

**Index of Field and Other Important Manuscripts
Relating to the Scandinavian Segment of the World Heritage Monument
“Struve Geodetic Arc”**

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Key words: Struve Geodetic Arc, field records, original manuscripts.

SUMMARY

Results of a search work in the archives of Russia, Norway and Sweden are presented. The positioned manuscripts originate from F.G.W. Struve, Chr. Hansteen and N.H. Selander's personal archives. The found material highlights details of observations and real circumstances of the field works carried out by the Swedish, Norwegian and Russian scientists and surveyors from 1845 to 1852 between Gulf of Bothnia and North Cape. While the surviving archive material in Russia has been nearly fully turned up by now, the recent findings in Norway and Sweden testify probable existence of other important manuscripts in those countries.

**Index of Field and Other Important Manuscripts
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1. ON THE HISTORY OF THE SGA MANUSCRIPTS

To perform a meridian arc measurement through vast East-European plains has been a persistent idea of men of science both in Europe and Russia since at least 1720ies when an appropriate proposal by the French astronomer J.-N. De l'Isle was first submitted to the Russian authorities. Paying tributes to first attempts made by him in 1737–1739 in Russia, one should note that the next century only provided real opportunities for “measurements of degrees” in the empire. The start was in 1816 due to efforts by two great Russian workers in geodesy and surveying: military surveyor Carl Tenner and outstanding astronomer Wilhelm Struve. The first 15 years of measurements across western provinces of Russia resulted in the united Tenner–Struve meridian arc of 8 degrees. In 1831–1849 a considerable extension was achieved: northwards (under Struve’s direction) through the then autonomous Russian principality of Finland up to the town of Torneå and southwards as far as the Danube delta (headed by Tenner). An important “Scandinavian extension” of the Russian operations was ensured farther northwards from the Gulf of Bothnia to nearly North Cape, thus Struve’s long-standing idea (at least, since 1828, see [Struve 1840]) to reach the limits of Europe came true in the north. During 1845–1852 the Royal Swedish Academy of sciences (RSAS) exercised general management over the works extending what is now called *the World Heritage Struve Geodetic Arc* (SGA). Those were carried out simultaneously in the historical Lapland by the Swedish team and in the Norwegian Finmarken by the Norwegians.

Leader and the main worker in Lapland was Nils Haqvin Selander (1804–1870), director of the Stockholm Royal observatory; his colleagues were: General baron F.J. Wrede, Prof. J.M. Agardh of University of Lund, captain–lieutenant Lilliehöök (Lilienhoek ?), lieutenant of the marine Skogman, and others. In Norway the measurements were directed by Chr. Hansteen who headed the Geographical department of the Norwegian Ministry of Home Affairs, field operations were conducted by military engineers Fr.L. Klouman and Chr.A.B. Lundh. Astronomical observations and two baseline measurements were performed in co-operation with the Main Imp. astronomical observatory in Pulkovo (Russia), particularly by Doctor D.G. Lindhagen who was then with its staff and responsible for use of the best instruments provided for the purpose by F.G.W. Struve. Personal documents of the mentioned persons, wherever they may be kept nowadays, are a valuable source for the history of the Scandinavian part of the SGA, for discovering professional, cultural and human aspects of *the World Heritage measurements*.

The SGA operations and appropriate actions took about 40 years (from 1816 till 1855), no wonder they are reflected in a huge amount of various documents. Those are in Russian,

German (Struve was a native German), French (the language of Russian high life), Swedish and Norwegian, both originals and copies, of particular and general nature. The basic field material, incl. that from Norway was published in Struve and Tenner's final descriptions in a possibly comprehensive way; unfortunately, the 1853 coordinated agreement of a separate publication describing the meridian arc operations through Lapland and Finmarken (see the related document) was not accomplished for unknown reasons.

Originally SGA manuscripts were never kept at one place, due to both inter-institutional and international nature of the measurements. The largest volume was preserved in the archive of the former Pulkovo Observatory (original German and French spellings were: Pulkowa and Poulkova) near St.-Petersburg directed by Struve from 1839 till 1862. Except of his later years of life, the outstanding astronomer since 1821 has been in permanent charge of scientific guidance and publication of results of the enterprise. Field registers, diaries, records, reports, calculation sheets and related correspondence had been in continuous demand by Struve and his associates till the end of the publication process (three editions within 1856–1861). A large volume of the documents related to the "Russian Arc" was accumulated in the archive of the former Military Topographers' Corps of the Russian army. Smaller collections of SGA documents, mostly correspondence, were kept at the Empire University of Dorpat, at the Russian Empire Academy of sciences, at the Russian Ministry of Public Instruction and at the Russian Geographical society. A few reports of the SGA workers have been published [Kaptüg 2002].

