

A neutron monitor on King George Island

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RESUMEN

Con el apoyo del Instituto Antártico Chileno (I.N.A.Ch.) la radiación de los rayos cósmicos solares y galácticos ha sido registrada desde el inicio de los años noventa en la Isla Rey Jorge. El registro continuo de un detector 6 - NM - 64 será usado para investigar las relaciones Sol-Tierra. Los instrumentos están ubicados desde enero de 1991 sobre una pequeña colina cercana al antiguo centro meteorológico 'E. Frei' y a una distancia de 400 metros de Villa 'Las Estrellas' (Base Tte. Marsh, Caleta Ardley - Bahía Fildes). Presentamos en forma conjunta características generales relacionadas con la instalación del monitor y sus mediciones iniciales.

PALABRAS CLAVE: Rayos cósmicos, Física subpolar, Datos meteorológicos, Bahía Fildes, Antártica.

ABSTRACT

With the support of the Chilean Antarctic Institute (I.N.A.Ch.) the galactic and the solar cosmic-ray radiation will be monitored during the early nineties on King George Island. The continuous registrations of a 6 - NM - 64 detector will be used to investigate solar-terrestrial relationships. The instrument has been placed in January 1991 on a hill near the old meteorological center 'E. Frei' and about 400 m from 'Las Estrellas' village (Tte. Marsh Base - Caleta Ardley - Fildes Bay). General features connected with the installation of the monitor and initial measurements are described.

KEY WORDS: Cosmic rays, Subpolar Physics, Meteorological data, Fildes Bay, Antarctica.

INTRODUCTION

Antarctic Science has been developed in this century. Relevant milestones for polar research are:

- the International Polar Commission (Hamburg, Germany, 1879);
- the First International Polar Year (1882-83);
- the Second International Polar Year (1932-33);
- the First Antarctic Conference (Paris, France, 1955);
- the International Geophysical Year (I.G.Y.: 1957-58);
- the Scientific Committee on Antarctic Research (S.C.A.R.: 1957).

Since then much work has been done in polar (Antarctic and Arctic) areas, adding significantly to the knowledge of the whole terrestrial environment. Moreover, the fast development of the instrumental technology has allowed us to pay attention on natural and anthropogenic phenomena on Earth.

Owing to a lack of reliable information in the pre-space age (i.e. prior to the I.G.Y.) the forecast of the long-term solar-activity control is still a difficult task (Storini, 1989; Storini, 1990a and b). Even more difficult is the separation

of helio-induced effects from terrestrial effects (e.g., the ozone issue, the greenhouse effect, the super-El Niño events, . . .).

Cosmic Ray Physics, particularly solar particles and modulation phenomena of galactic cosmic rays, may be viewed as one of the autonomous disciplines connected with the branch of Solar-Terrestrial Relationships. In recent years the Rome Cosmic Ray Section of I.F.S.I. (Istituto di Fisica dello Spazio Interplanetario, National Research Council of Italy) and the Cosmic-Ray Research Laboratory of Santiago (University of Chile) started new research programs aiming to investigate unsolved problems in the solar-interplanetary-terrestrial chain. A monitor network around the 60 - 70° West meridian zone (King George Island - Antarctica; Santiago; Arica) is being built (Cordaro, 1991).

'CALETA ARDLEY' INSIDE FILDES BAY

The South Shetland Islands are appropriate sites for interdisciplinary research programs on Solar-Terrestrial Physics. They are located outside the polar circle but inside the Antarctic Convergence in the Latin American sector. The final choice was King George Island (see Figure 1), near a weather reporting station (Meteorological center 'E. Frei'). The location is 'Caleta Ardley', inside Fildes Bay.

