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The GSE and the Negotiations for the CTBT in the Historical Context of the International Scientific and Political Process of Nuclear Arms Control

Sandra Alwardt
Internship at the ZNF
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Introduction

The CTBT (Comprehensive Nuclear-Test-Ban Treaty) is the most important cornerstone for the nuclear arms control process. It was a long negotiation process until the treaty could be adopted from the United Nations in 1996 and since then is opened for signature. It took more than four decades to accomplish this treaty banning nuclear test explosions. A significant role during the negotiation process and finally decisive for the accomplishment of the CTBT was the verification issue. A technical proven global monitoring system was necessary to provide technical facts for every country. Eventually confidence could be build up in favor for a Comprehensive Nuclear Test Ban Treaty. Scientists play a significant role for the non-proliferation and disarmament field. But the contribution of scientists for the successful negotiation of a test ban was often impelled to play a background role in the public, especially with regard to the complicated international political negotiations influenced through state interests during and after the cold war.

The scientist movement was confronted with the enormous technical progress in the 20th century. Because of new technical knowledge they got even more responsibility for arms control and became an essential part to keep going the negotiating process on different stages not only by the technical one. This article focuses on the importance of the scientific impact on political negotiation processes and raises the question how far the need for a scientific point of view in the field of International affairs has to be considered. Indeed there are significant dependencies between scientific experts as advisors for politicians. Not merely advisors engaged by governments play an important role; independent advisors from NGOs take much influence on negotiations as well.

The emphasis of this article lays on the Group of Scientific Experts to Consider International Co-operative Measures to Detect and Identify Seismic Events (GSE), established by the Committee of the Conference on Disarmament in Geneva in 1976. This group had a political mandate and the members were nominated by the corresponding state member states. Early before the final establishing of the CTBT, the GSE tested step by step relevant verification measures. Historically it predecessor was the Group of Geneva Experts with members from different countries who held its first meeting at the United Nations in Geneva in 1958. These two groups researching the verification measures should give an idea of the cooperation and communication between scientists and non-scientists to accomplish a Comprehensive Test

Ban Treaty in the political and scientific field of International Affairs. It may be helpful as well to mention briefly the NGOs movement, giving a brief consideration to the context of scientific influence by non-state actors.
The following main questions will be addressed. How far can we determine the scientific impact on political negotiations for the CTBT, regarding the Geneva Group of Experts and the GSE? How do NGOs take influence on political decisions regarding the Test Ban Treaty during the same time?

For this article the basic primary sources are the GSE Documents which are provided by Frode Ringdal, the former scientific secretary of the GSE. Very interesting is the book from Jaap Raamaker, which was published to give an insight of the history of the CTBT. Raamaker accomplished the task to transform the draft of the treaty into the official treaty text ready for signature. An interview of the CTBTO Preparatory Commission with Ola Dahlmann, the former chairman of the GSE and from 1996 to 2006 the Chairman of the CTBTO Working group B, shows some very appealing perspectives about GSE work until today. With regard to the Geneva Group of Scientists from 1958, Harold Karan Jacobson and Kai-Henrik Barth are providing remarkable considerations. An exemplary view of the NGO movement for a test ban in the context of International Affairs contributes Kai-Henrik Barth and Matthew Evangelista.

The Geneva Group of Experts

The Geneva Conference of Experts and the Limited Test Ban Treaty

From 1946 to 1957 an arms control agreement between the USA and the USSR could not be achieved. During disarmament talks in 1957 the difficult task to find adequate measures for detecting nuclear test explosions was not accomplished and the dispute went on. US- and Soviet negotiators had different point of views in terms of an agreement, in particular for providing the required monitoring measures. Both the Soviet and US-presidents had different opinions concerning the detection of nuclear explosions. Khrushchev argued that technical experts could not help to solve political problems. The USA were against an agreement unless there would be a reliable verification method developed by scientific experts. Eisenhower did not want to hold any further political talks until the objective of a sufficient scientific verification was achieved. The political negotiators were polarized, but the community of physicists was divided into test ban opponent and proponent as well.[i]

Nethertheless further technical talks for verification measures had been hold to shape negotiations towards a test ban. In July 1958, scientists met for the first time at the Geneva Conference of Experts, finding a solution for the verification problems of nuclear test explosions. The Geneva Group of Experts (1958-1960) was the first international group which worked on a verification system to detect nuclear test explosions. They adopted an independent role in negotiating security issues and ten countries participated in this group.[ii] The experts of Eastern and Western delegations studied the techniques of verification measures in 30 sessions until they published their final report in August. The most difficult task had been the detection of small underground explosions. In their final report they indicated that it is technically possible to establish an effective control system considering the elaborated capabilities and limitations. The issue of on-site inspections led to a dispute. They were considered as last measure but not further determined in its dimension. There was no agreement about voluntary or non voluntary inspections.

