

(200)

R290

no 81-261



Earthquake Prediction Research in Taiwan

Charles G. Sammis
Tien C. Lee

University of Southern California
University Park
Los Angeles 90007

USGS CONTRACT NO. 14-08-0001-16895
Supported by the EARTHQUAKE HAZARDS REDUCTION PROGRAM

OPEN-FILE NO. 81-261



U.S. Geological Survey
OPEN FILE REPORT

This report was prepared under contract to the U.S. Geological Survey, and has not been reviewed for conformity with USGS editorial standards and stratigraphic nomenclature. Opinions and conclusions expressed herein do not necessarily represent those of the USGS. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

Introduction

This report summarizes work under U.S.G.S. Contract #14-08-0001-16895. The purpose of this contract was to provide equipment to Taiwan to assist that country in establishing a program in earthquake prediction and hazards studies. Also, expert assistance was provided for Taiwan's establishment of a routine field program using the equipment.

In carrying out this objective, the following equipment was provided:

1. Two proton precession magnetometers
2. Two LaCoste-Romberg gravimeters
3. One H-P 3808 laser geodimeter
4. Three Kinometrics PDR-2 field digital event recorders
5. One groundwater radon measuring system

The equipment has been set up in Taiwan under the direction of Dr. Ben Tsai, Director of the Taiwan Earthquake Institute.

Results

Early data analysis is summarized in the following tables and figures. Table 1 lists the field magnetic stations. Figure 1 is a map showing the locations of the magnetic stations and early data analysis. Each graph indicates the difference between that station and the reference datum (LP-TW). No anomalies have been observed in the one year of data taken thus far.

Figures 2-13 are the raw magnetic data for the months of June 1979-May 1980. Figures 14-24 are the averaged data for each hour of the day for all days of the month for the difference reading LP-TW for the months June 1979 - April 1980. Figures 14a-24a are the averaged readings eliminating all readings greater than 1 standard deviation.

Figure 25 is a map showing springs being monitored for radon anomalies. Table 2 is early data from these sites.

| Station Name | | Code | MAGNETIC STATIONS | |
|--------------|-----|------|-------------------|----------|
| | | | Lat. | Long. |
| 站 | 名 | 編 號 | 緯 度 | 經 度 |
| 崙 | 坪 | LP | 25-00.0 | 121-10.0 |
| 竹 | 東 | G01 | 24-39.0 | 121-05.0 |
| 東 | 勢 | G02 | 24-16.6 | 120-51.7 |
| 達 | 見 | G03 | 24-15.4 | 121-10.0 |
| 埔 | 里 | G04 | 23-49.8 | 120-52.9 |
| 台 | 西 | G05 | 23-40.9 | 120-09.9 |
| 梅 | 山 | G06 | 23-34.0 | 120-35.2 |
| 曾 | 文 | G07 | 23-15.5 | 120-31.0 |
| 密 | 枝 | G08 | 23-12.1 | 120-30.5 |
| 灣 | 丘 | TW | 23-11.3 | 120-31.4 |
| 龜 | 丹 | G09 | 23-07.9 | 120-30.8 |
| 曾 | 文溪口 | G10 | 23-05.0 | 120-01.8 |
| 旗 | 山 | G11 | 22-51.0 | 120-26.7 |
| 枋 | 寮 | G12 | 22-22.1 | 120-37.0 |
| 恒 | 春 | G13 | 21-56.6 | 120-48.3 |
| 大 | 武 | G14 | 22-14.5 | 120-50.9 |
| 台 | 東 | G15 | 22-48.7 | 121-03.7 |
| 玉 | 里 | G16 | 23-21.2 | 121-17.8 |
| 花 | 蓮 | G17 | 24-04.4 | 121-36.2 |
| 天 | 祥 | G18 | 24-12.5 | 121-28.5 |
| 蘇 | 澳 | G19 | 24-36.6 | 121-51.4 |
| 內 | 城 | G20 | 24-43.5 | 121-40.5 |
| 宜 | 蘭 | G21 | 24-46.6 | 121-48.5 |
| 頭 | 城 | G22 | 24-52.2 | 121-48.1 |

LP、Continuous Recording Stations

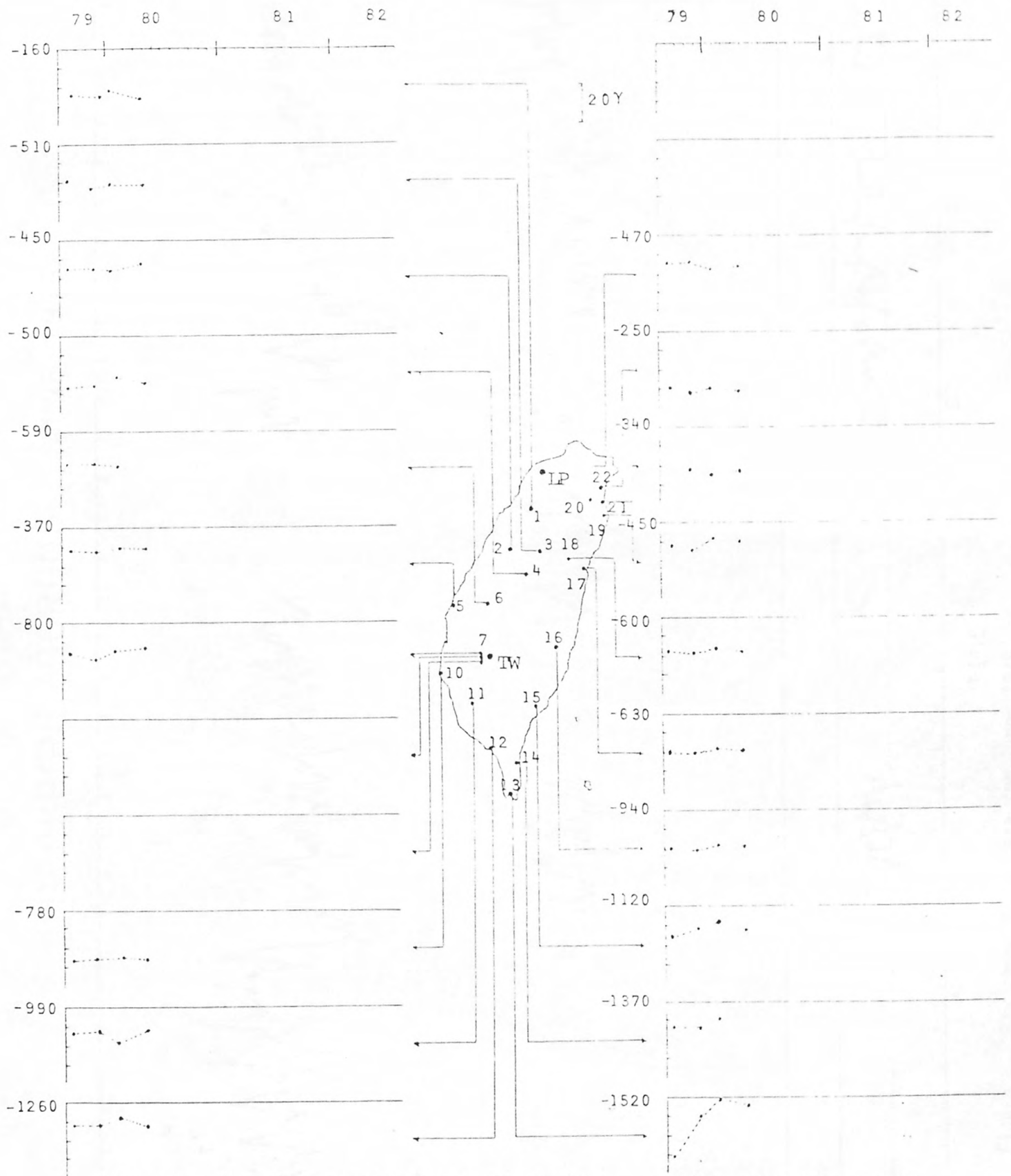


Figure 1. Map of geomagnetic stations in Taiwan; results of early magnetic data readings (scale on y-axis is difference between that station and LP-TW datum).

GEOMAGNETOGRAMS

JUNE 1979

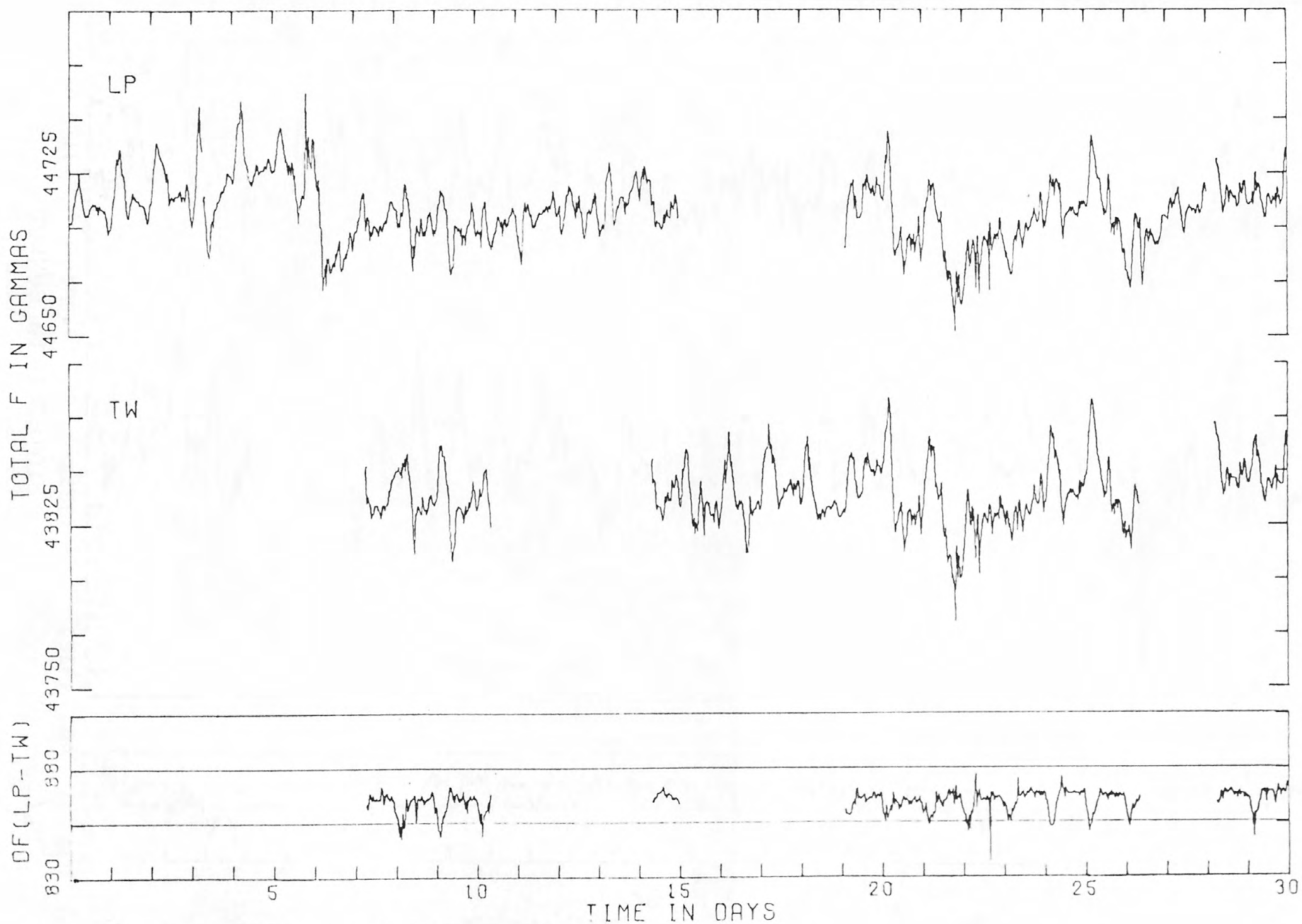


Figure 2. Raw geomagnetic data for June, 1979.

GEOMAGNETOGRAMS

JULY 1979

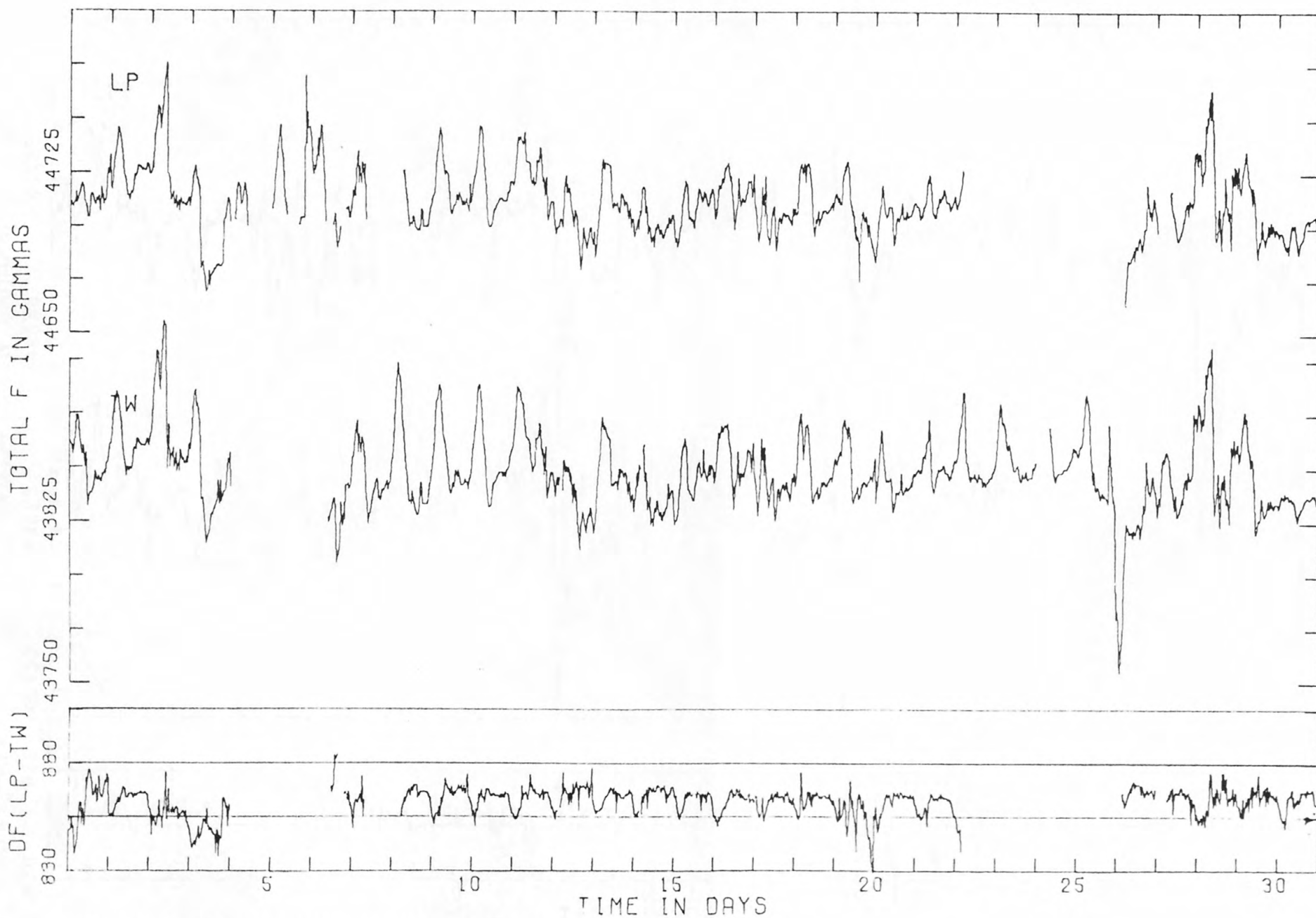


Figure 3. Raw geomagnetic data for July, 1979.