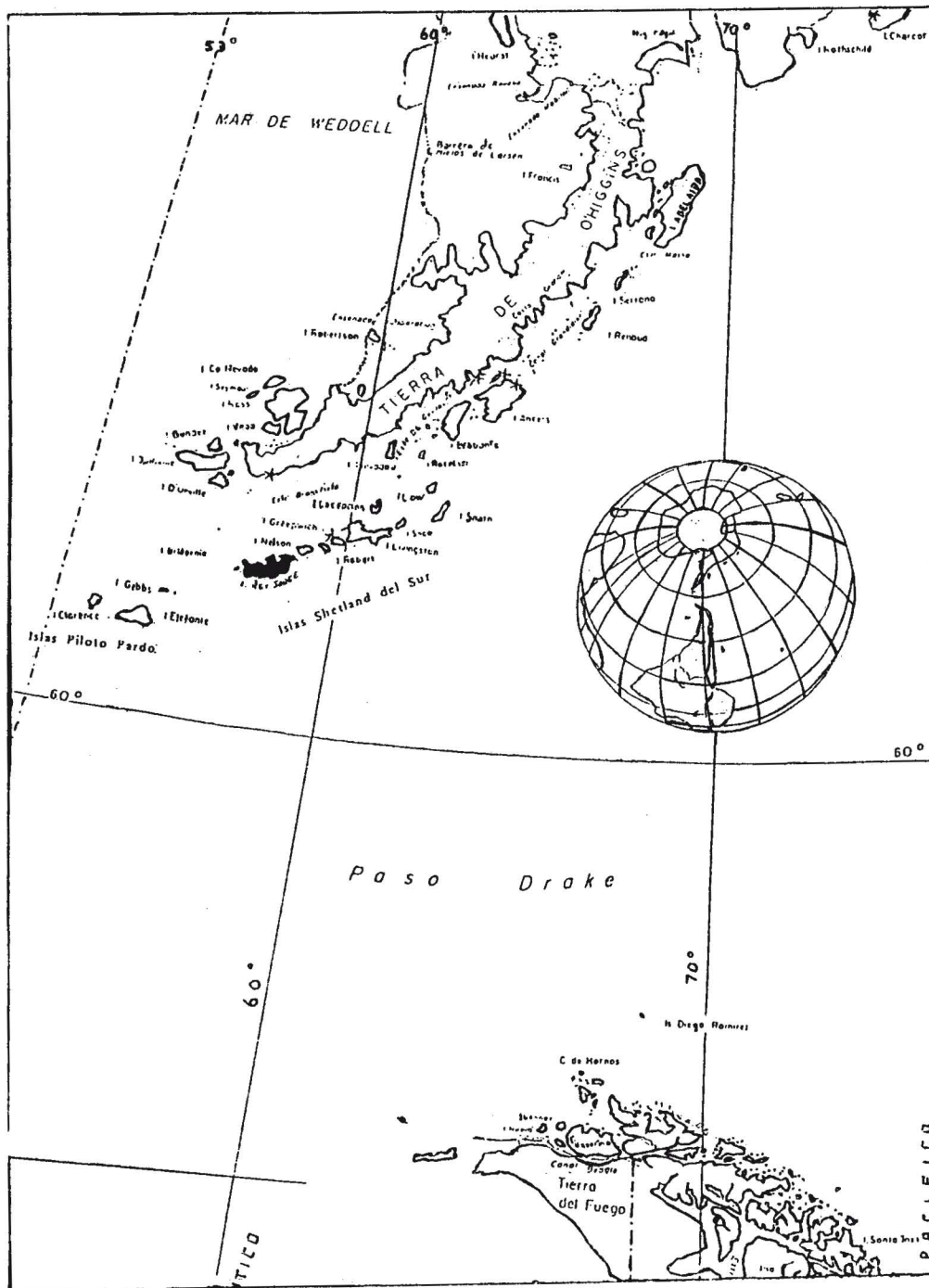


Fig. 1. King George Island position: black area.

The place was visited during 1989 winter and some study of the meteorological parameters was made. Data furnished by the Frei Center include measurements at 3-hour intervals of the following parameters:

- P, the atmospheric pressure at ground level;
- T, the surface temperature;
- H, the relative humidity (i.e., the ratio of the vapor pressure of the air to the saturation vapor pressure at the ambient air temperature);
- W and D, the wind speed and direction.

Data have been divided into four groups to evaluate seasonal variations. Figures 2 to 5 illustrate frequency distributions for the 1990 year. Extreme annual values suggest: $P_{max} - P_{min} \sim 80$ mb, $T_{max} - T_{min} \sim 30^{\circ}$ C, $H_{min} \sim 50\%$ and $W_{max} \sim 45$ Knot (nautical miles per hour). Speed distribution data has not been analyzed because of the lack of a historical record, necessary to obtain good estimates.

