THE STRUVE GEODETIC ARC AS A WORLD HERITAGE MONUMENT - PROGRESS TO DATE

Jim Smith
International Institution for the History of Surveying & Measurement

Summary

This paper summarises the various aspects of the project to preserve a selection of points from the Struve Geodetic Arc as a World Heritage Monument. Details are given of the further plans for a GPS project through all preserved points and for the possibility of extending the preservation to the Arc of the 30th Meridian.

It was at a scientific conference in Tartu in 1993 that the idea was first floated for a selection of the surviving station points on the Struve Geodetic Arc to be preserved as a World Heritage Monument under UNESCO. In 1994 at the FIG (International Federation of Surveyors) Congress in Melbourne a delegate from Finland put forward a Resolution along the same lines as did the IAU (International Astronomical Union) at its General Assembly in 1994. Support has also since been received from the IAG (International Association for Geodesy). Little progress was made until at the FIG Congress in Brighton, UK in 1998 what had been a small *ad hoc* Group for the History of Surveying was made a Permanent Institution for the History of Surveying & Measurement.

From then on that body has been gradually persuading each of the 10 countries concerned to cooperate in furthering the original idea. This has been a slow process for a variety of reasons not least of which has been finance. However the author is personally hopeful that by this time next year it will be possible to put a detailed case to UNESCO for consideration.

Each of the 10 countries has received a copy of an interim dossier that has been put to the EU and to UNESCO to further the aims for the arc. This contains all the details as held in April 2002 and will form the basis of the final submission. The photographs are reproduced in black/white although for the final submission they will be in colour. The long introductory notes are to assist those who might well not be surveyors to understand what it is that we are trying to preserve. With that is reproduced various maps and data from the original Struve volumes.

The further aims of the whole exercise have grown somewhat from the original idea and so should be spelt out here.

It is suggested that the aims should now be:-

1. Complete the choice, recovery, demarcation and documentation of a selection of points in each country.
2. Submit a detailed dossier to UNESCO
3. If successful, then a GPS project be organised to incorporate all the selected points (40-45 in total), in a single scheme.
4. That the idea of preservation be extended south from Izmail, across the Mediterranean Sea and down the 30th Arc of the Meridian of East Africa to its southern end in S Africa.
5. That the archive of the Struve Arc material which is to be found in several locations, be indexed for the benefit of future scholars and researchers.
6. That the Struve volumes relating to the Arc be scanned and recorded on CD and made available to researchers and libraries.

7. All this cannot be achieved without a large injection of finance and hence the recent submission to the EU through the Interim Report.

Taking each of these in turn.

1. Recovery and preservation of points

This is obviously the first priority since everything else revolves on its success. As an incentive for all countries to complete as soon as possible a copy of the Interim Report was sent to each authority. This allows each to see what the others have done and the type of material required for the final submission.

To those who received a copy of that document it is pointed out that the final submission will have the illustrations in colour to enhance its impact and in additional to the inclusion of the material not then to hand it will also incorporate a number of corrections and additions to the text and contain more information on the proposed follow-up activities.

We would have preferred to circulate more copies of this Report but with very limited resources and a high duplication cost per copy there had to be some selection. However those with a copy are at liberty to duplicate it for distribution in their own countries if they so wish.

Points selected for preservation have to be fully documented in terms of location maps, coordinates and access details as well as bearing an appropriate plaque and pertinent photographs. Where the maps are concerned, since they are mostly extracts from current national mapping which is no doubt under copyright, a blanket statement has been included under the acknowledgements that all maps used in the Interim Report, and in due course the Final Presentation, remain the copyright of the individual countries concerned and should not be reproduced elsewhere without due permission..

Each authority also has to supply a letter from an appropriate Government Minister signifying the Government's intention to maintain each point and to allow public access them.

One country, Lithuania, has supplied details (in English) of the History of the Triangulation Chain (within Lithuania) used for the Geodetic Arc Computation. This came too late to be put in the Interim Report but might well be incorporated in part in the final presentation. Any other countries that are able to supply similar details are welcome to submit their material for possible inclusion. In particular what could be of particular use are connections from the Struve arc to other triangulations either within the same country or across the border to a neighbour. Figures 1 and 2 show existing and proposed schemes and here the most likely connections from the Struve arc to neighbours would appear to be in the Poland - Lithuania region together with Yugoslavia, Romania, and the former Czechoslovakia. Of course, changing international boundaries present a problem so that the National Survey Authorities are in the best position to indicate which of them have connections and across which (modern) national boundary.