GEOMAGNETOGRAMS

AUG. 1979

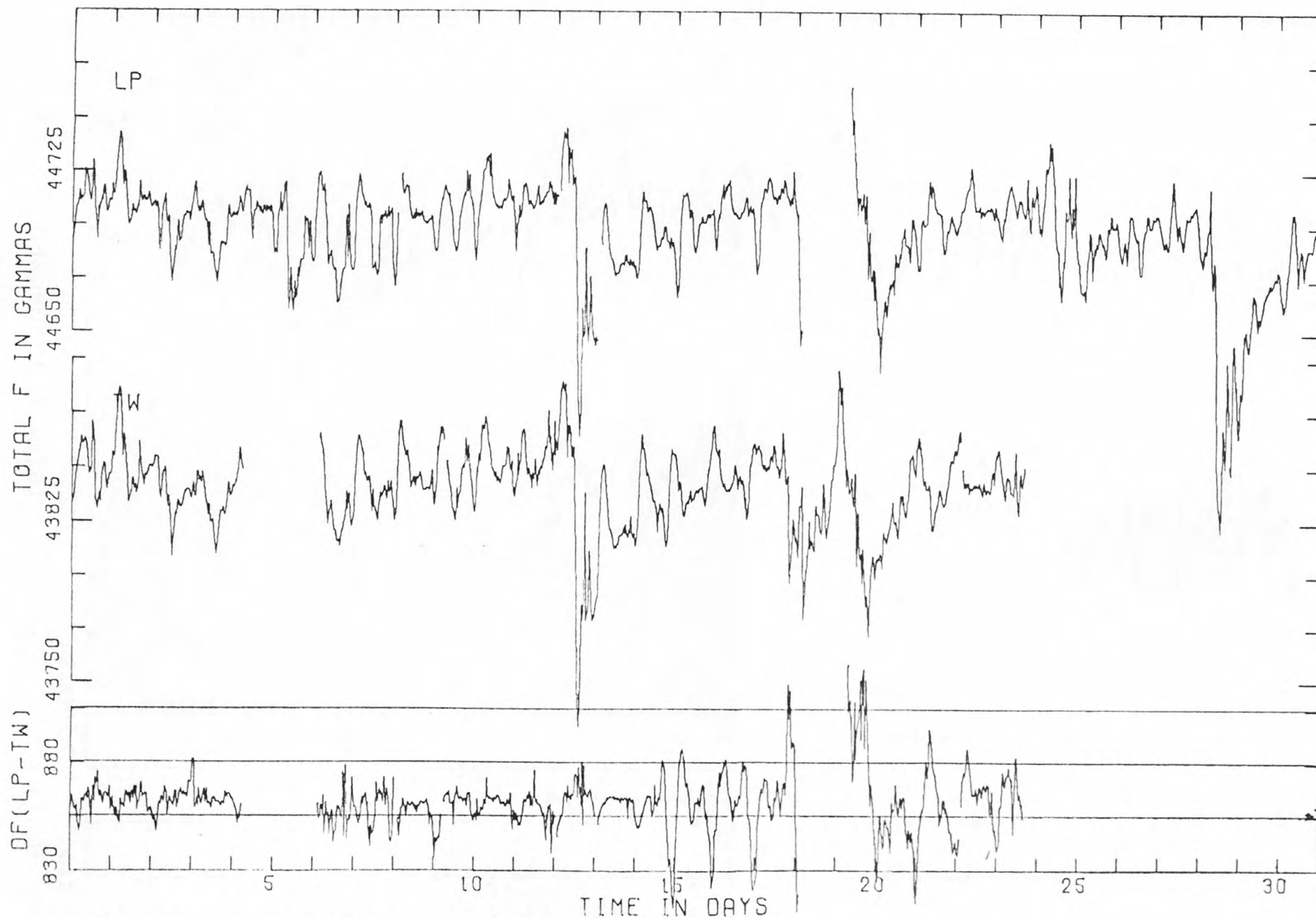


Figure 4. Raw geomagnetic data for August, 1979.

GEOMAGNETOGRAMS

SEPT 1979

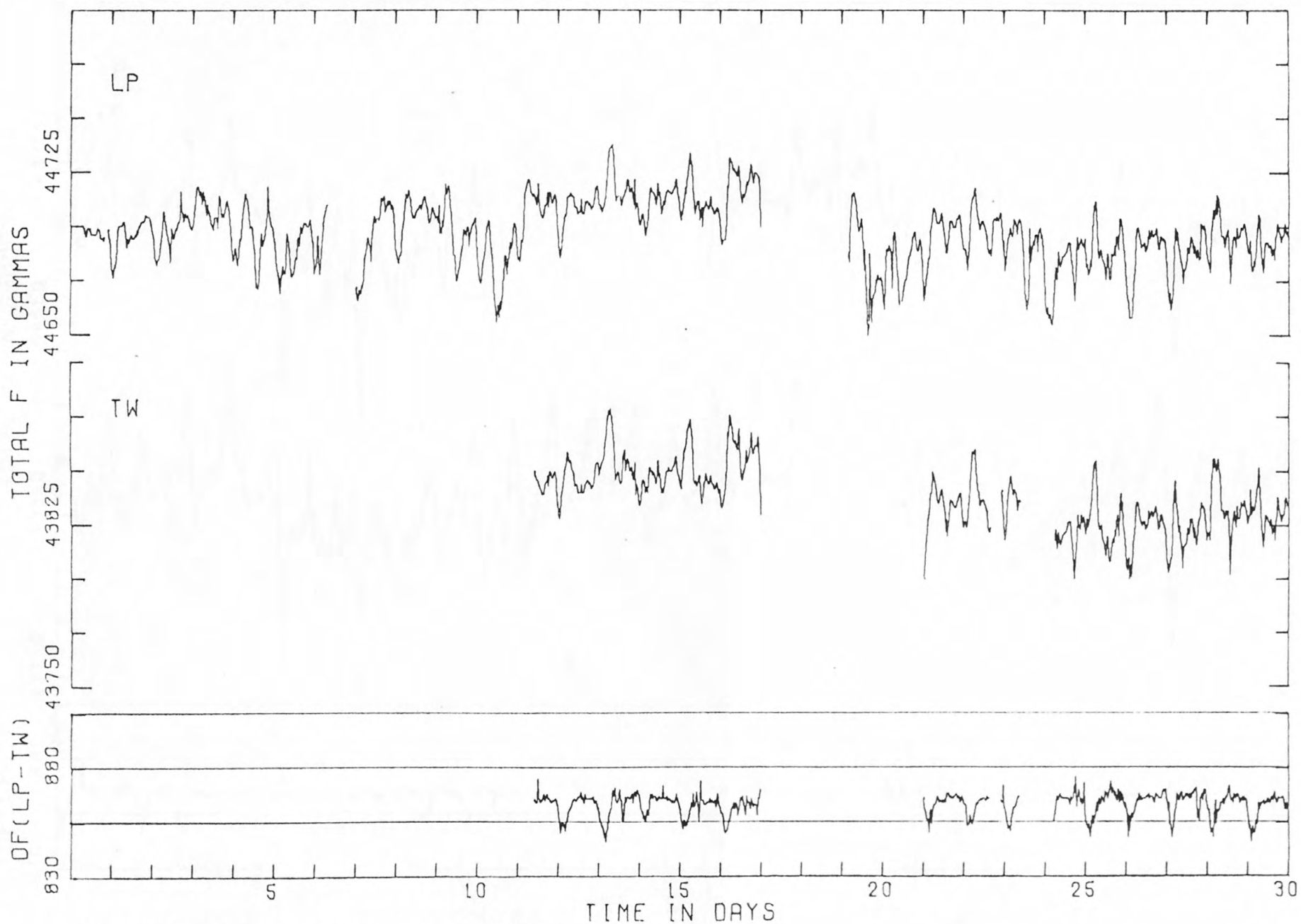


Figure 5. Raw geomagnetic data for September, 1979.

GEOMAGNETOGRAMS

OCT. 1979

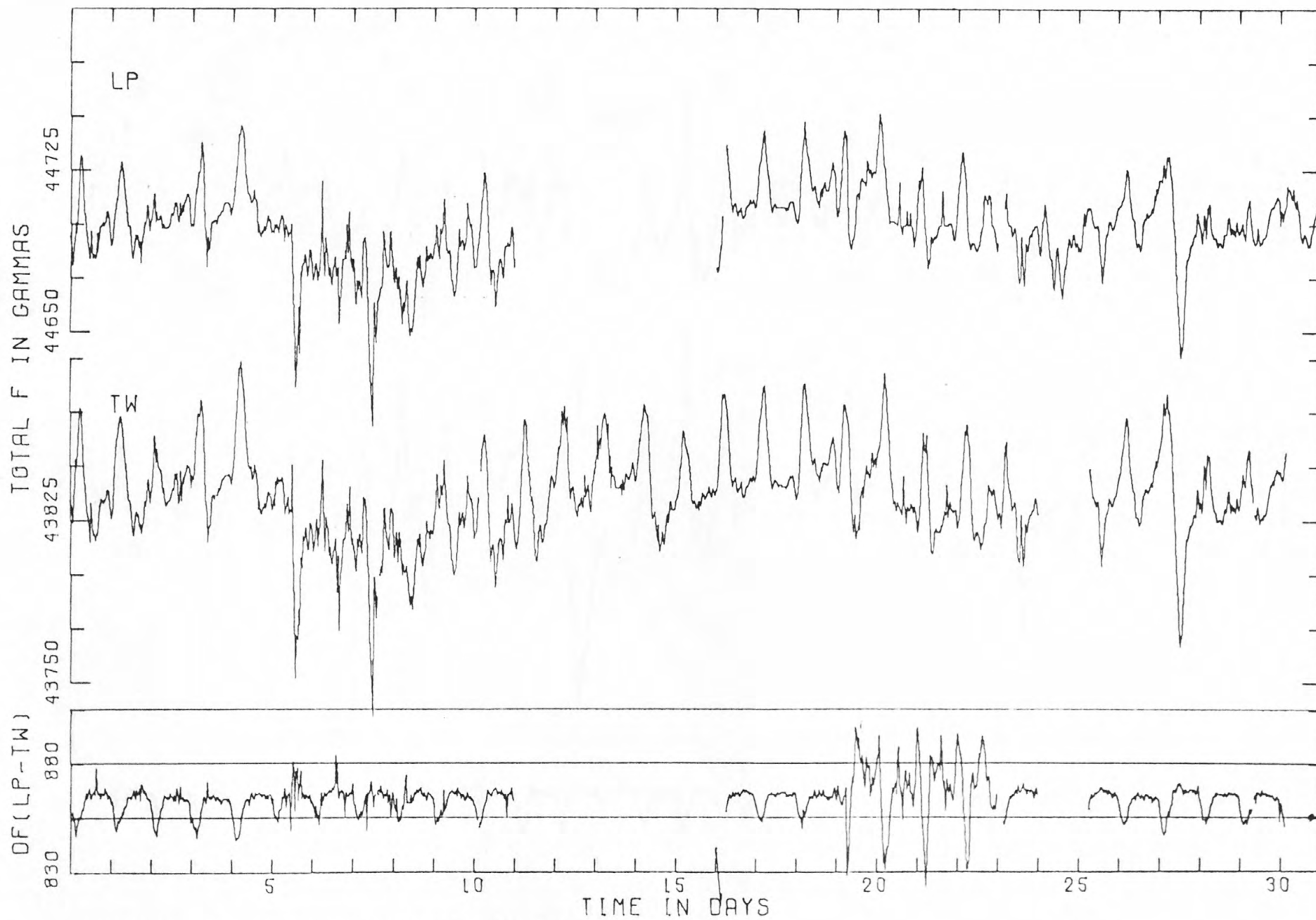


Figure 6. Raw geomagnetic data for October, 1979.

GEOMAGNETOGRAMS

NOV. 1979

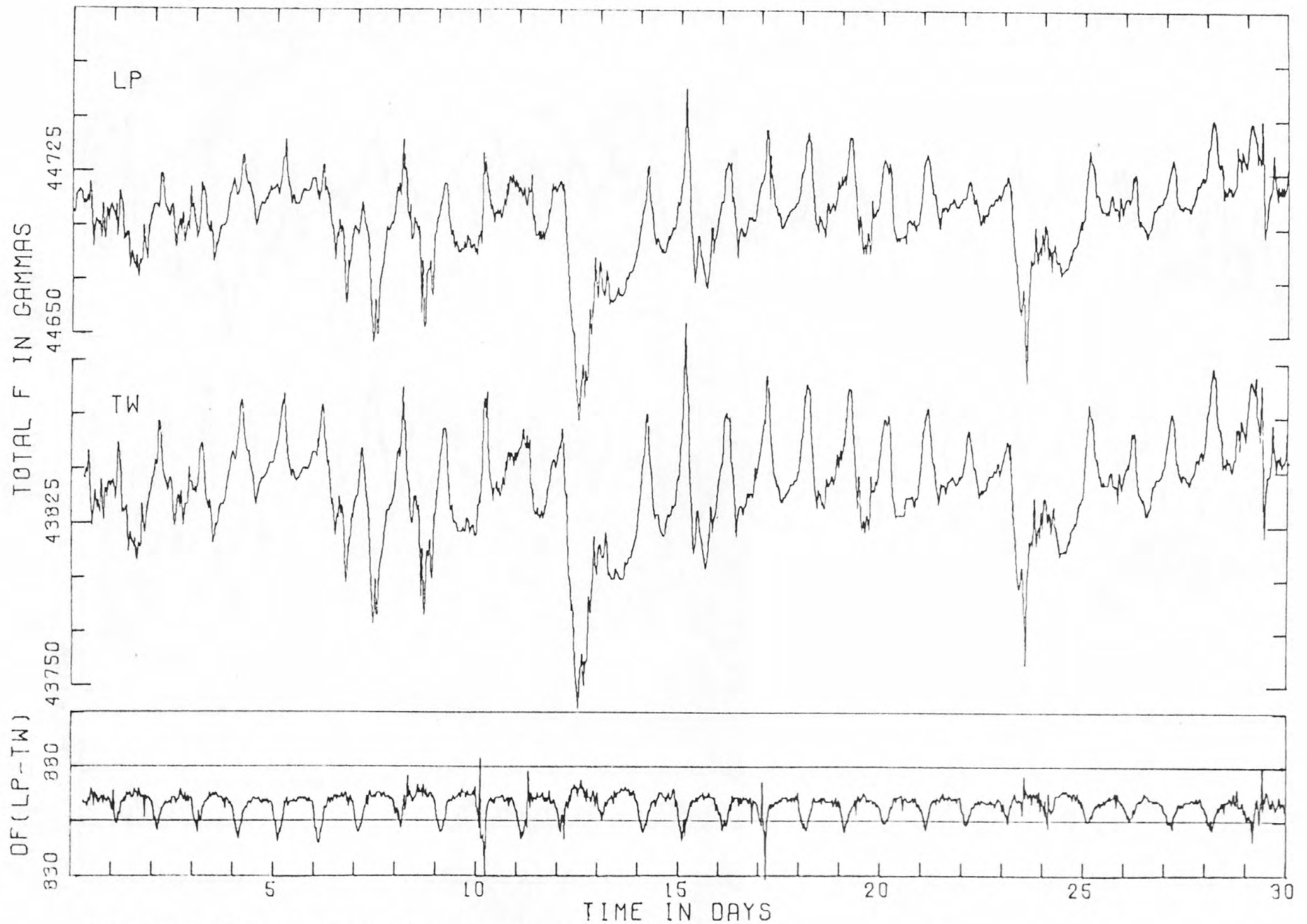


Figure 7. Raw geomagnetic data for November, 1979.

GEOMAGNETOGRAMS

DEC. 1979

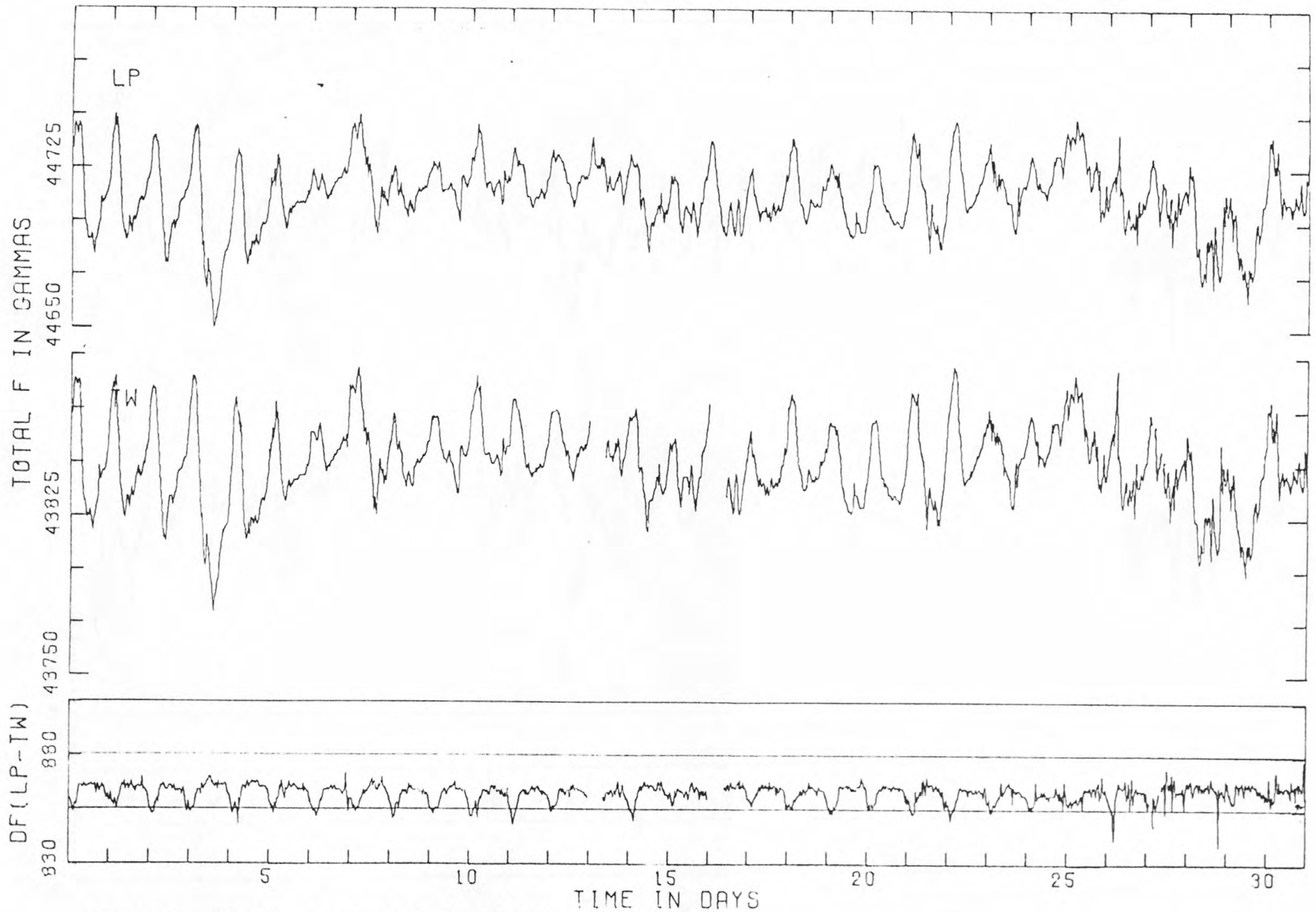


Figure 8. Raw geomagnetic data for December, 1979.

