

The Struve Arc Inscribed on the UNESCO World Heritage List

Bjørn Geirr Harsson (Norway) and Vitali Kaptüg (Russia)

SUMMARY

In 1687 Isaac Newton presented as the first scientist a theory where the Earth was not a perfect spheroid, but somewhat flattened at the poles (ellipsoid). A long ongoing dispute in the French Academy of Science about the real shape of the Earth ended in the 1730's with a victory for Newton's theory. Scientists in the next 200 years tried to get more accurate information about the size and the shape of the Earth by meridian arc measurements. So did also the Russian scientist Friedrich Georg Wilhelm Struve. Through the years 1816 to 1855 he managed the work on what previous was called The Russian-Scandinavian Meridian Arc Measurements, and which was inscribed in the UNESCO World Heritage List in 2005 as The Struve Geodetic Arc. Until about 100 years ago it was the longest meridian arc measured on the Earth, and the quality in all the work was exceptionally good. Here is the story of how it came on the famous UNESCO-list.

A WORLD HERITAGE MONUMENT

In 1989 on the initiative of Dr Seppo Härmälä the task to make an inventory of the Struve points in Finland was entrusted to Mr. Aarne Veriö. He took the issue seriously and collected much information. Doing this he has realized that the preservation of the remaining sites was very important to the honour that the Struve arc deserves. [Härmälä 2000; Veriö 1994]

Following from his researches Veriö prepared a paper to present at a scientific conference in Tartu in 1993 [Veriö 1994] but he was unable personally to be there. However the paper was presented on his behalf together with his idea for seeking a UNESCO declaration to preserve the remaining points as a World Heritage site.

The Scientific Conference in Tartu took forward the idea and on August 28, 1993 agreed the following:

Resolution No. 1.

"Considering the scientific, historical and practical importance of the measurement of the arc of meridian through Tartu, made by F.G.W. Struve,

Urge the governments of those countries that still possess relics of that enterprise to take all possible steps to preserve those relics, including an approach to UNESCO to declare them to be World Heritage sites."

At the FIG Congress in Melbourne, Australia, March 1994 Harsson presented the comprehensive paper on the Russian-Scandinavian meridian arc measurements written by Bjørn Geirr Harsson, Markiyani S. Chubey, Vitali B. Kaptüg, George Preiss and Nina D. Umarbaeva. After the presentation Dr Härmälä proposed that the idea about the World Heritage List should be followed up. Jan de Graeve (Belgium) and Jim Smith (England) who organised the session in Melbourne caught the idea and formulated the following resolution, which was accepted at the end of the FIG Congress.

"Considering the great historical value of the measurement of the arc of the meridian, and that an inventory exists of land monuments marking the arc of the meridian, called Struve, which extends over 9* countries and 25° of latitude from the Black Sea to Hammerfest situated on the north coast of Norway, Commission 1 recommends that FIG should present a request to the United Nations that the remains of this arc of meridian be added to the World Heritage List of Historical Monuments". (*one country, possibly Russia, was overlooked as in the original Tartu Resolution.)

De Graeve and Smith are respectively director and secretary of FIG International Institution for the History of Surveying and Measurement (IIHS&M)

Further on a resolution No B10 by Commission 41 of the International Astronomical Union (IAU) was made at its General Assembly in The Hague in 1994.

"Considering the scientific, historical and practical importance of the measurement of the arc of meridian made by F.G.W. Struve.

Urges the Executive Committee of the IAU to approach the governments of the following countries: Norway, Sweden, Finland, Estonia, Latvia, Lithuania, Ukraine, Belarus, Poland and Moldova, which still possess relics of that enterprise, with a view to taking all possible steps to preserve those relics, including an approach to UNESCO to declare them to be world-heritage sites." (It may be noticed that the drafters of this resolution followed the Tartu Resolution and mistakenly included Poland and omitted Russia.)

In an e-mail of March 1996 The International Association for Geodesy (AIG) also expressed its support.

THE PRACTICAL NOMINATION WORK STARTS

De Graeve and Smith were later the "running engines" to fulfil the intention of the resolution. They made all necessary initial contacts, and brought all the ten nations to cooperate for the idea of getting The Struve Arc Inscribed on the UNESCO World Heritage List. The title Russian-Scandinavian meridian arc measurements was changed to The Struve Geodetic Arc in honour to the famous Russian scientist Friedrich Georg Wilhelm Struve who had been responsible for the whole project in 41 years from 1816 until the work was published.

