 1 | 0 | 2 | 07    |
| 10  | 2         | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 19    |
| 11  | 2         | 2 | 4 | 4 | 3 | 3 | 4 | 4 | 26    |
| 12  | 3         | 4 | 3 | 2 | 3 | 2 | 2 | 3 | 22    |
| 13  | 2         | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 25    |
| 14  | 1         | 0 | 1 | 1 | 3 | 3 | 4 | 3 | 16    |
| 15  | 3         | 3 | 3 | 0 | 1 | 2 | 0 | 0 | 12    |
| 16  | 2         | 2 | 2 | 3 | 4 | 5 | 4 | 4 | 26    |
| 17  | 2         | 4 | 4 | 5 | 4 | 1 | 6 | 7 | 33    |
| 18  | 4         | 3 | 3 | 4 | 4 | 3 | 3 | 3 | 27    |
| 19  | 3         | 5 | 3 | 2 | 2 | 4 | 3 | 2 | 24    |
| 20  | 1         | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 14    |
| 21  | 2         | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 18    |
| 22  | 3         | 3 | 5 | 3 | 1 | 3 | 2 | 2 | 22    |
| 23  | 0         | 0 | 2 | 1 | 0 | 0 | 2 | 0 | 05    |
| 24  | 1         | 2 | 2 | 0 | 2 | 1 | 1 | 2 | 11    |
| 25  | 2         | 2 | 2 | 5 | 4 | 4 | 3 | 3 | 25    |
| 26  | 4         | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 29    |
| 27  | 3         | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 25    |
| 28  | 2         | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 19    |
| 29  | 3         | 3 | 3 | 3 | 4 | 1 | 2 | 3 | 22    |
| 30  | 2         | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 15    |
| 31  | 1         | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 20    |

Mean of K-Sum is 17.9

**Frequency of K-Indices**

|     |    |    |    |    |    |   |   |   |   |   |   |
|-----|----|----|----|----|----|---|---|---|---|---|---|
| K : | 0  | 1  | 2  | 3  | 4  | 5 | 6 | 7 | 8 | 9 | - |
| f : | 22 | 54 | 66 | 66 | 33 | 5 | 1 | 1 | 0 | 0 | 0 |

MAWSON

**MAGNETIC K-INDICES - DECEMBER 1988**

Range for lower limit of K=9 is 1500nT

| DAY | K-INDICES |   |   |   |   |   |   |   | K-SUM |
|-----|-----------|---|---|---|---|---|---|---|-------|
| 01  | 4         | 3 | 3 | 3 | 4 | 1 | - | - | --    |
| 02  | -         | - | 5 | 4 | 5 | 4 | 3 | 4 | --    |
| 03  | 4         | 5 | 4 | 4 | 4 | 6 | 6 | 5 | 38    |
| 04  | 5         | 5 | 3 | 4 | 3 | 3 | 3 | 5 | 31    |
| 05  | 4         | 3 | 2 | 2 | 2 | 2 | 1 | 5 | 21    |
| 06  | 4         | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 22    |
| 07  | 3         | 2 | 3 | 1 | 2 | 3 | 1 | 4 | 19    |
| 08  | 4         | 4 | 3 | 2 | 3 | 3 | 2 | 5 | 26    |
| 09  | 3         | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 18    |
| 10  | 4         | 3 | 3 | 5 | 4 | 4 | 2 | 1 | 26    |
| 11  | 3         | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 31    |
| 12  | 4         | 6 | 5 | 4 | 4 | 3 | 4 | 4 | 34    |
| 13  | 4         | 5 | 5 | 4 | 5 | 4 | 6 | 4 | 37    |
| 14  | 4         | 4 | 4 | 3 | 5 | 5 | 5 | 5 | 35    |
| 15  | 5         | 6 | 6 | 2 | 3 | 3 | 2 | 2 | 29    |
| 16  | 4         | 5 | 4 | 5 | 6 | 7 | 5 | 5 | 41    |
| 17  | 4         | 5 | 6 | 7 | 6 | 2 | 6 | 6 | 42    |
| 18  | 5         | 6 | 5 | 5 | 6 | 4 | 4 | 6 | 41    |
| 19  | 5         | 5 | 5 | 4 | 5 | 5 | 6 | 3 | 38    |
| 20  | 4         | 4 | 5 | 3 | 1 | 3 | 4 | 3 | 27    |
| 21  | 3         | 6 | 6 | 5 | 4 | 2 | 3 | 3 | 32    |
| 22  | 6         | 6 | 5 | 4 | 3 | 3 | 5 | 3 | 35    |
| 23  | 4         | 4 | 3 | 2 | 2 | 0 | 1 | 4 | 20    |
| 24  | 4         | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 22    |
| 25  | 5         | 4 | 4 | 4 | 6 | 5 | 4 | 3 | 35    |
| 26  | 5         | 5 | 5 | 6 | 5 | 4 | 4 | 5 | 39    |
| 27  | 4         | 5 | 6 | 5 | 4 | 5 | 5 | 2 | 36    |
| 28  | 4         | 5 | 5 | 5 | 4 | 4 | 5 | 3 | 35    |
| 29  | 5         | 4 | 4 | 5 | 5 | 2 | 7 | 6 | 38    |
| 30  | 4         | 4 | 3 | 5 | 3 | 3 | 5 | 4 | 31    |
| 31  | 3         | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 33    |