GEOMAGNETOGRAMS

JAN. 1980

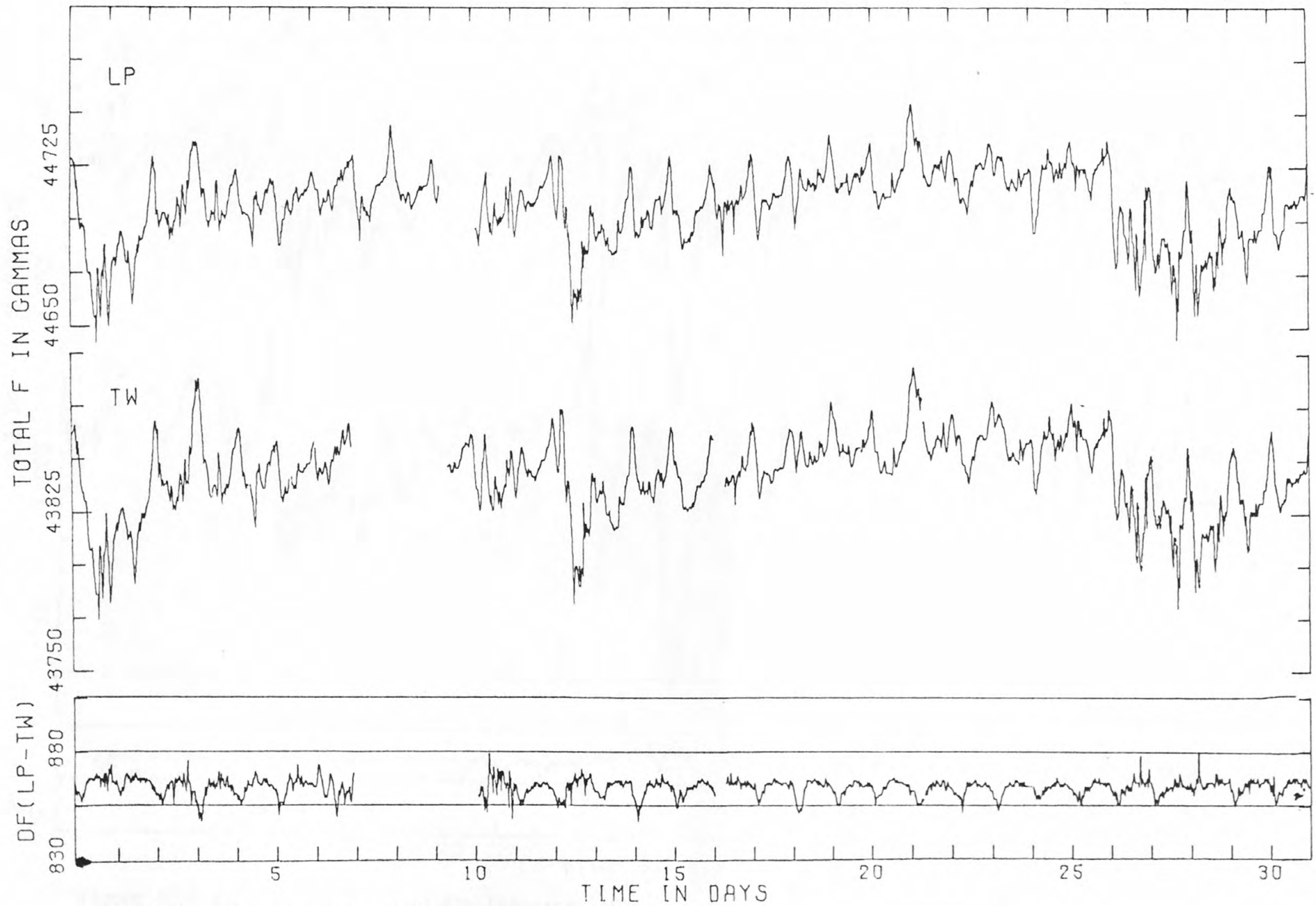


Figure 9. Raw geomagnetic data for January, 1980.

GEOMAGNETOGRAMS FEB. 1980

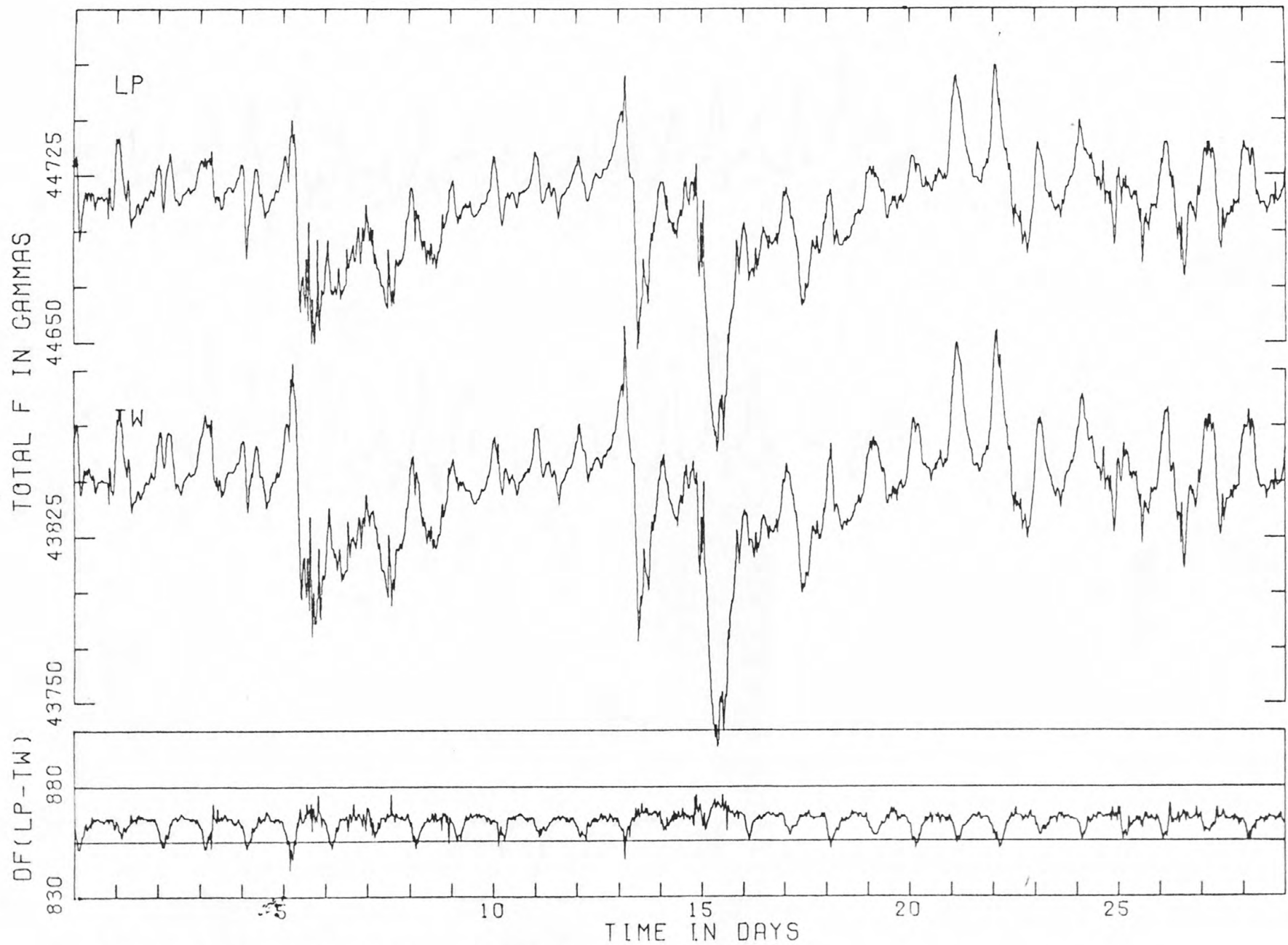


Figure 10. Raw geomagnetic data for February, 1980.

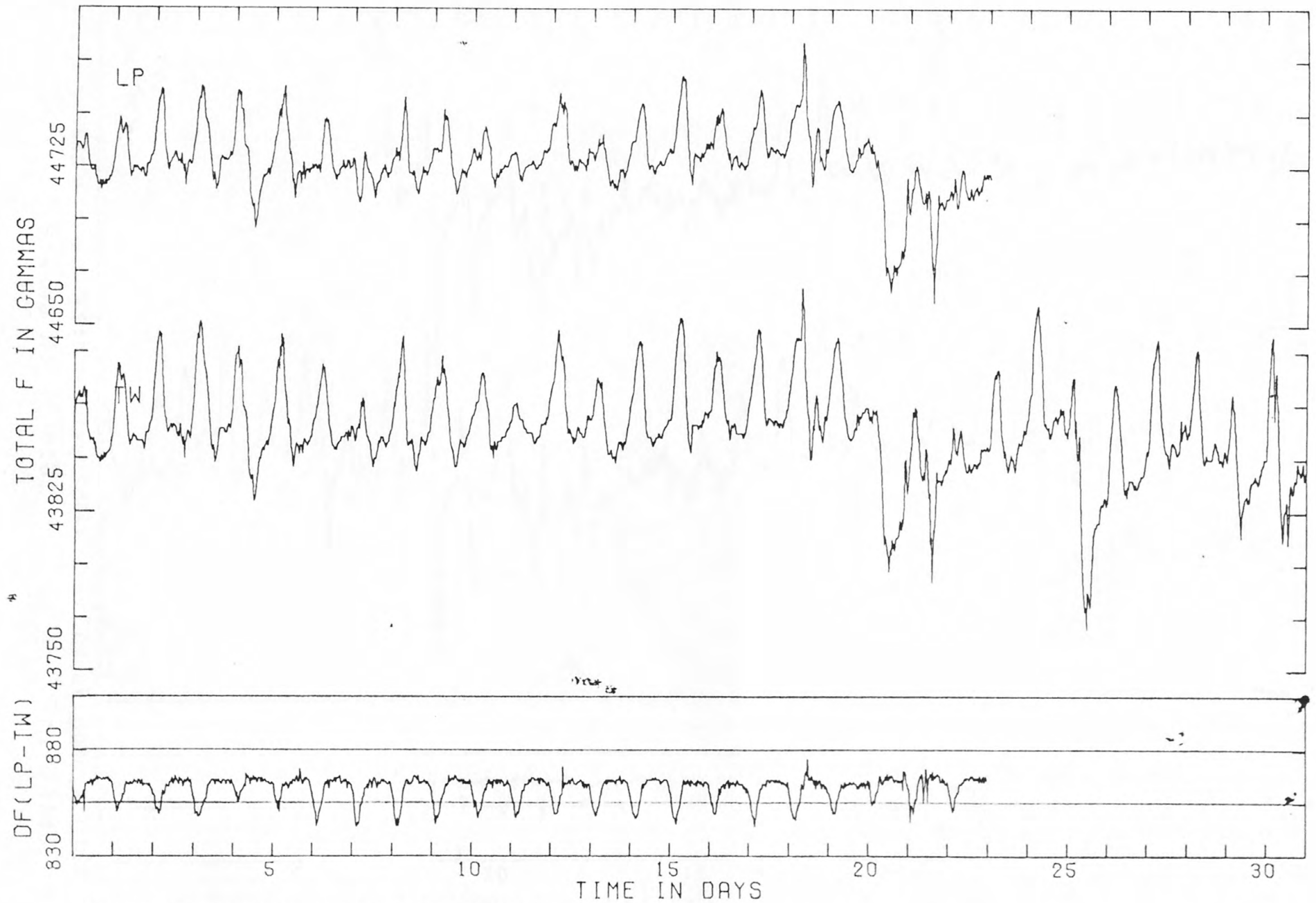


Figure 11. Raw geomagnetic data for March, 1980.

G·E·O·M·A·G·N·E·T·O·G·R·A·M·S

APRIL 1980

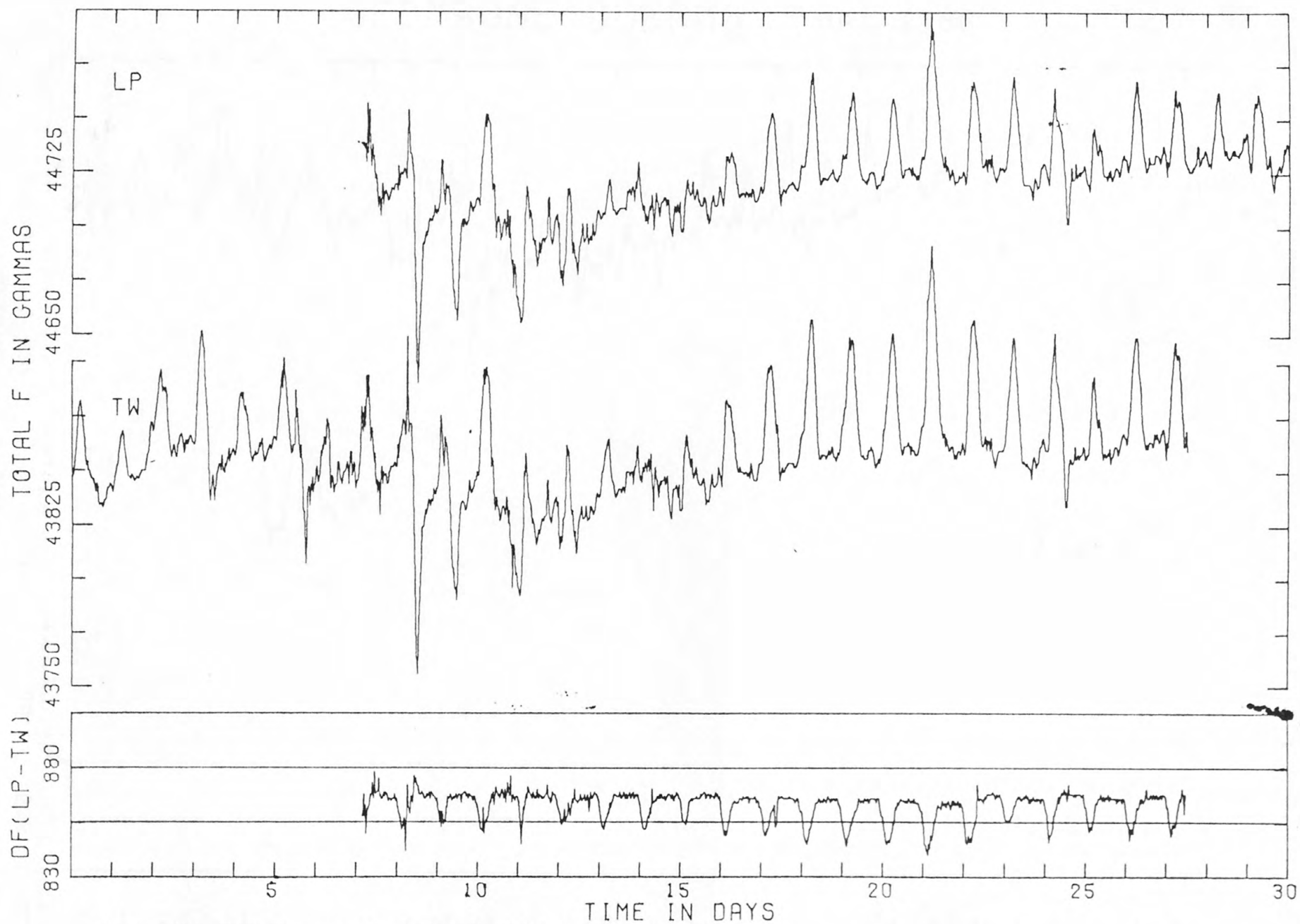
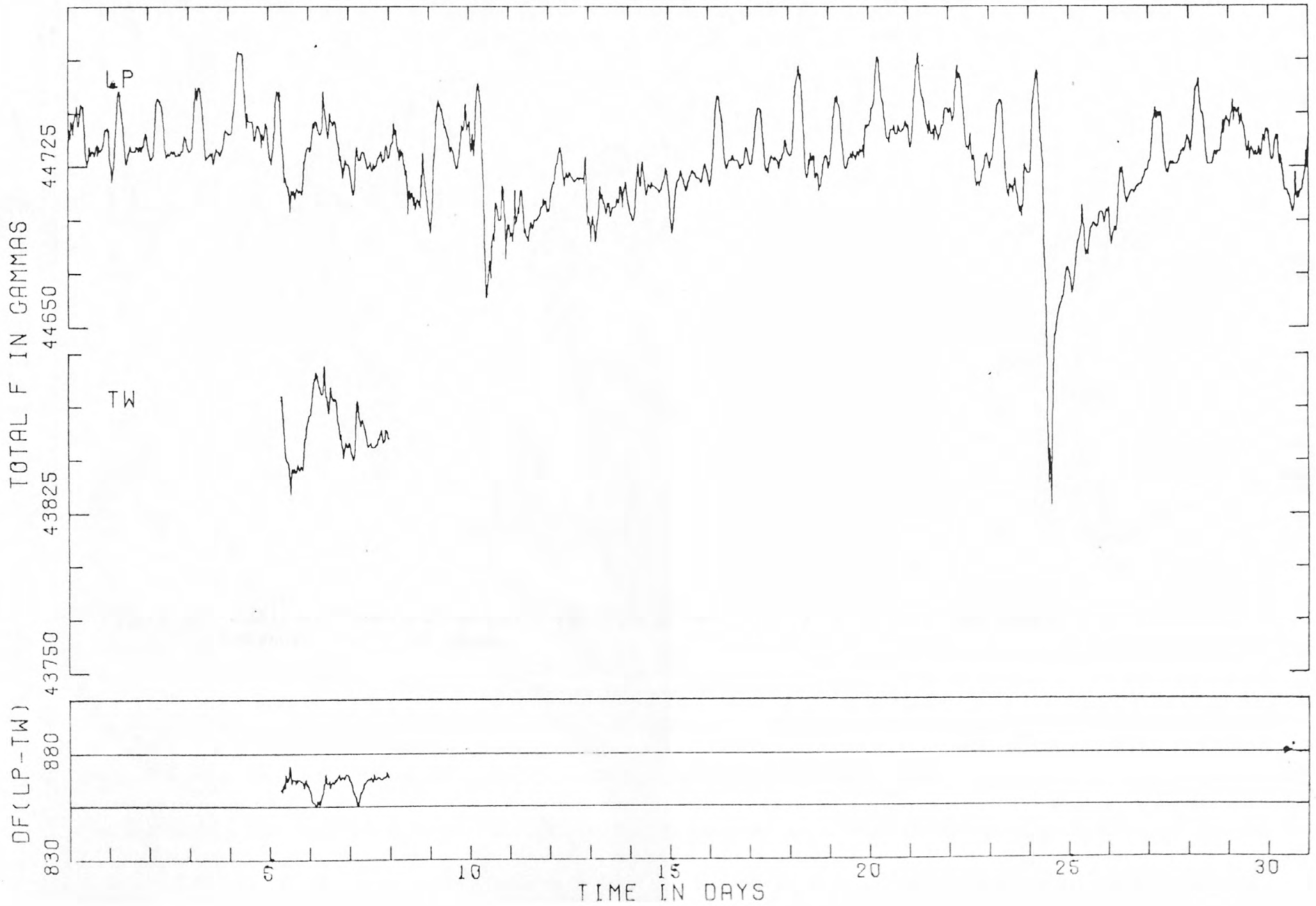


Figure 12. Raw geomagnetic data for April, 1980.