As a matter of fact, by 1994 no Struve arc points had been identified in three of the countries concerned (in Lithuania, Belarus and Moldova). In Norway, Sweden, Russia, Latvia, Ukraine there were only singular landmarks known. Only one country (Finland) had long-term experience of successful search for the Struve arc landmarks, however, that experience was unique; it was hardly applicable to other countries, because most of the Finnish points were well-marked on rock surface. A good deal of further search through archives and in field was required in 9 of the 10 countries to get information and find survivals of the historic measurement.

In 2000 the IIHS&M submitted financial support to a group of volunteers who had organized and carried out monumentation of the two Struve points on the Russian island of Gogland in the Gulf of Finland. Because of the well-known political and economical situation in changing Russia of that time the national surveying agency could not support that important work, which was why volunteers were involved. The work on the Russian Struve points was a lucky junction of historical, surveying and physical work of the same people. The following year financial support was provided to the same group going to Belarus for field search.

The search in Belarus was a unique experience of co-operation between volunteers of one country and surveying agency of another one. The search proved successful due to hard preparatory work done by both sides: archival and computational work in St-Petersburg, and establishment of a special local geodetic framework in Belarus. Authentic endpoints of a base line were dug out, one on a harvested field, the other in a forest. Those findings became the key to successive digging out of two dozen of original Struve arc landmarks in Belarus.

During 2000-2002 substantial time has been spent by the IIHS&M Secretary Jim Smith on compiling an important document called "Struve Geodetic Arc. Interim Report" that in fact was the first draft of the Submission document. This 132-page document is a valuable evidence of the then state-of-play in each of the countries. The immediate goal of the compilation was to seek financial support for accomplishing various specific tasks within the general frame of the project. In 2002 the IIHS&M was provided with a special grant from the UK Education Trust of the Royal Institution of Chartered Surveyors. The grant supported an extensive archive work in St-Petersburg and Moscow with the aim to find, sort out and index remaining important manuscripts of the Struve arc measurements. Further on some sporadic finance from the Institution's budget have been also delivered to this aim. The archival work in Russia is nearly completed, only few documents have to be added to the catalogue because in St-Petersburg two more collections of documents have recently been offered to study and there are some unknown Struve manuscripts there too.

A conference under the title "Struve Arc 150" was held in Estonia in September 2002. Estonian Association of Surveyors, Estonian Land Board, Tartu University, Estonian Agricultural University had as hosts invited representatives from all countries along the Struve Arc, and about 50 delegates from 8 countries attended – namely Norway, Sweden, Finland, Russia, Estonia, Latvia, Lithuania and Belarus. Also De Graeve and Smith were invited and attended. The conference was essentially commemorating the 150th anniversary of the geodetic work on the Struve Geodetic Arc. It was also an ideal opportunity to discuss the arc in detail and to progress the efforts of the National Mapping and Surveying Agencies of the concerned countries to have selected points in each country recognised on the World Heritage List. In this Conference the coordinating role of the Struve Arc World Heritage project was given to the National Land Survey of Finland, chaired by Jarmo Ratia and Pekka Tätilä as Project Manager. The nomination having the sole governmental character had to have a strong participation from respective National Land Boards of the countries.

In Tallinn four resolutions passed, of which the following two were the most important:

Resolution No. 1.

"Following Resolution No. 1 from the International Scientific Conference held in Tartu in August 1993 and resolution No. 1 of FIG, Melbourne Congress in 1994 the participants in the International Scientific Conference held in Tallinn and Tartu, Estonia, on September 26-28, 2002 to honour the scientific achievements of F.G.W. Struve, considering the scientific, historical and practical importance of the measurement of the arc of meridian through Tartu which stretches from near North Cape in Norway, through Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Belarus, Ukraine and Moldova to the Danube Delta made under the guidance of F.G.W. Struve, urge the authorities in the 10 countries through which the Struve arc passes, to complete the preservation of the arc of meridian and the documentation in their countries as soon as possible, so that in their turn the national representatives to UNESCO may be urged to put them on their national provisional list of World Heritage Monuments."

Resolution No. 4

"The participants in the International Scientific Conference held in Tallinn and Tartu, Estonia, on September 26-28, 2002 to honour the scientific achievements of F.G.W. Struve,

* considering the historical importance of the measurement of meridian arcs

* Encourage the International Institution for the History of Surveying & Measurement to continue its investigation into the connection between the Struve Meridian Arc and the Arc of the 30th Meridian in East Africa,

* urge the authorities of those countries concerned to assist in all ways they can to preserve selected points in their countries so that it is possible to achieve the aim of a World Heritage Monument stretching from near the North Cape of Norway at latitude 70° 40' 11" N to latitude 33° 59' 32" S in South Africa, making it the longest monument in the world."