The report was the first document of the Geneva Group of Experts before test ban negotiation began. Although the first conference was held in summer 1958, different nuclear testings occurred during the summer and fall. These series of tests were the foundation for a significant seismological analysis which leads to the conclusion that the detection of underground tests is much more difficult than from the Group of Scientific Experts expected. Nuclear explosions could be muffled and for this reason the extent could not be determined. This led to a dispute between the USA and the USSR. The latter wanted to keep going with the political talks based on the report of Scientific Experts. Finally in 1959 there were two more technical working groups established to study verification issues and the detection of nuclear explosions. Both powers disagreed about a diversity of technical verification measures, especially about on-site inspections. [iii]

In 1962, the Cuban missile crisis showed again the necessity for nuclear arms control.

For this reason in 1963 the Limited Test Ban Treaty (LTBT) was ratified, but the dispute about reliable verification methods to detect underground explosions was not resolved by this treaty. The LTBT banned nuclear explosions in the atmosphere and under water but underground explosions were not banned. That was left to the CTBT. China and France did not sign the treaty and its measures were rather environmental ones but not suitable for arms control.

The Role of Scientists and Diplomats for the Negotiations

How can the role and the "background" events of the Geneva Group of scientists for a limited test ban treaty be determined and why did a comprehensive test ban treaty fail in 1963? There are certainly a lot of important reasons but in this paper the focus should lay on the relationship of scientists and diplomats. Scientists prepared the ground for verification issues and began to negotiate towards a limited test ban treaty at the Geneva Conference of Experts before diplomats negotiated. The conference was a mix of diplomatic negotiations and a scientific congress. The experts examined all the basic methods to detect nuclear explosions.

But in what kind of way was the Geneva Group of Experts involved in the diplomatic process? Were the scientists obligated to represent a certain political position and therefore had to fit their results?

The main dilemma of the outcome of the meeting was not alone the technical data. The dilemma was the "interpretation" for political interests. The technical results allowed "different understandings" and interpretations in context to International Relations. Finding a common way to handle the results failed. Scientists ended up to represent the opinion regarding their nationality and on behalf of one of the two sides in the Cold War, either East or West.[iv] The Western scientists had a more conservative opinion, wanted to get more provable quantitative data in favor of an international control. The Eastern scientists in contrast laid their emphasis on the future progress of scientific detection measures. The challenge was that neither the Western nor the Eastern side was willing to reveal their status of detection capability and therefore was a huge mistrust.[v]

The course of the conference of experts showed that experts were widely influenced through their "state role" in the Cold War.

The chance of verification measures through scientific facts was dismissed by the scientists because of assumptions and accusations of both sides and the political interests of there representative governments. Scientists could not fulfil expectations, contributing their scientific research and facts in a more objective manner. The scientific talks and political issues could not have been separated adequately.[vi] Subsequently it was pleaded for informal scientific session's rather than formal ones. The failure happened because of strictly separated scientific country delegations which were mostly the representatives of their own national government.

One problem is that policy makers are confronted with the "scientific uncertainty". In this case many technical issues were raised for the first time during test ban negotiations. The scientific elements always are closely related to non-scientific factors like the scientists personal and political preferences, its experience and idea of International Relations. The policy adviser cannot separate these two matters. How can one know if the scientist has been very optimistic or very pessimistic regarding the "scientific uncertainty"? Another problem is that policy makers create their own interpretations to accomplish their goal.

An example is the conducted nuclear test series of the USA during the Conference of Experts in summer 1958. A motive could have been to reduce the effect of public pressure by holding the conference and at the same time going on with testing.[vii]

It is clear that the scientific experts were involved various times as political negotiators and advisers. They had an essential impact through their scientific knowledge and could so influence decisions on the diplomatic stage. The experts delivered different options and interpretations for a successful and unsuccessful negotiation. Clearly, it was made a beginning for a common understanding by outlining the capabilities and pointing out the limitations of the current method. After all it was demonstrated a perspective for carrying the control system in the future.

There was no seismologist during test ban negotiations at the US President's Science Advisory Committee until 1962. It was particularly composed by physicists specialised in nuclear energy aspects. In the 1950s and 1960s the policy makers did not have adequate knowledge about the work of the scientific experts. A mix of different disciplines would have been more effective. For policy makers it is indispensable to hear statements from both sides, of scientist opponents of nuclear arms control and proponents as well.[viii] Perhaps one of the reasons for the failed Geneva Conference was a lack of sufficient knowledge on both sides, for scientists on the diplomatic stage and for politicians on the scientific stage.

Besides all criticism we have to see the success of this conference regarding the accomplishment of the Limited Nuclear-Test-Ban. The role of scientists for political negotiations cannot be underestimated. New experiences were made, being useful for future negotiations and a better communication between scientists and non-scientists.