At present the surviving part of the original "Pulkowa" manuscripts which relates to the "Scandinavian part" of the SGA is kept in the St.-Petersburg branch of the Archive of the Russian Academy of Sciences. Here one can see field material, calculations, metrological research records, drawings and maps, letters and reports by the workers, draft copies of published material, official correspondence related to the works made in Norway [Kaptüg 2006] and northern Finland under Struve's responsibility; in the future some items of drawing material and maps (not yet available for inspection) may have been added. Other Russian archives do not have important documents relating to the SGA Scandinavian segment. Outside Russia, important field material and related correspondence originally was kept in the archives of Stockholm Royal Academy of sciences, the National Land Survey of Sweden (Lantmäteriet, Gävle), Norwegian Ministry of the Interior (Departementet for det Indre) and Norwegian Mapping Authority (Statens Kartverk, formerly Norges Geografiske Oppmåling, Hønefoss), as well as in the family archives of participants of those events: Selander, Wrede, Skogman, Lilliehöök, Agardh, Hansteen, Klouman, Lundh, particularly – Lindhagen, etc. At present much of that is still kept at those institutions: some manuscripts have recently been looked through in Stockholm and Hønefoss; many items of the related material are indicated in [Pettersen 2007]

Handwritten manuscript snippet in cursive script, likely German or French, with a signature 'W. Struve' at the bottom right.

2. THE CONTENT AND STRUCTURE OF THE INDEX

The Index presents the following types of archive material related to the SGA:

- 1) registers of field and indoor measurements and research, either original or copied by the observers themselves; those may relate to trigonometric (horizontal or vertical angles), base (linear) or astronomical measurements – all these are marked with the letters T, B and A correspondingly;
- 2) notebooks, cards or just sheets of paper containing mathematical calculations, often inseparable from ivestigations related to computed items – these are all marked with the letters C or CI;
- 3) diagrams, instrument situation plans, maps and other drawn material – these are marked with the letter D;
- 4) manuscript (text) material such as reports, letters etc., containing important or just interesting details and circumstances which are recognized within mostly illegible German or French handwriting – these are marked with the letter M.

Thus every type of material included into the Index is denoted with a particular letter, just for faster recognizing. Then, the material is separated into *Finmarken* (Norway) and *Lapland* (Sweden and northern Finland) *arc segments* distinguished first by Struve himself. Spelling of geographic names corresponds to that used in the sources involved. Years of “*field works*” correspond to original documents; they relate to reconnaissance surveys and measurements themselves. In the 2nd column of the Index words in *italics* are those of originals; notations within square brackets, e.g., [1854] mean that this information (e.g., the year “1854”) is specified with the help of another reference source rather than after this same document. In the 3rd column of the Index location (archive reference) is given. Numeral codes relate to the above-mentioned St.-Petersburg archive, they are separated by dots and commas which identify, correspondingly:

- number of the particular collection,
 - running number of the inventory within the collection,
 - running number of the folder within the inventory, followed by:
 - running numbers of particular sheets of the identified document; sheets may be presented in the following forms:
- * not specified, if the entire folder’s content relates to the item described,
 - * 3 ÷ 5 means “from sheet 3 to sheet 5”,
 - * 3 ÷ means “beginning from the sheet 3” (the end was not recognized),
 - * ÷ 5 means “ending with the sheet 5” (the beginning was not recognized),
 - * 14r means the reverse of the sheet 14.

Other denotations are:

NMA – for the Norwegian Mapping Authority;

ITA – for the Institute of Theoretical Astrophysics of the University of Oslo, Norway;

3. THE FINMARKEN ARC SEGMENT

Field works in 1845–1847, 1850 in Northern Norway under the guidance of Hansteen.

