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The construction and work of magnetic observatory "Arctowski" (King George Island, Sotuh Shetland Islands) *)

ABSTRACT: The paper presents a construction of magnetic observatory "Arctowski" on King George Island. The parameters of magnetic instruments and mean values of D , H , Z and $F(T)$ of magnetic field are presented. Examples of registration of changes of the magnetic field are noted.

Key words: Antarctic, magnetic observatory, earth magnetism

A group of workers of Institute of Geophysics, Polish Academy of Sciences, constructed a geophysical observatory during a period from 29th December 1977 until 15th March 1978; it included seismic and magnetic stations. Due to specific conditions of measurements and to avoid the artificial disturbances the observatory was localized at a some distance from the other buildings. A position of the magnetic observatory is presented on Fig. 1.

The observatory building is described in the paper of Kowalski (1980). The other construction problems had to be overcome during building works of magnetic pavillions. These buildings could not compose of any magnetic elements i.e. iron. The construction elements have been transported from the country and they were made of wood, connected with brass screws and nails. The pavillion foundations were laid of concrete. The soil on which the magnetic pavillions were built, composed of slightly cohesive rock material transported by water from the nearby Point Thomas massif. Therefore, to protect the buildings from subsidence and sliding two foundation courses, each 0.3×0.6 m were laid for every pavillion; on every course five concrete posts, each $0.4 \times 0.4 \times 1$ m, were put. These posts were connected with foundation courses by pouring them with concrete up to 0.5 m

*) This work was made during the Second Antarctic Expedition (1977/78) by scientists from Institute of Geophysics, Polish Academy of Sciences.

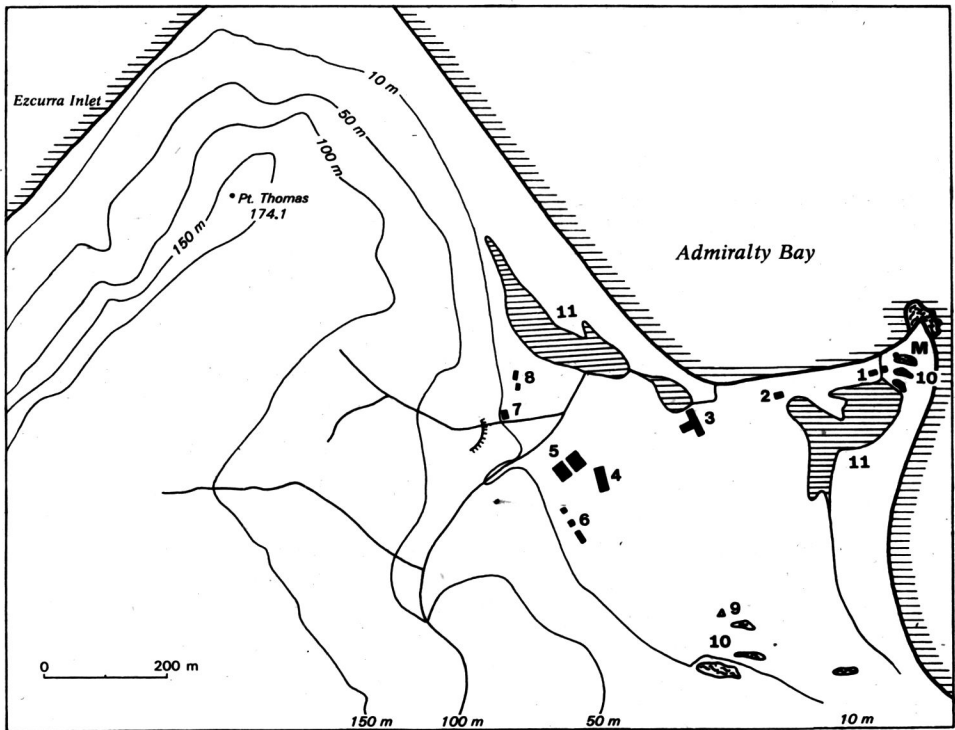


Fig. 1. Situation of geophysical laboratory and magnetic pavilions in Polish Antarctic Station Arctowski

1 — Biological laboratory, 2 — Meteorology — laboratory, 3 — Living house, 4 — Power station, 5 — Magazines, 6 — Summer laboratories, 7 — Geophysical laboratory, 8 — Magnetic pavilions, 9 — Geodetic pillar, M — Azimuth mark