Figure 13. Raw geomagnetic data for May, 1980.

GEOMAGNETOGRAMS MAY 1980



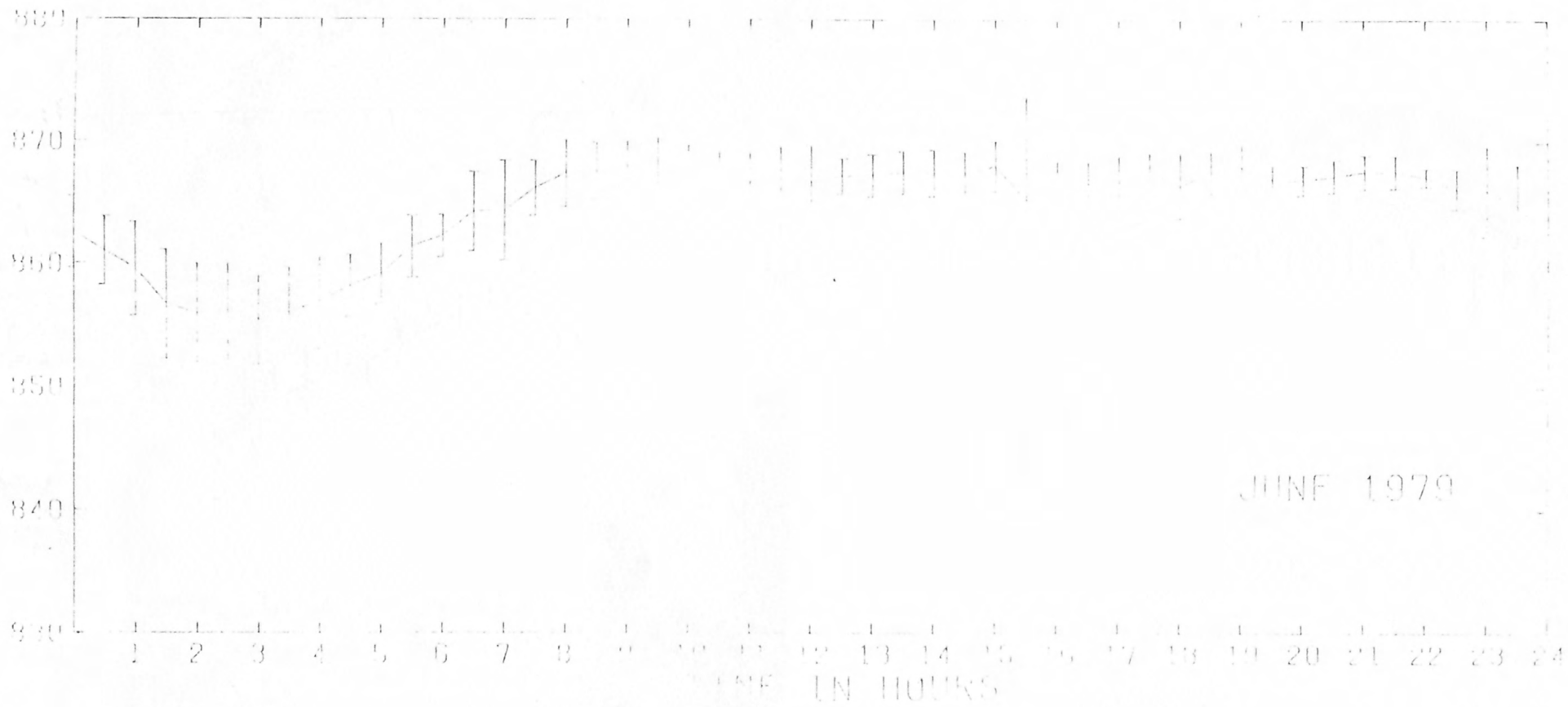


Figure 14. Daily difference of magnetic readings between LP and TW stations for June, 1979; standard deviation shown.

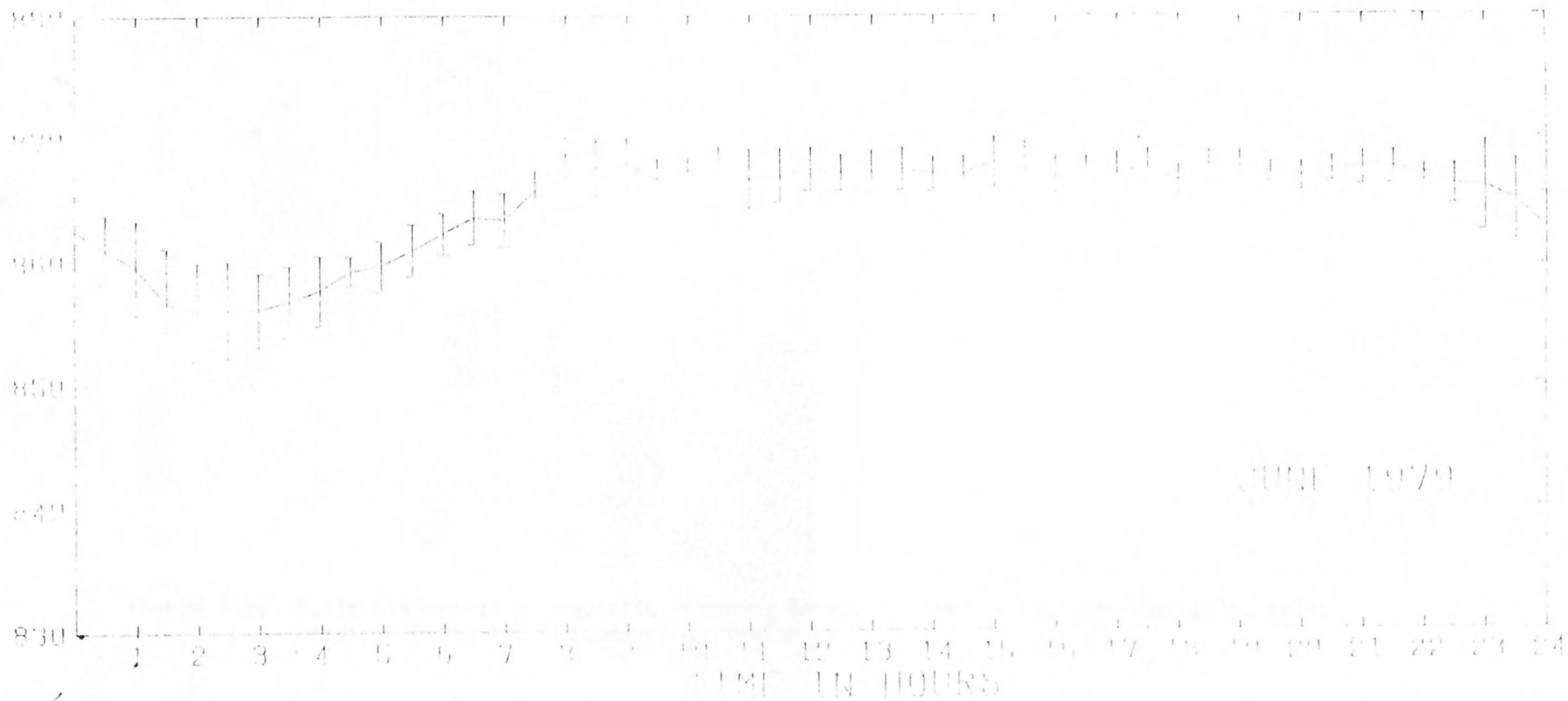


Figure 14a. Daily difference of magnetic readings between LP and TW stations for June, 1979; readings exceeding 1 standard deviation excluded.

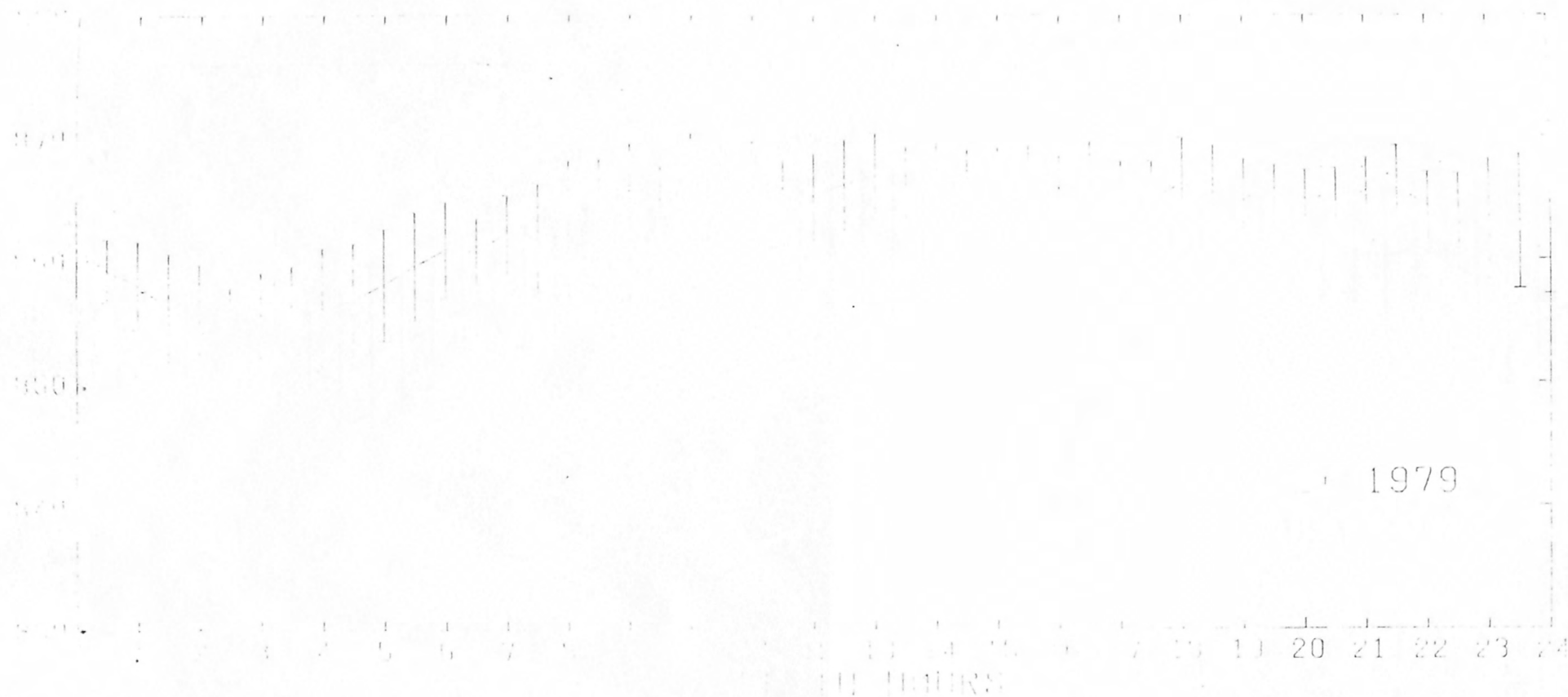


Figure 15a. Daily difference of magnetic readings between LP and TW stations for July, 1979; readings exceeding 1 standard deviation excluded.

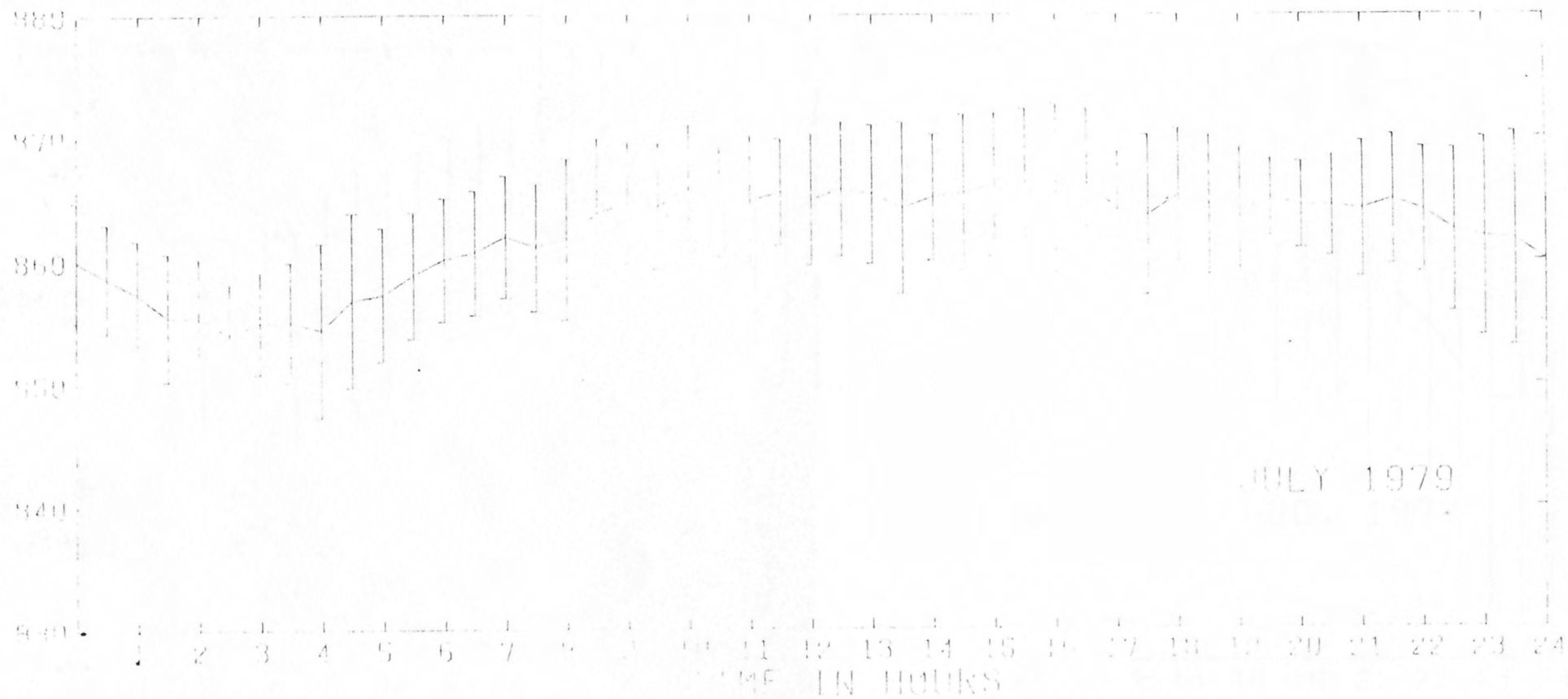


Figure 15. Daily difference of magnetic readings between LP and TW stations for July, 1979; standard deviation shown.

