FIG REPORT

FIG PUBLICATION
NO 59

International Boundary Making

Editor
Haim Srebro

FIG COMMISSION 1
Professional Standards and Practice

INTERNATIONAL FEDERATION
OF SURVEYORS (FIG)

ABOUT FIG

International Federation of Surveyors is the premier international organization representing the interests of surveyors worldwide. It is a federation of the national member associations and covers the whole range of professional fields within the global surveying community. It provides an international forum for discussion and development aiming to promote professional practice and standards.

FIG was founded in 1878 in Paris and was first known as the *Fédération Internationale des Géomètres* (FIG). This has become anglicized to the *International Federation of Surveyors* (FIG). It is a United Nations and World Bank Group recognized non-government organization (NGO), representing a membership from 120 plus countries throughout the world, and its aim is to ensure that the disciplines of surveying and all who practise them meet the needs of the markets and communities that they serve.

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Published in English

Copenhagen, Denmark

ISBN 978-87-92853-08-0

Published by
International Federation of Surveyors (FIG)

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Front cover and introdcution photos: Haim Srebro

Design: International Federation of Surveyors, FIG

Printer: 2013 Hakapaino, Helsinki, Finland

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PREFACE

Robert Frost in "Mending Wall" poetically said, "good fences make good neighbours". In the same vein, our Profession believes good boundaries make good fences that make good neighbours. This must particularly be so with international boundaries, as good boundaries unite rather than divide. The consequence of good international boundaries should promote and contribute towards peace and shared prosperity.

This publication addresses surveying methodology and experiences in the delimitation and demarcation of international boundaries. The process of international boundary making is generally categorised into four recognised phases. They are: the preparations for an agreement, boundary delimitation, boundary demarcation and, boundary maintenance and administration. Surveying for the delimitation and demarcation of international boundaries is highly specialised.

The team of contributing authors, Miklos Pinther, Bill Robertson, Maxim Shoshany, Buddhi Shrestha and Haim Srebro, who are also professionals and practitioners, must be congratulated for their diligent efforts leading to this publication. It is an accomplishment for this team of authors, from diverse background yet eminent in their experience and expertise, under the able leadership of Haim Srebro, Editor for the publication. The support from the team's families, employers, and FIG member organisations are equally appreciated. FIG thanks the New Zealand Institute of Surveyors for co-sponsoring the printing of this publication.

FIG extends gratitude to the United Nations Cartographic Section for their contribution to this publication, in particular the peer review carried out by Ms. Ayako Kagawa, Mr. Ghassan Mkhaimer and Mr. Kyoung-Soo Eom.

It is the hope that this publication will enhance information, knowledge and practices for the delimitation of international boundaries towards the promotion of peace throughout the world.

CheeHai Teo
President
International Federation of Surveyors
December 2013

ACKNOWLEDGEMENTS

The following experts and institutions are acknowledged for their valuable contributions to this FIG Publication:

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SPECIAL ACKNOWLEDGEMENTS

Very special thanks to the Cartographic Section, Division for Geospatial, Information & Telecommunications Technologies (DGITT), Department of Field Support, United Nations and in particular, Mr. **Kyoung-Soo Eom**, (Chief Cartographic Section), Ms. **Ayako Kagawa** (Chief Geo Support Unit) and Mr. **Ghassan Mkhaimer** (Technical Project Manager, Iraq-Kuwait Boundary Maintenance Project or IKBMP) for the support, the knowledgeable and invaluable review of the entire publication;

Special thanks to the New Zealand Institute of Surveyors for its support and contribution towards the publication including co-sponsoring the cost of printing of the publication;

Special thanks to the FIG Council and FIG Commission 1: Professional Standards and Practice for their support and encouragement;

Special thanks to Dr. **Bill Robertson** for his thorough review of the publication on behalf of FIG;

Special thanks also to the Survey of Israel, an Affiliate Member of FIG and its Director General, **Ronen Regev** for its support;

Thanks to the Association of Licensed Surveyors in Israel, a Member Association of FIG and the Technion Israeli Institute of Technology, an Academic Member of FIG for its support; and

Last but not least, to the FIG Office and its staff for administering the process from conceptualisation to completion of the print version and in particular, coordinating the layout, printing and despatch.

FOREWORD

It is a privilege to write this forword for this important FIG publication on international boundary making. The New Zealand Institute of Surveyors and I are proud to be part of the publication under the editorship of Haim Srebro, a highly experienced international boundary consultant. With this pedigree it presents an authoritative and knowledgeable outline of the surveyor's role and challenges in international boundary making. It serves its purpose well in promoting the sharing of information, methodological knowledge and experience required in the delimitation and demarcation of international boundaries.

As such it fills an important gap in publications on the subject of international boundary determination. Over the last century there have been numerous determinations of international boundaries and many books and papers on this. However, these are invariably concerned with the legal and political dimensions of international boundaries. Thus, this collection of surveying methodology and experience is particularly timely in emphasising the role of surveying and describing the range of processes and procedures involved. It records a full surveying and demarcation methodology that has existed previously only in the scattered records of various international boundary projects.

The contents confirm surveying for international boundaries is of a high level specialist nature and that the surveyors' role demands a wide portfolio of surveying expertise. These range through documentary research, geodetic surveying, digital imagery and mapping, reconnaissance, ground marking and positioning etc. The references to the surveyor working within strict legal and political parameters are most valuable and highlight the serious constraints imposed on surveying activity and conduct in the international legal and political arena. The proposed methodology for establishing a boundary making process between two states provides a very useful survey guidance model avoiding the need to continually reinvent from surveying first principles. The process of international boundary making is categorised in the four generally recognised phases. These are the preparations for a boundary agreement, boundary delimitation, boundary demarcation, and boundary maintenance and administration. All phases require significant surveyors' input. The compilation of chapters from five well experienced authors on seven different international boundaries provides a wealth of surveying experience. It contains a depth of learning through the application of survey practice in a wide variety of historic, physical and political circumstances. References to International Court of Justice and Permanent Court of Arbitration and other cases provide authoritative sources for detailed follow up by readers and practitioners.

This publication is timely and it provides comprehensive documentation and guidance on a specialist topic of surveying that has been lacking up until now. It is a very good reference publication for all involved or interested in international boundaries and fills a gap both in surveying and international boundary literature. FIG is to be congratulated on producing this publication at this time as a valuable service to the international surveying community.

Dr **Bill Robertson** ONZM FNZIS
New Zealand Institute of Surveyors
December 2013



INTRODUCTION

The existence of physical and behavioral boundaries is essential for our societies to co-exist. Territorial boundaries are essential for managing property rights regarding individuals and organizations. Inside a state, territorial boundaries are required for proper administrative division and management. Between states they define international boundaries.

In the past conquering empires used to enforce their laws and impose their culture over large areas of the Earth, as an expression of their power and control and in order to ensure the continuation of their rule. They usually used prominent natural physical obstacles as their boundaries, such as mountain crests, seas, rivers, and deserts. The definition of detailed individual boundaries was mainly used for delimitation of land property rights at the tribal and family level and for assessing land taxation.

Since the second half of the 19th century and the beginning of the 20th century, and following the gradual disintegration of colonial powers, the trend of establishing new states has gained popularity. This required a detailed definition of the boundaries of the new states. In 1945, upon the establishment of the United Nations, it had 51 member states. Today there are 193 UN member states. The establishment of new states has been the driving force for creating international boundaries. In addition, many international boundaries have been changed after wars, mainly after WWI and WWII, in accordance with the consequences of the wars. The independence of new states after the disintegration of the Soviet Union and of Yugoslavia contributed to the upgrading of many internal boundaries to the level of international boundaries. There have been attempts in which districts in a few existing states have struggled for independence or at least to achieve autonomy. Such an example is South Sudan, which successfully seceded from Sudan and was granted independence as a sovereign state.

International boundaries of a state define the territorial limits of its sovereignty and the area where its laws are applicable. These local laws define the legal, administrative, social, and economical regulations to which the inhabitants of the state are obliged to

follow. Although often most of the inhabitants of a state consist of one nationality, in modern times, most states have large populations that include minorities. The global economic development, especially the development of international trade and bilateral trade agreements, the establishment of many multi-national companies, and the continuous emigration of populations from poor countries to wealthy ones are all factors that contributed to the development of international law, including international customary law and international conventions (part of them under the auspices of the UN), and to the establishment and maintenance of international organizations.

In many parts of the world, states have joined forces to form regional organizations, mainly for economic cooperation and joint ventures, for example, the European Union, which has changed the traditional division of separate national states. Nevertheless, there is still great importance attached to the recognition and maintenance of international boundaries between states.

The lack of clarity in defining international boundaries between states has been one of the main reasons for territorial disputes and ensuing wars. Such conflicts may arise because of economic interests (ownership of natural resources), national and ethnic reasons, or even religious beliefs.

Lord Curzon stated more than one hundred years ago: *'Frontiers are indeed the razor's edge on which hang suspended the modern issue of war and peace' (Curzon, 1907)*. Interestingly, 193 UN member states have almost eight hundred international boundaries on land and in the sea. Moreover, 164 states plus the European Union are members of the UN Convention on the Law of the Sea (UNCLOS). The desire to prevent or reduce wars, conflicts, and boundary disputes engendered the establishment of international organizations and forums to deal with such cases and contributed to their solutions. Such organizations include the International Court of Justice (ICJ) and the Permanent Court of Arbitration (PCA) in The Hague, the International Tribunal on the Law of the Sea (ITLOS) in Hamburg, and other international tribunals that have been established ad-hoc for conducting arbitrations between states. Sometimes regional organizations, like the African Union, try to resolve the conflict. In severe cases of wars and armed conflicts, however, the UN Security Council may take appropriate measures in order to achieve a cease fire and restore order, or in very extreme cases, it may impose a boundary demarcation by delegating the boundary decision to a special international committee, like in the case when Iraq invaded Kuwait.

Internationally recognized and maintained boundaries of a state are an external expression of its stability, and often reflect the state's internal strength and stability. They enable the development of the economy, trade, and tourism with neighboring states and are important for promoting collaboration regarding agriculture, environmental protection, taxation, national security, and other national issues. The bilateral settlement of the boundary line between states is also essential for maintaining agreements regarding cross-boundary issues such as common exploitation of natural resources, including mineral deposits and oil and gas fields.

Unresolved disputes regarding boundary lines have potential for flaring up. They create friction even during calm periods, but when combined with other conflicts of interest between two neighboring states, they may ignite a cross-boundary explosion. In the past, most of the severe boundary conflicts were concerned with land boundaries, because of conflicts of interest between the indigenous populations living on both sides of the boundary. Disputes regarding limits in the seas mainly referred to fishing rights,

and rarely developed to levels requiring national strategies and international intervention. During the last fifty years the number of maritime boundary disputes has increased significantly. The discovery of many oil and gas fields under the sea, as a result of technological development enabling sub-sea drilling to depths of kilometers, has increased the importance of settling international maritime boundaries and limits. Such a settlement regarding sovereignty over islands has special importance because of its projection on the rights in the Exclusive Economic Zone of states up to a range of 200 nautical miles from the coasts of the island. Thus, even if the island does not have any economic importance by itself, the potential rights of exploitation of natural resources in the adjacent marine zone may lead to severe confrontations between states. Thus, substantial international efforts have been invested under the auspices of the UN to settle international boundary disputes for the sake of peace and stability throughout the world.

Most of the international boundaries of modern times evolved from colonial boundaries from the 19th and the beginning of the 20th centuries. Since the colonial division had been defined top-down by colonial governments and not bottom-up, the boundaries were defined according to the interests and convenience of the colonial power and not according to the interests of the local populations. Furthermore, in many cases the conquering nations had confrontations with the local population and pursued their own interests of exploiting a state's natural resources and strengthening the infrastructure to support their own government. In addition, the colonial powers used to rule over large continuous geographic areas, often from both sides of the delimited boundaries. Such a rule changed many international boundaries to a de facto status of internal administrative boundaries, often having limited influence regarding the ruling government. Owing to the low importance of these boundaries, it was not justified to invest resources, neither in topographic surveys for precisely defining the boundaries, nor in boundary demarcation and maintenance.

Part of the problems of such boundary delimitations resulted from selection of insufficiently defined or unstable geographic features for describing the natural boundary lines, such as mountain crests and watersheds. Attempting to clarify such definitions after hundreds of years, in order to precisely interpret them using modern technologies, often resulted in severe difficulties owing to the discontinuity of mountain crests and the existence of wide valleys between them. In some cases, flat valleys, tens of kilometers wide, or rivers that change their course for kilometers along flooded areas and estuaries were chosen for boundary descriptions. Other difficulties often encountered when re-evaluating colonial boundaries are associated with the selection of cultural features, like roads, which have changed or have disappeared entirely throughout time. Even geographic names often change. The selection of very long arbitrary straight lines, like parallels and meridians for depicting boundary lines, is another known problem. In the sea it also involves the difference between the geodesic and the loxodrome. The most sensitive problems arise when a new interpretation of boundary lines divides villages or populations having a similar identity.

This FIG Publication elaborates on the process of boundary making. Its purpose is to propose a comprehensive methodology for establishing a boundary making process between two states that wish to constructively and fairly settle their international boundary together. It begins with preparations for a boundary agreement and continues with the boundary delimitation, the boundary demarcation, boundary documentation, and boundary maintenance, including considerations regarding long-term boundary maintenance and administration.

The methodological part, chapters 1–3, includes a model for initiating a boundary making process, an order of precedence of boundary definitions, and a model for the boundary chapter in a peace/boundary agreement. This part is augmented by reflections made in the second part regarding the methodology, including those of William Robertson in chapter 6 regarding the role of the surveyor in the process.

Part two, chapters 3–7, includes practical cases of delimitation of international boundaries. Many lessons can be learned from these diverse cases regarding disputes and regarding the models and mechanisms used for dealing with the issues. We focused on land boundaries between states. The practical cases have been especially selected in Asia and Africa, two continents in which a significant part of their area had been controlled by colonial governments. Most of the new states that have been established since WWII are in Asia and Africa. Owing to formal decisions and practical trends, the international boundaries of the post-colonial states follow the colonial boundaries and, thus, inherited the delimitation problems mentioned above.

The presented practical cases refer to such boundaries.

The **Israel–Jordan boundary** was defined in a peace treaty, following bilateral negotiations between the two sovereign states. All the relevant activities were achieved by collaborative work between the parties. This boundary serves as a successful model for implementing the methodological model of the boundary-making process. A joint team of experts of boundary surveyors (JTE) was fully integrated into the process from its beginning and continues today to be a major contributor to successful ongoing boundary maintenance and boundary administration.

The **Iraq–Kuwait boundary** is the first international boundary demarcated by a special Demarcation Commission in accordance with a UN Security Council resolution. The boundary line had been demarcated through a systematic methodological process. An international surveying team carried out the decisions of the Commission and contributed to its success.

Three boundaries in Africa are presented in the FIG Publication.

The **Ethiopia–Eritrea boundary** – A special international Boundary Commission was established in a peace agreement between the states for interpreting the delimited and demarcated colonial boundary according to international law. A professional surveying team successfully supported the commission's work. Lack of a full agreement between the two states regarding the placement of boundary markers prevented the completion of the task.

The **Cameroon–Nigeria** boundary – The two states agreed to establish a common boundary committee chaired by the UN, in order to implement the decision of the International Court regarding the international boundary between them. The level of involvement of the two states regarding the decisions and their execution was very high. A joint technical committee (JTT) was established for implementing the decisions.

The **Abyei boundary Sudan** – The parties established a special arbitration tribunal regarding the reliability of the interpretation of a previous boundary committee (ABC) that had discussed the colonial historical boundary, which was subjected to an arbitration agreement and the law of the Permanent Court for Arbitrations, The process has not yet been completed.

Another practical case deals with the **Nepal–China and Nepal–India boundaries**. Unlike the other cases, these boundaries are not cases from the last twenty years, but instead, they are historic boundaries that have been dealt with for the last 200 years and whose full and final settlement still has not been achieved. These problems are due to the problematic selection of topographic features, either not clearly and finely defined or because there are features like rivers whose locations have changed. They may also be due to the use of geographic names that have changed – similar to what was discussed above. This case illustrates the value of long-term maintenance and the possible problems that may arise regarding the administration of international boundaries that evolve through long periods of time – over a hundred years. From the presented problems one can learn about the various considerations that should be taken when preparing an international boundary for long-term maintenance and administration, in order to achieve stability along the boundary line.

This FIG Publication has been prepared by senior practical professionals, with expertise in boundary delimitation. Three of them served as Director Generals of national surveying and mapping organizations (William Robertson in New Zealand, Dr. Haim Srebro in Israel, and Buddhi Shrestha in Nepal), and one served as the Head of the UN Cartographic Section (Miklos Pinther). Prof. Maxim Shoshany contributed as a co-author and Prof. Moshe Brawer as a peer reviewer.

This FIG Publication has been prepared under the framework of the FIG Commission 1: Professional Standards and Practice work plan for 2011–14. It is intended to promote the sharing of methodological knowledge and experience regarding delimitation of international boundaries and to promote peace throughout the world.

Haim Srebro
July 2013

PART I

A METHODOLOGICAL COMPREHENSIVE INTERNATIONAL BOUNDARY MAKING MODEL

PART I: PROLOGUE

This Methodological part is the first part of the FIG publication on International Boundaries. It discusses the theory and methodology of boundary making, including a model of the international boundary making process, a model of order of precedence of boundary definitions, and a model of boundary delimitation in a Peace Agreement or in a Boundary Agreement. This part integrates and updates our earlier publications within FIG [Srebro (2007, 2009 & 2012) and Srebro and Shoshany (2006 & 2007)] and in Survey Review (2009).

The comprehensive methodology presented results from long-term practice and a study covering a wide diversity of topics: from political and technical to stages of precise documentation and boundary maintenance. In this part dealing with methodology, precise boundary definitions are discussed in light of existing theoretical research, the order of precedence of boundary definitions, and the precedence of implementing practical evidences.

A new modern methodological model to support boundary making is introduced. Special importance is given to the operation of a joint team of experts throughout the process, taking responsibility over all the technical activities.

This model is based on many practical cases, reflecting the decisions of the ICJ, international tribunals, existing theory and international practice, as well as the practice of the authors in various cases, especially with regard to the boundary-making process of the international boundary between Israel and Jordan, which serves as a case study for the research.

Haim Srebro

CHAPTER 1:
THE PROCESS OF INTERNATIONAL BOUNDARY MAKING

Haim Srebro and Maxim Shoshany, Israel

Key words: FIG, International Boundary, Demarcation, Delimitation.

1 INTRODUCTION

The basics of the modern theory of practical boundary making were established by Lord Curzon (1907), Sir Henry McMahon (1935, and earlier presentations since 1896), Col. Sir Thomas Holdich (1916), and C.B. Fawcett (1918). Their practical involvement in boundary making in numerous cases gave their publications a special impact. Significant attention was given to differentiating terminologies of the stages of boundary making: especially between the terms delimitation and demarcation. Delimitation represents the preparatory work and it defines the boundary in the treaty either by words or on maps, whereas demarcation represents the laying down of the boundary on the ground after the treaty has been signed [Mc Mahon in1896 according to Trotter (1897)].

Publications of Lapradelle (1928) and Jones (1945) reflect the second major step in separating the practical stages of boundary making. Jones separates the process into four basic stages: Allocation, Delimitation, Demarcation, and Administration, whereas Lapradelle refers to the first three stages (according to Prescott and Triggs, 2008) as preparation, decision, and execution. Other examples of early publications refer to desirable boundaries of states, which are linked to their evolution (Ratzel, 1897); to boundary evolution ranging from tribal through transitional lines of defense to permanent boundaries (Brigham, 1917); and to military boundaries with reference to cultural boundaries reflecting the instability of boundaries (Haushofer, 1927). Boggs (1940) emphasized the need for international boundaries and for their proper delimitation and management.

In spite of the fact that international boundaries are a very important tool, maybe the most essential one for stabilizing the relations between nations, an up-to-date, internationally agreed model of boundary making does not exist, nor does a comprehensive attempt to extend the early four-phase description of the process. The lack of such a model leads to insufficient technical support for statesmen with regard to delimitating the boundary and the practical arrangements associated with it. Statesmen on both sides usually have to come to an agreement in a tense atmosphere, sometimes after wars or during tough conflicts. They act under public and sometimes even international pressure. The process of negotiation, which usually includes the requirement to compromise with regard to national interests, leaves them no room for any technicalities: these must be dealt with by professional staff with legal and geospatial training and professional experiences. Consultation with people who may not have the proper knowledge and technical skills may cause problems later on during the boundary-making process.

Unclear defining of the boundary in the allocation may result in problems during delimitation and subsequent delays in executing the agreement. If the definition of the delimitation and the guidance to the demarcation are insufficient, a conflict may arise before

or during the demarcation. If the demarcation is not well documented and mutually and formally agreed on, it may cause conflicts and even wars in the future. If the boundary is not well maintained and the boundary zone not well administered, the behavior on the ground will not fit the boundary line, which may cause conflicts in the future.

A comprehensive boundary model may resolve these potential problems prior to their appearance. It serves as a source of reference and as a check list, which may reduce complications and speed up negotiations. It can also, if followed by the two parties, reduce misinterpretations and conflicts, and speed up the process of the demarcation on the ground, which follows the agreement, as well as contribute to future precise reconstruction or densification of the boundary markers.

Our practical experience, based on the demarcations of the International Boundary between Israel and Egypt, of the Intermediate lines between Israel and Egypt during the years 1973–1979, and of the Israeli–Syrian buffer zone of area of Separation 1974–1975 led us to conclude that additional stages should be added to the four accepted basic ones. We implemented these conclusions in the process of boundary making between Israel and Jordan during the years 1994–2000.

2 THE POLITICAL AND ADMINISTRATIVE FRAMEWORK

The political and administrative framework includes three stages with regard to the boundary: (1) Negotiations, which include the allocation of a boundary line; (2) a Treaty or Agreement that includes the delimitation of the boundary line; and (3) the ongoing Frontier Administration including the boundary maintenance. These will be discussed in detail in the following sections (see Figure 1).

2.1 The Terms of Reference in the Negotiations including the Allocation

A Peace Agreement between two states usually is the result of a long process of negotiations between the governments of the states. The purpose of the negotiations is to bring the sides together in a mutual agreement from a previous conflict situation reflecting a disagreement over different interests. The gaps between the sides in various issues, such as boundaries, use of water resources, military considerations, ethnic problems, and economic disputes are so wide, and the heritage of hatred and violence is so deep that the breakthrough can sometimes only be achieved with the assistance of third parties.

Thus, paving the way to an Agreement reflecting the mutual interests of all parties requires the following stages.

The initial stage usually follows internal disputes in each of the countries, because of the need to compromise on national interests. The target in this stage is to agree on a framework of negotiations and on a common Agenda. The common Agenda defines the subjects to be discussed for integration in the final Peace Agreement, and also the framework of initial agreements on crucial subjects; it usually includes a rough outline of the specific agreements.

The allocation of the boundary line is either a part of a Common Agenda document or is defined separately. It serves as a directive to the Boundary Commission about the

framework of the negotiations and discussions to achieve an agreed detailed delimitation, which will be integrated into the Treaty itself.

The stage of negotiations, which leads to a Common Agenda, is characterized by heavy political pressures. The tense, loaded atmosphere sometimes leads to limiting the size of the team for the sake of secrecy. Preparations for this stage suffer from this limited use of professional support. The main professional and technical support is provided after the Common Agenda is published; the practical negotiations are conducted in designated committees, one of which is a committee on boundaries; and other territorial issues.

The allocation is a directive to the boundary committee. In spite of the range of freedom that the boundary committee has over details, the allocation does put certain limits and constraints on it, from which it cannot deviate. If it does, the mutual understandings that are the foundation of the Common-Agenda will collapse and the process will cease.

In order to prevent inopportune surprises, which may cause either of the parties to discontinue the negotiations after the allocation has been determined by the two sides, the allocation should be carefully scrutinized by professionals. This scrutiny should be judicious, to ensure that the wording of the allocation is not misunderstood and that potential interpretations are acceptable. This requires the involvement of a professional boundary engineer, at least for limited consultancy, at this stage (the term "boundary engineer" was suggested by Adler (1995) and Rushworth (1996); it refers to a geospatial expert who is well experienced in the process of boundary making).

2.2 The Treaty/Agreement

The Treaty is a formal document that legally defines all relevant issues between the parties and systematizes their relationships. An essential part of the Treaty between the parties is the territorial one, including the boundaries between them. The delimitation of the international boundary is an integral part of the Treaty and a specific article is usually dedicated to it. The delimitation is an accurate, detailed, legally phrased definition, to avoid any future dispute over its practical interpretation. Using up-to-date technologies, including commonly used geodetic equipment like GPS, and common worldwide geodetic reference systems like WGS84, it is possible to define the boundary very precisely by coordinates at the centimeter level. This frees both sides from the constraints of local, uncommon geodetic reference systems. Meanwhile, until the coordinates will be prepared after the demarcation, it is recommended to use for the delimitation high resolution orthophoto or orthorectified imagery

The boundary demarcation follows the delimitation in the Treaty, which functions as the professional directive concerning the demarcation; this, too, is done by boundary engineers. The more professional the delimitation is, the easier and more accurate will its implementation on the ground be, where it forms the demarcation. Hence, boundary engineers, with their geodetic knowledge and experience in boundary making, including field demarcation, should be involved in preparing the delimitation document.

To become the ultimate source for boundary maintenance and future boundary restoration or reconstruction, the delimitation must be precise by accurately defining the coordinates. For this purpose, in the article dealing with the international boundary

in the Treaty, our model defines a clear procedure for incorporating precise boundary coordinates, in spite of the fact that the coordinates have not yet been defined at the time of the original signing of the Treaty.

The procedure sets out a timetable for a professional team to accomplish a sequence of tasks, including demarcation, field survey, and documentation specifying a list of boundary coordinates.

The model designates the geodetic technology and common reference system, and stipulates that the final coordinates be produced by the predefined procedure, and later be incorporated as part of the Treaty.

Thus, in spite of the early stage of the Treaty in the process of boundary making, the Annex referring to the international boundary in the Peace Treaty includes instructions about the demarcation and field measurements, and the documentation of the list of coordinates. It also specifies procedures for their adoption in advance, so that the documentation of boundary coordinates can become part of the boundary annex to the Treaty of Peace.

In addition, the Annex refers to the maintenance of the boundary pillars and to the use of coordinates for reconstructing the pillars.

3 THE INTERNATIONAL BOUNDARY-MAKING PROCESS

Linear and Non-linear Models

The model covers all the stages of the process of boundary making, the components and activities to be included in the process, and the recommended technologies and technical means. The latter should be revised from time to time due to technological progress.

The model does not always reflect a linear process of succeeding steps, though the linear option is more common nowadays. The linear process includes the stages of allocation, delimitation, boundary agreement, demarcation, documentation, and boundary maintenance (see Figure 1).

Even this linear process is based on interrelations between the activities of the technical experts and the politicians. The allocation is a task for the statesmen but it is strongly influenced by the technical preparations of the experts. The agreement, which is produced by the statesmen, contains the delimitation, which is prepared by the experts. The boundary administration, which is a task for the politicians, includes boundary maintenance, which is the responsibility of the technical experts. Sometimes even the documentation has to be authorized by the politicians.

The non-linear process was mainly used in the past, during the colonial period, when geographic knowledge of the areas of boundary delimitations was very poor. In that version of the model the process used to be iterative. The initial delimitation served as an "advanced, detailed allocation", giving the demarcation team wide latitude to change the lines according to local considerations, mainly geographic and ethnographic. This actually transformed the demarcation process into a complex technical/political task. The resulting delimitation, which was incorporated into the treaty, was actually a formal documentation of the demarcation.

The various stages throughout the process are interrelated in any option including the modern linear process. This is expressed by integrating considerations belonging to later stages while implementing earlier stages. In order to optimize the process, the analysis should be made from the last stage backwards, and then the relevant considerations should be integrated. Since the last stage is the boundary maintenance as part of the boundary administration, the ease of maintenance, including the potential requirement of restoration, reconstruction, or boundary pillar densification, and the requirements of the administration in practice should all be considered during the documentation and the demarcation of the boundary.

The ease of practical demarcation, depending on the type of terrain, the accessibility and the stability of the area, and the stability of the soil and potential natural erosion must be taken into consideration during the delimitation process. Major issues of administration, too, including the use of natural resources and ethnographic considerations, have to be taken into consideration during the delimitation stage, and even as early as the allocation stage. This is reflected, therefore, in the preparatory work before the allocation.

Furthermore, since the delimitation is integrated into the formal Treaty, which is signed by the Statesmen, whereas the coordinates of the boundary line are produced only after the field demarcation, we recommend that the coordinates be defined in the delimitation, which will become part of the Treaty at a later stage, thus empowering the list of coordinates by the authorization of the Statesmen and the Treaty.

But in spite of all the interrelations, we consider differentiating the process into the above-mentioned stages to be very important.

The Stages of the Process

The model is based upon the following sequential stages. Srebro and Shoshany (2009) analyzed the model and presented a scheme regarding the interrelations between the surveyors and people at the political level involved in all stages of the process.

3.1 The Allocation

This is the first step of the agreement and it reflects the statesmen's directive with regard to the international boundary. We follow the definition of Jones (1945): "Allocation means the initial political division of territory between two states".

In modern times the allocation is usually a result of compromise between the two parties representing the two bordering countries. In colonial times it used to be either a general agreement between two colonial powers – for example, between Great Britain and France after World War I with regard to the boundaries between the Levant (Syria and Lebanon) under France and Palestine (including Trans Jordan) and Mesopotamia under GB – or as an international decision of a Colonial Power regarding separation or creation of States within its protectorate or Mandate – for example, the separation of Lebanon from Syria in 1920 by France or the separation of Trans Jordan from Palestine in 1922 by Great Britain.

The Allocation used to be defined in a few ways. One of the methods used to allocate a territory commonly referred to a general inherent boundary, such as a line separating two tribes or two villages or a line along a watershed. This kind of unclear defini-

tion resolved preliminary territorial conflicts by postponing the disputes to later stages. Another method is by referring to previously known administrative or international boundaries. An example of a reference to existing districts can be found in the definition of the separation line between Lebanon and Syria in the Order of Governor Gureau on August 31, 1920, or the reference to the boundary under the Mandate in the language of the 1979 Peace Treaty between Israel and Egypt.

A third method was to refer to natural prominent geographical features. This method was used throughout the British Empire and was described largely in publications (Curzon, 1907, Holdich, 1916, Fawcett, 1918). Its use enabled a very quick description of the boundary, without knowing well the area itself or visiting it. It resulted in many conflicts that rose during the implementation process owing to a bigger mismatch between the definition and the actual geographical situation on the ground. In other cases the administration avoided demarcation in order not to encounter conflicts. The usual geographical features used for that method are chains of mountains, rivers, lakes, and valleys. This method was used in the separation between the Mandated area of Trans Jordan and that of Palestine in 1922.

A fourth method, which was used during the colonial period, was the geometrical method (Curzon, 1907). This method, which defined long straight lines along meridians or parallels, was used largely in Africa. It was used mainly in deserts and in unimportant and less populated areas. This method actually refers to astronomical lines, and is referred to by others as the astronomical method.

This was also the general directive of the 1906 administrative line between the Egyptian Chadivate and the Ottoman Empire, which later became the international boundary between Egypt and Mandatory Palestine. The intention of the allocation was, roughly, a straight line between Raffa in the north and Taba in the south (this line fully annexed the entire Sinai to Egypt for the first time, due to British interests). This line was actually changed during the physical demarcation owing to local problems and considerations. The allocation expresses the intention of the statesmen. In the past it was usually done at a very early stage with lack of knowledge of the actual situation on the ground. At a later stage, during the delimitation process, after a long process of negotiation, which takes into account better knowledge about the geography and the economic and political interests, the boundary line may be moved, sometimes tens of kilometers or more. An example of this can be seen in the initial delimitation of the boundary between Syria and Palestine in the Franco-British December 23, 1920 Paris Convention, which reflected a remarkable deviation from the 1916 Sykes-Pico Agreement, which can be considered as the original allocation. Furthermore, even the delimited line can be changed, usually during demarcation, when representatives of the two parties are exposed to the situation, including the physical geographic situation, the population in the area, the water sources, the roads, as well as various economical and natural facts. Such an additional change was put into practice in the same case, when in 1921–1922 the demarcation team significantly changed the 1920 line, as previously mentioned. The requirement to make changes on the ground, in order to adapt the line to local constraints, was well known. In many cases, the demarcation teams were given the authority to perform such changes.

In spite of the fact that the allocation is an act of statesmen, it is interrelated with the activities of the professional staff. The positions of the statesmen of both sides are based on information of all kinds. The positions are based on knowledge about the topog-

raphy, about the population, about the natural resources, and about additional geographic, as well as historic, ethnographic, anthropologic, and cultural information. The positions are based on an evaluation of the information translated to national interests, mainly economic and security interests and with regard to legal considerations. These interests, together with political interests, are factors in building the positions.

A proper way of organizing the information and its integration can improve the process of decision making.

Since most of the information is location based, the modern technology of GIS (Geographic Information Systems) is suitable and is very powerful, and can be used both for the collection, integration, and management of the information, and for supporting the decision-making process, adding to it the flexibility of evaluating, in real time, the results of changes in the parameters that are considered for the decision.

For proper implementation of the above-mentioned information-based environment, an expert, or a team of experts, should be designated. The one or more experts should serve as technical consultants to the statesmen at an early stage of the boundary allocation.

This technical support has additional importance. Since the allocation has a major influence on the delimitation, being its directive, and, later on, on the demarcation, it is beneficial that a technical expert, preferably a boundary engineer, who already has had experience in boundary making, participates in the early stage. This participation can prevent unexpected complications when implementing the boundary process.

When a Joint Team of Experts is established, after the allocation and before the delimitation, this technical consultant should be part of the team.

3.2 Boundary Delimitation

We follow the earliest definitions of the term made by McMahon in1896 (Trotter, 1897): "…*the definition on paper either in words or on a map of the limits of a country",* and according to Curzon (1907): *"Delimitation signifies all the earlier processes for determining a boundary down to and including its embodiment in a Treaty or Convention".* Whereas the delimitation is signified by work with documents, the physical aspects of demarcation are signified by the laying down of the boundary on the ground.

The Delimitation stage is the most complicated stage during the implementation after the Allocation. In some cases it is comprehensive and fully achieved before the signing of the Treaty. As was defined by Curzon and McMahon, it covers "all the preliminary processes and procedures before a boundary is laid down on the ground" [McMahon in 1896 according to Trotter, (1897)]. Whereas the allocation refers to a general reference to the boundary and thus leaves uncertainty regarding the actual boundary line, the delimitation defines the boundary line in specific terms and locations, thus resolving the problem of uncertainty and any possible disputes, and it enables the state to develop along the boundary. But sometimes, during the demarcation on the ground, additional changes are required, and the delimitation is changed because of those changes. If the topographic information or other important, relevant information, such as the characteristics of the populations and their sources of living, is insufficient at the time of the delimitation, before signing the treaty, it is advisable to grant the demarcation team a specified level of freedom when interpreting the delimitation, in order to prevent future disputes. In such cases, as will be elaborated on later, there is an option to

add an additional stage of final delimitation in order to incorporate the changes made during the demarcation into the final precise definition of the boundary line.

The delimitation of the boundary between Palestine and Syria (and Lebanon) is a typical example of such a case. The final delimitation of the boundary line, which was defined in the 1923 Agreement, adopted the significant changes that were made during the demarcation process of 1921–1922 in pursuing the initial delimitation in 1920.

In order not to mix the various stages, our core model refers to the modern boundary-making process, in which there is only one stage of delimitation, followed by demarcation. The above-mentioned examples reflect the tradition, a century ago, due to the lack of geographic knowledge about the area, to perform an initial or preliminary delimitation followed by a physical demarcation, and then to arrive to a final delimitation that is a very detailed, mutually agreed upon professional definition of the boundary. For these cases, which can be considered today as a legacy, we will add an optional stage to the model, which we will term "the final delimitation". In modern cases, when the preliminary delimitation is also the final one, there will be no distinction.

In this stage the experts on both sides translate the general definitions included in the Allocation to practical, precise definitions, taking into account local considerations. Sometimes the experts deviate from the original definition to adapt it to the local conditions. This is due to preliminary or post authorization.

The negotiations during the delimitation stage are handled before the signing of the Treaty, and therefore they may be complex and tense, which may lead to serious disagreements among the parties. This is why the statesmen are still involved either directly or indirectly in this process. But since the precision of the delimitation process is very important, in order to avoid problems during the demarcation on the ground, the participation of practical experts, who are capable of anticipating the practical problems of demarcation, is essential.

McEwen (1971), Kadmon (1994), and Adler (2001) recommend that practical experts should participate in the wording of the treaty or agreement at the delimitation stage. Rushworth (1996) recommends the participation of experts, at least as consultants to Tribunals, when deciding on delimitation.

The importance of such an involvement was discussed by Cukwurah (1967, p. 34).

According to our model, the two parties to the negotiation should establish a team termed the "Joint Team of Experts", as early as possible, in order to accomplish jointly all the professional tasks of the boundary process. This team should include geodesists, cartographers, and other mapping experts. The team should be a part of a Joint Boundary Commission, together with lawyers, liaison personnel, consultants when necessary, and a commissioner who has the confidence of the statesman who is leading the negotiation between the states.

The joint team of experts should be assigned the task of defining and preparing all the necessary professional data and tools for the boundary annex of the treaty, including defining the wording and the graphical expression of the delimitation, which will be incorporated into the Treaty.

The joint team of experts will also be assigned the tasks following the delimitation, including the demarcation, the surveying, the field measurements, the documentation, and the boundary maintenance.

The advantage of establishing this team as early as possible is that since they are professional, the members of the joint team of experts share a common technical language, and they are used to team work. Thus, once their task is clear, the level of suspicion between them is much lower than between the politicians. As the cooperative work proceeds, the level of confidence grows, and this greatly contributes to the implementation of the task.

According to our model, the joint team of experts should begin to prepare as early as possible, even before the delimitation is ready, the professional tools required for the whole process. The essential tasks involving technical support of the joint team of experts during this stage include (1) preparing for the delimitation, including field reconnaissance; (2) defining the parameters of the geodetic support and implementing the relevant activities associated with it; and (3) defining the mutual set of graphic aids, including maps, which is required as a background for depicting the layout of the boundary line in the Treaty.

The tasks include preparing the delimitation of the boundary line itself, both in the wording and on the set of mutual maps of the Treaty, in coordination with the statesmen. If the delimitation covers sections other than the land boundary, like a boundary line in a river, in a lake or a maritime boundary, it is the task of the joint team of experts to define the technical parameters and methods for this delimitation and to implement them.

The last task of the joint team of experts at the delimitation stage is to precisely state the method of defining boundary coordinates, and of the order of precedence of the various boundary definitions in the future (for example, between boundary coordinates, delimitation on maps, the wording of the Treaty, and the physical signals).

The delimitation should be carefully handled, and be honestly conducted by both sides on the basis of the best available data, in order to ensure a successful demarcation, as well as permanence of the boundary in the future.

3.3 Boundary Demarcation

McMahon (Trotter, 1897), Holdich [July 28, 1902 letter to Under Secretary of State (Rushworth, 1997)] and Curzon (1907) defined the demarcation as laying the boundary on the ground. Curzon referred to demarcation "*as applying to the final stage and the marking out of the boundary on the spot*". He referred to demarcation as a more mechanical process than delimitation, which involves setting up beacons or pillars or posts, numbering them, and recording them on maps (Rushworth, 1997).

This stage is accepted as the third of the four stages, the last to be boundary administration (Jones, 1945, Prescott, 1987).

According to McMahon (1896), the delimitation does not supply "*Stability and finality which should be the underlying object of all international boundaries*". According to ICJ (1962, Preah Vihear Case), only the demarcation defines the final boundary.

There is a level of latitude that is granted to the demarcation teams, when implementing their task, in order to take into account local geographical, administrative, or other considerations (Curzon, 1907, Jones, 1945, Cukwurah, 1967, Brawer, 1988, Rushworth, 1997). Rushworth (1997) commented that although latitude was more essential when

the delimitation maps are of poor quality, it is still considered necessary for modern demarcation.

According to Jones (1945, p. 59), the provisions that are granted to the demarcation teams to deviate from the delimitation usually refer to equitable compensation. He gave a few examples for such provisions, which include the Argentina-Chile convention of May 2, 1904 and the Estonia-Latvia delimitation convention of October 19, 1920. Jones recommends not to mention territorial compensation in the treaty, thus enabling non-territorial compensatory measures. Jones (1945, p. 60) also referred to the restriction of the deviations to slight or minor modifications and gave examples in cases like the Colombia-Ecuador treaty of July 15, 1916, the Colombia-Peru treaty of March 24, 1922, and the Costa Rica-Nicaragua convention of December 24, 1886, which specifies that the commissioners impose a limit of one mile for a deviation from the delimited line. However, the Protocol of Peace, Friendship, and Boundaries between Ecuador and Peru, which was signed in Rio de Janeiro on January 29, 1942, does not put a limit to the parties who may "*grant such reciprocal concessions as they may consider advisable in order to adjust the aforesaid line to geographical realities*" (United States, Executive Agreement Series, No. 288 (Washington, 1943), Article 9).

Prescott and Triggs (2009) gave examples in Africa and Asia regarding the discretion that the demarcation teams were permitted: One case involved an agreement between Russia and Britain regarding the boundary between Russia and Afghanistan in 1885: "*…in tracing this boundary so that it conforms with the description in this protocol, and the points marked on the annex maps, the said commissioners will take due account of local details and the needs and well-being of the local population*" (Prescott, 1975, 124). Another referred to the advice given in 1927 by the British and Belgian Governments to the demarcation teams regarding the Northern Rhodesia-Katanga boundary: "*The commissioners shall have the authority, generally, to make such minor rectifications and adjustments to the ideal watershed as are necessary to avoid the troubles which may arise from a literal interpretation of the treaty*". (Brownlie, 1979, 709)

The demarcation process is sometimes delayed for very long periods of time. Until the 20th century only a few boundaries were demarcated (Brawer, 1988). Later on, colonial powers preferred not to demarcate many boundaries because of economical reasons, mainly because the boundary was in an uninhabited area such as Wadi Araba between Palestine and Trans Jordan (Brawer, 1988) and Wadi Batin between Iraq and Kuwait (Brown, 1994).

The trend today is to demarcate international boundaries, but there are countries that still avoid it because of economical reasons, or in order not to enter into potential conflicts. The logistical component of demarcation today is much easier than in the past because accessibility to rural areas is much better. This is a result of the development of modern transportation infrastructures, the use of field vehicles and helicopters, and improved communication throughout the world. In addition, the revolution in surveying tools, including satellite surveying and high-resolution commercial satellite imagery, greatly contributed to realizing fast, high-quality reconnaissance, high-quality mapping, precise measurements, and precise documentation of the demarcation. The development of international geospatial standards has contributed to collaboration between the surveying parties, and has made possible the use of a common geodetic boundary datum.

Our experience during the demarcation of a few boundary lines resulted in the following conclusions:

1. Delimitation lines that are marked on generalized maps (1:250,000 and smaller scales) are not adequate for field demarcations and cause very serious problems of interpretation.

2. A verbal description is not a sufficient tool for delimitation, when used for a demarcation, which is performed after many years.

   One reason is that the verbal description refers to features that change or disappear, for example, trees, buildings, and wells. The description may be well interpreted just after its definition, but not after a long delay.

   Another reason is that the verbal description usually refers to natural geographical features, mainly ridges of mountains, river beds, and wadis, which are difficult to interpret as a definitive line. Another reason is the use of geographical names.

3. Various kinds of boundary definitions may contradict each other. One example is a contradiction between a verbal description and a geographical layout or delineation on a map. This was experienced in 1981 with reference to interpreting the definition of the international boundary between Israel and Egypt in the Peace Treaty, and during the Mandate over Palestine with reference to interpreting the definition of the boundary in 1922 in the Order in Council and the representation of the boundary on the mandatory maps (Brawer, 1988 pp. 86–87). Sometimes, when a boundary is depicted on maps of various scales the depictions contradict each other. This was experienced in 1979 in the case of the Peace Treaty between Israel and Egypt with reference to the depiction of the withdrawal lines on the 1:250,000 and the 1:100,000 maps. The recommended solution is to reduce the use of various descriptions and, if they are used, to define an order of precedence between them.

4. Tracing remnants of old demarcation lines may also cause complications. This occurred in 1981 during the demarcation of the international boundary line between Israel and Egypt, especially in the sandy areas in the north and in the southern area. In the north there were in certain cases various physical pillars, not far from each other, representing generations of renewal of boundary pillars. In other cases, the pillars disappeared in the sand dunes, and they were exposed in a windstorm in places different from the new demarcated boundary, or did not fit the original verbal description (e.g., of a straight line). In the south, some pillars disappeared or the ground was removed in the past for construction work and only contradictory definitions existed.

5. The best results of demarcation, and the easiest to implement the process, are achieved if the delimitation is performed through joint efforts, including thorough field reconnaissance, and physical marking of the delimited line. Latitude should be given to the demarcation teams to adjust for topographical obstacles and other problems including accessibility problems, or any anticipated lack of stability of the boundary pillar, which requires continuous maintenance. The result of the survey should include a detailed description of the demarcated boundary, the core of which should be a joint list of boundary coordinates in a common geodetic system. This will be the binding source for boundary restoration in the future.

3.4 The Final Delimitation

This stage is not always put into practice. It is mentioned here to represent historical cases, in which the final delimitation of the boundary in the treaty was formulated, after a joint commission of experts demarcated the boundary, which had already been preliminarily delimitated in a formal document/agreement by the statesmen.

Jones (1945) recommends that the boundary should be ascertained on the ground and then be delimited.

An example of such a case can be seen in the 1923 agreement between GB and France with regard to the international boundary between Palestine and Syria (and Lebanon). This boundary, as described in the previous paragraphs, had been initially delimited in the Paris convention in 1920, and was demarcated in 1921–1922 by the field commission, which was headed by Paulet and Newcombe. (The demarcation team made significant changes to the original line. Part of the changes had been made according to Franco-British agreed instructions that were delivered to the boundary demarcation committee.)

The final delimitation includes a descriptive part and accurate data of field measurements. The most accurate definition today is an analytical list of coordinates for the entire boundary on a common geodetic system including a common accompanying data file.

If the final delimitation is included in the document of the treaty, it receives direct authorization and no additional demarcation is legally required, like in the case mentioned above between Palestine and Syria (and Lebanon). (But in practice the demarcation is required for the boundary administration.)