(Fig. 2). The connection of the building with a foundation was done in the following way: the posts were covered by wooden beams attached with special copperplate bands. The floor of the building was fastened to the beams by proper brass screws. Such connection of the pavillion with its foundation was in fact good and resistant to very strong winds in the station area. The pavillions were quite large and of perpendicular parallelepiped shape of $2.5 \times 2.5 \times 6$ m. A localisation of the pavillions on the posts prevented a formation of snow-drifts just at the building walls and protected from flooding by water of melting snow. Thus, the pavillions were easily accessible all the year round. During laying of the foundations the ones for instrument columns were also built. In the measuring pavillion (Fig. 3). the column passed through the floor and was covered by a concrete plate strengthened by reinforcement of brass bars. A dilatation space between a floor and a column prevents a transfer of building vibration to the column. In the registration pavillion (Fig. 4) the weight of pillar was decreased by exchanging it into two smaller posts passing trough the floor and connected by concrete plate, which was reinforced by brass bars.

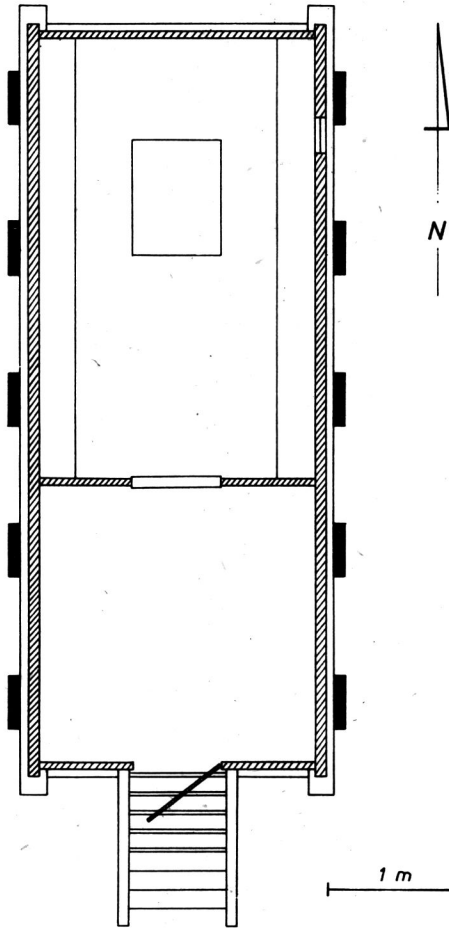


Fig. 2. Plan of the pavillion for magnetic measurements

On that plate there were the magnetic variometers. Both magnetic pavillions had the roofs covered with tar-board, tarred and strengthened by wooden battens. They have resisted very well the climatic conditions at the station. The magnetic pavillions possessed an installed electric system of 220 V, 50 Hz for lighting and heating and also a system of 12 V of direct current for feeding the instruments. In the registration pavillion there were the heaters controlled by a thermostatic system. The registration pavillion was localized at a distance of about 25 m and the measuring pavillion at about 50 m from the laboratory. In the latter there were a set of batteries of 12 V feeding the instruments, a three-channel recorder for recording the changes of a magnetic field and a clock, giving the time marks at the recording tape.

A preliminary registration was started in March 1978. In April the nonmagnetic heaters were installed for heating the registration pavillion and installing of thermostat was finished, than the parameters of registration

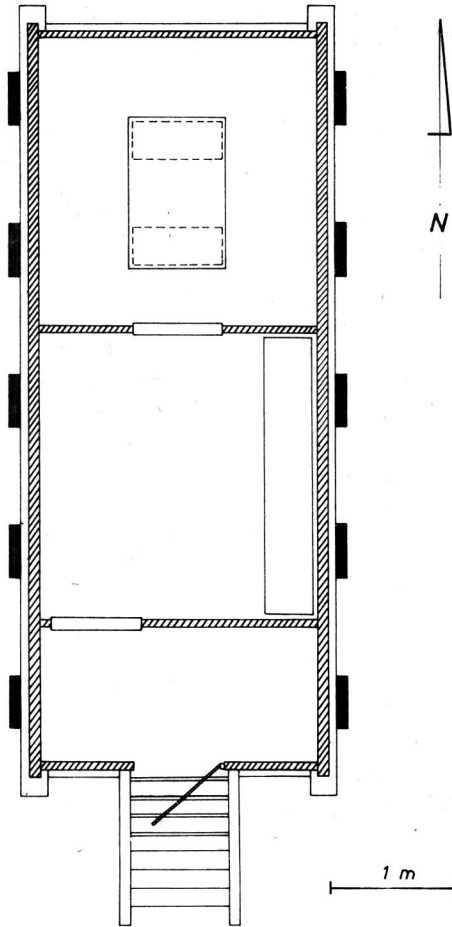


Fig. 3. Plan of the registration pavillion

instruments were chosen. From 18th May regular measurements of the magnetic field were started.