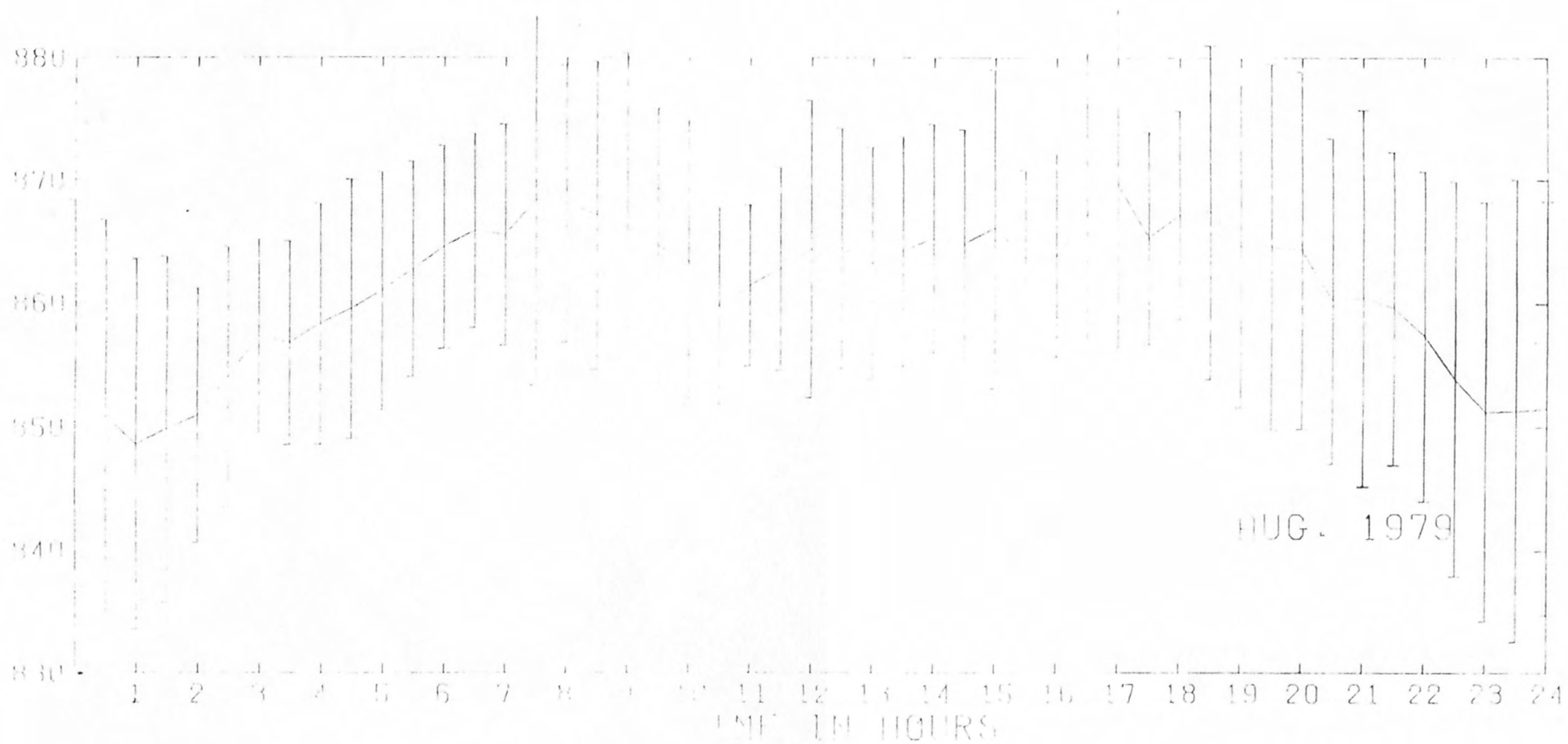


Figure 16. Daily difference of magnetic readings between LP and TW stations for August, 1979; standard deviation shown.

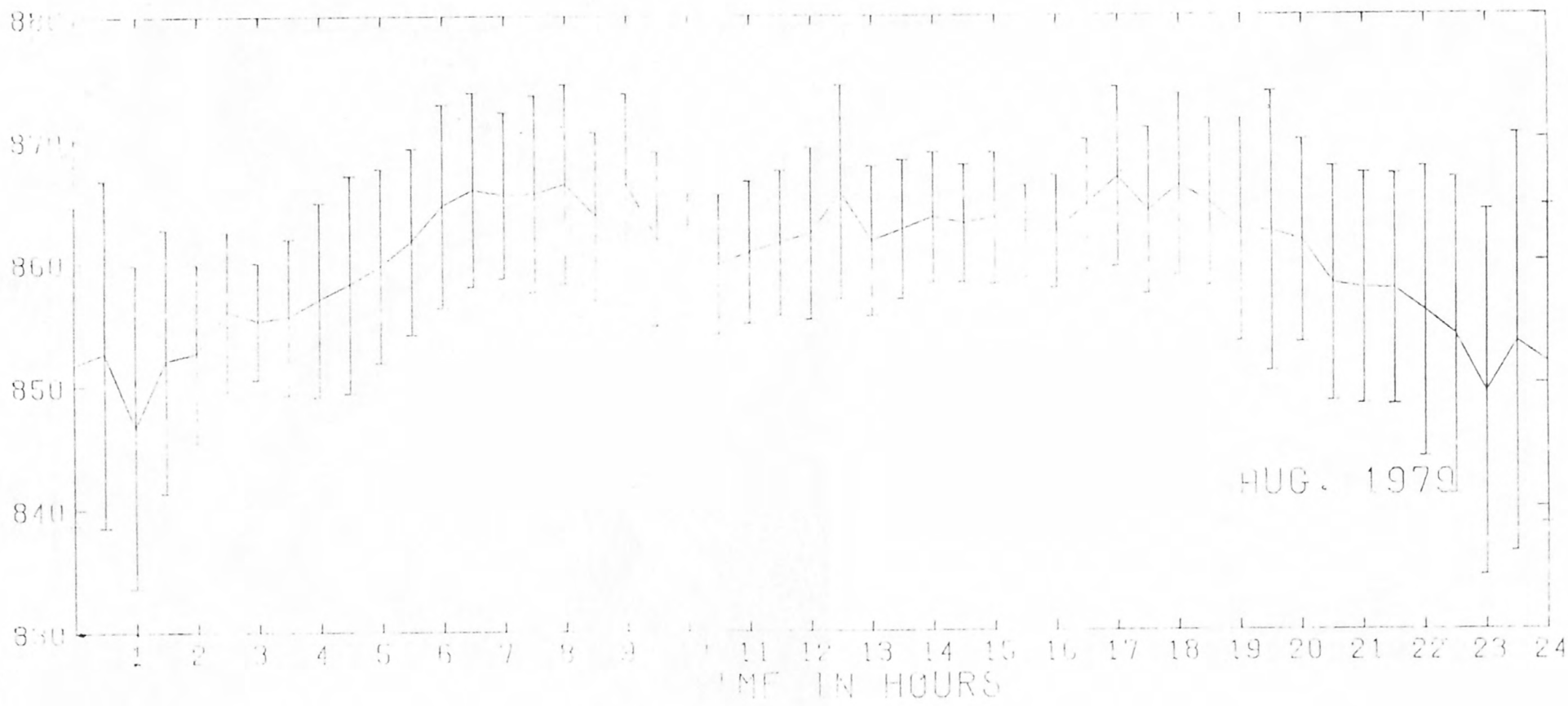


Figure 16a. Daily difference of magnetic readings between LP and TW stations for August, 1979; readings exceeding 1 standard deviation excluded.

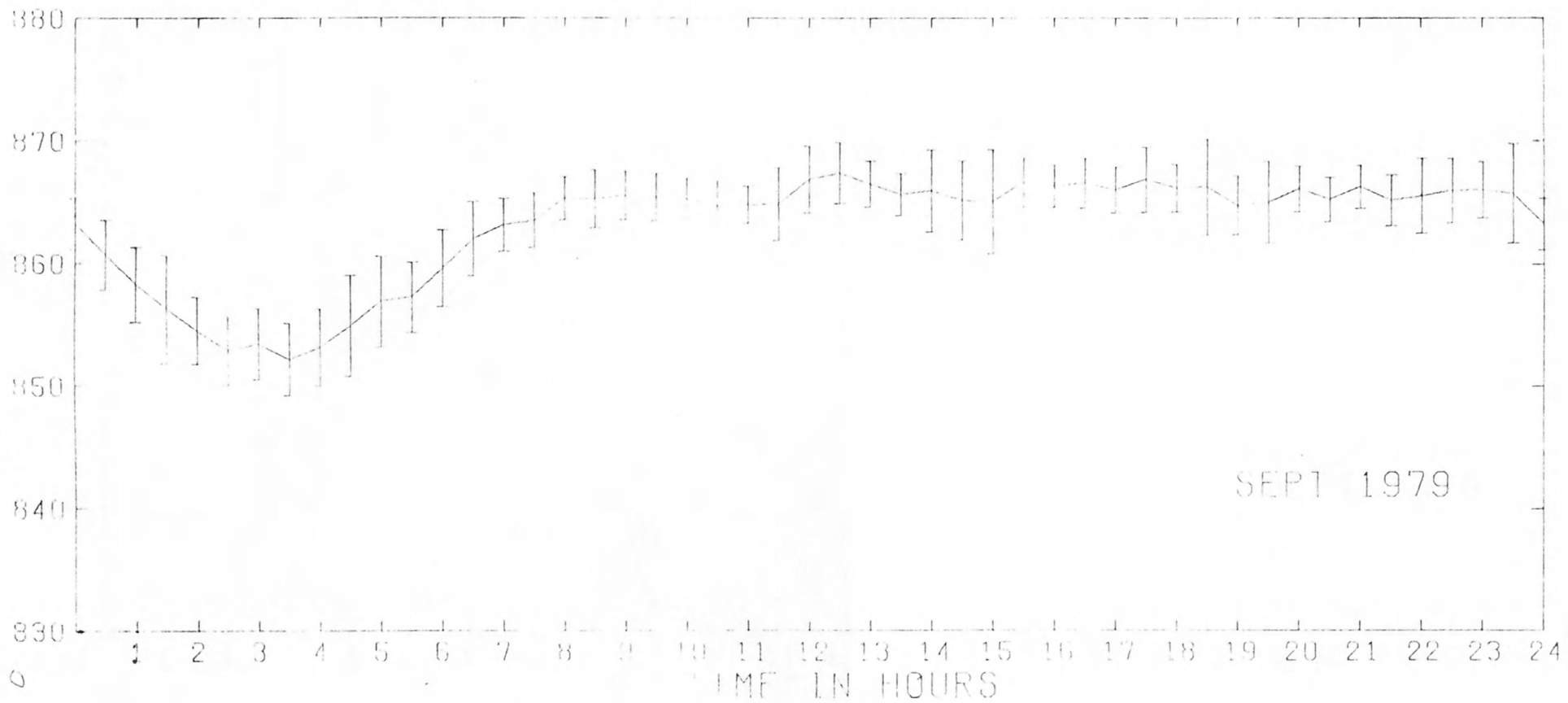
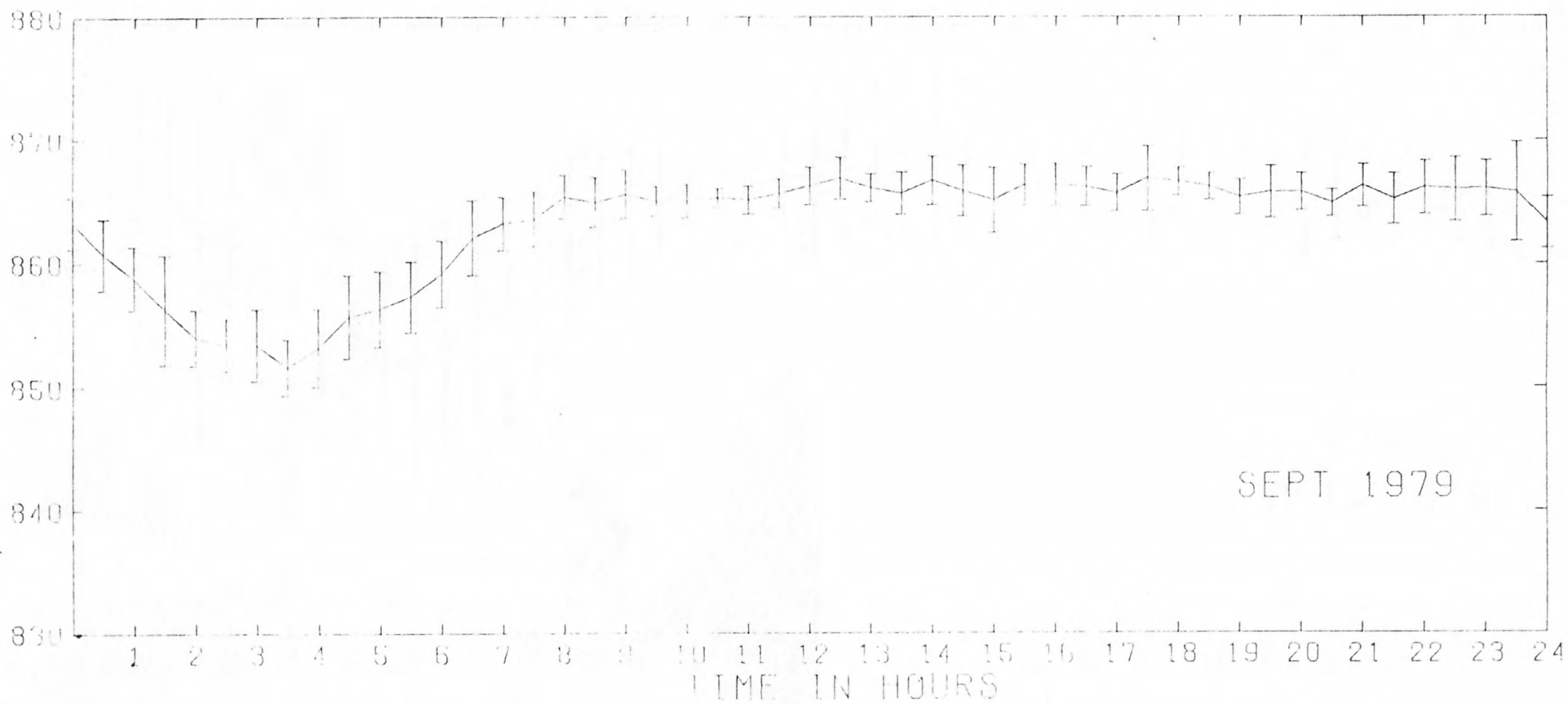


Figure 17. Daily difference of magnetic readings between LP and TW stations for September, 1979; standard deviation shown.



1 Figure 17a. Daily difference of magnetic readings between LP and TW stations for September, 1979; readings exceeding 1 standard deviation excluded.

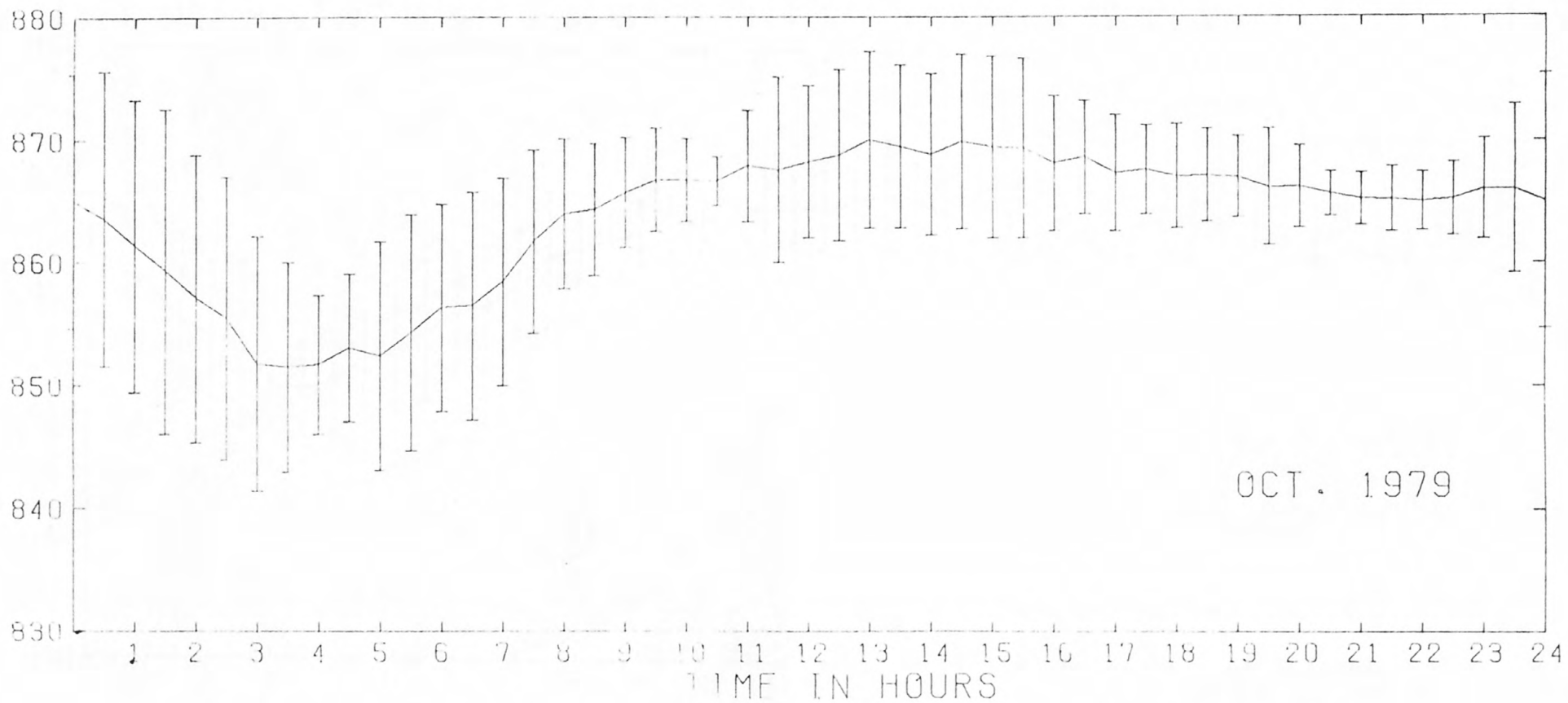


Figure 18. Daily difference of magnetic readings between LP and TW stations for October, 1979; standard deviation shown.