Sometimes the treaty itself assigns a commission to perform certain duties after the treaty is signed. In such a case the additional document should be authorized by the two parties. An example of such a case is the Treaty of Peace between Israel and Jordan. The Treaty assigned a Joint Team of Experts to demarcate the land boundary and to define geographic coordinates that will be agreed upon by both parties, and that will be binding and will take precedence over the maps. (The treaty delimitation is defined in the Map Album, which was appended to the Treaty of Peace.)

As previously mentioned, this stage can often be omitted. We preferred to designate it as an option, in order to include any activities that may exist in.

In the case of a preliminary geometric delimitation that refers to meridians or parallels, this may impose many practical problems in the field, but, on the other hand, theoretically and legally, neither additional delimitation nor demarcation is required.

3.5 Boundary Documentation

Following the Court's leading principle, that the element of stability and finality should be the underlying object of all international boundaries (ICJ, 1962 Preah Vihear Case), we think that joint comprehensive detailed documentation of the boundary, which is sufficient to support an accurate construction or reconstruction of every boundary pillar, is the ultimate means to achieve it.

Furthermore, in spite of the fact that physical demarcation of the boundary is recommended, especially in areas of tension, for the ease of boundary administration and re-

duction of violations, theoretically and legally, a combination of a mutual delimitation and comprehensive documentation may also be sufficient.

My recommended approach is to define the documentation of the boundary as a designated major stage in the process of boundary making, similar to land registration in the land administration process, the difference being that the final approval and authority is not given by an authority of a single state but is given by the two neighboring states, along the relevant boundary line, by their authorized representatives.

Achieving comprehensive detailed documentation should be the ultimate goal of boundary makers; it maintains the quality of finality and theoretical stability. In order to obtain the full range of stability, including a practical point of view, it should follow and achieve a thorough, well-maintained demarcation.

Current technologies can support an accuracy level of several centimeters. That is ten times better than is required for most cases of international land boundaries, and a hundred times better than the accuracy of most of the existing international boundaries in the world.

An accurate detailed comprehensive documentation supplies the technical solution for any potential conflict between relevant countries, with regard to accurately locating the boundary line, or any interpretation concerning it.

If it does not prevent arbitration, shared accurate, detailed documentation can, at least, shorten the work of an arbitration or conciliation tribunal or of a jury of the Court, since it contains the solution for the case. The accuracy and the comprehensiveness of the documentation define the technical solution, whereas the signatures of the authoritative representatives grant it legal decisiveness.

It might be even a constructive idea to advance an international effort for promoting peace throughout the world, to document accurately international boundaries, especially in areas of tension or conflict.

The importance of a certain level of documentation was recognized in the past. Jones (1945, p. 199) noted that a technical report of the demarcation is important for preventing loss of data, which may be valuable for future demarcations and future surveying and geodetic work. Cukwurah (1967, p. 79) mentioned that "*on completing demarcation work, it is the duty of demarcators to compile a detailed general description of the posts, marks, and beacons including their types, forms, dimensions and coloring*".

According to our experience, the value of the descriptive data with regard to the type and shape of the pillars is only complementary, whereas the positional and geodetic data that fully document the location of the boundary, and which are sufficient to support any objective technician to reconstruct the boundary line are essential.

Our experience is based on a few practical cases with regard to reconstructing old international boundaries. The first case was experienced in 1981, when a joint team of experts tried to trace the international mandatory boundary line between Palestine and Egypt. It was agreed that this line will be the new International Boundary between the State of Israel and the Republic of Egypt according to the 1979 Peace Treaty between the States. This line had been delimited and demarcated in 1906. The joint team tried to trace the old pillars on the ground (the pillars were of different types). Most of the pillars along the mountainous southern part of the boundary were found in the field, except the southern edge, including Taba, which was a populated area. All of the pil-

lars along the sandy northern part disappeared, and only part of the pillars in the hilly central part existed. Had there been proper certified, detailed technical documentation during the mandatory period, it could be implemented in the Peace Treaty, and in any case the dispute would have been prevented.

The second case was experienced in 1994, when the Joint Team of Experts had to define the international mandatory boundary line between Palestine and Trans-Jordan. This line was supposed to serve, according to the agreed Common Agenda, as the reference line for the international boundary between the State of Israel and the Hashemite Kingdom of Jordan to be incorporated into the 1994 Treaty of Peace between the States.

Since the mandatory boundary had not been demarcated, and definitely was not documented, the only existing material consisted of various interpretations either verbal or on inaccurate maps. The parties employed good will and their creative professional skills to overcome the complicated problems. It could also have ended with a dispute. All of this would have been prevented if proper technical documentation had existed.

The third case was the marking of the "blue line" between Israel and Lebanon in 2000. This task of the United Nations Cartographic Section's team was based, according to the UN documents, on the international mandatory boundary that was delimited in 1923.

Since no common certified documentation of the international boundary existed, the team reported on difficulties in the negotiations with the two parties until its final definition. The difficulties could have been prevented if such documentation had existed.

Following this experience, in 1992 we tried to implement our conclusions in detailed documentation of the international boundary between Israel and Egypt. The joint technical work included GPS measurements of the boundary pillars, which resulted in technical data about the boundary line, including a list of coordinates, distances between the pillars, the horizontal angles of directions of the boundary line for each boundary pillar, the slope distances between boundary pillars, a 1:250,000 graphical layout of the boundary, and 1:100,000 maps showing the boundary. Technical reference data was also included, such as the datum definition and the computation of grid coordinates.

The content of the documentation also included background data about concepts, chronology, data about the boundary line route, a description of the documentation procedure, general data about the GPS survey, the equipment, the data processing, the technical problems, and the boundary line maintenance. The Annex to the documentation includes relevant clauses from the Treaty of Peace and a map album of the boundary pillars, showing for each boundary pillar three aerial photographs taken from a helicopter (one vertical and one from each side of the boundary pillar), in addition to the coordinates and a graphical scheme.

The detailed album was produced jointly by the technical teams of the two States, and was fully agreed upon at a technical level in 1996. However, the Egyptian technical team did not receive approval from the political level to sign it.

The fact that, since the Treaty of Peace, the boundary area between Israel and Egypt is not abandoned anymore, and that two roads follow the fences on both sides, is a tribute to the stability of the boundary line. The existing agreed documentation is also a supporting factor, but the absence of a continuous joint maintenance program, together with the absence of signatures from both parties, may contribute to the instability of the boundary line in the future.

The lesson learned from the peace process between Israel and Egypt was that the agreement about the core of the documentation, which includes the initiation of boundary coordinates, as well as the creation of a joint team to carry out the task, was incorporated into the Treaty of Peace between Israel and Jordan itself, thus granting preliminary authorization to the experts. This is a very powerful way to ascertain stability of the boundary line.

The process of documentation was, in the case of Israel and Jordan, inherent in the workflow of the JTE. The preparation of documentation that includes coordinates of the boundary line, with an accuracy frame of one decimeter, with an attached graphically scaled chart showing the boundary line and documentation of the geodetic reference, and a description of the process was prepared gradually for each part of the boundary. This includes the land boundary, the maritime boundary in the Gulf of Aqaba, the boundary in the Dead Sea, and the boundary line along the Yarmouk River (the documentation of which was required because of the construction of a dam on the river). The documentation for each sector was prepared separately, and was signed upon finalization by an expert from each party and by the head of the JTE from each party.

In order to strengthen the legal authorization of the documents, a special document was prepared to confirm the documentations, and consider them as implementing of the Treaty of Peace. This document was signed by both chairmen of the Joint Boundary Commission.

During the first nineteen years, following the Treaty of Peace, the documentation has already shown its importance in maintaining the boundary. It was put into practice to solve practical issues in each of the portions of the international boundary.

Conclusions and Recommendations:

The documentation stage should be considered essential and is one of the main stages in the process of boundary making. The core and most important part of it is a joint list of precise coordinates defining the boundary line, accompanied by supporting technical data. In addition, it is recommended to add descriptions and details of the process, and relevant connections, to the Peace Treaty and the implementation process.

3.6 Boundary Maintenance

Since the field-demarcated boundary is very important for maintaining the practical behavior around it, it is important to maintain the boundary's appearance in the field. From a practical point of view, this refers to maintaining the boundary pillars and the associated arrangements, which are constructed along the boundary line between the pillars for that purpose.

In places other than the land boundary, maintenance has different meanings, for example, the placement of buoys in the sea, or arrangements that are made along rivers in order to monitor the boundary line with reference to the river changes.

With reference to the land boundary, in the absence of detailed joint boundary documentation, the demarcated posts are the leading evidence, pointing out the location of the boundary. They are important for continuous boundary administration, in order to prevent unintended penetrations and violations of sovereignty. Their existence helps people near the boundary to be acquainted with the boundary location, to adjust their

behavior to the existence of the boundary, and to prevent intentional and unintentional violations of sovereignty. Such violations may be expressed even by violations of infrastructure, including roads and constructions, or illegal exploitation of natural resources. Such violations may, in the long run, result in disputes between the relevant states and even in armed conflicts.

Cukwurah (1967, p. 83) emphasized its importance in the following: "*The delimitation and demarcation of an international boundary will be no avail if, in the long run, no provisions are made by parties for the protection, maintenance and repair of an established boundary. The inviolability of such boundaries is generally recognized in its policies and practices of states. This sanctity can advance (if continuously respected) or destroy (if violated), the good neighborliness existing between adjoining states. And this fact is very often reaffirmed in boundary treaties*". Jones (1945, p. 214) refers to it as well.

The reasons for the disappearance of boundary pillars can be many, either natural or man-made. Examples of natural reasons can be: unstable ground like on sand dunes, muddy soil, or a slope of soft soil. In addition to a potential tilt because of unstable ground, the pillar may fall down, and be moved from its place, mainly because of water erosion or wind erosion. If possible, the demarcation team should avoid constructing boundary pillars on unstable ground, which will require continuous and costly procedures of maintenance, or if there is no choice, a proper type of pillar should be adopted (usually involving very deep construction, sometimes a pipe type).

Sometimes water erosion or wind erosion causes a pillar to come apart, especially if masonry constructions or cairns are not sufficiently fortified, or if iron parts are rusted.

Examples of those types of natural causes were put into practice along the international boundaries between Israel and Egypt (mainly in the sand dunes), and between Israel and Jordan, either the exposition of bases of pillars in sandy areas and in the waterbed of the wadi (in both cases fortification with stones around the bases of the pillars solved the problems), or in the muddy area south of the salt pans of the Dead Sea (where a very long pipe replaced the standard concrete pillar), and in the special case of the boundary pillar on the water line of the Gulf of Aqaba, where the salty water erosion caused the concrete pillar to disintegrate (This was solved by replacing the pillar with one that was made of special concrete with anti-salt water additives and elevating it on top of a high concrete base). In extreme cases, potentially even along the Wadi Araba, which is part of the Great Rift, pillars may move because of an earthquake.

Many man-made problems could cause damage or the disappearance of boundary pillars. This resulted in defining punishment for such offenders according to international law. According to Cukwurah (1947, p. 84), under Roman law the punishment was to be sacrificed to god…

Proper maintenance of the boundary requires a continuous procedure of periodical reconnaissance. This process should be preliminarily agreed upon, if possible, during the negotiations of the peace treaty, or by the joint team of experts if such a team is authorized. It is recommended that the reconnaissance tour be concluded in a report that will point out all the problems, the required measures, and a follow up of previous items that had been raised in the past.

The easiest maintenance, to be taken care of, refers to minor actions, like repainting a pillar. The more complicated actions refer to the reconstruction or replacement of boundary pillars. In order to do a proper job in this regard, proper detailed technical

documentation is required. In order to achieve successful maintenance of the boundary line, a few decisions have to be made:

1. The task should be assigned to a joint active technical team.
2. The preplanning of the location of the boundary pillars, as well as their types and materials, should consider optional requirements of the boundary maintenance.
3. Detailed technical boundary documentation is essential, and should be prepared as soon as possible and authorized by the parties of the two States.
4. Periodical reconnaissance tours in the field are required, and maintenance actions, like repair, reconstruction, etc., should not be delayed for a long time in order not to cause deterioration of the boundary condition.

A permanent designated joint team of specialists is the proper way to maintain the boundary. An example of tasks assigned to the joint team is given in Article 4 of the Treaty between the United States and Canada of February 24, 1925, where with regard to the demarcated boundary the Commissioners are empowered and directed.

Long-term Boundary Maintenance

Since the final goal of the process is to achieve a stable and durable boundary, there are measures and activities that should be taken into consideration when planning for long-term maintenance of an international boundary line.

Most of the international boundary lines are relatively new and were agreed upon after WWII. Many political changes have taken place during the last century, which influenced most of the international boundaries. Although such a trend is not expected for the coming century, no one knows what will happen in the future. Unification of states such as a multi-national European Union is one possible direction. The disintegration of multinational states, such as the Soviet Union and Yugoslavia is another possible development. Secession of districts from the main state, forming a new independent state, like South Sudan from Sudan, may be another possibility. Today we face a trend of ex-Yugoslavian states joining the European Union, so we may encounter in the future a reality in the international arena similar to parcelling and re-parcelling in cadastre. This requires preparing an improved environment having controlled, well-defined documented and well-maintained boundaries.

Many delimited boundaries were not demarcated in the past. Many others, which had been demarcated, were changed afterwards or the physical markers disappeared owing to natural or man-made reasons. Prescott and Triggs described such a situation: "*Vegetation grows up in cleared lines, plants can break down pillars and cover them. Floods and natural movement of river meanders across plains can undermine markers. Sometimes, local populations will move the markers because they do not agree with their location or because they are useful building materials or ideal as sharpening stones.*"(Prescott and Triggs, 2008, 69).

International boundaries have changed as a result of wars, like the boundaries of Europe after WWI and WWII, the boundaries of Korea, the boundaries of Vietnam, and others. They are often changed following political developments, like the unification of Germany and the disintegration of Yugoslavia and the Soviet Union; and following international arbitrations, although the latter usually involve minor changes.

In addition, international boundaries evolve, mainly because of two reasons: one is due to natural changes. The most prominent of these refers to changes in the water course of rivers. This phenomenon may refer to small changes caused by seasonal changes in meanders like along the Jordan River between Israel and Jordan, or it may refer to significant changes in the course of larger rivers due to floods in Africa, in America, in Central and South-East Asia, and in Europe. In certain cases such geographical changes cause the migration of populations into and from the relevant areas, like in the case between Nepal and India regarding the changes in the course of the Narayani/Gandak River (Shrestha, 2003, 161). If the boundary agreements between the states do not specify the legal status of such changes and they are not monitored and maintained, such changes may be followed by boundary disputes regarding changes in sovereignty. A rarer example of natural changes is the gradual shrinking of closed bodies of water, such as the Dead Sea between Israel and Jordan and the Aral Sea between Kazakhstan and Uzbekistan, which influence the boundaries between the states. The other reason is because of man-made changes. Sometimes, usually because of economic development, the population along the boundary grows significantly, changing the infrastructure, the use of land, and the landscape along the boundary. If the boundary lines in such cases are not demarcated or not maintained, this may result in severe boundary disputes in time.

The remedy in such cases is to adopt a comprehensive approach regarding long-term boundary maintenance. In order to achieve durable stability the boundary should be continuously maintained. This should be executed by a joint professional team of surveyors, who will check the boundary line periodically, resolve all problems, and jointly document their work.

Such maintenance depends on the existence of a well-documented and demarcated boundary line. In addition, there should be a jointly agreed formal document specifying the required activities of the joint maintenance working group, as well as jointly agreed procedures regarding the agreement and regarding measures to be taken in case of disputes. In our opinion, in order to encourage long-term duration and stability of international boundary lines, states throughout the world should upgrade their existing boundary agreements to a level where there is precise documentation and they should establish bilateral agreements regarding continuous maintenance of their boundary lines. We think that the up-to-date surveying technologies, and especially satellite surveying, is an opportunity in many cases to upgrade the documentation of boundary lines and boundary pillars to precise coordinated lists, by referring to a commonly used world geodetic reference system.

We chose three positive examples that support long-term maintenance of international boundaries. Two of them refer to two of the longest boundary lines: The US-Canada international boundary line, 8,891 km long, including 2,475 km along the boundary of Alaska; and the China–Mongolia boundary line, 4,672 km long. Both also have been discussed and quoted by Prescott and Triggs (2008, 68–70). The third example refers to the Israel–Jordan international boundary, about 400 km long.

As already mentioned, the US-Canada Treaty of February 28, 1925, assigned in Article 4, tasks to the joint team and empowered and directed the Commissioners to monitor the boundary line and to settle all problems that will be encountered. These guidelines were very specific: "*…repair all damaged monuments and buoys, to relocate and rebuild monuments which have been destroyed; to keep the boundary vistas open; to move bound-*

ary monuments to new sites and establish such monuments and as they shall deem desirable; to maintain at all times an effective boundary line as defined by the present treaty and treaties heretofore concluded, or, hereafter to be concluded; and to determine the location of any point on the boundary line which may become necessary in the settlement of any question that may arise between the two governments" (O'Sullivan, 2001,88).

These guidelines empower the Commission to have full authorization regarding existing and future treaties. The work of the Commission is continuous including annual reports. Such an attitude is a proper and successful solution to the big challenge of administering and maintaining the longest international boundary between two states in the world.

The 1971 China–Mongolia Protocol regarding the maintenance of the boundary line assigns tasks and responsibilities to the representatives of both sides, and gives special importance to sharing information and to jointly approving any activity regarding the boundary line. The Protocol gives specific guidelines for detailed cases regarding the land boundary and the boundary in rivers: "*Pillars with odd numbers will be maintained by China and pillars with even numbers will be maintained by Mongolia. If one party discovers a pillar has been destroyed, moved or damaged the other party must be informed. The damaged pillar must be repaired in presence of the other party. If for natural reasons, the pillar cannot be exactly replaced, the two parties may select another position under the principle of not changing the boundary line. When both countries agree to insert new markers, sketch maps and other documents should be changed and signed by representatives of both parties. Both countries have agreed to prevent, if possible, the change of course of major streams marking the boundary. If the river changes course naturally the original boundary remains unchanged unless there is agreement to change the line*." (Prescott and Triggs, 2008, 68 following Department of Commerce, 1971, 176–7).

The two sides agreed to inspect the boundary every five years in addition to partial joint boundary reconnaissance as necessary. The detailed guidelines of the Protocol, including (1) specific guidelines for changes of courses of rivers; (2) the restoration of old pillars and their replacement by new boundary markers; (3) the reference to boundary documentation, accompanied by very detailed descriptions of each boundary pillar and detailed documentation, including maps; and (4) the agreement regarding periodical field reconnaissance of the boundary are very important for long-term maintenance of such a long boundary.

The 1994 Israel–Jordan Peace Treaty refers to the land boundary maintenance, leaving the specific procedures to a special agreement, specifying the reference to the agreed boundary coordinates as the leading source for the definition of the boundary line: "… *the boundary coordinates shall be binding and shall take precedence over the maps as to the location of the boundary line". It states that "the coordinates … shall be used to reconstruct boundary pillars in case they are damaged, destroyed or displaced."* Regarding the boundary line in rivers, unlike the Sino-Mongolian Protocol according to the Israel–Jordan Peace Treaty *"The line shall follow natural changes (accretion or erosion) in the course of the rivers".* The agreement elaborates on the changes in the course of rivers by setting up guidelines regarding the measures to be taken by the Joint Boundary Commission.

The JBC established the Joint Team of Experts of boundary surveyors, which conducts all the activities regarding boundary line maintenance. The JTE meets a few times a year, including an annual boundary pillar field reconnaissance; it documents all the activities and submits an annual report to the JBC.

These arrangements are suitable for long-term boundary line maintenance, with the specific advantage of being suitable for a relatively "young" boundary (19 years old), with detailed documentation of precise joint boundary coordinates in a joint boundary datum, based on WGS84.

As can be seen, the three successful examples have very much in common: (1) They all rely on the work of a joint team of representatives from both sides; (2) all the activities are executed and documented jointly; (3) the activities and decisions refer to detailed bilateral agreements and documentation; (4) the working groups are guided by detailed instructions; and (5) the joint teams conduct periodical field inspection reconnaissance tours and prepare joint reports.

3.7 Boundary Administration

Boundary Administration is the stage that follows the Treaty between the States, and includes all the activities with regard to the area close to the boundary line and sometimes even the boundary zone. It mainly refers to the administrative rules and behavior on both sides, but also to the behavior of the inhabitants. It includes interrelations like the passage of people and the passage of goods, including the existence of passage stations and passage control, security control, including trespassing and smuggling, roads and other means of traffic and communication, usage of water, agriculture, etc. It covers the boundary maintenance as well, and forms a well-maintained boundary line, but it is required even when the boundary is not well demarcated, or even if the boundary is disputed. In such cases its responsibilities are even bigger.

Jones (1945) defined the boundary administration as the 4th definite and last stage of the boundary process. Others also referred to the administration, either before Jones (Lapradelle, 1928), and mainly after him (Prescott, 1987, Brawer, 1988). Cukwurah (1967, p. 85) declared that "*In effect, the continuous functioning of the boundary commission in all cases is an important factor in the efficient operation of the boundary*."

We do not consider boundary administration to be a separate stage that refers to boundary making, but rather, forming an umbrella, governing the practical, interrelated life within the boundary zone, also covering boundary maintenance.

We also attach great importance to the influence of the boundary administration on boundary maintenance, the condition of the boundary pillars, and the monitoring of cross-boundary intended or unintended projects and activities. Sometimes, for administrative purposes the parties establish physical barriers along the boundary, such as a cleared corridor or fences, mainly to prevent smuggling. In rare cases a wall is erected, mainly to prevent illegal immigration or because of security issues that exist between hostile states.

Because of the importance (sometimes crucial) of the boundary administration for maintaining good interrelations between the relevant states and in preventing conflicts, it is strongly recommended that a joint committee be established to deal with the issues of boundary administration. Because of the positive and important impact (sometimes crucial) that boundary administration and maintenance have on each other, it is recommended that the two teams governing them be connected.

In certain cases, like between the US and Canada (McEwen, 2001), the permanent Boundary Commission monitors all the components of boundary administration, with

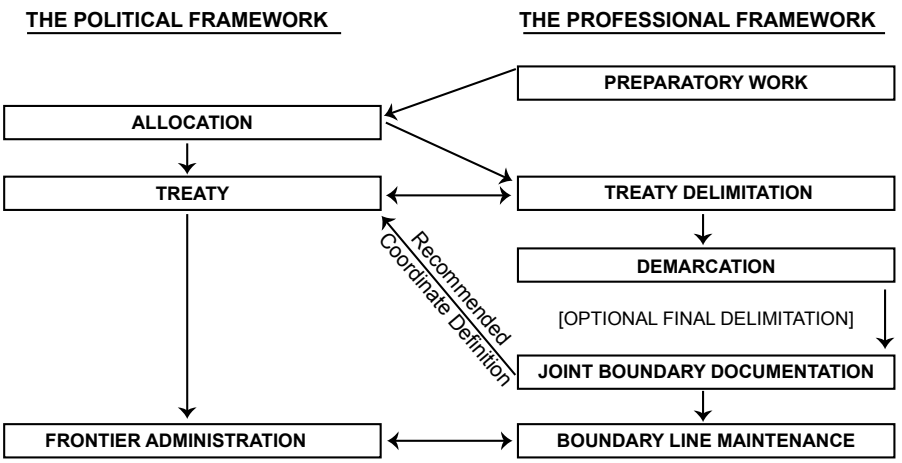


Figure 1: *The boundary making framework.*

Figure 2: *Successful demarcation. Nidal Al-Sagarat, Jordan and Haim Srebro, Israel.*

Figure 3: *GPS survey for documentation.*

regard to physical penetrations or violations of the international boundary line, including cooperative projects, and boundary maintenance. The boundary maintenance is covered directly by a team sponsored by the Boundary Commission, which is the Joint Team of Experts.

Sometimes there are various committees dedicated to special subjects (boundaries, water, customs, environmental issues, etc.) rather than one all-purpose committee, like

Figure 4: *Situation requiring maintenance.*

between Israel and Jordan. Often the boundary administration is done unilaterally by each side. This is mainly typical of states that are hostile to each other.

4 SUMMARY AND CONCLUSIONS

This chapter elaborated on the issue of the boundary-making process and proposed innovations by adding two designated stages to the traditional three stages. The three traditional theoretical stages include the allocation, the delimitation of the boundary, and its demarcation on the ground. These stages were reviewed including the interrelationship between them. The basic terms and definitions were also reviewed.

The two additional designated stages, proposed in this chapter, include the preparation of mutually agreed precise documentation, and implementation of boundary maintenance.

Mutually agreed upon precise documentation of the boundary, which is adequate for boundary maintenance and boundary restoration, is considered to be the most important tool for preventing future conflicts over the location of the boundary.

Adequate ongoing boundary maintenance is an important contributor to maintaining continuous boundary stability.

This chapter also analyzed the interrelations between the political and technical stages and the associated activities.

We believe that a joint effort in following the proposed model, including thorough preparation of the delimitation line and the treaty, to ensure the proper incorporation of the main essential elements, greatly contributes to stabilizing the boundary. This, supported by ongoing joint boundary maintenance, will prevent future boundary disputes, thus, contributing to peace and security for all the parties.The proposed model has been successfully implemented during the last nineteen years along the international boundary between Israel and Jordan.

References are at the end of Part I, p. 64.

CHAPTER 2: THE ORDER OF PRECEDENCE OF BOUNDARY DEFINITIONS

Haim Srebro and Maxim Shoshani, Israel

1 INTRODUCTION AND BACKGROUND

The objective of this chapter is to introduce an order of precedence of boundary definitions that results from analysis and evaluation of the implementation of boundary definitions throughout the boundary making process. The use of such an order of precedence may improve new boundary delimitation and may contribute to better evaluations of boundary evidences when restoring old boundaries. This analysis refers to the boundary making process as described in Chapter 1. Chapter 3 presents the implementation of such an order of precedence in a new peace agreement, and shows a method of envisaging later activities such as demarcation and documentation in the early stage of boundary delimitation.

The authors of this chapter recommend making a list of order of precedence. This list is based on judgments of ICJ and of international Tribunals, on the practice of states and on the practice of the authors during the tracing of several international boundaries.

The adoption of the conclusions may prevent future boundary disputes all over the world and thus may contribute to peace. Stable international boundaries contribute to peace all over the world.

The achievement of stability and the finality of the boundary is one of the primary objects according to the International Court of Justice (ICJ reports, 1962, 34).

There are various ways of defining the boundary lines. The traditional ones, which were put into practice in unilateral Orders or formal Declarations, or in bilateral Agreements, include verbal descriptions, graphic charts or schemes, maps, coordinates, or a combination of them.

Sometimes their quality is poor and sometimes there are contradictions between various definitions. Such cases do not contribute to the stability of the boundary. Since the boundary-making process takes time, problems may arise as early as the demarcation phase, when the definition of the boundary in the delimitation has to be transferred in practical terms to the ground in the implementation stage.

Furthermore, in time, physical markers may disappear and the boundary line may require restoration. The political status regarding the two sides of the boundary may also change, and disputes and conflicts may arise with regard to the location of the boundary line. The solution of such a conflict can be resolved either by bilateral negotiations, or conciliation, or arbitration by an international Tribunal and sometimes by the International Court of Justice itself. Such a solution will always depend on defining a final boundary line, based on various evidences of the boundary delimitations, which are available to the Tribunal or the Court.

This article deals with the order of precedence, given to the various boundary definitions in the delimitation and demarcation stages, in order to provide the boundary engineer with

essential information about the measures, methods, and techniques that should be used during the boundary-making process, to ascertain a stable, final, easy-to-restore boundary.

As was already mentioned by Rushworth (1997–1998), it would be beneficial if a scholarly, international lawyer would collect helpful comments and guidance with regard to the order of precedence of evidences, either geodetic, cartographic, or physical markers, with regard to their legal aspects and relevance as evidences in land frontier arbitrations. Such a work should be mainly based on international law and on judgments of the International Court of Justice and other arbitration Tribunals.

In the absence of such a commentary or guide, the following is an attempt by a boundary engineer to suggest a preliminary recommendation, which reflects the personal experience of the authors, as well as various judgments of ICJ and arbitration Tribunals. This recommendation is introduced with the reservation that the authors do not pretend to be considered legal experts.

On the other hand, such a model has a considerable importance for boundary engineers, who have to decide on the technological support, including the technical methods to be implemented during the boundary-making process including the boundary documentation.

References and Sources Leading to the Introduced Model

The following is a partial list of cases that were referred to in our analysis:

The ICJ Judgment in the Preah Vihear Temple Case between Cambodia and Laos (ICJ reports, 1962), with regard to the objective of achieving stability, with regard to the importance of behavior and acceptance over the years relative to the parent treaty, and with regard to the acceptance of maps as evidence.

The ICJ Judgment in the Burkina Faso-Mali Dispute Case (ICJ reports, 1986) with reference to the pre-eminence accorded to the legal title over effective possession served as a basis for sovereignty. In the same case there was a reference to the relative importance of coordinates and maps for reaching the decision.

In the El Salvador-Honduras Case (ICJ reports, 1992) the Court referred to the interrelation between coordinates and maps.

The Award of the Egypt-Israel Arbitration Tribunal (September 29, 1988) refers to the weight of an accepted demarcation, relative to the Agreement or with regard to maps in case of contradiction. In the same Award the Tribunal also refers to the acceptance of maps with regard to their exactness and scale.

The dissenting opinion of Professor Ruth Lapidoth, in the same Award, refers to the preference of the boundary as established in the agreement (in conformity with the principle of *uti possidetis juris)* versus changes (of boundary markers) in the field (which conform to the principle of *uti possidetis factis*).

The Arbitration Tribunal in the Beagle Channel Award (ILR, 1977 vol. 52) refers to the evidence of maps, in comparison to a description or a definition in an agreement.

Our analysis also refers to various publications that refer to this subject, including Ress (1985), Munch (1977), Jones (1945), Cukwurah (1967), Adler (2001), and Rushworth (1996, 1997, 1997–98).

The analysis will refer to the above-mentioned references throughout the following relevant paragraphs.

The precedence of boundary definitions, as reflected in the Court decisions, the decisions of International Tribunals, and the practice of States, follows, in general, a direction that is in reverse order to the stages of boundary making.

Special weight is given to the joint acceptance of the two states. The highest degree of joint acceptance is expressed by the signatures of authorized official representatives of both sides regarding the relevant documents that define the boundary line.

If joint signatures do not exist, then an exchange of official notes, with regard to the acceptance of the boundary line, stands (the Iraq–Kuwait example (Brown, 1994)).

At the absence of any mutual written acceptance, the practical behavior of the States, which reflects their de facto acceptance, is relevant (*Uti possidetis*). The acceptance of the appearance of a line on maps either by an act (like when a State publishes its own official maps with the appearance of certain boundary line) or by a silent acceptance, comes, in the order of precedence, after the practical behavior in the field.

The length of the period of time, along which a de facto situation exists without an objection, is also considered relevant, since the desire not to interfere with the peaceful reality of the population that resides in the area is valuable in itself.

The following is a general list of the order of precedence, before taking into account the joint acceptance of documents or of markers in the field, and the length of the period of that acceptance.

This list is our offer. It is based, as indicated before, on Court and International Tribunal judgments, on the practice of States, and on our own practice during the tracing of old boundaries, together with members of mixed international teams, for example: with Egyptian surveyors in 1981, in the process of tracing the 1906 boundary pillars; with Jordanian surveyors in 1994, in the process of tracing the 1922 boundary, and with members of the UN cartographic team in 2000, in the process of tracing the 1923 boundary between Palestine and Lebanon.

The importance of the order of precedence is revealed when an old boundary should be reconsidered, and especially if the old boundary had been demarcated on the ground and has to be traced and restored or reconstructed.

2 THE MODEL OF ORDER OF PRECEDENCE

The following is a model of order of precedence of boundary evidences:

- official jointly signed precise boundary documentation
- existing original boundary pillars
- list of coordinates of boundary pillars
- appearance of the boundary line on maps
- graphic description
- verbal description.

2.1 Precise Detailed Documentation

This is a document that results from the demarcation that follows a treaty or an agreement between two states. It consists of a list of coordinates of boundary pillars and/or boundary points, preferably on a common datum that is agreed upon by both parties.

In addition, this document usually includes a map or a layout showing the boundary line route and the boundary pillars. The document should declare whether the coordinates or the maps are binding.

In addition, the documentation should be sufficient in order to maintain well the boundary line, to enable the restoration or replacement of any boundary pillar or to increase the number of boundary posts if required.

The main legal strength of such documentation lies in its signatures of the authorized official representatives of both States. The existence of such documentation has the potential to prevent boundary disputes or to support quick resolutions with no need for Arbitration.

The importance of precise boundary documentation has been in practice for the last nineteen years along the Israeli–Jordanian boundary since the peace treaty between the two states was established. Every construction near the boundary is easily monitored by a combined team, using the mutual boundary documentation, and any suspicious deviation is corrected according to the documentation, thus preventing future disputes.

The first step of a professional surveyor that intends to restore a boundary, either a cadastral boundary or an international boundary, is to look for existing, authorized, preferably registered documentation. This was exemplified even in 1979 in the case of the restoration of the mandatory line between Israel and Egypt. Both professional teams looked for documentation of the 1906 Turco-Egyptian boundary. Wherever reliable documentation was found, it was used for restoring the boundary. Even the UN cartographic team that was responsible for defining the Israeli line of withdrawal from Lebanon in 2000 invested significant efforts in looking for documentation of the mandatory boundary between Palestine and Lebanon to serve as the reference line.

In the case that precise boundary documentation is officially adopted and made part of the peace treaty – like in the case of the Israel–Jordan Peace Treaty, it shares the legal quality of the treaty and it is binding on the parties, otherwise, if not specifically jointly agreed upon, long accepted boundary pillars may challenge the superiority of documentation.

2.2 Existing Boundary Pillars

In the absence of a precise detailed documentation, existing boundary pillars, preferably accompanied by partial documentation, constitute the significant evidence.

These boundary pillars, if recognized by both sides, and especially by the people in the area, for a long period of time and influence their behavior, point out a situation de facto.The situation de facto, as mentioned earlier, supports the legal claim of *Uti Possidetis.*

An example of the relatively high order of precedence of boundary pillars over maps can be found in the decisions of the special tribunal to the 1986 arbitration between

Israel and Egypt with regard to the boundary dispute between the two states. The tribunal preferred to take decisions with regard to evidences on the ground, either boundary pillars or remnants of boundary pillars, rather than on the basis of maps. Furthermore, the tribunal gave precedence to existing pillars that had been accepted by the two sides for a long period, even over the original agreement! *"It is therefore to be concluded that the demarcated boundary line would prevail over the agreement if a contradiction could be detected."* (Award of the Egypt–Israel Arbitration Tribunal, September 1988, para. 210). With regard to the precedence of existing pillars over maps, the tribunal states: *"If a boundary line is once demarcated jointly by the parties concerned, the demarcation is considered as an authentic interpretation of the boundary agreement even if deviations may have occurred or if there are some inconsistencies with maps"* (Ibid). The tribunal refers in this case to the ICJ Judgement in the Temple case (1962 ICJ Reports 34) and to Munch (1977) and Ress (1985). Robertson (2013) emphasizes the significance of the tribunal's Award saying: *"In the judgement, the tribunal noted that boundary markers, long accepted by both parties, should be respected and not open to challenge indefinitely on the basis of error. This guidance emphasizes the traditional hierarchy of accepting the position of original monumentation as being superior to measurement or description".*

2.3 Maps

Maps are complicated evidence, but have much potential in cases in which recognized coordinates and pillars do not exist.

The basic value of maps is that they are linked to the real world by a known coordinate system, that they are scaled, so measurements can be made on them, that they include geographic data about the landscape in the area, either natural or man-made, that they make use of regular language and names, as well as a recognized cartographic language (map symbols), and that they include the boundary on top of the reference data of the real world and the coordinate grid.

The basic problem of maps, however, is that they are usually published by one country and that they are not common to both States. This fact removes from maps a strong legal argument, which refers to joint acceptance. Considering that states tend to produce maps that are in their favor, so that an official map may show, to a certain extent, the acceptance of the state, it can strongly serve in an argument against the state that published the map, by obliging it to the interpretation shown on its maps (ICJ, 1962, The Temple Case).

Typical problems for the joint use of maps are different languages, different coordinate systems and reference geodetic data, different cartographic projections, different names for the same places, different cartographic symbols and, especially relevant, different interpretations of the boundary line.

There are various parameters that define the adequacy of a map to serve as evidence in boundary disputes:

- The scale of the map: International standards and conventions usually define ranges of precision with reference to map scales. The larger the scale of the map, the higher is the resolution of the details and features on the map, and the higher is its expected accuracy.

One millimeter on a 1:10,000–1:20,000 map means 10–20 meters on the ground with up to several meters of accuracy, whereas one millimeter on a 1:250,000 map means 250 meters on the ground and around 100 meters of accuracy, which makes it irrelevant for disputes of several meters or even tens of meters. Often, especially in rural areas, existing maps were produced in the past, using low-accuracy equipment and methods, and they are far from meeting even the present standards of small-scale maps.

The Egypt-Israel arbitration tribunal referred to the issue of scale, when it did not accept a map as evidence in the case of the absence of alleged remnants or other physical markers stating: **"***The Tribunal does not consider these map based indications to be conclusive since the scale of the map (1:100,000) is too small to demonstrate a location on the ground as exactly as required…" (Award of the Egypt-Israel Arbitration Tribunal, September 29, 1988, para. 182). On the other hand, the tribunal stated that "maps can be of some assistance, for instance when they show straight lines through a number of boundary pillars."* (Ibid).

- The quality of the mapping data: This quality is analyzed by two parameters: the richness and density of the geographical features (due to rich or poor mapping or qualitative or poor cartographic selection of features), and the positional accuracy of the features on the map. These parameters are crucial with regard to the usefulness of the map. The quality of the map decreases in time, due to changes in the area, which increase the problem of the updateness of the map and the difference between the real world and the way that it is represented on the map.
- The presentation of the boundary line on the map: In areas of dispute, state maps are usually bias by favoring the approach of the state rather than presenting the positions of both sides. In intermediate situations there is a remark indicating the dispute. But there are additional problems with regard to the presentation of boundary lines. In many cases they are shown on maps in the wrong places because of mistakes or because of poor mapping. The way to qualify the position of the boundary line on the map, after the qualification of the map itself, is by measuring its turning points with regard to the map features. In the case of poor quality maps the result is different, and if one tries to transfer the data to an accurate new map or to the ground, it will result in two different boundary lines, as an outcome of contradicting data from other sources, such as a detailed description of the boundary line in the delimitation. This may be manifested in the shape of the line or in the distances from recognized features.

Kadmon (1993) analyzed the depiction of the historic roots of the boundary between Israel and Egypt on 107 maps between the years 1906 and 1982, and referred to the maps, which were submitted to the Tribunal dealing with the boundary dispute between the states. He found big differences due to a variety of reasons, such as geodetic transformation, cartographic projection, the accuracy of mapping features, the accuracy of the boundary line interpretation, and depiction, scale problems, etc. The result of his analysis is that maps are not reliable enough to be used as the sole evidence for locating a boundary line. This was why the Tribunal did not base its decision on maps but instead on field evidences. I compared many maps covering the same area during the years 1979–1982 and found relative differences larger than 500 meters between the depiction of the boundary line on historic maps due to the choice of the basis of comparison, either with reference to the coordinates or with reference to the position of recognized features.

These reasons undermine the legitimacy of maps as evidence. An example of a disqualification of maps is given by the Tribunal on the Beagle Channel Award (ILR 1977 Vol. 52:82). This approach is also reflected in the ICJ words in the Burkina Faso V Mali case (ICJ, 1986:562), where the Court says: "…. *Map can still have no greater legal value than that of corroborative evidence endorsing a conclusion at which a court has arrived by other means unconnected with maps.*" However, later on the Court did accept the map in the absence of other sources. *"…where all other evidence is lacking, or it is not sufficient to show an exact line, the probable value of the IGN map becomes decisive".* Even an ambiguous definition in an agreement can have preference over a map. Much importance is given to the acceptance of the map by the two parties. On the other hand, it is noteworthy to mention the acceptance of the map by ICJ in the Temple Case (ICJ Reports 1962) in spite of its poor quality. The EEBC referred to this issue, stating: *"The effect of a map that is not part of a treaty will vary according to its provenance, its scale and cartographic quality, its consistency with other maps, the use of it made by the parties, the degree of publicity accorded to it…"* (Robertson, 2013, citing EEBC Decision, 2002 p. 26).

Precedence should be given to the use of maps with regard to the following parameters: (1) maps that were made part of a treaty. In such cases the map "*shares the legal quality of the treaty and is binding on the parties"* (Robertson, 2013 citing EEBC Decision, 2002 p. 26); (2) maps that were prepared close to the time of the agreement by official authorities; (3) maps of the parties that clearly show the location of the boundary on an accurate topographical background; and (4) contemporary maps at the time of the agreement that illustrate the state of contemporary geographical knowledge, etc.

2.4 Graphical Scheme or Layout

This is a graphic description, which may in certain cases show the boundary line, like a chart or a map but without a coordinate reference system, and, usually, with no accurate scale.

In old boundaries, a graphical description of a narrow strip sometimes defined the boundary delimitation. Such graphical descriptions were usually drawn after a field reconnaissance or survey. They include the geographic information, which is incorporated into the boundary allocation or delimitation, and additional descriptive data, sometimes with regard to boundary pillars, if they had already been demarcated, and sometimes with distances or configuration with regard to well-known features.

In the extreme cases, these schemes were even called maps though not meeting map standards.

In the absence of better witness documents, graphical schemes like these, if prepared in the relevant period of time (close to the delimitation or demarcation) can add significant information for the geographic interpretation of old delimitations.

2.5 Verbal Delimitation

This constitutes a very basic definition and description of the boundary. In the absence of all the more accurate, preferably joint, and later definitions of the boundary, there is always a reference to verbal delimitation or even allocation. Its strength lies in its originality and its guiding directive, that actually, whatever came later has its roots in it and

therefore has merit. In addition, if all the later evidences fail legally, this is the last resort. In addition, in spite of any other evidences, even much stronger ones, the original verbal definition, which was created at the same time as the specific boundary, or maybe the State itself, usually during the colonial time, has special value.

The verbal definition suffers usually from many weaknesses. First of all, it is not accurate enough, so it can be interpreted in many ways. The geographic names and features, which are contained in it, change over time, and in many cases, are either not relevant, or cannot be recognized or traced after many years.

In addition, later interpretations, especially if demarcated, documented, and accepted by both sides, are much stronger legally, even if they were based on misinterpretation. The behavior de facto in the relevant area is stronger legally than the documents, including the original verbal definition, according to the *Uti Possidetis principle*.

3 AN EXAMPLE OF THE ORDER OF PRECEDENCE OF BOUNDARY EVIDENCES – THE HISTORICAL LAND BOUNDARY NEAR THE GULF OF AQABA

The allocation of the 1994 International Boundary between Israel and Jordan, as defined in the Common Agenda, was 'with reference to the boundary under the Mandate'. Since the section of the boundary near Aqaba was demarcated in 1946 during the Mandate, the tracing of this demarcated section could serve for the reconstruction of the required reference. In fact, this process unveiled all the components that are included in our model. This is why this case was chosen as an example illustrating the order of precedence of boundary definitions.

Background: The issue of the land boundary between Israel and Jordan near the Gulf of Aqaba was raised during the peace negotiations in 1994 as a potential area of dispute.

The original verbal definition of the September 1922 Order in Council defined the boundary in this area by the following: "*from a point two miles to the west of the town of Akabah in the Gulf of Akabah up the center of the Wady Arabah*".

This line had not been demarcated until the recent days of the British Mandate over Jordan in May 1946. Until May 1946, interpretations of the undemarcated boundary line were shown on maps (only small-scale maps, 1:250,000 and smaller, were published during that period) beginning at the northwestern corner of the head of the gulf.

During the 1946 demarcation, the line was demarcated from the gulf northwards to a distance less than 4 km, beginning at a point on the gulf close to the center of the northern shore of the gulf.

During 1946, the Survey of Palestine published two versions of a 1:250,000 map including the relevant area: One shows the line beginning at the northwestern corner of the gulf. The other shows the 1946 demarcated line beginning near the center of the gulf (two miles from Aqaba).

The 1949 Armistice Agreement between Israel and Jordan included an attachment of the 1946 edition of the 1:250,000 pre-demarcation map showing the line beginning in the northwestern corner of the gulf in favor of Jordan. This map was signed by the representatives of both states, Dayan of Israel and Jundi of Jordan.

The Armistice Agreement states that: *"The Armistice Demarcation Lines… are agreed upon by the parties without prejudice to future territorial settlements or boundary lines…"* (Article VI, paragraph 9).

The Armistice line is marked on the map along the international boundary, with a written indication "not demarcated", though it was already demarcated at that area three years before the agreement was signed.

Since the Armistice Agreement in 1949, Israel continued to occupy the area according to the 1946 demarcation and to show it on maps accordingly. The line following the 1946 demarcation was also shown on Jordanian large-scale maps.

Until the peace negotiations in 1994, and during the peace talks, the Jordanians claimed this small, but very important area (from the point of view of the city of Eilat), according to the Armistice map.

The following is an example of the implementation of the model of order of precedence of boundary definitions as a methodological way of evaluating and presenting the evidences.

3.1 Precise Detailed Documentation

Following the 1946 demarcation, a documentation report was prepared. The documentation was signed by authorized representatives from both sides, the Director of the Survey of Palestine, Mr. Mitchell, and the Director of Lands and Surveys of Trans-Jordan, Mr. Walpole.

This documentation contains the following components: a description of the process of demarcation (including the costs), the field surveys, the computations, a list of coordinates of the boundary pillars, and a large-scale 1:25,000 chart. This chart shows the boundary pillars, the boundary line, and all the relevant geographic features that had been mentioned in the 1922 definition: the last house in Aqaba in 1922 (to show the reference for the 1946 interpretation of the definition of the first point of the boundary line), the northern relevant shore of the Gulf of Aqaba, and the Wadi Araba as interpreted in 1946, in the relevant sector, to define the end of the line in this section.

Since the historical mandatory line was chosen as the reference line for the new international boundary, this official mandatory documentation, signed by the authorized representatives of both governments, is actually sufficient from any point of view.

3.2 Existing Boundary Pillars

Photographs of pillar no.1, the first pillar that was demarcated in 1946, and which were taken in 1946, still exist and were presented. This pillar was hardly observed from the Israeli side in 1994, because of bushes and inaccessibility due to minefields, but a photograph of it, as observed from the Jordanian side, was published in 1994 in the Jordanian Newspaper Al Rai.