The GSE beyond its Scientific Perspective

The Establishment of the GSE at the Conference on Disarmament

The development of the verification system for the Comprehensive Nuclear-Test-Ban Treaty took almost half a century until the United Nations General Assembly Resolution A/RES/50/245 was adopted September 10, 1996.
The GSE (Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Event) was sett up in 1976, long before the CTBT was ready for signature in 1996.

On April 22, 1976 the Conference of the Committee on Disarmament (CCD) decided through a proposal of the Swedish Delegation to establish an "Ad hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events", GSE.
GSE members were appointed by governments through CCD-member States and the group consisted of non-CCD-member states of the United Nations as well. In the "Conference Room Paper one" the CCD made an outline of the procedure of the establishment of the group and its working responsibilities.
The GSE had to submit a progress report to the CCD to a certain deadline and elected its own chairman. Appealing is that the group had to achieve consensus in its reports. If this could not be accomplished every experts had to state his own point of view. The meetings and the work of the group were informal with mostly informal proceedings. Merely the report of the GSE should be on a formal basis. The main objective of the GSE was to specify the characteristics of an international monitoring system with all its seismological stations, an analysis for detecting seismic events, the transmission of the data to data centres and a cost estimation for an international monitoring system.
The CCD determined that the GSE should not evaluate the adequacy of a monitor system for a comprehensive nuclear test ban treaty. The emphasis laid on the "purely scientific responsibility" getting factual results, assisting the governments in making an assessment and in guiding a future research.[ix] Lessons had been learned from the Geneva Conference of Experts, not vanishing the line between scientific knowledge and taking influence on policies by evaluation and interpretation of verification measures.
Nonetheless the "purely scientific responsibility" determined in the first Conference Paper was not the only contribution of the GSE group to the CTBT. During long years of work it emerged a much more diverse role.

A composition and method for the GSE work, its date for the first meeting and a final time table with a table of content followed in further official documents.[x]
GSE work was grounded at the first meeting on an agenda. All the procedures for the group and the work to accomplish were listed and determined by a specified schedule.[xi]
Hence GSE work was regulated through conference decisions, fulfilling a specific timetable of tasks and submitting its report to the Conference on Disarmament.

Only few members are on the first participation list (1976) of experts and representatives. It strikes that only one representative of the USA was present. Comparing this fact with the participant list of the last GSE meeting (45th session, 1996)[xii] a remarkable progress was made during all the years if only seen in the context of participating members. A full range of countries are listed for the last meeting. The USA had seven members more than in the first GSE meeting in 1976. Why did the USA have only one participant at the first GSE meeting? Early the need of a reliable verification method was evident. Evidently The United States were the most dominant group at the 45th meeting. Why did the USA have more participants than every other country participating in the GSE in 1996?
The significance of GSE-work for a technical verification method for the CTBT was evident and could not be longer ignored.

The GSE Technical Tests and the "Confidence Issues"

How did the GSE help to keep going the political process?
At early negotiations it was widely accepted that the core of a monitoring system would be the seismic verification stations.
The GSE fundamentally conducted three technical tests: GSETT-1 (GSE First Technical Test, 1984), GSETT-2 (1991) and GSETT-3 (1995).
37 countries and 75 seismic stations participated during GSETT-1. The main purpose was the rapid global exchange and the analysis of Level I data (basic parameters of detected signals) of seismic events by the stations. To accomplish this task, the Global Telecommunication System of the World Meteorological Organization (WMO/GTS) was used. The transmission of Level I data from national stations to the three International Data Centres in Moscow, Stockholm and Washington D.C was developed and tested.

The GSETT-2 was modernized compared to GSETT-1. Now an analysis of Level I Data and additionally of the waveform data (Level II data) of seismic events with 60 seismograph stations from 34 countries was made . [xiii]

The GSETT-3 experiment is the key of GSE work and the seismic network for the CTBT. It was necessary to establish further stations for a more detailed contribution. Fifty primary stations (Alpha stations) are responsible for the first detection of seismic events all over the world. The data is submitted to the IDC (International Data Centre). The secondary stations (Beta Stations) can improve the accuracy of event analysis. So we can talk about a robust verification system for detecting a treaty violation. Finally the IDC had to analyse, to archive and to send the data quickly to the interested party. [xiv] The GSETT-3 could not be finished by the GSE until 1996. A rather gradual transition into the International Monitoring System regarding future years was made.

Ramaker writes in his book "The final test: A history of the Comprehensive Nuclear-Test-Ban Treaty Negotiations" about the three technical tests undertaken by the GSE, how data from separated seismic stations on the world could be transmitted to an International Data Centre and finally could be used to detect local events in one or two days. He stated that "The value of this work and its contribution to the success of the CTBT negotiations cannot be overestimated. The software for the processing of the data already was developed by the USA during GSE work. For this reason savings were made through establishing a seismological monitoring network and an IDC for use during the GSE experiments."[xv] It is clear that the whole process could be accelerated by this conducted way.