CODE	DESCRIPTION	ARCHIVE REFERENCE
T, CI	Field registers (“ <i>Trigonometriske observationer...</i> ”) of 1846–1847, 1850, copied by Klouman, in Norwegian; calculations and notes added by Lindhagen, sometimes by Struve, in German. [1850–1856]. Field register of angular measurements at 3 base extension points, original by Lindhagen of 1850, in German.	721.1.83, 54 ÷ 161 (four notebooks “2” to “5”); 721.1.88, notebooks “X”, “XI”, “XII letztes”. 721.1.86, notebook “III”, part 3a.
B	Field register of the base measurement at Alten, original by Lindhagen of July 1850, in German.	721.1.86, notebooks “II”, “III”.
B, CI	” <i>Basismessung bei Alten. Tagebuch von Fred. Klouman. 1850</i> ”, clean copy, in German [after 1852].	721.1.86, 374 ÷ 409 (the last notebook).
A	Field registers of the latitude and azimuth observations at Fuglenaes, originals by Lindhagen of 1850, in German.	721.1.86, six notebooks “IV” to “IX”.
CI	Two registers of investigations made with the Struve base apparatus in Pulkowa in May 1850, and in Bosekop, June to July 1850, originals by Lindhagen, in German. Registers of final investigations of the instruments: “ <i>Zwei supplement Hefte zu den Operationen in Finnmarken und Lapland</i> ”, originals of 1852 [by Lindhagen], in German. “ <i>Berechnung der Norwegischen Grundlinie von Lindhagen</i> “, a copy of an original report by Lindhagen, 1851, in German.	721.1.86, notebooks “I”, “II”, “III”. 721.1.87, notebooks “I”, “II”. archive of Hansteen’s correspondence, ITA (filed under the letter “S”).
C	Computation material related to the base measurement and astronomical observations, originals by Lindhagen, Struve, etc. [1850–1856].	within 721.1.84.

CODE	DESCRIPTION	ARCHIVE REFERENCE
D	<p>Drawing material, maps.</p> <p>Position of the astronomical instruments at Fuglenaes, scheme, ink, original by Lindhagen [1850].</p> <p>Drawing of the monument at Fuglenaes, gouache, pencil, 18 x 30 cm, original, signed in ink: “<i>Christiania, 14/8 – 54, von Hanno</i>”, 1854.</p>	<p>703.12.339, 703.12.340, 703.8 (not yet available).</p> <p>721.1.86, notebook “V”, 200r.</p> <p>721.1.79, sheet 1.</p>
M	<p>Three annual reports on the progress of the field works of 1845, 1846, 1847; originals by Klouman and Lundh, of 31 Dec. 1845, 7 Nov. 1846, 8 Febr. 1848, in Norwegian.</p> <p>Report on results of the negotiations in Christiania and Stockholm, original of November 30, 1849 by Lindhagen, in German.</p> <p>Receipt listing the Pulkowa instruments taken for the measurements in Finmarken, original of May 20, 1850 by Klouman, in German.</p> <p>Notes on the comparison of the Norwegian and Swedish baselines; a draft inscription for the proposed monument at Fuglenaes – these within the original letter by Struve to Hansteen of September 14/2, 1853, in German.</p> <p>“<i>Ueber den geodätischen Theil der Norwegischen Gradmessungsoperationen</i>”, report by Lindhagen, corrected fair copy, in German [spring 1854].</p> <p>Notes on general circumstances of the field works: “<i>Momenter til Indledningen ved Beskrivelsen over Gradmaalingen i Finmarken</i>”, original by Klouman, in Norwegian [1853 ?]; followed by translation to German, by Lindhagen, dated March 20, 1856.</p> <p>Notes about progress of the measurements: “<i>Suplement til... Struves historiske Beratning om Gradmaalingen...</i>”, original by “K.” [Klouman], in Norwegian [1853?].</p>	<p>NMA archives.</p> <p>721.1.85, 240 ÷ 250.</p> <p>721.1.85, 267.</p> <p>721.1.85, 612 ÷ 617.</p> <p>721.1.32, 401 ÷ 440.</p> <p>703.12.67, 102 ÷ 112.</p> <p>721.1.85, 582 ÷ 583r.</p>

CODE	DESCRIPTION	ARCHIVE REFERENCE
	<p>“Über das Gradmessungsmonument bei Fuglenaes” – description of the monument at Fuglenaes, translated by Lindhagen from a lacking letter by Klouman, in German [before 1856].</p> <p>Correspondence between Struve and Hansteen: * 20 originals by Hansteen and 6 drafts by Struve, in German. 1848–1855; ---> *3 originals by Struve, in German. 1849–1850; ---> *5 originals by Struve, in German. 1851–1855 ---> (3 drafts by Struve do not match their originals in Oslo and Hønefoss).</p>	<p>703.12.68, 11 ÷ 12; the inscription on the monument: 14 ÷ 14r.</p> <p>within 721.1.85; NMA archives; archive of Hansteen’s correspondence, ITA (filed under the letter “S”).</p>

4. THE LAPLAND ARC SEGMENT

Field works in 1845–1852 northwards across Lapland up to Kautokeino in Finmarken, under the guidance of Wrede (1845) and Selander (from 1846 till 1852).