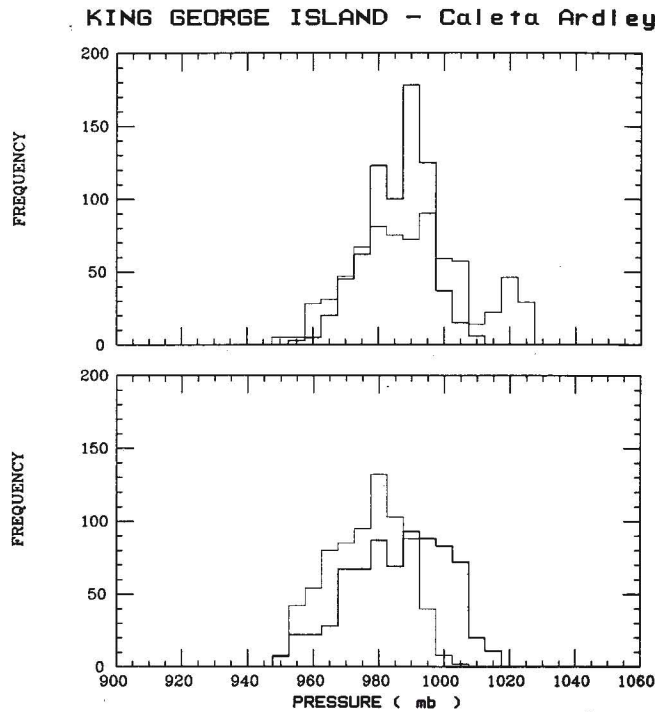


Fig. 2. Frequency distributions of the atmospheric pressure registered during the 1990 year by Frei Center: January - March (upper panel, thick line), April - June (upper panel, thin line), July - September (lower panel, thick line) and October - December (lower panel, thin line).

L.A.R.C.: Preliminary data

The cosmic ray laboratory (L.A.R.C., Laboratorio Antártico de Radiación Cósmica / Laboratorio Antártico per la Radiazione Cosmica) is located on a small hill (~ 25 m

KING GEORGE ISLAND - Caleta Ardley

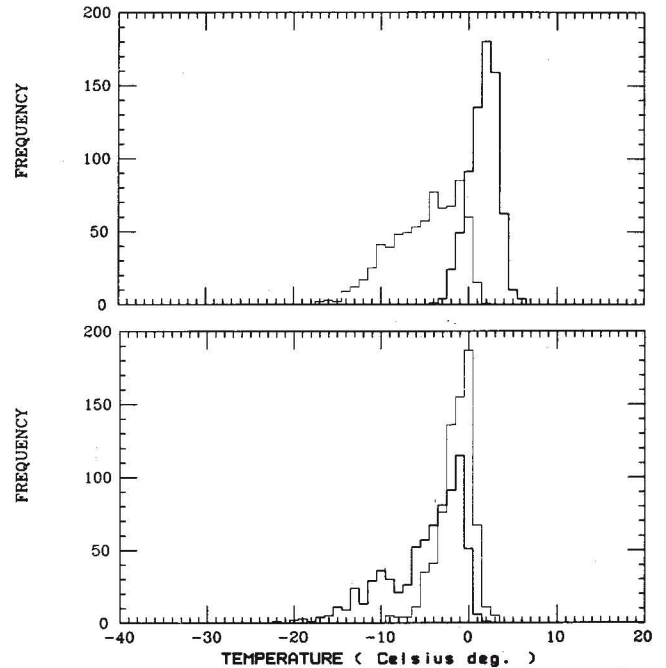


Fig. 3. As in Fig. 2 for the ground temperature.

KING GEORGE ISLAND - Caleta Ardley

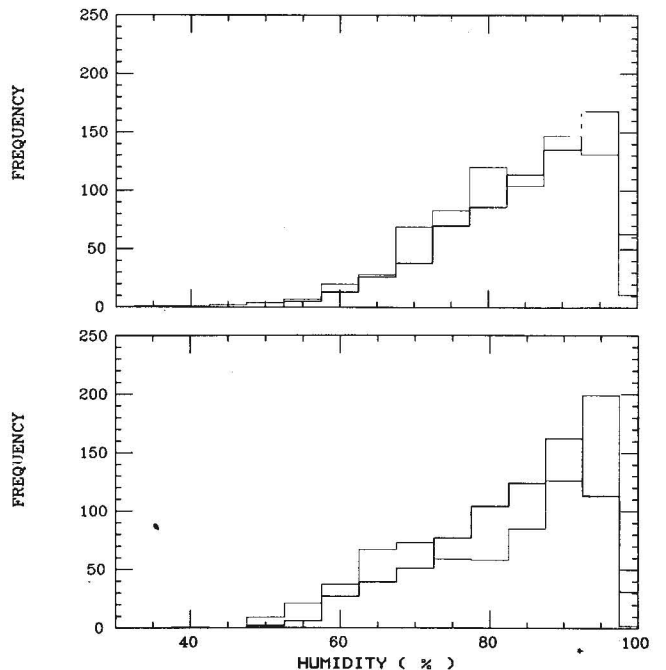


Fig. 4. As in Fig. 2 for the relative humidity.