The technical progress influenced this long path towards an effective trustable verification system significantly. Since ever scientists had to challenge the immense technical progress because the "scientific facts" had to be renewed a lot of times. This is the difficult context to the impact of scientific progresses on political negotiations and new chances for a positive communication in International Affair. Especially arms control measures are vulnerable to new technical development.[xvi] But there are other contributions of the GSE concerning the confidence issues as well which we cannot observe at a first glance. The criticism to GSE work was that the content of its work was merely a technical and scientific one but the most important issue is that the progress helped to pave the way for the CTBT. For this reason it is interesting to observe the development of political negotiations and simultaneously the scientific research. Initially the GSE was appointed by two political time limited mandates

through the CCD, the third and last mandate was unlimited. Remarkable is that GSE work went on even when political negotiations were set out for some time.[xvii]

The table below illustrates the parallel development of the global verification system and the political conditions for the CTBT. Remarkable are the years between the first Comprehensive GSE Report in 1978 and the end of the GSE Global Telecommunication System Technical Test in 1983. There are no parallel political negotiations. The same happened during GSETT-1 in 1984 and GSETT-2 in 1991. Even more noteworthy is that two years after GSETT-1 and after GSETT-2 negotiations took place. From 1986 to 1987 were held bilateral negotiations between the USA and USSR and new protocols for the TTBT (Threshold Test Ban Treaty) and PNET (Peaceful Nuclear Explosions Treaty) were agreed in 1990. From 1993 to 1996 after GSETT-2 and during GSETT-3, CTBT negotiations took place, finally approved by the UN. Evidently the GSE went on to accomplish its task, finding a reliable verification method even if political negotiations were in a deadlock and consequently furthered new initiatives after years without negotiations.

	Verification related scientific activities	**Political developments**
1945		First nuclear explosion
Since 1945	National technical means to detect nuclear tests	
1958 – 1960	Geneva Group of Experts (with experts from 10 countries)	
1963	PTBT verification with national technical means	Partial Test Ban Treaty (PTBT)
1974	TTBT verification with national technical means	Threshold Test Ban Treaty (TTBT)
1976	PNET verification with national technical means	Peaceful Nuclear Explosions Treaty (PNET)
1976	Establishment of the Group of Scientific Experts (GSE)	By the Geneva Conference of the Committee on Disarmament (CCD)
1977 – 1980		Trilateral test ban negotiations
1978	First comprehensive GSE report	
1980 – 1983	GSE Global Telecommunication System technical tests	
1982/83		Ad Hoc Committee at the Conference on Disarmament
1984	GSE Technical Tests GSETT-1	
1986/87		US-USSR bilateral negotiations
1990		New protocols agreed for the TTBT and the PNET
1991	GSE Technical Tests GSETT-2	
1993 – 1996		CTBT negotiated at the Conference on Disarmament in Geneva
1995	GSE Technical Tests GSETT-3 with Prototype International Data Center in Arlington	
1996		CTBT opened for signature
Since 1997	The Provisional Technical Secretariat of the Preparatory Commission for the CTBTO is being established in Vienna. It builds up the International Monitoring System and the International Data Centre	

See: Martin B. Kalinowski, "Comprehensive Nuclear-Test Ban Treaty" in eds. Rudolf Avenhaus, Nicholas Kyriakopoulos, *Verifying Treaty Compliance,* (Berlin, Heidelberg, New York: Springer, 2006), 139.

The GSE activity was the base to keep going the political progress and shaping political negotiations. This led to continuity and assurance for political negotiations because the development of technical verification measures was the key for an agreement of a Comprehensive Nuclear-Test-Ban Treaty. The technical facts served for building confidence and guaranteeing a ban of nuclear tests with same conditions for all states.
Members came from different countries, possessing diverse knowledge of scientific verification. Together they were moving step by step forward towards a seismic verification system, a difficult task during Cold War with little political progress.

Ola Dahlman from Sweden, the Scientific Secretary through all the years of the GSE describes the progress to build up confidence by at least three ways.
The first is a technical one. The group worked for a long time to prepare the ground for the verification regime with emphasis on the seismic monitoring. Secondly the Group was very important for its global reach. It could help to extend the confidence because of the regular meeting of 30 to 40 countries in Geneva.
Another reason for building up confidence was the "knowledge exchange" by the scientists. The field of verification was not well developed. The group members could educate each other.[xviii]
In the reports of GSE to the Conference on Disarmament we can observe clearly the emphasis on the experiences through GSE experiments. The Group learned continuously during all the years and its work served as a "big training exercise".
In the progress report of February 1996 the GSE concludes regarding the GSETT-3:

[…] To have knowledgeable experts available in many countries is a prerequisite to obtaining a credible global verification system. GSETT-3 could, in this perspective, be looked upon as a large, global training exercise in which all countries[xix] can participate, especially in the operation, calibration and evaluation. […].[xx]