The desired World Heritage declaration requires that the included Struve stations are already protected in those countries where they are situated. This task was not easy because the legislation deviates from one country to another. The IIHS&M secretary Jim Smith circulated many copies of CDs presenting the latest explanations and specifications required to start necessary documentation work in each of the 10 countries.

PREPARATIONS FOR NOMINATION

But how then does all this fit into the concept of a World Heritage monument? Such monuments approved to date have all been very large structures or features for which the area is often measured in many hectares. With the arc, the area covered by the chain of triangulation stations is large, but the actual survey station defining it are essentially point positions only, and even with any cairn that covers some of them the area taken up is but a few square metres per point. That does not appear to present a problem to the authorities who rather see the unusual concept as a challenge.

Today the Struve arc passes through the following ten countries – Norway, Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Belarus, Moldova and Ukraine. Each of these countries contains a good number of the Struve stations except Russia that has only one double point – on the island of Hogland in the Gulf of Finland.

The originally arc consisted of 265 main points plus 60 ancillary ones in base extension networks. Of the main points a few were soon permanently monumented such as the one at Fuglenes in Hammerfest, Norway, and the one at Staro-Nekrassowka in the Ukraine, respectively in 1854 and 1858. Both places there are an obelisk with inscription. For calculation purposes Struve numbered all together 258 triangles in the arc from south to north.

The aim of the submission was to select one to six points in each of the ten countries that are recoverable as definite Struve positions and to have them marked in some commemorative manner. Those selected would be in positions of reasonable access to the public and be spread throughout the country. (Some in North Norway for example require a helicopter to achieve access or alternatively several hours trek).

The structure at the selected points varied from country to country, but each would bear a plaque giving the briefest of information about the arc and the particular point.

Each of the countries involved was required to first of all identify a selection of points and then to indicate how they would see them being permanently marked and maintained in good order and access. The authority for this was needed to come from the national government department concerned. Among main difficulties were the age of the points, the access to many of them and the recovering of ground marks. 2003-2004 saw decisive success of national works of search and recovery efforts of the Belarusian, Latvian, Lithuanian, Moldovan, Swedish and Ukrainian surveying agencies.

The task of compiling a summary for submission to UNESCO took considerable effort to complete. The desired World Heritage declaration required that the included Struve stations were already protected in those countries where they are situated. This task was not easy because the legislation deviates from one country to another.

The compilation of the official document of "Nomination of the Struve Geodetic Arc to the inscription on the World Heritage List" has been coordinated by Pekka Tätilä from the National Land Survey of Finland. The arc passes through that country from the south to the north – having nearly 30% (83) of its points within the territory of Finland – and much of the material necessary is also available there.

The draft Nomination was circulated at the following meeting of the 10 countries in Minsk for last corrections and official signing up. An important decision of creation a special international management committee was approved there too. So, the finalised Nomination document was ready by the end of 2003.

The distribution of the Struve points in the nomination document was from north to south:

Norway	4
Sweden	4
Finland	6
Russia	2
Estonia	3
Latvia	2
Lithuania	3
Belarus	5
Moldova	1
<u>Ukraine</u>	<u>4</u>
Sum	34

A project such as that for the Struve Geodetic Arc requires co-operation from many people. The following National Mapping and Surveying Agencies have been involved into the project and have been in the charge of the preparations and have collected the data, selected the points and documented sites for the Nomination:

Belarus	Georgy Kusnetzov, Vladimir Abramnikov, Vladimir Mkrtychyan
Estonia	Kalev Kangur, Raivo Vallner, Kalev Pärtna
Finland	Jarmo Ratia, Pekka Tätilä
Latvia	Guntis Grūbe, Jānis Kaminskis, Uldis Freimāntals
Lithuania	Kazys Maksvytis, Vitalija Jucevičiūtė, Eimuntas Parseliunas, Zeononas Kumetaitis
Moldova	Nicolae Şveţ, Ion Stratulat, Maria Ovdii
Norway	Knut O. Flåthen, Bjørn Geirr Harsson

Russia Alexander Borodko, Alexander Drazhnyuk, Alexander Yuskevich, Vitali Kaptjug
Sweden Stig Jönsson, Joakim Ollén, Hans-Fredrik Wennström
Ukraine Ivan Makarenko, Anatoli Bondar, Tatyana Gavrilyuk, Yuri Stopkhav

THE NOMINATION

In January 2004 the nomination of the Struve Geodetic Arc for inscription on the UNESCO World Heritage List was delivered UNESCO by the Finnish Minister of Culture, Ms Tanja Karpela on behalf of all the 10 countries. The 18 month period of scrutiny within UNESCO and ICOMOS (International Council on Monuments and Sites) seemed endless but at last a decision was made on 15 July 2005 at the UNESCO annual meeting in Durban, S Africa. World Heritage status had been achieved.