As far as the number of points for preservation in any one country is concerned it is difficult to generalise when the actual Struve Arc stations per country vary from 1 to 83. The two countries with by far the most possibilities are Finland and Ukraine with 83 and 50 respectively. So it might be expected that each of these has, say, five spread through the country. Six of the countries have between 15 and 30 possibilities so they might select 3 or 4 whilst Sweden with 7 might select 2 or 3 and Russia has only one choice which has been completed. This would give a total of between 31 and 38 but all countries are at liberty to select more (or less).

Which points to select should take into account such factors as ease of access, distribution across the country and significance of the point - e.g. baseline terminal or astronomical point. In Norway for example most points were recovered but some required a helicopter trip to be reached or were many hours trek from civilisation.

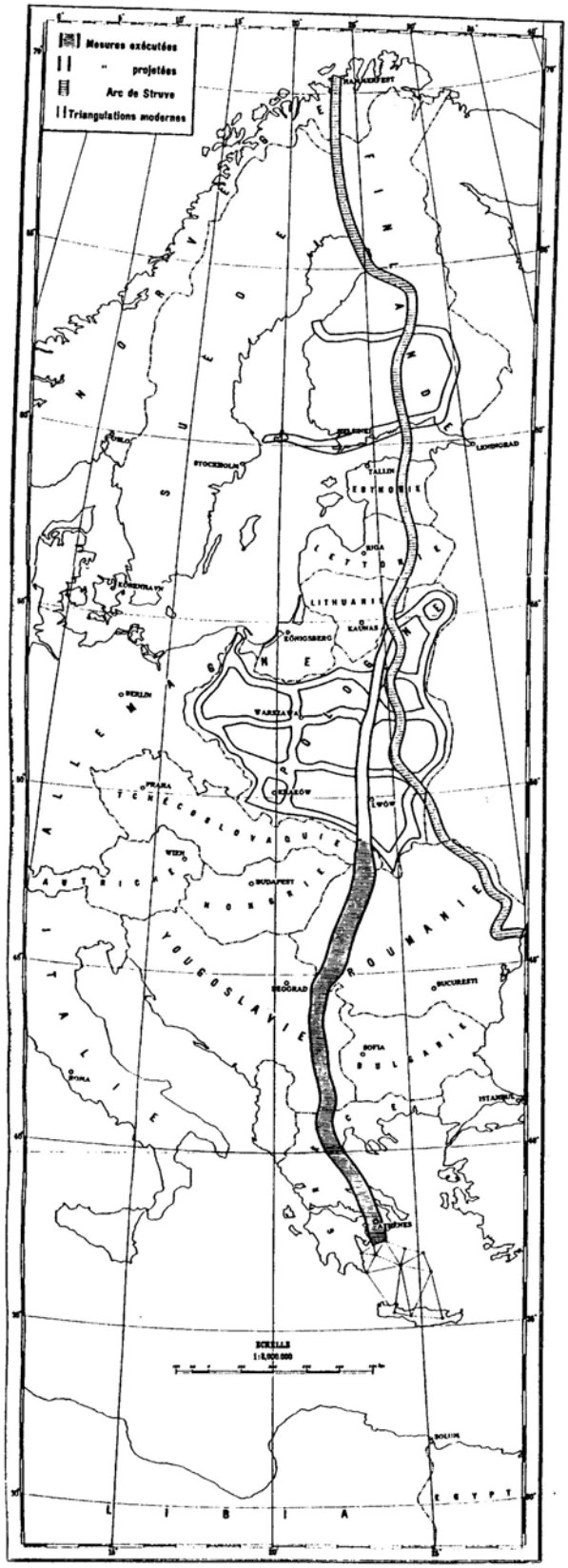

Figure 1.

Proposed and existing triangulation schemes through Europe.

Note the existing work in dark colour and the Struve arc in hatching. Which of the proposed schemes (as open lines) were observed and which physical points, if any, were common between the general triangulation and the Struve arc points is not known. This Figure and the next relate to the situation around 1930.