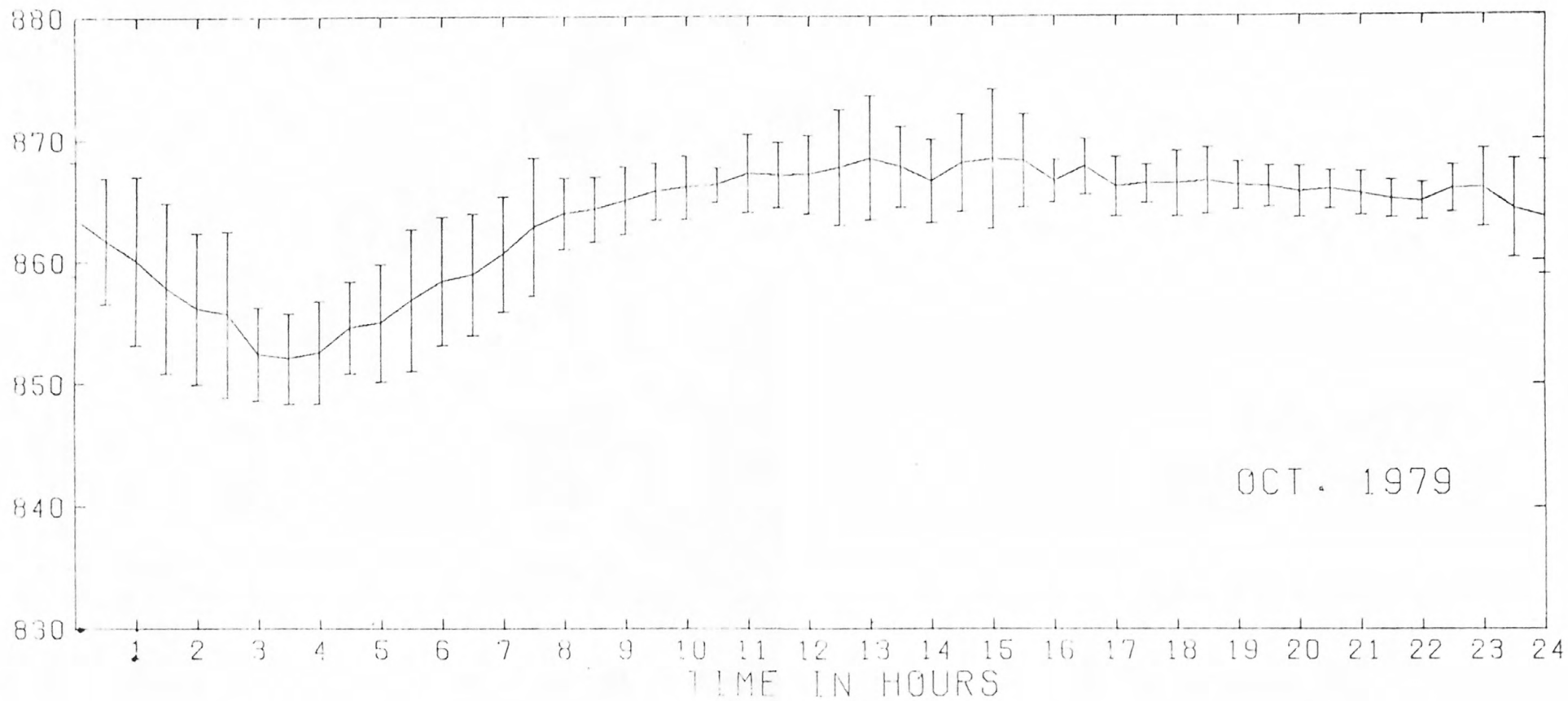


Figure 18a. Daily difference of magnetic readings between LP and TW stations for October, 1979; readings exceeding 1 standard deviation excluded.

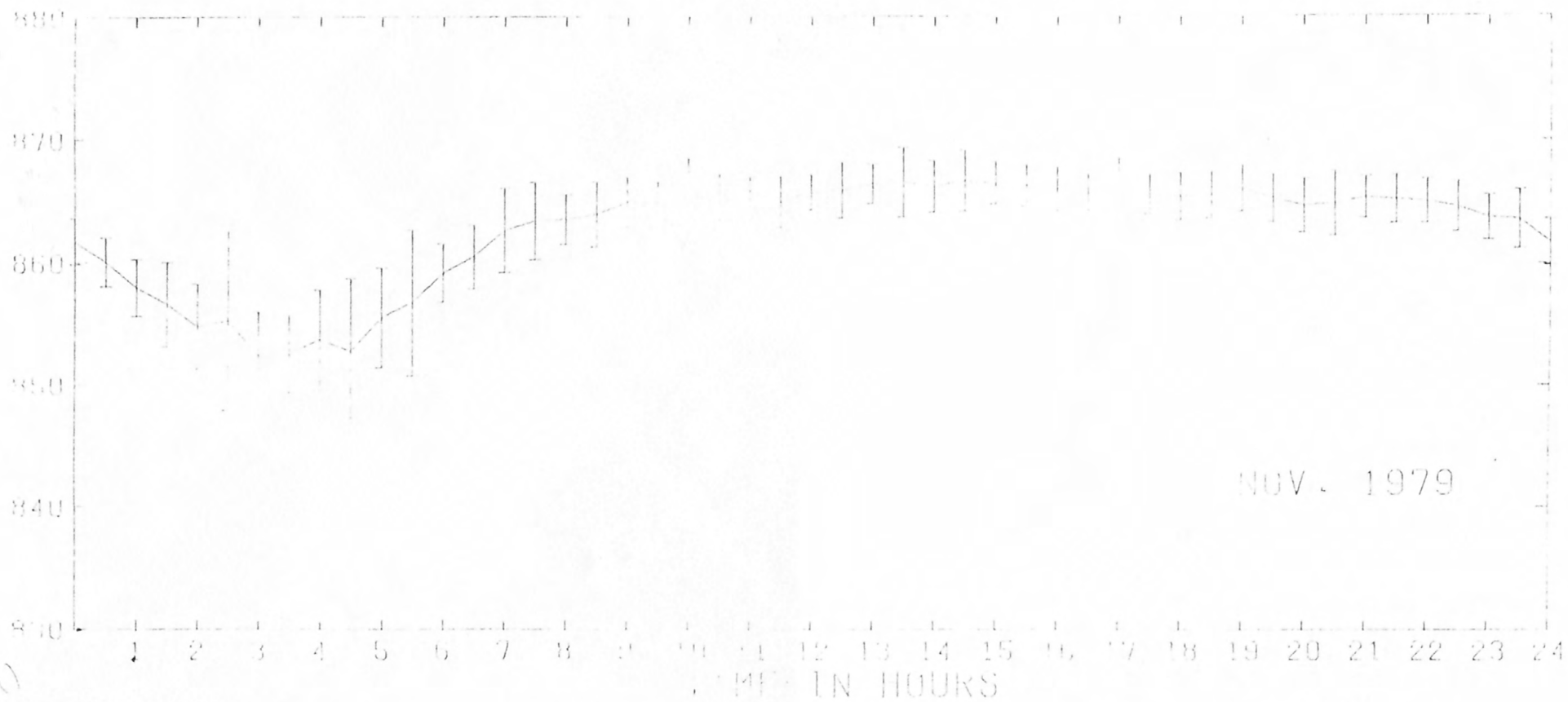


Figure 19. Daily difference of magnetic readings between LP and TW stations for November, 1979; standard deviation shown.

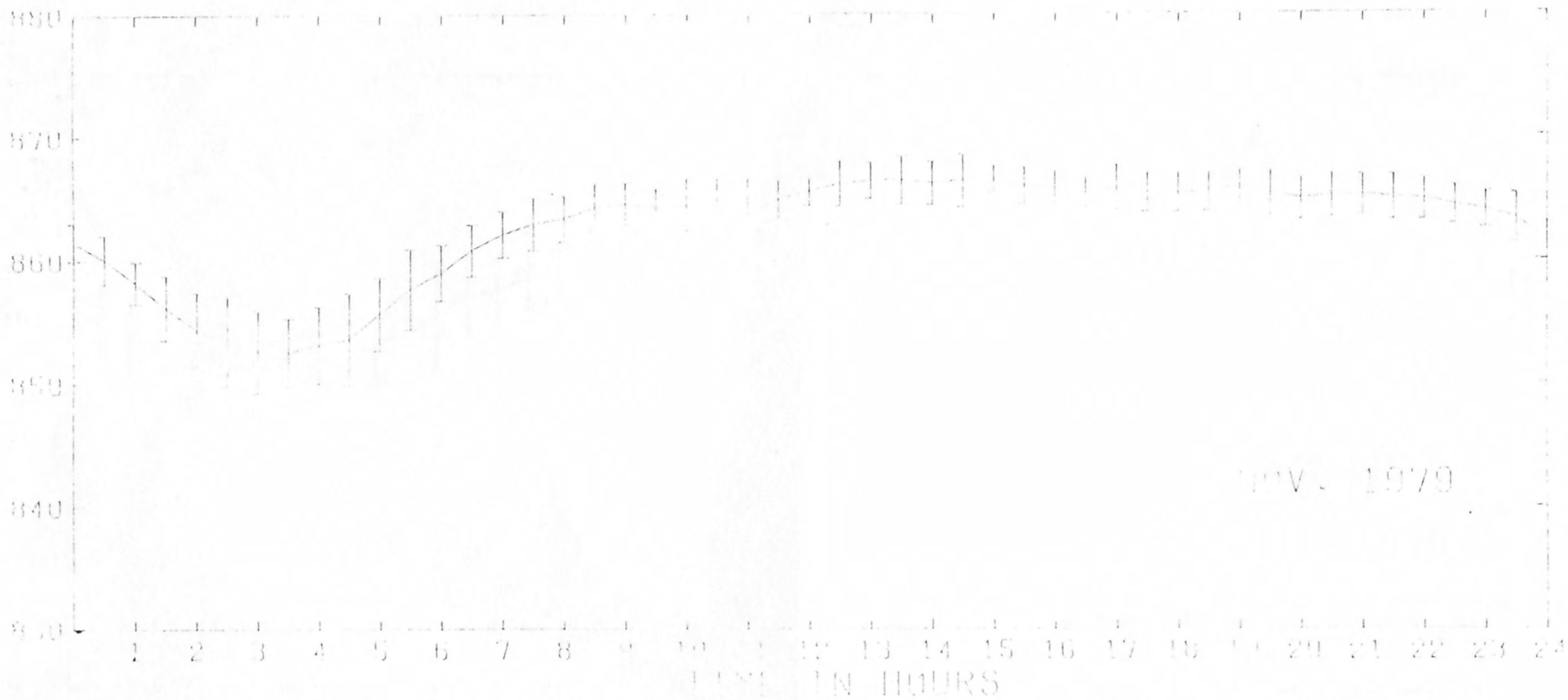


Figure 19a. Daily difference of magnetic readings between LP and TW stations for November, 1979; readings exceeding 1 standard deviation excluded.

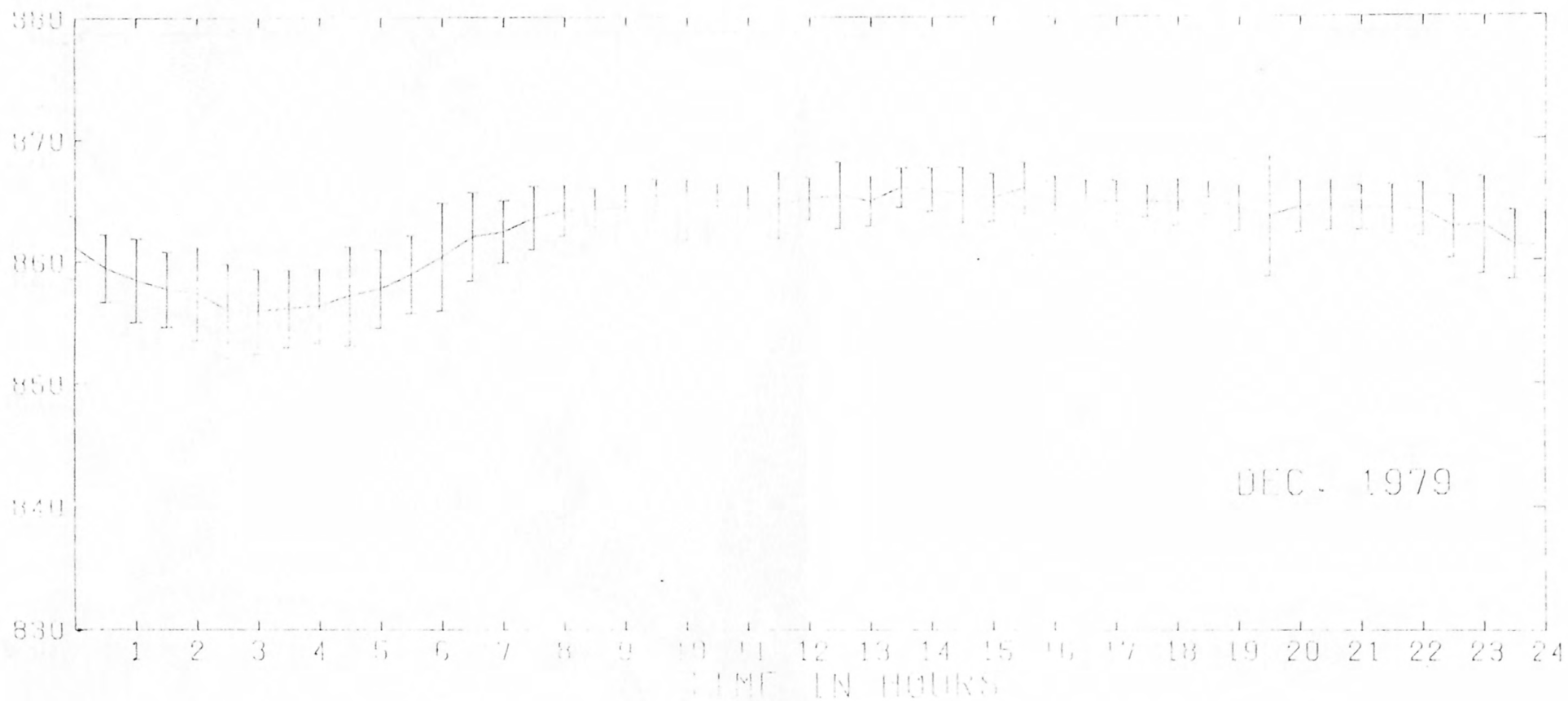


Figure 20. Daily difference of magnetic readings between LP and TW stations for December, 1979; standard deviation shown.

0

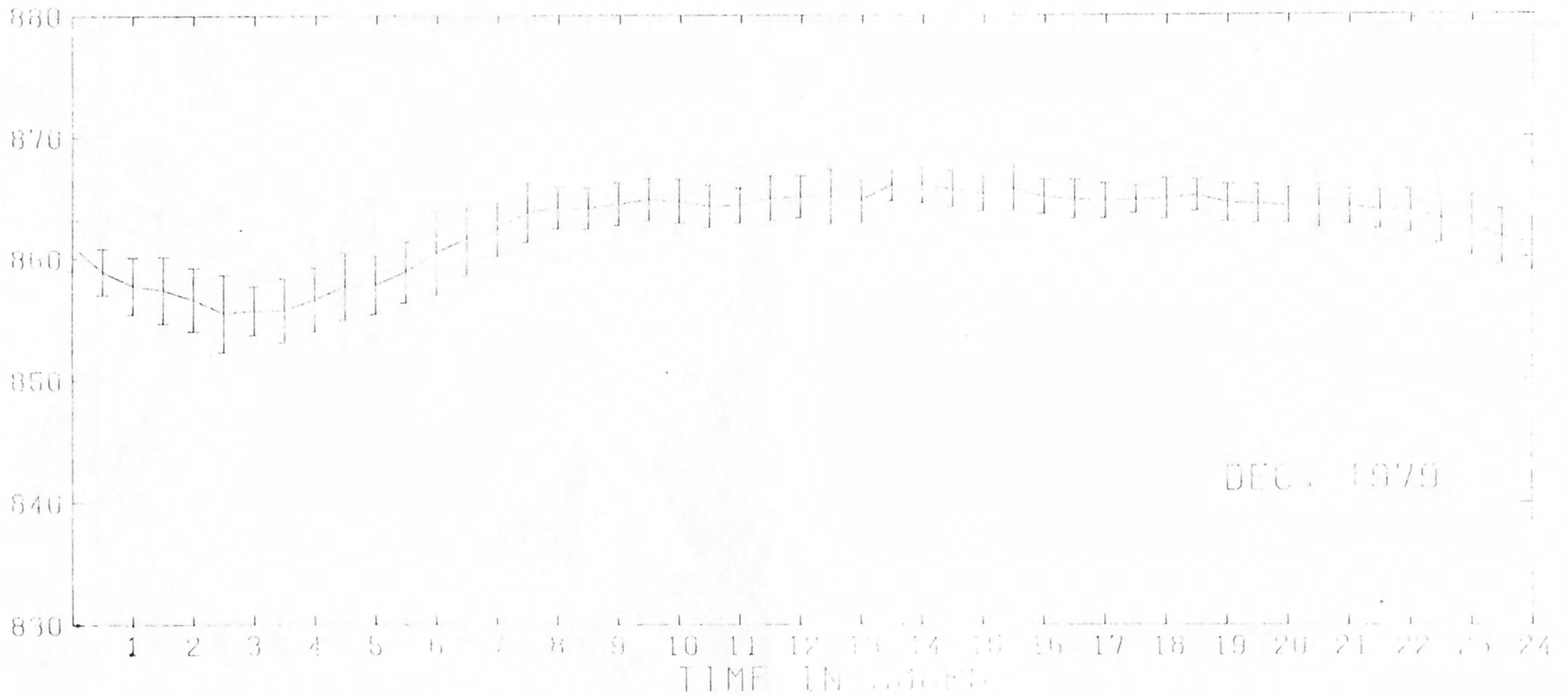


Figure 20a. Daily difference of magnetic readings between LP and TW stations for December, 1979; readings exceeding 1 standard deviation excluded.