Those photographs of 1946 and of 1994 of pillar no.1, near the center of the northern shore of the gulf, were very strong evidence, and would be first in order of precedence in the absence of the above-mentioned documentation. Figure 1 shows part of the 1946 documentation: the coordinates, a pillar, and a chart. In fact, a strip of land, on

Documentation

As a result of an exchange of notes between the two Governments it was agreed that the application to the ground of the frontier defined in the Order of the High Commissioner dated 1st September 1922 shall be as follows :

a) The point two miles West of 'Aqaba shall be measured from the most westerly house of 'Aqaba, and that for this purpose the town of 'Aqaba shall be deemed not to include the port and other military installations which were erected later than the date of the definition of 1922.

b) Since the two-mile point does not coincide with the centre of the Wadi 'Araba, which is further to the West, a line shall be traced due North from the said point until the thalweg of the Wadi 'Araba is reached.

2. The boundary has been demarcated by 5 rubble masonry pillars. The pillars marking the ends of the demarcated frontier were fixed by a triangulation survey, and the rectangular coordinates, computed in the Palestine Transverse Mercator system, are :-

South Pillar ... Y (East) 147,525.52
X (north) 883,920.33

North Pillar ... Y (East) 147,532.14
X (North) 887,595.32

3. It is agreed that all pillars shall be maintained by the Transjordan Government and that expenses incurred on repairs shall be borne equally by both Governments.

4. The frontier delimited on the ground is shown on the attached map signed by us.

DIRECTOR OF LANDS & SURVEYS, TRANS-JORDAN GOVERNMENT.

DIRECTOR OF SURVEYS, PALESTINE GOVERNMENT.

Date May 5th 1946

Boundary Pillar

Chart (map)

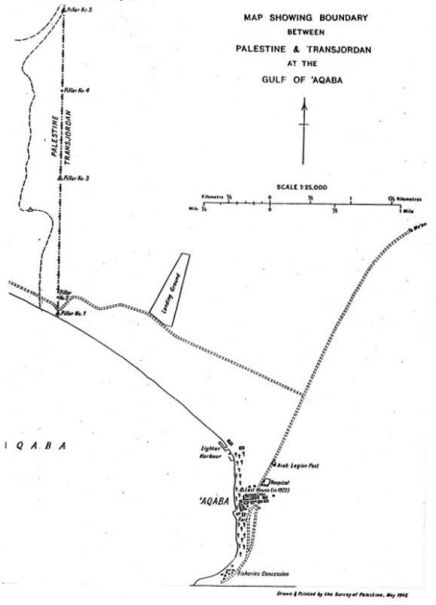


Figure 1: *Boundary Documentation, Pillar, Chart.*

both sides of the 1946 demarcated line, which was closed by fences on both sides, contained minefields, and was not accessible to both sides, so the 1946 mandatory demarcated section was also a de facto boundary barrier from 1949 until 1994.

3.3 Maps

In spite of the 1949 Armistice Map, which was signed by two authorized representatives of both sides, showing the Armistice Line beginning at the northwestern corner of the gulf, almost all the maps, drawn since 1949 by the two states, show the international boundary line according to the 1946 demarcation, beginning at a point near the center of the northern shore.

All the Israeli maps, at any scale, show this line, calling it the international boundary, as well as the Armistice Line between 1949 and 1967 and the Cease Fire Line between 1967 and 1994.

Most of the Jordanian maps either at medium scale, like 1:100,000, or at small scales, including part of the tourist maps, show the 1946 demarcated line.

Even a large-scale map of about 1:5,000, which the Jordanian team brought to the negotiations, showed the 1946 demarcated line.

Based on the analysis of the maps from both sides, it was concluded that both states accepted the de facto 1946 interpretation of the mandatory international boundary.

3.4 A Graphic Scheme or Layout

The chart, which was produced in 1946 after the demarcation, shows the only known attempt of large-scale graphic interpretation of the definition of the 1922 OIC line.

3.5 The Verbal Definition

According to the 1922 verbal definition, the boundary should begin at a point two miles west of the town of Aqaba. According to maps, drawings, and photographs there was no actual town at Aqaba but instead, a Fort and a few huts, and many trees from the northeastern corner of the gulf and southwards. The interpretation in 1946, referring to a suspicious single hut to the west of Aqaba as representing the town of Aqaba for the interpretation of the 1922 boundary verbal definition was biased in favor of Trans-Jordan.

In any case, the point two miles west of that hut is near the center of the northern shore, whereas the northwestern corner of the head of the gulf is about 3.5 miles west of it.

Conclusion:

An analysis of the example of tracing the mandatory boundary near the Gulf of Aqaba shows that all the evidences – the precise documentation, the existing boundary pillars, the map and the verbal definition – show the same results, which confirm the boundary shown by the tracing of the old demarcated boundary. However, the order of precedence shows the relative strengths of the evidences, which is important in case of contradictions between the evidences.

Since the above-mentioned order of precedence is only a recommendation, it is recommended to specify this order in the original documents.

This recommendation was implemented in ANNEX I (a) paragraph C.3 of the 1994 Peace Treaty between Israel and Jordan: "*… This list of geographic and U.T.M. coordinates …. Shall be binding and shall take precedence over the maps as to the location of the boundary line*".

As a result of the analysis and the model introduced at the first part of this chapter and considering the case study of the 1946 demarcation of the boundary between Palestine and Trans Jordan, we can see the importance of a model of order of precedence of boundary delimitations in documents and on the ground and especially the importance of joint precise documentation of the boundary. This is a real contribution to the stability of the boundary for a short and long-term period, enabling future boundary restoration, eliminating boundary disputes and thus contributing to peace all over the world.

References are at the end of Part I, p. 64.

CHAPTER 3:
A MODEL OF BOUNDARY DELIMITATION IN A PEACE AGREEMENT

Haim Srebro, Israel

1 INTRODUCTION

The purpose of this chapter is to present a model of boundary delimitation in a peace agreement that will enable a successful process of boundary making, thus reducing many problems during the demarcation stage, preventing future disputes, and supporting reliable future boundary restoration if required.

The boundary delimitation in a peace agreement is the most critical stage in the process since all the following stages of implementation and documentation depend on that initial stage. Any ambiguity at this stage will result in a dispute between the demarcation teams.

Since a peace agreement is usually concluded under a tense and suspicious atmosphere, the chance of ambiguity in the boundary delimitation as a result of compromises is high. In addition, the common professional means at that stage are also limited, including the lack of a common geodetic reference and coordinate system, the lack of common maps and sometimes even a common language, names, and terminology.

This chapter elaborates on the subject and introduces a comprehensive model to overcome problems.

The model makes use of orthophoto or ortho-images, of GPS measurements, of the establishment of a joint boundary datum, a joint production of coordinates as well as other means.

The suggested model is unique and was first successfully implemented in the October 26, 1994 peace agreement between Israel and the Hashemite Kingdom of Jordan. The fact that the implementation of the process was carried out smoothly and that during the last nineteen years, since the signing of the treaty, no serious problem arose, reflects the reliability of the model.

The implementation of the recommended model has the potential to stabilize the boundary-making process and reduces unnecessary friction and disputes between the parties. This is beneficial and especially important at the critical stage of defining the boundary when suspicion between the parties is at its highest level. Thus, it improves the chance for a successful process and sustainable peace.

The Basic Stages of the Boundary-Making Process

The basic stages of the boundary-making process begin with the preparation of documents and supporting materials for the negotiations between the politicians to achieve a peace agreement and finish with the maintenance of the boundary. They include the following:

1. The preparation stage before the peace agreement.
2. The delimitation of the boundary in a peace agreement – This stage refers to the earlier processes for determining a boundary, including its embodiment in a Treaty.
3. The demarcation of the boundary – This stage refers to marking the delimited boundary on the ground.
4. Documentation of the boundary – This stage refers to the field survey of the boundary markers, the recording of boundary coordinates and documentation of all these materials and additional ones like maps, drawings, and photographs to support future boundary restoration if required.
5. Boundary maintenance – This stage refers to the ongoing process of taking care of the boundary condition, usually as part of the boundary administration.

2 THE RECOMMENDED MODEL OF BOUNDARY DELIMITATION IN A PEACE AGREEMENT

1. A small-scale map index.
2. Large-scale orthophoto sheets or orthoimages showing the boundary delineation.
3. Instructions for boundary demarcation.
4. Instructions for surveying, recording of coordinates, and boundary documentation , including the horizontal and vertical datums and projection.
5. Instructions for a procedure of authorizing the coordinates and defining the order of precedence with reference to the binding materials.
6. Instructions for boundary maintenance and boundary restoration.
7. Defining a time schedule.
8. Establishing a joint professional team that will be responsible for the implementation.

2.1 Elaboration

1. **Map Index:** A general small-scale map index, covering the boundary sections, showing the index of the map sheets and showing the boundary line delimitation in an annex to the peace agreement.

   At the early stage of the delimitation usually there is no common agreement about the use of a common map. Every party has its own maps, sometimes in different cartographic projections, different scales, different levels of accuracy, with different cartography and symbols, different locations of the boundary line, and even different names.

   The boundary and the names are sometimes a major reason for disputes.

   If there is no agreement about a common small-scale map to be used as a reference for a map index, the parties may especially prepare a blank chart, draw only

a small-scale skeleton of natural features like rivers, adding possibly a few main roads, and show the index of the boundary map sheets on top of it. This index could be used with no names on it.

2. **Large-scale orthophotos:** A series of orthophoto maps attached as an annex to the peace agreement, showing the delimitation of the boundary line.

   The advantages of the orthophotos for this purpose are as follows:

   Fast production: Orthophotos or ortho-images are produced much faster than maps, with no need for interpretation of natural or artificial features, and no need for cartography and names. The production of common maps for the common use of the negotiating parties may be a non-achievable mission due to time constraints of the political process.

   Easy availability: Aerial photographs are currently much more available than in the past when they used to be restricted to military use only. In any case, even where aerial photographs are not available or releasable, there is an alternative to use high-resolution satellite images. They are available commercially all over the world at a relatively low cost, and many companies worldwide are ready to rectify the images to be suitable for use as ortho-images. The open source non-dependent solution enables the two parties to adopt that alternative.

   Up-to-dateness: The up-to-dateness of the material, the short time required to obtain and to rectify aerial photographs or the high frequency of commercial high-resolution satellite imaging all over the world enables up-to-date acquisition of images of the boundary zone.

   Support of demarcation: Since the orthophotos or ortho-images, used for the delimitation, represent the real physical situation on the ground, it is relatively easy to use them in the field during the initial marking of the delimited line during the demarcation. At that stage the boundary has not yet been surveyed and has not yet been defined by precise coordinates.

   The Scale of the orthophoto: Having in mind the expected use of the delimited orthophotos during the demarcation, the professional joint team has to provide proper delimitation. In order to ensure adequate interpretation in the field, a proper scale should be chosen.

   Our experience was to use 1:10,000 scale orthophotos unless a smaller scale of 1:20,000 is adopted because the boundary is very long and too many orthophoto sheets are required. In special important areas a larger scale 1:2,000–1:5,000 should be adopted. In strategic points a larger scale as large as 1:1,000 may be required.

3. **Instructions for the boundary demarcation:** The instructions refer to the implementation of a joint process, the reference materials for the demarcation (referring to the delimited orthophoto maps and additional materials) and the way using them, including the order of precedence in case there are a few sources of delimitation.

   The instructions should refer to the process of locating, constructing, and placing boundary pillars and to additional requirements with reference to the line of sight or the distances between boundary pillars.

4. **Surveying, recording of coordinates, and boundary documentation:** It is recommended that the wording in the boundary annex in the treaty will define the task of surveying the boundary pillars, and the production and the recording of their coordinates, in order to prepare comprehensive documentation of the boundary.

   It is recommended that the coordinate system and the reference data of the coordinates be specified and sometimes the methodology and technology if there is a preference.

5. **Authorization of the list of coordinates:** An important step would be to specify the procedure of approving and adopting the coordinates.

   An order of precedence of the various definitions of the boundary should be specified. Our recommendation is that the joint coordinates will be binding and will take precedence over the maps and over any other source as to the location of the boundary.

   A major strength would be given to the coordinates if when produced, they will become retroactively part of the treaty itself, thus gaining the highest political authorization. This can be implemented if specified in the original peace agreement itself.

6. **Maintenance:** Instructions should be given with reference to the procedures of joint maintenance of the boundary pillars, including their reconstruction in case of damage, destruction, or displacement.

7. **Schedule:** The process should be given a schedule.

8. **Joint team of experts:** It is recommended to specify the organization/team that will be responsible for taking care of implementing the boundary-making process. Our recommendation is that this should be the responsibility of a joint team of experts headed by experienced boundary engineers under the Joint Boundary Commission.

2.2 The JTE

The importance of a precise definition and appropriate implementation is so great, and the necessary professional skills to cover all the up-to-date technologies are so many, that we designate in our model a special joint team of experts (JTE). This must be set up as early as possible in the boundary-making process, to be responsible for all the technical issues and to advise the political leaders in this respect. The JTE is part of the Joint Boundary Commission (JBC) and is its main operational organization during most of that body's work.

The advantage of establishing this team as early as possible is that being professionals, the members of the JTE have a common technical language, and are used to teamwork. Thus, once their task is clear, the level of suspicion between them is much lower than between the politicians. As the cooperative work proceeds, their level of confidence grows, which contributes significantly to the implementation of the task.

According to our model, the JTE should begin to prepare the required professional tools for the whole process, as early as possible, even before the delimitation is ready.

The main tasks of the JTE until the Treaty of Peace are as follows:

1. To assist the Boundary Commission in preparing the wording of the Article of the International Boundary in the Treaty of Peace.
2. To assist the Boundary Commission in preparing the wording of the Annex to the Treaty of Peace, specifying the delimitation and demarcation of the International Boundary.
3. To prepare all the required data and materials for the technical Appendix to the Annex of the Treaty of Peace with reference to the International Boundary.
4. To delineate the boundary line on the proper technical aids in accordance with the decision makers.
5. To define and prepare the technical Appendix of the delimitation for the signatures to the Treaty of Peace.
6. To define a common geodetic framework to serve as geodetic control and a reference for defining the boundary coordinates.

The main tasks of the JTE after the Peace Treaty are as follows:

1. To demarcate the land boundary, including the construction of boundary pillars.
2. To conduct a field survey of the boundary pillars and to define the boundary coordinates of the pillars.
3. To document the International Boundary demarcation, including the coordinates of the boundary pillars.
4. To be responsible for the maintenance of the boundary line after the Peace Treaty, including technical support to resolve any technical issues that may arise with regard to the location of the boundary.

It is recommended that the JTE will be headed by boundary engineers who have experience in the implementation of a boundary-making process.

The Implementation of the model in the 1994 Peace Treaty between Israel and Jordan with regard to the land boundary:

2.3 The Joint Boundary Datum

Determination of a Reference Frame

The basic practical step of the JTE work from the geodetic aspect is the determination of a reference frame (system). Determination of a reference frame is an essential step that enables the professionals to "speak the same language". After this stage, the JTE can continue its professional activities, which are controlled by the existence of a common reference frame. Determining the reference frame involves defining a 3D system (the geodetic datum) and a 2D system (the grid). The JTE may decide to determine a unique and local geodetic datum based on the WGS84 ellipsoid, and to use a well-known UTM convention as the grid system.

Technically, a series of control points (datum points) are recommended to be established on each side along the boundary line, which will be measured jointly by both parties.

It is recommended that prior to the official GPS survey of the joint datum points, both parties conduct a "pilot Project" to check the joint survey work and exchange GPS data that was collected in Jordan and Israel. The purpose was to examine the possibility of GPS data processing by both sides with different types of software. The "pilot-project" was coordinated and the ability to adjust different software ended successfully.

Defining a Joint Boundary Datum

An optional way of creating the reference of the geodetic datum is to determine it by fixing the coordinates of one of the datum points, adopting the WGS84 ellipsoid, and fixing the reference ellipsoid in the geocenter according to the precise GPS vectors that were measured between the datum points. Robertson (2013) prefers the use of ITRF 2000 instead of WGS84 for international boundaries.

Concerning the vertical datum, the JTE can agree to adopt the ellipsoidal heights (for all the boundary coordinates) with reference to the joint boundary datum and to the WGS84 reference ellipsoid. Such a decision simplifies and facilitates the computation since only one 3-dimensional datum has to be determined. Though not mandatory required, it is possible to attempt to determine the geoid, or the sea level surface, as the datum of the vertical component of the coordinates.

The coordinates of a common reference point may be computed by obtaining an average between the results of the absolute positioning, which may be calculated by each side, using broadcast ephemeris.

3 THE CASE STUDY: THE IMPLEMENTATION OF THE MODEL IN THE 1994 PEACE TREATY BETWEEN ISRAEL AND JORDAN

The relevant wording of the peace agreement:

ANNEX I (a) – ISRAEL–JORDAN INTERNATIONAL BOUNDARY DELIMITATION AND DEMARCATION:

"*2.C. Emek Ha'arava/Wadi Araba*

1. *The boundary line is shown on 1:20,000 orthophoto maps (10 sheets, Appendix I attached to this Annex)*
2. *The land boundary shall be demarcated, under a joint boundary demarcation procedure, by boundary pillars which will be jointly located, erected, measured and documented on the basis of the boundary shown in the 1:20,000 orthophoto maps referred in Article 2-C-(1) above. Between each two adjacent boundary pillars the boundary line shall follow a straight line.*
3. *The boundary pillars shall be defined in a list of geographic and UTM coordinates based on a joint boundary datum (IJDB 94) to be agreed by the Joint Team of Experts appointed by the two parties (hereinafter the JTE) using joint Global Positioning System (GPS) Measurements. The list of coordinates shall be prepared, signed and approved by both Parties as soon as possible and not later than 9 month after this Treaty enters into force and shall become part of this Annex. This list of geographic and UTM coordinates when completed and agreed upon by both Parties shall be binding and shall take precedence over the maps as to the location of the boundary line of this sector.*
4. *The boundary pillars shall be maintained by both Parties in accordance with a procedure to be agreed upon. The coordinates in Article 2-C-(3) above shall be used to reconstruct boundary pillars in case they are damaged, destroyed or displaced."*

"3. Joint Boundary Commission

A. For the purpose of the implementation of this Annex, the Parties will establish a Joint Boundary Commission comprised of three members from each country.

B. The Commission will, with the approval of the respective governments, specify its work procedures, the frequency of its meeting, and the details of its scope of work. The Commission may invite experts and/or advisors as may be required.

C. The Commission may form, as it deems necessary, specialized team or committees and assign to them technical tasks."

These excerpts of the peace agreement cover boundary delimitation, demarcation, surveys and documentation, and boundary maintenance regarding the land boundary. Other paragraphs refer to delimitation and maintenance of the boundary line along the rivers.

4 ANALYSIS AND DISCUSSION

The Israel–Jordan Peace Treaty is a good example of implementation of the recommended model. The following is a discussion of the implementation of the model in this treaty and recommendations that are an outcome of the lessons learned. The numbers are with respect to the numbers of the activities specified in the recommended model.

1. A small-scale map index was included in Annex I to the treaty. It is shown in figure 1. It also indicates the various sections of the boundary, the maps of which are included as appendices in Annex I.

2. Image maps in various scales, which show the boundary line in the different sections of the boundary, are included as appendices in Annex I to the Peace Treaty.

   The land boundary along the Aravah Valley (Emek Ha'Aravah/ Wadi Araba) is shown on 1:20,000 orthophoto sheets. The boundary in the rivers (Jordan River and Yarmouk River) is shown on 1:10,000 orthophoto sheets. The boundary of the Dead Sea is shown on 1:50,000 ortho-images and the relevant part of the Gulf of Eilat (Gulf of Aqaba) is shown on a 1:50,000 ortho-image. An example of an orthophoto of the land boundary in a reduced scale is shown in figure 2.

   The 1:20,000 orthophoto for the land boundary was used successfully in the field during the demarcation, augmented by photo enlargement of a scale of 1:10,000 and in certain cases even higher enlargements of regular air photos. In spite of the significant length, the land boundary, and the additional preparation work, a 1:10,000 scale orthophoto is recommended. This recommendation is more important if all the copies used by the parties are reproduced from one source. If the copies used by the parties for demarcation are not produced from one source, then there will always be slight differences that may be potential sources of disputes.

   The 1:10,000 orthophoto for the river sections was used successfully, but in order to see better small islands in the river of a magnitude of several meters, a color orthophoto of a larger scale is recommended. The 1:50,000 orth-images were used successfully for the Dead Sea and the Gulf of Eilat. The use of this scale was the only choice to see both sides of the coastline because of the widths of

the sea and the gulf. In addition to the 1:50,000 ortho-image coverage, a larger scale imagery of each of the coasts is recommended to improve the interpretation of the coastlines.

3. The instructions in the treaty with regard to the boundary demarcation are included in paragraph 2 of ANNEX I (a) defining that there will be a demarcation by boundary pillars, that it will be based on the boundary line shown on orthophoto maps (as part of the delimitation in the treaty), that it will be a joint procedure, that the pillars will be jointly located, erected, measured, and documented, and that the boundary between adjacent boundary pillars will follow straight lines.

4. Instructions for surveying, recording of coordinates and boundary documentation are included in paragraphs 2 and 3 of ANNEX I (a) defining that the measurement of the boundary pillars and documentation will be a joint procedure.

   It specifies that the result will be a jointly agreed list of geographic and UTM coordinates based on a joint boundary datum. It specifies the technology of measurements (GPS) and that the measurements will be jointly performed. It specifies that the list of coordinates will be prepared, signed, and approved by both sides. An example of the opening page of the Israeli Jordanian boundary documentation is attached as figure 3.

5. Instructions for authorization of coordinates and for defining their order of precedence are specified in paragraph 3 of ANNEX I (a). It is specified that the coordinates when completed and agreed upon by both parties will be binding and will take precedence over maps regarding the location of the boundary line.

   Moreover, it says that the list of coordinates will become part of the Annex of the Treaty of Peace (receiving the direct powerful original authorization of the treaty itself). An example of the form of approval, adoption, and authorization of the coordinates of the international boundary line is given in figure 4.

6. Instructions for boundary maintenance and reconstruction are defined in paragraph 4 of ANNEX I (a) specifying that there will be joint maintenance. The specific procedure is left for the future but there is specific guidance stating to use the agreed coordinates for reconstruction of boundary pillars in case they are damaged, destroyed, or displaced.

7. A time reference of up to 9 months is specified in paragraph 3 of ANNEX I (a) for the approval of the list of coordinates.

8. With reference to construction of a dedicated professional team, the Israel–Jordan Peace Treaty takes into account that the joint professional team was already working for the purpose of preparing the treaty itself.

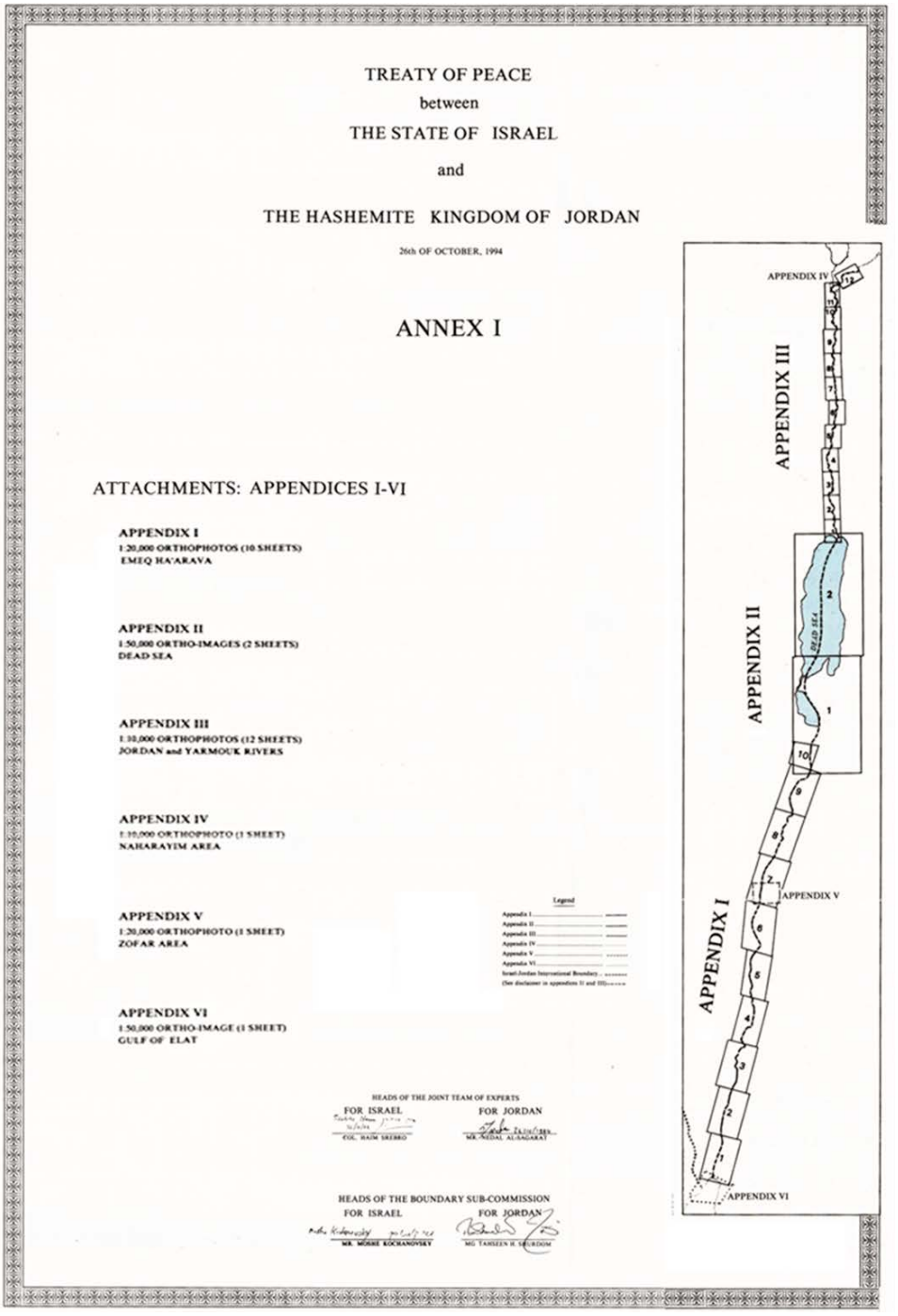
   It specifies especially in article 3 of ANNEX I (a) the establishment of Joint Boundary Commission consisting of three members from each side. This commission may form, as it deems necessary, a specialized team and assigns it technical tasks. It specifies in paragraph 3 of ANNEX I (a) that the Joint Team of Experts appointed by the two parties should agree on the coordinates.

5 SUMMARY AND CONCLUSION

This chapter presents a model of reference for the responsibilities and assignments to tasks that should be taken care of in treaty delimitation. In addition, the chapter also refers to specific instructions that refer to technical activities throughout the boundary-making process.

It recommends a model for incorporating these tasks and instructions into the treaty delimitation. The chapter shows the implementation of the recommended model in the case of the 1994 Israel–Jordan Peace Treaty. It analyzes the implementation of the model in this special case and discusses technical lessons learned from the special case.

The joint smooth implementation of the model during the Israeli-Jordanian boundary-making process, and the fact that all the practical problems with regard to the boundary line for the last 19 years since the treaty were successfully solved using the model show the importance of such a model for boundary management and for prevention or solution of boundary disputes.



TREATY OF PEACE

between

THE STATE OF ISRAEL

and

THE HASHEMITE KINGDOM OF JORDAN

26th OF OCTOBER, 1994

ANNEX I

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APPENDIX VI
1:50,000 ORTHO-IMAGE (1 SHEET)
GULF OF ELAT

Legend

HEADS OF THE JOINT TEAM OF EXPERTS

FOR ISRAEL — COL. HAIM SREBRO

FOR JORDAN — MR. NIDAL AL-SAGARAT

HEADS OF THE BOUNDARY SUB-COMMISSION

FOR ISRAEL — MR. MOSHE KOCHANOVSKY

FOR JORDAN — MG TAMEEN H. SHUBDOM

APPENDIX IV

APPENDIX III

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APPENDIX I

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DEAD SEA

Figure 1: *The Israel–Jordan Peace Treaty: The map index.*

Figure 2: *The 1st Peace Treaty orthophoto sheet.*

JORDAN - ISRAEL

BOUNDARY LINE

DOCUMENTATION

Wadi Araba /Emeq Ha'arava sector

This document is a geodetic appendix following the demarcation of the boundary pillars in Wadi Araba / Emeq Ha'arava and fulfilling the task of Annex I(a) para. 2.C.3 of the Treaty of Peace between Israel and Jordan of october 26th 1994. The documentation was achieved by the JTE as part of the tasks of the Joint Boundary Commission.

The State of Israel — The Hashemite Kingdom of Jordan

Signatures

For Israel — *For Jordan*

Tzvika ..... *Technical Experts* ..... Maddallah

Srebro Haim ..... *Head of JTE* ..... Nidal Al-Jagarat

Date 19/9/1996

Figure 3: *The Israel–Jordan boundary documentation.*

JORDAN ISRAEL BOUNDARY COMMISSION
FORMAL APPROVAL AND ADOPTION OF THE COORDINATES
OF THE INTERNATIONAL BOUNDARY LINE

The Government of the Hashemite Kingdom of Jordan and the Government of the State of Israel hereby agree:

1. In conformity with Article 3 and in accordance with Article 2.C.3 and Article 2.B respectively of Annex I(a) of the Treaty of Peace between Israel and Jordan of 26 October 1994, the Jordan Israel Joint Boundary Commission hereby approves and adopts the Jordan Israel International Boundary Line Documentation including:

   a. the list of coordinates of the boundary pillars of the Wadi Araba/Emek Ha'arava sector, agreed to by the Joint Team of Experts on 19 September 1996, a copy of which is appended hereto; and

   b. the list of coordinates of the Southern part of the Dead Sea and Salt Pans sector, agreed to by the Joint Team of Experts on 10 March 1998, a copy of which is appended hereto.

2. By this act the coordinates of these parts of the international boundary are formally approved by the Parties as required by the Peace Treaty and become part of Annex I(a) of the Peace Treaty.

3. The approved coordinates are henceforth binding and take precedence over the maps, orthophotos and orthoimages as to the location of the boundary line of these parts of the international boundary, as envisaged and specified in Article 2.C.3 and Article 2.B respectively.

Done at Bet She'an on this twenty-ninth day of December, 1998, which corresponds to the eleventh day of Ramadan, 1419 and to the tenth day of Tevet, 5759.

Signed by:

Lt. Gen. Tahsin Shurdum
For the Government of the
Hashemite Kingdom of Jordan

Moshe Kochanovsky
For the Government of the
State of Israel

Figure 4: *The approval of boundary coordinates.*

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PART II

PRACTICAL CASES

PART II: PROLOGUE

Part 2, chapters 4–7, includes practical cases of international boundaries, illustrating the implementation of the methodological issues of this FIG PUBLICATION. These cases are diverse cases involving disputes and mechanisms used for dealing with the issues. They have been especially selected in Asia and Africa, where most of the states that have been established since WWII have inherited the colonial delimitation problems. Chapter 4 discusses boundary delimitation in a peace agreement between two sovereign states, whereas chapter 5 discusses the first international boundary demarcation conducted by the UN Security Council. Chapter 6 discusses several boundary cases in Africa regarding interpretation of colonial boundaries, in which various international organizations were involved, making use of diverse legal and managerial mechanisms. Dedicated surveying teams participated in all of these cases, contributing significantly to the process, which took place during the last twenty years. Unlike these cases, chapter 7 discusses historic boundaries that have been dealt with for more than 200 years, illustrating similar problems, and in addition, problems regarding long-term maintenance and administration.

The authors of these chapters are senior practical professionals in surveying and mapping, with extensive experience in boundary making. They have had personal involvement and responsibility in the illustrated cases.

Haim Srebro

CHAPTER 4:
THE ISRAEL–JORDAN INTERNATIONAL BOUNDARY

Haim Srebro, Israel

Key words: boundary delimitation, boundary demarcation, boundary documentation, boundary maintenance, boundary datum, GPS.

1 INTRODUCTION

The boundary-making process of the Israel–Jordan boundary has implemented the methodological and practical recommendations presented in the first part of this FIG publication.

The collaborative successful implementation by the two parties, through the entire process, from boundary delimitation to boundary maintenance, including boundary demarcation and boundary documentation, and the continuous maintenance through the last 19 years following the agreement, are a major contribution to stability and Peace along the boundary, and thus, it serves as a successful reference model for boundary making.

This boundary has been agreed upon through a bilateral process of direct negotiations, becoming, for the first time, a recognized international boundary between Israel and Jordan as two independent States.

During the collaborative process both parties have implemented a comprehensive methodological model, and in addition they have implemented modern technologies, part of which have been implemented for the first time, as far as we know, in a boundary delimitation in a Peace Agreement, including the use of orthophoto and orthoimages, GPS and WGS84, and the use of GIS.

The international boundary between the State of Israel and the Hashemite Kingdom of Jordan was agreed upon in a Peace Treaty signed on October 26, 1994. But, like many international boundaries in Asia and Africa, this boundary has roots in the Colonial period because in the past the territories of both Jordan and Israel had been under the British Mandate.

The main issue that arose during the new delimitation of the land boundary in WA referred to the interpretation of the center of WA during the British Mandate. The difficulties included a traditional interpretation of the center as the line of lowest points versus the geographical center and the practical situation on the ground, where agricultural cultivation and installations existed, east of the lower points, but west of the geographical center. The aim was to obtain a solution that was considered logical and fair, so that, with respect to the logical interpretation of the geographical center and with respect to traditional interpretations, flexibility was given to the final line and most of the existing Israeli agricultural cultivations remained in Israel and alternative areas were adjusted along the two sides of the traditional line.

Another issue involved two agricultural areas in which Israelis have rights of ownership and/or rights of use, but the areas were left on the Jordanian side of the international

boundary. The final agreement defined these two areas under a special regime, so that they are under full Jordanian sovereignty and jurisdiction, but at the same time, Israelis have their rights of use under well-defined rules for 25 years with automatic extensions for additional terms of 25 years unless otherwise agreed upon.

The examples mentioned above, as well as two other cases and their solutions, involving an artificial dam on the Yarmouk River and an extension of the Jordan River to the drying Dead Sea, present constructive logical and fair attitude and solutions, given the geographical, political, legal, and practical challenges. Moreover, they show the ability to overcome complicated problems by good will, collaboration, and under the auspices of constructive leadership.

The geographical diversity associated with this boundary, including a land boundary, a boundary in rivers, a boundary in a closed sea, and a maritime boundary, as well as the political diversity associated with it, including sections of final status, of temporary status, and the requirement that a third neighboring state be involved, make this case more interesting and one that others around the world can study and later draw conclusions.

2 DESCRIPTION OF THE BOUNDARY LINE

The agreed international boundary between Israel and Jordan is geographically diverse. The boundary runs along more than 400 km, following various geographical sections: a land boundary, a boundary in a closed sea, a boundary along rivers, and a maritime boundary (see figure 3).

It begins in the north, in an Israel–Jordan–Syria tri-point; it follows a section in rivers along the Yarmouk River, which is a tributary of the Jordan River and along the Jordan River southwards until reaching its estuary to the Dead Sea. Then, it follows a section in a closed sea along the Dead Sea and the Dead Sea salt pans; thereafter, it follows a section along Emek Ha'Arava/Wadi Araba valley (WA), which is a land boundary until reaching the Gulf of Aqaba (GOA) – called in Israel the Gulf of Eilat – and then, it follows a section of a maritime boundary in the territorial sea, along the median line of the GOA, which is part of the Red Sea, until reaching the Israel–Jordan–Egypt tri-point.

Most of the boundary, except the first section along the Yarmouk River, follows the Great Rift – which is also called the Dead Sea Rift and the Syrian-African Rift – including the lowest place on earth at the Dead Sea.

The original boundary delimitation referred to the allocation of the boundary under the British Mandate, which had defined the boundary with reference to geographic features. Owing to erosion and other forms of land degradation, these geographic features keep changing. The absence of a clear, precise unequivocal definition created problems and presented challenges during the delimitation and demarcation of the boundary line. The following examples describe the problems that arose due to the original shortcomings and lack of professionalism by the Government of the British Mandate when geographic features were selected in 1922 for the delimitation of the boundary. The main weaknesses were ambiguity and instability of the selected geographic features. The first geographic section is a boundary situated in rivers. The flow of the river changes its course seasonally throughout the years, and thus, influences the boundary line. The second geographic section is the boundary in the Dead Sea,

which is a closed water body at the lowest height on earth, the level of which has been becoming increasingly lower by more than 1 meter each year, owing to deterioration of water sources and to over exploitation of its waters by the potash industries on both sides. The lowering of the water level – approximately 430 m below sea level – changes dramatically the size of the water surface and the coastlines of the Dead Sea. The third geographic section is the land boundary in the WA following the center of the valley. The width of WA varies between 7.5 km and 25 km. It is doubtful whether one can define the center of such a valley even with the use of modern technologies. The length of the valley is approximately 165 km. The elevation of the northern margin of WA is approximately 280 m below sea level; then the land drops an additional 100 m to the level of the Dead Sea along the area of the salt pans. The southern margin of WA is on the coast of the GOA at sea level. The topography along the valley on the eastern Jordanian side is much higher (up to 1,730 m) than the western Israeli side (200–800 m). Between the mountains there are wide low areas that channel sporadic streams and floods from the Negev area on the west and from the Edom area on the east to the northern basin of the valley towards the Dead Sea. The depression is divided into two basins by a hilly area, at a height up to 300 m, which crosses the entire width of the valley about one third of the valley from the GOA. The gradient of the northern basin towards the Dead Sea is much steeper. The southern basin is characterized by flat marshy areas of internal drainage. The fourth geographical section is the maritime boundary in the GOA, in a special case involving a head of a gulf having both adjacent and opposite coast lines. As already mentioned, in addition to the geographic diversity regarding the boundary, there is a political diversity as well. The southern segment of the boundary in the Jordan River and the northern segment of the boundary in the Dead Sea are on the eastern side of Judea and Samaria – the West Bank. This section is considered in the Israel–Jordan Peace Treaty as an administrative boundary between Jordan and the territory under Israeli military government control, without prejudice to the status of that territory. All the sections of the boundary that have an agreed status of an international boundary, except the section along the Jordan River until its junction with the Yarmouk River, have agreed and documented coordinates, whereas the other sections are not documented in coordinates. In addition, since Syria and Egypt did not participate in the Israeli–Jordanian bilateral process, a final agreement regarding the location of the tri-points on the edges of the international boundary line could not be made.

The land boundary is demarcated by a boundary comprising 124 pillars between the GOA and the Dead Sea Salt Pans.

3 HISTORICAL BACKGROUND

The historical reference of the international boundary between Israel and Jordan comes from the international boundary between Palestine and Trans-Jordan during the British Mandate. This boundary was formed after the end of WWI, following the disintegration of the Ottoman Empire. Great Britain was granted a Mandate over Palestine and Trans-Jordan (and over Mesopotamia – Iraq today). On September 1, 1922 the British High Commissioner published an Order in Council (OIC) that defined the separation line between Palestine and Trans-Jordan. The British Government delivered the documents to the League of Nations (LON) on the 16th of September and the League of Nations approved the statement on the 23rd of September as part of the official document of the Mandate, Article 25. This line became, for the first time, an official boundary between

Palestine and Trans-Jordan, but actually served as an administrative line between two areas under the British Mandate until the end of the Mandate, since the British governed both sides of the line, and the High Commissioner in Jerusalem was responsible for both sides.

The Boundary Allocation

The purpose of the original delimitation was to specify the eastern limit of the territory that the provisions of the Jewish homeland in Palestine apply to. The British commitment to the Jewish Homeland in Palestine was included in the Balfour Declaration in November 1917. The area east of the delimited line – Trans-Jordan under the British Mandate – was allocated for the future establishment of an Arab independent State based on the British High Commissioner of Egypt, Sir Henry Mc Mahon's promise to Sheriff Hussain of Mecca in October 1915. During the preparatory process of allocation, before the delimitation of the line in the Order in Council, there were official meetings and discussions and an exchange of ideas through telecommunications between the British Government in London and British local representatives. The process had been finalized in August 1922, in an exchange of telegrams between the Secretary of State for the Colonies, Winston Churchill and the High Commissioner, Herbert Samuel. They referred to the need to allocate to Palestine half of the Wadi Araba along the center of Wadi Araba between the Dead Sea and the Gulf of Aqaba. In the north, the intention was to allocate the Jordan and Yarmouk Rivers as the separating line and to allocate half of the Dead Sea to each side.

The 1922 Boundary Delimitation

The official boundary delimitation between Palestine and Trans-Jordan was published in the official gazette on September 1, 1922 as part of the Order in Council, stating:

"The Palestine Order in Council 1922 shall not apply to the territory lying East of a line drawn from a point two miles west of the Town of Akabah in the Gulf of Akabah up the centre of the Wady Arabah, the Dead Sea and the River Jordan to the Junction of the latter with the River Yarmuk, thence up the centre of the River Yarmuk to the Syrian Frontier."

The purpose of this initial declaration was to invalidate all the laws and provisions referring to Palestine from the area of Trans-Jordan. The line was approved, as mentioned by the LON, in the Mandate over Palestine. The same wording for the definition of the line, separating Palestine and Trans-Jordan, was also used in the 1928 Agreement between the Government of Trans-Jordan and the United Kingdom.

The acceptance of the administrative line by the LON granted it international recognition. This delimitation had not been changed during the period of the British Mandate and it was considered an international undemarcated boundary.

1922–1948: The Interpretations, Delimitation, and Demarcation During the British Mandate

Interpretations: There was an understanding, from the beginning, that the definition of the line is not clear enough and that interpretations are required for practical purposes. The basic problems had already been presented in 1923 by C. H. Ley, the Director of Surveys in Palestine, who asked for a useful definition, since the center of the undefined WA, some 10 miles broad, was not a useful definition for delimiting the line on

maps. This ambiguity lasted through the whole Mandatory period, in spite of an official interpretation of the lowest points in WA as representing the center of WA. The Director of Surveys pointed out later that implementing the interpretation of a line having the lowest points is not possible in various parts of WA, like on the elevated Araba Divide and in the flat marshy areas along the southern basin of WA. Even the last Statistical Yearbook of Palestine under the British Mandate, printed on November 28, 1944, refers to the uncertainty of the area of Palestine because "the centre line of the valley has yet to be determined."

The unclear definition led the British administration in 1923 to adopt a practical interpretation of the boundary line in WA, referring to the lowest points (the thalweg) as the center of the valley. But, due to lack of geographic and topographic data, this interpretation could not be translated into a definite delimitation. Actually, during the period of the British Mandate over Palestine and Trans-Jordan the topography of WA was not professionally surveyed on both sides of the boundary. The area was not developed, and the investment of such expenditure was not justified. A letter sent in 1943 to the British Resident in Amman, asking for a permit for a party of civilian surveyors of Syrian nationality, to complete a military survey of Trans-Jordan, as far south as Aqaba, shows that not only a civilian proper topographic mapping of WA did not exist during the Mandatory period – a military one did not exist as well.

Delimitation: The results of lack of topographic surveys were manifested in boundary delimitations on maps. The first official drawing of such delimitation by the Survey of Palestine was recorded in 1930. It followed a request by the War Office to portray the boundary on the new compilation of the 1:250,000 series, GSGS 2761. The Director of Surveys, who had already pointed out the problem in 1923, followed the instructions to implement the interpretation of the lowest points and the line was drawn manually, with the Director of Surveys' reservation that the limited quality of the maps and topographical limitations prevent a proper delimitation of the line. Thereafter, this became the approach used for the delimitations made by the Survey of Palestine in the following years until the May 1946 demarcation near Aqaba, just before the termination of the British Mandate over Trans-Jordan. But, owing to the poor quality of the maps at that time, there were significant differences between the delimitations of the boundary line on those maps. The differences were up to 7–8 km east-west, between the locations of the boundary delimitations on the Survey of Palestine maps. All the maps show the boundary line as an undemarcated international boundary, except a section of 3.7 km near Aqaba according to the 1946 edition map. In spite of the differences between the lines on the maps of the Survey of Palestine, one can trace a tendency to follow the lowest point approach.

The consequences leading to the ambiguity of the delimitation were a result of poorly defining the boundary in the OIC and of the successive interpretations of the line of the lowest points as the official interpretation of the center of WA. This was not a result of a scientific research. Actually, nobody knew, neither how to draw a geometrical median line of a wide unclear geographic valley nor how to draw a line indicating the low points in an unknown (unsurveyed) topography. In addition, even the significance of the decision regarding the recommended interpretation was not known. British maps of the same period, which had been produced by different survey organizations or cartographic publishers, show different interpretations of the boundary delimitation. For example, the maps of the Survey of Egypt, which used to be the leading Survey in the area, show the boundary 8 km east in comparison with the maps of the Survey of Pal-

estine. Exceptionally different is a 1931 1:250,000 TRANSJORDAN Survey of Egypt map. This map was the earliest printed map that we know of that indicates the international boundary between Trans-Jordan and Palestine. This map had been officially adopted by the Trans-Jordanian authorities and had been personally approved and signed by the commander of the Arab Legion Emir Lewa Peake. Interestingly, Wadi Araba on this map is shown as a wide depression between the Dead Sea and the Red Sea. The boundary on this map is shown as almost a straight line, composed of three sections of straight lines bisecting the valley. The interpretation of the boundary on this important map differs from the interpretation of the lowest points. Here the boundary appears to bisect the WA valley, which is a wide depression along the Great Rift, fits the original intentions underlying the 1922 allocation. The signature of the commander of the Arab Legion strengthens the authorization given to this interpretation of the boundary delimitation. Additional maps showing similar interpretations were published in smaller scales.

Demarcation: Most of the boundary line in WA had not been demarcated during the period of the British Mandate, and it was indicated on the maps as not demarcated, until the end of the Mandate. As mentioned earlier, neither a precise survey nor a boundary demarcation were carried out during the Mandatory period, from 1922 to May 1946 along the WA land boundary. It was considered an unjustified economic cost, since most of the area was not populated, except for a few nomadic Bedouin tribes, which were moving freely on both sides of the undemarcated boundary. In May 1946, on the eve of Jordanian Independence and at the end of the British Mandate over Trans-Jordan, the British administration of both sides demarcated a section of 3.7 km at the head of the Gulf of Aqaba, in order to leave room for two separate ports to be constructed in the future on the side of Trans-Jordan – later to become Jordan – and on the side of Palestine – later to become Israel. Surveyors from both governments – Trans-Jordan and Palestine – demarcated the 3.7 km boundary line by boundary pillars, surveyed them, prepared coordinates and a map, and signed the documentation. Importantly, this demarcation was based on a study of the 1922 definition and a mutual original interpretation of the 1922 definition, and did not follow the Mandatory interpretation of the lowest points.