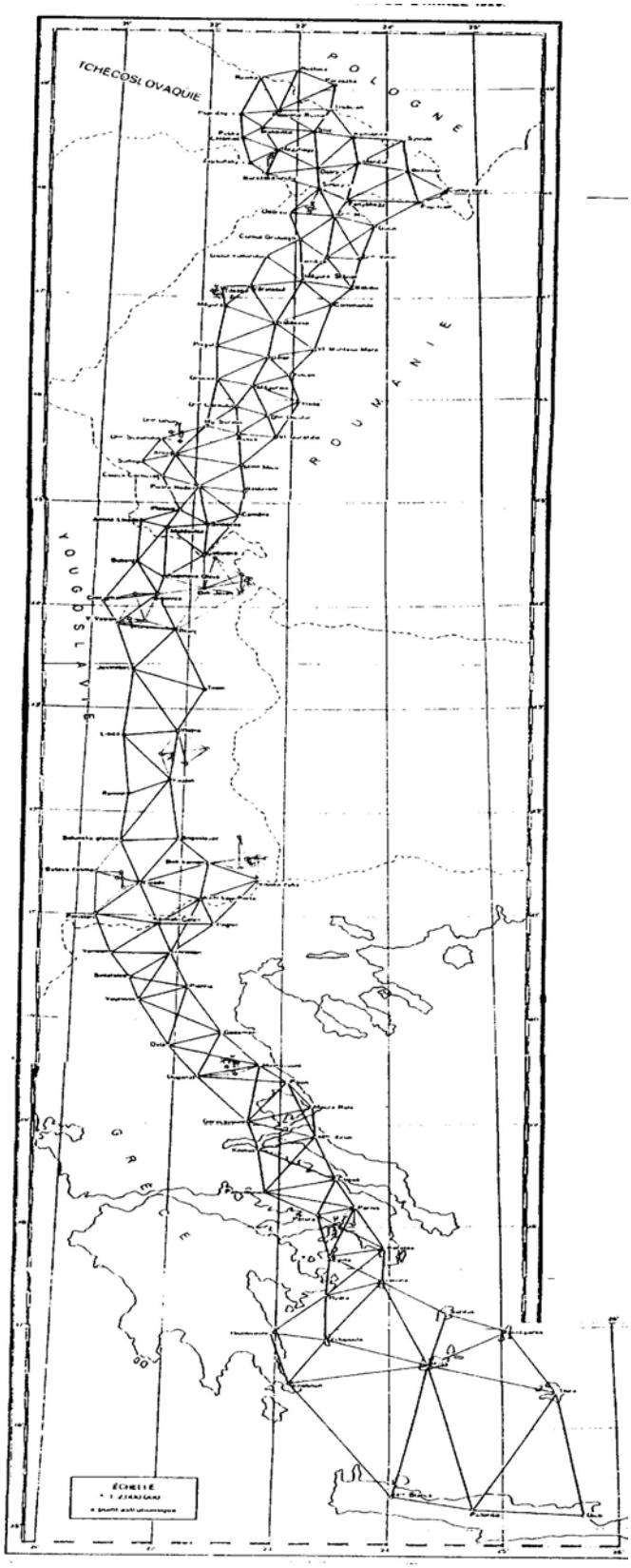

Figure 2.
This triangulation diagram would suggest that there could be common points from the triangulations of the "Struve" countries into Poland, Slovakia, and Yugoslavia. If that is so, do any details exist?

As of 1 July 2002 the situation was that some 27 points had been identified and a further 12 or so were awaited. Moldova has indicated that during August 2002 they were to start searching while we have no information regarding the Ukraine. All other

countries have progressed some of the way and just a few have completed their requirement.

Different countries have used different methods to locate Struve points and it is interesting that modern technology has been used as successfully as has older technology such as EDM and straightforward digging.

2. Submission to UNESCO

The Interim Report contains some 20 pages of background information and Struve triangulation diagrams compiled in such a way that takes into account that within UNESCO it could well be scrutinised by people who know little or nothing about geodetic surveying. Any corrections, additions, suggestions etc that readers might wish to send me will be gratefully received since it is vital that the final submission is as comprehensive, informative and complete as possible.