a.s.l.), with the Meteorological Center (Tte. Marsh Base) just down of it. Figure 6a shows the measurement site (left), 'Las Estrellas' village (center) and the Soviet Union Base (right). Figure 6b shows the L.A.R.C. building.

The cosmic ray detector is a standard neutron monitor type 6 - NM - 64. It was tested operationally in Santiago from August 1988 to December 1990 (Cordaro *et al.*, 1990;

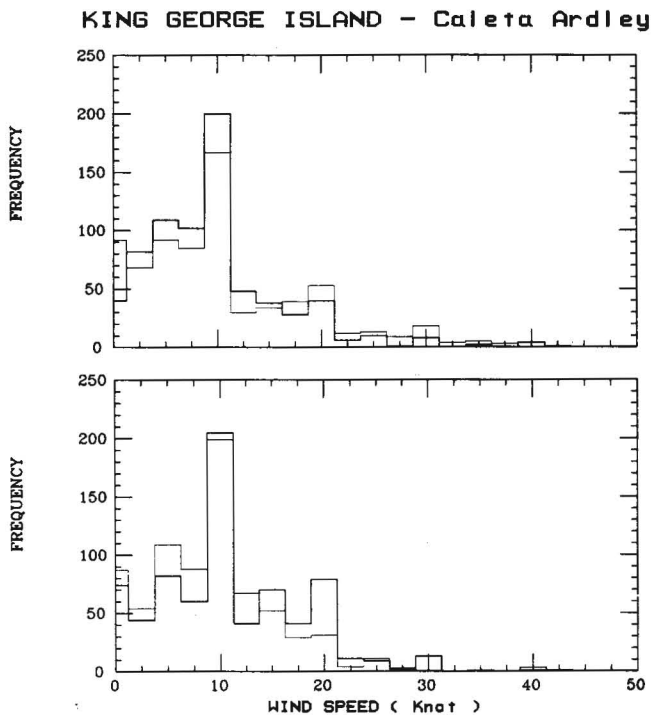


Fig. 5. As in Fig. 2 for the wind speed.

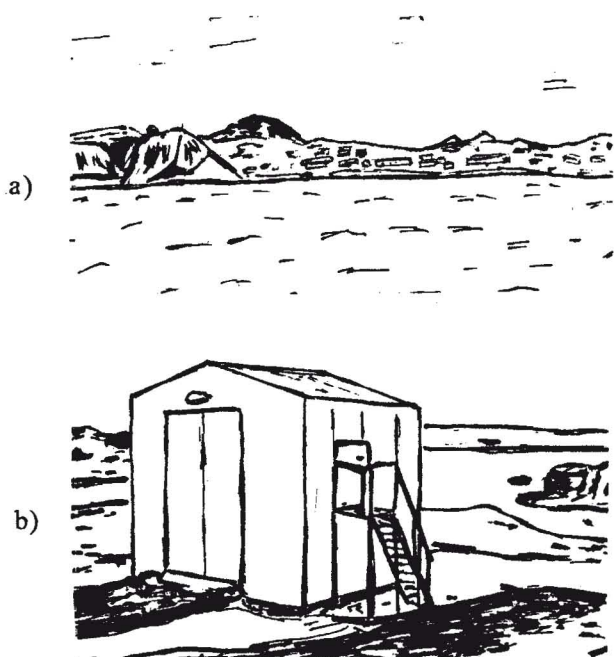


Fig. 6. a) Artistic view of the measurement site from sea: L.A.R.C. position in the left side (up on the hill); Tte Marsh Base and 'Las Estrellas' village in the center; the U.S.S.R. Base on the right side. b) the L.A.R.C. building.

Cordaro and Storini, 1991, 1992). From January 19, 1991 it is continuously recording on 5 minute base; data collected every 15 days are transmitted to Santiago for processing and then delivered to Rome.

