Struve Geodetic Arc

No 1187

1. BASIC DATA

State Parties: Belarus, Estonia, Finland, Latvia, Lithuania, Norway, Republic of Moldova, Russian Federation, Sweden, Ukraine

Name of property: Struve Geodetic Arc

Location: Different parts of the nominating States

Date received: 28 January 2004

Category of property:

In terms of the categories of cultural property set out in Article 1 of the 1972 World Heritage Convention, this is a *site.*

Brief description:

The Struve Arc is a chain of survey triangulations, stretching from Hammerfest in Norway to the Black Sea, through 10 countries and over 2820 km. These are points of a survey, carried out between 1816 and 1855, by the astronomer Friedrich Georg Wilhelm Struve. The original arc consisted of 258 main triangles with 265 main station points. The survey helped in determining the shape of earth and its size and played an important role in the development of accurate topographic mapping. The nomination includes 34 of the original station points, with different marking – from a drilled hole in rock, through iron cross, cairns, or built obelisks.

2. THE PROPERTY

Description

Since around 500 BC it had been known that the earth was not flat, but of some spherical shape. In the 3rd century BC the surveying technique and theory, for determining the size of the earth, has been developed by Eratosthenes. This theory remained in use until the era of satellite geodesy. Eratosthenes' theory, using length measurement and angles determined by star observations made it possible to determine the size of earth, while the measurements themselves were still not accurate, mainly due to methods and equipment.

In the 17th century better measuring equipment was developed, together with a new method, using triangulations. According to this method, a much shorter line had to be measured accurately, while the long distances were covered by a chain of triangles. These triangles, spanning several hundreds kilometres, having each of their sides (**base lines**) as long as 100 km and each triangle in the chain having at one common base line with at least one other triangle and two common corners or **station points** with another triangle.

The triangulation method helped establishing in the 1730s-40s the true shape of earth, through long arcs in Peru and Lapland. There was still the unsolved problem of the size of the world, getting now even more complicated, knowing that the world is not a perfect sphere. The different early arcs in France, Peru, Lapland, Italy, S. Africa and Austria had different shortcomings which did not allow for an accurate solution of this issue.

The defeat of Napoleon, followed by the Vienna conference and the decision in 1815 of the establishment of agreed international boundaries in Europe required accurate mapping. At the same time, accurate mapping became a priority for the new European rulers who did not trust a long lasting peace and needed those maps for military purposes. These needs were strongly felt in Russia, where Tsar Alexander the 1st provided the astronomer Wilhelm Struve with all the resources for a project he suggested of a new long geodetic arc. This can be seen as the first step for the development of modern geodetic framework and topographic mapping.

At this time a very long arc has been measured in India by Lambton and Everest, completed in 1840. Another, shorter arc has been measured in Lithuania, by Carl Tenner. Struve was aware of these arcs and at the opportunities presented by their results (two long arcs are needed to establish the most accurate shape and size of the world). Struve was working at the Dorpat (Tartu) university in nowadays Estonia, and decided that the arc he is going to establish will follow a line of longitude (meridian) passing through the observatory of the university. The new long arc, called later "The Struve Arc" was finally established by connecting earlier, shorter arcs, with a southern one measured by Tenner, and their extension to the north and south. The arc covered thus a line connecting Fuglenaes near Hammerfest in the far north, along 2800 kms, with Staro-Nekrasowka, near Ismail, on the Black Sea shores. It stretches today through ten different countries.

The subject of this nomination are 34 of the original **station points** established by Struve and his colleagues, between 1816 and 1851, in order to establish the Struve Arc (see the attached list).

There are 4 points in Norway, 4 in Sweden, 6 in Finland, 1 in Russia, 3 in Estonia, 2 in Latvia, 3 in Lithuania, 5 in Belarus, 1 in Moldova and 4 in Ukraine.