1949–1967: The Armistice Period

In May 1948 Israel declared its independence after the end of the British Mandate, and in 1949, after the 1948 war, Israel and Jordan agreed on an Armistice Agreement under the auspices of the United Nations. The wording of the 1949 General Armistice Agreement between Israel and Jordan states that the demarcation lines are military lines and not political, and that they are defined without prejudice to future territorial settlements of boundary lines. The 1949 Armistice Demarcation Line (ADL) between Israel and Jordan was in accordance with the Mandatory international boundary along the Yarmouk River and the northern section along the Jordan River. Then the ADL turned around the northern, the western, and the southern limits of the West Bank under the Jordanian government, and again along the Mandatory boundary along the center of the southern section of the Dead Sea, the Salt Pans, and Wadi Araba. With regard to the ADL, the Agreement refers to the existing military positions. On the other hand, the ADL had been marked by a thick marker on the map of the Agreement. Thus, the width of the line covered a strip hundreds of meters wide on the ground, in addition to additional uncertainty owing to the low accuracy of the basic map. However, since

the main map of the Agreement was a British Mandatory map that included a drawing of the international boundary, the ADL was drawn on top of the printed boundary. The shortcoming of making use of the printed line, which continued the traditional Mandatory boundary problems, raised new delimitation problems. One such new problem referred to the delimitation of the ADL in the vicinity of Aqaba. The 1946 map, which had been used for depicting the ADL, did not show the 1946 jointly demarcated international boundary. Thus, the ADL missed the only demarcated section of the boundary, which served as the legitimate boundary between Israel and Jordan, thus putting the delimited ADL and the actual international boundary in contradiction. During the period of the Mixed Armistice Commission (MAC), 1949–1967, which was chaired by an officer from the UN Truce Force, the population was still small and only a few boundary incidents occurred. These incidents referred mainly to the location of the ADL in WA – which followed the Mandatory interpretation of the lowest points – and to the location of the ADL along the newly constructed dykes of the Dead Sea Salt Pans.

During the Armistice period between 1949 and 1967 the interpretation of the line of the lower points in WA still dominated. Then, hostile activities and the 1967 war nullified the Armistice status.

1968–1994: The Boundary Line between the 1967 War and the 1994 Peace Treaty

Following the 1967 war, Israel declared that the Armistice Agreement had lost its validity and the boundary lines between the two countries became cease fire lines. During this period, the small towns of Eilat and Aqaba developed extensively, becoming crowded cities including ports. Major roads along WA were constructed. Israeli agricultural settlements were established along WA and their number increased to 19. Their main expertise was agricultural cultivation in an arid area, having the considerable advantage of supplying products ahead of season. In addition, the improved road to Eilat plus local attractions brought prosperity, tourism, and local services to WA. The increased development encouraged the settlements to expand the cultivated areas to the east, close to sources of water and agricultural soils. On the other hand, the requirement to secure the settlements forced the military to construct fences and to patrol roads on higher stable ground to the east of the old ADL. In their activities in the WA region both countries actually preserved their legal interests. Israel, in addition to supporting practical essential requirements, could reserve the possibility of considering in the future to re-open for discussion the issue of interpreting the geometric center of WA. Jordan, by continuing to complain annually, maintaining the existence of the ADL and the Mandatory interpretation of the center of WA – along the line of the lowest points. Jordan published in 1984, in 1991, on the eve of the Madrid Conference, and in 1994, on the eve of the Peace talks, charts showing Israeli penetrations along WA, covering an area around 380sq km east of the ADL. In the Agreement between the parties concerning a Common Agenda for the talks towards achieving a Peace Agreement, it was specified that the international boundary line in the Peace Treaty will be defined with reference to the international boundary under the British Mandate.

4 THE 1994 PEACE NEGOTIATIONS AND THE BOUNDARY DELIMITATION

The practical negotiations following the Common Agenda until their finalization in a Peace Treaty, including the boundary delimitation, continued for three and a half months from July 12, 1994 to October 26, 1994.

The general negotiations included almost weekly meetings of the negotiating committees. One of the committees, probably the most critical one, was the boundary committee. Actually the advances of other committees, including the security committee and the water committee, depended on advances regarding the boundary issues.

During the last month of negotiations by the committees, a very small team conducted in parallel secret talks in which the most delicate issues were discussed, mainly regarding the boundary, but also regarding water and security. These secret talks were under the auspices and the personal involvement of the two late leaders, Prime Minister Rabin of Israel and King Hussein of Jordan. The persistent initiative of the two leaders, who handled in parallel a continuous dialog that supplied directives to the secret discussions, enabled the task to be successfully completed.

As mentioned earlier, the main issue regarding the boundary line referred to the delimitation of the land boundary in WA. Following the reference to the boundary under the British Mandate, as agreed in the Common Agenda, the two sides negotiated the Mandatory interpretation of the 1922 definition of the boundary line along the center of WA. The traditional interpretation of the center was a line having the lowest points. Jordan claimed this line. This line is in certain cases on the extreme western edge of the valley, a few kilometers west of the center of the valley. In addition, the WA divide is an elevated hilly area rather than a low valley and the flat marshy areas covering large areas of the southern basin have no definite low point line. The other interpretation was the geographical center of WA, referring to the British 1922 original intention of bisecting the valley between Palestine and Trans-Jordan. Israel claimed this line, which considered the practical situation on the ground, where installations, mainly agricultural ones, existed east of the lowest points but west of the geographical center. The final agreement adopted most of the traditional line with certain flexibility, so that most of the agricultural installations remained in Israel, and alternative areas were adjusted on the other side of the reference line. Two of the Israeli agricultural areas were left on the Jordanian side but it was agreed that they would be under a special regime. They are under full Jordanian sovereignty and jurisdiction, and at the same time, the Israelis residing there have their rights of use under well-defined rules for 25 years with automatic extensions.

The first step of the boundary committee was to create a joint team of experts (JTE) and to nominate the two chairs of the JTE, to take over the task of managing all the professional issues, in order to prepare the boundary delimitation in the Peace Treaty, including issues regarding the technical chapter to support the successive stages after the Peace Treaty. These tasks included the boundary demarcation, boundary documentation, and boundary maintenance, as well as delimitation of the maritime boundary.

The goals of the JTE, covering in advance the above-mentioned stages, was a result of lessons learned from the lack of considering these things in the Peace Process and the Peace Treaty between Israel and Egypt, the cost of which was very high. The two chairs of the JTE were surveying and mapping engineers having extensive experience. For the

sake of confidence building and for ensuring a common language, the discussions and measures taken during the first stages were devoted to technical issues. These included a discussion and agreement on the technological methods and work plan for creating a common geodetic frame, based on satellite measurements (GPS), and the creation of a common datum IJBD94 (Israel–Jordan Boundary Datum 1994), based on WGS84 and a framework of 12 control points, 6 on each side, along 400 km from north to south along the boundary.

Another preliminary technical issue was to agree on mapping aids that will serve to depict the delimitation of the agreed international boundary in the expected peace agreement. The first suggestion was to use a small-scale (1:250,000) map for general purposes and 1:50,000 maps for detailed delimitation, just for the Peace Treaty, taking in consideration the need to produce precise delimitation by coordinates after the physical boundary demarcation that will follow the Peace Treaty. Samples of 1:50,000 "bare" maps, without a grid and without names, were introduced, in order to avoid problems of lack of a common language and different names for the same places. An additional suggestion was to use orthophoto sheets without grids and names. However, the idea to use the suggested maps was not accepted. A counter suggestion to apply to external advisers for preparing the required materials for the boundary delimitation was also rejected. The final agreement within the JTE was to adopt the option based on using image maps without grids and cartographic information as a basis for the boundary delimitation in the Peace Agreement.

The agreed scales of the orthorectified images were chosen to fit the various sections of the boundary: 1:10,000 orthophotos for the Jordan and Yarmouk Rivers, 1:20,000 orthophotos for the land boundary along WA, and 1:50,000 Satellite orthorectified images for the area of the Dead Sea and the Salt pans. The larger scale was required to track the meandering of the rivers and to identify the main flow of the stream. The small-scale images were required to cover the full width of the Dead Sea of about 20 km.

The delimitation of the international boundary in the Peace Treaty was an inter-correlated process between the JTE and the authorities at the political level. The final delimitation was agreed upon only at the last stage before the treaty was concluded. Therefore, there was a mutual understanding between the chairs of the JTE that the delimitation in the Peace Treaty on the rectified images should only serve as a temporary definition of the boundary line, for the purpose of signing the treaty and for serving as an initial guideline for the field demarcation.

The heads of the JTE agreed on the following process:

"*After signing the treaty, the boundary shall be mutually marked on the ground by temporary markers, which will be replaced later on by boundary pillars, and then surveyed by the two sides and coordinates shall be jointly defined and documented. Then, the agreed coordinates of the boundary, which define it precisely, shall take precedence over any other definition of the boundary, including the temporary delimitation of the boundary in the Peace Treaty on the orthorectified images.*

Then, this documentation shall serve the sides for the ongoing boundary maintenance within the framework of the boundary administration."

The result of this understanding was that the preparation of boundary documentation should be prepared in the most precise way, so that it will be sufficient for restoring

boundary pillars or any other required measure, either for checking of possible deviations along the boundary line, or for constructions along the boundary line and even for densification of boundary markers.

Thus, the surveying and documentation were preplanned in order to support the boundary maintenance. The boundary demarcation was preplanned in order to optimize boundary documentation and the technical methods of the boundary delimitation were preplanned to support the boundary demarcation.

This reverse-engineering chain had a major impact on the delimitation, with reference to the text of the Peace Treaty regarding the international boundary, the boundary delineation in the Annex to the Peace Treaty with its map appendices, as well as regarding technical measures that were agreed upon and prepared in advance to enable its successful implementation throughout the whole process.

The texts of the Peace Treaty regarding the international boundary include the following:

Article 3 – International Boundary – of the Peace Treaty and Annex I(a) – Israel–Jordan International Boundary Delimitation and Demarcation.

Article 3 defines in its first paragraph a reference to the boundary delimitation, which is the boundary definition under the British Mandate, as shown in Annex I(a) to the treaty, the attached mapping materials, and the coordinates specified therein.

The other paragraphs refer to the political status of the international boundary including the status of various sections of the boundary line, to the time table of the demarcation and of the maritime boundary delimitation, to the general agreements regarding the delimitation of the boundary line along the rivers, and to the areas of the special regime.

It is worthwhile to examine the first paragraph, which refers to three definitions of the boundary: (1) the historical mandatory one, which is mainly based on a verbal definition; (2) the maps, which are attached to the treaty and are part of it; and (3) the coordinates, which are specified therein. However, the coordinates still did not exist at the time of the Peace Treaty. They were defined in the documentation after the demarcation and after the land boundary was surveyed, and a few years later in the documentation of the boundary line in the GOA, in the Dead Sea and Salt Pans, and in the Yarmouk River; however, they still do not cover all sections of the boundary line.

This innovation, followed by detailed technical guidelines in Annex I(a), anticipated the whole process and established the rules for it. The circle was completed by the inclusion of a reference to this in the approval and adoption of the coordinates by the JBC, following each stage of documentation by the JTE.

In the documents that approved the documentation and coordinates, which were prepared by the JTE, the JBC declared that the coordinates are approved "*as required by the Peace Treaty and become part of Annex I(a) of the Peace Treaty"* and this closes the circle.

Moreover, the JBC approval of the documents gave precedence to the coordinates over the maps and, thus, made a final order in the first paragraph of the Peace Treaty delimitation of the international boundary (Article 3).

Annex I(a) to the Peace Treaty *("Annex I(a) – Israel–Jordan International Boundary Delimitation and Demarcation")* is much more detailed regarding the guidelines set for implementing the successive stages of the boundary-making process. Regarding the

land boundary, it refers to the delineation of the boundary line in the attached maps (Appendix I), to the demarcation process, to the field surveys and documentation, including the coordinates and their formal adoption, declaring them part of the Peace Treaty Annex, binding, and taking precedence over the maps.

In addition, the annex refers to the maintenance of the boundary pillars and to the use of the coordinates for their reconstruction. It also refers to special regime zones.

"2.C. Emek Ha'arava/ Wadi Araba

1. *The boundary line is shown on 1:20,000 orthophoto maps (10 sheets, Appendix I attached to this Annex)*

2. *The land boundary shall be demarcated, under a joint boundary demarcation procedure, by boundary pillars which will be jointly located, erected, measured and documented on the basis of the boundary shown in the 1:20,000 orthophoto maps referred in Article 2-C-(1) above. Between each two adjacent boundary pillars the boundary line shall follow a straight line.*

3. *The boundary pillars shall be defined in a list of geographic and UTM coordinates based on a joint boundary datum (IJDB 94) to be agreed by the Joint Team of Experts appointed by the two parties (hereinafter the JTE) using joint Global Positioning System (GPS) Measurements. The list of coordinates shall be prepared, signed and approved by both Parties as soon as possible and not later than 9 month after this Treaty enters into force and shall become part of this Annex. This list of geographic and UTM coordinates when completed and agreed upon by both Parties shall be binding and shall take precedence over the maps as to the location of the boundary line of this sector."*

Annex I(a) refers to the delimitation of the boundary line in the Jordan River and the Yarmouk River in more detail than does Article 3 of the Peace Treaty, including: (1) guidelines for changing delineation – which actually refer to long-term maintenance of the line and (2) the political status of its sections and the special regime area of Naharayim/ Baqura.

"2.A. Jordan and Yarmouk Rivers:

1. *The boundary line shall follow the middle of the main course of the flow of the Jordan and Yarmouk Rivers.*

2. *The boundary line shall follow natural changes (accretion or erosion) in the course of the rivers unless otherwise agreed. Artificial changes in or of the course of the rivers shall not affect the location of the boundary unless otherwise agreed. No artificial changes may be made except by agreement between both Parties.*

3. *In the event of a future sudden natural change in or of the course of the rivers (avulsion or cutting of new bed) the Joint Boundary Commission (Article 3 below) shall meet as soon as possible, to decide on necessary measures, which may include physical restoration of the prior location of the river course.*

4. *The boundary line in the two rivers is shown on the 1:10,000 orthophoto maps dated 1994 (Appendix III attached to this Annex).*

5. *Adjustment to the boundary line in any of the rivers due to natural changes (accretion or erosion) shall be carried out whenever it is deemed necessary by the Boundary Commission or once every five years."*

Regarding the maritime boundary, Annex I(a) does not add to the guidelines of Article 3 (3.7) of the Peace Treaty.

Regarding the Dead Sea and Salt Pans, Annex I(a) establishes guidelines for the successive process:

> *"2.B. Dead Sea and Salt Pans*
>
> *The boundary line is shown on the 1:50,000 image maps (2 sheets, Appendix II attached to this Annex). The list of geographic and Universal Transverse Mercator (UTM) coordinates of this boundary line shall be based on Israel Jordan Boundary Datum (IJBD 1994) and, when completed and agreed upon by both parties, this list of coordinates shall be binding and take precedence over the maps as to the location of the boundary line in the Dead Sea and the salt pans."*

The agreed delimitation of the international boundary is shown on the Peace Treaty maps (Appendices I-VI), separated according to the boundary sections.

The map attachment to the Peace Treaty was part of Annex I(a), including two opening pages and six appendices. The opening pages served as a place for the signatures of the two Prime Ministers and validated the signatures of the chairs of the JBC and the JTE. In addition, a small-scale map index covering 27 map sheets is included. To avoid disagreements, the map index does not include names and the map sheets do not include a coordinate grid (see figure 1).

The 27 sheets of the map attachment consist of image maps at various scales: 10 orthophoto sheets for the land boundary line in Emek Ha'Arava/Wadi Araba, 2 ortho images for the Dead Sea and Salt Pans, 12 orthophoto sheets for the Jordan and Yarmouk rivers, 1 orthophoto sheet for the Naharayim/Bakura special regime, 1 orthophoto sheet for the Zofar/Al Gammr special regime, and 1 1:50,000 ortho image of the head of the GOA, which will serve as a reference for the time of the maritime boundary delimitation.

The land boundary along the Aravah Valley (Emek Ha'Aravah/Wadi Araba) is shown on 1:20,000 orthophoto sheets. The boundary in the rivers (the Jordan and Yarmouk Rivers) is shown on 1:10,000 orthophoto sheets. The boundary in the Dead Sea is shown on 1:50,000 ortho-images.

The 1:20,000 orthophoto for the land boundary was used successfully in the field during the demarcation, augmented by photo enlargement at a scale of 1:10,000 and in certain cases even larger scales of regular air photos.

In spite of the significant length of the land boundary, and of the additional preparatory work required, a 1:10,000 scale orthophoto is recommended. Such a recommendation is more important if all the copies used by the parties are reproduced from one source. If the copies used by the parties for demarcation are not produced from one source, there will always be slight differences that may be potential sources of disputes.

The 1:10,000 orthophoto for the river sectors was used successfully but in order to see better the small islands in the river, of a magnitude of several meters, a color orthophoto of a larger scale orthophoto is recommended.

The 1:50,000 ortho-images were used successfully in the Dead Sea and in the Gulf of Eilat. The use of this scale was the only way to see both sides of the coastline because of the widths of the sea and the gulf.

In addition to the 1:50,000 ortho-image coverage, larger-scale imagery (aerial photographs), of each of the coasts, was required to improve the interpretation of the coastlines.

Figure 1: *The Israel–Jordan Peace Treaty: The map index (see Figure 1, p. 60 in Chapter 3).*

Figure 2: *The delimitation of the boundary line in the Peace Treaty.*

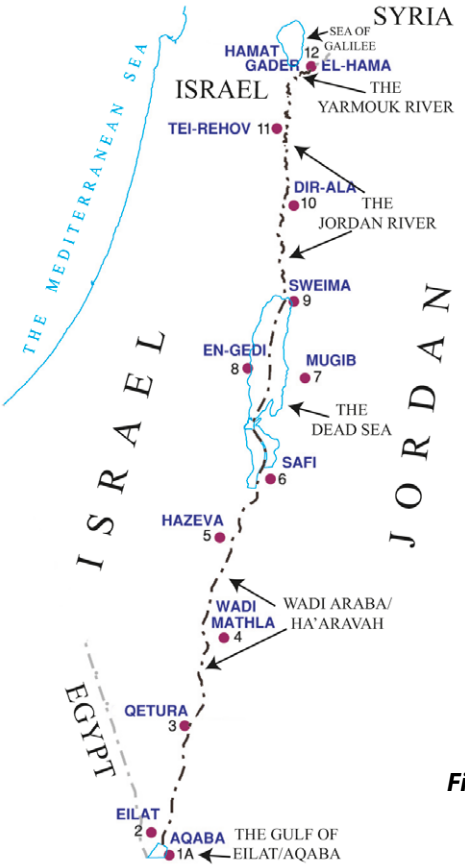

Figure 3: *IJBD94 reference points.*

An example of an orthophoto of the land boundary at a reduced scale is shown in figure 2.

During the phase of the negotiations, in parallel with dealing with the political and geographical delimitation of the boundary line and in parallel with preparing the orthophotos and ortho-images and with the delineation of the agreed boundary line on them, the JTE also prepared the geodetic framework, to serve for the required geodetic surveys of the boundary pillars after the demarcation, and to serve for the processing of agreed coordinates along the boundary line in the various sections and for preparing adequate documentation.

The JTE agreed on the use of GPS measurement and on the creation of a joint boundary datum – IJBD94 (Israel–Jordan Boundary Datum 1994) – based on the adoption of the WGS84 ellipsoid, fixing the coordinates of one of the 12 points of the joint reference geodetic framework that was constructed along the boundary (Figure 3). The reference ellipsoid is centered in the geocentric center according to the precise GPS vectors of the 12 datum reference points.

The joint measurements and processing of the IJBD94 reference points were achieved by the JTE before the Peace Treaty was signed, facilitating the final wording of the Delimitation in the Peace Treaty, regarding the ensuing phases of the process after the Peace Treaty was signed, including the land boundary survey and documentation, the delimitation of the maritime boundary, and the definition of coordinates of the boundary line along the land boundary, in the Dead Sea and Salt Pans, and in the rivers.

The final delimitation of the boundary in the Peace Treaty was denoted on a series of orthophoto maps, following mainly the lower points in WA, but including most of the Israeli cultivated agricultural lands in Israel, except two areas under the special regime of Jordanian sovereignty that permitted Israeli use. This has been generally considered as a logical and fair solution, contributing to Peace and to stability along the boundary.

5 BOUNDARY DEMARCATION, DOCUMENTATION, AND BOUNDARY MAINTENANCE

Boundary Demarcation

The instructions in the treaty with regard to the boundary demarcation are included in paragraph 2 of Annex I(a), stipulating that the demarcation will be by boundary pillars, that it will be based on the boundary line shown on orthophoto maps (as part of the delimitation in the treaty), that it will be a joint procedure, that the pillars will be jointly located, erected, measured, and documented and that the boundary between adjacent boundary pillars will follow straight lines.

The demarcation of the land boundary in WA was carried out by the JTE following the instructions of the Peace Treaty according to a methodology set up by the JTE.

The task was achieved in two phases: Phase I included demarcation of temporary markers and phase II included demarcation by boundary pillars.

Phase I was carried out by three joint field teams working in parallel, using: (1)Copies of the 1:20,000 orthophoto maps attached to the Peace Treaty; (2)Enlargements of the orthophoto and aerial photographs in scales of 1:10,000, 1:5,000 and even larger in

some cases. (3)Surveying equipment; (4)Anti-mine sandals (where required) and logistical support; (5)Temporary markers.

Every point was located according to its identification on the orthophoto map, and according to its relative position to identified close objects on the ground. Then, the temporary marker was inserted in the ground, a color ribbon was tied around it, and distances from close witness points, such as fixed objects, including iron angles, were taken to validate the demarcations. The photographic aids were prepared by each side from its own original copy.

During the first phase the joint teams had to overcome some difficulties such as:

1. Working in land mine areas or suspicious areas (some points), mainly in the wadis.
2. Access to some boundary points.

To overcome these difficulties, some measures had to be taken: (1)Using anti-mine sandals to work in the mine fields;(2)Using helicopters to put a few markers in place.

Remarks about phase I:

1. All the points were demarcated in a continuous process except those that are south of the Araba/Arava crossing (called today the Yitzhak Rabin Terminal), which were finally marked as boundary points no. 0, 1, and 2.
2. The points were assigned initial numbers that were changed during the final demarcation.
3. Points 0 and 2 were finally demarcated after concluding a mutual implementation agreement using large-scale aerial photographs.

Phase II refers to the placement of boundary pillars. The pillars were produced by Jordan. The work was carried out by both sides, Israel erecting 62 BPs and Jordan 62. The actual work was carried out by Military Engineering Organizations and Construction Centers of the two countries, with the participation of civilian contractors. This phase of work required the inspection of the JTE members, to ensure that the permanent pillars were erected on the exact same spot as were the temporary markers.

Before removing the temporary markers and erecting the BPs, measurements were made from close objects used as "witness points". After erecting the BP, final measurements were made to ensure that the BP was in the right place. JTE members supervised and inspected the work.

Remarks about Phase II:

1. A few pillars were put in place by a helicopter because of access difficulties to the sites.
2. Two points were not demarcated by standard boundary pillars because the ground near the site was not suitable for a heavy concrete pillar.
3. BP no. 0 was placed with the intention of stabilizing it later on.
4. BP no. 1 – It was agreed that the 1946 old historic boundary pillar will remain in place. (However, it was replaced in 2011 by a standard pillar.)
5. In a few points, which were thought to be mined, a small area around the point was cleared from mines.

General Remark:

The overall task was to achieve a successful professional low-cost boundary demarcation. The success was due to the joint cooperation and coordination of all the members involved including the JTE, the JBC, the liaison officers, the engineering and construction units, the local military forces, and the contractors.

Boundary Documentation

The instructions of the Peace Treaty regarding the documentation were as follows:

Annex I(a) 2.C.3

"*The boundary pillars shall be defined in a list of geographic and UTM coordinates based on a joint boundary datum (IJDB 94) to be agreed by the Joint Team of Experts appointed by the two parties (hereinafter the JTE) using joint Global Positioning System (GPS) Measurements. The list of coordinates shall be prepared, signed and approved by both Parties as soon as possible and not later than 9 months after this Treaty enters into force and shall become part of this Annex. This list of geographic and UTM coordinates when completed and agreed upon by both Parties shall be binding and shall take precedence over the maps as to the location of the boundary line of this sector.*"

Thus, Annex I(a) specifies the ultimate goal of documentation, which is defining a list of coordinates pertaining to the boundary pillars and recognizing the coordinates as being binding, becoming part of the Peace Treaty (Annex I(a)), and taking precedence over the maps regarding the location of the boundary.

The instructions not only define the goal but also refer to technical details, including the geodetic reference for the coordinates, specifying geographic and UTM coordinates and a joint boundary datum (IJBD94), and referring to the technology (GPS measurements). They also refer to the managerial instrument (the Joint Team of Experts) and to the stages (prepared, signed, and approved) and the schedule of the process (not later than 9 months).

The instructions for documentation refer to the boundary pillars along the land section and to the section of the Dead Sea and Salt Pans.

To the best of our knowledge, this is the first time that such comprehensive, detailed instructions were specified in the documents of a peace agreement complementing the boundary documentation.

In practice, except for the time schedule of 9 months, the two parties accomplished all the tasks.

Moreover, the parties also adopted the instructions for two additional sections along the boundary, regarding the GOA and the Yarmouk River.

The documentation of the boundary line was prepared by the JTE and was summed up in four documents: for the WA section, for the maritime boundary in the GOA, for the Dead Sea and Salt Pans, and for the Yarmouk River (El-Hamma–Adassiya Area).

Each of these documents describes the technical process and presents the coordinates of the boundary line in the relevant section.

After these documents, including the boundary line coordinates, were prepared by the JTE (Figure 4), the JBC approved and adopted them, declaring the list of coordinates as binding. Thus, they became part of Annex I(a) of the Peace Treaty and took precedence

over the maps and orthophotos regarding the location of the international boundary as envisaged and specified in the Peace Treaty (Figure 5).

The documentation of each section, prepared and signed by the JTE also describes how the reference frame, including 12 points along the whole boundary line six on each side, the field measurements, the processing, and defining the coordinates of the datum points were determined.

Then, it reports in detail the demarcation of the boundary pillars, the GPS field observations, the data processing, and the outcome of the formal list of boundary coordinates.

Whereas the documentation of the coordinates of the boundary pillars in WA was based on direct GPS surveys of the boundary pillars and the datum control points of the reference fame, in the other three sections the definition of the coordinates was not based on direct measurements. In these sections the boundary line follows water bodies and the definition of boundary coordinates depended on extraction of coordinates from the orthophoto and ortho images of the Peace Treaty, like in the case of the Dead Sea and the Yarmouk River, or using additional sources, like in the case of the GOA.

Figure 4: *The cover page of documentation of the land boundary*
(see Figure 3, p. 62 in Chapter 3).

Figure 5: *The approval and adoption of the documentation and coordinates by the JBC*
(see Figure 4, p. 63 in Chapter 3).

In all four cases the definition of coordinates depended on the joint IJBD94 reference datum, which had been measured and agreed upon by the JTE before the Peace Treaty was signed.

In the process of documenting the boundary line in the Dead Sea and Salt Pans the JTE mutually agreed on selected points along the boundary line, depicted on the 1:50,000 ortho- images of the Peace Treaty, to reflect the boundary line in this section. In addition, the JTE agreed on 36 control points, 18 on each side of the boundary, which were identified using the same ortho-images and on the ground.

Thereafter, the JTE measured, by GPS field surveys, the 36 control points and the relevant IJBD94 datum points, and agreed jointly on the coordinates of the 36 ortho-image control points.

Following that, both parties digitized on the ortho-images the agreed selected boundary line points and the control points, and, after a joint adjustment of the two unilateral files of processed data, defined the boundary line coordinates.

The documentation of the coordinates of the boundary line in the Yarmouk River followed a process similar to the process used at the Dead Sea. The definition and digitization of points along the boundary line in this section were done on a 1:10,000 orthophoto of the Peace Treaty. The requirement for documentation of the boundary line in this section, in spite of the fact that it follows a river, followed the guidelines of the Peace Treaty, regarding a case when the change in the course of the river is artificial. In such a case, the change in the course of the river does not change the route of the boundary line. Therefore, in the case of the construction of a dam on the Yarmouk River the boundary line was fixed.

The process of documenting the maritime boundary in the GOA also followed a definition of agreed base points on both coast lines. These control points were jointly identified on the ortho-image and measured in a joint GPS field survey campaign with reference to the relevant IJBD94 datum points. However, the method of defining points along the maritime boundary line was different. A special maritime boundary agreement defined the method for the delimitation, based on the median line. The points of the median line were computed analytically on the basis of base points along the digitized coastlines that had been defined jointly. The computed median line was generalized to three points connected by straight lines so that the small residuals from both sides were compensated.

As mentioned earlier, all four documents were agreed upon and signed by the JTE. Then, those documents of the JTE were agreed upon and adopted by the JBC and became part of Annex I(a) to the Peace Treaty.

Boundary Maintenance

The instructions of the Peace Treaty regarding the boundary maintenance state:

"*2.C.4 The boundary pillars shall be maintained by both parties in accordance with a procedure to be agreed upon. The coordinates in Article 2.C.3 above shall be used to reconstruct boundary pillars in case they are damaged, destroyed or displaced."*

In addition, Annex I(a) states that the parties will establish a JBC and the JBC may form specialized teams.

Thereafter, the JTE was formed. The JTE is active since its establishment in 1994 for the last 19 years, and is responsible for most of the boundary maintenance activities.

The JTE meets, at least once a year, for the annual boundary reconnaissance, and provides an annual report for the JBC. This includes a visual check, stabilization of the boundary pillars, and checking along the boundary line to determine whether there was any encroachment on the boundary line. If local encroachment is discovered, the JTE provides remedy measures. If a boundary pillar is damaged because of wind or water erosion, this is taken care of. Sometimes bases of boundary pillars are exposed due to winds that move the sand or due to floods and the staff of the JTE stabilize the pillar. In extreme cases, the pillars are damaged and replaced by new pillars, mounted on new stable and massive concrete bases.

For example, two boundary pillars, which were placed along the river bed in the northern section of WA, had been swept by strong floods and were re-constructed by the JTE on stabilized bases.

The work of the JTE also deals with the need to clear areas near the boundary pillars from mine fields to enable maintenance, and deals with the coordination and supervision of constructions or physical changes on, or close to, the boundary line.

During 19 years of close cooperation, the JTE has worked smoothly and solved all the problems that were raised, in addition to fulfilling the tasks assigned by the Peace Treaty, like the boundary demarcation and documentation. The JTE reports to the JBC, which approves the activities during a joint meeting every one or two years or as required.

6 SPECIAL CASES

In addition to the innovative approach regarding the boundary-making process, in which a comprehensive methodology is followed, there are a few special cases along the boundary that were taken care of during the boundary delimitation that may be of special interest.

The Naharayim/Bakura and Zofar/Al-Ghamr Areas that Pertain to Special Regimes

It is worth noting the arrangements pertaining to two areas having a special regime along the international boundary under Annex I of the Israeli–Jordanian Peace Treaty. These two areas – Naharayim/Baqura, which is in the north, at the Jordan-Yarmouk Rivers' confluence, and Zofar/Al-Ghamr in the south, in the area of WA – are located east of the agreed upon international boundary and, accordingly, are under Jordan's full sovereignty. However, in light of private land ownership rights and property interests ("land owners") of Israelis in the Naharayim area, and in light of private land use rights of Israelis in the area of Zofar, the two States agreed to create special regimes, within the framework of the Peace Treaty, whereby these Israelis would be granted the right of use in those areas for a period of 25 years. This arrangement has an automatic renewal mechanism for an additional 25 year terms, unless one of the parties requests, one year in advance, to terminate this special arrangement. The special rights granted to Israelis in these areas are subject to Jordanian law and to certain terms and conditions set forth in Annex I(b) and Annex I(c) of the Peace Treaty.

Changes in the Water Courses of Rivers

Article 3 and Annex I(a) of the Israel–Jordan Peace Treaty state that in the event of natural changes (accretion or erosion) in the course of the flow of a river, the boundary will follow the new course of the flow. "*In the event of a future sudden natural change in or*

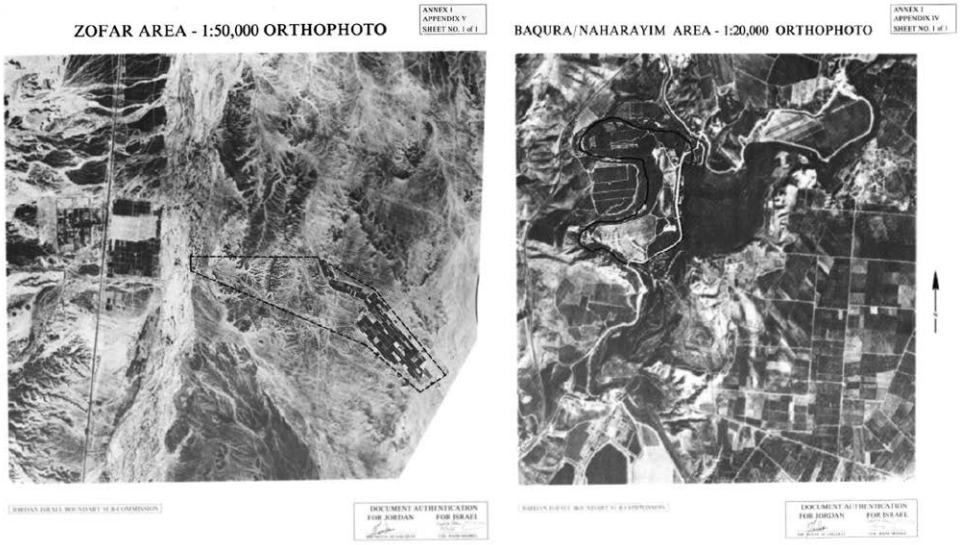

Figure 6: *The Naharayim and Zofar special cases.*

of the course of the rivers (avulsion or cutting of a new bed), the Joint Boundary Commission shall meet as soon as possible, to decide on necessary measures, which may include physical restoration of the prior location of the river course." In the event the change in the course of the flow is not natural (artificial), the boundary line will not be affected unless otherwise agreed.

Such changes occur mainly along the Jordan riverbed and in the southwestern part of the Yarmouk River just before the Yarmouk-Jordan Rivers' confluence, where the Yarmouk runs through a fairly wide and moderate open valley. The topography in this area contributes to the extensive meandering in the river bed. These changes occur because the areas adjacent to the river bed in this area are relatively flat, and covered by flora and the current flows down a relatively gentle slope with no steep side slopes along the way. There are two reasons for local changes in the course of the river bed: (a) the slow current in this section of the Jordan River over the past few years, particularly in the summer and autumn months, which allows any obstacle forming in the river bed to create an obstruction that causes a diversion of the current and a bend in the river bed; (b) flooding in the rainy season – the strong current running, when floodwater breaks through any obstacle in its path and shortens the bends. Since there are no residential areas along the river banks in this area, the problem is mainly technical and confined to developed sites such as the baptism site (El Ma'tas) and around the King Hussein Bridge (previously called the Allenby Bridge).

There are steep inclines along both banks of the Yarmouk in its northeastern area and the range of change along the river bed in this area is small. The dam constructed jointly by Israel and Jordan across the Yarmouk in the Adassiya area created a water reservoir upstream and resulted in artificial changes in the flow of the river and, therefore, the JTE agreed to fix the boundary line prior to constructing the dam. The boundary line in this segment was to be fixed in accordance with the delimitation of the boundary line on the maps attached to the Peace Treaty. Further to this agreement, in 2000 the JTE measured and documented the boundary line along the Yarmouk River by relying on the map attached to the Peace Treaty (Annex I(a)) and also on field surveys. Based on this work, coordinates of points along the boundary line were determined and recorded in the joint boundary datum IJBD94. This joint documentation was signed by the chairs of the JTE and adopted by the JBC. This process fixed the boundary and set coordinates of the boundary line in this segment.

The Estuary of the Jordan River to the Dead Sea

As mentioned earlier, Annex I(a) to the agreement stipulates that the boundary will follow natural changes in the course of the rivers unless otherwise agreed. Owing to the fall in the water level of the Dead Sea as a result of it drying up and due to gradual depletion, the northern coast has moved to the south, extending the Jordan River southward, thus changing the location of its estuary to the Dead Sea relative to the situation on the Mandatory reference map. During the preparation of the delimitation of the line for the Peace Treaty, the joint experts had to solve the problem.

Given the change in the location of the Jordan River estuary from its location on the British Mandate map to its actual one in 1994, as shown on the orthophoto attached to the Peace Treaty, the Peace Treaty gave preference in determining the boundary line along the Jordan River to the actual course of the river bed. The boundary line has been determined as the center of the river bed in the section added to the river extending to the location of the new estuary. A line joining this point by an adjusted curve for

smooth integration with the British Mandate boundary line in the middle of the Dead Sea has been delineated.

With regard to the northern edge of the Dead Sea, it is likely that a special arrangement will be required in the future, if the Dead Sea continues to shrink. The more its northern edge will move southwards, the more the border in the Dead Sea section will be shortened, while the Jordan River will be extended.

Figure 7 shows, on the base of the Peace Treaty map, the southern estuary of the Jordan River as mentioned above; the estuary moves southward as the Dead Sea shrinks as a result of the lowering of the sea level.

The maritime boundary – This is a sector of the boundary that had not been delimited at the time of the peace agreement. Since this section was not of major importance, the solution was to define in the agreement a time schedule for its delimitation – within 9 months. Although this goal was not achieved, the parties concluded the terms of the maritime boundary delimitation in an *'ad referendum'* document on October 18, 1995, twelve months after the Peace Treaty, followed by a Maritime Boundary Agreement in January 1996. The JTE developed an innovative method for delimiting this maritime boundary in the Territorial Sea, in the special case of both adjacent and opposite coast lines at a head of a gulf.

The definition of the edge points of the boundary line – The northern edge point of the boundary is common to Jordan, Israel, and Syria. Since there is no agreement between the State of Israel and the Republic of Syria, this edge point was not mentioned in the Israel–Jordan delimitation.

The southern edge of the boundary is common to Israel, Jordan, and Egypt. The maritime boundary between Israel and Jordan was not delimited at the time of the Peace

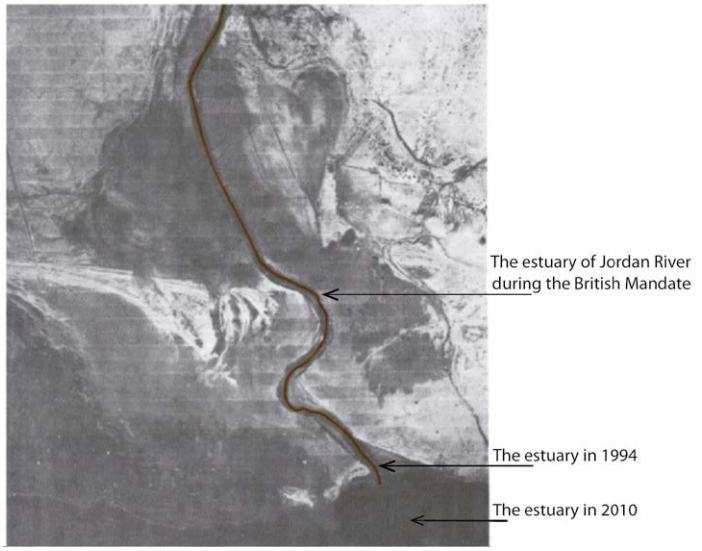

Figure 7: *Changes in the location of the estuary of the Jordan River to the Dead Sea, shown on the 1994 peace treaty orthophto.*

Treaty but instead, was a year later. Since there are no agreed maritime boundaries between Egypt and both Israel and Jordan, this point is not delimited.

The status of the delimited line – Since part of the delimited line, with reference to the boundary under the British Mandate, is stretched east of Judea and Samaria – The West Bank, Israel and Jordan agreed to delimit the line along this section, but referred to its status as an administrative line without prejudice to the final status of this area.

7 SUMMARY, CONCLUSIONS, AND LESSONS LEARNED

The international boundary between Israel and Jordan has been defined for the first time as an international boundary between two sovereign states in the 1994 Peace Treaty. The allocation of this boundary has been referred to as the boundary during the British Mandate. The boundary-making process followed a systematic methodological model of boundary making, which had been developed following (bad) experience in other boundary cases around the world.

The model, which includes the stages of preparatory work, boundary delimitation, boundary demarcation, boundary documentation, and boundary maintenance has been developed so that reverse engineering considerations influence the process from its beginning. In such a way, the requirements for the boundary maintenance are taken into consideration and implemented in the boundary documentation and are considered at earlier stages, from the technical geodetic preparation before the boundary delimitation, to a peace/boundary agreement and onwards. The requirements for boundary demarcation influence the boundary delimitation and associated issues. Thus, thorough preparation, both regarding technical aspects and methodological considerations, should be carefully handled before the boundary is delimited in the peace agreement.

This can be achieved only if a joint technical team is established as early as possible, when the process is launched, to carry out all the required activities. This was implemented by Israel and Jordan, establishing the Joint Team of Experts on the first day that the two negotiation committees, including the boundary sub-commission, convened in WA to open practical negotiations for a Peace Treaty. Not only was the JTE responsible for the technical activities prior to the Peace Treaty and for implementing the process during the demarcation and documentation of the line—the JTE has been playing an important role regarding the boundary maintenance through the years. For the last 19 years since the 1994 Peace Treaty was signed, the JTE has been conducting annual reconnaissance surveys and maintenance activities, repairing and reconstructing damaged or missing boundary pillars, monitoring deviations, and providing remedies. The chairs of the JTE prepare a signed annual report to the chairs of the Joint Boundary Commission. The continuous joint activity of the JTE, strictly following the predefined process, and quickly monitoring and preventing local encroachments, greatly contributes to the exceptional maintenance and stability of the boundary line, in spite of the development on both sides of the boundary. The JTE tries to actively support the requirements of the development and to prevent potential obstacles.

Lessons Learned

1. The delimitation of the international boundary in a peace agreement has the potential to become the crucial subject of the peace negotiations and a major

obstacle for achieving an agreement. Therefore, a way should be found to create flexibility regarding this issue.

2. The early preparation work, regarding geographical, historical, and other aspects along the boundary is very important for both sides, both for the best reflection of mutual interests and for finding a way to compromise, culminating in an agreement with full faith and conscience.
3. The construction of a joint team of experts at the beginning of the negotiations was a big success, and greatly contributed to the political negotiations.
4. Professional experts have common technical language and positively contribute to continuous communication and technical work. In times of tensions and crisis, which occur in most negotiation processes, their continuous work may bridge the gap and prevent total undesired disconnection between the parties.
5. The direct and interactive connection between the professional negotiators and the decision makers is of great importance.
6. Mutual confidence between the negotiators is an essential component in the negotiation and is crucial for reaching an agreement.
7. Mutuality is very important for building confidence. A joint work, especially on the basis of common surveys, using advanced technologies and mutually agreed on common coordinates, great contributes to this process.
8. Natural geographic features are not suitable for precise delimitation of international boundaries. They may, however, serve for temporary allocation of a boundary, but will usually create disputes as a result of different interpretations and sometimes due to geographic changes taking place in time.
9. Maps, especially old maps of low accuracy, are not a legal reliable source as evidence for location, but may serve as important evidence regarding the use of geographical names.
10. Regarding technical use of aerial photographs and satellite images for the delimitation and demarcation processes, in case identification on the ground is required, image magnification at a large scale, not less than 1:10,000 (preferably larger) is required.

8 RECOMMENDATIONS

The following are recommendations regarding the boundary-making process based on the experience of implementing the international boundary between Israel and Jordan:

1. A model of the stages including boundary delimitation, boundary demarcation, boundary documentation, and boundary maintenance handled by a joint team of experts is highly recommended.
2. Preliminary preparation for boundary maintenance with reference to the specific boundary conditions and their influence on the demarcation and documentation is recommended, along with preliminary preparation for boundary demarcation and documentation and their influence on the boundary delimitation in a Peace Agreement.

3. Establishing an internal team of experts is recommended for any state at the beginning of a peace process, to collect documents and data, to conduct research, and to build a database of knowledge and documents for elucidating the State's position and for preparing for negotiations regarding the boundary delimitation. This team should be the source for the representatives of the State in the form of a joint team of experts.
4. A joint team of experts should be established at the beginning of practical negotiations towards achieving an agreement. The team should be assigned the technical tasks regarding the international boundary throughout the process.
5. The participation of mapping experts in the negotiations on the delimitation of the boundary line is recommended, with direct communication with the chief negotiators and the leaders (the decision makers), making use of the technical infrastructure prepared for it, both the internal one (including a boundary data base) and the one commonly used.
6. The participation of mapping experts in the wording of the boundary delimitation in the Peace Agreement is recommended, along with their participation in defining in the agreement paragraphs regarding the successive stages that will serve in the demarcation, the field measurements, the determination of coordinates, documentation and boundary maintenance, including the definition of the apparatus to carry out these activities after the peace agreement is agreed and signed.
7. In order to build confidence between the professional participants, it is recommended to begin the dialog by discussions on the preparation of the required technical means to support an agreement. These include the following:
   - Agreement on mapping materials on a small scale and a large scale for the negotiations and for delimiting the boundary in an agreement, in accordance with the sections of the boundary (land, maritime, and river).
   - Assigning tasks, agreement on procedures, and production and approval of the mutually agreed mapping materials.
   - Agreement on a common geodetic datum and a grid and on a joint control system for defining coordinates along the boundary.
   - Field surveys and geodetic adjustment of a joint control network.

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CHAPTER 5: DEMARCATION OF THE IRAQ–KUWAIT BOUNDARY

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The present chapter is a summary account of the first complete demarcation of the international boundary between Iraq and Kuwait, a process undertaken between May 1991 and September 1993; the first demarcation of an international boundary to be carried out at the request of the United Nations Security Council. The chapter describes the circumstances that led to the formation of the boundary commission, including the geographical setting and the historical background, the process of surveying the land and off-shore sections, the deliberations and decisions reached by the commission and the installation and documentation of the boundary markers. The concluding remarks offer a brief assessment of the work accomplished[1].

1 OVERVIEW

In the spring of 1991, following the liberation of Kuwait from the occupying forces of Iraq, the United Nations Security Council adopted resolution 687 (1991) to address issues of property restitution, compensation and disarmament. In that resolution, the Security Council also called upon the Secretary-General to assist in the demarcation of the boundary between Iraq and Kuwait and requested the deployment of an observer unit (the United Nations Iraq–Kuwait Observer Mission or UNIKOM) to monitor a demilitarized zone established across the borders between the two countries.

