Astronomy for the developing world
IAU Special Session no. 5, 2006
J.B. Hearnshaw and P. Martinez, eds.

doi:10.1017/S1743921307006941

The astronomical observatory "Khurel Togoot" of Mongolia

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Abstract. In this paper the basic researches, telescopes and devices of the Khurel Togoot astronomical observatory, which was founded during the International Geophysical Year, are briefly described. Our astronomical observatory is located on Bogd Mountain near the capital city Ulaanbaatar. Almost 50 years of scientific work has been carried out there. In particular, astrometric researches, GPS, solar researches and observations of minor planets are conducted. Now these scientific researches basically are maintained and extended, with the introduction of modern technology. As an example of the data received by our solar telescope 'Coronagraph', some solar images will be shown. Recently we equipped this telescope with a CCD camera. Because of the transformation of the economy in Mongolia, there are at present difficulties with the preparation of young professional astronomers and with the purchase of new astronomical equipment.

Keywords. Khurel Togoot Observatory, Mongolian astronomy, solar physics

1. Introduction

The astronomical observatory ($\phi = 47°51'50''$, $\lambda = 107°03'02''$) of Mongolia is located on the "Bogd" mountain, about 15 km south-east of the capital city Ulaanbaatar. The words "Khurel Togoot" (bronze cauldron) are the name of the site. The astronomical observatory was founded during the first International Geophysical Year by the initiative of our astronomer S. Ninjbadgar in close cooperation with scientists from Russia and Germany.

In 1957, the construction of the main buildings (Figs. 1, 2, 3) had begun and some telescopes produced by Carl Zeiss, Germany were ordered to develop the following research activities: determination of time and latitude by astronomical observations; observation of near-Earth artificial satellites; observation of solar active phenomena; recording and study of earthquakes; observation and investigations of the telluric magnetic field and its variations; study of impact of atmospheric turbulence on seeing quality ("astro-climate").

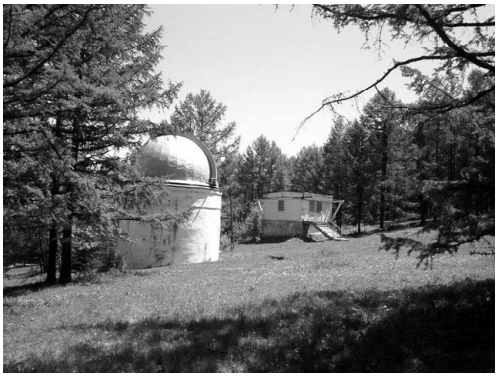
Now these scientific directions basically are continued and expanded and are based on modern information technology. During the period of the socialist system collapse, astronomy and other fundamental sciences in our country were in a difficult situation, because of insufficient financial support.

Presently, the restoration of the fundamental sciences has begun, though gradually. In 1996, the Research Centre of Astronomy and Geophysics of the Mongolian Academy of Sciences was founded. Our astronomical observatory has become the part of it.

Now there are 20 research workers in the staff of our observatory; the majority of them were educated and trained in Russia. Some our scientific results were published in Russian and Mongolian journals. In our library, we have copies of astronomical books and journals, published in Russia and East Europe 15-30 years ago. Now we use freely

Figure 1. l: The main building of the Astronomical Observatory "Khurel Togoot"

Figure 2. r: Buildings of the Coronagraph and permanent GPS station (altitude 1608 m)



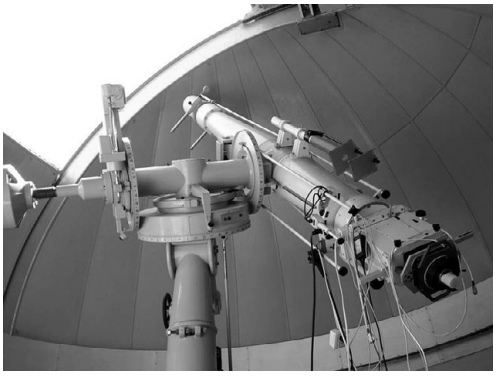


Figure 3. l: Buildings of the coudé refractor and the meridian circle.

Figure 4. r: The Coronagraph telescope with Hα Halle filter

accessible via Internet scientific papers, in particular, from the NASA ADS database. In the condition of economic reconstruction in Mongolia, we are facing difficulties in training young professional astronomers and in acquisition new astronomical instruments.

2. Instrumentation

Our observatory is equipped with the following instruments: Zenith and Meridian Circle for definition of latitude and time series, the Coronagraph telescope for observations of solar active phenomena and solar corona, permanent GPS (IGS) station, coudé refractor and 45-cm Meade Schmidt Cassegrain telescope. In the Figures 4–6 some telescopes are shown, they are used now for the scientific and educational purposes.