The full description of each one of the 34 nominated points is in the nomination file. In general, these are different markings which could be described as:

- Small hole drilled in rock surface. Sometimes filled with lead.
- Cross shaped engraved mark on rock surface.
- Solid stone or brick with a marker set in it.
- Structure of rocks (cairn), with a central stone or brick, marked by a drilled hole.
- Single brick.
- Specially constructed "monument" to commemorate the point and the arc.

Management regime

Each of the nominating countries has their own regime to manage the heritage. At the same time the ten countries are setting up a joint "management mechanism", in the form of a coordinating committee, to coordinate the management of the nominated sites.

Many of the nominated "sites" are points in rock or of another shape, with very small area around them, as part of the nomination. Most of them are still part of the national geodetic system and therefore still in potential use and practical importance. Therefore they are managed by national geodetic services and controlled by national cultural heritage institutions.

The existing management and legal protection were two of the criteria used by the state parties to choose the 34 points out of many more in the Struve Arc.

Legal provision:

All the suggested points are legally protected, and in most cases by two laws – the one protecting geodetic points and the other for the protection of cultural heritage.

Resources:

Most of financial resources are provided by the geodetic services, as a regular activity of maintaining their active geodetic points. They are also responsible for the regular maintenance of the sites. Few of the nominating states indicated that additional funding will be required if the sites are inscribed on the World Heritage list. These funds will be required for setting the proper plaques and for the improvement of presentation.

Justification by the State Parties (summary)

Determining the size and shape of the world has been one of the most important problems of natural philosophy since at least the 4th century BC. The development, in the 17th century, of a measuring system called "triangulation", improved the ability to determine the size and shape of the world. By this system long chains of triangles, creating "arcs", were measured stretching along hundreds and thousands of kilometres. "Struve Geodetic Arc" is one of them.

No accurate mapping is possible without a framework of triangulation stations. No navigation, planning or any cartography, is possible without such mapping. The arcs helped in developing this system and its accuracy.

Struve's arc is outstanding in its length (over 2820 km) and accuracy. Only an arc completed in 1954 exceeded it for length. Its accuracy equals to 4 mm in a km. It assisted in developing new and more accurate measuring equipment, and indirectly in the "promotion" of the standard metric system. It was the first meridian measurement crossing borders of several countries – now ten. It was the base for mapping the countries it went through as well as of Central Eastern Europe.

Suggested Criteria:

Criterion ii: The site exhibits an important interchange of human values of collaboration amongst scientists from different countries. It exhibits an important step in the development of the sciences of the earth and the use of the state of the art technologies.

Criterion iii: The arc bears an exceptional testimony of measuring the earth over a time of three centuries, using trigonometric and astronomical observations along lines of longitude.

Criterion iv: The points of the arc are an outstanding example of an extraordinary development in science and knowledge of the world.

Criterion vi: The points of the arc are associated with Sir Isaac Newton's theory that the world was not an exact sphere, but rather an oblate spheroid.

3. ICOMOS EVALUATION

Actions by ICOMOS

An ICOMOS evaluation mission visited the sites in August 2004 and an ICOMOS representative attended a conference on the "Future of the Struve Geodetic Arc" held in September 2004.

ICOMOS has also received scientific desk evaluations and consulted its International Scientific Committee on CIPA – Heritage Documentation.

Conservation

The state of conservation of the different points being nominated is good. Many of them are still part of their national geodetic grid, and permanently maintained.

Conservation history:

The historic-cultural importance of some of the points was recognized long ago and many of them came under the protection of the cultural heritage legislation of the relevant countries. As recognized monuments, all rules were applied, including those of conservation. Most points lost their original plaques or lead in the holes. Some were re- installed, but at the exact original place.

Management:

The sites are properly managed.

Risk analysis:

The only potential risk could be the result of more visitors, following a World Heritage inscription. Such risk is one of the considerations of the new coordinating body created by the nominating countries.

Authenticity and integrity

This point is almost not applicable because of the special characteristics and value of the nominated property. All points are in their original location, some are in remote areas which have not been changed since the creation of the arc.