Mean of K-Sum is 31.4

**Frequency of K-Indices**

|     |   |   |    |    |    |    |    |   |   |   |   |
|-----|---|---|----|----|----|----|----|---|---|---|---|
| K : | 0 | 1 | 2  | 3  | 4  | 5  | 6  | 7 | 8 | 9 | - |
| f : | 1 | 8 | 28 | 50 | 73 | 58 | 23 | 3 | 0 | 0 | 4 |

# PRINCIPAL MAGNETIC STORMS - DECEMBER 1988

| OBSERVATORY     | Commencement |      | SSC-amplitude |       |       | Max. 3hr K-index |   | Ranges |       |       | UT End |    |
|-----------------|--------------|------|---------------|-------|-------|------------------|---|--------|-------|-------|--------|----|
|                 | day hr min   | type | D(')          | H(nT) | Z(nT) | day (3hr-period) | K | D(')   | H(nT) | Z(nT) | day    | hr |
| Port Moresby    | 16 09 ..     | ..   | ..            | ..    | ..    | 17 (4)           | 5 | 9      | 140   | 70    | 17     | 17 |
|                 | 17 18 24     | SSC* | +0.3*         | +44   | +35   | 17 (8)           | 6 | 12     | 100   | 80    | 20     | 00 |
|                 | 25 07 ..     | ..   | ..            | ..    | ..    | 25 (4,5)         | 5 | 13     | 150   | 70    | 28     | 00 |
| Charters Towers | 17 18 24     | SSC* | +0.9*         | +33   | -5    | 17 (7,8)         | 6 | 16.1   | 113   | 41    | 18     | 08 |
|                 | 25 09 ..     | ..   | ..            | ..    | ..    | 25 (4)           | 6 | 15.5   | 117   | 47    | 27     | 21 |
| Gnangara        | 17 18 25     | SSC  | +5.4          | +59   | +35   | 17 (8)           | 6 | 28     | 120   | 150   | 18     | 19 |
|                 | 25 09 ..     | ..   | ..            | ..    | ..    | 25 (4,6,7)       | 5 | 21     | 110   | 140   | 27     | 19 |
| Canberra        | 17 18 23     | SSC* | +4.0*         | +46   | +8    | 17 (8)           | 7 | 29.8   | 266   | 81    | 18     | 09 |

DECEMBER 1988

PRELIMINARY MONTHLY MEAN VALUES

| OBSERVATORY     | H     | D   |         | Z      | F     |
|-----------------|-------|-----|---------|--------|-------|
|                 | nT    | deg | min     | nT     | nT    |
| PORT MORESBY    | 35923 | 06° | 36.0' E | -23724 | 43050 |
| CHARTERS TOWERS | 31760 | 07° | 46.8' E | -38268 | 49731 |
| LEARMONTH       | 29487 | 00° | 35.6' W | -44430 | 53324 |
| GNANGARA        | 23216 | 03° | 10.0' W | -53814 | 58608 |
| CANBERRA        | 23672 | 12° | 27.7' E | -53680 | 58668 |
| MACQUARIE IS.   | 12652 | 29° | 32.4' E | -63571 | 64818 |
| MAWSON          | 18457 | 64° | 05.4' W | -46122 | 49678 |
| DAVIS           | 16680 | 77° | 00.2' W | -52090 | 54695 |
| CASEY           | 9705  | 90° | 41.6' W | -63956 | 64688 |