With printing and postage the Interim Report cost around £20 per copy. If any Survey Department is in a position to assist with printing the final document, bearing in mind that it will have the illustrations in colour and possibly an extra 50 pages, then again, I would be interested to hear from them.

This is thought that the submission to UNESCO is unlike any other since they normally deal with structures such as factories, castles and the like that cover a single, recognisable, large area, perhaps of many hectares extent. In our case we are seeking to preserve some 40 points each of a few square cm. in extent and separated by hundreds of km. Whilst each point has a cairn, pillar or equivalent it is in effect the small spot (cross, hole, nail or whatever) that is our prime concern, all interconnected by intangible lines that are nowhere visible on the ground.

3. GPS scheme

If the submission is successful then it is proposed to organise a single GPS project covering all of the preserved points. This will obviously be extremely expensive and was the main reason for the submission of an Interim Report to the EU and UNESCO in the hope of getting a financial grant to cover this operation. A private expert in GPS has been identified who is willing to supervise such a project but he will obviously require cooperation in each of the 10 countries not only with the logistics but also local assistance from each Survey Department. Such a project would require considerable organisation and take some six months to execute properly.

One long term use of such a co-ordination would be for those scientists who monitor the movement of continental plates.

4. Connection to the Arc of the 30th Meridian

Some 40 years after the completion of the Struve arc work on another began in South Africa. Like the Struve Arc it goes through many countries- S Africa, Bechuanaland (Botswana), S. Rhodesia (Zimbabwe), N. Rhodesia (Zambia), Tanganyika (Tanzania), The Congo (Urundi), Uganda, Sudan and Egypt. This extends some 65½º (7200 km) with over 600 points and took over 60 years to complete. Figure 3, gives an overall idea of it.

This did leave the gap across the Mediterranean Sea and a join to the southern end of the Struve Arc. In 1953 the 1370th Photo-Mapping Group, of the US Air Force completed a Shoran connection from Northern Egypt to Crete and from there a normal triangulation connection exists to Greece. See Figures 1, 2 and 4. Alternatively there is a connection from Egypt through the Eastern Mediterranean countries to Turkey and thence into Bulgaria, Rumania and the Ukraine. Thus one way or another there is apparent bridging of the gap of 14º between the 30th Arc and the Struve Arc. Whether

any one point of the Struve Arc is coincident with any one point on the triangulation either northward from Greece or from Turkey remains to be determined. One obvious