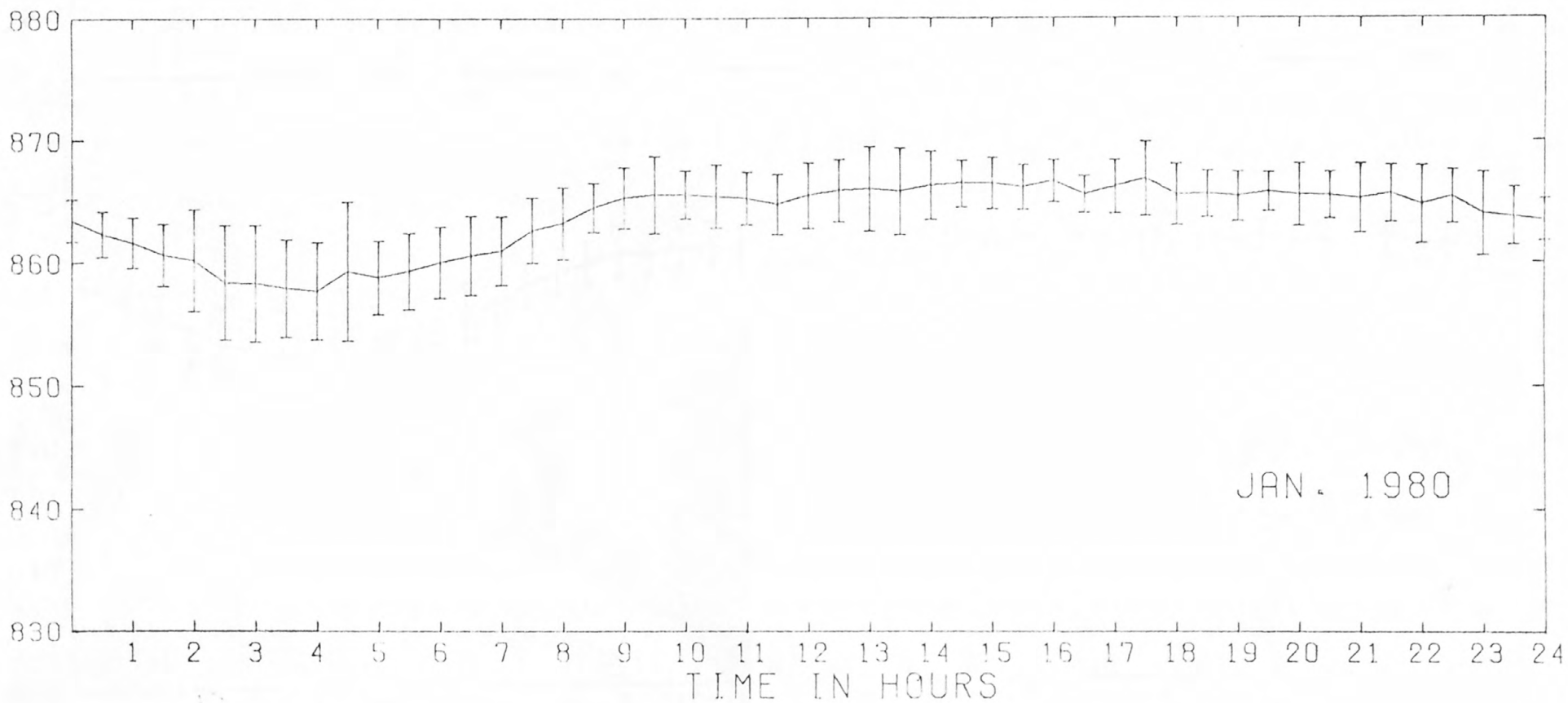


Figure 21. Daily difference of magnetic readings between LP and TW stations for January, 1980; standard deviation shown.

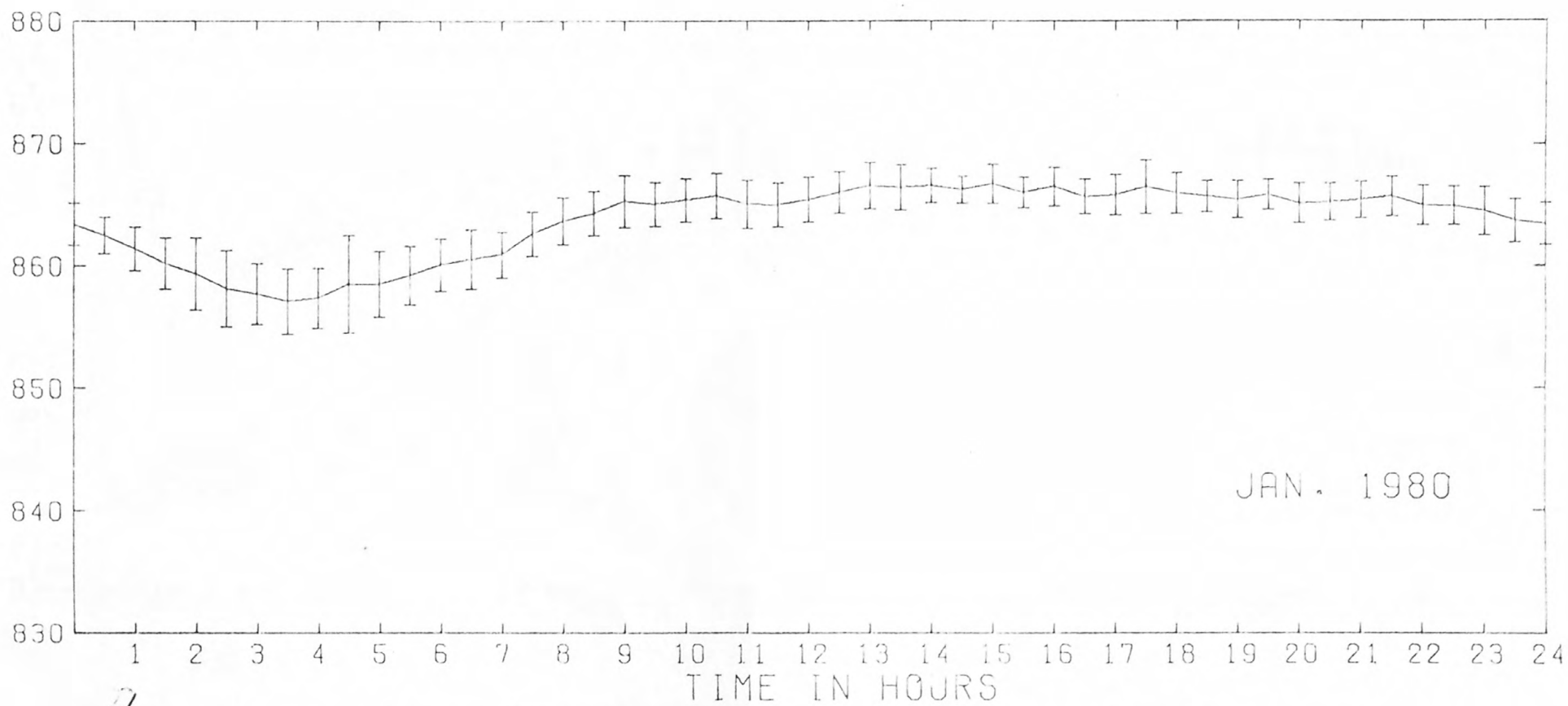


Figure 21a. Daily difference of magnetic readings between LP and TW stations for January, 1980; readings exceeding 1 standard deviation excluded.

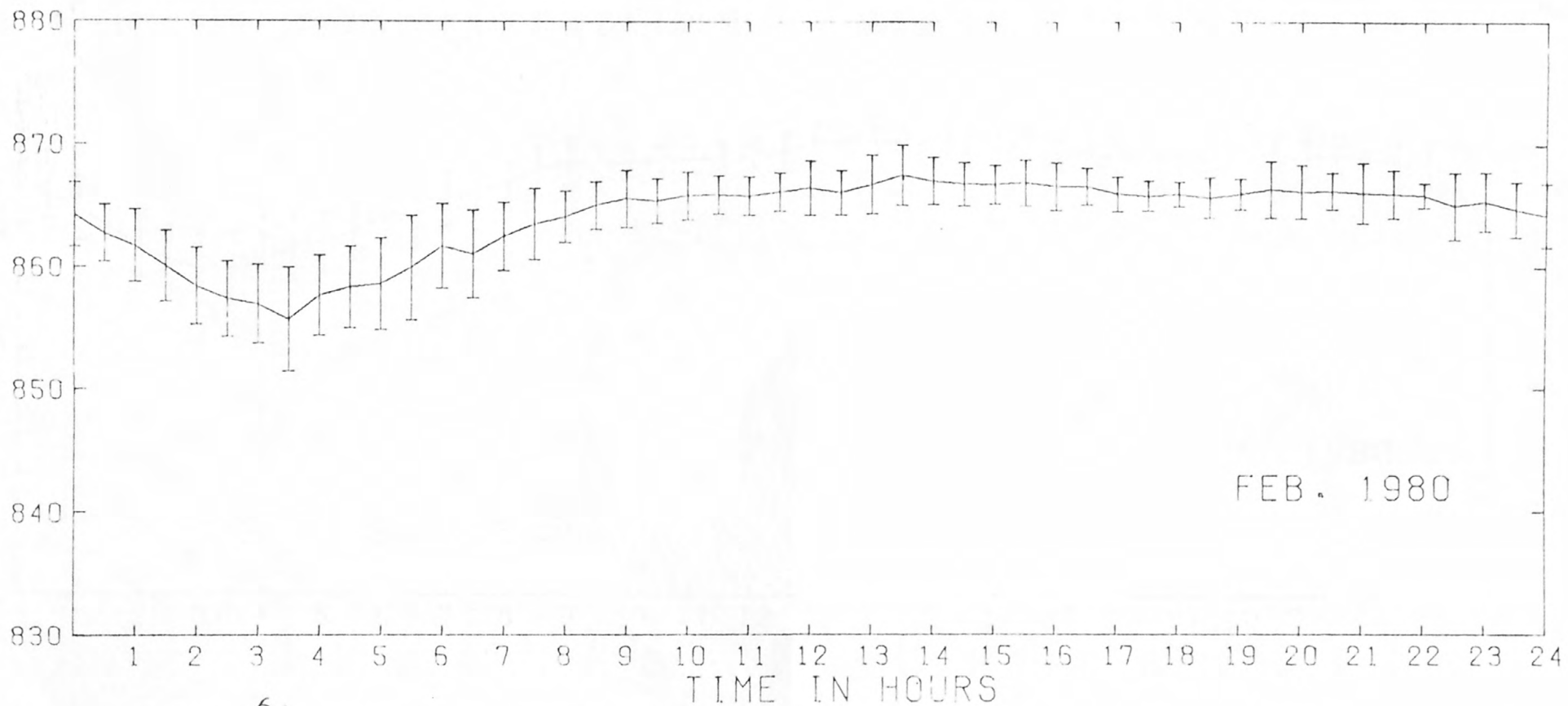


Figure 22. Daily difference of magnetic readings between LP and TW stations for February, 1980; standard deviation shown.

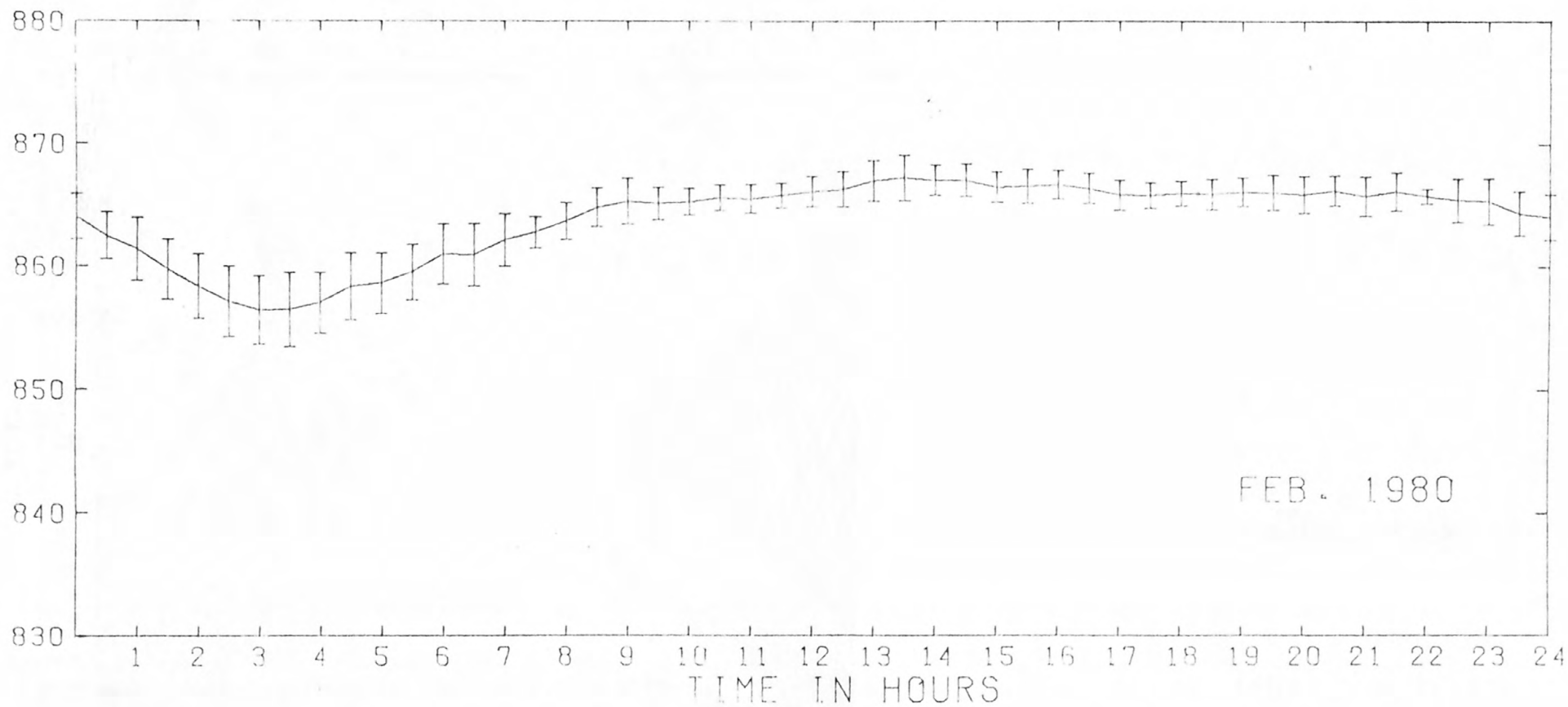


Figure 22a. Daily difference of magnetic readings between LP and TW stations for February, 1980; readings exceeding 1 standard deviation excluded.

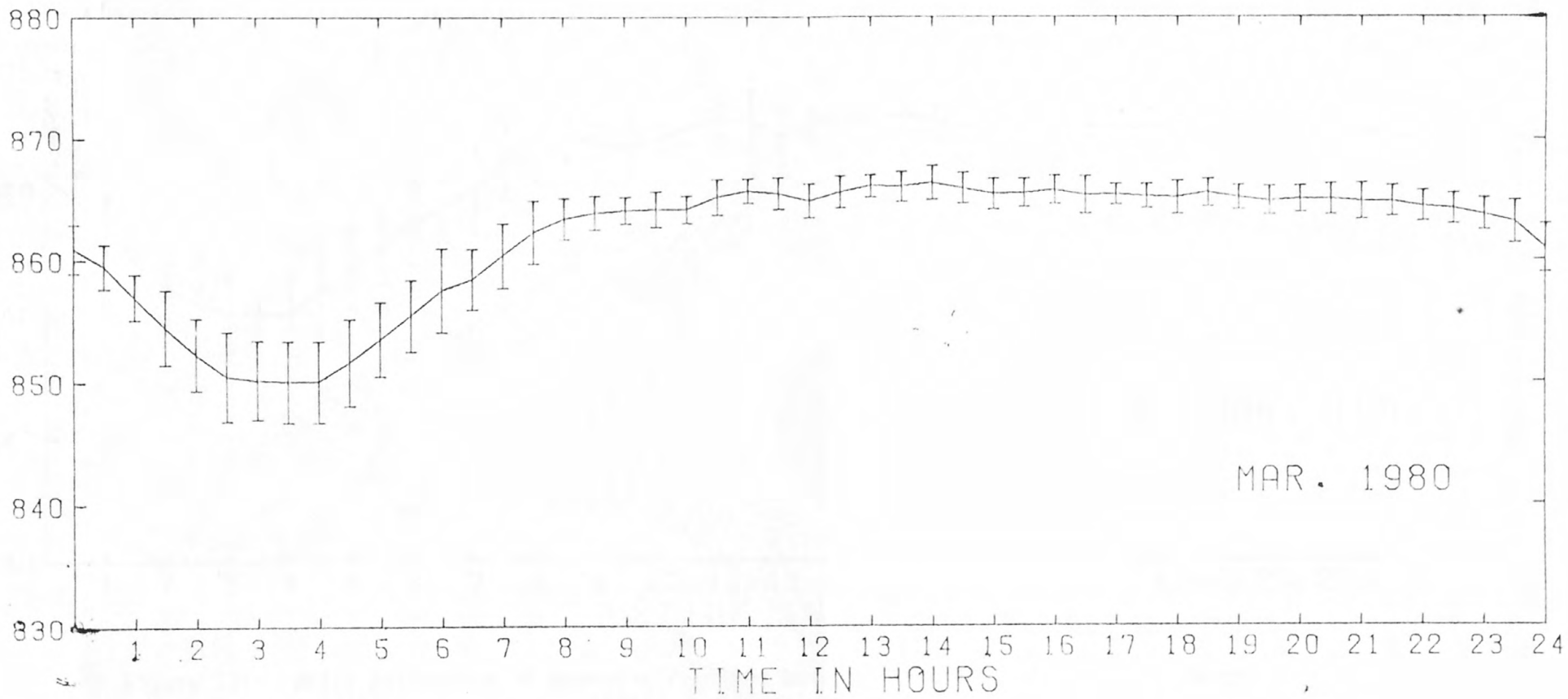


Figure 23. Daily difference of magnetic readings between LP and TW stations for March, 1980; standard deviation shown.