Uncorrected-pressure data are here presented for January to April, 1991 together with the average atmospheric pressure on hourly base (see Figure 7 to 10). Contemporary meteorological data have been obtained. In general, their time behaviours agree with the picture of the natural environment derived from the 1990 data set. In particular, atmospheric pressure data have been used to check our own measurements. Scientific results based on the above data will be discussed in a forthcoming paper.

CONCLUSIONS

With the support of the Chilean Antarctic Institute (I.N.A.Ch.), the high-latitude detector (6 - NM - 64 type) of the Chilean cosmic ray network has been installed on King George Island (Fildes Bay, 'Caleta Ardley'; geographic position: 62° 11' 8" S and 58° 55' 0" W). Preliminary data are presented.

Computed effective vertical cosmic-ray cutoff rigidities for Epoch 1980 (Smart and Shea, 1985) suggest for 'Caleta Ardley' a cosmic-ray threshold near 3 GV. A more accurate cutoff evaluation will be made in the near future.

Revised hourly data will be available on request after about 12 months. Briefly, cosmic ray measurements from 'Caleta Ardley' will be useful to investigate solar modulation of galactic cosmic rays, adding a key measurement site to the world-wide network of neutron monitors (Shea *et al.*, 1984). Moreover, we expect to learn more about Subpolar Physics, particularly in the following areas:

- geomagnetic-induced effects;
- north-south asymmetries;
- solar particle features;
- solar proton-influence on the terrestrial environment (atmosphèric ozone dynamics, radiobiological protection, hazard for flying electronic devices, . . .).

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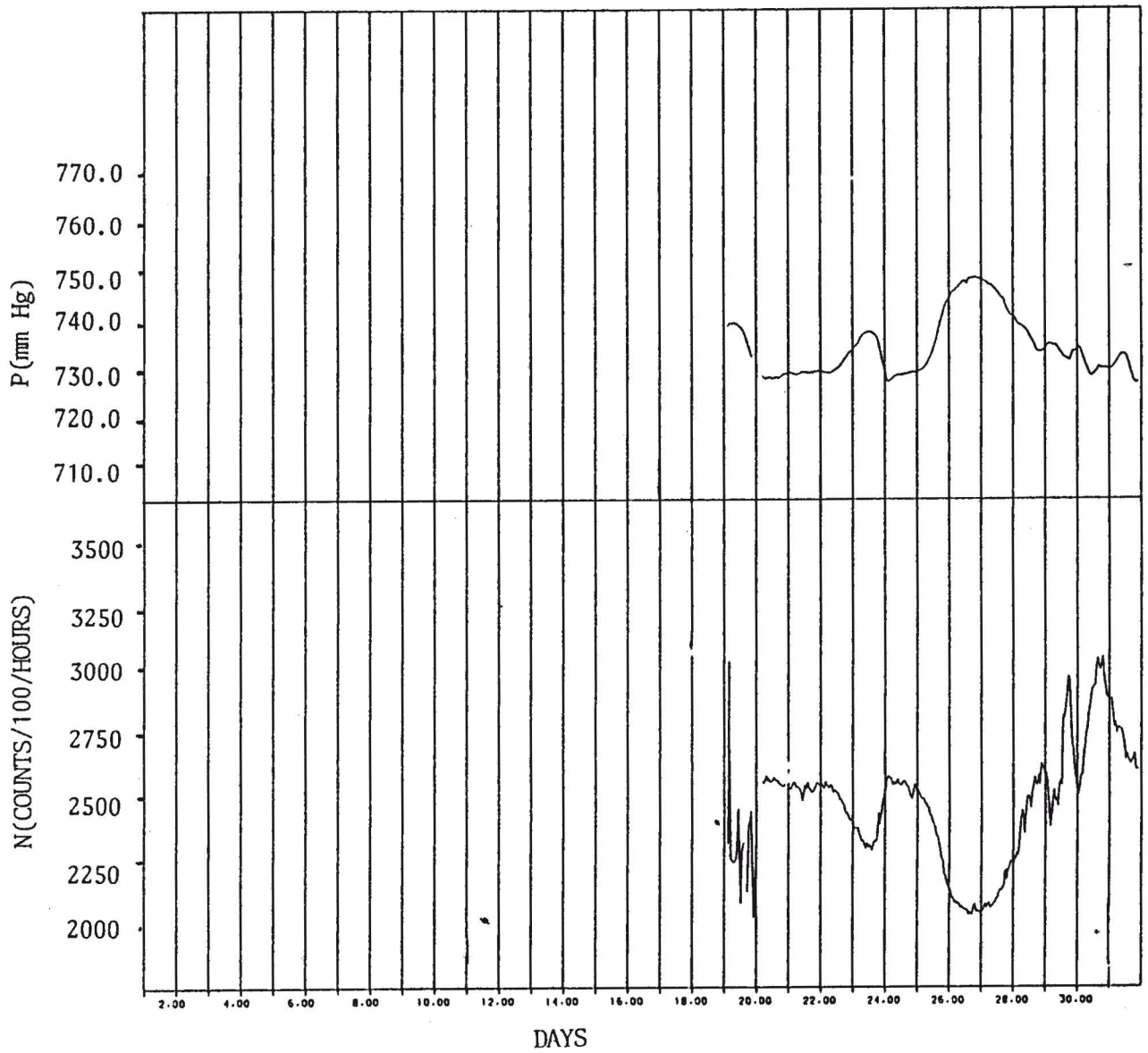