In May 1991, a five-member boundary demarcation commission (the United Nations Iraq–Kuwait Boundary Demarcation Commission or UNIKBDC) was established. It included one representative each from Iraq and Kuwait and three independent experts appointed by the Secretary-General, one of whom served as Chairman. The Chief of the Cartographic Section of the United Nations was selected to serve as the executive secretary. The Commission was to demarcate the boundary between Iraq and Kuwait as set out in the "Agreed Minutes" signed by the Governments of the two countries in Baghdad on 4 October 1963. This agreement reaffirmed the delimitation of the boundary as stated in an exchange of letters in 1932 between the Prime Minister of Iraq and the Ruler of Kuwait.

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1 This narrative is based on the documents of the Commission and the personal notes of the author. See also:

(a) Security Council document S/25811, 21 May 1993, and S/25811/Add.1, 24 May 1993, "Letter dated 21 May 1993 from the Secretary-General addressed to the President of the Security Council." This is the comprehensive report of the Commission, which also includes the geographical coordinates that define the international boundary and a map at the scale of 1:250,000 depicting the demarcated line.

(b) Grant, Donald B. and Olsson, Anders, "Iraq–Kuwait Boundary Demarcation: Technical aspects of an independent international survey project." Proceedings, Commission 5, 20th FIG Congress, 5–12 March 1994, Melbourne, Australia.

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The terms of reference for the Commission were: to determine the boundary in geographical coordinates of latitude and longitude, which would constitute the final demarcation of the international boundary between the States; to physically mark the boundary by the emplacement of boundary pillars and markers; and to provide recommendations for continuing maintenance and locational accuracy of the surface boundary representation. The Commission established its own rules of procedure, under which decisions that were taken by majority vote were final with respect to demarcation. All members participated in the first five sessions, held between 23 May 1991 and 16 April 1992, during which time the Commission took decisions on the land boundary, carried out aerial photography and a survey of the boundary area, set out physical markers and considered the Khawr Az Zubayr – Khawr 'Abd Allāh section. The representative of Iraq did not attend the subsequent six sessions, held between 15 July 1992 and 20 May 1993, during which time the Commission reached decisions on the offshore section. The Government of Iraq was, however, provided with all documents generated or studied by the Commission, as well as the minutes of the meetings.

It is noted that the Commission did not reallocate territory between Kuwait and Iraq, but rather carried out the required technical work to demarcate with precise coordinates the international boundary reaffirmed in the 1963 Agreed Minutes. It deliberated on the interpretation of the delimitation formula, took account of earlier clarifications, examined and considered all available documentation and evidence, discussed relevant demarcation issues and heard statements of position. Work was carried out in closed meetings, by visits to the border area and through field assignments. In conjunction with the establishment of geographic coordinates and the emplacement of boundary pillars and markers, new surveying and mapping of the entire length of the border area was carried out. At its final session in May 1993, the Commission approved and certified the coordinates for the final demarcation of the international boundary and reported on the conclusion of its work. Subsequently, following a special meeting held on 16 and 17 September 1993, the Commission heard a final inspection report and certified all large-scale maps of the boundary and technical documentation comprised of records of survey stations and boundary pillars.

On 27 May 1993, following receipt of the "Final Report on the Demarcation of the International Boundary between the Republic of Iraq and the State of Kuwait by the United Nations Iraq–Kuwait Boundary Demarcation Commission," the Security Council adopted resolution 833 (1993), in which it reaffirmed that the decisions of the Commission were final. It demanded that, in accordance with international law and relevant Security Council resolutions, Iraq and Kuwait respect the inviolability of the international boundary as demarcated by the Commission, and that the right to navigational access be upheld. The Council welcomed the decision to make the necessary arrangements for the maintenance of the physical representation and underlined its decision to guarantee the inviolability of the boundary.

On 16 June 1993, Kuwait stated "*that it will honour and be bound by Security Council resolution 833 (1993) and all the relevant Security Council resolutions*"[2]. On 12 November 1994, Iraq transmitted to the Security Council the "Declaration" of its National Assembly, which affirmed "*Iraq's recognition of the sovereignty, territorial integrity and political independence of Kuwait and of its international boundaries as endorsed by the provisions*

2 Security Council document S/25963, 17 June 1993, "Letter dated 16 June 1993 from the Permanent Representative of Kuwait to the United Nations addressed to the Secretary-General."

of Security Council resolution 833 (1993)"[3]. In a statement issued by the President of the Security Council on 16 November 1994, the Council welcomed the decision of the Iraqi Revolution Command Council and noted that it represented an unequivocal commitment, by full and formal constitutional procedure, "*to respect Kuwait's sovereignty, territorial integrity and borders, as required by Security Council resolutions 687 (1991), 833 (1993) and 949 (1994).*"

2 GEOGRAPHICAL SETTING

The Iraq–Kuwait frontier region lies between 29° and 30°15′ north latitudes and 46°30′ and 48°30′ east longitudes. It is to the west of the northern end of the Persian Gulf, a generally featureless area gently sloping from the west to the east from an average height of 200 meters to sea level.

The frontier is situated within a desert belt characterized by anticyclones. There are no permanent or intermittent lakes or streams, although the wadis in the western part have had flash floods,[4] and humid air masses from the Persian Gulf often settle over the area. The entire western portion of the frontier is defined by the Wādī Al Bāţin, whose upper reaches begin around Hafar Al Bāţin in Saudi Arabia and continue north toward Al Başrah in Iraq. Towards the northern end the wadi flattens out to a broad plain several miles wide. The nearly treeless landscape is covered in patches by low-growing brushwood and, in parts, by grasses.

Along the west-east section of the frontier region the terrain from the Bāţin continues to slope towards the Persian Gulf, dropping only about 60 meters over a distance of 60 kilometers. Towards the west, the southern tip of a large oil pool, which principally lies in Iraq, crosses the frontier. Several oil wells are found on both sides of the border in the Ar Rukţah Al Janūbīah (Iraq) and Ar Ritqah (Kuwait) districts. Continuing eastwards, the most conspicuous feature is Jabal Sanām, located 9 kilometers due west of the village of Şafwān. This small, round, steep-sided hill, less than a kilometer wide, suddenly rises to about 150 meters above the plain. Consequently, it is often used as a reference point in geographical descriptions of this area. There are several wells around Şafwān, and in the Al 'Abdelī district to the south-east in Kuwait, which sustain irrigated farming. The eastern portion of the frontier is characterized by a complex of khawrs, which are channels or inlets of the sea, and several islands of extensive mudflats. Historically these channels have been an important outlet to the sea for Iraq because the Shaţţ Al Arab (River of the Arabs) often silts up, making navigation difficult[5].

During the summer, the sun can be brutal and temperatures often reach above 40° Centigrade. Winters are quite cool, with night-time temperatures dropping below freezing. Most precipitation occurs from December to February, too early for the growing season. The saline mud flats along the coastal regions may be covered with water for extended periods at this time. Convectional air currents are strong and, as in most arid regions, the Iraq–Kuwait frontier area tends to be windy, causing protracted sand storms, which may occur in any season.

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3 Security Council document S/1994/1288, 14 November 1994, "Letter dated 13 November 1994 from the Permanent Representative of Iraq to the United Nations addressed to the President of the Security Council."

4 Unusually heavy rainfall occurred in the early spring of 1994 causing flash floods in the Wādi Al Bāţīn and requiring maintenance to some of the boundary markers constructed in 1993.

5 In 1990, a navigational channel was dredged in the khawrs to an average depth of 13 meters.

Traditionally, the frontier area was very thinly settled as most of the local people followed a nomadic or semi-nomadic life. Principal towns were established at more commercially viable locations the two most important in this area being Şafwān along the ancient route from Kuwait City leading to central Iraq, and the old fort town of Umm Qasr along the shores of Khawr Az Zubayr.

These environmental features and the sparse population contributed to a relatively imprecise boundary definition. The conditions also affected demarcation work in the field, and they were taken into consideration during the staging of surveying and the manufacture of boundary markers.

3 HISTORICAL PERSPECTIVE

Iraq has a well-documented, long and rich history associated with ancient Mesopotamia. In the 16th century, the Ottoman Turks extended their political control over this region, eventually establishing the three Turkish provinces, or vilayets, of Mosul, Baghdad and Basra. Kuwait's history is far more recent. Present-day Kuwait was settled by Arab tribes migrating eastward from the central region of the Arabian Peninsula in the early part of the 18th century. Kuwait was established as a significant transit port for goods from India to Aleppo through an overland caravan route, bypassing Basra.

The Ottoman Turks later came to wield their influence south of Basra, but they exercised only nominal authority over Kuwait. It is to this era, in the 19th century, that the Iraqi claim that Kuwait is one of her provinces can be traced. The process of defining the boundary between Iraq and Kuwait took up almost the entire 20th century. This period, leading up to final demarcation in 1993, can be divided into two parts: (a) events culminating in a written agreement on where the boundary lay; and (b) clarifications and attempts to mark the boundary on the ground.

During the last decades of the Ottoman rule, the turmoil of war, the advent of oil wealth, military coups, political scams, strong-willed tribal leaders and a few Britons formed the lines that defined the boundaries and divided Eastern Arabia. In 1902, as a consequence of political and armed pressures in the region, the Turkish army moved in and occupied the areas around Şafwān, Umm Qasr and Būbiyān Island, hitherto regarded within the jurisdiction of Kuwait. To counter aggression, Great Britain also pursued an increasingly hard line of diplomacy to protect and control her routes to India against threatening Ottoman allegiances. As Britain secured the political agency in the area, the question of the limits of the territory of Kuwait remained unsettled. To resolve this issue, Britain sought an agreement, which resulted in the 1913 Anglo-Ottoman Convention. The Convention, for the first time, set out to delimit the frontiers of Kuwait in more precise terms:

"The demarcation line departs from the coast at the mouth of the Khor-Zoubair estuary towards the north west and passes immediately south of Oumm-Kasr, Safouan and Djebel-Sanam, in a manner as to leave these places and their wells to the vilayets of Basra; arriving at the Batine, it follows it towards the south west up to Hafr-el-Batine which it leaves on the Koueit side; from this point the said line goes to the south east leaving to Koueit the wells of Es-Safa, El-Garaa, El-Haba, Ouabra and Antaa to end up at the sea close to Djebel-Mounifa."

While some changes were subsequently made to the above description of the limits of Kuwait, the 1913 Anglo-Ottoman Convention, in spite of the fact that it was never

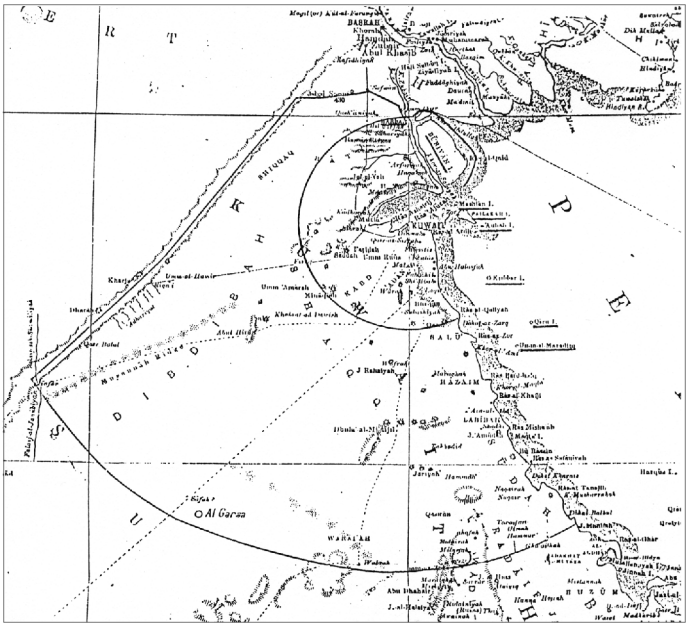

Figure 1: *Detail from the 1913 Anglo-Ottoman map.*

ratified, set the substantive style of the "delimitation formula" for many years, in fact up to the time that the Security Council issued the mandate for the demarcation of the boundary in 1991 (see figure 1).

The First World War and its aftermath brought profound changes to the region. Britain actively fomented Arab nationalist movements against the Turks. Communications became vital, and consequently a telegraph line was erected between Kuwait and Basra, which stood for about thirty years. In later years, on more than one occasion, the telegraph line became an important reference guide for the location of the Iraq–Kuwait boundary; a marked feature in an otherwise featureless terrain.

Under the aegis of the newly formed League of Nations, the former territories of the Ottoman Empire were divided into mandates. Mesopotamia became a British mandate and Kuwait a protectorate. Soon, however, in face of considerable native opposition, Britain began to reduce her administrative responsibilities in Iraq's internal affairs, which eventually led to the end of the British mandate and to a new Treaty of Alliance in 1930. Iraq had a functioning judiciary and parliament, and a monarch who pressed for full independence and admission to the League of Nations. In anticipation of Iraq's application for membership, in mid-July 1932, the British Secretary of State and the High Commissioner of Iraq began planning how best to reaffirm the existing boundary between Iraq and Kuwait in a formal manner. A series of notes were exchanged between the High Commissioner of Iraq (Baghdad), the Political Resident in the Persian Gulf (Bushire), the Political Agent (Kuwait) and the Acting President of the Council of Ministers (Baghdad), which eventually produced the following formal agreement between the Prime Minister of Iraq and the Ruler of Kuwait:

"From the intersection of the Wadi-el-Audja with the Batin and thence northwards along the Batin to a point just south of the latitude of Safwan; thence eastwards passing south of Safwan Wells, Jebel Sanam and Um Qasr, leaving them to Iraq and so on to the junction of the Khor Zobeir with the Khor Abdullah. The islands of Warbah, Bubiyan, Maskan (or Mashjan), Failakah, Auhah, Kubbar, Qaru and Umm-el-Maradin appertain to Koweit".

This effectively sealed the delimitation of the boundary between Iraq and Kuwait. In the years following the formal declaration on the Iraq–Kuwait boundary there were numerous attempts to clarify the nature of the line and to mark it on the ground. Questions lingered and frequent border incidents occurred. A number of meetings were held in which the British Foreign Office was deeply involved. Moreover, it was thought that since the frontier was now well defined in documents and maps, the boundary could be easily demarcated by the use of pillars on land and by the use of beacons and buoys in the water. Nevertheless, altercations, claims and counterclaims continued, prompting the deployment of British troops along the northern and western borders of Kuwait in the summer of 1961. In response to pressure from all sides, including from the Arab League, Iraq and Kuwait signed the "Agreed Minutes" at Baghdad on 4 October 1963, which reaffirmed the delimitation of the boundary as stated in the 1932 "Exchange of Letters." Nevertheless, the boundary remained un-demarcated, perhaps because of the sensitivities such an action would have aroused.

In the ensuing years tensions between Iraq and Kuwait often flared up. The war with Iran in the late 1980s, and the general lowering of oil prices, placed a heavy burden on Iraq's economy to the point where it could no longer meet its financial obligations to Kuwait. Amid such disaccord, Iraq revived its old claim to Kuwait, asserting that it belonged to the Ottoman province of Basra and, hence, was part of Iraq. In August 1990, Iraq invaded Kuwait. The United Nations called the invasion a violation of Kuwait's territorial integrity. In spite of broad condemnation and threat of economic sanctions, Iraq refused to withdraw. Consequently, in January 1991, an international coalition of armed forces was formed which mounted massive military action against Iraq. By the end of February, Kuwait was liberated.

The recognition of the importance of resolving boundary disputes and definitive demarcation of international boundaries was a critical element of the aftermath of this conflict. On 3 April 1991, in an unprecedented action, the United Nations Security Council adopted resolution 687 (1991), in which it stated that it was "*conscious of the need for demarcation" and called upon the Secretary-General "to lend his assistance to make arrangements with Iraq and Kuwait to demarcated the boundary.*"

4 SETTING THE COURSE

Subsequent to the issuance of Security Council resolution 687 (1991), UN Cartographic Section. and the Office of the Legal Counsel became involved in several weeks of intense preparations and consultations on how best to accomplish the work of demarcation. It was decided that the Chief Cartographer of the United Nations, Miklos Pinther, would be selected as the secretary of the eventual Commission, and, in that capacity, tasked with setting up an office and recommending two independent, technical experts as members of the Commission. Following a wide search, William Robertson, Director General/Surveyor General of the Department of Surveying and Land Information of New Zealand, and Ian Brook, founder and Managing Director of Swedsurvey,

Figure 2: *Members of the Commission, from left: Pinther (Secretary), Brook, Al-Qaysi, Kusuma-Atmadja, Robertson, Razzouki. Photo: UN.*

National Land Survey of Sweden, were appointed to the Commission. The then Secretary-General, Javier Pérez de Cuéllar, invited Mochtar Kusuma-Atmadja, former Minister of Justice and former Foreign Minister of Indonesia, to chair the Commission, and Government representatives were also appointed to serve. Kuwait selected its Ambassador to France, Tarek A. Razzouki, and Iraq nominated Riyadh Al-Qaysi, head of the Political Department of the Ministry of Foreign Affairs. On 17 May 1991, the Secretary-General informed the President of the Council that, "the Iraq–Kuwait Boundary Demarcation Commission has been established" (see figure 2).

The first session of the Commission was held on 23 May 1991. Opening remarks were given by the Legal Counsel, Carl-August Fleischhauer, who welcomed the Chairman and the members of the Commission, called attention to its mandate under Security Council resolution 687 (1991), and summarized the Secretary-General's report issued pursuant to that resolution, which gave it its modus operandi[6]. The Chairman then outlined the key aspects of the work that lay ahead. He noted that the mandate was a limited one and emphasized that the Commission could not go beyond it, that is to say that its work was to be focused on the demarcation of a boundary and not on delimitation, which was the sole prerogative of the two sovereign States.

Following statements by Kuwait and Iraq, it was agreed that the mandate of the Commission was technical and not political. An initial trip to the border area was agreed upon, and the technical experts were invited to visit the national mapping offices in Baghdad and Kuwait City. The representatives underlined the role of the survey departments of the independent experts (Sweden and New Zealand) as potential "vital components" of the Commission's work. The independent experts were asked to prepare a plan for the field work, which subsequently became known as Discussion Paper

6 Security Council document S/22558, 2 May 1991, "Report of the Secretary-General regarding paragraph 3 of Security Council resolution 687 (1991)."

No. 1. There was also a call for establishing a standard for the terminology that the Commission could refer to and use. To that end, a synopsis on international boundary concepts and definitions, prepared in advance by the Secretary, was adopted as the first document of the Commission. In addition, the Commission agreed to welcome the participation of experts from both parties to further its work.

A four-day visit to the field, which was undertaken from 15 to 19 June 1991, included calls on the survey offices of both parties and an overflight of the border area. After the aerial reconnaissance, the Commission as a whole met briefly at Umm Qasr, where UNIKOM's headquarters was established,[7] to review the onsite inspection and establish the agenda for the next meeting. Initial observations confirmed that: (a) fieldwork could only be carried out during the period from September to April; (b) the Commission would have to establish a field office at UNIKOM headquarters for logistical and security reasons; (c) given the uncertainty surrounding the availability of surveyors from Iraq and Kuwait, the independent experts would most likely have to form and lead a third party group; (d) different sections of the boundary required different approaches, hence, the examination of the boundary and associated demarcation issues would have to be divided accordingly; and (e) it did not seem feasible to use any of the existing large-scale maps, therefore, the Commission would have to generate its own cartographic material and examine how that could be tied to national surveys. The independent experts were also tasked with drafting a plan, cost estimates and scheduling for the several stages of surveying and demarcation as part of the proposed "discussion paper."

Following the initial field investigation, two substantive sessions were held in July and August 1991 at the United Nations Office at Geneva. At those sessions, as a first step, the Commission considered and approved its rules of procedure. Rule 1 covered the composition of the Commission. Rule 2 provided that the relevant provisions of the report of the Secretary-General (UN document S/22558) would constitute the terms of reference of the Commission. According to those rules, the decisions of the Commission regarding the demarcation of the boundary were final. The rules of procedure further stipulated that the quorum would be met by the presence of at least three members, including the Chairman and at least one representative (rule 3), and that decisions would be taken by majority (rule 5). The Commission carried out its work in closed meetings (rule 4), by visits to the border area and through field work. The Secretary of the Commission was entrusted with making all arrangements connected with the work of the Commission (rule 8). The crucial aspects of the rules were that the Commission could take decisions by majority vote with only one of the representatives present, and that the Chairman was given adequate power of control over the way the Commission conducted its business to meet its terms of reference and to protect its neutrality from pressure or influence either from within or from outside of the United Nations.

The independent experts presented the aforementioned Discussion Paper at these sessions. The paper was divided into two main parts: the first part traced the history of boundary definition issues in substantial detail and presented various documents for the consideration of the Commission; the second part dealt with the technical aspects of surveying and mapping. Proposals included aerial photography, the establishment of ground control using a combination of the Global Positioning System (GPS) and

7 In May 1991, UNIKOM established a demilitarized zone extending 10 kilometers into Iraq and 5 kilometers into Kuwait. On 17 March 2003 UNIKOM's operation was suspended and withdrawn from the area. On 6 October 2003, the Mission's mandate was ended and the demilitarized zone terminated.

Doppler methods combined with conventional survey techniques, the production of orthophoto maps, the construction of boundary markers and the preparation of appropriate documentation of the entire process. The independent experts also made recommendations regarding technical requirements, presented a 16-stage plan of activities and provided a preliminary budget.

Considering the delimitation formula and the physical nature of the boundary, the independent experts suggested that it be reviewed and examined in three separate sections: the Western Section, which essentially follows the course of the Wādī Al Bāţin, the Northern Section, where the location of the boundary depends on the point south of Şafwān and the junction of the Khawrs near Umm Qasr, and the Offshore Section, which includes Khawr Shityānah and Khawr 'Abd Allāh. After extensive debate, the Commission decided to adopt the thalweg as the criteria to be used for demarcating the Western Section, agreeing that the boundary south of Şafwān lies between approximately 900 yards and 1,900 yards south of the old customs post, and further instructed the independent experts to gather additional material necessary to decide on the precise location of the northern boundary. No decisions were taken on the Offshore Section, but it was generally considered that new mapping would be needed to determine the location of the junction of the Khawrs in 1932, the year the delimitation formula was agreed upon.

On 18 August 1991, immediately following the third session of the Commission, the Secretary and the independent experts travelled to the headquarters of the National Land Survey of Sweden at Gävle to hold a two-day technical conference. In attendance were surveyors, photogrammetrists and geodesists from New Zealand, Sweden and Kuwait. The representative of Iraq did not attend. At the meeting, a number of decisions were reached on aerial photography, geodetic control and orthophoto mapping, as well as on the formation of a ten-member joint field team. Within a month, survey plans, specifications and equipment were finalized. Principal members appointed were D. Vincent Belgrave, Project Leader, and Donald B. Grant, Chief Geodesist, both of New Zealand, and Anders Olsson, Geodesist of Sweden.

Given the war-torn conditions in the area and lack of available personnel from the parties, formal requests for assistance were made to and granted by UNIKOM on an at-cost basis. The survey team arrived in the area on 24 September and began work on 2 October 1991.

5 SURVEYING AND MAPPING

As described above, the boundary line comprised of several distinctive features: a natural line following the course of a wadi (thalweg) in the Western Section; a latitude line determined by a point south of Şafwān and a straight line from there to a point on the shore south of Umm Qasr in the Northern Section; and the junction of the Khawrs and the low water line in the Eastern Section. The character of each of these segments required separate consideration for the survey work. In addition, the location of several key points necessitated the study of historical documents, photographs and maps.

The Western and Northern Sections

The basic purpose of the survey work was to provide an accurate network of photo control points for the production of orthophotos for the boundary area and for the cross-sectional profiles along the Wādī Al Bāţin. The resultant orthophoto maps were to assist the Commission in its deliberations. Furthermore, it was important to leave a primary

control network in place, to be used for setting out the boundary markers once a decision on the location of the boundary was reached. As noted above, the Commission decided, for a number of reasons, that the survey network that was to be used in this demarcation exercise should be independent of the existing Iraqi and Kuwaiti networks.

In order to achieve those objectives, the first requirement was to determine a new three-dimensional datum, the Iraq–Kuwait Boundary Datum 1992 (IKBD-92), and a new orthometric height datum, known as the Iraq–Kuwait Height Datum (IKBHD-92), the latter based on the IKBD-92 ellipsoidal heights and the Ohio State University global potential model (OSU-86E). This was accomplished with one existing and three new datum stations. The existing station (NGN-43) is situated on Doha Peninsula near Kuwait City. This station was already provided with offset marks and Doppler coordinates, and while it was distant from the general boundary survey area, it gave good overall geometry for the network. One new datum station (D-12) was established in Kuwait on the south-eastern side of Wādī Al Bāţin, inside UNIKOM observation post S4, and another in Iraq (D-5) on the north-western side, at observation post C5. A third new datum station was set out in Umm Qasr (D-1), just inside Iraq, at UNIKOM headquarters. Each was provided with buried offset marks to allow reinstatement, if necessary.

It was estimated that IKBD-92 was in agreement with World Geodetic System 1984 ellipsoid (WGS-84) to approximately 1 to 2 meters. It was further noted that a difference of this magnitude between IKBD-92 and WGS-84 would have no effect on the boundary demarcation as all survey work related to the boundary was in terms of IKBD-92. The four datum stations were observed over a period of four days using Doppler and GPS equipment. Doppler observations were obtained with JMR-1A receivers and GPS observations with Ashtech LXII receivers. The relative positions from these measurements indicated a horizontal coordinate accuracy better than 0.010 meters + 1 part per million (ppm) of interstation distance. The relative ellipsoidal height accuracy was better than 0.020 meters + 2 ppm of the interstation distance.

In addition to the datum stations, 28 primary control stations were established along the boundary zone, equally divided between Iraq and Kuwait. The ones in Kuwait were existing, first and second order stations. No existing stations in Iraq could be occupied as no information was made available of their locations or coordinates. The primary control stations (as well as the datum stations along the boundary) were situated at approximately 20-kilometer intervals. The relative positions of the primary control stations were determined by GPS observations. Independent computations were run on the computer systems of both the Department of Survey and Land Information (New Zealand) and the National Land Survey of Sweden as a check on results. Horizontal coordinate accuracy was indicated as better than 0.020 meters + 2 ppm and the relative ellipsoidal height accuracy was better than 0.030 meters + 3 ppm of the interstation distance (see figure 3).

For the photo control survey, 137 stations were set out consisting of metal stakes driven into the ground. All points were signalized by creating four arms made up of painted bags filled with sand. Orthophoto and profiling flight plans dictated network geometry. The high-level photo control stations were constructed at approximately 6.25 to 12.5 kilometer intervals along the north-south and east-west lines. For the purpose of profiling, low-level photo control marks were set out in twos or threes at approximately 3.5 kilometer intervals across the Wādī Al Bāţin. Some photo control was also provided east of Umm Qasr and on Warbah and Būbiyān islands to allow rectified photography to be produced for this area. A total of 693 baselines were observed. Data processing for the photo control survey was similar to that for the primary control. The accuracy

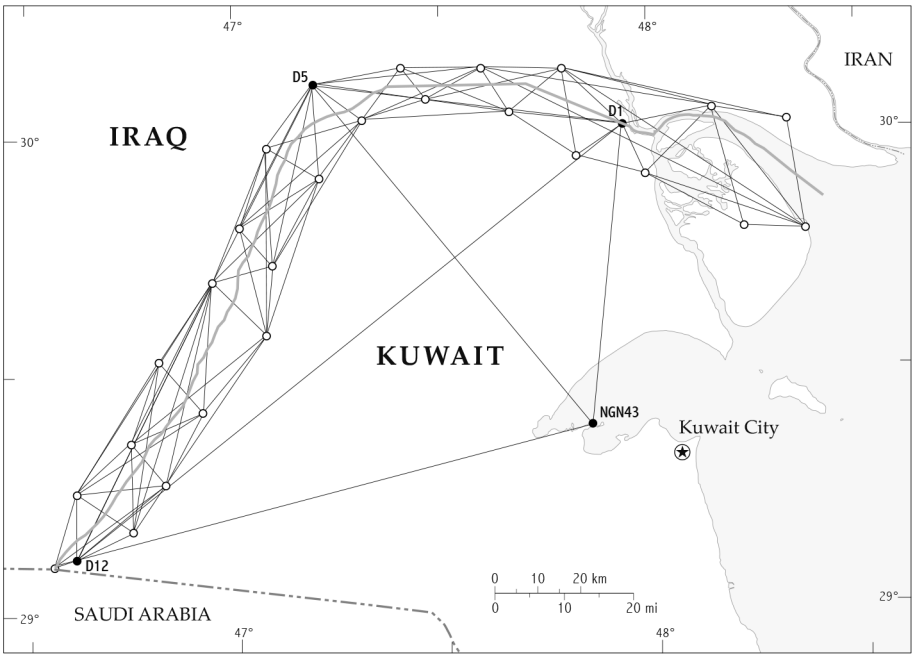

Figure 3: *Primary control network.*

Figure 4: *A GPS survey station.*

requirement for orthophoto control was 0.20 meters for horizontal coordinates and 0.50 meters in height. The requirement for profiling was 0.10 meters relative accuracy between adjacent stations in each point (see figure 4)[8].

Aerial photography was flown using a Rockwell Turbo Commander, model 690A aircraft from Sweden, displaying the United Nations insignia[9]. It was outfitted with a Zeiss Jena LMK 500 FMC camera mounted on an SM 2000 gyro ring mount. The calibrated focal length of the lens was 152.44 mm. The aircraft was equipped with an Ashtec GPS receiver for navigation and steering of exposures at predetermined points.

Photography, using Kodak Panatomic X film, was carried out at two altitudes. For the orthophoto mapping, ten strips along the western boundary and four strips along the Northern Section were flown at 5,500 meters (high-level) producing film negatives at the scale of 1:36,000. For profiling the Wādī, one strip in four segments was flown at 3,000 meters (low-level) producing film negatives at the scale of 1:19,000. The longitudinal and lateral overlap for the high-level photography was 62 per cent and 25 per cent respectively. For the low-level photography the overlaps were 60 per cent and 30 per cent. At a later stage, the towns of Şafwān and Umm Qasr were also photographed at the scale of 1:6,500 for the production of orthophoto maps at the scale of 1:2,500. The developing of films and the production of contact prints and diapositives were done at the National Land Survey of Sweden.

From the aerial photography, 31 orthophoto maps (bromide and ozalid prints) were produced at the scale of 1:25,000, each measuring 67 × 77 cm. The exposure points for the photography were pre-planned so that each sheet could be assembled from four negatives. Aerial triangulation of a total of 203 models was performed using Zeiss and Wild analytical plotters. Digital terrain models (DTM) were created by measuring a 100 × 100 meter grid, equivalent to approximately 15,500 points per sheet. From the DTMs 5-meter contours were plotted. The final halftone sheets were produced with Arabic and English text. The map projection used for the mapping was the Universal Transverse Mercator (UTM) projection, zone 38 extended eastward to cover the entire boundary area.

For the Şafwān and Umm Qasr areas separate orthophoto maps were produced at the scale of 1:7,500: one sheet for Şafwān and three sheets for Umm Qasr.

In order to determine the lowest point line in the Wādī Al Bāţin 1,420 profiles were measured from the low-level photography using Wild analytical plotters. The length of each profile was approximately 3,500 meters spaced at 100-meter intervals. Measurements were made along the profiles at 50-meter intervals. A Department of Survey and Land Information (New Zealand) program package was use to determine the X, Y and Z coordinates of the lowest point on every profile. A digital terrain model with 2-metre contours was generated using the Intergraph system for final viewing the position of the profiles in the terrain. The orthophoto maps for the wadi depicted the profile lines, the lowest points and the 2-meter contour lines[10].

In the Western Section of the boundary, a location that required further examination by the surveyors was the north-eastern part of the wadi where the thalweg would intersect with the latitude of a point south of Şafwān. In this general vicinity the wadi turns eastward and flattens out to such a degree that leveling across the area did not

8 For logistical reasons all control points were set out within the demilitarized zone.
9 The border area was a "no-fly zone," hence it was essential that the aircraft could be clearly identified as in the service of the United Nations.
10 The thalweg line was first proposed by British diplomats in the 1940 and 1951 clarifications of the delimitation formula.

prove useful in finding the lowest point. The surveyors, however, noticed a band of vegetation indicating a shallow channel in the wadi[11]. The low point along the latitude determined by leveling across this band of vegetation was subsequently used as the turning point.

In the Northern Section of the boundary the key location of note was the point south of Şafwān. This was the most frequently cited reference in conventions, agreements and various official and unofficial documents. This was the sole location where the marking of the boundary was attempted on several occasions between 1923 and 1940 by erecting a noticeboard along the old road leading from Kuwait City to Basra. The independent experts analyzed the language of a large volume of documents in order to understand the various references to this point. One of the important locations often cited for setting out the distance to the noticeboard was the old customs post at Şafwān. In order to determine the location of the customs post, several vertical and oblique aerial photographs from 1945 and 1990 were rectified and analyzed. Additionally, from a helicopter, the surveyors took low-level oblique photographs of the south-central portion of the town. This information made it possible to plot the old customs post on a map graphic at the approximate scale of 1:1,000, and the alignment of the old road on the 1:7,500 orthophoto map.

The final point on the Northern Section was the point south of Umm Qasr where the boundary met the western shore of Khawr Az Zubayr. Several historical maps were examined, including a 1936 map[12] with trigonometric location marks, as well as topographic maps from 1990. Significant coincident was found for this point in comparison with the new orthophoto maps.

The Eastern Section

In compliance with the phrasing of the delimitation formula, the Commission had to decide on how to determine the location of the junction of the Khawr Az Zubayr with the Khawr 'Abd Allāh, and how a line, in the direction from Şafwān to Umm Qasr, would reach that junction point. Since a straight-line connection from Umm Qasr to the junction was improbable, the low water line in Khawr Az Zubayr was examined.

In order to determine the low water line, two complete tide gauge systems were installed at the outer end of the middle of three jetties at Umm Qasr. The gauges took hourly recordings of the tide which were registered in a data recorder along with date and time. It was noted that preferably recordings over a period of 19 years were required to determine lowest low-water levels. However, considering the large tidal range at Umm Qasr (in excess of 3 meters) and the component parts that describe the tide generating force, it was deemed possible to arrive with reasonable certainty at the lowest low-water spring tide (LLWST) with the gauges operating for a period of only 7 months. Two bronze survey marks were grouted into the northern end of the jetty and were leveled from the four witness marks of the Umm Qasr boundary pillar. The top of each stilling pipe of the gauges was leveled from these survey marks and the relationship of the pressure sensors to the survey marks was thus established (see figure 5).

At the end of this period, false-color infrared aerial photography was taken of Khawr Az Zubayr based on the tidal prediction. The level of tide at the time of the photogra-

11 Studying the vegetation as a clue to identifying moisture gathering on slopes in the otherwise flat part of the wadi was first proposed by D. Grant. It was attempt to divide the grazing areas more equitably.

12 "Basra-Kuwait," 1:500,000, Map No. 3954. London, War Office, Geographical Section General Staff, 1936.

Figure 5: *Installation of a tide gauge on a pier jutting into Khwar Az Zubayr.*

phy was estimated to be within the 95 per cent confidence interval of the LLWST. The position of LLWST was determined with photogrammetric methods using false-color infrared imagery. In all, 424 points were measured at 15-meter intervals which were then reduced to 28 points so that the generalized straight-line segments did not deviate more than ± 5 meters from the derived line.

To determine the probable 1932 location of the junction of Khawr Az Zubayr and Khawr Shityānah, and to find out whether significant erosion or accretion had occurred since that time, the independent experts gathered and studied all available aerial photographs and nautical charts. Photographs taken in 1951, 1953, 1961 and 1965 were compared with the aerial photography taken by the Commission. In addition, seven nautical charts, produced in 1907, 1926 to 1934, 1939, 1948, 1964, 1971 and 1991, were analyzed and matched up. It was found that, apart from some man-made changes (such as dredging), no significant erosion or accretion had occurred on the banks and mud flats during the 40 years prior to 1991. The result of the study of the nautical charts indicated that while the derived junction points varied, the points could be plotted within a very small radius.

In March of 1992 the Commission was able to report that survey work was essentially completed by the joint team from the national survey offices of New Zealand and Sweden and that new, precise orthophoto maps would be produced within a short time.

Additional large-scale mapping: At a later stage during the monumentation process it became clear that the identification of the boundary line would greatly benefit from larger scale mapping at certain locations. Hence the Commission decided that a series of 1:2,500 scale maps should be produced for a section of the Rumailah–Ratqa oil fields and the settled areas at Şafwān and Umm Qasr. Additional ground control points were set out and several strips of 1:6,500 black and white aerial photography were taken at the same time as Khawr Az Zubayr, Khawr Shityānah and Khawr 'Abd Allāh were photographed. The resultant maps were particularly useful in the process of establishing compensation to Iraqi private citizens whose assets remained on Kuwaiti territory following demarcation.

6 DELIBERATIONS AND DECISIONS

Over a period of nine months, during five sessions of nearly forty meetings, the Commission debated the location of the boundary on the land portion. At the outset a decision was reached whereby the independent experts were tasked to conduct any investigation and to collect any material they considered essential. Furthermore, the representatives of Iraq and Kuwait were requested to provide the independent experts with any and all relevant information. Thus a pattern was established whereby, at each stage of their work, the independent experts conducted exhaustive analyses, presented detailed documentation, gave accounts of progress in the field and made recommendations. At each stage, at each session, the Commission discussed these issues in full.

At its fifth session, in April 1992, the Commission reached the following conclusive decisions on key elements of the boundary based on the components of the delimitation formula.

"From the intersection of the Wadi-el-Audja with the Batin and thence northwards along the Batin…"

The Commission labeled this initial phrase of the delimitation formula as the "Western Section." At the "intersection" of Wādī el Audja and Wādī Al Bāţin the existing pillar of the Iraq–Saudi Arabia boundary was adopted as the starting point, thereby making this location a tri-junction point between Iraq, Kuwait and Saudi Arabia. The Commission further decided that the thalweg of this shallow dry river bed would define the course of the boundary in the Wādī Al Bāţin. For the purposes of demarcating the line on the ground, the Commission decided to emplace boundary pillars at approximately 2-kilometer intervals. Therefore, the actual boundary line is formed by a series of 2-kilometer, straight-line segments along the lowest point line. Since the thalweg is an undulating line which may criss-cross the more rigid, 2-kilometer line segments, the latter were to be situated in such a way that the low areas between them and the thalweg on either side balanced out for the length of the wadi.

"…to a point just south of the latitude of Safwan;…"

The Commission also decided that the location of the boundary just south of Şafwān, the latitude of which determines the terminal point of the boundary running northward in the Bāţin, could be best represented by the earliest and sole demarcation of the boundary, which was a noticeboard. This was erected in 1923 along the old road leading south from Şafwān, and it remained there until 1939. The Commission noted that for years this boundary point was recognized by the local population, by

the British who erected the noticeboard and by both the Iraqi and Kuwaiti authorities. Since no physical evidence had apparently survived, the Commission turned to historical records consisting of notes, letters, various statements, survey records and aerial photographs in order to determine the original position of the noticeboard. In this way the Commission was able to locate the old customs post, in particularly its south-west corner, which was often used as the set-off point for the site of the noticeboard. The Commission was also able to define the approximate alignment of the old road by the use of earlier aerial photographs. The distance from the customs post along the old road to where the noticeboard once stood was not as clear however. After careful study, the Commission decided to take two measurements into consideration: the distance of one mile (1,609), which was most often cited, and the distance of 1,250 meters contained in an Iraqi protest note. Lacking any further evidence, the Commission decided to take a median distance of between 1,250 meters and one mile (1,609 m) south of the old customs post. This distance was determined to be 1,430 meters, which is 180 meters further south of an earlier Iraqi claim and 430 meters south of the northern most Kuwaiti claim.

"…thence eastwards passing south of Safwan wells, Jebel Sanam and Um Qasr leaving them to Iraq…"

The latitude of the point just south of Şafwān, as described above, was determined by the Commission to be 30°06'13"N (to the nearest second). This latitude determines the terminal point for the boundary in the Wādī Al Bāţin and it is the latitude along which the boundary runs eastwards, passing south of Jabal Sanām, south of where the wells were situated in 1932, to the point south of Şafwān determined by the old noticeboard. In comparing this line with the depiction of the boundary on earlier maps, it was noted, for instance, that it is 1,900 meters north of the line on the 1936, 1:500,000 British map and 950 meters north on the more recent, 1:50,000 map circulated in Security Council document S/22412[13].

For the location of the boundary south of Umm Qasr, the Commission looked for evidence of where the old fort once stood and where the position of the junction of Khawr Az Zubayr and Khawr 'Abd Allāh was located. Lack of proper information turned the Commission's attention to the above-mentioned 1936 British map, which does contain an astronomical station near Umm Qasr, observed in 1935, indicating a certain degree of reliability of the map for this area. Furthermore, on that map, the meeting of the boundary with the shore of Khawr Az Zubayr coincides with the boundary drawn for this location on the map circulated in Security Council document S/22412. The Commission therefore decided to adopt that position and determined that the boundary shall run east of Şafwān directly to it by the shortest line, a geodesic.

"…and so on to the junction of the Khor Zobeir with the Khor Abdullah.…"

In order to determine the location of the junction of Khawr Az Zubayr and Khawr 'Abd Allāh the Commission first identified the thalweg of the channels using the most reliable chart produced as close to the year 1932 as possible. A comparison of various charts, maps and aerial photographs from the 1940s and 1950s indicated that little accretion had occurred during the past 60 years, and that hence, the position of the thal-

13 Security Council document S/22412, 28 March 1991, "Letter dated 28 March 1991 from the Permanent Representative of the United Kingdom of Great Britain and Northern Ireland to the United Nations addressed to the Secretary-General." Submission of 10 maps at the scale of 1:50,000 (K7611 Series); used for setting out the parameters of the demilitarized zone monitored by UNIKOM until the Iraq–Kuwait boundary was demarcated.

wegs of the channels would most likely have remained the same had dredging not occurred. Having thus identified the thalwegs, the Commission determined the location of the junction of the Khawrs. Following the delimitation formula by drawing a straight line on the new, precise, orthophoto maps, from the point south of Şafwān passing south of Umm Qasr to the junction of the Khawrs, the Commission found that such a line would have sliced into the southern shore of the Fāw Peninsula, thereby closing off the mouth of Khawr Az Zubayr. Such a line would have denied Iraq access to the port facilities of Umm Qasr and eventual access to the Gulf. An examination of the 1936 map indicates that this was not the case with the way the boundary is shown on it. Further study revealed that this was the result of incompatible topographic and hydrographic survey data, with hydrographic charts of the time being less reliable. Searching for an equitable solution, the Commission turned to one of the earlier clarifications of the delimitation formula and decided that the boundary from the point south of Umm Qasr shall follow the low water line of the southern shore of Khawr Az Zubayr to a point opposite the junction of the Khawrs, and from there along a straight line to that junction. In this way, Iraq was accorded the use of the full width of the channel for unrestricted access to the port at Umm Qasr.

Specifications for the manufacture of the final pillars were also agreed upon. It was further decided that the entire length of the land boundary would be demarcated by pillars emplaced at 2-kilometer intervals. Having taken these decisions, the Commission requested the survey team to construct temporary pillars at Umm Qasr, at Şafwān, and at the northern end of Wādī Al Bāţin. The demarcation of the land boundary was thus effectively finalized.

At this session the Commission also considered the Eastern Section, or the "Off-Shore" Section, which was expressed in the final phrase of the delimitation formula. It received a working paper on this matter from the representative of Kuwait and decided to hold further meetings on the subject.

According to its rules of procedure, the Commission arrived at the decisions by majority vote, a voting process in which the Iraqi representative chose not participate. However, the Chairman, in his concluding remarks, pointed out that, "not participating in the vote could not be construed as not participating in the work of the Commission or not cooperating with the Commission." He then thanked all members of the Commission, their staff and their advisers for their contributions, and added that, "the discussions had been heated, but they should leave no aftertaste; all members had done the jobs given to them."

7 MONUMENTATION OF THE LAND BOUNDARY

Immediately following the fifth session the survey team was mobilized to erect temporary markers at the three primary positions, it being understood that the coordinates provided were temporary and would be adjusted at final emplacement. These markers consisted of 15 cm diameter, 2-meter long metal tubes at Umm Qasr and Şafwān, and a 3.5-meter long tube at the northern end of Wādī Al Bāţin. The tubes were set in concrete and were surrounded with sand filled bags in a cross shape. The pillars and buried witness marks were set out from the established primary control network. These tall, temporary markers, which stood in place through the summer of 1992, were the first physical indications for the local population where the boundary line would eventually run.

For the design of the final boundary marker, the existing Iraqi-Saudi pillar at the tri-junction point, the suggestions of Kuwait and the specific environmental conditions were taken into consideration. UNIKOM's procurement office was tasked with making the necessary arrangements for the manufacture of the markers. On behalf of the Commission, the Commercial Contracting Establishment (CCE, Saudi Arabia) was hired to draft the final specifications, assist in the evaluation of bidders and serve as the Commission's representative for quality assurance of the manufacturing process and the on-site construction. UNIKOM prepared a tender package, which was submitted to eight companies. Following the identification of the two lowest bidders, the United Nations Committee on Contracts approved the award of the work to Eastern Asphalt and Mixed Concrete Company (EAMCO) of Bahrain.

The boundary markers were 3.3-meter tall, pyramidal shaped, steel-reinforced concrete (silica-mica aggregate) pillars, waterproofed, set in concrete/gravel filling and surmounted by square 2.5 meter reinforced concrete collars at ground level. Each pillar stood approximately 1.3 meters above ground. The top measured 45 × 45 cm and the base 90 × 90 cm. A standard surveyor bronze marker with a 5/8 Whitworth thread was embedded on the top. Bronze plates were affixed on two sides with the name of the country and pillar number in Arabic and English. To assist in orienting the line of sight from one boundary pillar to another, so-called "pointers" were also emplaced at a close distance on either side of the monuments. These were 10 cm diameter, 2-meter long, concrete-filled, corrosion resistant, metal pipes set in concrete/gravel fill. To allow re-establishing the pillars in the event of damage, one witness mark on the Kuwaiti side and one on the Iraqi side was buried in the ground at each site. The total weight of each pillar group was approximately 16 tons.

The logistics of the final emplacement of the pillars were complex: 75 truckloads of pillars and their components, heavy construction equipment, and the construction crews with field accommodation had to be moved from the EAMCO construction yards in Bahrain, through Saudi Arabia, to Kuwait. This required applicable transit visas and permits from Saudi Arabia, Kuwait and Iraq. It was also necessary to reinspect the entire border zone for unexploded ordnance[14]. UNIKOM had to undertake additional preparations for security and helicopter service, and the survey teams had to be ready at the installation points. Transporting the heavy loads through soft, sandy terrain also required UNIKOM Army engineers (a Canadian contingent) to assist with large recovery vehicles. It was thus remarkable that, in spite of some delays, a few personal injuries and, with the exception of one incident involving a severed water main at Umm Qasr, the emplacement of the pillars progressed relatively efficiently (see figure 6).