3. Research activities

The astronomical observatory (AO) had and has been conducting observations and research in the following fields:

(a) **Astrophysics**: Since 1964 the study of solar active phenomena has been started. The following researches were carried out:

- Theoretical calculation of line formation in the atmosphere of the Sun,
- Development of computation methods for radiative transfer problems,

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Figure 5. Meridian circle for time service

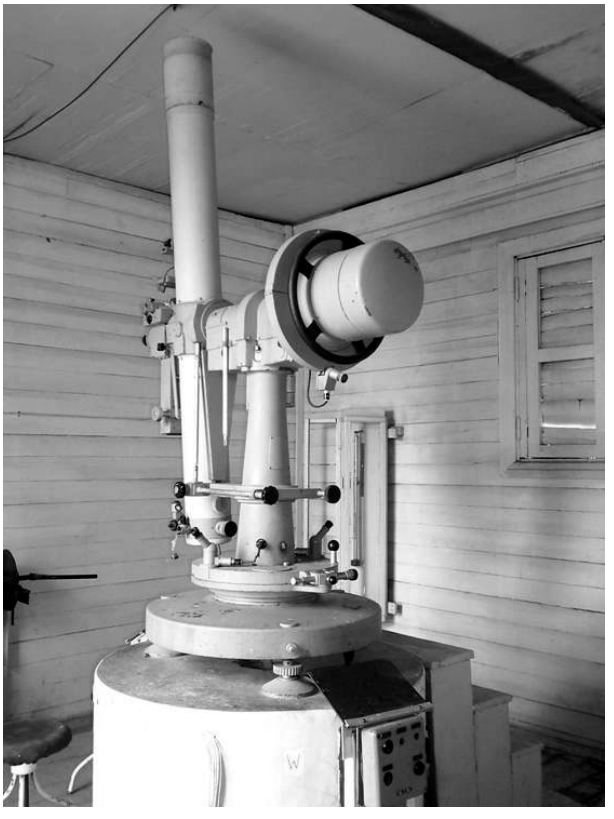

Figure 6. Zenith telescope for definition of latitude

- Physics of formation of spectral lines of H and CaII in the chromosphere and in the prominences of the Sun,
- Observing a flares and filament ; prominence,
- Observations of the coronal lines 530.3nm 637.4nm near prominence and study of the correlation between prominence and physical conditions of the corona,
- Emission of the solar "cold" corona.

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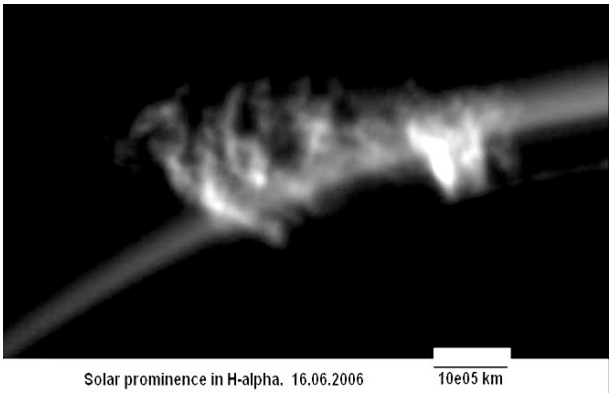

Figure 7. Solar prominence in Hα, 16 Jun 2006

(b) **Astrometry**: The astrometric continuous latitude and time determination by observation of accurate star position have been performed at the observatory since 1958. By definition of the local latitude and longitude, and their variations our AO were contributing to the international program for Earth's polar motion study and Earth Rotation Service.
Since 2002 our AO has begun the observation of minor planets (asteroids) and meteors by "MEADE" telescope with mounted CCD and its astrometrical processing.

(c) **Satellite geodesy**: Since 1967, the satellite observation group of our AO had been involved in global satellite geodesy and geodynamics projects based on satellite photographic methods using the AFU-75 and FAS cameras, and a first generation satellite laser ranging system. The staff has participated in a number of international observational campaigns and primary data processing within the "Intercosmos" programme, including determination of the Earth's primary parameters, study of the Earth's atmosphere, establishment of a high accurate geodetic network in Mongolia by the balloon-triangulation method.
Since 1995 AO conducts GPS research for geodynamics and geodetic purposes and its aim is focussed on the establishment of geocentric geodetic network, study of dynamics and kinematics of Mongolian tectonics thus contribute to the Asian deformation model. Currently the AO maintains and operates four permanent GPS stations almost evenly distributed around the territory of Mongolia and has more than 15 points for campaign style GPS measurements.

4. Examples of solar images

As an example of our results I present here the last images of the solar active phenomena observed by the coronagraph. Last year we bought an Apogee CCD camera U4 for the coronagraph. The Hα-filter with half bandwidth of 0.5 Åis used. We obtained excellent images of solar prominences, sunspots and active regions.

5. Conclusions

Considering still good condition of our telescopes and available scientific staff we conclude that:

• Our telescopes can be used successfully for the scientific and educational purposes. It is clear from the solar images obtained with the Coronagraph.