The magnetic observatory "Arctowski" is a typical, standard magnetic observatory. The registration instruments consist of photoelectric transformers of the magnetic field (described in the papers: Marianiuk (1977), Marianiuk, Gnoiński and Szymański (1978), amplifying and controlling systems, three-channel galvanometric recorder and clock for time signals. The recorder is produced by Metra Blansko in Czechoslovakia, the other instruments — in Institute of Geophysics, PAS. The registration is carried on for 24 hours a day. A visual record enables to estimate at once the state of magnetic activity. A standard recording speed equals 20 mm per hour. Changes of three elements of the magnetic field of the earth are registered: declination — D , horizontal component — H and vertical component — Z . The scale values for each element equalled in 1978: for declination — 0.16 minute per millimetre, for H — 1.15 nT per millimetre,



Fig. 4. Foundations of magnetic pavilions under construction

Photo R. Czajkowski

for Z — 1.01 nT per millimetre. The time signals are given by a quartz contact clock constructed in Institute of Geophysics, PAS. A control of the clock work was done by comparisons with signals of the radio time station of Buenos Aires. The clock worked very well and its correction in 1978 has not exceeded ± 30 sec what was entirely enough for registration with a recording speed of 20 mm/h.

Control measurements of the magnetic field have been carried through systematically from 20th May 1979 with QHM-410 La Coura of Danish production and with a proton magnetometer PMP2-252-69-01 produced in Institute of Geophysics. The values of declination and intensity of a horizontal component of the magnetic field were defined by QHM-410. The proton magnetometer enabled to measure a full intensity of the magnetic field F . The value of intensity of the vertical component Z was found by the formula: $Z = (F^2 - H^2)^{1/2}$. To find the value of declination a known geographical azimuth of a stable point — azimuth mark — from the measuring place was necessary. Such point was fixed on a pinnacle Hydrographic Point at a distance of about 500 m from the measuring pavillion and its geographical azimuth was found. The method of defining the azimuth mark is presented on Fig. 5.

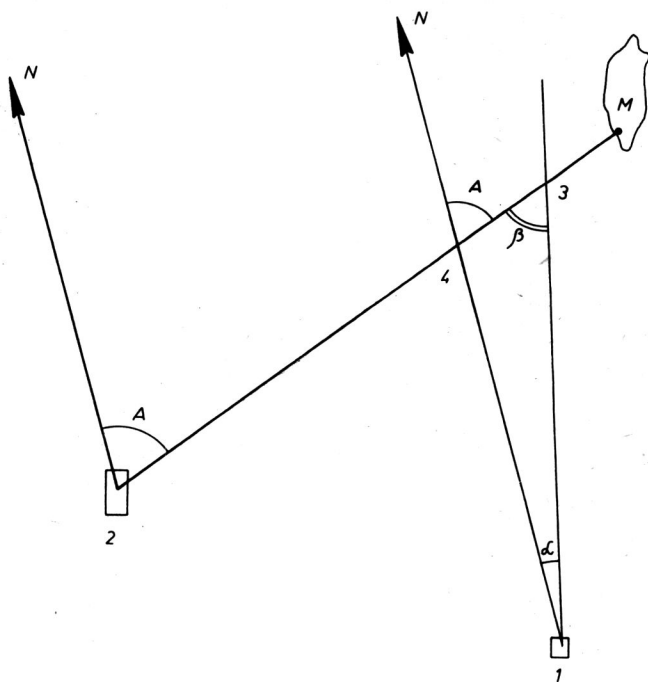


Fig. 5. The determination of the azimuth of azimuth mark from the pillar in pavillion for magnetic measurements

1 — Geodetic point, 2 — Pillar in pavillion for magnetic measurements, 3 — Standpoint of theodolite, N — Geographical azimuth (north), M — Azimuth mark, A — Geographical azimuth of azimuth mark determined in point 2

$$A = \alpha + \beta$$

The geographical co-ordinates of the magnetic observatory "Arctowski":
 are: $\varphi = 62^{\circ}09.6'S$; $\lambda = 58^{\circ}27.1'W$,
 the geomagnetic coordinates:

$$\Phi = 50.8^{\circ}S, \quad \Delta = 7.8^{\circ}E$$

and it lies on the elevation 6 m a.s.l.