In October 1992, the survey team began preliminary GPS work. In the Wādī Al Bāţin two temporary marks were emplaced at each pillar site. The pillars were set out from these marks and connected to the primary control network. "As-built" coordinates were determined for wadi pillars 2 through 71. In the Northern Section the pillars were surveyed and set out so that the latitude passed across the top of each from the northern end of the wadi to Şafwān, and the geodesic from there to Umm Qasr.

The actual emplacement of the pillars took less than two months. On 14 December 1992, at the eighth session of the Commission, the independent experts were able to declare that monumentation of a total of 106 pillars had been completed ahead of schedule. The independent experts also reported, however, that intervisibility between

14 It was estimated that at least 20 per cent of the air-dropped ordnance (cluster bombs, etc.) did not explode.

Figure 6: *Installation of a pillar complex.*

the pillars spaced approximately two kilometers apart was not possible at certain locations either because of the terrain or because of buildings in populated areas. To resolve that issue, 29 intermediate pillars (and two road markers) were erected at a later stage, consisting of 2-meter high steel tubes set in concrete. Eventually all markers along the entire length of the boundary were painted with black and yellow stripes to increase visibility.

8 DELIBERATION AND DEMARCATION OF THE OFFSHORE SECTION

As the monumentation of the land boundary neared its completion there was a change of chairmanship of the Commission. In November, the Chairman, Mr. Mochtar Kusuma-Atmadja, resigned for personal reasons. The Secretary-General regretfully accepted his resignation, but pointed out with appreciation that, "thanks to the leadership and experience of Mr. Mochtar, the Commission had succeeded in finalizing the work on the land part of the boundary." Subsequently the Secretary-General appointed Mr. Nicolas Valticos, of Greece, a former Assistant Director-General of the International Labour Office, an ad hoc Judge at the International Court of Justice and a Judge at the European Court of Human Rights, as Chairman. Under the chairmanship of Mr. Valticos, the Commission returned its attention to the Khawr 'Abd Allāh section of the boundary.

Deliberations continued methodically since, because of the lack of clear evidence for an agreed boundary line in the Khawr 'Abd Allāh, different opinions were expressed on

how to deduce the meaning of the final phrase of the delimitation formula. Questions were also raised as to whether the statement required demarcation action.

"…The islands of Warbah, Bubiyan, Maskan (or Mashjan), Failakah, Auhah, Kubbar, Qaru and Umm-el-Maradim appertain to Koweit."

Once again the Commission turned to historical documents, particularly clarifications and communications between Iraq and Kuwait in the 1950s. As mentioned earlier, the representative of Kuwait shared with the Commission a lengthy paper in which these were traced in detail. The independent experts also reported on their preliminary study of various charts, especially a 1959 work commissioned by Iraq and prepared by Capt. Coucheron-Aamot, which depicted a median line in the Khawr 'Abd Allāh[15].

Having heard the various arguments, the Commission decided that historical evidence from the "1913 red and green lines" (Anglo-Ottoman Convention) to the 1963 Agreed Minutes indicated that there had been general agreement on delimitation, entitling the Commission to proceed to the demarcation of the Khawr 'Abd Allāh. It was noted that the determination of the line was subject to certain requirements, namely: it must reflect precisely the location according to the States' common interests; it must take into consideration the geographical characteristics of the Khawr and applicable international law and rules followed by both parties; it must be technically irreproachable; and it must meet the complex test of practicality, reasonableness and stability. The Commission further noted that in the past both Iraq and Kuwait had agreed to the principle of equidistance, or a median line. Taking these factors into consideration the Commission decided that the demarcation of the Khawr 'Abd Allāh was to be based on the median-line principle, and further agreed to request the United Nations Office of Legal Affairs to submit a paper on "navigation in the Khawr 'Abd Allāh." The decisions were reached by unanimous agreement[16]. The representative of Iraq did not attend these meetings, but all documents, reports and the minutes of the meetings were submitted to him.

For a historical examination of Khawr Az Zubayr and Khawr 'Abd Allāh, separate, independent research was carried out by hydrographers from the Swedish Maritime Administration and the Royal New Zealand Navy under the supervision of the independent experts. The aim of the study was to identify the thalweg and the median line in the Khawrs from large-scale charts issued by the Port Directorate of Basra, Iraq, in 1939, 1941 and 1948. These charts were digitized and brought to the same scale and projection. From the data generated, terrain models, transverse profiles, contours and low-water lines were derived. Thalweg and median lines were both digitally and manually interpreted and compared with Captain W. Coucheron-Aamot's 1959 study and plotted on the 1991 edition of British Admiralty Chart No. 1235.

Noting the decision of the Commission to apply the median-line principle in the Khawr 'Abd Allāh, and considering the directive of the United Nations Convention on the Law of the Sea in determining baselines for measuring the breadth of territorial seas, the independent experts were requested to undertake new aerial photography and to produce new orthophoto maps for locating the median line. The Swedish aircraft was recalled and newly programmed. During the second week of February 1993, it undertook several flights over both the Khawr Az Zubayr and the Khawr 'Abd Allāh producing five strips of

15 Coucheron-Aamot, W., "Memorandum on Iraqi Territorial Sea and Continental Shelf with Lateral Boundaries and on the Methods Used in Their Construction." Baghdad, 5 December 1959.

16 In response to a few negative comments upon the completion of the demarcation exercise one of the legal advisers associated with the Commission remarked that, "to demarcate the land boundary without guaranteeing to both parties free access to the sea might have appeared, in retrospect, a self-defeating exercise."

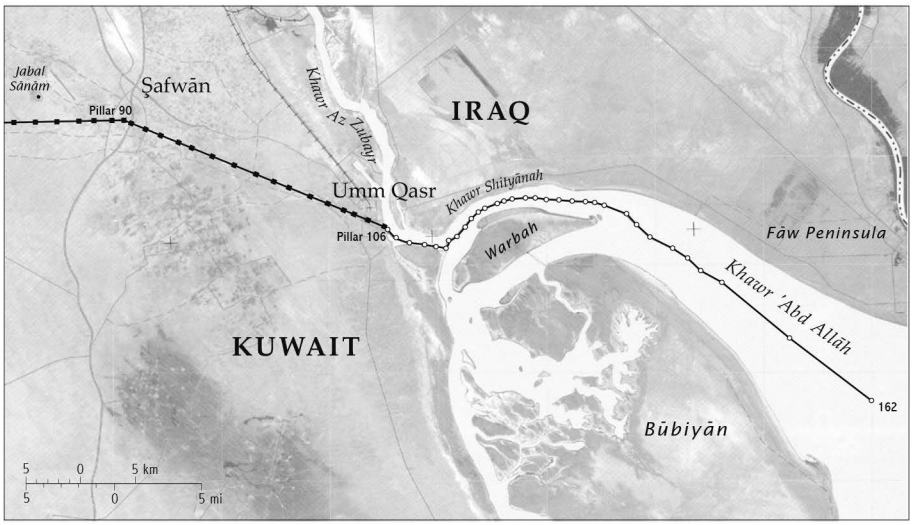

Figure 7: *The demarcated boundary from Safwan eastwards.*

1:25,000-scale false-color infrared photography during low-water springs at an altitude of 3,800 meters, and seven strips of 1:36,000-scale black and white photography at an altitude of 5,400 meters during both low and high tide. The timing of the photography was based on the tide table produced from the recordings of the tidal gauges installed at Umm Qasr. The false-colour infrared photography was used for the precise interpretation of the low-water line, and black and white photography was used for the production of orthophoto maps. In comparing the results of the photogrammetric work with the 1991 British Admiralty Chart No. 1235 (as well as the Coucheron-Aamot chart), close agreement was found between the positions of the low-water line. The Commission therefore decided to use this chart to plot the median line in the Khawr Shityānah and the Khawr 'Abd Allāh, representing the international boundary between Iraq and Kuwait.

For the determination of the median line, 89 base points were identified on the Iraqi side and an equal number on the Kuwaiti side. These were submitted to both parties for consideration and comments. Kuwait accepted the proposed base points; no response was received from Iraq. The base points were plotted on the chart and a generalized median line comprising 27 turning points was produced. The western end of the median line in the Khawr Shityānah was connected to the junction of the Khwars by the shortest line. The eastern terminal point of the line, at the entrance of Khawr 'Abd Allāh from the open sea, was established where there was a significant change in the direction of the coastlines of the two States. No physical marks were emplaced to identify the median line. The straight-line connection from the low-water line in the Khawr Az Zubayr to the junction of the Khwars is identified by two pointer posts emplaced in the muddy shore.

The Commission concluded the demarcation of the Offshore Section by adopting a statement that expressed the importance it placed on the right of navigational access through the Khawrs, and to and from the respective territorial waters, in accordance with the United Nations Convention on the Law of the Sea, which had been ratified by both Iraq and Kuwait (see figure 7).

9 CONCLUSION AND DOCUMENTATION

At its final substantive session the Commission reviewed its work in totality and approved its final comprehensive report. The Commission also adopted the geographical coordinates that constituted the final demarcation of the international boundary between Iraq and Kuwait.

On 20 May 1993, almost exactly two years to the day after it began its work, the Chairman handed to the Secretary-General three copies of the final report and the certified list of geographical coordinates, one to be deposited with the archives of the United Nations and the other two to be communicated to the Governments concerned. The Secretary-General congratulated all members and staff of the Commission for their excellent work and added that it "marked a noteworthy international success; law, technology, diplomacy and security had come together in a unique United Nations endeavour."

On 16 and 17 September 1993, the Commission held a special, technical meeting during which it heard reports by the independent experts on the final verification of the work of the Commission as well as on the preparation of supplementary technical documentation. These documents consisted of (a) a bound, bilingual (English and Arabic) volume of a complete set of records of survey stations of the primary control network; (b) a bound, bilingual volume of a complete set of records of all of the boundary markers for the physical representation of the international boundary; and (c) a boxed set of bilingual maps consisting of one regional map at the scale of 1:250,000, a set of 18 maps covering the entire length of the boundary at the scale of 1:25,000, and a set of 1:2,500 sectional maps: 6 sheets for the oil field area, 26 sheets for the Şafwān area and 9 sheets for the Umm Qasr area. Certified copies of these documents were also deposited with the United Nations and the Governments of Iraq and Kuwait (see figure 8).

At the same meeting, the Commission also expressed the view that in order to preserve the integrity of the boundary, the same high standards employed in its demarcation

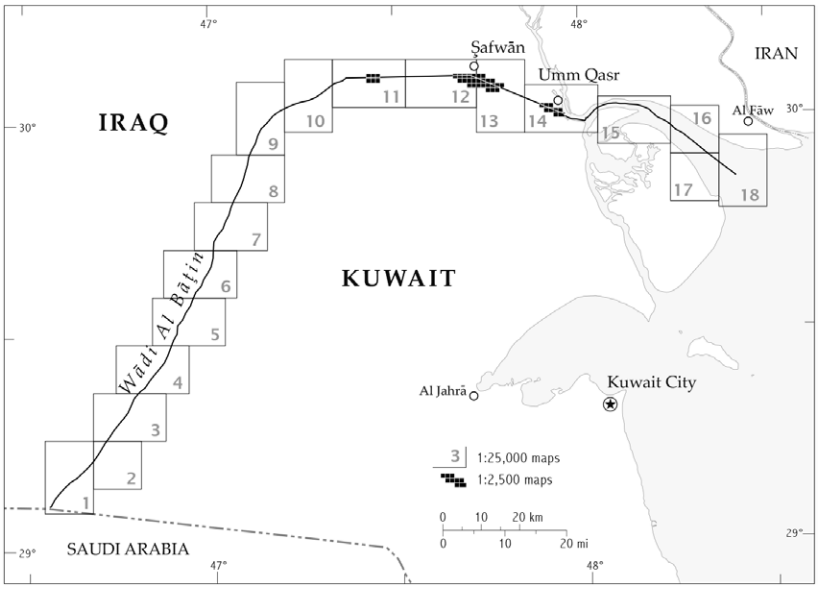

Figure 8: *Sheet layout of maps documenting the boundary.*

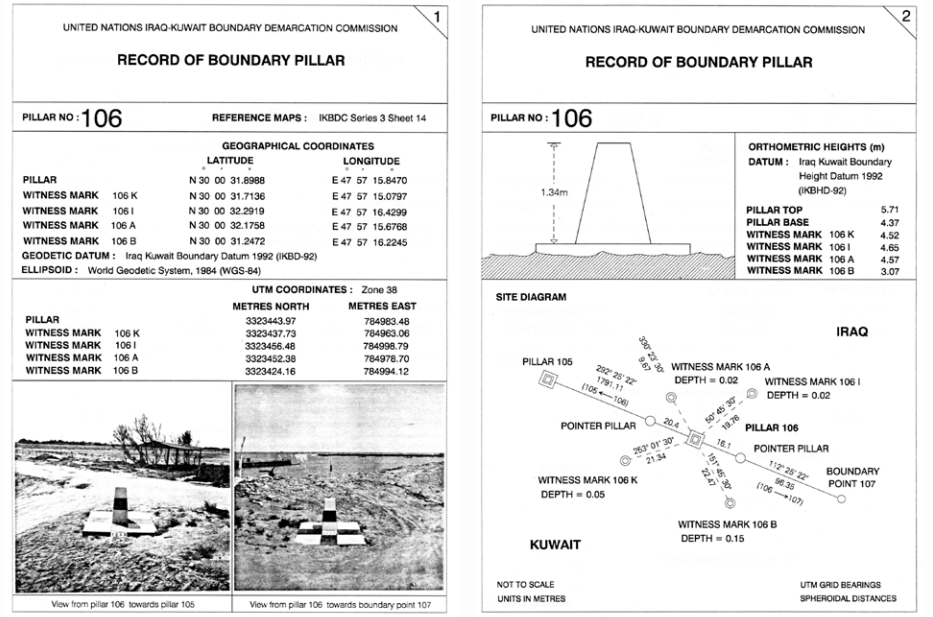

Figure 9: *An example from the "Records of Boundary Markers".*

should be applied to a continuous maintenance program. Furthermore, the Commission stressed the importance of safe-keeping and archiving all essential elements of the records of the Commission consisting of the certified minutes of the meetings, reports, documents, maps and digital survey data.

Recognizing the historic significance of this work, the Commission generated highly detailed documentation of every step of the process: (a) 31 documents of a total of 450 pages with over 130 ancillary maps, lists and tables, and over 1,500 cross sectional profiles of the wadi and khawrs; and (b) eight reports of 240 pages in addition to illustrative diagrams and maps. And finally, the 82 formal and 5 technical meetings of the Commission were covered by a small team of exceptional professional verbatim reporters/précis writers who produced nearly 1,000 pages of minutes to high acclaim (see figure 9).

As stated in the introduction, the United Nations Security Council reaffirmed that the decisions of the Commission were final, and the Governments of Kuwait and Iraq ratified the results as endorsed by the Council

10 OBSERVATIONS

Twenty years ago this was the first international boundary demarcation to utilize the Global Positioning System throughout the entire process. Members of the Commission were eminent experts and distinguished Government representatives. And while the world watched, the surveying and mapping teams set an example by achieving outstanding technical results. The formation of the Commission including both technical and legal experts, and the modality of the procedures it adopted, proved to be an effective approach and perhaps a model for future international boundary demarcation commissions.

Nevertheless, questions remain—however uncomfortable this may be for those who were intimately involved and who believed in the work of the Commission. This is understandable given the political climate at the time, unfortunate military actions and the continued strained circumstances since.

Boundary experts frequently underline the importance of maintenance: for just as delimitation remains ineffective without demarcation, so too demarcation erodes without appropriate maintenance. In its final report, the Commission put forth specific recommendations for establishing a regular maintenance program until other technical arrangements are established between Iraq and Kuwait. The Secretary-General endorsed these recommendations and the Security Council welcomed the decision in its resolution 833 (1993). This matter, however, has never been properly dealt with by the United Nations administration. Monitoring of the boundary has been left up to UNIKOM. But, as a temporary military mission, its priorities lay elsewhere, and it clearly lacked the technical expertise. Policing a boundary is not the same as maintaining it. Unfortunately, this was a missed opportunity of promoting peace in the region at a crucial time. As envisioned by some, the maintenance procedures could have served as technical assistance to both Governments, played a role in conflict resolution and thereby contributed to the preservation of national sovereignty; perhaps it would have put lingering doubts to rest.

A Postscript

In March 2003, UNIKOM was withdrawn. Subsequently, the Cartographic Section was tasked to develop the Iraq–Kuwait Boundary Maintenance Project (IKBMP) in accordance with Security Council resolution 833 (1993). It consisted of three phases: assessment, preparations, and maintenance. In February 2006, an assessment mission was undertaken with the participation of technical teams from Iraq and Kuwait. A few months later, recommendations and preparations were completed and a report was submitted to both Parties. The final phase of field maintenance, however, was postponed several times[17]. In 2003, the Security Council established the United Nations Assistance Mission for Iraq (UNAMI) whose mandate has been updated and expanded several times over the years. In 2012, UNAMI was tasked to support the Department of Political Affairs on the implementation of IKBMP.

ollowing the Arab League Summit in March 2012, a joint request by Iraq and Kuwait was received whereby agreements were reached on several outstanding bilateral issues, including boundary maintenance. The file was reactivated at the UN and was followed by a quick tripartite field assessment in June. The procurement exercise and finalizing of a contract for field work was completed by October 2012. Actual field maintenance took place between January and March 2013. The two Governments also signed an agreement for the establishment of a Joint Border Committee. Subsequently, the UN reported on the completion of its obligations and the Cartographic Section undertook the finalizing of technical inputs with regards to documentation and updated satellite image maps of the newly maintained boundary.

It is hoped that the successful conclusion of the maintenance program not only reaffirms the now 20-year old demarcation process, but also guides the Parties to a normalized relationship along their common frontier.

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17 See reports of the Secretary-General, in particular document S/2009/385, 27 July 2009, section II B and document S/2009/585, 11 November 2009, section II para 21.

CHAPTER 6:
CONTRIBUTIONS OF AND CHALLENGES FOR SURVEYORS IN THE ESTABLISHMENT OF INTERNATIONAL BOUNDARIES – CASES IN AFRICA

William Alexander Robertson, New Zealand

1 INTRODUCTION

The determination of territorial boundaries has accompanied civilization for millennia and has always been very important for the governance of the state. In more recent colonial times the boundaries of colonies were established through many bilateral treaties and agreements on a piecemeal basis. Today this has left a legacy, for many developing countries, of a lack of detailed definition of their international boundaries. Over recent decades increasing attention has been directed to the establishment definition of international land and maritime boundaries. Many new states have been established since World War II. In June 1945, 44 countries signed the United Nations Charter but today there are 193 member countries of the United Nations. Many new countries were established through the ceding of independence to colonies in the post war period. Another wave of new countries was established in the wake of the disintegration of the Soviet Union after the end of the "Cold War". At present there are many international boundaries needing greater definition and clarity on the ground. The United Nations Convention on the Law of the Sea (UNCLOS) has greatly increased the need for definition of maritime boundaries around the world to enable an ever increasing use of maritime resources. Since July 1996 some 162 countries have ratified UNCLOS and this has precipitated a huge amount of maritime boundary determination activity. The potential for disputes over maritime boundaries has been defused greatly through the process and protocols of UNCLOS although several high profile maritime boundary disputes remain unresolved at present.

International boundaries epitomize the ultimate in the demarcation of citizens' administrative, social and legal rights and as such are of prime significance to relevant populations, communities, administrations and governments. They are the acme in the hierarchy of all cadastral, land or administrative boundaries and bound the fullest degree of rights and ownership accruing to citizens and to sovereign states. The importance of well established international boundaries is now well accepted as a stepping stone to national social stability and economic development. Adequately defined and/or demarcated boundaries enable the building and maintenance of peace and enhance and growth of trade and social interaction between sovereign states. In particular boundary demarcation is crucial to effective and efficient border control, tourism and immigration policies, trade and marketing of goods, administration of taxes and customs, agricultural protection and national management of national security etc. Where major resources such as petroleum, minerals or water straddle an international boundary, the demarcation or delineation of that boundary is critical to fully effective collaboration and joint administration of the exploitation and management of that resource to best economic advantage.

International territorial disputes can aggravate difficulties between states over international boundaries and often relate to border areas. Such disputes may arise through ambiguities in, or different interpretations and understanding of historic treaties and agreements, or different settlement and occupation policies escalating over many years through a lack of sufficient boundary agreement, marking or identification.

Where the sovereign states are in agreement and jointly delimit or demarcate their international boundaries cooperatively the role of surveying is apparently a straight forward technical and professional exercise. A big advantage in these cases is that issues of delimitation or further clarification can be, where necessary, referred to the two parties for further interpretation or decision. Nevertheless, the trust vested in the surveyor's expertise and advice requires conduct which will accord with applicable legal and judicial parameters and that will withstand any future local or international scrutiny.

Land surveyors have a widely recognized expertise in the definition, description, delineation and demarcation of a wide range of boundaries of all sorts of land, resource and territorial, allocation, subdivision or classification. They provide a singular expert input into the determination of international land and maritime boundaries. As the priority for international boundary identification and demarcation has become increasingly important, surveyors in many countries around the world have been called on by their governments to assist with this work. Indonesia for example has international land and maritime boundaries with 10 countries and the role of their surveyors has been widely used and has been formally recognized since 1969.

There are major additional challenges in surveying for international boundaries where that process follows on from major disagreements or disputes between the two sovereign states. In these cases a formal judicial process is likely to be invoked at least partially when the two states agree to a process for resolving their dispute. The implementation of the subsequent demarcation of the international boundary requires sensitivity in executing the surveying role in relation to the judicial and political framework which applies in each case. Major security limitations and strictly controlled access to material may present much difficulty. Such restrictions can require the basic method of surveying to be augmented with innovative techniques and technology e.g. the use of satellite imagery, relief models, GPS etc. in non traditional ways. With the continual development of the capability of new spatial technology the inventiveness of surveyors in its application is a valuable tool for progressing otherwise intractable international boundary access and surveying problems.

The three case studies provide examples of three different roles and circumstances of the respective boundary commissions. In the case of Eritrea and Ethiopia the commission had authority to delimit and demarcate, for Nigeria and Cameroon the role was to demarcate only, after an authoritative determination by the International Court of Justice (ICJ) confirmed the delimitation. The role of the Sudan Tribunal was to decide if the earlier commission had exceeded its mandate and only as far as this was found to be so could the Tribunal then delimit the boundary. Each of these cases presented a range of political judicial parameters and surveying challenges and required demanding levels of surveying and cartographic capability advice and support in implementation of the boundary determinations.

2 BACKGROUND

Delimitation is a sovereign and political process but where there is inability to achieve agreement, delimitation of problem boundaries or sections of boundaries may be delegated to a third independent party. Although conflict may not always mark international boundaries which are referred to third parties for arbitration and resolution, major disagreement will normally be a feature of events leading up to such a referral. Where there has been conflict the delimitation or demarcation or both, of the borders, is likely to feature in the ensuing peace agreement with provisions made there for the establishment of a Boundary Commission, its terms of reference and any special limits on these. The resolution of boundary issues may involve reference to the International Court of Justice (ICJ) or to a specially established boundary tribunal or commission or other form of arbitration. Inevitably a specific legal direction will be provided for the boundary determination and this will influence the order and process of the surveying and mapping components.

Delimitation determines in general terms where the boundary is intended to lie although specific detail may not be given in any great degree. This is particularly true if the delimitation is based on historic treaties or agreements. It may employ a general identification traversing topographic features such as rivers, mountain ranges, hills and ridges, relationships to existing markers or cultural features or the allocation of these to a particular territory. Villages or settlements may be referred to and identified as being on one or other side of the boundary. The circumstances of each international boundary situation all have their particular individual features and difficulties. The surveyor will often be faced with a range of challenges, arising both from interpretation of the delimitation or subsequent clarifications, in addition to the implementation of the demarcation. Delimitation is a political and legal process but it incorporates significant technical input and a discreet role for the surveying professional. Where the Treaty was unclear the practice of the parties in question becomes significant evidence as to what they each understood the ambiguous provisions of that agreement to mean in a territorial extent. Issues commonly arise in relation to the division of local settlements or populations, the division of major or strategic resources, or where legal, political or security constraints limit the demarcation process. Technical facts and cartographic material can provide important evidence in the resolution of these issues. In any event, mature professional insight and innovative surveying thinking and applications will remain critical in moving the boundary determination process forwards. Delimitation is an important first step but only becomes fully effective when supported by the demarcation of the boundary.

Demarcation is a secondary phase involving accurate and unequivocal determination of the position of the boundary as previously delimited. Demarcation then allows the international boundary to fulfill its efficient function for citizens and the state. Traditionally it has involved the emplacement of boundary monumentation or employed detailed definitions of defined topographic features such as rivers, mountain ranges and ridges or various combinations of these. However, in some cases specified coordinates have been used as an initial means of accurate and unequivocal definition of boundary points. In the case of the Iraq/Kuwait boundary the legal coordinates were supported by substantial pillars. On the Eritrea/Ethiopia boundary the legal coordinates were used when access to the boundary was prevented. The emplacement of pillars was left to such time as both parties were in agreement for this to be undertaken.

In these cases modern GPS positioning technology and datum were applied to ensure precise coordinate determination of the boundary.

3 INTERNATIONAL BOUNDARY SURVEYING CHALLENGES

The Surveyors Quasi Judicial Role

In the complex environment of delimitation, surveyors work within confined legal parameters in assisting their legal, administrative and political colleagues in determining delimitation issues and resolving related problems. Their evidence relates to agreement on arrangements of binding legal value and commitment for recipient countries. Although the documents relevant to delimitation and demarcation have marked technical content they are not simply a collection of technical cartographic and topographic material. They have legal force reflecting the legality of agreements and commitments of the parties usually over many years.

The quasi-judicial function of the surveyor is a well established concept in cadastral surveying. Kelly uses this term to describe the role of a cadastral surveyor in New Zealand when re-establishing the location of existing ownership boundaries. This arises from the role of the surveyor in comprehending the inexact nature of earlier control and cadastral surveys used in the definition of current cadastral surveys. In certain circumstances it is necessary to recognise inaccuracies and govern a definition by facts which can vary from the exactitude of plan measurements taken on their own. For this reason the cadastral tradition in New Zealand has been that the hierarchy of reliability places the original position of monuments above plan dimensions for cadastral surveys. It is the quasi-judicial role of the professional surveyor to balance the range of physical and documented survey evidence and occupation to establish the boundaries as originally understood by the owner or owners.

In the case of International Boundaries the interpretation of the original meaning and application of technical documents of treaties, agreements and maybe associated legislation can be beset by many ambiguities, doubts and deliberate misinterpretations. Original documentation may be general and vague in terminology, fragmented in relation to the total boundary they relate to and inconclusive in relation to the accuracy, scale and datum of the measurements, sketches or maps attached or referenced in the documentation. The important principle is that the intention of the parties at the time of definition of the boundary and the way it was meant to allocate land and settlements is paramount. No subsequent refinement or increased accuracy of technical measurement should be allowed to redefine allocations of the original understandings and agreements of the sovereign parties. Difficulties that arise through the passage of time and changes in governance following the initial boundary agreements inevitably raise uncertainty in relation to the survey or mapping depictions accompanying these. Nevertheless, these difficulties do not enable a departure from the original allocations of territory and therefore require integrity, objectiveness and perception in the analysis by the surveyor. The surveyor's role is not to depart from the original boundary or its more recently officially confirmed position but to advise on the relevant physical and historic evidence to establish the positions that best reflect the original intention of the parties.

In the case of disputed boundaries the circumstances will inevitably consist of two significantly different views on some parts of the boundary. In formal determinations, considerable evidence will be produced by both parties with contrary interpretations or different emphasis of events and mapping or survey evidence. The starting point for delimitation is the relevant treaties and agreements and meaning of the relevant provisions as understood at the time of agreement.

Thus, intent always remains paramount. For example: where a mountain peak is identified and coordinates given then, the position of the peak today is the critical issue, with the value of the coordinates qualified by whether they are on the peak or positioned elsewhere. In the later case the actual position of the peak takes priority. The intentions with respect to the reality found on the ground are the determinant rather than the coordinates, measurements or variations in naming which indicate an alternative position.

The overarching context is a political and legal one and the surveying role needs to be accomplished in recognition and observance of applicable international law.

Surveyors Technical Role

The surveyor is an important technical advisor in the determination or demarcation of the position of the boundary. He/she may have to exercise responsibilities assigned through servicing the boundary commission, as well as to plan and implement technical and operational surveying and mapping responsibilities. All surveying phases are involved and range from first principles to basic field work. It can involve a complete suite of survey phases, including: provision of geodetic datum, medium and large scale mapping and imagery, field assessment, surveying for placement of pillars, as built survey, final documentation and quality assurance of all surveying and demarcation activity and the accompanying planning, project planning and logistics. The comprehensive education and training of an experienced cadastral/land surveyor provides a sound basis for undertaking technical role required of survey involvement in the determination of international boundaries.

Experience over the years in international boundary determination confirms the strong technical support role required from surveyors. Currently, four major phases of boundary making is recognized by experts in this field. These phases are allocation, delimitation, demarcation and long term administration and management. Surveyors can be involved in all of these phases with their contribution being particularly important for delimitation and critical to the integrity of demarcation. The surveyor's contribution may occur as assistance to a government in the case of two sovereign states determining and demarcating undisputed boundaries. It may, alternatively, involve assistance to a government to provide evidence to a third party. The arbitrating third party will also require its own independent expert survey assistance. In-house surveyors or independent surveying expertise may be contracted by any of the parties involved in international boundary determination for support and advice as required.

At the initial allocation stage survey advice is valuable in providing geographical and surveying references for the interpretation of historic maps and evidence and patterns of administration and the location and extent of areas affected through political negotiations, policies, decisions and agreements. Delimitation and the associated legal process involving treaty interpretation can involve many technical and positioning issues. Surveying expertise may be called on a wide range of technical, survey, mapping

or data bases, issues. This can include identification of boundary and reference points by coordinates or other measurements, watershed and thalweg descriptions, mapping, imagery and data base support for the description or identification of boundary lines and turning points and a wide range of geographical and spatial problem solving.

For Maritime boundaries the establishment of baselines, median lines and the location and extent of the territorial sea the extent of the Exclusive Economic Zone (EEZ) and projections of continental shelf criteria may be required. Critical issues such as the identification of thalweg intersections, rhumb lines and bearings or other directions need careful examination. Frequently older maritime charts lack a reliable horizontal datum. In such cases determining the relationship to modern positioning systems then requires careful searching, re-calculation and/or field survey comparisons to establish a standard relationship between current GPS measurements and relevant maritime charts.

Over recent decades the continuing availability of new technology has been a great assistance to surveyors involved in international boundary determination. The improvements in remote sensing and satellite position systems, as well as in the fields of geodesy, surveying, mapping, imagery, 3D fly visualization, and GIS, provide greatly increased capability, cost effectiveness and time saving. In many boundary projects the mapping coverage of the border areas includes historic maps and subsequent mapping of variable quality and limited in coverage. Satellite imagery provides good opportunities to source preliminary partially controlled mapping coverage quickly. This enables the delimitation and demarcation planning and preparation to be fully supported by fit for purpose mapping and geographic information. The standards of initial geo and ortho rectification are improving steadily and preliminary image maps are able to be sourced readily and economically to meet initial mapping requirements. The compilations of imagery and DEMs into three dimensional relief models of boundary areas, now offer reconnaissance, planning and demarcation preparation material not readily available in the past. Economies of scale can be achieved where mapping and imagery is planned ahead, making full use of existing imagery, to ensure that it is synchronized with survey activity and that topographic demarcation requirements are adequately supported and expedited.

In difficult country the emplacement of boundary pillars of conventional design and structure becomes uneconomical and/or impracticable and alternative approaches are needed. These include the drilling of pillars with provision of strength and durability through high tensile steel and portable drilling and construction equipment. This was a feature of the selected tender for the eastern sector of the Eritrea/Ethiopia International Boundary.

An important strategy is the early establishment of procedures and protocols, for all stages of demarcation, collaboration with the parties and dispute resolution. A proactive approach will avoid fragmented ad-hoc responses after difficulties are encountered. This requires good anticipation by the boundary commission and early establishment of demarcation directions anticipating the range of issues likely to be encountered in the implementation of the demarcation. Establishing processes and procedures and involvement in demarcation of the two state parties' technical experts prior to field work is important. It will facilitate the subsequent resolution of demarcation problems and avoid demarcation difficulties or delays jeopardizing the surveying and/or emplacement of pillars. The roles and limitations applying to the

field representatives of the different parties needs to be strictly defined and accepted prior to field operations.

Demarcation is the visible sign of the location of the boundary on the ground for the government, administrators and citizens of each state. It is important that the demarcation be implemented in terms of the following basic principles. Firstly the demarcation should be clear and unambiguous on the ground marked where possible by pillars or otherwise by legal coordinates, notices and relevant mapping and documentation. Secondly there should be clear records including graphics and photographs to permit ready reference to ground marking, physical detail and records at a later date. Thirdly all parts of the border should be capable of ready identification on the ground at any future date. Fourthly all boundary pillars should be surveyed to such accuracy, that the surveyed position falls on the top of the boundary pillar. Lastly a sufficient density of intervisible boundary pillars should be provided to make the position of the boundary clear, particularly around or through settlements and villages and at road, rail and river crossings.

The Important Role of a Geodetic Datum

The accurate demarcation of boundaries requires the application of standards of accuracy that will enable relocation or reinstatement to the precision agreed and specified. Demarcation must be able to withstand intense scrutiny and be able to be sustained for decades in the future. For these requirements a documented relationship to a sound modern and accepted boundary datum is essential. Although each party to the boundary determination will have their own national datum, these may not be satisfactory for the boundary project. They may have a less than acceptable accuracy to one of the parties, or be derived from dated traditional methodology and not provide the standard geodetic reference frame now expected of international boundaries. In cases of disputed boundaries, the establishment of a new specific boundary datum has the advantage that it is not the datum of either party, and can be seen as an objective basis for coordinate reference for future boundary surveying and mapping activity and border identification, administration and management. A technical flaw or divergent coordinate systems can lead to serious difficulties in the demarcation or at any stage in the duration of the boundary. It is most important to ensure the boundary can be replicated on the ground with no significant error or ambiguity through a robust and recognized geodetic datum and network, tied firmly into an accepted international reference frame.

The accuracy for survey positioning has been rapidly improving over the last two decades since GPS was used to survey the Iraq/Kuwait International Boundary. With this new technology the accuracy/cost ratio has dropped spectacularly over recent years. Modern boundary surveying now reflect these continued changes and the current capability of the improved survey technology. Consequently, specifications for international boundary surveying now need be output oriented and sufficiently flexible to accommodate the continual rate of change in current reference frames, practice, methodology and new technology. GPS now allows a boundary datum to be referenced to control points in other countries thousands of kilometers away, and an international boundary can be related accurately to a civilian global geodetic reference system that is managed openly and for the long term.

The international Earth Rotation Service (IERS) is charged with the responsibility for maintaining long-term consistency in the International Terrestrial Reference System

(ITRS) and its Frames. The ITRS accommodates changes due to earth deformation and the movement of continental tectonic plates. This adjusts against the potential for a slow drift of coordinates over time. International boundaries require long term stability and the ITRS is the system with the administrative strength and certainty to remain a long term framework for boundary definition. This reference system will continue to be for the foreseeable future to accommodate improvements in geodetic technology and changing techniques. Confidence in the ITRS stems from the following recognition by the International Association of Geodesy (IAG) [a member of the International Union of Geodesy and Geophysics]. The IAG provides international best practice for definition and use of reference systems and datum's. Most countries follow IAG resolutions in these matters where practicable. In 1991 the IAG passed Resolution No 1 and Items 1) and 3) of that resolution confirms this recognition.

1) That groups making highly accurate geodetic, geodynamic or oceanographic analysis should either use the ITRS directly or carefully tie their own system to it.

3) That mapping, navigation or digital databases where sub-meter accuracy is not required WGS84 may be used in the place of ITRS.

International Terrestrial Reference Frame 2000 (ITRF 2000) is a recent realization of the ITRS and it has used criteria from 54 global sites for its geodetic analysis. As noted by IAG the datum shifts between WGS 84 and ITRF 2000 are not significant at a mapping scale. However, WGS84 is less suitable for international boundaries. This is mainly due to uncertainty about the detailed relationship of WGS84 to ITRF2000. WGS84 parameters are not publicly available in contrast to the transparency of ITRF. There is no certainty WGS84 will be maintained in the long term (decades and more) for civilian purposes. Thus, ITRF 2000 or its successors are to be strongly preferred as a more accurate and responsive reference frame for connecting geodetic datum for international boundaries to a global reference network.

An international boundary datum can be designed to take the fullest advantage of the precision now available through the ITRS framework and observe the professional guidance implicit in the 1991, IAG Resolution 1 item 1). A valid geodetic datum will be needed in many parts of the world to support the demarcation of an international boundary where reference to the ITRF is not sufficient on its own. GPS measurements have in addition to a constant error a further error component which is proportional to the distance from the base stations. The base stations available for a boundary project can be a considerable distance from the site. Long distances introduce a quantum of error which may not meet the specifications for an international boundary datum. In these cases it is important to establish an independent boundary datum surveyed in terms of ITRF. Such a datum provides an authoritative survey reference frame for all spatial data derived for the boundary project. It will ensure all mapping and survey work can be referenced reliably and consistently in terms of the standards of accuracy specified for the demarcation. For the future it will provide an unequivocal reference for determining the ground accuracy of coordinates for location, further re-definition of the boundary or re-instatement of boundary marks.

4 ERITREA/ETHIOPIA INTERNATIONAL BOUNDARY

4.1 Historical Issues

Background

Ethiopia has had a long history as an independent state. In the past it has been subject to Ottoman and Egyptian authority and was invaded and occupied by Italy from 1935 until 1941. After the defeat of Italian forces there was then a year of British Military Administration before Ethiopia resumed its independence. Eritrea was a part of Ethiopia occupied by Italy after the Suez Canal was built in the mid 1800's and was formally established as an Italian colony in 1890. Eritrea came under British administrative control from 1941 until 1952. From 1952 Eritrea was included as an autonomous province in a Federation of Eritrea and Ethiopia under the sovereignty of the Ethiopian Crown. Shortly after the federation of Eritrea and Ethiopia, local dissatisfaction with the federation began and armed Eritrean resistance developed. This, then, led to a protracted civil war. By the late 1980's the Eritrean Peoples Liberation Front (EPLF) controlled most of Eritrea except the cities of Asmara and Massawa. After a change in Government in Ethiopia, a Conference on Peace and Democracy was held in Addis Abba in 1991 ending over thirty years of civil war. At this conference it was agreed that the people of Eritrea would have a right to determine their future through a referendum. This referendum was held in 1993 and supervised by the United Nations and international observers. A vast majority of the voters chose independence. Eritrea became an independent nation in 1993. In that year the Governments of Ethiopia and Eritrea made an Agreement of Friendship and Co-operation. After the Algiers Peace Agreement to settle the 30 years war of independence, a 30 km wide demilitarized zone was established along the border, separating the armed forces of both countries and monitored by the United Nations Mission to Eritrea and Ethiopia (UNMEE). The area along the border remained badly affected by the war with deserted and damaged villages and many displaced people and refugees, damaged buildings and property.

Establishment of the Boundary Commission

The Eritrea/Ethiopia Boundary Commission (EEBC) was established by the 1993 Algiers Peace "Agreement between the Government of the State of Eritrea and the Government of the Federal Democratic Republic of Ethiopia" dated 12 December 2000 in Algiers. Article 4 of the December Agreement provided:

"*The Parties agree that a neutral Boundary Commission composed of five members shall be established with a mandate to delimit and demarcate the colonial treaty border based on pertinent colonial treaties (1900, 1902 & 1908) and applicable international law. The Commission shall not have the power to make decisions ex aequo et bono.*"

The Terms of Reference (TOR) for the Boundary Commission prohibit the making of decisions ex aequo et bono i.e. the power to dispense with the law and consider what is thought fair and reasonable. This condition is consistent with standard practice and strictly limits the Boundary Commission from any departure from its legal mandate. The implications of this prohibition are that all decisions made in regard to human geography must be in terms of the Treaty's or applicable international law, otherwise there is no discretion to accommodate this factor. The EEBC found it necessary to remind the Parties of

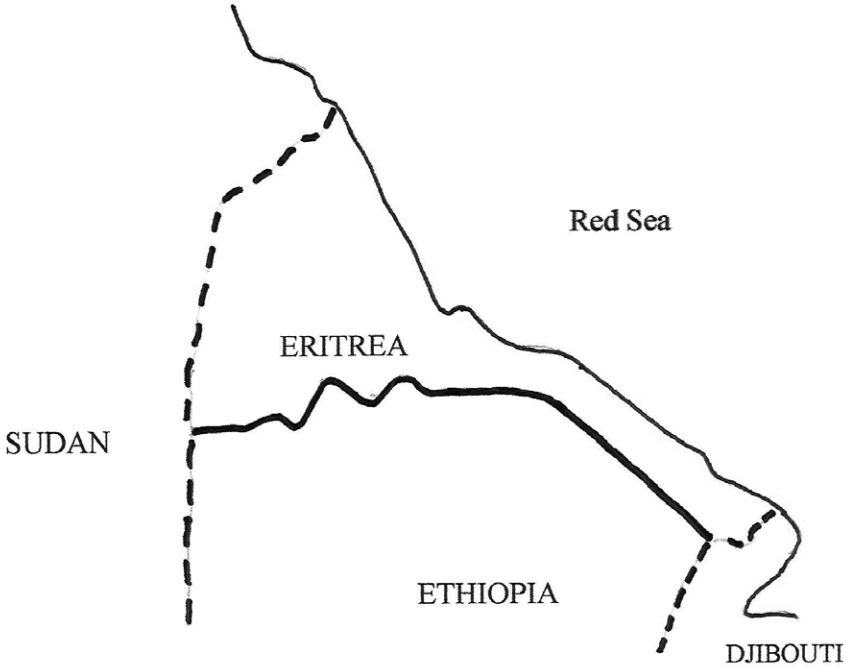

Figure 1: *Eritrea–Ethiopia boundary.*

this during its consideration of later submissions by the Parties, in regard to the strict limits this provision placed on EEBC's ability to adjust the boundary line after its delimitation decision. The Boundary commission was composed of Professor Sir Elihu Lauterpacht CBE, QC, President, Prince Bola Adesumbo Ajibola, SAN, KBE, CFR, Professor W. Michael Reisman, Judge Stephen M. Schwebel and Sir Arthur Watts, KCMG, QC.

The EEBC in considering the meaning of "applicable international law" in its TOR, concluded that this term was wider than just the law related to the interpretation of Treaty's. It interpreted this term to require it to apply those rules of international law applicable generally to the determination of disputed borders, including in particular the rules relating to the effect of the conduct of the parties. This was considered to cover maps, activity on the ground showing the exercise of authority (effectivites) and a range of diplomatic exchanges constituting, assertion of sovereignty, acquiescence of, or in opposition to such assertions.

4.2 Geography of the International Boundary

Physical

The international boundary extends for approximately 1,200 km from Sudan to Djibouti. It consisted of three major sections initially recognized in the three colonial treaties of 1900, 1902 and 1908. Each of these sections, i.e. western, central and eastern, reflect markedly different geography. The western section, from a junction of two rivers on the Sudan boundary, runs eastwards along the Setit River to a junction with a tributary.

The boundary then crosses the Badme plains to a point on the Mareb River. The central sector boundary continues up the Mareb River to follow another river, the Belesa, flowing from the east. It then runs overland into the plateaus of the highlands and across the headwaters past the city of Zalambessa to the Muna River and on, down the Regali River to the salt lake. The eastern sector runs direct from the salt lake to the coastal mountains and traverses the coastal range to the east of the Danakil Depression, at a distance 60 km parallel to the coastline, to the eastern end tri-point between Ethiopia, Eritrea and Djibouti on Mount Moussali. The Danakil Depression is an extension of the Great African Rift Valley linking it to the Red Sea. It is distinctive geographic and historic feature in the region and presents hot arid desert conditions.

Human Settlement

The main settlement issues related to the three cities/towns of Tserona, Zalambessa and Bure and environs and the relationship of the international boundary to the town of Badme. As well as this, there are three villages that have the boundary running through them. The boundary around the two cities/towns of Zalambessa and Tserona was delimited as running at a distance of 1 km around the outskirts of the urban area. The boundary at Bure was delimited to run through the old customs post. The allocation of the town of Badme depended on the location of the straight-line boundary across the Badme plains, and was located on the Eritrean side of the boundary as a result of the delimitation decision.

4.3 General Features of the Delimitation

The treaties establishing this boundary date back to agreements between the Italian administration of Eritrea and the Emperor of Ethiopia in the early twentieth century. In 1900, 1902 and 1908 Ethiopia and Italy made three boundary agreements addressing the three sections of the boundary between the Colony of Eritrea and the Empire of Ethiopia. None of the boundaries were demarcated and in places not fully delimitated. The 1900 Treaty related to the western sector but was further amended by the 1902 Treaty. The 1900 Treaty also provided delimitation along the central sector. The eastern sector was delimited in the 1908 Treaty. The delimitation formulae were in general terms with references to some of the boundary being shown on a map attached to one of the Treaties. The EEBC observed that pre-treaty materials could be used to assist in determining the intention of the Parties in regard to specific treaty provisions. The 1908 treaty made it clear that subsequent activities should not be taken into account. However on the Badme plains, because of the difficulty locating the boundary on the ground, 1935 was used by the EEBC as the limit to looking at each country's governance practice. This decision was taken because the treaty was judged inconclusive in indicating the position of this part of the boundary.

The TOR required the EEBC to delimit and demarcate the boundary based on the pertinent treaties. However, the rider that they do this based on applicable international law added a very significant additional dimension. The deliberations of the EEBC in regard to this requirement provide valuable insight and learning as to how surveying, mapping and occupation material was judged relevant to applicable international law. The EEBC noted the precedence set by the International Court of Justice (ICJ), who decided this wording did not limit consideration only to the effect on the international law applicable to the interpretation of treaties. The EEBC agreed with

this and considered it was required to apply the rules of applicable international law more generally and in particular the rules relating to the effect of the conduct of the parties. This meant they would examine the significance of subsequent practice or conduct developed in the evidence of the Parties and consider if these were sufficient to vary the treaty provisions. The EEBC noted that the degree of the conduct sufficient to produce a change in the Treaty depended on the circumstances assessed by the Tribunal in each case. This could relate to conduct by one party at odds with a Treaty provision, which is accepted or not rejected by the other Party, where this could reasonably be expected if it disagreed with the treaty provisions. That is any act by one Party which is at variance with a treaty provision which is known by the other Party and not opposed by it. Similarly such conduct also sets a precedent for the first Party which cannot then act inconsistent with this. An example of this directly relevant to surveying occurred in the Taba arbitration between Egypt and Israel. In this case there was a dispute over the location of the final pillar. The agreement provided that the pillars should be intervisible. Although the position of the final pillar was not visible from the previous pillar the fact that the position of the final pillar had been recognized and accepted by both Parties overrode the intervisibility criteria in the agreement. In that judgement, the tribunal noted that boundary markers, long accepted by both Parties, should be respected, and not open to challenge indefinitely on the basis of error. This guidance emphasizes the traditional hierarchy of accepting the position of original monumentation as being superior to measurement or description. Nevertheless, a treaty wording is determinative subject to compelling evidence to the contrary. Such evidence would be the proof that the conduct of the Parties directly involved has agreed with a modification.