Nowadays we recognize that it was much more than a "training exercise".
The GSE members built up knowledge and this was transferred by personal involvement. Later, members of the last 45th GSE session became staff members of the PTS (Provisional Technical Secretary), staff of NDCs (National Data Centres) in their own countries or active WGB participants (Working Group B), responsible for the technical issues of the CTBTO.[xxi]

In August 1996 at the final GSE session, 52 members from 26 different countries were presented. Five members of this session are now in the PTS and seven are active WGB participants. In March 1997 was the first session of the PTS. In the following two years 250 persons became staff members.
Moreover the "transfer" included the technical results of GSE work. The basis software came from the USA (Prototype International Data Station in Arlington) and was developed and used in the GSETT- 3. This software of GSETT-3 was transferred as a whole "software package" at the end of GSE work to the PTS in Vienna in May 1998.

The GSE reports list all the detailed results of the experiments and problems to be solved for the accomplishment of a good verification and monitoring system towards a Comprehensive Nuclear Test Ban Treaty.
The essential core of GSE work was the enhancement of the communication and working process between countries represented within the group. The establishment of a modern communication system and method to achieving a reliable data system was essential. The coordination of work, including institutions of each country, was the central task, especially concerning those which had little possibilities and knowledge for the development of a national network.
The GSE members conducted additionally extensive work in between the sessions which were held normally twice a year. These results were presented and discussed at the GSE sessions.
The GSE describes the cooperation between the scientists and the WMO and the national meteorological and seismic stations during GSETT I as excellent.[xxii] Without these many participants from different countries and their institutions, the test would not have been successful at all.
A lot of effort had been made to establish the infrastructure needed for GSETT-3 with the IDC, NDCs and communication links. In the report of the GSE in August 1995, the group listed which kind of technical results had demonstrated GSETT-3 and concluded in one point:

[…]The Ad Hoc Group considers it essential that the operation of key elements of this infrastructure that could contribute to the future IMS established under a CTBT maintained.[…][xxiii]
The national institutes in all the countries were crucial for the work of verification measures and fulfilled one of the biggest tasks to achieve the technical foundation for the treaty.

[…]

(b)The GSETT-3 has demonstrated the importance of practical training of international staff at the IDC and of national staff at NDCs. This training, which is already taking place, should be continued and expanded.

(c) The GSETT-3 had demonstrated that an international technical staff can work effectively together at the IDC. In fact, this international participation in the IDC work has been crucial to the success of GSETT-3.

[…][xxiv]

Regional informal workshops in South America and Africa should help to increase the participation and development of auxiliary stations for the network development. For example a workshop was held in Argentina in November 1995.

[…]

14. This workshop was convened with the objective of increasing awareness of the GSETT- 3 experiments and encouraging participation from seismological institutes in the Central and Latin American regions. The workshop was hosted by Argentina and its National Institute for Seismic Prevention (INPRES) in San Juan. The workshop was well attended by seismologists and government representatives from many countries in Central and Latin America. […][xxv]

A similar workshop was convened in South Africa in September 1996. A lot of experts from different countries and representatives from governments as well met to participate at this workshop about the GSETT-3 and an International Monitoring System.

[…] …the ad hoc group noted that training and education of experts worldwide will be an important issue in the future monitoring system. The IMS will need trained experts in all the monitoring technologies, both at the national level and at the IDC. […][xxvi]

Step by step the participation of GSETT-3 increased. On all continents including Antarctica are stations, yet the geographical distribution was uneven.[xxvii]

After all, in its final 45th session in August 1996 the GSE wrote the progress report and summarizes the experience of 18 months duration of GSETT-3 in an Executive Summary. In this Summary the Group also gave recommendation for the transition into a International Monitoring System.[xxviii]

The GSE is mentioned in the Resolution for the CTBTO adopted November 19, 1996: *Text on the Establishment of a Preparatory Commission for the Comprehensive Nuclear Test- Ban Treaty Organization.*

[…]

The Commission shall:

(a) At its second plenary session, taking into consideration all relevant reports, including those prepared in the course of the CTBT negotiations and by the conference on Disarmament's Group of Scientific Experts:

(i) Establish an initial plan for the progressive commissioning of the International Data Centre and the International Monitoring System, and for the implementation of related responsibilities;

(ii) Assume responsibility for relevant technical tests, including the work begun under the Group of Scientific Experts´ Technical Test 3, and for the development and management of any arrangements required to provide an uninterrupted transition from such technical tests to the future International Monitoring system;

[…] [xxix]

The examples of the communication between the GSE and the CD and the Resolution on the establishment of the CTBTO, give a deeper understanding of GSE work and its contribution towards the CTBT. We recognize that the work of GSE cannot be described merely as a scientific one. This scientific experiment could only work because of the deeply interrelated communication and confidence issues, achieving a global cooperation with different countries and their institution in order to build up a world wide verification network.

The scientific results could not have been approached without gaining experience and improving technical measures by working together in world wide cooperation.