The values are derived from magnetograms for selected quiet days except at Davis, Casey and Macquarie Is. where they are derived from semi-weekly absolute measurements

SUDDEN COMMENCEMENTS AND OTHER RAPID VARIATIONS

| OBSERVATORY     | DAY | TYPE AND<br>QUALITY | TIME | SENSE AND AMPLITUDE<br>OF CHIEF MOVEMENT |       |       |
|-----------------|-----|---------------------|------|------------------------------------------|-------|-------|
|                 |     |                     |      | H(nT)                                    | D(nT) | Z(nT) |
| PORT MORESBY    | 17  | ssc*B               | 1824 | +44                                      | +3*   | +35   |
|                 | 09  | sfe                 | 0315 | +6                                       | +4    | +8    |
|                 | 17  | sfe                 | 0345 | +4                                       | +3    | +4    |
| CHARTERS TOWERS | 17  | ssc*B               | 1824 | +33                                      | -8*   | -5    |
| GNANGARA        | 17  | ssc A               | 1825 | +59                                      | +37   | +35   |
| CANBERRA        | 17  | ssc*B               | 1823 | +46                                      | +28*  | +8    |

**Preliminary Monthly Mean Values for 1988**

| <b>PORT MORESBY<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|------------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                      | 35930             | 06 35.7              | -23720            | 43053             | -33 25.8             |
| February                     | 35930             | 06 35.3              | -23718            | 43052             | -33 25.7             |
| March                        | 35932             | 06 35.7              | -23716            | 43053             | -33 25.6             |
| April                        | 35925             | 06 36.0              | -23717            | 43048             | -33 26.0             |
| May                          | 35922             | 06 36.0              | -23719            | 43046             | -33 26.2             |
| June                         | 35929             | 06 36.2              | -23718            | 43052             | -33 25.9             |
| July                         | 35923             | 06 36.0              | -23720            | 43048             | -33 26.2             |
| August                       | 35911             | 06 36.3              | -23716            | 43035             | -33 26.5             |
| September                    | 35933             | 06 36.0              | -23719            | 43055             | -33 25.7             |
| October                      | 35931             | 06 35.8              | -23719            | 43054             | -33 25.8             |
| November                     | 35931             | 06 35.8              | -23723            | 43056             | -33 26.1             |
| December                     | 35923             | 06 36.0              | -23724            | 43050             | -33 26.5             |
| <b>Annual Means</b>          | <b>35927</b>      | <b>06 35.9</b>       | <b>-23719</b>     | <b>43050</b>      | <b>-33 26.0</b>      |

| <b>CHARTERS TOWERS<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|---------------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                         | 31769             | 07 45.7              | -38270            | 49738             | -50 18.2             |
| February                        | 31776             | 07 46.1              | -38271            | 49743             | -50 17.9             |
| March                           | 31770             | 07 46.2              | -38270            | 49738             | -50 18.1             |
| April                           | 31761             | 07 46.6              | -38270            | 49733             | -50 18.6             |
| May                             | 31758             | 07 46.7              | -38270            | 49731             | -50 18.8             |
| June                            | 31763             | 07 46.6              | -38268            | 49733             | -50 18.4             |
| July                            | 31760             | 07 46.4              | -38267            | 49730             | -50 18.6             |
| August                          | 31761             | 07 46.5              | -38266            | 49730             | -50 18.4             |
| September                       | 31763             | 07 46.4              | -38263            | 49729             | -50 18.2             |
| October                         | 31761             | 07 46.4              | -38264            | 49728             | -50 18.3             |
| November                        | 31766             | 07 46.5              | -38267            | 49733             | -50 18.2             |
| December                        | 31760             | 07 46.8              | -38268            | 49731             | -50 18.6             |
| <b>Annual Means</b>             | <b>31764</b>      | <b>07 46.4</b>       | <b>-38268</b>     | <b>49733</b>      | <b>-50 18.4</b>      |