The EEBC noted that in this case the conduct of parties fell into three broad categories, namely maps, evidence of effectivites (the exercise of sovereign authority (some form of governance) on the ground) and a range of diplomatic and other similar exchanges and records. Their rulings on these three categories follow.

Maps

Although maps provide clarity of information on the position of boundary lines the application of this information to delimitation needs to be in terms of a range of legal precedent related to what constitutes evidence of sovereignty. International tribunals have consistently viewed simple interpretations of maps with caution. Maps may not be accurate or objective representations of ground truth. This is particularly so with older maps surveyed, compiled or collated when topography and cultural knowledge of the coverage was sparse and early surveying techniques were of lower orders of accuracy, consistency and coverage. Boundary information on maps may also be ill sourced subjective or self serving. However, maps provide important information from the past but should be used in terms of the relevant practical and legal qualifications. For example: in the case of the 1900 Treaty a map of the boundary was annexed to the Treaty and, although referred to as a sketch, was a copy of a map in use at the time of the Treaty. The EEBC states:

"*where a map is made part of a treaty then it shares the legal quality of the treaty and is binding on the parties. This is the case with the map annexed to the 1900 Treaty……. It needs to be scrutinised with the greatest care, since detail it contains can greatly assist in giving specific meaning to an other wise insufficiently detailed verbal description.*"

The EEBC notes further:

"*The effect of a map that is not part of a treaty will vary according to its provenance, its scale and cartographic quality, its consistency with other maps, the use of it made by the parties, the degree of publicity accorded to it and the extent to which, if at all, it was adopted or acquiesced in by the parties adversely affected by it, or the extent to which it is contrary to the interests of the party that affected by it, or the extent to which it is contrary to the interests of the party that produced it. A map that is known to have been used in negotiation may have a special importance. A map that emanates from third parties (albeit depending on the circumstances), or is on so small a scale that its import becomes a matter for speculation rather than precise observation, is unlikely to have great legal or evidentiary value.*"

Widely available maps produced by official government agencies of one party which have either been acquiesced to, or objected to by the other party, will have significant legal import if they clearly bear on the territorial interests of the other party. The ICJ has found that it is the maps in association with other circumstances which produce the legally significance evidence. The EEBC accepted with caution that the signature, shape, silhouette or outline at a different, usually smaller, scale of a boundary, can indicate or confirm the general position and location of the boundary. They concluded that if the general shape is sufficiently clear and specific on a range of maps, particularly those of each party, the signature will be of legal significance. They considered that a lesser standard is required to confirm a boundary already established in other ways, as compared to the use of a signature to establish a boundary. The EEBC observed that where disclaimers are made on maps, particularly in relation to the standing of boundaries depicted, this does not automatically deprive the map of all evidential value. The disclaimer does not completely neutralize the authority of state who published the map. A disclaimer is seen merely as an indication that the body making the map is not to be treated as having an accorded legal authority in relation to the boundaries marked thereon. They also noted that the State adversely affected by such a map is not absolved from recording its objections.

Thus, careful historic detective work on the probity and effect of maps is essential but always in the context of the legal framework applicable. Early sketch maps are helpful and may be followed so long as they are not shown to be so at variance with modern knowledge to render them valueless as an indication of what the Parties intended at the time on the ground.

Effectivites

Over the years occupation and administration may have developed within and across the boundary. The memorials, counter-memorials and responses of both Parties presented the EEBC with a wide range of documentary evidence. Much of this evidence was map and geographically based and interpreted the position of the boundary in markedly different locations. The EEBC noted that administrative or judicial assertions of authority over disputed areas can assert sovereignty and will have greater or lesser strength depending on how the other party has reacted to this. "*there is no set standard of duration and intensity of such activity. Its effect depends on the nature of the terrain and the extent of its population, the period during which is has been carried on and the extent of any contradictory conduct (including protests) of the opposing State. It is important to bear in mind that conduct does not of itself produce an absolute indefeasible title but only a title relative to that of the competing State.*"

In considering conduct as a basis for effectivites firm evidence may be scant as often the claims of Parties are poorly supported because of doubt over the actual location and extent of the area claimed and the differences in the names in documentation and those on the old maps. Activities relevant to substantiating effectivites include the provision of telephone and telegraph activities, holding of elections, the stationing of military and police posts and the conduct of associated patrols, regulation of land use, provincial administration, education, health, maintenance of local records, e.g. birth, deaths and marriages, payment of taxes, structure of local administration and regulation of religious and social institutions etc.

Diplomatic and Other Exchanges

A matter covered in this category by the EEBC is recognition of the principle of respect for borders as existing at the independence stated in a resolution adopted by the Organisation of African Unity Summit in Cairo in 1964. They noted:

"*The Parties committed themselves to these principles in the Agreement on Cessation of Hostilities concluded between them on 18 June 2000 and reaffirmed their respect for the principle of respect for the borders existing at independence appears in Article 4, paragraph 1, of the December 2000 Agreement.*"

The EEBC interpreted this as setting the date of the independence of Eritrea, April 1993, after which developments are not to be taken into account save in so far as they can be seen as a continuance of the line of conduct already decided or take the form of express agreements between them.

4.4 Delimitation Issues Related to the Eritrea/Ethiopia Boundary

The EEBC was faced with a huge amount of material and some confusion of the current location of the geographical features and positions referred to in the original Treaties. The river names used at the beginning of the century in the Treaties were subsequently changed or related to only a part of the river with alternative names for other parts of the same river. There had been much population growth in the border region over the last century with the historic settlement pattern badly impacted by the 30 years of civil war.

Both Parties had the initial opportunity to provide three consecutive tranches of material in submissions, counter submissions and responses and this provided much diverse and contradictory information for examination and analysis. The location of a tributary and adjacent mountain that provided for a turning point for a line across the Badme plains was interpreted very differently (many kilometers) by each Party. The boundary here also related to the inclusion of a local tribe the extent of whose territory was very difficult to determine a century later. In two cases cities belonging to each Party had to be circumscribed to ensure they were included with their environs on the correct side of the boundary. Establishing an equitable boundary around these two cities was a testing exercise in surveying and collaboration with the Parties.

Of particular interest is the ruling of the EEBC that the dipositif is operative and binding and prevails if there is any discrepancy between it and the body of the tribunal award. This significant ruling was made in response to a difference subsequently identified in the 2002 Delimitation Decision.

4.5 Demarcation

The task of the EEBC of both delimiting and demarcating the boundary had advantages and disadvantages. A major advantage being that the demarcation could proceed on the basis of the considerable knowledge gained in the delimitation phase and at speed up the demarcation process. However, a major disadvantage was that after the delimitation decision the EEBC was tasked with implementing the pillaring of the boundary points with the attendant difficulties of getting access to the boundary in a politically difficult situation. This put them in the position of having potentially unfinished business over the long term.

After making the delimitation decision and prior to field operations the EEBC prepared, detailed rules and procedures for the demarcation field work were determined through the production of detailed Demarcation Directions. For the two cities of Tserona and Zelambessa the demarcation was determined in collaboration with the views of both parties with an equitable balance being achieved in the treatment of both cities. Some difficulty arose in the implementation of the delimitation around the city of Zelambessa where parts of settlements would have been cut off from their only infrastructure. For these settlements no possibility of servicing from the other state was feasible because of major barriers of the terrain. In this circumstance the principle of manifest impractibility was applied to ensure that because of the position of the boundary no community was totally isolated. Along the eastern boundary the demarcation of 60 km of the boundary, parallel to the shoreline, was right lined in conformity with the delimitation. The selection of the boundary positions was such that the additions or subtractions from the territory of one Party were equivalent in total to that of the other party.

Technical Challenges

These included the definition of moving river boundaries which were delimited as the lowest point of the streams of greatest flow and the intersection of these with straight line boundaries. This delimitation formula for the river boundaries provided for continuing access of people on both sides of the border to the water in the river irrespective of whether the river was at full, at low flow or pooled in the dry season. Minefields were present along a large section of the boundary and required carefully programmed support from UNMEE Mine Action experts to ensure security for survey and reconnaissance activity. A major issue that developed was the lack of field access for the EEBC to the boundary for pillar emplacement. This required the use of the new computer technology including the application 3D relief imagery to provide an initial demarcation based on coordinates. The 3D imagery and the appropriate software facilities were provided by Terralink International Limited (TIL) Wellington New Zealand. The identification of the boundary positions were then undertaken on the 3D imagery together with supporting applications for intervisibility, measuring viewing and areal capability. The accuracy of the coordinates was initially estimated to an accuracy of plus or minus 15 m from the imagery. The coordinate positions were then determined judicially to plus or minus 1 m as the final legal boundary.

4.6 Operations

Logistics and Support

The EEBC registry was at the Permanent Court of Arbitration based in the Peace Palace in The Hague. Field offices were established in Eritrea and Ethiopia co-located with the UNMEE. UNMEE provided helicopter support for access of staff, equipment and materials to all boundary sites. UNMEE Mine Action provided mine clearing services for survey sites in mined areas and were authorized to provide this service for all boundary points when the pillars were to be emplaced. Direct demarcation advice and support for the EEBC was provided through the appointment under the Algiers Peace Agreement of the Head of the UN Cartographic Section in New York Hiroshi Murikami who served the EEBC as Secretary from its inception. An Assistant Secretary, Alice Chow, was appointed to assist the EEBC Secretary, also from the UN Cartographic Section. On the retirement of Mr Murikami from that position in 2005 he was replaced by Kyoung-Soo Eom the new Head of the UN Cartographic Section. The EEBC then appointed Vincent Belgrave as Chief Surveyor in 2001 with William Robertson appointed as Special Consultant in 2002. Garth Falloon was installed as Assistant Chief Surveyor in the field office in Adigrat in 2002. EEBC administrative and support staff were also provided in the Asmara, Addis Abba and Adigrat offices.

Eritrea/Ethiopia Boundary Datum (EEBD2002)

To provide an authoritative and independent geodetic reference network the EEBC established its own datum. EEBD2002 provides a modern geodetic reference for all demarcation and future boundary reference purposes. This datum was emplaced and measured by the EEBC Chief Surveyor and staff. It consists of 6 primary datum stations approximately 150 kilometers apart and ten secondary datum stations approximately 50 kilometers apart. All measurements were made in terms of EEBC approved geodetic specifications for this work. On completion of field survey and data processing the observations and data was sent to independent quality geodetic control experts[18] who were contracted to apply a rigorous quality assurance process to this work. The quality assurance assessment examined all potential sources of error, including instrument errors, systematic errors, field recording errors, transcription or data copying errors, data processing errors, software errors, errors in analyses of results and publishing errors.

A series of checks were applied to either detect or eliminate these errors. The quality assurance report (Independent Quality Assurance Report: Geodetic Data Processing: Eritrea/Ethiopia Boundary Commission) advised that all of the geodetic observations and processing had been undertaken to the standards prescribed in the specifications and fully satisfied these. The establishment of EEBD2002 was fully in accord with IAG resolution 1991, 1 and followed international geodetic best practice. This has enabled the unambiguous determination of coordinates for all boundary points. They can be reproduced in the future exactly to this position on the ground to a high level of confidence.

Mapping

The Eritrea/Ethiopia Boundary Commission was able to source medium scale satellite imagery (1:50,000) of the border for reference during its deliberations on its delimitation de-

18 Dr D Grant MNZIS, Dr M Pearce MNZIS.

cision and report. Aerial photography was contracted to Swedesurvey to provide higher quality imagery along the length of the boundary. This imagery was used to provide imagery to support the demarcation activity and for the depiction of the boundary on the final 1:50,000 maps. Where the boundary passed close to towns or villages, enlargements of the aerial photographs provided greater detail. Other related activity included imagery and ground control surveys and initial identification of pillar sites.

This imagery was also used for relief models to identify and fix the boundary positions once access to the boundary in the field was stopped. This work enabled the final coordination of all proposed boundary pillar positions.

Specifications

Detailed specifications were prepared and approved for the datum survey, mapping ground control survey, pillar construction and as built survey and quality assurance of these. For the pillar emplacement along the eastern sector of the boundary specifications and tender documents were produced and advertised by the United Nations. To ensure potential contractors were fully briefed a contractors site visit to the boundary with field briefing sessions was arranged prior to the submission of tenders with the support of UNMEE. Although a preferred contractor was selected by the UN circumstances did not permit the implementation of this contract. Currently, the eastern, central and western sectors remain without boundary pillars emplaced.

4.7 Documentation

In preparing for demarcation and settling related issues the EEBC produced many reports and papers including an initial project plan, schedule of activity ahead, demarcation directions, observations etc. The demarcation outputs included; preliminary image maps at a scale of 1:50,000, survey reports and data for the datum survey, the field survey of Ground Control Points (GCPs) and an independent quality assurance report of the geodetic survey and data processing of the datum. The final record of the boundary consisted of: 1:50,000 maps showing all boundary positions, a single map of the boundary at a scale of 1:1,000,000 showing the boundary line and pillar positions and coordinates, a register recording each boundary point and listing geographic and UTM coordinates for all boundary points and a description for the complete course of the boundary line by line.

4.8 Observations

This boundary determination was fully authorized by both Parties through the Algiers Peace Agreement but its background from the long war for the independence of Eritrea left a sensitive and complicated situation for the delimitation and demarcation. As the UNMEE Headquarters was in Asmara, the capital of Eritrea initial, EEBC office was based there. To ensure an equivalence of involvement and communication with both Parties the EEBC also established an administration office in Ethiopia in Addis Ababa and a field office in Adigrat. Initially it was agreed that the Parties would not be involved in the demarcation in the field. This lack of involvement built up some issues about the work method and the lack of knowledge about field activity of the Parties. This was resolved by the appointment of two Field Liaison Officers by each Party who were assigned to field parties with observer only responsibilities.

A program of regular briefing visits to each Party by the Special Consultant was instituted so that both Ethiopia and Eritrea were kept up to date with overall progress of field operations and current demarcation issues. This contact was also valuable in developing understanding and the quicker resolution of field and operational problems as they occurred. Although both Parties fully accepted the EEBC delimitation it became evident that the expectations of one Party for adaptation of the boundary at the demarcation stage exceeded what was legally possible in demarcating the delimitation. Adjustments of such materiality could not be authorized during the demarcation process. The eventual result was no further access to the boundary by the EEBC for boundary field assessment and the emplacement and survey of boundary pillars. For this reason the innovative fixing of the boundary by legal coordinates was undertaken. This enabled completion of the demarcation by fixing the boundary coordinates for all boundary positions and mapping and recording these as the positions of this international boundary. This approach to defining the boundary has removed all technical ambiguity about the exact position of the boundary. In January 2008, Eritrea accepted the demarcation of the boundary by the EEBC but Ethiopia rejected it as invalid because there were no pillars placed.

5 CAMEROON–NIGERIA INTERNATIONAL BOUNDARY

5.1 Historic Issues

Background

Agreements on this boundary go back to the Anglo and German colonial administration pre World War I. Cameroon was established as a German colony in 1884. After World War I Cameroon was divided between Britain and France. In 1946 both French and British Cameroon's were made UN Trust Territories. In 1960 French Cameroon became the independent Republic of Cameroon. In 1961 the northern part of British Cameroon merged with Nigeria and the southern part joined with the Republic of Cameroon to become the Federal Republic of Cameroon.

The agreements determining the international boundary, arising from these various administrations, were the 1913 Anglo German Agreement, the Thomson -Marchant Agreement and the 1946 Order in Council. Over the years the interpretation of these agreements in some parts of the boundary was difficult and confusing, giving rise in some places to strong disagreement between the Parties regarding the position of the boundary. This caused tensions between both countries which escalated into military confrontation between them in 1993 with the deployment of Nigerian military to the Bakasi peninsula. In 1994 Cameroon brought the border dispute to the International Court of Justice. This resulted in a lengthy hearing and a decision by the ICJ in 2002. This decision confirmed the delimitation of the earlier Colonial Treaties, and clarified areas of sovereignty and the different interpretations of the boundary submitted by the Parties.

Establishment of the Boundary Commission

After the ICJ judgement, the Secretary General (SG) of the United Nations facilitated a meeting between the Presidents of both Countries in Geneva in 15 November 2002.

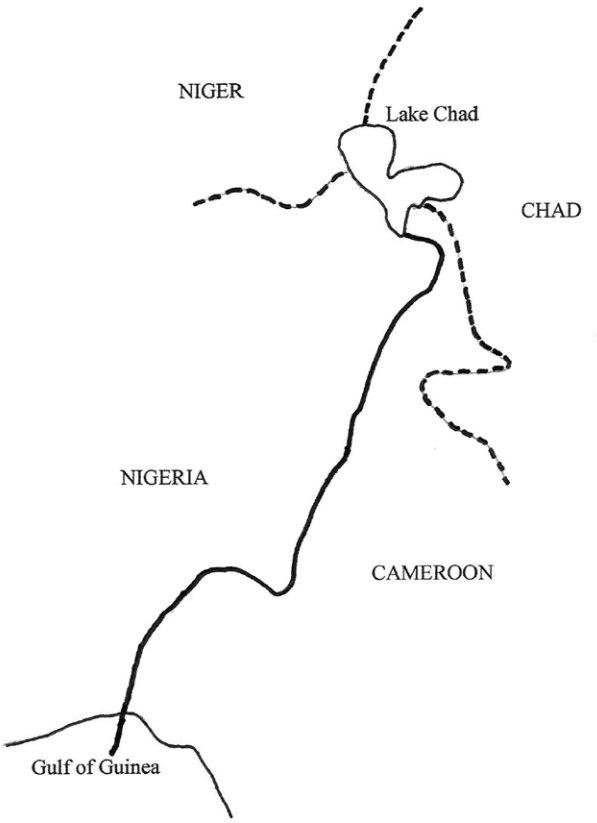

Figure 2: *Cameroon–Nigeria boundary.*

Both Presidents renewed their commitment to renounce the use of force in the bilateral relations and pursue peaceful ways for the settlement of their boundary differences. At this meeting, it was agreed for the UN Secretary General to establish a Mixed Commission to be chaired by the Special Representative of the Secretary General for West Africa to follow up on the ICJ ruling and move the process forward. The duties of the Mixed Commission were to: "*consider all the implications of the decision, including the need to protect the rights of the affected populations in both countries. The commission shall inter alia, be entrusted with the task of demarcating the land boundary between the two countries. It will also make recommendations on additional confidence building measures and the holding on a regular basis of meetings between local authorities, Government official and Heads of State; developing projects to promote joint economic ventures and cross-border cooperation: avoidance of inflammatory statements of declarations on Bakasi by either side; troop withdrawal from relevant areas along the land boundary; eventual demilitarization of the Bakasi peninsula with the possibility of international personnel to observe withdrawal; and the reactivation of the Lake Chad Basin Commission.*"

The Mixed Commission was initially chaired by Ahmedou Ould Abdallah, UN Special Representative of SRSG, with the Cameroon delegation to the Mixed Commission being led by Amadou Ali, Minster of Justice and Keeper of the Seal, and the Nigerian del-

egation to the Mixed Commission being led by H.E. Prince Bola Ajibola (CFR). Administrative and operational support was provided from the United Nations Office of West Africa (UNOWA). William Robertson was appointed as a Senior Consultant to the Mixed Commission. At its first meeting in December 2002 the Cameroon/Nigeria Mixed Commission decided: "*to establish a Sub-commission which would be responsible for the demarcation of the land boundary between the two countries. The Sub-commission shall be composed of legal experts and cartographers form the two parties and the United Nations.*"

The Sub-commission on Demarcation subsequently established a Joint Technical Team (JTT) to undertake field responsibilities for field assessment and identification and surveying of boundary positions.

At the second meeting the Cameroon/Nigeria Mixed Commission decided to: "*establish a Sub-Commission on Affected Populations with the mandate to assess the situation of these populations and consider modalities relating to the protection of their rights. The Sub-Commission shall include demographers, human rights experts, cartographers, sociologists and lawyers from the two parties and the United Nations.*"

At the eighth meeting the Cameroon/Nigeria Mixed Commission decided to: "*establish a Working Group, to be composed of five experts each from Nigeria and Cameroon, along with United Nations experts, in order to make a preliminary study and submit recommendations. In particular, this Group will propose a delineation of the maritime boundary as delimited by the Court in its decision, and produce a map on that basis.*"

Despite the initial difficulties in agreeing on the interpretation of the historic agreements and the previous tensions, in some parts of the border the tripartite involvement through this Mixed Commission provided a very sound basis for consensus and effective and efficient demarcation.

5.2 Geography of the Boundary

Physical

The land boundary extends for some 1,950 km, runs through a wide range of terrain from Lake Chad in central Africa to the concave coast of the Gulf of Guinea. It consists of 960 km of land boundary sections and 990 km of river boundaries. The terrain along the boundary varies greatly. In the north it includes flat dry land south of Lake Chad, then hills and the Mandara Mountains interspersed with cultivated high land and pastures and then the boundary follows rivers down to the Benue River. The middle section is also along major rivers, over the high ranges of the Atlantica Mountains and Gotel Ranges and associated foothills. The southern section runs along rivers and descends through heavy jungle headwaters to savannah and lowland forests to the Bakasi Peninsula and the coast.

Human Settlement

The boundary in the north runs through partially populated areas with the middle section being sparsely populated with occasional villages along the southern section. The boundary divides or circumscribes several villages and settlements. Those that existed at the time of the early colonial boundary agreements were generally nominated to go to one or other of the Parties. However, in one case where farmlands attached to a vil-

lage which had expanded since the early agreement the ICJ ruled that these remained divided by the delimited boundary.

5.3 Delimitation

At the end of the nineteenth century and early in the twentieth century various agreements on boundaries were made by Germany, France and Great Britain. These were refined by further agreements and clarifications after World War I. Consequently the delimitation was derived from several agreements which were not always sufficiently clear. The ICJ considered submissions and evidence on these differences from both Cameroon and Nigeria at lengthy hearings in the Peace Palace in The Hague. The ICJ confirmed that the Henderson-Fleuriau Exchange of Notes of 1931 was the delimitation at Lake Chad. The ICJ noted that both parties agreed the boundary south of Lake Chad was already delimited – partly by the Thomson-Marchant Declaration incorporated in the Henderson-Fleuriau Exchange of Notes, partly by the British Order in Council of 1946 and partly by the Anglo-German agreements of 1913. However, there was a lack of detail in the delimitation in many places along this long international boundary. Some major differences had also arisen in interpretation of this boundary on the ground between the parties. The ICJ heard submissions from both parties and deliberated on this evidence to confirm the boundaries as initially determined by the Treaties. It noted in its decision that it had no authority to vary the course of a boundary established by the early delimitation. An exception to this was for the Sapeo area, where it concluded that both parties had accepted this area lay within Nigerian territory contrary to the text of the agreement. The ICJ also provided clarity about the areas along the boundary where different interpretations of the Treaty have caused contention between the parties.

Although the early agreements had references to specific geographic features, the identification of these posed some major problems. Most of these were raised in the ICJ hearing and dealt with there. However, even after the ICJ clarifications, differences in the interpretation of mountains and rivers arose in the field and required careful and studied examination and committee consideration, with reference to the ICJ judgement, to reach collaborative resolution.

5.4 Demarcation

There was a significant amount of historic mapping and reference material which required careful interpretation. The features on the old Moisel map were specifically referred to in the Thomson-Marchant Declaration and needed careful interpretation on the ground because of the age and limitations of this map. Much of the boundary involved watersheds and rivers and collaborative cartographic interpretation and field assessment was necessary to establish the watershed and the actual courses of the rivers referred to in the delimitation. The joint working on all technical issues had major advantages but required coordination, transparency and collaboration on all field identification and surveying, geodetic surveying, calculations, and adjustment. Technical issues and problems were resolved through a consensus of the experts of the parties and the UN. This was initially time consuming but then allowed for robust and efficient field demarcation activities to proceed quickly.

Preliminary partially controlled satellite imagery was acquired at the scale of 1:50,000 and produced in a series of photomaps in a provisionally rectified form. A pilot study was completed to check the accuracy and reliability of these photomaps for use in the field. The pilot study demonstrated that their accuracy was sufficient for identification of the boundary on the ground and for field assessment of boundary positions. These images proved of great value to the survey teams, in guiding them to the general location of the delimited boundary on the ground and to assess the terrain and identify the boundary position. However, the difficulty of relating the delimitation, contained in the Treaties and referred to in the early maps, meant that some differences occurred in the field. These differences were either resolved through agreement through further examination in the field or set aside for a decision by the Sub Committee on Demarcation or reference back to the Cameroon–Nigeria Mixed Commission.

Field Operations

The demarcation of this land boundary was a complex task involving many surveying components and interrelated activities. Initially a work plan was prepared setting out the order time schedule of the demarcation survey, mapping and pillar emplacement work. A geodetic datum was designed and contracted to an international survey firm. This datum consisted of 10 primary points and 30 secondary geodetic points. The results of this work were subject to a quality control assessment by an independent international assessor before sign off by the Mixed Commission.

Technical Guidelines and Instructions were agreed for the operations of the Joint Technical Team (JTT) during field assessment and later on for pillar emplacement and survey. The JTT comprised survey personnel from both Parties and the UN. It undertook an immense field assessment exercise of the whole boundary in a series of stages. Each Party contributed planning, logistical support including security for the JTT as it operated in their territory. The field work in identifying the boundary and locating boundary positions was very demanding and required considerable demarcation judgement and collaboration in finalizing the general location of agreed boundary positions. Despite the good in-country support, field conditions were often very trying and were at times particularly hazardous. The hazards included difficult land and helicopter access to boundary positions, the presence of hippopotamus, and other wild animals, dangerous rivers, angry villagers etc.

The density of boundary pillars was decided early in the process and set at a distance of 500 m for intermediate pillars with a primary pillar located at every 5 km. Around or close to settlements intermediate pillars were to be placed at every 100 m. Boundary pillars were constructed with witness marks for all primary pillars and smaller pillars for intermediate boundary positions. Some boundary turning points were located where pillars could not be emplaced such as in lakes, riverbeds or marsh. Alternatives such as drilling or offsetting on the boundary line were considered in the planning for these locations. The boundary in rivers in the north and central sectors was the median line along the main course of the rivers. In the field, positions on both banks of these rivers were surveyed at regular intervals. In the southern sector, the boundary was determined as the thalweg by the 1946 Order in Council. The current position of the thalweg was surveyed along this section by field methods for all but the last 80 km of the Akwayafe River. For one part of the boundary the delimitation was along an "incorrect line of the watershed" which was recognized as not being a watershed. This historically incorrect line of the boundary was delineated on an old map depicting this

agreed boundary and referred to in the delimitation. The demarcation was undertaken as a direct translation onto the ground of incorrect line of the watershed as shown on the old map.

The boundary was divided into three main categories for the purposes of demarcation: The boundary on land accessible for the emplacement of boundary pillars; the boundary along the high mountain ranges where access was impracticable; and the boundary along rivers. The boundary positions along high mountain ranges were identified and fixed by the "office method". This involved the combination of satellite imagery and space shuttle DEMs to assess and agree on these inaccessible boundary positions. The combined imagery and space shuttle DEMs proved fit for purpose and provided a much more economical alternative to costly acquisition of 3D convention stereoscopic relief information. This work was supported by the UN Cartographic Section and the GIS Centre at UN Logistics Base in Brindisi, Italy using modern hardware and software. For the first stage of the land boundary, for which pillars were emplaced, an agreement was made with the United Nations Office for Project Services (UNOPS) to provide management services for pillar construction. The construction of these pillars was contracted out by UNOPS to local Cameroon and Nigerian construction firms. 378 boundary pillars have been constructed and surveyed under this agreement to the specifications approved by the CNMC.

The demarcation outputs and documentation too date include: preliminary image maps at a scale of 1:50,000, a geodetic datum survey, ground control survey and as built pillar survey, an independent quality assurance assessments[19] of these surveys, a listing of geographic and UTM coordinates for all pillared boundary points, documents for each pillar including a diagram of the pillar and witness marks, pillar coordinates, pillar photographs showing pillar identification, and a listing of witness mark coordinates. A report on the positions of the maritime and coordinates as finally approved by the Cameroon/Nigeria Mixed Commission has also been provided. 147 final boundary maps at a scale of 1:50,000 will provide the final record of the designation, coordinates and location all boundary pillars and boundary positions. To achieve this standard the satellite imagery needed to be fully geo and ortho rectified. The survey control for this was contracted out to two Cameroon and Nigerian survey firms. Some 160 ground control points were identified and surveyed. These were subject to a quality assessment by an independent international expert.

Maritime Boundary Issues

The maritime section of the boundary starts from the mouth of the Akwayafe River and extends some 50 km out to a tri-point with the stare of Equatorial Africa. It follows the "compromise line" drawn jointly at Yaoundé April 1971 and the line adopted in the Maroua Declaration as finalised in June/July 1975. The ICJ confirmed these two earlier agreements. They then fixed, by coordinates, the departure point at the terminus for the loxodrome boundary and its direction. This loxodrome boundary then extends seawards from the middle point of the baseline at the mouth of the inlet. The meeting of this loxodrome with the maritime boundary of Equatorial Africa determines the tri-point terminus of the boundary and is yet to be determined. The coordinate references were all to an old British Admiralty chart which had no planimetric datum and for which there was no mathematical way of calculating a datum

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relationship to GPS measurements. This demanded an empirical correction method involving survey measurement of fixed points on the chart and the derivation of a correction factor from a comparison of the GPS field survey and the chart positions. The final delineation of the Maritime Boundary was approved by the Mixed Commission in 2008. In relation to the joint management of mineral and petroleum resources straddling the boundary the cooperation already achieved through the working of the Mixed Commission and the planning work of the Maritime Working Group now positions both Parties well for close collaboration and joint management to achieve full use their all marine resources.

Affected Populations

From the establishment of the Cameroon–Nigeria Mixed Commission by the Secretary General of the United Nations and the Presidents of Cameroon and Nigeria a robust confidence building pathway for the demarcation was established. The visits by the Sub-Commission on Affected Populations to villages along the boundary were welcomed by the people in the border area and it was repeatedly stressed by them that they all wanted the boundary demarcated to promote stability and peace in the border areas. This aspiration was realized with withdrawal of forces from boundary areas, full administrative coverage of border areas and the good progress on demarcation of the boundary. However, in one case initial field assessment through a village aroused great concern among the villagers. In this case issue, the line of the boundary was referred back to the Cameroon–Nigeria Mixed Commission for further direction.

5.5 Observations

The collaboration of the Secretary General of the United Nations with the Presidents of Cameroon and Nigeria provided very successful tripartite leadership. To date, there have been four meetings of this leadership group to monitor and advance progress on the demarcation of this boundary. The tripartite nature of the Cameroon–Nigeria Mixed Commission and its two Sub-Commissions and the Maritime Working Group, enabled early development of efficient working relationships and the building of consensus on the wide range of issues, procedures, standards and specifications and identification of the boundary. Once a consensus had been achieved, it then led to a marked capability to progress the demarcation rapidly and to delegate responsibility to resolve the majority of difficulties as they arose in the field. It is clear that tripartite participation of the Parties, involving an independent party, has played a major part in advancing the demarcation of what had previously been a highly sensitive boundary situation. The joint working of both Parties with the UN has built a high level of confidence, understanding and respect between them. This has enabled effective resolution of problems and issues and efficient administration of the boundary demarcation operations. To date, there has been pillar emplacement for the first stage of the land boundary, the delineation of the maritime boundary, effective joint communication with and management of affected populations and implementation of administration services in these areas. Despite the tripartite collaborative boundary demarcation process being initially time consuming, it has been a major factor in the impressive progress on the implementation of this boundary demarcation and confidence building for access to member countries funding.

Although demarcation is considered a technical exercise in this boundary project it required a significant level of quasi-judicial surveying expertise. The positions of the physical elements of the delimitation were found in the field to be imprecise, ambiguous and occasionally apparently in contradiction. The resolution of the resulting issues required continuous consultation and a range of techniques including sharing the differences where no exact identification could be made. The initial interpretation of the delimitation was made on the ground by the JTT. This was confirmed by the Mixed Commission and accepted as legally binding on the Parties. The legal force applying to the definition and surveying by the JTT derived from the formal hierarchy of delegation from the Presidential Committee, the Mixed Commission and the Sub-Commission on Demarcation. It was the high level negotiations and diplomatic decisions which shaped the implementation of demarcation and ensured authoritative monitoring and validation. The documents and directions of demarcation were of a legal nature bearing the successive commitment of the Parties and requiring strict observance. The demarcation experts were to some degree interpreting the law and detailing it as they undertook demarcation in the field.

6 ABYEI BOUNDARY SUDAN

6.1 Historic Issues

Background

This boundary was a portion of an internal territorial boundary between north and south Sudan but was expected to serve as an international boundary should South Sudan become independent. The North and the South have fought a long internal war for control in Sudan and this ended in 2008 in a Peace Agreement. The agreement initially recognized a significant degree of autonomy for the South with an agreed division along old provincial boundaries. The provision for elections on both the future of Abyei and South Sudan in 2011 required the treatment of the proposed boundary between Sudan and South Sudan as a potential international boundary. However the boundary for the Abyei area was not finally established. Thus, the authoritative delimitation of the boundary to the north of the Abyei area became critical to progress on the future effective government of Sudan.

Establishment of the Sudan Tribunal

The Abyei Protocol May 2004 established the Abyei Boundaries Commission (ABC) to define and demarcate the boundary of the Abyei area. This mandate was also included in the Comprehensive Peace Agreement (CPA) of January 2005. The terms of reference of the ABC required it to determine the extent of the Ngok Dinka people at the time of the change to the Kordofan Provincial Boundary in 1905. Their decision was to be final. A dispute arose subsequently between the Government of Sudan (GOS) and the Sudan Peoples Movement/Army (SPLM/A) over the findings of the ABC. In July 2008 the GOS and SPLM/A agreed to refer their dispute to final and binding arbitration under the Arbitration Agreement and the Permanent Court of Arbitration (PCA) optional rules. Under the Arbitration Agreement the Parties agreed to form an arbitration tribunal. The issues to be determined by the Tribunal were:

"(a) *whether or not the ABC Experts had…exceeded their mandate which is 'to define (i.e. delimit) and demarcate the area of the nine Ngok Dinka kingdoms transferred to Kordofan in 1905'"*

(c) If the Tribunal determines…that the ABC Experts exceeded their mandate, it shall make a declaration to that effect, and shall proceed to define (delimit) on map the boundaries of the area of nine Ngok Dinka chiefdoms transferred to Kordofan in 1905, based on the submissions of the Parties."

The Arbitral Tribunal appointed was Professor Pierre-Marie Dupuy (Presiding Arbitrator), H.E. Judge Awn Al-Khasawneh, Professor Dr Gerhard Hafner, Professor W. Michael Reisman and Judge Stephen M. Schwebel. The registry support was provided by the Permanent Court of Arbitration at the Peace Palace The Hague. Aloysius Llamzon was appointed as the Registrar and he and his staff provided full administrative support to the Sudan Tribunal. Vincent Belgrave and William Robertson were appointed as Senior Consultants to assist the Tribunal on technical issues as required.

6.2 Geography of the Boundary

Physical

The Abyei Area lies in south-western Sudan, close to the border between the northern and southern parts of the country. It includes a large ecological system referred to as the Bahr region containing several major rivers. To the north there is a large arid sandy area termed the Goz. In this area there are significant petroleum resources which would be of economic value to both countries. The boundary of Abyei area, for which clarification of the delimitation was required, runs from the west on the agreed boundary of the Kordofan province for some 250 km to again join this boundary in the east.

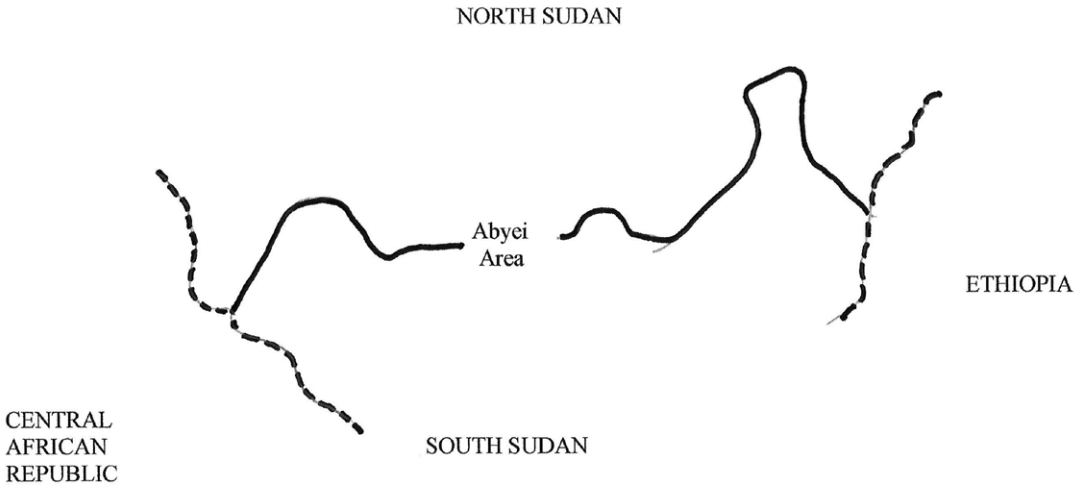

Figure 3: *North–South Sudan boundary.*

Human Settlement

The Ngok Dinka people were a settled agricultural people. They moved seasonally along the frontage of their land to get better grazing in the dry season. The extent of their territory was difficult to determine and overlapped with the neighboring Mysseria people. The Mysseria people of the north were nomadic and travelled long distances to subsist. The interpretation of the Ngok Dinka territory was also complicated by a range of cultural, geographic and climatic factors, as the land transitions into the Goz human settlement gets increasingly limited and scattered. Settlement is sparse along the area of the boundary and is not very helpful in indicating the likely area or tribal extent of the Ngok Dinka a century earlier. The relation of the boundary to the nearby town of Abyei is regarded as of utmost importance to the local inhabitants in the Abyei area.

6.3 Delimitation

Oral pleadings which were open to the public and attended by over 200 representatives of the Parties were held in the Peace Palace in The Hague in April 2009. The GOS submitted substantial evidence that the ABC Experts exceeded their mandate while the SPML/A submitted substantial evidence that the ABC Experts did not exceed their mandate.

The Tribunal was not in the position of reviewing the correctness of the boundaries as decided by the ABC Experts. Its TOR required it to delimit the boundaries if it found the ABC Experts had exceeded their mandate. Its task was difficult as although there was various geographic, map and field report information of the area, over the years, there was ambiguity and confusion in this evidence and a lack of clarity in regard to the particular location of the boundary. The geographical information and spatial references in the evidence was important and surveying expertise was drawn on heavily by both Parties for their submissions to the Tribunal. These submissions raised many cartographic issues relevant to the arguments of the Parties. The role of the Tribunal was solely a judicial and delimitation function. The role of the expert survey services to the Tribunal reflected this legal situation. The experts were strictly limited to providing factual map information on the routes, places, and features and probity of the maps relevant to the evidence and presenting the Tribunal's findings and supporting graphics.

In its final award, the Tribunal decided that there was some excess of mandate by the ABC Experts in regard to the drawing of the northernmost limit of the Ngok Misseryia's shared rights area and by implication the northern limit of the Abyei area and for the eastern and western boundary lines. They ruled that the southern boundary was not in excess of the mandate. Given this excess of mandate by the ABC Experts, the Tribunal defined (delimited) on a map the new eastern and western boundaries as running along the longitudes of 29 degrees East and 27 degrees 50 minutes East respectively. The Abyei boundary as delimited by the Sudan Tribunal extends some 250 km east north and west from the southern boundary.

6.4 Demarcation

The demarcation of the Sudan Tribunals delimitation is still in the future. UN Cartographic Section was involved in providing technical boundary workshops to the Boundary Technical Committee but the political negotiations of the issue of Sudan and South Sudan are led by African Union (AU). As for Abyei region, there is UN peacekeeping presence through United Nations Interim Security Force (UNISFA), whose mandate is to monitor the flashpoint border between north and south, and protect civilians and humanitarian workers in Abyei. As the delimited Abyei sector boundary consists of lines of longitude and latitude the technical work will consist of demarcating these lines with geodetic exactitude.

6.5 Observations

The Comprehensive Peace Agreement establishing the procedure for self determination in the respective territories set up a process of restoring peace and stability in Sudan. Establishing the boundary of the Abyei area was a critical part of completing the determination of the boundary defining the potential areas for the referendums and the potential areas of sovereignty of both Parties. The finding of the ABC Experts introduced a disagreement from the GOS. However the decisions of the Sudan Tribunal in July 2009 were accepted by the GOS and the PLAM/A of South Sudan. The delimitation and the pending demarcation will be seen as in the future as important milestones in the journey towards peace and stability for both Sudan and South Sudan. Nevertheless, over the last 56 years since the independence of the Sudan, civil war and unrest has been deep seated and will take time to completely resolve. Currently adverse occupation and hostility exist prior to withdrawal of each country's forces to each side of their respective delimited boundaries.

7 SUMMARY

The surveying role reflected in the three international boundary determinations reported above demonstrate the contribution of surveying in disputed international boundaries. Although the emphasis in the three boundary projects is from the perspective of survey support for Boundary Commissions, surveyors had a much wider involvement. National surveying organizations belonging to each Party were fully involved throughout the long process of advising their governments and preparing successive submissions, counter submissions and responses for the various stages and hearings of the administrative, political and judicial processes involved. As well as this, counsel and other expert witnesses in their evidence made frequent references and use of spatial, geographical and mapping information.

Surveyors are recognized and valued by boundary commissions and tribunals for the integrity and professional expertise they provide. This role in a testing advocacy oriented environment inevitably subjects their work and evidence to the closest of scrutiny, checking and cross examination. The survey role is therefore not simply a technical one but requires a careful consideration of the role and function of surveying and cartography in the specific political and legal environment that applies in each individual international boundary case. The performance of the surveyor in this role is highly transparent and accountable. He/she needs to analyze the range of expert evidence submitted

and provide independent, objective and reliable findings and advice. Although this requires a level of insight, maturity of judgement and expertise at a higher level than that required in normal cadastral surveying it is derived from the same base of knowledge and skills.

The boundaries described here involved the determination of international borders where there had been some dispute and hostility. In each of these cases historic treaties and the establishment of a judicial commission set strict legal parameters for the conduct of surveying. The discipline involved in such cases also applies to the contribution of surveyors where two sovereign states are independently determining their boundary. In this much more usual situation, knowledge of the legal/judicial constraints on map and understanding surveying evidence and documentation is still very important. However surveyors discharge their technical and quasi judicial role, their performance needs to withstand searching legal scrutiny.

The Eritrea/Ethiopia and Abyei borders have been determined after long drawn out hostilities with the requirement for boundary determination written into the peace agreements. With the Cameroon/Nigeria border there was a serious dispute over parts of the boundary and this was resolved through a judgement from the International ICJ and the establishment of a tripartite demarcation process. In each of these cases surveying has played an important role in assisting the delineation and/or demarcation of the boundary[1]. In delimitation, such as for the Sudan boundary, the surveying role is generally confined to the degree of relevance, quality and probity of historic maps and geographic material and the relation of physical and cultural features to the boundary. This can involve the analysis of the source, content and quality of map and other reference material, interpreting the geographic signatures and the relative significance of the various documents. The delimitation process may also require surveying interpretation or advice to define the impact on the ground of the boundary limits being investigated or decided. This can include the indicative location of the border along ridges and rivers and around or through settlements and towns etc. There are special challenges for surveyors in working within the legal limitations applying in historic treaties' and the individual features of the terms of reference that direct each boundary determination. Their brief can also be hedged with legal conditions arising from a tightly negotiated peace agreement, which strictly limit the surveyors input till after the delimitation decision. Where two sovereign parties are delimiting an agreed boundary, the role of the surveyor will be important in providing technical evidence related to the position of the boundary and the range of related historic evidence. In these circumstances, although the legal political context is not highlighted, the observance legal protocols remain important in the delimitation and the implementation of the demarcation.

At the demarcation stage, the surveying contribution can involve a complete suite of survey activity, including: project planning, setting specifications and technical standards provision of geodetic datum and referencing, medium and large scale mapping and imagery, field assessment, surveying for placement of pillars, as built survey and quality assurance of all surveying activity. Although all surveying phases are involved from first principles to the highly technical operations the context remains a political and legal one. At the demarcation stage surveyors are acting with delegated authority

1 Please note for the Cameroon/Nigeria boundary that currently there are still some areas which the parties have not yet agreed and identifying a way forward to resolve them.

and their interpretation on the ground is a serious commitment of the relevant states to accept the resulting boundaries of their territorial sovereignty.

A broad vision of surveying and its mission is essential to accommodate the various political and judicial constraints applying in surveying for international boundaries. The successful demarcation and its implementation depend on a mature professional and surveying and cartographic understanding and insight. The capability required of surveyors is a depth of knowledge of the wide gamut of surveying skills. These include geodetic referencing and positioning, mapping techniques and new technology including current GPS and remote imaging capability and applications. It is clear that the qualities of our hardy and adventurous predecessors provided a sound basis for agreement and determination of boundaries in earlier years. Long after they have gone their maps and reports of their expeditions have proved critical to the demarcation of modern boundaries. The same competencies of professional insight, integrity, independence, objectivity and collaborative skills are as relevant today as they ever were for the determination and surveying for international boundaries.

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CHAPTER 7: DEMARCATION OF THE INTERNATIONAL BOUNDARIES OF NEPAL

Buddhi Shrestha, Nepal

1 HISTORICAL BACKGROUND

The Himalayan Republic of Nepal is situated between two emerging Asian giants, India and China. The frontier of Nepal is surrounded on its south, east, and west by India, and on the north by China. Nepal is elongated at the east-west in a rectangular shape.

The Himalayan range is a natural wall between Nepal and China. There are neither natural walls nor man-made fences along the Indo–Nepal border. The flat Indo-Ganges flood plain extends from India towards the Nepali frontier. The less porous barrier border has challenged the identity of Nepal at the local and national level.