Moreover we can observe through the GSE a perfect example that the biggest challenge for arms control is the continuously changing scientific progress and its impact on International Affairs, considering the 1-3 GSE-Tests through many years of technical research. The GSE confronted the challenge to modify the verification system, going on step by step without any cessation even if political negotiations stagnated.

NGOs and their Contribution to the CTBT

Transnational Co-Operations

The GSE was not the only group of scientists trying to achieve a consensus for a verification system. This part of the paper will briefly refer to the role of transnational collaborations by shaping the states` policy and enforcing the arms control debate. Some examples will be demonstrated regarding non-governmental cooperation and its influence on state governments. Finally we notice that both, the GSE members and the scientists of the NGOs movement came to a similar conclusions regarding the CTBT negotiations and the dilemma between scientists and politicians in the context of International Affairs.

First, scientific technology is deeply interrelated with the political process. Technology is essential, dealing with other states and for the consolidation of the own state's power .[xxx]

Secondly, science follows the idea and has the reputation to create an objective trustable knowledge. Considering these two issues the role of NGOs for the political negotiations of the CTBT will be stressed.

One of the examples for the 1980s is the project of the NRDC (Natural Resources Defence Council) a US non-governmental organisation and the Soviet Academy of Sciences (SAS). The project idea was to establishing three seismic nuclear monitoring stations at the Soviet test site in Semipalatinsk and later a Soviet monitoring stations at the US test site in Nevada. The idea of a non-governmental scientific group was born, leading the on site monitoring in the USSR.[xxxi] The two leading persons were NRDC physicist Thomas Cochran and SAS physicist Yevgeny Velikhov.

Both the NRDC and the SAS contributed considerably to the national and international debate for a CTBT and had significant influence on their own governments. Where politicians failed to negotiate, scientists set an example for a successful negotiation despite strong opposition from the US and Soviet administration. The central key question is how far the scientists took influence on the establishment of the first monitoring stations. This transnational effort between scientists from East and West changed the debate about a CTBT.

Scientists as "Political Players" in the Public

The monitoring project was converted to a public relation issue and was widely covered by the media. This led to discussions and attacks by Soviet and US policy makers. The criticism was that non-governmental groups had nothing to do with the promotion for setting up seismic stations. The NRDC became a rival to the Department of Defense regarding the important question of security issues during that time.[xxxii] But the public discussion helped fundamentally to support the accomplishment of the project. The Public perception was decisive because it had to be maintained the seriousness of the project. At the same time it was essential maintaining discussions with policy makers to accomplish the project.
The NRDC-Soviet Academy seismic verification project was the largest privately-funded scientific exchange ever undertaken with the Soviet Union. [xxxiii]
The financial fund raising to maintain projects for arms control are deeply related to the public perception. A negative view can endanger the financial assistance of foundations. On the one hand a support through foundations is considered positively because the donators are not governments and consequently less influence by states exists. On the other hand there is always a possibility to take influence in certain matters by those who contribute the money.

A comprehensive cooperation between scientists of East and West were important to move the international arms control agreement outside of official government to government contacts. For a CTBT all efforts had to be taken, achieving a more substantial arms control agreement. Such a treaty could be verified by seismic means, believing that the "other side" of scientists of the cold war shared this as well. They believed in their responsibility and moreover in the capability to solve the technical problems for arms control. These scientific channels could lead to results when political negotiations failed. A decisive issue was the personal influence of scientist as "political players". One example is the Soviet Velikhov who had on the one hand good relationships to US scientists and on the other hand access to Gorbachev. Consequently he could take influence on the policy process as a professional adviser. [xxxiv]
The involvement of scientists in the scientific and political field, gaining extensive knowledge, experience, connections and access to higher circles of the political stage are important for the cooperation between scientists of different countries and the outcome of there objectives.

In November 1986 a workshop at the Ruhr University in Bochum was conducted. One aim of the workshop was to discuss the status and limitations of verification concepts for a nuclear test ban. This workshop showed that persons from collaboration with transnational networks and expert groups from different scientific fields participated all together. Velikhov from the SAS and Dahlman from the National Defense Research Institute in Stockholm Sweden and chairman of the GSE were present. Both tried to explain the problems to accomplishing a CTBT. The technical possibilities to establish a sufficient verification system existed, but the matter is the political will to start the progress towards a CTBT.[xxxv]

It is necessary to separate scientific problems from political problems to achieve some sort of demonstration of a verification method.[xxxvi]

Scientists are not required to be representatives of their states and its political concepts.