This was the first scientific cultural object to appear on the World Heritage List, and the first time more than two countries had gone together to get something on the list. From an historical point of view it seems as the success of the Struve Geodetic Arc can be looked upon as the precursor of international scientific organisations like International Association of Geodesy (IAG) and International Union of Geodesy and Geophysics (IUGG) as we know them today.

UNESCO'S JUSTIFICATION FOR INSCRIPTION

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.

ACKNOWLEDGEMENTS

A project such as that for the Struve Geodetic Arc requires co-operation from many people. The following National Mapping and Surveying Agencies have been involved into the project and have been in the charge of the preparations and have collected the data, selected the points and documented sites for the Nomination:

Belarus	Georgy Kusnetzov, Vladimir Abramnikov, Vladimir Mkrtychyan
Estonia	Kalev Kangur, Raivo Vallner, Kalev Pärtna
Finland	Jarmo Ratia, Pekka Tätilä
Latvia	Guntis Grūbe, Jānis Kaminskis, Uldis Freimāntals
Lithuania	Kazys Maksvytis, Vitalija Jucevičiūtė, Eimuntas Parseliunas, Zeononas Kumetaitis
Moldova	Nicolae Şveţ, Ion Stratulat, Maria Ovdii
Norway	Knut O. Flåthen, Bjørn Geirr Harsson
Russia	Alexander Borodko, Alexander Yuskevich, Vitali Kaptüg
Sweden	Stig Jönsson, Joakim Ollén, Hans-Fredrik Wennström
Ukraine	Ivan Makarenko, Anatoli Bondar, Tatyana Gavrilyuk, Yuri Stopkhay

Beside Jan de Graeve Belgium and Jim Smith UK who were the main characters up to 2002, sincere thanks are expressed to the following experts who have been helping in the preparation of the process of The Struve Geodetic Arc for inscription on the UNESCO World Heritage List:

Aarne Veriö	Finland
Seppo Härmälä	Finland
Alan H. Batten	Canada
Bernard Chovitz	USA
Drahomir Dusatko	Czech Republic
Martin Ekman	Sweden
Jane Insley	UK
John Leonard	UK
Yuri Sokolov	Russia
Erik Tobé	Sweden
Christian Tscherning	Denmark
Saulius Urbanus	France
Johan Vanvolsem	Belgium
Sergey Vereshchagin	Russia
David A. Wallis	UK
Alan F. Wright	UK
Tom Zakiewicz	South Africa

LITERATURE:

- Graeve, J. de, 2001, *La Protection et concervation de l'arc de meridian de Struve par l'inscription a l'inventaire de l'UNESCO comme monument historique de l'humanite par la FIG*. Colloquium. La Condamine et la Mesure de la Terre. Toulouse.
- Härmälä, S. 2000, *Struve Arc*. Paper presented at FIG Working Week in Prague
- Harsson, B.G., Chubey, M.S., Markiyan, S.C., Kaptüg, V.B., Preiss, G., Umarbaeva, N.D., 1994, *The Russian-Scandinavian Meridian Arc Measurements 1816 - 1852*, FIG Congress Melbourne, Paper TS 101.3.
- Smith, J.R. 2002, *The Struve Geodetic Arc as a World Heritage Monument - Progress to date*. Conference Tallinn - Tartu. pp4-11.
- Veriö, A. 1990, *One and a half centuries from the measuring of the Struvian chain*. FIG Congress Toronto. Paper 101.3.



UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND
CULTURAL ORGANIZATION

CONVENTION CONCERNING
THE PROTECTION OF THE WORLD
CULTURAL AND NATURAL
HERITAGE

*The World Heritage Committee
has inscribed*

Struve Geodetic Arc

on the World Heritage List

*Inscription on this List confirms the exceptional
and universal value of a cultural or
natural site which requires protection for the benefit
of all humanity*

DATE OF INSCRIPTION

17 July 2005

A handwritten signature in blue ink, likely belonging to the Director-General of UNESCO at the time of the inscription.

DIRECTOR-GENERAL
OF UNESCO



The northern end point of Struve Geodetic Arc, Fuglenes in Hammerfest, Norway.



The southern end point of Struve Geodetic Arc, Ismail, Ukraine.

CONTACT

Mr. Bjorn Geirr Harsson
Statens kartverk, Geodesidivisjonen
Kartverksveien 21
Tel.: + 47 32118185
Fax: + 47 32118101
Email: bjorn.geirr.harsson@statkart.no
N-3511 Hønefoss
Norway
Email: bjorn.geirr.harsson@statkart.no