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Figure 8. left: Solar prominence and chromosphere

Figure 9. right: Same as Fig. 8

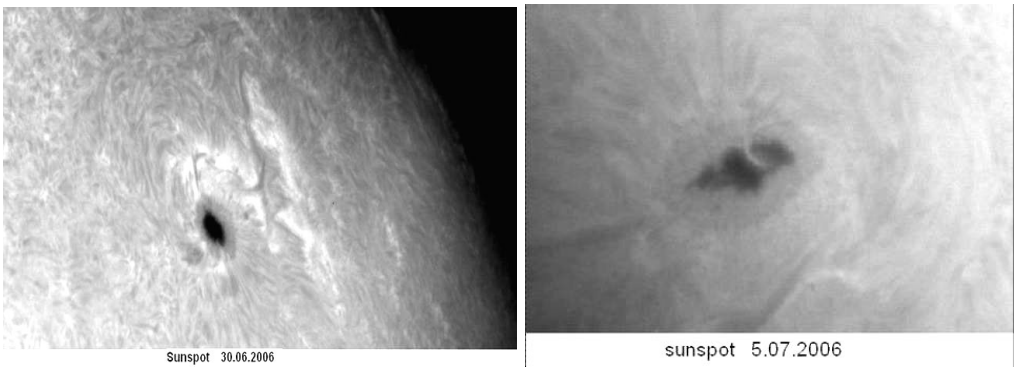

Figure 10. a: Big sunspot and filament; b: Big sunspot in fig. 10a after 5 days

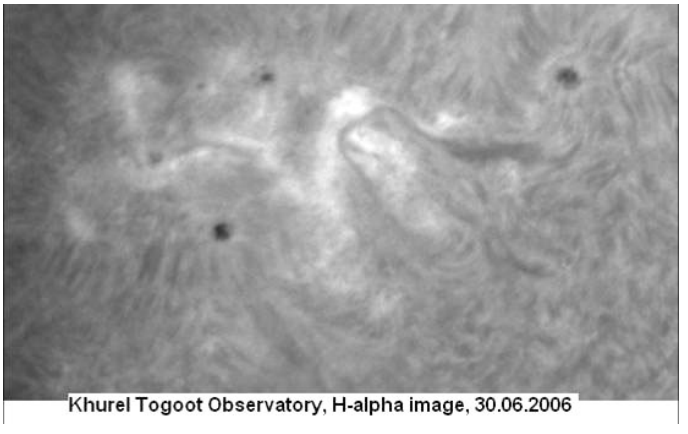

Figure 11. Solar active region

- All data and results obtained during 1964-2006 years have great scientific value.
- The further improvements of telescopes and the supply of them with modern devices are required.
- Training of young astronomers at foreign universities is very actual.
- It is necessary to expand scientific collaboration with the international astronomical organizations.

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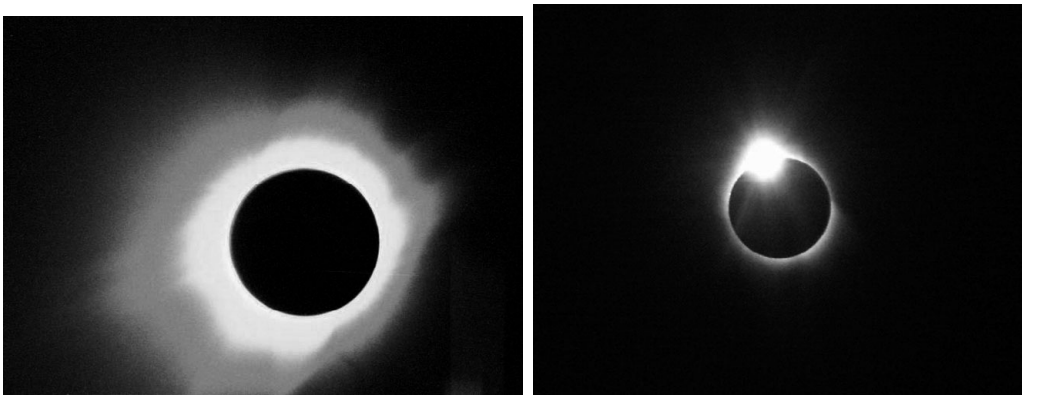

Figure 12. left: Green solar corona, at total solar eclipse, 29.03.2006. Photo by D. Batmunkh, Ch. Lkhagvajav and G. Davaakhuu. From Terskol Observatory, Russia; right: Diamond ring, otherwise same as figure on left.

Acknowledgement

The author would like to thank Prof. Oddbjorn Engvold for financial assistance to attend the IAU General Assembly in Prague. I express thanks also to Prof. John Hearnshaw for the invitation to participate in the special session 'Astronomy for the Developing World' of the IAU.