Fig. 7. Atmospheric pressure and hourly-counting rate registered by L.A.R.C. during January 1991.

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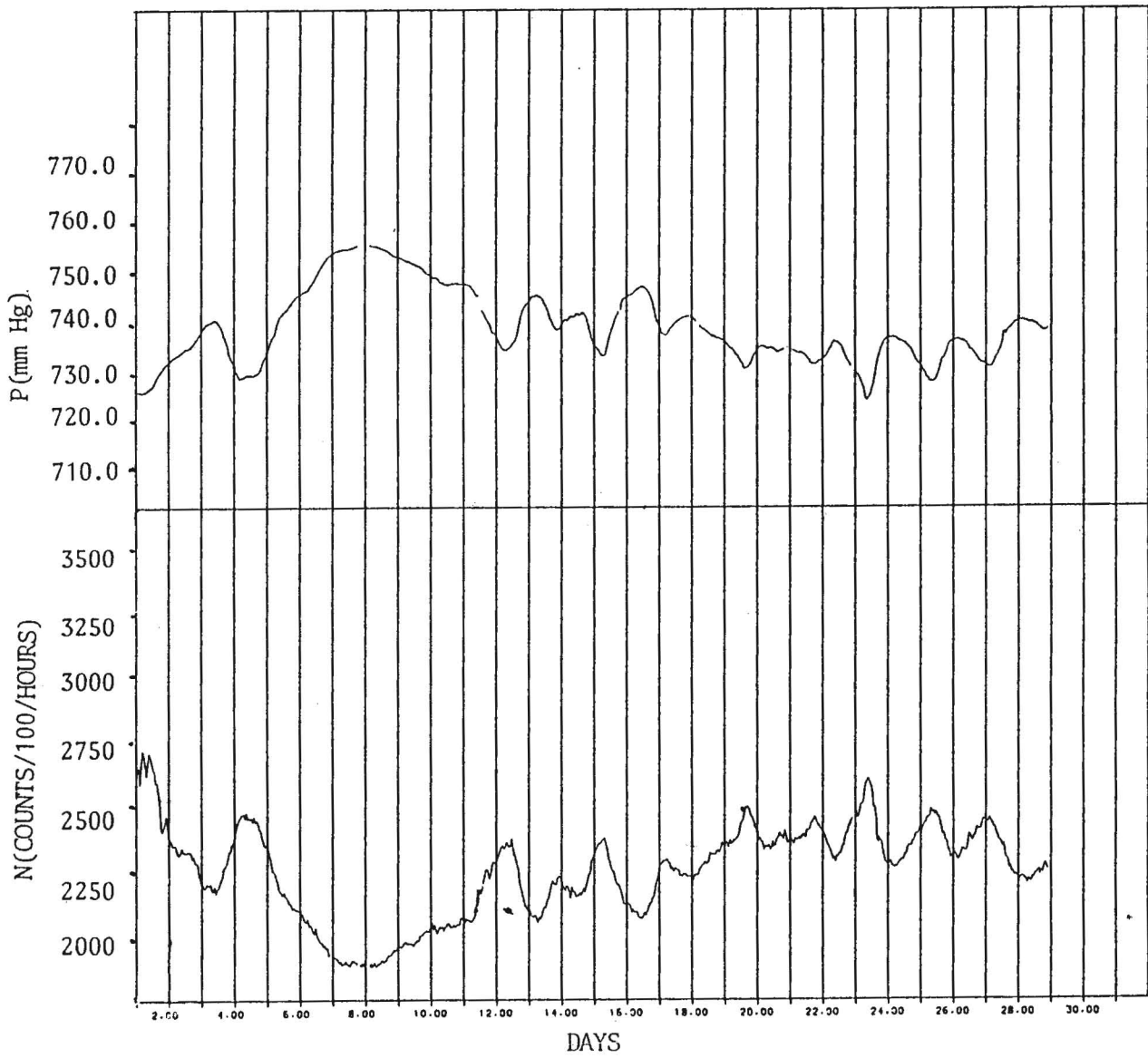