| <b>LEARMONTH<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|---------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                   | 29492             | -00 37.5             | -44423            | 53321             | -56 25.2             |
| February                  | 29495             | -00 37.3             | -44421            | 53321             | -56 25.0             |
| March                     | 29481             | -00 37.0             | -44419            | 53312             | -56 25.7             |
| April                     | 29472             | -00 36.6             | -44424            | 53311             | -56 26.3             |
| May                       | 29472             | -00 36.6             | -44426            | 53313             | -56 26.4             |
| June                      | 29480             | -00 36.3             | -44424            | 53315             | -56 25.9             |
| July                      | 29479             | -00 35.9             | -44429            | 53319             | -56 26.2             |
| August                    | 29485             | -00 36.2             | -44434            | 53327             | -56 26.0             |
| September                 | 29488             | -00 35.9             | -44436            | 53330             | -56 25.9             |
| October                   | 29484             | -00 36.2             | -44436            | 53328             | -56 26.1             |
| November                  | 29488             | -00 35.9             | -44430            | 53325             | -56 25.7             |
| December                  | 29487             | -00 35.6             | -44430            | 53324             | -56 25.8             |
| <b>Annual Means</b>       | <b>29484</b>      | <b>00 36.4</b>       | <b>-44428</b>     | <b>53320</b>      | <b>-56 25.8</b>      |

**Preliminary Monthly Mean Values for 1988**

| <b>GNANGARA<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|--------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                  | 23223             | -03 12.5             | -53812            | 58609             | -66 39.4             |
| February                 | 23222             | -03 11.8             | -53810            | 58607             | -66 39.4             |
| March                    | 23218             | -03 11.6             | -53810            | 58605             | -66 39.6             |
| April                    | 23206             | -03 11.4             | -53811            | 58602             | -66 40.3             |
| May                      | 23209             | -03 11.2             | -53816            | 58607             | -66 40.3             |
| June                     | 23216             | -03 11.1             | -53810            | 58605             | -66 39.8             |
| July                     | 23212             | -03 11.0             | -53812            | 58605             | -66 40.0             |
| August                   | 23209             | -03 10.9             | -53812            | 58604             | -66 40.2             |
| September                | 23207             | -03 10.6             | -53806            | 58597             | -66 40.1             |
| October                  | 23211             | -03 10.3             | -53806            | 58599             | -66 39.9             |
| November                 | 23220             | -03 10.4             | -53810            | 58606             | -66 39.5             |
| December                 | 23216             | -03 10.0             | -53814            | 58608             | -66 39.8             |
| <b>Annual Means</b>      | <b>23214</b>      | <b>-03 11.7</b>      | <b>-53811</b>     | <b>58604</b>      | <b>-66 39.9</b>      |

| <b>CANBERRA<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|--------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                  | 23683             | 12 26.5              | -53693            | 58685             | -66 11.9             |
| February                 | 23686             | 12 26.6              | -53691            | 58684             | -66 11.7             |
| March                    | 23677             | 12 26.8              | -53689            | 58677             | -66 12.2             |
| April                    | 23669             | 12 27.3              | -53690            | 58675             | -66 12.6             |
| May                      | 23671             | 12 27.2              | -53692            | 58678             | -66 12.6             |
| June                     | 23677             | 12 27.4              | -53688            | 58677             | -66 12.1             |
| July                     | 23671             | 12 27.4              | -53688            | 58675             | -66 12.4             |
| August                   | 23671             | 12 27.8              | -53687            | 58673             | -66 12.4             |
| September                | 23673             | 12 27.7              | -53683            | 58671             | -66 12.2             |
| October                  | 23669             | 12 27.6              | -53684            | 58670             | -66 12.4             |
| November                 | 23677             | 12 27.9              | -53680            | 58670             | -66 11.9             |
| December                 | 23672             | 12 27.7              | -53680            | 58668             | -66 12.2             |
| <b>Annual Means</b>      | <b>23675</b>      | <b>12 27.3</b>       | <b>-53687</b>     | <b>58675</b>      | <b>-66 12.2</b>      |