Comparative evaluation

There were earlier arcs than the Struve and there are longer ones now. The Struve Arc though was the longest and

most accurate when created and the longest for more than a century. It was the first for which special equipment was created and the first one crossing several countries

Outstanding universal value

General statement:

The Struve Arc has certainly Outstanding Universal Value, based on its contribution to the development of sciences, and collaboration amongst scientists, monarchs and nations.

ICOMOS believes that this nomination has an added value, being based on technological-scientific values and being submitted by ten state parties together.

An extension of this nomination, to include the arc connecting it with South Africa, should be considered in future.

Evaluation of criteria:

The nomination meets criteria ii, iv, vi.

Criterion iii does not apply.

4. ICOMOS RECOMMENDATIONS

Recommendation with respect to inscription

ICOMOS recommends that the World Heritage Committee adopt the following draft decision:

The World Heritage Committee,

1. Having examined Document WHC-05/29.COM/8B,

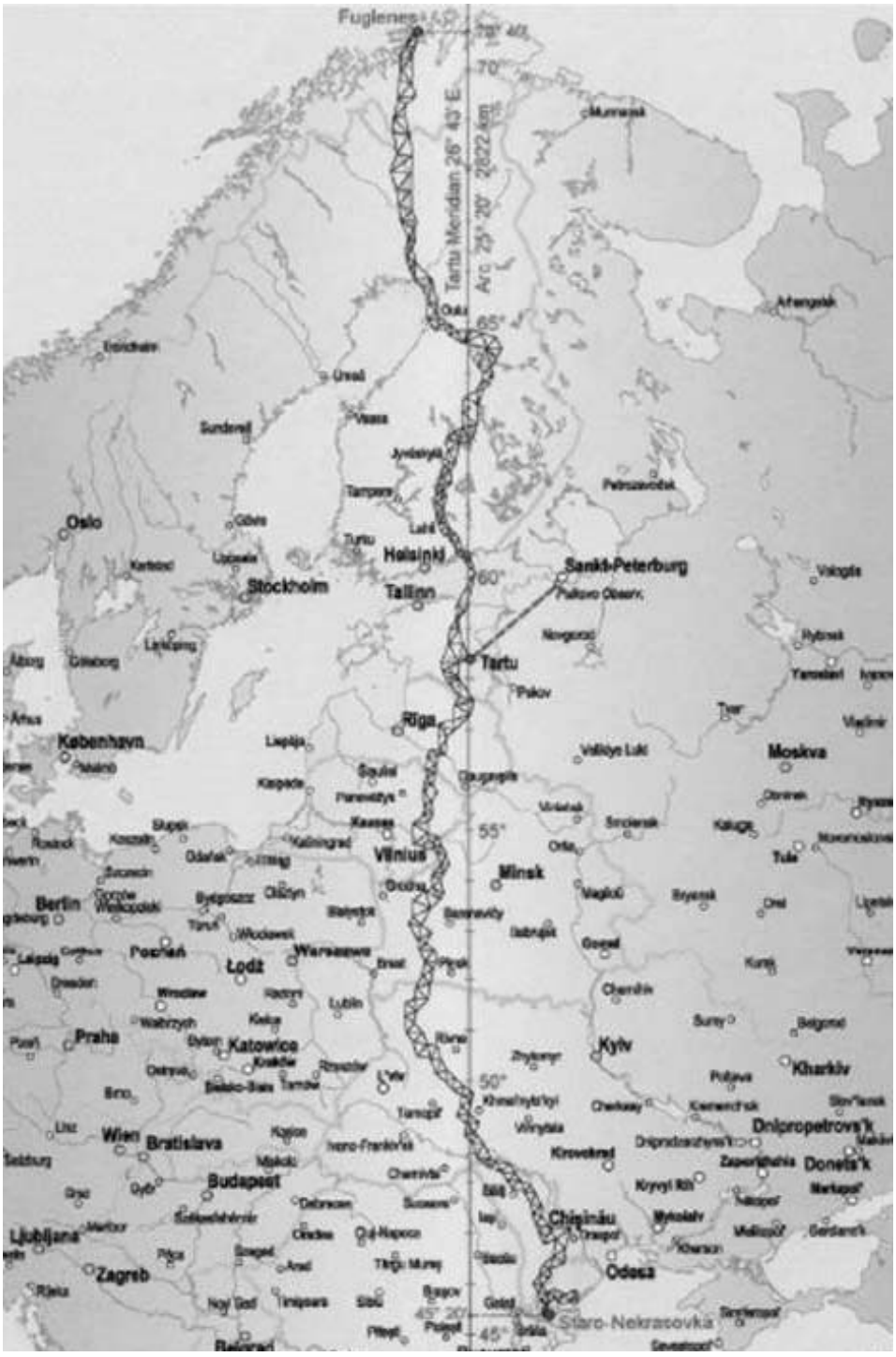
2. Inscribes the property on the World Heritage List on the basis of ***criteria ii, iv and vi***:

> ***Criterion ii***: The first accurate measuring of a long segment of a meridian, helping in the establishment of the exact size and shape of the world exhibits an important step in the development of earth sciences. It is also an extraordinary example for interchange of human values in the form of scientific collaboration among scientists from different countries. It is at the same time an example for collaboration between monarchs of different powers, for a scientific cause.
>
> ***Criterion iv***: The Struve Geodetic Arc is undoubtedly an outstanding example of technological ensemble – presenting the triangulation points of the measuring of the meridian, being the non movable and non tangible part of the measuring technology.
>
> ***Criterion vi***: The measuring of the arc and its results are directly associated with men wondering about his world, its shape and size. It is linked with Sir Isaac Newton's theory that the world is not an exact sphere.

ICOMOS, April 2005

Site No	ORIGINAL NAME Present name	State Party
1	**FUGLENAES** Fuglenes	Norway
2	**LILLE-REIPAS** Raipas	Norway
3	**LOHDIZHJOKKI** Luvdiidcohkka	Norway
4	**BÄLJATZ-VAARA** Baelljasvarri	Norway
5	**PAJTAS-VAARA** Tynnyrilaki	Sweden
6	**KERROJUPUKKA** Jupukka	Sweden
7	**PULLINKI** Pullinki	Sweden
8	**PERRA-VAARA** Perävaara	Sweden
9	**STUOR-OIVI** Stuorrahanoaivi	Finland
10	**AVASAKSA** Aavasaksa	Finland
11	**TORNEA** Alatornion kirkko	Finland
12	**PUOLAKKA** Oravivuori	Finland
13	**PORLOM II** Tornikallio	Finland
14	**SVARTVIRA** Mustaviiri	Finland
15	**MÄKI-PÄÄLYS** Mäkipällys	Russia
16	**HOGLAND, Z** Gogland, Tochka Z	Russia
17	**WOIBIFER** Võivere	Estonia
18	**KATKO** Simuna	Estonia
19	**DORPAT** Tartu Observatory	Estonia
20	**SESTU-KALNS** Ziestu	Latvia
21	**JACOBSTADT** Jekabpils	Latvia

22	**KARISCHKI** Gireišiai	Lithuania
23	**MESCHKANZI** Meškonys	Lithuania
24	**BERESNÄKI** Paliepiukai	Lithuania
25	**TUPISCHKI** Tupishki	Belarus
26	**LOPATI** Lopaty	Belarus
27	**OSSOWNITZA** Ossovnitsa	Belarus
28	**TCHEKUTSK** Chekutsk	Belarus
29	**LESKOWITSCHI** Leskovichi	Belarus
30	**RUDY** Rudi	Moldova
31	**KATERINOWKA** Katerinowka	Ukraine
32	**FELSCHTIN** Felschtin	Ukraine
33	**BARANOWKA** Baranowka	Ukraine
34	**STARO-NEKRASSOWKA** Stara Nekrasivka	Ukraine



Map showing the location of the nominated property

The Tartu Observatory - Tartu, Estonia – Dorpat (19)

The monument at the northern terminal of the arc - Fuglenaes (1), Norway