Fig. 8. As in Fig. 7 for February 1991.

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ANTARTICA-CHILE MARZO 91

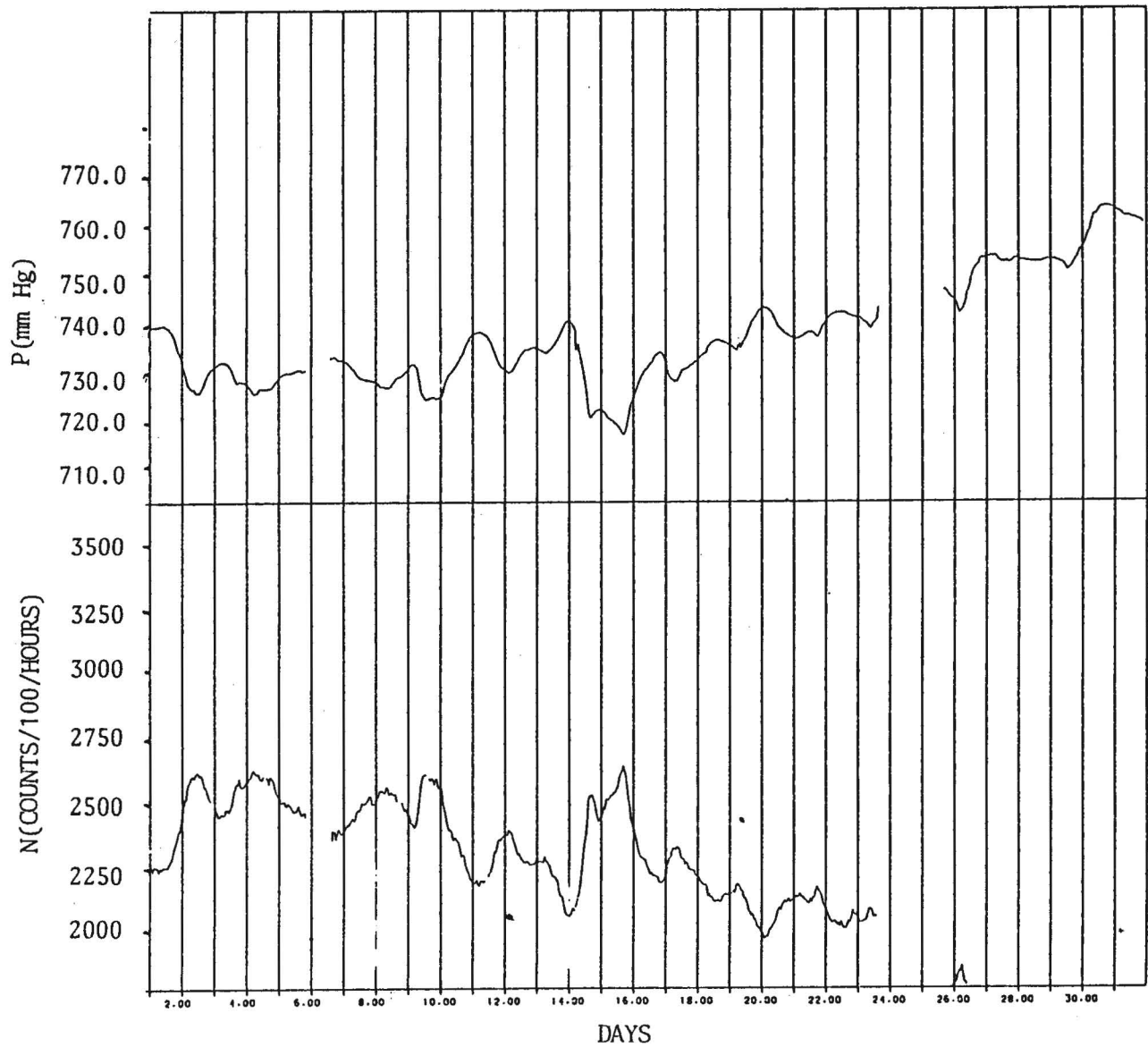


Fig. 9. As in Fig. 7 for March 1991.