| <b>MACQUARIE IS.<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|-------------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                       | 12592             | 29 19.2              | -63553            | 64789             | -78 47.6             |
| February                      | -----             | -- -----             | -----             | -----             | --- -----            |
| March                         | 12549             | 29 25.0              | -63555            | 64782             | -78 49.2             |
| April                         | 12816             | 29 33.4              | -63553            | 64832             | -78 35.9             |
| May                           | 12562             | 29 31.9              | -63563            | 64793             | -78 49.3             |
| June                          | 12572             | 29 33.7              | -63558            | 64790             | -78 48.7             |
| July                          | 12574             | 29 34.7              | -63562            | 64794             | -78 48.6             |
| August                        | 12597             | 29 36.3              | -63563            | 64799             | -78 47.4             |
| September                     | 12607             | 29 39.3              | -63560            | 64798             | -78 46.9             |
| October                       | 12579             | 29 36.6              | -63559            | 64792             | -78 48.3             |
| November                      | -----             | -- -----             | -----             | -----             | --- -----            |
| December                      | 12652             | 29 32.4              | -63571            | 64818             | -78 44.6             |
| <b>Annual Means</b>           | <b>12610</b>      | <b>29 32.2</b>       | <b>-63560</b>     | <b>64799</b>      | <b>-78 46.7</b>      |

**Preliminary Monthly Mean Values for 1988**

| <b>MAWSON<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|------------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January                | 18486             | -63 59.5             | -46166            | 49730             | -68 10.7             |
| February               | 18483             | -64 01.9             | -46158            | 49721             | -68 10.6             |
| March                  | 18471             | -64 02.7             | -46155            | 49714             | -68 11.3             |
| April                  | 18475             | -64 03.3             | -46158            | 49718             | -68 11.1             |
| May                    | 18476             | -64 03.9             | -46151            | 49712             | -68 10.9             |
| June                   | 18479             | -64 04.2             | -46136            | 49699             | -68 10.3             |
| July                   | 18470             | -64 05.3             | -46137            | 49697             | -68 10.9             |
| August                 | 18471             | -64 06.3             | -46133            | 49693             | -68 10.8             |
| September              | 18473             | -64 07.5             | -46131            | 49692             | -68 10.6             |
| October                | 18476             | -64 06.7             | -46136            | 49698             | -68 10.5             |
| November               | 18483             | -64 05.7             | -46121            | 49687             | -68 09.7             |
| December               | 18457             | -64 05.4             | -46122            | 49678             | -68 11.4             |
| <b>Annual Means</b>    | <b>18475</b>      | <b>-64 04.4</b>      | <b>-46142</b>     | <b>49703</b>      | <b>-68 10.7</b>      |

| <b>DAVIS<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|-----------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January               | 16660             | -77 06.9             | -52176            | 54771             | -72 17.5             |
| February              | 16697             | -76 53.6             | -52174            | 54781             | -72 15.2             |
| March                 | 16665             | -77 01.9             | -52148            | 54746             | -72 16.7             |
| April                 | 16663             | -77 02.9             | -52156            | 54753             | -72 16.9             |
| May                   | 16655             | -77 04.4             | -52136            | 54731             | -72 17.0             |
| June                  | 16637             | -77 07.1             | -52087            | 54680             | -72 17.2             |
| July                  | 16643             | -77 06.5             | -52100            | 54694             | -72 17.1             |
| August                | 16685             | -77 03.5             | -52127            | 54732             | -72 15.1             |
| September             | 16663             | -77 03.6             | -52107            | 54706             | -72 16.0             |
| October               | 16685             | -77 03.5             | -52127            | 54732             | -72 15.1             |
| November              | 16719             | -76 57.9             | -52103            | 54720             | -72 12.6             |
| December              | 16680             | -77 00.2             | -52090            | 54695             | -72 14.6             |
| <b>Annual Means</b>   | <b>16671</b>      | <b>-77 02.7</b>      | <b>-52128</b>     | <b>54728</b>      | <b>-72 15.9</b>      |