The observatory belongs then to the one of lying on mean geomagnetic latitudes. The registered phenomena are similar to the one observed in other mean-latitude observatories.

A position of the magnetic observatory "Arctowski" in relation to the other magnetic observatories in Antarctic is presented on Fig. 6. It fills the gap between the observatories "Laurie Island" (Argentina) and Argentine Island (United Kingdom). The mean values of the element of the magnetic field observed in 1978 are:

declination D	—	+ 12.5°
horizontal component H	—	22 000 nT
vertical component Z	—	30 800 nT
total intensity $F(T)$	—	37 000 nT

The tables of indices of magnetic intensity K and of special phenomena from April to December 1978 have been prepared. The tables of mean hour values of three elements D , H , Z of the magnetic field from 1st June to 31st December 1978 have been prepared.

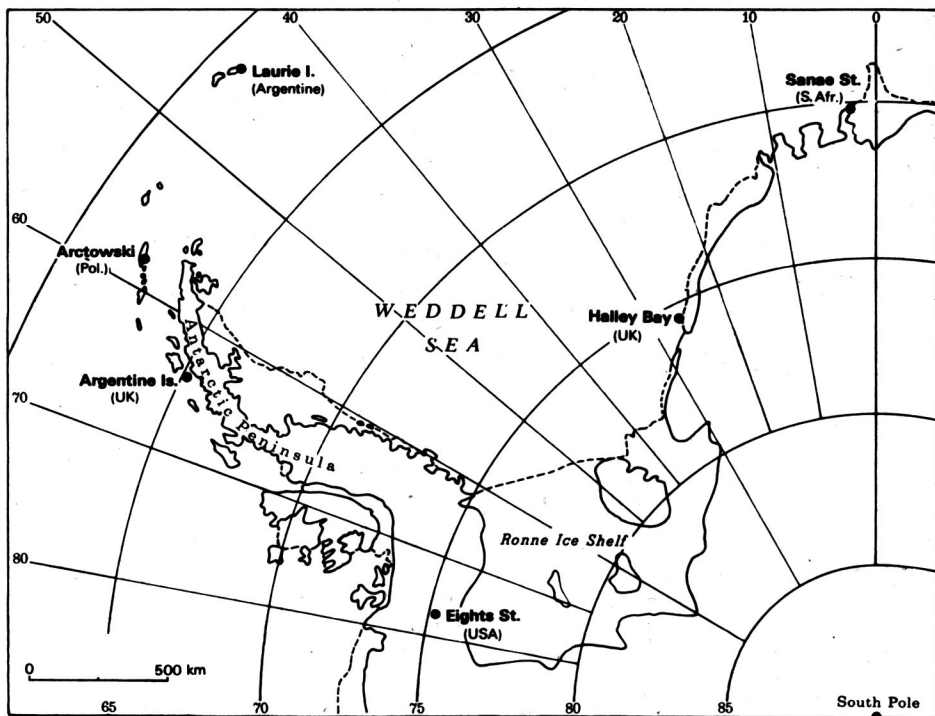


Fig. 6. Situation of magnetic observatory Arctowski and the nearest observatories in Antarctic