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ANTARTICA-CHILE ABRIL 91

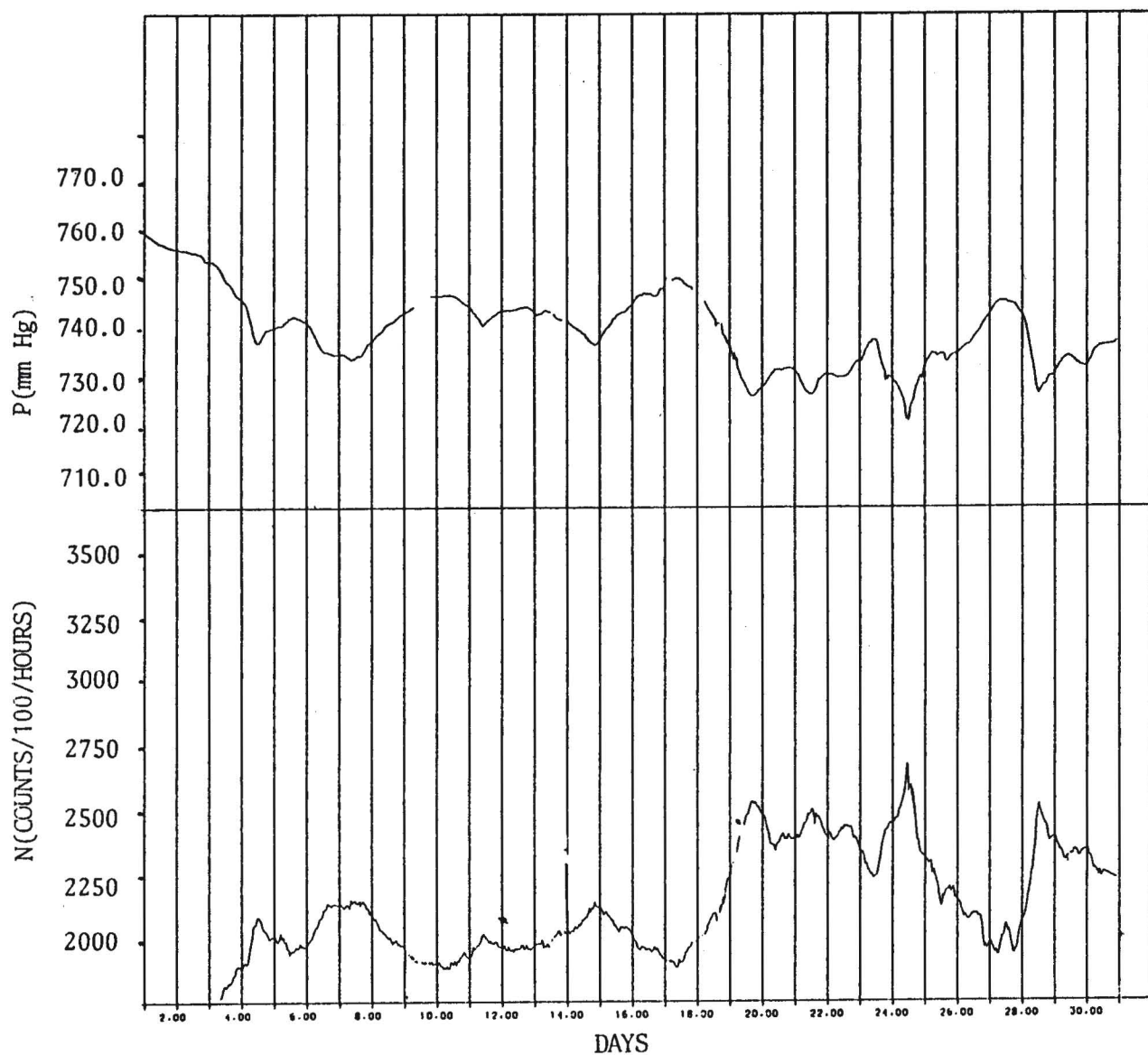


Fig. 10. As in Fig. 7 for April 1991.

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