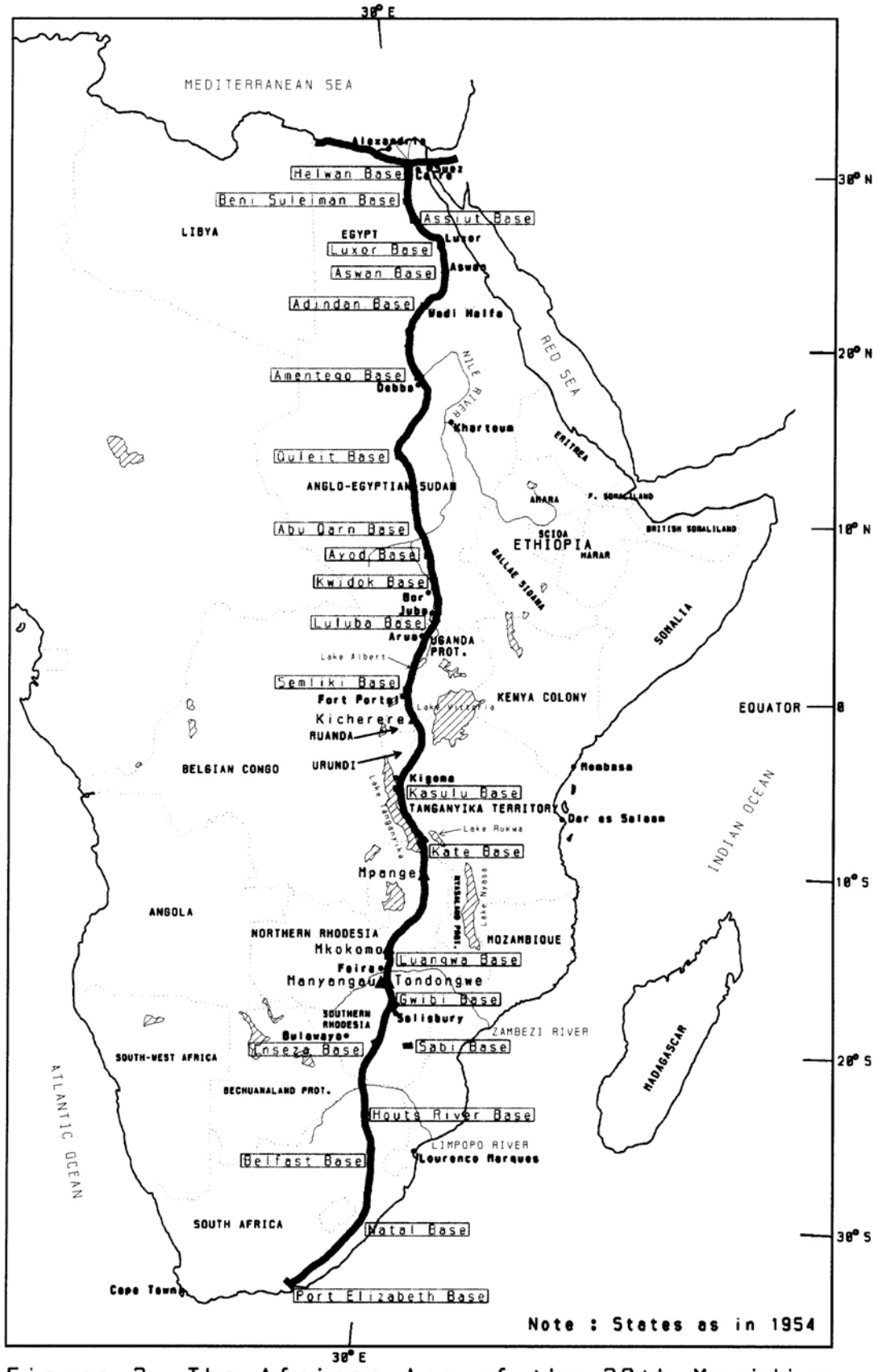

Figure 3. The African Arc of the 30th Meridian (1883 - 1954)