A noteworthy aspect is that during the Cold War, scientists of arms control shared same common beliefs. The input from transnational scientists had a significant impact on shaping International Affairs. They became “catalysts of change” and “advocates” towards a test ban.[xxxvii]

The project of the NRDC and the Soviet Academy of Science is very noteworthy for the 1980s but not the only one. Scientists from the Pugwash Conferences, first held in 1957 share common beliefs and a common language as well where the diplomacy of states failed. Another group is the Soviet American Disarmament Study Group in the 1960s and 1970s. Other cooperations took place, recalling the relation between the Federation of American Scientists and Soviet scientists.[xxxviii]

NGOs have as non-state actors the opportunity to fulfil the task of creating more transparency and even adopting the role as “political players”.

Conclusion

The Geneva Group of Experts was confronted with an immense challenge. The field of verification of nuclear explosions was rather undeveloped and moreover the Cold War tensions between the USA and USSR were difficult to challenge. The Geneva Group of Experts was the first group confronting this challenge and was a considerable example for the difficult communication between scientists and politicians, the fast achieving of technical facts on the one hand and the influence of dominant political interests through states on the other hand. Although a comprehensive nuclear test ban treaty could not have been accomplished, the Geneva Experts shaped the political negotiations and paved the way towards the Limited Nuclear-Test-Ban Treaty.

Lessons were learned from the formal Geneva Conference in 1958. The GSE was established in 1976 and hold informal sessions, conducting three technical tests during twenty years. The responsibility of the group laid on the accomplishment of technical verification results rather than on the political assessment.
The challenge towards a CTBT was the development of technical requirements for the verification system and even more to keep going political negotiations by building confidence and achieving a consensus. Different state interests often led to a “political deadlock”. These political conflicts were significantly threatening and slowing down the process. During this time the GSE helped to keep going the political process by developing the seismic monitoring system. For creating technical confidence states had to be engaged in the process of technical development. A significant communication channel between scientists on a national and international base connected with other organizations was achieved.

In workshops interdisciplinary exchange took place and scientists of different fields could discuss together with non-scientists, holding interdisciplinary discussions concerning verification measures. This led to an exchange with participants from NGOs and members from other institutions. Hereby NGOs often have the power and public recognition to take influence on policy decisions and contributing an alternative view and way to achieve a goal.
Unfortunately the contributions of scientists were underestimated by fulfilling their task in the “background” of a difficult diplomatic Cold War time. When political negotiations were in a deadlock the GSE went on with verification tests. The GSE helped to extend confidence between different countries and moreover created nowadays base through GSETT-3 by

transfer of knowledge in “persons” and technical results for the PTS and the CTBTO. After all, the contribution of scientists were the background force to accomplish an official diplomatic agreement. Even if a monitoring system is not an obstacle anymore, politicians have to make the final decision in favor of the Comprehensive Nuclear-Test-Ban Treaty.

List of Abbreviations

CCD	Conference of the Committee on Disarmament
CTBT	Comprehensive Nuclear Test Ban Treaty
CTBTO	Comprehensive Nuclear Test Ban Treaty Organization
GSE	Ad Hoc group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events
GSETT	GSE Technical Test
IDC	International Data Centre
INPRES	National Institute for Seismic Prevention, Argentina
IMS	International Monitoring System
LTBT	Limited Test Ban Treaty
NDC	National Data Centre
NGO	Non Governmental Organization
NRDC	Natural Resources Defence Council
PNET	Peaceful Nuclear Explosions Treaty
PTBT	Partial Test Ban Treaty
PTS	Provisional Technical Secretary
SAS	Soviet Academy of Sciences
TTBT	Threshold Test Ban Treaty
UNGA	United Nations General Assembly
WGB	Working Group B
WMO	World Meteorological Organization
WMO/GTS	Global Telecommunication System of the World Meteorological Organization

[i] Kai- Henrik Barth, "Science and Politics in Early Nuclear Test Ban Negotiations," *Physics Today* (March 1998), 34-35.

[ii] Martin B. Kalinowski, "Comprehensive Nuclear-Test Ban Treaty" in eds. Rudolf Avenhaus, Nicholas Kyriakopoulos, *Verifying Treaty Compliance,* (Berlin, Heidelberg, New York: Springer, 2006), 138-139.

[iii] Jaap Ramaker, *The Final Test: A History of the comprehensive Nuclear-Test-Ban Treaty Negotiations (Austria: PTS, CTBTO, 2003), 4-5.*

[iv] Barth, 38-39.

[v] Harold Karan Jacobson and Eric Stein, *Diplomats, Scientists and Politicians: The United States and the Nuclear Test Ban Negotiations* (USA: University of Michigan Press, 1966), 68- 69.

[vi] Barth, 35, 38-39.

[vii] Harold Karan Jacobson and Eric Stein, *Diplomats, Scientists and Politicians: The United States and the Nuclear Test Ban Negotiations* (USA: University of Michigan Press, 1966), 487.

[viii] Ibid., 481, 484.

[ix] Conference Room Paper No1: Decision of the Conference of the Committee on disarmament of 22 July 1976, Geneva, 2 August 1976, 2.

[x] Conference Room Paper No 3, Composition and Method of Work of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 3 August 1976. Conference Room Paper No5: Time-Table for the work of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 5 August 1976.