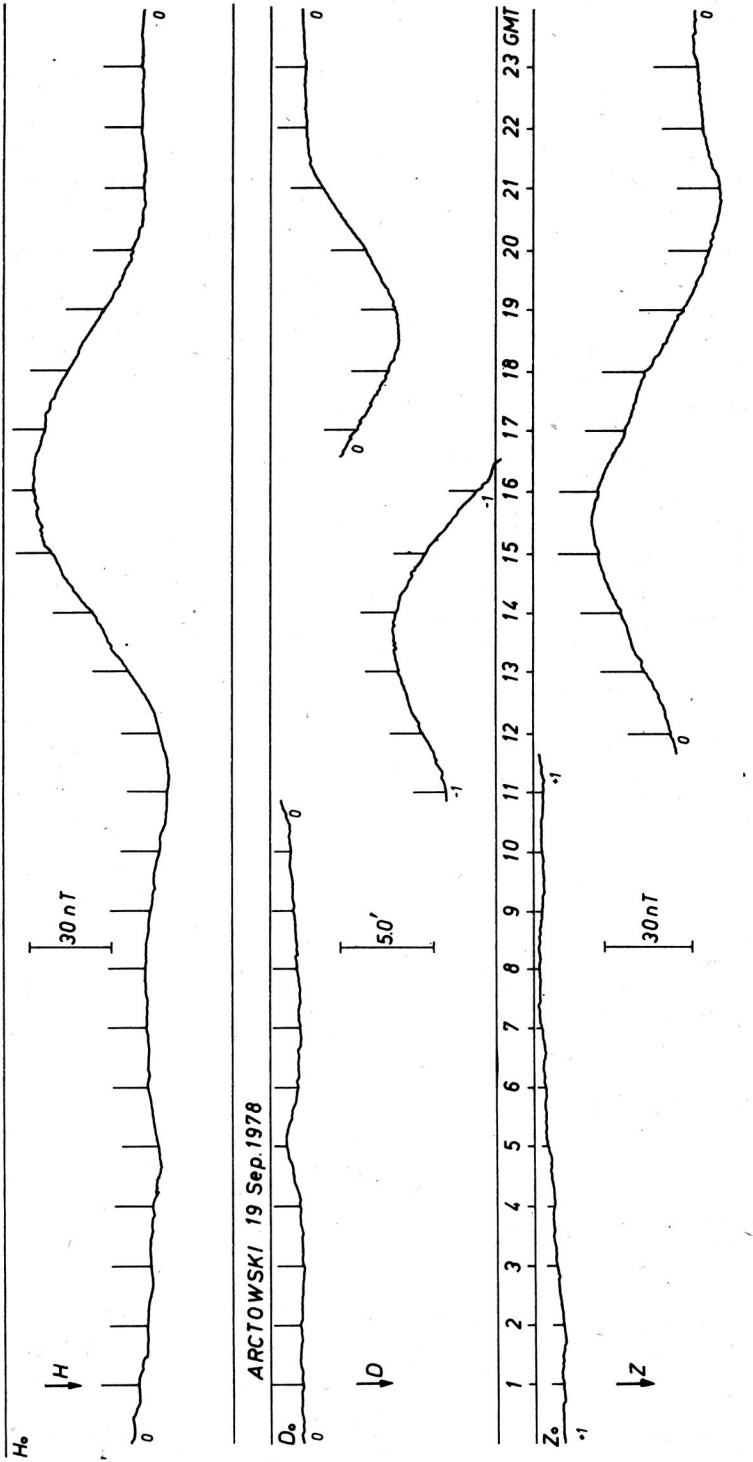


Fig. 7. Example of registration — magnetic quiet day

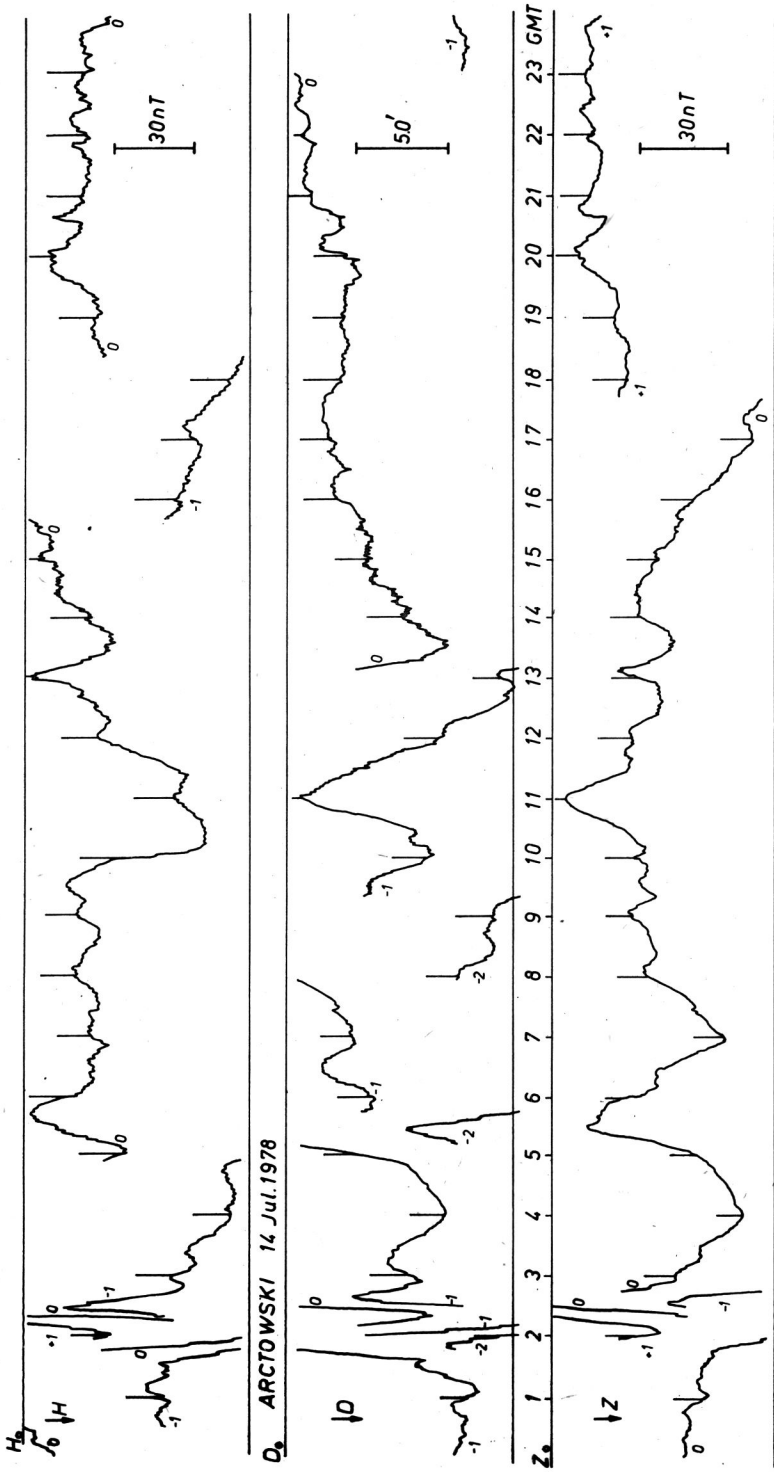


Fig. 8. Example of registration — magnetic disturbed day

The received records (examples of records on Figs. 7 and 8) of changes of the magnetic field elements and results of the measurements have been analyzed and are to be used to the edition of a magnetic yearbook.

The magnetic observatory "Arctowski" continues its work.

Summary

In summer 1978 a geophysical laboratory was constructed with a magnetic station "Arctowski". Construction of two magnetic pavilions, instruments for registration of changes of a magnetic field and other instruments for registration are described in the paper (Figs. 1, 2 and 3).

Parameters of registration instruments as well as geographic and geomagnetic co-ordinates of the observatory are presented as well as values of D , H , Z and $F(T)$ of geomagnetic field at the very beginning of the station work. Figures 7 and 8 present the examples of magnetic registrations of magnetically quiet, and disturbed days.

Резюме