CODE	DESCRIPTION	ARCHIVE REFERENCE
T, D	Notebook labelled: “1849. Avasaxa, Perrawara, Kakamawara, Huitaperi, Torneå. 1850. Af Agardh. Oiwi, Kuivaskerro” – clean copy of field registers of August–September 1849 [of Skogman?] and July–August 1850 of Agardh, by unidentified author [Selander? Lindhagen?], in ink, in Swedish.	CHS archives, the folder of 6 notebooks ascribed to “Agardh”.
T, A, CI, D	Notebook labelled: “1850. Agardh” – field register of “July” [1850?], original by Agardh, apparently relating to the astronomical station <i>Stuor-oivi</i> [“Oiwi”], pencil, calculations in ink, in Swedish.	ibid.
T, CI, D	Notebook labelled: “Winkelobservationer. 1852” and “Agardh 1852” – field register of August–September 1852, original by Agardh, pencil, calculations in ink, in Swedish.	ibid.
B	Field registers of the base measurement at Öfver–Torneå, originals by Lindhagen, in German, 1851.	703.7.155, notebooks “I”, “II”.

CODE	DESCRIPTION	ARCHIVE REFERENCE
A, D	Notebook labelled: “ <i>Astron. observ. på S. Oivi</i> ” – field register of astronomical observations of latitude at <i>Stuor-oivi</i> in June–July 1850, original by Selander, pencil, in Swedish.	CHS archives, the folder of 5 notebooks ascribed to “ <i>Selander</i> ”.
A	Notebook labelled: “ <i>Astron. observationer i Haparanda. 1851</i> ” – field register of astronomical observations with universal instrument and vertical circle, the readings dated September 1850 and September 1851, original by Selander, pencil, in Swedish.	ibid.
A, D	Field registers of the astronomical observations at <i>Torneå</i> , incl. a situation plan, originals by Lindhagen and Wagner, in German; June to September 1851.	703.7.155, notebooks “ <i>III</i> ” to “ <i>VII</i> ”.
CI	Results of a linkage of the Swedish and Finnish arc segments, original by Lindhagen, 1851. Finalized angular directions observed from <i>Torneå</i> to <i>Bälljatzvaara</i> , incl. base extension stations, Struve’s copy from Selander’s original of “ <i>27 Juli 1853</i> ”. Paper cards of computation of the arc chain from <i>Torneå</i> to <i>Alten</i> , originals by Struve. 1853. Original computation material by Lindhagen, Struve, etc. related to the base measurement and astronomical observations, [1851–1856].	721.1.84, 548. 2.1/1850.2, 81 ÷ 82. 721.1.90, 78 ÷ , 551 ÷ , 614 ÷ . within 721.1.84.
D	Drawing material, maps. Situation plan of the astronomical instruments established near <i>Torneå</i> , original [by Lindhagen, 1851]. Diagrams of the Öfver– <i>Torneå</i> base extension points, originals by unidentified author, August 1853.	703.12.339, 703.12.340, 703.8 (not yet available). 721.1.84, 537. 721.1.90, 516, 519 ÷ 520.
M	Report on results of the negotiations in Christiania and Stockholm, original of November 30, 1849 by Lindhagen, in German.	721.1.85, 240 ÷ 250.

CODE	DESCRIPTION	ARCHIVE REFERENCE
	Report on the arc measurement works accomplished by 1851, [original by Selander or a copy by Lindhagen, 1851], in Swedish.	721.1.85, 334 ÷ 335.
	Minutes of the joined Russian–Swedish–Norwegian meeting of the leaders of the meridian arc measurements of 1816–1852, signed on July 26, 1853 by Hansteen, Selander and Struve [one of the 3 originals]; in German.	721.1.85, 563 ÷ 564; 2.1–1850.2, 87 ÷ 87r.
	<i>“Ueber den geodätischen Theil der Schwedischen Gradmessungsoperationen, nach Herrn Professor Selander vorläufigen Mittheilungen”</i> , report by Lindhagen, the second half is lacking, fair copy, in German [1855].	721.1.89, 318 ÷ 340.
	Correspondence between Struve (5 draft copies of 1845–1855) and Selander (10 originals of 1844–1853), Wrede, Wahlberg, Lindhagen, RSAS; in German.	within 721.1.85.
	Letters to RSAS and Academy’s permanent secretary P.F. Wahlberg, originals by Selander. [1846 – 1852].	CHS archives; access via the box “Se – ” of the alphabetic catalogue of correspondence.