[xi] Conference Room Paper No. 2: Agenda for the 1st Meeting of the Ad hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and to Identify Seismic Events, Geneva, 2-6 August 1976.

[xii] Conference Room Paper No 8 /Rev 1: List of Scientific Experts and Representatives participating in the First Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 6 August 1976.

GSE/CRP/271: List of Scientific Experts and Representatives Participating in the Forty- Fifth Session, Geneva 5-15 August 1996.

[xiii] Hans- Peter Harjes, "Towards a Global Seismic Monitoring System- Lessons learned from Geneva Experiments" in eds. E.S. Husebye and A.M. Dainty, *Monitoring a Comprehensive Test Ban Treaty*, (Netherlands: Kluwer Academic Publisher,1996), 421, 427.

See also: Frode Ringdal, "GSETT -3: A Test of an Experimental International Seismic Monitoring System" in *Anali di Geofisica, Vol. XXXVII, N. 3*, (June 1994), 242-243

[xiv] Ibid., 242-244.

[xv] Ramaker, 91-92.

[xvi] Eugene B. Skolnikoff, *The Elusive Transformation: Science Technology and the Evolution of International Politics* (Princeton New Jersey: Princeton University Press, 1993), 85.

[xvii] Conference Room Paper 62: Terms of Reference to the Continued Work of the CD Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 11 February 1980.

[xviii] Interview: Ola Dahlman, Chairman, CTBTO Working Group on Verification (Vienna: CTBTO) http://www.ctbto.org/verification-regime/potential-civil-and-scientific-applicationsof-ctbt-verification-data-and-technologies/page-1/ (accessed August 25, 2008)

[xix] The GSE was open to all CD Member States and also to non-member states invited upon their requests by the CD, ibid., 1.

[xx] CD/ 1385: Progress Report to the Conference on Disarmament on the Forty-Third Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 23 February 1996, 4, 23.

[xxi] GSE/CRP/271: List of Scientific Experts and Representatives Participating in the Forty- Fifth Session, Geneva 5-15 August 1996. Not publicly available, private communication with Prof. Martin B. Kalinowski, 1rst October 2008.

[xxii] CD/681/Rev.1, Summary of the Fourth Report to the Conference on Disarmament of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events (CD/720), Report on the Group of Scientific Experts Technical Test (GSETT) 1984 , 31 July 1986, 3.

[xxiii] CD/1341: Progress Report to the Conference on Disarmament on the Forty-First Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 18 August 1995, 3.

[xxiv] CD/1341: Progress Report to the Conference on Disarmament on the Forty-First Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 18 August 1995, 5.

[xxv] CD/1372: Progress Report to the Conference on Disarmament on the Forty-Second Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 12 December 1995, 4.

[xxvi] CD/1398: Progress Report to the Conference on Disarmament on the Forty-Fourth Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 24 May 1996, 3, 13-14.

[xxvii] CD/ 1385: Progress Report to the Conference on Disarmament on the Forty-Third Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 23 February 1996, 1-2.

[xxviii] CD/1422: Progress Report to the Conference on Disarmament on the Forty-Fifth Session of the Ad Hoc Group of Scientific Experts to Consider International Co-Operative Measures to Detect and Identify Seismic Events, Geneva, 16 August 1996 , Annex I, 1-9.

[xxix] Keith A. Hansen, The *Comprehensive Nuclear Test Ban Treaty: An Insider's Perspective,* (Stanford, California: Stanford University Press, 2006), Annex, Appendix D, 187.

[xxx] John Krige and Kai-Henrik Barth, "Introduction: Science Technology and International Affairs," *OSIRIS* Vol. 21 (2006), 2-3.

[xxxi] Matthew Evangelista, *Unarmed Forces: The Transnational Movement to end the Cold War,* (New York: Cornell University Press, 1999) , 279-280.

[xxxii] Kai-Henrik Barth "Catalysts of Change: Scientists as Transnational Arms Control Advocates in the 1980s," *History of Science Society*, *OSIRI, 21* (2006), 205.

[xxxiii] Ibid., 190.

[xxxiv] For further information about transnational organizations within the US and Soviet domestic structure see: Evangelista, Unarmed Forces: The Transnational Movement to end the Cold War, 279 ff.

[xxxv] Ola Dahlman, "Verification of a Nuclear Test Ban," in *Hamburger Beiträge zur Friedensforschung und Sicherheitspolitik IFSH,* Vol. 19 (Hamburg, June 1987), 32.

[xxxvi] J.Velikhov, "Comments on the Verification of a Nuclear Teststop," in *Hamburger Beiträge zur Friedensforschung und Sicherheitspolitik, IFSH,* Vol. 19 (Hamburg, June 1987),54.

[xxxvii] Barth, *Catalysts of Chang,* 185.

[xxxvii] Barth, Catalysts of Change, 182-188.

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