Летом 1978 г. построено геофизическую лабораторию в состав которой вошла магнитная станция „Арцтовски”. Описано конструкцию двух магнитных павильонов, аппаратуру для регистрации изменений магнитного поля и другие приборы для проведения измерений (рис. 1, 2 и 3).

Представлено параметры регистрационной аппаратуры, географические и геомагнитные координаты обсерватории, а также приблизительные величины элементов D , H , Z и $F(T)$ земного магнитного поля в начальном периоде существования станции. Рисунки 7 и 8 представляют примеры магнитограмм в магнетически спокойном и возбужденном дне.

Streszczenie

W lecie 1978 r. zbudowano laboratorium geofizyczne, w którego skład weszła stacja magnetyczna "Arctowski". Opisano konstrukcję dwóch pawilonów magnetycznych, aparaturę do rejestracji zmian pola magnetycznego i inne przyrządy do przeprowadzania pomiarów (rys. 1, 2 i 3).

Podano parametry aparatury rejestrującej, geograficzne i geomagnetyczne współrzędne obserwatorium oraz przybliżone wartości elementów D , H , Z i $F(T)$ ziemskiego pola magnetycznego w początkowym okresie istnienia stacji. Rys. 7 i 8 przedstawiają przykłady rejestracji magnetycznych w magnetycznie spokojnym i zaburzonym dniu.

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Paper received 17 December 1979

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