Two Notes

One important Selander’s letter to Struve (of August 10, 1855) included the rest of his final results relating to the Swedish arc segment. Until it was received Struve had only been able to perform interim linkage computations south and north of the segment, basing on the data submitted by Lindhagen. Unfortunately, Selander’s original has not been found.

Within the CHS Stockholm “folder of 5 notebooks” ascribed to “Selander”, there is a notebook labelled: *“Höjdoobservationer i Lappmarken. 1852. Selander I”*. It contains a separate (ripped out) piece of paper which reads: *“22 hæften Selanders och Agardhs och Skogmans Gradmåtningsjournaler i Lappland. 1846 – 1852”*. Apparently, it is written by G. Lindhagen and speaks of a complete amount of the field registers relating to the SGA Lapland segment.

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My search for the SGA manuscripts began in St.–Petersburg as far back as 1997, it was just an overture. A deeper identification of the found documents required more spare time; it became possible some later thanks to co–operation with the *International Institution for the History of Surveying and Measurement (IIHSM)* – a body within FIG. Care by the IIHSM for my archive work, financial support to find and catalogue still unknown SGA documents was most important. The criteria of sorting out the documents as well as the final form of indexing them resulted from fruitful discussions with the IIHSM officers – Messrs. J. De Graeve, D.A. Wallis and J.R. Smith; it is my pleasure to acknowledge their efforts and express my gratitude to them. I am also much grateful to Dr. Nina Moskovchenko, presently research worker with the *Museum of Pulkovo observatory*, for her continuous co–operation. I am indebted to Dr. habil. Irina Tunkina and other staff of the *St.–Petersburg Branch of the Archive of the Russian Academy* for fruitful co–operation. Thanks are also to Dr Aleksey Litvin of the *State Archive of the Russian Federation (Moscow)* and Dr Natalia Gordeeva of the *State Military–Historical Archive (Moscow)* for providing valuable information regarding lost archive documents of the former Military Topographers’ Corps. Special thanks are to the manageress of the *Archive of the Russian Geographical society* Mrs. Maria Matveyeva for important technical help and consultation at early stages of my research. Many archive documents have been recognized due to permanent reference to F.G.W. Struve’s “Arc du méridien...”, the 1861 edition in Russian, which has been in my unusually long use in the *library of the Russian Geographical Society*; it is my pleasure to express cordial thanks to the library manageress Mrs. Svetlana Savina.

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REFERENCES

- Kaptüg, V., 2002. General Review of the History of the Manuscripts Related to the Struve – Tenner Arc Measurements. *STRUVE ARC 150. Reports of the International Scientific Conference*, p. 68–71. Tallinn – Tartu, Association of Estonian Surveyors, et al.
- Kaptüg, V.B., 2006. What Was Found in the Russian Archives About Geodetic Works in the Norwegian Part of the Struve Arc (1844–57). *Read at the Norwegian Mapping Authority (Statens Kartverk)*. August 24, 2006. 15 p. Hønefoss.
- Pettersen, B.R., 2007. The Norwegian Part of The Struve Geodetic Arc – an Original Instrument Rediscovered. *Survey Review*, 39, 306 (October), p. 294–307.

Struve, M. [Monsieur, F.G.W.], 1840. Sur la mesure des degrés de méridien en Russie. *Bulletin scientifique publié par l'Académie Imp. des sciences de St.-Pétersbourg*, VII, 163 (19), p. 282.

BIOGRAPHICAL NOTES

Born in 1947. Graduated in astronomy at the Faculty of Mathematics and Mechanics of the Leningrad University. Experience in satellite and astronomical observations, management. Headed volunteer expeditions aimed at preservation of artifacts of historic geodetic measurements. In 2003–2004 charged with compilation of the national documents for the FIG–UNESCO project “Struve Geodetic Arc”. Since 2004 – elected Secretary to the Board of the St.–Petersburg Society for Surveying & Mapping. Member of the Russian Geographical Society. Some 40 publications on historic geodetic measurements and artifacts in Russia.

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