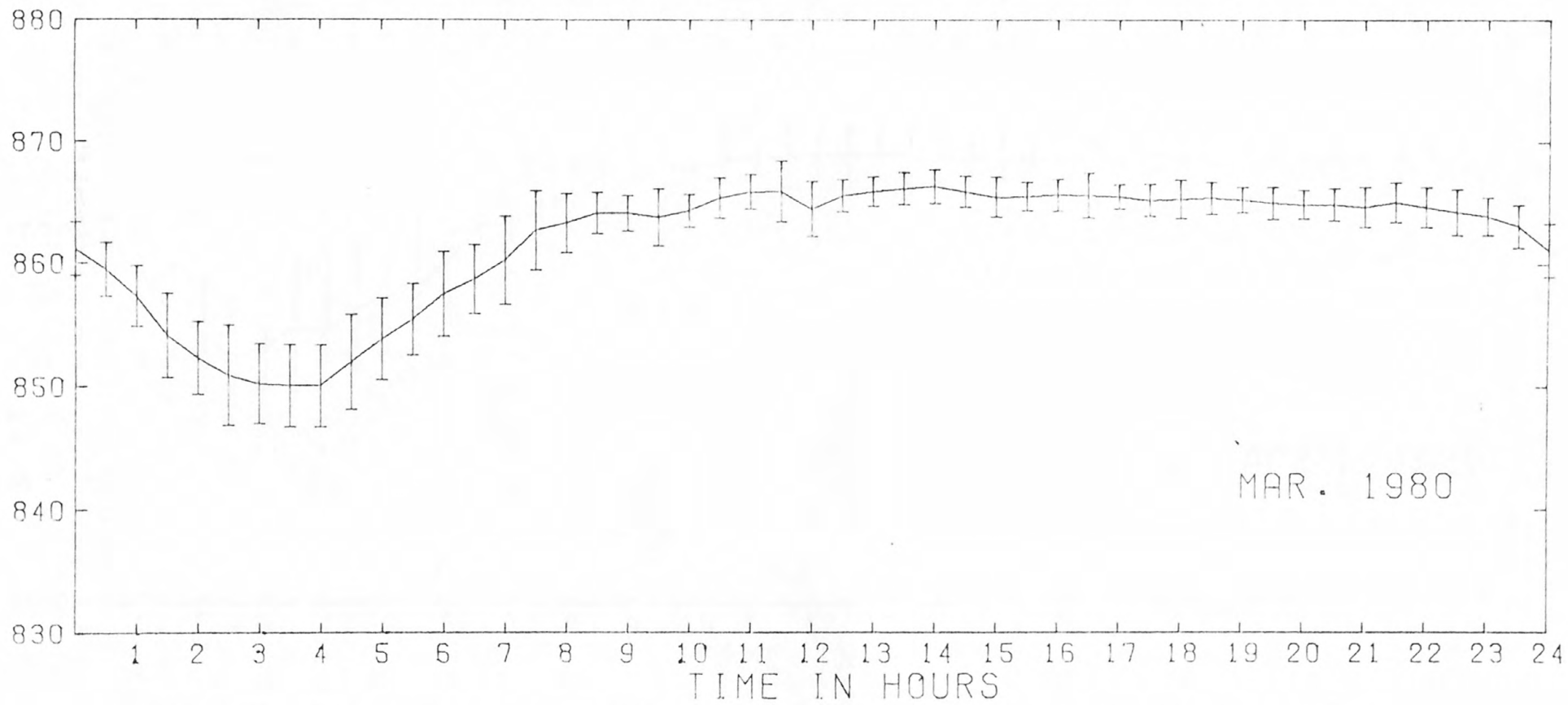


Figure 23a. Daily difference of magnetic readings between LP and TW stations for March, 1980; readings exceeding 1 standard deviation excluded.

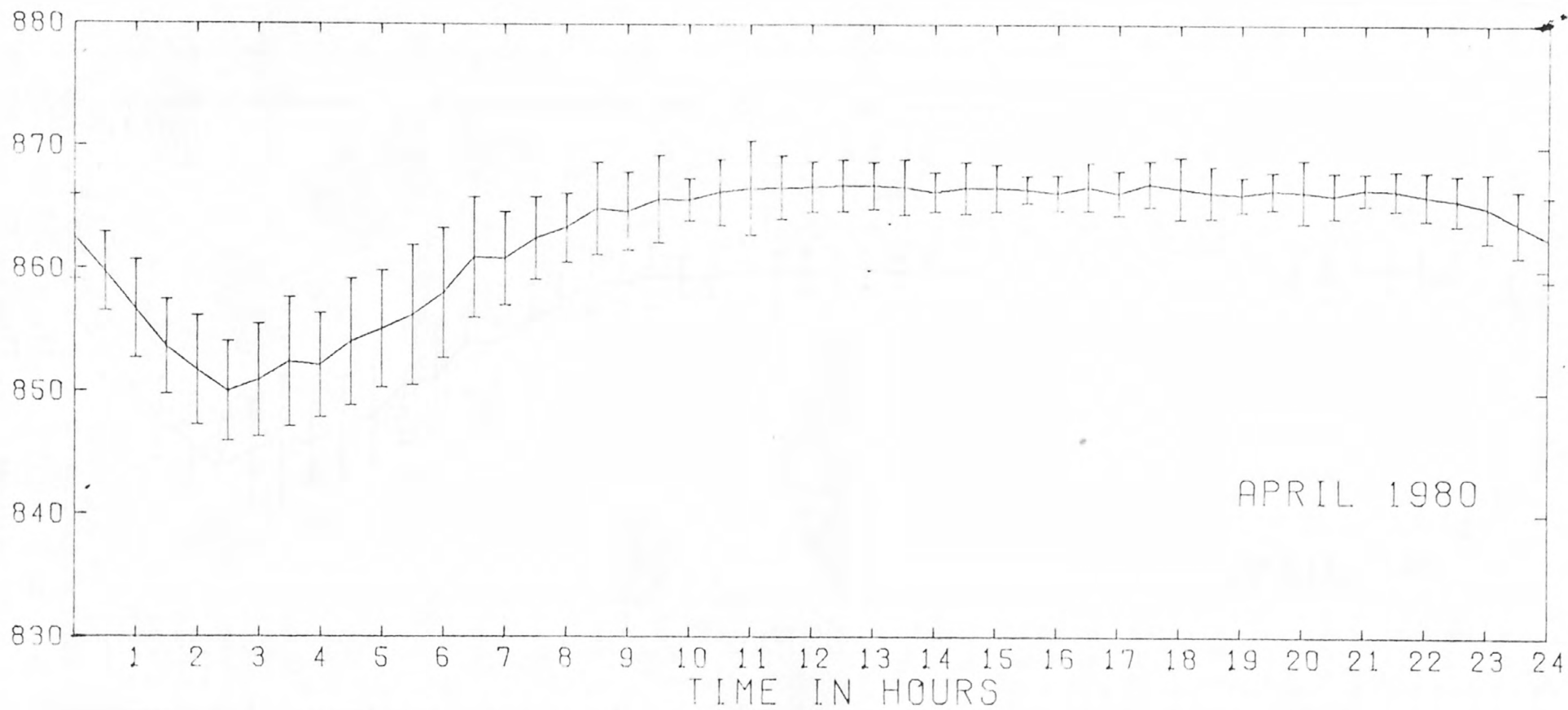


Figure 24. Daily difference of magnetic readings between LP and TW stations for April, 1980; standard deviation shown.

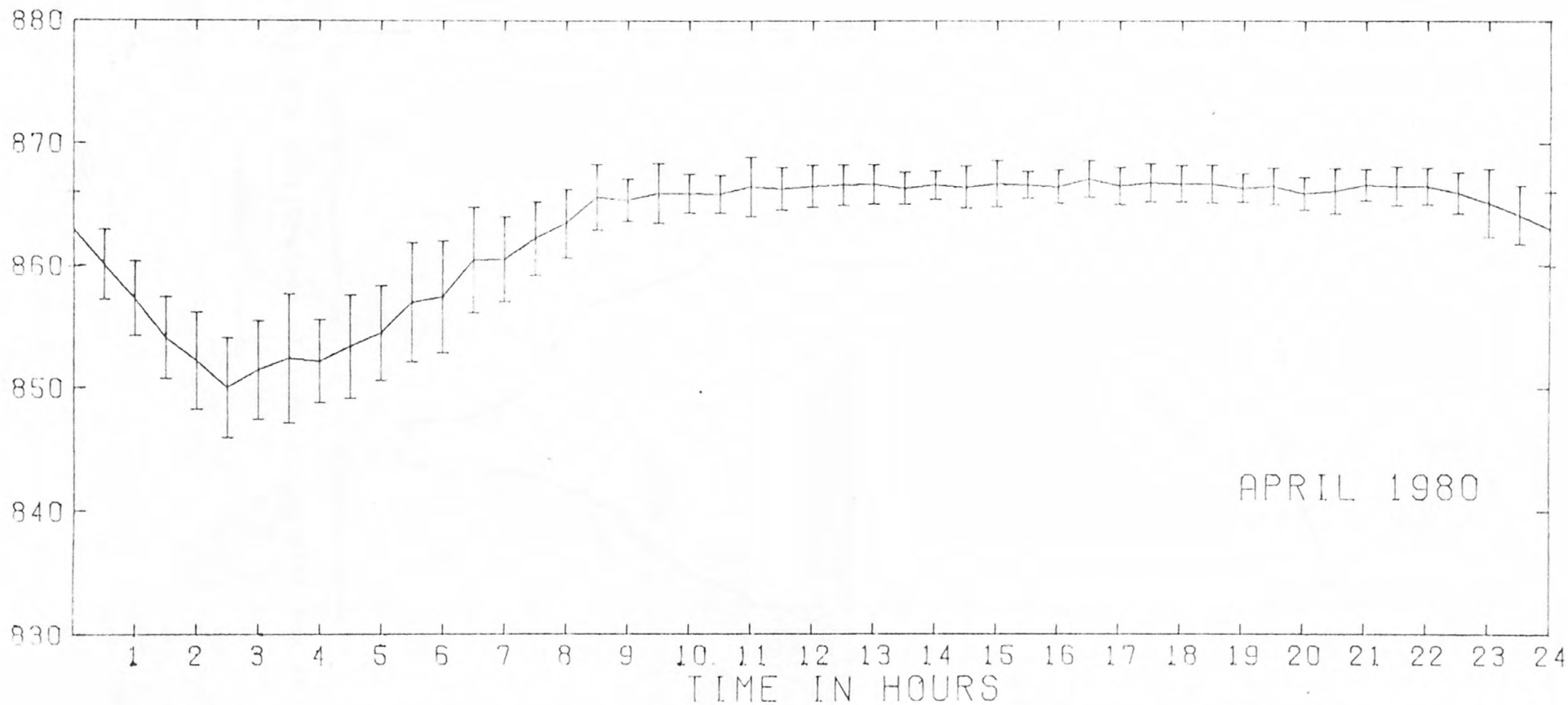


Figure 24a. Daily difference of magnetic readings between LP and TW stations for April, 1980; readings exceeding 1 standard deviation excluded.

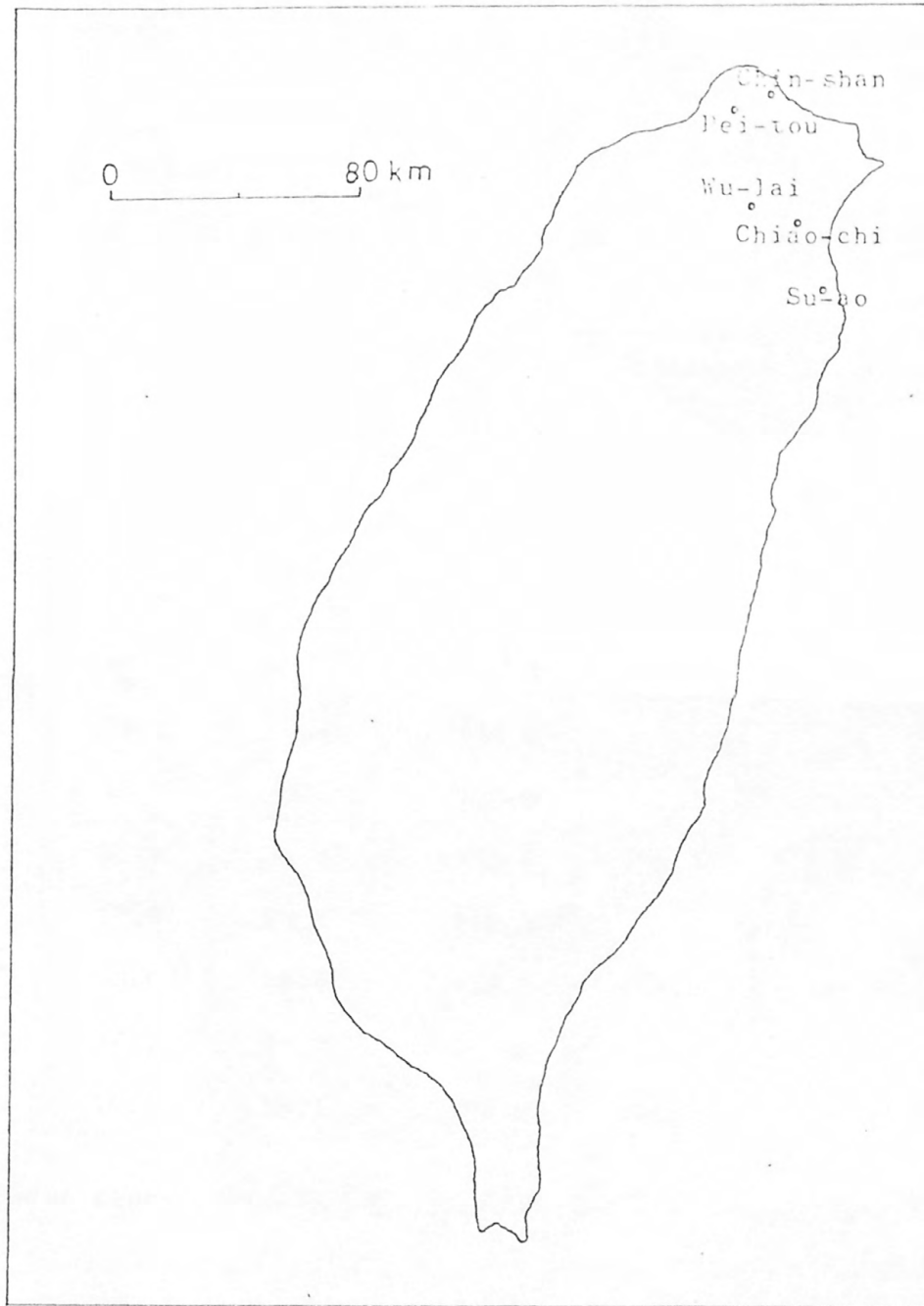


Figure 25. The distribution of five spring stations in north-eastern Taiwan.

| | Chinshan | Peitou | Wulai | Chiaochi | Suao |
|-------|----------|--------|-------|----------|-------|
| March | 25.4 | 33.5 | 120.2 | 118.5 | |
| | 20.8 | 28.4 | 124.2 | | |
| | 5.7 | 36.4 | 132.8 | 134.9 | 230.8 |
| April | 21.2 | 25.7 | 156.2 | | |
| | 28.3 | 31.7 | 102.7 | | |
| | 21.4 | 28.4 | 158.9 | | |
| | 18.7 | 28.0 | 150.0 | | |
| May | 20.9 | 25.9 | 135.5 | 122.3 | 299.8 |
| | 17.4 | 24.4 | 149.5 | | |
| | 22.6 | 24.0 | 135.7 | 126.0 | 405.9 |
| | 17.9 | 21.0 | 141.3 | | |
| June | 16.0 | 28.1 | 153.9 | 134.0 | 478.4 |

Table 2. Radon concentrations (dpm/kg) of five spring stations.

USGS LIBRARY-RESTON



3 1818 00077579 9