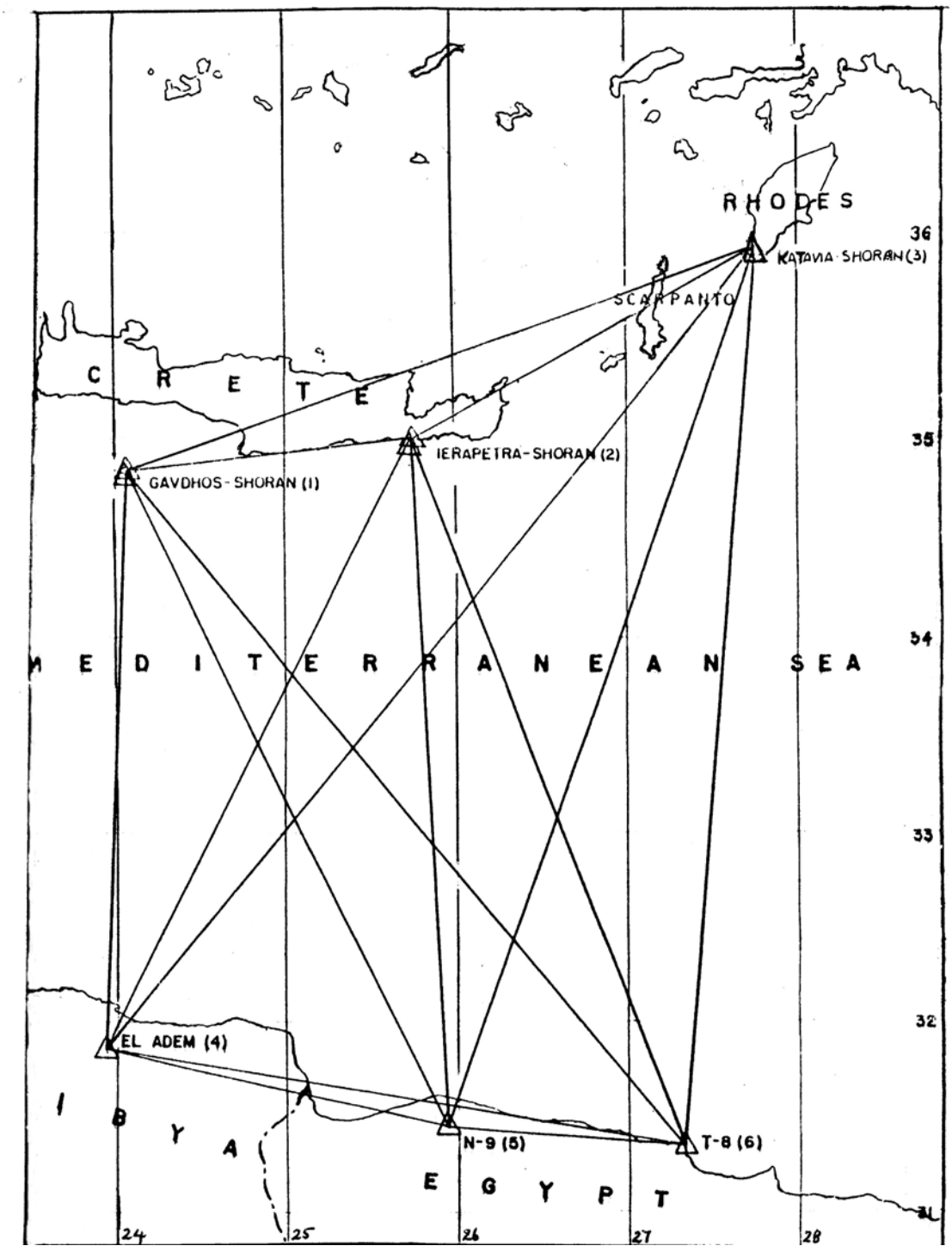

Figure 4. The Shoran connection from North Africa to Crete, from where triangulation joins it to Greece.

possibility is that there is a connection from the Tuirkish triangulation across the Black Sea to the southern end of the Struve arc. Whether or not this exists is not known.

The total distance from Buffelsfontein in S Africa to Fuglenaes in N Norway is around 104º 40’ or about 11450 km (7150 miles).

The stations in the African countries on the whole tend to be as some form of concrete pillar or surface mark so should be more readily identifiable than those on the Struve Arc and also more readily refurbished and marked with a plaque. Thus it is

hoped that once the Struve Arc is accepted the 30th Meridian section could follow within one or two years. The connection across the Mediterranean Sea would need to be resolved and help is sought from any readers who know about that work. Are there any triangulation diagrams, coordinates or other information indicating connections between the Struve Arc and other triangulation schemes in your countries?

5. The Struve Archive

Indexing of Struve material in Moscow has been underway since June 2002 through the good work of Vitali Kaptjug. Finance for this has been partially provided by the Royal Institution of Chartered Surveyors in London and by the FIG History Group but further support is sought within the request to the EU. Initially it was hoped to copy all the archived material in some form and put it on CD but this proved too difficult to achieve. In particular the sudden ten fold increase in the required royalty per sheet made it prohibitive. As an alternative detailed indexing should at least be of considerable assistance to future researchers.

6. The Struve Volumes

These are very scarce and at present the Institution for the History of Surveying does not possess a copy. As such volumes are of prime importance to any Struve researchers it is hoped that someone with access to the volumes will offer to put them on to a CD for the benefit of future researchers.

7. Finance

Throughout the above points finance has a major part to play. Hence the Interim Report and its submission to the EU and UNESCO for possible funding. If all of that which is sought materialises then it would greatly assist each of those aspects above that refer to the Struve Arc (as opposed to its extension southwards). Failing that, either cuts will need to be made in the plans or more assistance sought from the participating countries.

Acknowledgements

Particular thanks are extended to Vitali Kaptjug for all his assistance. Figures 1 and 2 can be found in various publications from 1930. Figure 3 is by kind permission of Tomasz Zakiewicz. Figure 4 is from the Final Report of the Shoran connection from Crete - North Africa of 1954

CONTACT DETAILS

J R Smith
24 Woodbury Ave,
Petersfield,
Hants GU32 2EE,
UK.

Tel and fax. +44(0)1730 262619
e-mail. 101765.332@compuserve.com