| <b>CASEY<br/>1988</b> | <b>H<br/>(nT)</b> | <b>D<br/>deg min</b> | <b>Z<br/>(nT)</b> | <b>F<br/>(nT)</b> | <b>I<br/>deg min</b> |
|-----------------------|-------------------|----------------------|-------------------|-------------------|----------------------|
| January               | 9689              | -91 21.7             | -64112            | 64840             | -81 24.4             |
| February              | 9596              | -91 25.6             | -64393            | 65104             | -81 31.4             |
| March                 | 9594              | -91 22.6             | -64468            | 65178             | -81 32.1             |
| April                 | 9557              | -91 50.1             | -64071            | 64780             | -81 31.0             |
| May                   | 9593              | -91 28.0             | -64102            | 64816             | -81 29.3             |
| June                  | 9595              | -91 35.3             | -64014            | 64729             | -81 28.5             |
| July                  | 9595              | -91 43.9             | -63995            | 64710             | -81 28.4             |
| August                | 9638              | -91 28.9             | -63937            | 64659             | -81 25.6             |
| September             | 9617              | -91 18.4             | -64001            | 64720             | -81 27.2             |
| October               | 9603              | -91 35.5             | -63985            | 64702             | -81 27.9             |
| November              | 9775              | -91 48.9             | -63997            | 64739             | -81 18.9             |
| December              | 9705              | -91 41.6             | -63956            | 64688             | -81 22.3             |
| <b>Annual Means</b>   | <b>9630</b>       | <b>-91 28.4</b>      | <b>-64086</b>     | <b>64805</b>      | <b>-81 27.2</b>      |

**Preliminary Annual Mean Values of the Magnetic Elements 1988**

| OBSERVATORY        | D<br>deg min | I<br>deg min | H<br>(nT) | X<br>(nT) | Y<br>(nT) | Z<br>(nT) | F<br>(nT) |
|--------------------|--------------|--------------|-----------|-----------|-----------|-----------|-----------|
| Port Moresby #     | 06 35.9 E    | -33 26.0     | 35927     | 35689     | 4128      | -23719    | 43050     |
| Charters Towers    | 07 46.4 E    | -50 18.4     | 31764     | 31472     | 4296      | -38268    | 49733     |
| Learmonth          | 00 36.4 W    | -56 25.8     | 29484     | 29482     | -312      | -44428    | 53320     |
| Gnangara           | 03 11.7 W    | -66 39.9     | 23214     | 23178     | -1294     | -53811    | 58604     |
| Canberra           | 12 27.3 E    | -66 12.2     | 23675     | 23117     | 5106      | -53687    | 58675     |
| Macquarie Island * | 29 32.2 E    | -78 46.7     | 12610     | 10971     | 6217      | -63560    | 64799     |
| Mawson             | 64 04.4 W    | -68 10.7     | 18475     | 8078      | -16616    | -46142    | 49703     |
| Davis *            | 77 02.7 W    | -72 15.9     | 16671     | 4142      | -16247    | -52128    | 54728     |
| Casey *            | 91 28.4 W    | -81 27.2     | 9630      | -248      | -9627     | -64086    | 64805     |

# Port Moresby results were provided by the PNG Geological Survey

\* The Annual means for Casey, Davis and Macquarie Island were obtained graphically from the periodic absolute observations.

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# Preliminary Annual Mean Values of the Magnetic Elements 1988

| OBSERVATORY        | D<br>deg min | I<br>deg min | H<br>(nT) | X<br>(nT) | Y<br>(nT) | Z<br>(nT) | F<br>(nT) |
|--------------------|--------------|--------------|-----------|-----------|-----------|-----------|-----------|
| Port Moresby #     | 06 35.9 E    | -33 26.0     | 35927     | 35689     | 4128      | -23719    | 43050     |
| Charters Towers    | 07 46.4 E    | -50 18.4     | 31764     | 31472     | 4296      | -38268    | 49733     |
| Learmonth          | 00 36.4 W    | -56 25.8     | 29484     | 29482     | -312      | -44428    | 53320     |
| Gnangara           | 03 11.7 W    | -66 39.9     | 23214     | 23178     | -1294     | -53811    | 58604     |
| Canberra           | 12 27.3 E    | -66 12.2     | 23675     | 23117     | 5106      | -53687    | 58675     |
| Macquarie Island * | 29 32.2 E    | -78 46.7     | 12610     | 10971     | 6217      | -63560    | 64799     |
| Mawson             | 64 04.4 W    | -68 10.7     | 18475     | 8078      | -16616    | -46142    | 49703     |
| Davis *            | 77 02.7 W    | -72 15.9     | 16671     | 4142      | -16247    | -52128    | 54728     |
| Casey *            | 91 28.4 W    | -81 27.2     | 9630      | -248      | -9627     | -64086    | 64805     |

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\* The Annual means for Casey, Davis and Macquarie Island were obtained graphically from the periodic absolute observations.

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