In 1745 Prithvi Narayan Shah the Great initiated the unification of various petty kings, small kingdoms and principalities of the Himalayan region. He formally established Nepal as a Himalayan State on November 17, 1769. His descendants continued the unification movement; in 1806 Nepal's border was extended from the Tista River on the east to Kangra on the west. Similarly, Nepal was extended up to the confluence of the Gandak and Ganges Rivers to the south, and to Shigatshe and Tashilhunpo Gomba (monastery) across the Himalayas to the north, which falls today in the Tibetan Autonomous Region (TAR) of China. It was called the 'Greater Nepal'.

In ancient times Nepal's north-western border reached nearly to the Mansarovar and Rakchhyas (Monster) Lakes of the present TAR. According to historians, there were four Thum areas (the then hill administrative units) on the north of the present Darchula, Bajhang, and Humla districts of Nepal. The border in those times had nearly reached the Kailash Mountain, and the four Thum areas, as mentioned, were Konghe, Munge, Saker, and Laddhak. It is also said that Prime Minister (PM) Jung Bahadur handed over the four Thums to China for Rs. 6,000.

Studies of various historical maps show that the borders of these districts had been extended from the Gurla Mandhata range of the Purang province of Tibet to the margin of the Laddhak mountains and to the vicinity of the Konghe lake, which is the origin of the Bramhaputra River. But the Tishe Kailash is seen even north of Mansarovar. This shows that Nepal's northwestern border reached farther north than the present border.

Centuries ago, there were a few confrontations between Nepal and China, especially regarding economic and trade affairs. In this context, there were border conflicts in a few trade and transit points. Agreements and treaties were made from time to time to settle such conflicts amicably. As a result, the Khasa Treaty (1775) was signed to main-

tain the borderline in its previous position. In the Kerung Treaty (1789) Nepal withdrew from the invaded Tibetan land. The Treaty of Betrawoti (1792) aimed at preventing an unprovoked dispute regarding the possession of each party's territories, and the Treaty of Thapathali (1856) aimed at restoring Taglakhar, Chewur Gumba, Kerong, Jhunga, Kuti, and Dhakling to territorial ownership by Tibet and at withdrawing all the Nepalese troops that were on Tibet's side of the Bhairab Langur range.

After the Treaty of Thapathali, also termed the Nepal–Tibet Treaty of Peace-1856, Nepal has had no conflicts and disputes with Tibet. Since then, a mutually agreed upon borderline has been maintained and economic, social, and cultural relations have developed smoothly. To promote relations and friendship between the two countries, the Sino–Nepal Boundary Agreement was signed on March 21, 1960. As a result of this agreement, a Boundary Treaty was made on October 5, 1961. The boundary line was demarcated accordingly and the first boundary protocol was signed on January 20, 1963. This is the present northern boundary line of Nepal.

Regarding the southern boundary, when India was ruled by the East India Company, British India did not like Greater Nepal as a unified and integrated country. Following conflicts regarding territory between Nepal and British India, the western border of Greater Nepal shrunk to the Sutlej River in 1809. Border disputes, claims, and counterclaims intensified, which resulted in the 1814–1816 Anglo-Gurkha War. British India initiated steps towards establishing a treaty. The Treaty of Sugauli was signed between Nepal and British India on March 4, 1816. According to this treaty, Nepal lost one third of its territory from Mechi to the Tista River on the east and from Mahakali to Sutlej (Kangra) on the west.

Nepal had to concede all the territories within the hills east of the River Mechi, including the fort and lands of Nagree and the Pass of Nagarcote, leading from Morang into the hills, together with the territory lying between that Pass and Nagree to the Company Government. In the west, the territory west of the Mahakali River was transferred to the Company Government, and a provision was made that the King of Nepal would undertake a commitment not to be concerned with these countries or the inhabitants thereof. Besides, the whole plain Tarai region (except for the Butwal area) from the Koshi River to the Kali River came under British control.

Nepal was very uncomfortable due to the compulsory signing of the Sugauli Treaty. In order to console and appease the King of Nepal, the British prepared an agreement, whereby they were ready to return to Nepal the Tarai plains from the Koshi River to the Rapti River. However, the British discontinued paying the 200,000 Rupees they had been paying to the King of Nepal to mollify the high officials of the Royal court. The agreement was signed by the King on December 11, 1816.

In course of time, discontent and agitation against the British rule in India began in 1850. The first struggle for independence in India started with the Sepoy (Soldiers) Mutiny. British India requested Nepal's friendly offer of help to quell the Sepoy Mutiny. Nepal sent at first six regiments of Gurkha troops on July 2, 1857 to assist the British. Later, PM Jung Bahadur led the Gurkha army with an additional three regiments and suppressed the fighting, and consequently the mutiny subsided.

The British were highly impressed by the bravery and tactics of the Nepalese troops in suppressing the rebels, especially their leader, Jung Bahadur. As a reward, the British decided to return the territory called Naya Muluk of the plain areas from the Kali River

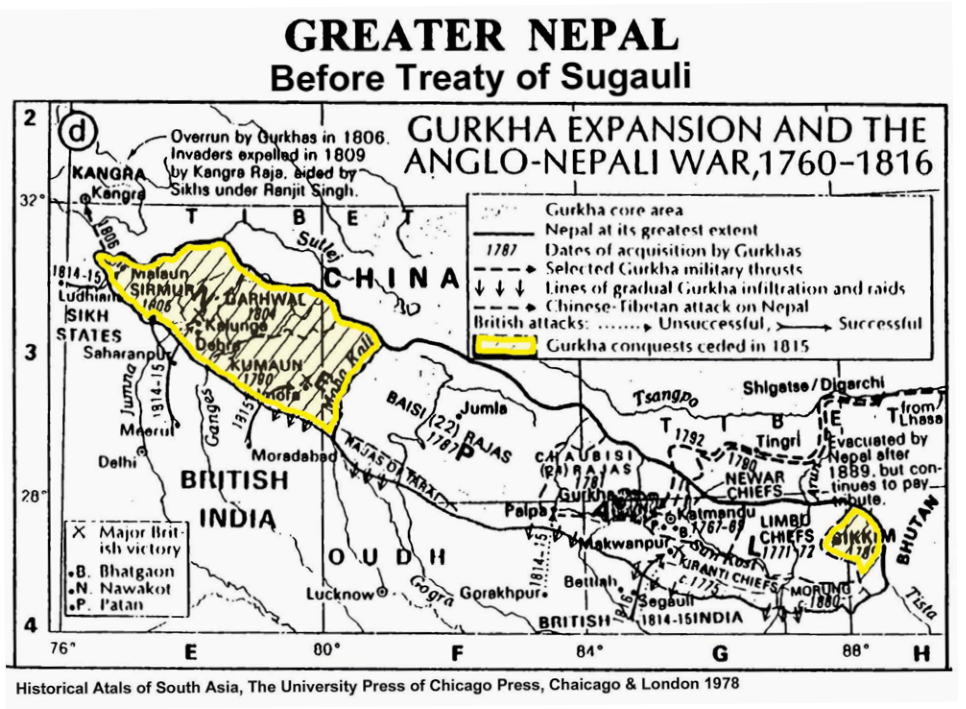

Figure 1: *Greater Nepal.*

to the Rapti River, which was taken away from Nepal by the stipulations of the Sugauli Treaty. This return of territory was formalized through a border agreement signed on November 15, 1860.

In time, and owing to past developments, the borderline of Nepal has been constricted to the present territory of Nepal – the Mechi River on the east, the Mahakali River on the west, the watershed of the Himalayan Range on the north, and to the plains of the Tarai on the south.

2 BOUNDARY DELIMITATION

Nepal is surrounded by its neighboring countries: China and India.

2.1 The Nepal–China Boundary Delimitation

The allocation of the boundary between Nepal and China was agreed upon at the political level. The borderline was drawn along the Himalayan Range, between the Chinese territory in the north and the Nepalese frontier in the south. The allocation states that the borderline runs west to east along the Himalayan Range, including peaks, summits, crests, mountain passes, narrow river valleys, pasturelands, and along the slopes. The main Himalayan range, which is perennially covered with snow, and the other smaller ranges and sub-ranges between the Zanskar range, in the west and the Janak sub-ranges along the east, contain eight of the highest peaks, with heights of over 8,000 meters, including Mt. Everest (Sagarmatha), and 34 main mountain passes.

PM Bisheswor Prasad Koirala of Nepal and Chou En-Lai of China signed the Sino–Nepal Boundary Agreement on March 21, 1960 to scientifically demarcate the traditional border between the two countries and to resolve, once and for all, minor differences of opinion about the borderline. The agreement contains six articles. It includes a provision whereby the traditional border recognized by both countries will be accepted and that a Nepal–China joint border committee will be established for demarcation with equal representation from both sides. The committee was assigned the job of solving border issues through mutual talks and understanding. It could carry out border surveys, erect border pillars, and draft the border treaty.

The 1960 agreement made a provision whereby three techniques would be adopted to deal with three different types of cases while the border was demarcated. Having studied the delineation of the boundary line between the two countries, the contracting parties decided to determine the boundary in the following ways in accordance with three cases:

1. In sections where the delineation of the boundary line on the maps of the two sides is identical, the boundary line will be fixed according to the identical delineation on the maps. The parties will conduct a survey on the spot and erect boundary markers.
2. In sections where the delineation of the boundary line on the maps is not identical, whereas the state of the actual jurisdiction by each side is undisputed, the joint committee will authorize joint survey teams to conduct surveys on the spot, determine the boundary line, and erect boundary markers in accordance with concrete terrain features (watershed, valleys, passes, etc.) and the actual jurisdiction (possession or user's rights).
3. In sections where the delineation of the boundary line on the maps is not identical and the two sides differ in their understanding of the state of the actual jurisdiction, the joint team will immediately ascertain the state of the actual jurisdiction, make adjustments in accordance with the principles of equality, mutual benefits, friendship, and mutual accommodations to determine the boundary line and erect boundary markers in these sections.[2]

2 Bhasin, Avtar Singh, (1994) Nepal's relations with India and China, Siba Exim India.

Figure 2: *The 1960 Peace and Friendship Agreement.*

Figure 3: *The 1961 Boundary Treaty.*

To make the provision of the agreement a reality, a Nepal–China joint border committee was formed on March 21, 1960 in an agreement to draft the treaty. The Nepali delegation was chaired by Major General Padam Bahadur Khatri and included seven members. The Chinese delegation, chaired by the Ambassador of China to Nepal Changshi China, included seven members.

Two advisors from each side were nominated to provide the necessary counseling to the joint committees. The first meeting of the committee was held from the 12th of August to the 26th of October 1960 in Kathmandu with six rounds of talks. Follow-up meetings were held in Beijing (the 18th of January to the 15th of February,) and in Kathmandu (July 31 to August 24, 1961). The committees then delineated the border and formulated the draft of the treaty cordially.

The boundary treaty, prepared by the Nepal–China Joint Boundary Committee, was signed by His Majesty King Mahendra Bir Bikram Shah Dev of Nepal and by Chairman Liu Shao-Chi of China on behalf of their respective governments on October 5, 1961. The treaty adopted the traditional border as the basis on which the joint committee should demarcate the borderline from west to east under the principle of equality for

mutual benefit and friendship, and the parties agreed to make on-the-spot decisions by mutual coordination.

It was agreed that the formal settlement of the boundary between China and Nepal is of fundamental interest to the peoples of the two countries. It was believed that a formal delimitation of the entire boundary and its consolidation as a boundary of peace and friendship not only constitutes a milestone in the further development of the friendly relations between Nepal and China—it also contributes towards strengthening peace in Asia and the world.

Nepal has had border issues with both India and China. Regarding China, these issues were settled and resolved upon the signing of the Boundary Treaty of October 5, 1961 and by the delineation and the physical demarcation of the boundary line. However, there were disputes, conflicts, controversies, debates, claims, and counter-claims in 32 places along the boundary, including Mt. Everest, during the joint boundary demarcation on the Sino–Nepal borderline.

It is commendable that all the disputes, claims, and counter-claims were settled forever in accordance with the principles of equality, mutual benefits, friendship, mutual understanding, and accommodation. Both parties adopted the Five Principles of Peaceful Co-existence and in a spirit of fairness, reasonableness, mutual understanding, and most importantly, respecting each other as having equal rights. All the issues, except Mt. Everest, were settled by the Joint Boundary Committee. Regarding the question of Everest, during the visit of PM Chou En-Lai to Kathmandu on April 28, 1960, he stated that "Mount Everest belongs to Nepal."

2.2 The Nepal–India Boundary Delimitation

Prithvi Narayan Shah the Great started to unify 56 small kingdoms and principalities into the strong Himalayan State of Nepal in 1769. His successors completed the unification campaign and the territory of Nepal was extended from Tista to Kangra as Greater Nepal by 1806. In those days, the British, who had entered India with the intention of doing business there, ruled India. They began to turn their eyes towards Nepal. The East India Company Government was looking for an opportunity to expand trade to Tibet. But since the border of the then Nepali Kingdom had extended west to east, covering the northern frontier of British India, the Indian businessmen did not have direct access to Tibet. All the easy access transit points to enter into Tibet from India were under the territory of Nepal. The British did not see alternative ways to fulfill their wish to trade with Tibet through Nepal, except by using military force. They raised the issue of the boundary of Seuraj and Butawal of Nepal as a pretext for them to go on war.

The British sent a letter to Nepal in March 1814, giving it an ultimatum, to be replied to within 25 days, namely, to abandon its occupation of the territory of Seuraj and Butawal. Nepal did not respond. Therefore, Lord Hastings officially declared war against Nepal on November 1, 1814. Then, a dreadful war between the Nepalese and British army took place. Many fighters from both sides lost their lives during the war, which continued until May 16, 1815. In the meantime, the British proposed a peace treaty and Nepal was also ready to negotiate terms for achieving peace. Finally, a treaty of peace and friendship was drafted and sent to Nepal by the East India Company on December 2, 1815. Nepal counter signed the treaty on March 4, 1816 at Sugauli, officially ending the war.

In the ensuing days, this treaty became known as the 'Treaty of Sugauli 1816.' The major conditions stipulated by this nine-article treaty included the following: 'the King of Nepal shall give up the claim on all the territories that had become a matter of dispute before that war, he shall accept the authority of the Company Government over the Tarai (plain area) across the River Tista in the east; to Satlaj and Kangra in the west.' This treaty largely shrank the border of Nepal from the Mechi River to the Mahakali River. As a result, one third of the Nepalese territory was chipped off.

In fact, this treaty was in favor of the East India Company and Nepal lost a lot of territory. Nepal was highly dissatisfied to lose a large chunk of land from Mechi to Tista, where there was no war. Therefore, to pacify Nepal and as an indemnity, a Supplementary Boundary Treaty was signed in December 11, 1816, which resulted in Nepal being restored the lowlands (Tarai) from the Koshi River to the Rapti River. In the course of time, as a reward to Nepal, which had survived the Sepoy Mutiny in India, British India returned the ceded lowland of Nepal from Rapti to Mahakali as new territory (Naya Muluk) by signing the Boundary Treaty of November 15, 1860.

Importantly, the Treaty of Sugauli (March 4, 1816) and the Supplementary Treaty (December 11, 1816) are the bases for the delineation and demarcation of the eastern, the western, and a portion of the southern borders of Nepal, even though the Boundary Treaty (November 15, 1860) specifically implied the southwestern portion, as the restoration of the Banke, Bardiya, Kailali, and Kanchanpur districts as new territory (Naya Muluk). This became the boundary of present-day Nepal.

3 DESCRIPTION OF THE BOUNDARY LINE

Nepal is bordered to the north by China and to the south, east, and west by India. Nepal shares a 1,880 km border with India, as an open border regime. Nepal shares a 1439.18 km borderline with China. There is a regulated border management between Nepal and China.

3.1 Description of the Nepal–China Boundary Line

The boundary treaty of October 5, 1961 resulted in dividing the Nepal–China borderline into 13 sectors. The Chinese-Nepalese boundary line starts from the point where the watershed between the Kali River and the Tinkar River meets the watershed between the tributaries of the Karnali River, on the one hand, and the Tinkar River on the other hand. Hence, it runs south-eastwards along the watershed between the tributaries of the Karnali River and the Tinkar River and the Seti River, passing through the Lipudhura snowy mountain ridge and Tinkarlipu (Lipudhura) Pass to Urai Pass – Nala Kankar Himal (6,550 m) – Kali Gandaki (6,241 m) – Chaklo-Gyala pass – Thaple Bhanjyang (pass) – Yangra Himchuli – Chusumdo – Chomo Parmari – Nechle Sanghu (bridge) – Popti Bhanjyang – Rakha pass – Kangla pass and Chabuk pass to the terminal point where the watershed between the Khar River and the Chabuk River meets the watershed between the Khaar River and the Lhonak River.

Maps on a scale of 1:500,000 were prepared showing the entire boundary line, and were attached to the treaty. Other maps, on a scale of 1:50,000, were prepared to show the location of temporary boundary markers to be erected by both sides and the detailed alignments of certain sections of the boundary.

The agreement of March 21, 1960 states that the boundary between the two countries will be set up by permanent boundary markers as necessary along the boundary line, and then a protocol will be drafted, setting forth in detail the alignment of the entire boundary line and the location of the permanent boundary markers with detailed maps. Upon signing the boundary protocol, the tasks of the Chinese-Nepalese Joint Boundary Committee were terminated and the question of the boundary between the two countries ceased to be in force.

It was also agreed that any dispute concerning the boundary, which may arise after the formal delimitation of the boundary, will be settled by the two parties through friendly consultations.

3.2 Description of the Nepal–India Boundary Line

Whereas the northern borderline of Nepal along the boundary with China follows the watershed of the Himalayan Range, passing through high peaks, mountains, gorges, and pasturelands, the southern borderline of Nepal with India runs through fertile plains, jungles, and rivers. On the east, the Mechi River and the watershed of the Singhalila Range with hills and hillocks represent the border. On the west, the borderline between Nepal and India runs along the Mahakali River.

According to the Treaty of Sugauli, the Kali River defines the whole western boundary of Nepal with India. Kali as the boundary river is delimitated by Article 5 of the treaty. It states "*the Rajas of Nepal renounces for himself, his heirs, and successors, all claim to or connection with the countries lying to the west of the River Kali and engages never to have any concern with those countries or the inhabitants thereof*." Thus, the place where the Kali River originated is the northwestern corner border limit of Nepal with India that forms a tri-point with China.

Regarding the eastern border, the line was delimited by the course of the Mechi River, as mentioned in article 3 (5) of the Sugauli Treaty. It includes the fort and lands of Nagree and the Pass of Nagarcote leading from Morung into the hills, together with the territory lying between that Pass and Nagree. The uppermost eastern boundary, north of the origin of the Mechi River, is delimited to the watershed ridge of the Singhalila Range up to the Jhinsan peak, forming the Nepal–India–China tri-point.

The southern boundary of Nepal starts east of the low lands of the older river course of the Kali River (Mahakali/Sharada) at Khatima of India and Kichka Sundarnagar of Nepal. The borderline goes eastward from this point to Belauri and further ahead, and then it turns to the north until it reaches the Mohana River of the Indian District of Gorakhpore, which was in Nepal territory until 1815. Then, the borderline follows the Mohana River to the confluence with the Karnali River. It then goes east and turns south to Bhada Nala and then a little bit north to the Babai River. From Babai, the delimitation line goes east and turns south to meet Man Nala.

From Man Nala, the boundary extends east to the Rapti River. Following the Rapti River a little bit, the delineation line goes to the foothills north of Baghaura Tal, which join the eastern border of Rohil Khanda, following the boundary between the British Province of Oudha and the territories of the then Maharaja of Nepal. Thereafter, it follows the southern foothills of the Dhundwa Range. Then, it reaches the confluence of Arrah Nala (Nudee) via Koilabas.

Following Arrah Nala a little, the line runs eastward to the Kothi River and then turns south to the Ghongi River. From Ghongi, the border takes a turn northward to the Tinau River. In this sector, the boundary line goes through an area where there were inconsistencies regarding the border and disputes along Oudh, Rohilkhanda, and Gorakhpur, before and during the 1814–1816 Anglo-Gurkha war. Then, the line proceeds straight, east to the Gandak River (Narayani). Thereafter, the boundary line follows northward along the river course of Gandak to Tribeni Ghat. Then, the line goes eastwards to the Panchanad River. From Panchanad, it follows the Someswor Range until it reaches Thori. Then, the borderline turns to the Uriya River.

From Uriya, the border goes eastward to the Bagmati River and the Lakhandehi River; later it extends farther east to the Hardi River. From Hardi, it turns south and east and then turns north and again east to the Kamala River. The boundary line advances farther east to the old course of the Koshi River. Next, the borderline tracks north-east and then turns to a little south and again it runs east to the Ratuwa River. From Ratuwa, the border extends farther east and then somewhat north and then again east, and ultimately the borderline meets the Mechi River near Sukhani Lodabari of Nepal and Kado Gaun of India, as the end of the southern borderline.

4 THE PROCESS OF NEGOTIATIONS

Nepal and China negotiated the adoption of the following principles and guidelines for the delineation of the boundary between the two countries:

1. Follow the watershed.
2. Include the mountain peaks, passes, ravines, gorges, and river valleys.
3. Follow the river's course and its confluence.
4. Adjust territory on the basis of give and take.
5. Honor actual jurisdiction (user rights and possession).
6. Choose citizenship, in case of cross-holding occupations.

Regarding Nepal's present border with India, it is said that in general it is delineated and demarcated by the Sugauli Treaty and its subsequent treaties.

After the Sugauli Treaty, there were disputes and differences at various places. According to the agreement of December 11, 1816, such disputes should be settled with mutual understanding, on the basis of exchanges of equal portions of land, as mutually considered desirable for the new boundary. It further states that in case it is impossible to establish desirable limits between the two States without a survey, it will be expedient that Commissioners be appointed on both sides, for the purpose of arranging in concert a well-defined boundary on the basis of the preceding terms, and for establishing a straight line of frontier, with the aim of distinctly separating the respective territories of the British Government to the south and of Nepal to the north. In case any indentations occur that will destroy the even tenor of the line, the Commissioners should arrange an exchange of lands guaranteeing interference on principles of clear reciprocity.[3]

3 Aitchison, C.U. (1929), A Collection of Treaties Vol. VIV, Calcutta, p 65.

The above-mentioned examples illustrate that there were disputes on the border just after the Treaty of Sugauli, which showed Nepal's disenchantment regarding the treaty. Disputes in several areas were settled, but in many other places the disputes remain to be settled and there are still debates, conflicts, and controversies.

The 1869 land dispute at Bhagaura Tal (Lake) and Arrahnala was negotiated and settled in 1874, after Jung Bahadur returned from Calcutta, upon signings by Captain Samuel and Subba Padmanabha Joshi. There was also the provision that if the Nepalese and British commissioners disagree on the settlement of the border, a third official would look into the dispute and he would settle the dispute with mutual confidence from both sides. One example of that was when Lt. Col. McAndrew and Captain Siddhi Man Singh Rajbhandari had a difference of opinion and the case was settled by Sir Dite Forseyth, who was appointed as the third official. This was agreed upon by both parties and an agreement was signed by Mc Andrew and Siddhi Man Singh.

There are other examples as well. A letter written by Jung Bahadur to Lt. Col. George Ramsey also reveals that there were border disputes at various places. The letter reads: "*In order to avoid any future conflict, I want to draw the boundary line with the statement mentioning about the border pillars at several places of the big villages and settlements of both sides. The British commissioners had erected permanent concrete pillars in various distances. They had also constructed earthen pillars at various points of the settlement in between permanent concrete pillars but they were weak earthen pillars at every 130 steps (foot) both of which are not strong enough. I hope they will be made strong and permanent so that they will last longer. There are 210 concrete but small pillars from the northern hills of Baghaura Tal, which meet with the eastern border of Rohil Khanda*."[4]

Similarly, the letters exchanged between Jung Bahadur and Lt. Col. Richard Charles Lawrence also refer to border disputes. The letter reads: "*It was taken that the border points on the area near Sharada River, which was received from the British, had been demarcated in the map by the British and the Nepali representatives. But the lines demarcated by the British are put in red and that by the Nepalese in green ink border line. The green signs signify the Nepalese limit of the frontier had reached from Ghusarighat to Brahmadev. The border demarcation and the markings of the land, received from British to Nepal government have been done according to the report of the British commissioner commissioned in 1860 for the same purpose. The border line drawn on the map as mentioned in that report was accepted and approved by the British government*."[5]

4 Ministry of Foreign Affairs (A letter from Prime Minister Jung Bahadur Rana to Lt. Col. George Ramsey on Thursday, September 21,1860).

5 Ministry of Foreign Affairs (A letter from the Prime Minister Jung Bahadur Rana to Lt. Col. Richard Charles Lawrence on April 5, 1865).

5 BOUNDARY DEMARCATION

The demarcation work between Nepal and China was completed. Regarding the boundary demarcation with between Nepal and India, three percent of the boundary remain to be completed.

5.1 The Nepal–China Boundary Demarcation

There were more than six joint meetings, between August 12, 1960 and February 15, 1961, for preparing an outline to form joint field survey teams, before the boundary treaty was formally signed. In the joint committee meeting of January 28, 1961, it was decided to deploy five joint survey teams to conduct a survey, especially in disputed areas.

It was agreed that wherever the boundary follows a river, the midstream line will be the boundary line. In case a boundary river changes its course, the original line of the boundary will remain unchanged in the absence of other agreements between the two parties. Both sides also agreed that if the border river looked like it was changing its course, both sides would work to prevent it, and neither side would deliberately divert the direction of the river.

The demarcation on the ground was made according to the delimitation of the treaty. Joint Survey Teams were formed to carry out the border survey, and they began erecting permanent pillars and markers on June 21, 1962 at different points of the borderline. The west to east elongated borderline was divided into 13 sectors for the purpose of the demarcation, and six joint border survey teams were assigned as follows:[6] (1) the Nara Pass segment; (2) the Mustang segment; (3) the Larke segment; (4) the Rasuwa segment; (5) the Kodari segment; and (6) the Kimathanka segment.

Under the treaty, the border areas were adjusted for either country according to its traditional uses, possessions, and its convenience, for example, the borderline after the Arun Valley followed the southern watershed of the Arun River instead of the Naktang and Chusar Valleys. This shifted the borderline southwards, to a distance of 2 to 3 kilometers for 16 kilometers, in favor of China. Similarly, at several places, lands belonging to China, which had been traditionally used by the Nepalese, were included inside Nepalese territory. These adjustments were made on the basis of 'give and take'. Thus, 302.75 square kilometers of Chinese territory was transferred to Nepal following this principle.[7]

With regard to the demarcation of a boundary following a watershed, there were some problems of cross-holding occupation. For example, when possession of some land and pasture land owned by the citizen of one country extended to the other side of the border, it would belong to citizens of the other country. To resolve this problem, there was an understanding regarding the choice of nationality. As mentioned in the Notes exchanged on the Sino–Nepalese boundary (August 14, 1962 in Kathmandu), any inhabitant of these areas who does not wish to become a citizen of the country to which the area belongs, may retain his previous nationality by making a declaration within one year of the date that the agreement came into force. Persons who make such declarations may either stay where they are as foreign residents or may at any time move into the territory of their country of nationality.[8]

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6 Nepali, Chitta Ranjan (1964), Nepal–China Boundary Treaty, Kathmandu, p. 31.
7 Nepali, Chitta Ranjan (1964), Nepal–China Boundary Treaty, Kathmandu, p. 69.
8 Notes exchanged on agreed points on the Sino–Nepalese boundary, Kathmandu, August 14, 1962.

On the other hand, any inhabitant of these areas who wishes to become a citizen of the country to which the land belongs, has to move from his present frontier and accept the citizenship of the acquired country. He was not permitted to retain his immovable property as it is, in his previous country. Therefore, he should have sold his land in cash within a period of one year. Otherwise, the government would take his land and compensation would be provided to him at a rate fixed by the local authorities of both frontiers.[9]

The survey teams replicated the details mentioned in the boundary treaty in the actual demarcation, and jointly ascertained the position of the permanent border points. Thus, the borderline between Nepal and China was fixed clearly and formally. The joint teams carried out their assigned task of undertaking the survey work and erected border pillars and markers within about a year.

The joint boundary survey teams erected two types of reinforced concrete cement (RCC) pillars. The larger size pillar has a length of 150 cm, of which 80 cm is underground. The smaller size pillar is 80 cm, of which 30 cm is above the surface of the ground. A third category was a marker on hard rock. A center point was marked with the drawing of a square line.

The joint teams demarcated and established pillars and markers, specified by serial number 1 to 79 from west to east. Of these, there were 48 larger and 31 smaller size pillars. In addition, they established 20 offset pillars, in locations near the possible disappearance of the main pillars due to natural circumstances. The total number of constructed pillars and markers was 99. The erected main pillars/markers' details are as follows:

Joint Team No.	**Demarcated Segments**	**Number of Main boundary Pillars/Markers**
1	Lipudhura to Lapche Pass	12
2	Marem Pass to Chakla Pass	20
3	Gyala Pass to Thaple Pass	7
4	Kerabas to Chusumdo	12
5	Bhaise Bridge to Neule Bridge	10
6	Popti Pass to Tiptala Pass	18
Total		79

Figure 4: *The demarcation plan.*

The demarcation of the Nepal–China border began by establishing the 1st boundary pillar at Tinkar pass (where the watershed between the Kali River and the Tinkar River meets the watershed between the tributaries of the Karnali, on the one hand, and the Tinkar, on the other hand). The 79th boundary pillar was established at Chabuk pass (where the watershed between the Khar River and the Chabuk River meets the watershed between the Khar and the Lhonak Rivers), 14 kilometers west of the Jhinsang peak lying at the tri-point of Nepal–China–India.[10] Similarly, the western tri-point may be located a few kilometers west of pillar number 1, erected at Tinkar Pass. Since no triple-point pillars were constructed at the Nepal–China–India tri-junctions, the border demarcation is incom-

9 Devkota, Grishma Bahadur (1983), Nepalko Rajneetik Darpan (Political Mirror of Nepal) Vol. III, Kathmandu.
10 Nepali, Chitta Ranjan (1964), Nepal–China Boundary Treaty, Kathmandu, p. 31.

plete on both ends of the borderline. This could not be accomplished due to the absence of an Indian representative at the relevant time. Such common tri-point pillars must be constructed in the presence of representatives of the relevant three countries.

The total length of the demarcated borderline was 1,439.18 kilometers. The position and condition of the constructed boundary pillars were clearly indicated on detailed maps. The maps are included in the border treaty, so that the maintenance and reconstruction of broken, damaged, or missing pillars could be done at their actual locations.

The border treaty that was signed between Nepal and China was signed in accordance with the wishes of the leaders of the two states. The construction of the boundary pillars was completed within a period of one year without any discrepancy, and the Nepal–China boundary protocol was signed on January 20, 1963. With this signing, the border that had remained undefined for thousands of years was formally demarcated by a scientific method.

5.2 The Nepal–India Boundary Demarcation

It was realized and agreed that the border demarcation between Nepal and India would be impossible to achieve without carrying out a survey. Thus, commissioners from both sides were appointed for the demarcation, according to the pre-conditions, to establish well-defined borderlines. In addition, there were also provisions for exchanging portions that jot in and out of the straight line based on the principle of clarity and mutuality. The commissioners agreed that if the land of any individual extended across the boundaryline, the issue would be put before the governments of the two countries to solve the dispute. The Commissioners were also given the authority to make agreements and to arrange exchanges of such lands, to allow the landowners to remain within their previous territory. It was also agreed to carry out a survey to establish border markers, and to exchange documents bearing the borderlines, for approval by both governments.

With this mandate, the border demarcation work between Nepal and India started with the spirit of the Treaty of Sugauli (ratified on March 4, 1816). Surveying, demarcating the border, and constructing pillars started just after the monsoon season of 1816. The borderline was divided into nine segments, starting from point A to J. Point A was located at Phalelung of the Panchthar district, whereas the last station J was established at Brahmadev Mandi of the Kanchanpur district.

The boundary line between the two countries was surveyed and demarcated in the years 1816 to 1860; 1882; 1885; 1906; 1940–41; the line was divided into nine different sectors with 913 boundary pillars, erected from Phalelung to Brahmadeo Mandi. The demarcation work started from east to west.

In the first stretch, 26 pillars from Phalelung to Antu Hill and an additional 120 pillars from the origin of the Mechi River to Bhadrapur were constructed. Then, it continued westward from Bhadrapur to the Koshi, Lakhandehi, Uriya, and Narayani Rivers along the second to the fifth sectors, and 101, 113, 73, and 61 pillars were erected, respectively. It was further extended to Arrah Nala, Tal Baghaura, and the Sharda River and ultimately to Brahmadeo Mandi as the ninth and last stretch erecting 72, 95, 211, and 41 pillars, respectively, along the boundary line.

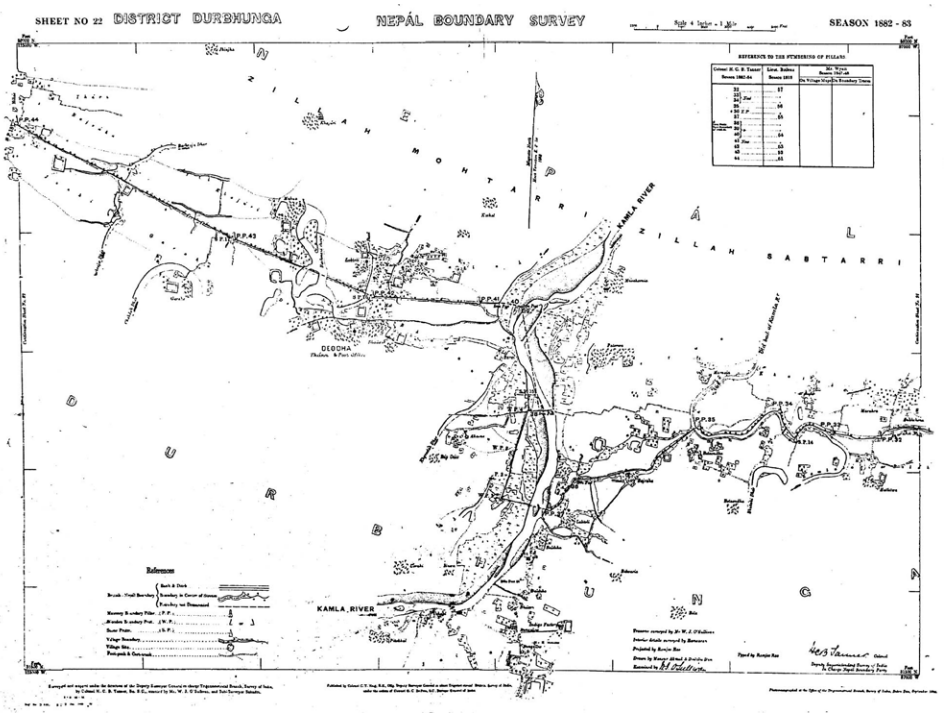

Figure 5: *A boundary map.*

The survey and demarcation work was not completed during the British regime in India.[11] The areas north of Brahmadeo Mandi along the Kali River in the western segment and north of Phalelung along the Singhalila in the eastern segment had not been surveyed and demarcated. The uppermost area of the Kali River north of Brahmadeo Mandi, characterized by a deep river basin in the mountains, remains to be demarcated. Where the river emerges from the gorge to the plain area near Brahmadeo Mandi (Boundary Pillar1), it has branches and sub-branches southward on the fan-shaped flood plain.

Description of a Masonry (Junge) Pillar

Masonry boundary pillars were erected during the demarcation. PM Jung Bahadur Rana (1846–1877) maintained all the main Nepal–India boundary pillars so that they would retain the same shape and size. He also maintained and painted with lime water those pillars that were constructed before his regime. The masonry pillar was named Junge Pillar after him. Since then, the Nepalese people used to call these pillars Junge pillars, and Junge became synonymous to a masonry boundary pillar.

Junge pillars, with their fixed shape and size, are considered the main boundary monuments. Their height is 2.2 m and their diameter is 3 m. Their foundation is 1 m deep under a rectangular platform 2 m by 1 m. The pillar is constructed with bricks, mortar of brick-powder, as well as limestone and glued materials. It is a pre-cast monument homogenously round in shape with a top round and smooth slope. A ditch, 2.5 m deep

11 A letter from the British Embassy, Kathmandu to the HMG Ministry of Foreign Affairs, July 2, 1980 with an attached note.

and 1.5 m wide, is dug around the pillar for protection. It is painted with lime water so that it can be seen from far.

After the Sugauli Treaty, Nepal and the Company Government had disputes regarding several places over the demarcation of the border. For example, in 1840, Nepal claimed the ownership of several settlements including the lands at Ramnagar. This dispute was settled by a mutual understanding in a friendly manner, after the Company Government had gathered 95 witnesses, including the village chief, priests, and other Nepalese personalities.

Nepal and Sikkim had disputes over the ownership of Antu hill. There are two river origins from the two sides of Antu hill. Sikkim claimed that the northwest origin was the source of the Mechi River, and thus Antu hill should belong to them. Nepal stated that the river originating on the northeast is the source of the Mechi River and thus Antu hill should belong to Nepal.

The King of Sikkim asked the British to mediate. The British assigned two British officials, J.W. Grant and Captain J.S. Lloyd, to arbitrate. They decided in 1827 that Antu hill belongs to Sikkim. The government of Nepal appealed to the government of Bengal against the decision. Dr. Campbell was appointed to investigate the claims. Sikkim argued that the Antu area had belonged to them long before the Gorkhali's attack, and that the Gorkhali had captured it in a war. Nepal asserted that since Antu hill lies west of the Mechi River, it falls within its territory. In this context, the question arose as to which of the two sources was the origin of the Mechi River. The British theorized that the river, which is longer, wider, and deeper, and its water volume discharge is bigger, should be considered as the main river, and the other as its tributary. Under this provi-

Figure 6: *A boundary pillar .*

sion, the river flowing from northeast was longer, wider, and had more discharge; thus was called the Mechi River. Campbell concluded in 1838 that Antu hill, lying west of the Mechi River, belongs to Nepal. Thereafter, the other river flowing northwest of Antu hill was called the Siddhi River.[12]

Disputes and Conflicts between Nepal and India in the Present Era

The distance between the boundary pillars during the demarcation from 1816 to 1906 was 1–2.5 km. Portions of the line are sharply bent in between boundary pillars, thus creating ambiguity regarding the exact boundary location. A No-man's land having a ten-yard width (Das Gaja) on both the sides was not maintained in these areas. Later, these were causes of disputes in a few spots.

In addition, in the course of time, portions of the dense forest (Charkoshe Jhadi) along the Tarai border strip were cut off and cleared to provide settlements for the hill people. Some border rivers changed their courses during the monsoon floods and eroded the boundary pillars. Owing to population pressure in Indian settlements, especially in the Bihar State, the Indian inhabitants encroached the Nepali frontier in order to sustain their livelihood; later they migrated into Nepali territory.

In due time, the government of Nepal was aware of of the Indian encroachment and occupation. The government formed an inspection team. They inspected the location of border pillars and the No-man's land during the dry seasons of 1965 to 1967. Finally, they submitted a report to the government. Hundreds of boundary pillars were missing and others were destroyed or damaged. Many spots on No-man's land were cultivated.

Nepal communicated with India for almost a decade to formulate a common joint inspection mechanism regarding the boundary. On February 25, 1981 the two sides agreed to work jointly to clear and maintain the borderline, and formed the 'Nepal–India Joint Technical Level Boundary Committee' (NIJTLBC). The first joint meeting was held in New Delhi, India from November 15–17, 1981. The terms of reference (TOR) of this joint committee were as follows:

1. To resolve deputes using joint survey teams for field surveys and mapping.
2. To fix working procedures and to determine basic working materials for the field teams, which are agreeable to both countries.
3. If there are no old maps, materials, papers, documents and data available, the boundary will be demarcated traditionally as agreed upon by both sides.
4. To make joint field inspections and provide joint directives.
5. To revise specifications, norms, and standards for surveys and strip mapping.
6. To evaluate the progress of the field teams.
7. To determine the target and working sectors for the field teams.
8. To form joint Working Groups as and when necessary under the joint committee.
9. To form district level joint committees.

12 Singh, Amar K.J. (1988) Himalayan Triangle, The British Library, London, p. 183.

10. To hold joint meetings two times a year in Nepal and India, taking turns.
11. To submit work progress to the respective governments.

At the same time, to realize the TOR, it was agreed that five to seven joint survey and mapping teams would be sent to the border field areas. The following TOR for the field teams was defined:

1. Repair and maintain the broken and dismantled boundary pillars.
2. Establish the missing pillars on the basis of co-ordinates and old documents.
3. Re-erect pillars, which are washed away by a river at their positions.
4. Establish and erect subsidiary pillars in between major pillars, which were previously established at a long distance.
5. Construct reference pillars of old main boundary pillars, as necessary.
6. Demarcate the boundary line in the sectors where delineation was not made during the British India period.
7. Establish coordinates of the pillars and markers using the Global Positioning System (GPS).
8. Prepare strip-maps, half a kilometer on each side of the borderline.
9. Remove illegal occupation and construction, if they exist, on the No-man's land (*Das Gaja* area).
10. Keep clear records of the No-man's land area, on each side of the border.

The NIJTBC was formed to resolve and settle the outstanding border problems and issues between two countries. The committee was composed of eleven to thirteen member delegates from the Ministries of Foreign Affairs, Home Affairs, Defense, National Planning Commission, Law & Justice and Survey Department, led by the Director General of Survey of Nepal and the Surveyor General of India. The committee worked together for 26 years.

Minor issues were resolved, a few pillars were erected, and strip-maps were prepared but the joint committee could not settle major issues of dispute and encroachment. In December 2007 the Survey of Nepal mentioned that there are unsolved issues in more than 54 places.

On May 31, 2001, during the demarcation, the government of Nepal decided to adopt a policy, which was reciprocated by India, as follows:[13]

1. The demarcation in the mountainous area will follow the maps and records. If there is no document, the watershed principle will be followed.
2. The demarcation in other areas will follow the boundary line as shown on the basic map and supporting documents.
3. If there are boundary pillars, a straight line from one pillar to the other will be the boundary line.
4. If there is no straight line of the border, additional pillars will be erected on the curved lines to make the line straight between boundary pillars.

13 Survey Department Briefing Paper (December 27, 2007) to the Constitution Assembly IRHR, Kathmandu.

The Nepal government cabinet also decided on December 8, 1988 that:

1. A Fixed Boundary Principle will be adopted for demarcating the Tarai low land area, on the basis of the boundary line shown on the maps agreed upon by both sides, which were prepared after the Treaty of Sugauli.
2. In the case of mountainous rivers, the median line of the high banks will be taken as the border between two countries.

The joint demarcation work started in 1981. From 1992, after achieving considerable demarcation progress, strip-maps were scientifically prepared, using GIS, GPS, and digital mapping technologies. To date, 182 strip-maps on a scale of 1:15,000 have been prepared and a borderline has been drawn on the map. It is thought that it covers 97 percent of the total length of the border, except the disputed Susta area and the encroached Kalapani area.[14] However, there are disputes and conflicts regarding the cross-holding occupation in some other spots. The JTC could not resolve the issues underlying these occupations, encroachments, and disputes at the technical level. The reasons regarding the other remaining disputes include technical reasons, like differences of opinion regarding basic materials such as maps and old documents for demarcation, the slackness in joint survey field teams, and others. The remaining three percent of the border issues make up 56 km of the total span of the Nepal–India border. The Kalapani-Limpiyadhura encroachment refers to 17 km, Susta to 24 km, and other 68 spots of dispute refer to 15 km. These disputes cover approximately 60,650 hectares of land.

The main issues that remained in order to settle the borderline were due to the following:

1. Cross-holding occupation.
2. Controversies regarding the actual habitation and the title of land ownership.
3. Disagreements regarding common basic maps and supporting documents.
4. Changing of river courses during floods.
5. Disagreements regarding the demarcation of river courses during the treaty of Sugauli.
6. Rivers washing out pillars, which created controversies regarding the coordinates.
7. Up-rooting of the precast concrete pillars by frontier inhabitants of India.
8. Obscurity regarding the borderline due to vandalism and demolition of border pillars.
9. Encroachment of No-man's land from either side of the boundary, mainly from India.

Territorial Disputes Immediately after the Sugauli Treaty

1. After Nepal lost the plain area from the Koshi River to the Kali River, disputes arose regarding the northern boundary line of the plains – for example, whether the top ridge or the southern foot or northern foot-hill of the Chure Range

14 Survey Department (April 21, 2009), Brief Account on Nepal–India and Nepal–China Boundary Surveying-Mapping (Briefing to IRHR Committee members), Kathmandu.

would be considered as a boundary line. In this regard, disputes erupted in the area from the Dunduwa Range of Dang to Arra Nala and Taal Bagoda in 1817.

2. Similarly, there was a dispute regarding ownership of Antu Danda of Ilam in 1825.
3. There were disputes until 1838 regarding the origin of the Mechi River, whether the river originated from northeast or from northwest.
4. In 1840, there were claims and counter-claims regarding the ownership of several villages and settlements in the Ramnagar area.
5. There was also a 'mine-and-yours' controversy regarding the border areas adjoining the Tirhut and Sarun districts of India.

6 BOUNDARY DOCUMENTATION

Various boundary documents, including strip-maps and descriptions of the pillars, markers, and boundary protocols were prepared during the boundary business. The following are the main documents.

6.1 Nepal–China Boundary Documentation

Following hundreds of years, through which the boundary remained undetermined, it being used according to the tradition and conveniences between Nepal and Tibet Autonomous Region China, the boundary treaty signed on October 5, 1961 determined the borderline in a formal and scientific manner. The treaty also solved the minor scuffles that remained, and gave rise to the borderline as a symbol of peace and friendship. After signing the treaty, officials from both countries expressed satisfaction for resolving once and for all, the problems that had remained throughout history. It was also felt that the treaty greatly contributed to the future generation of both countries.

The First Boundary Protocol-1963

After the process in which land possessed by one party was exchanged to the other, and pastureland used traditionally by one side or the other was exchanged, and after the border pillars were constructed, a protocol was required to formalize the demarcation of the borderline. To fulfill this need, the boundary protocol was prepared and it was signed by Dr. Tulsi Giri, Vice-Chairman of the Council of Ministers, on behalf of Nepal and by the Deputy Prime Minister and Foreign Minister Chen Yi on behalf of China on January 20, 1963 in Beijing.

The protocol contains five sections. Section 1 (Articles 1 to 5) mentions general provisions. Section 2 (Articles 6 to 19) describes details about the alignment and demarcation of the borderline. Similarly, Section 3 (Articles 20 and 21) describes the positions and locations of the border pillars; Section 4 (Articles 22 to 31) mentions the maintenance of the borderline and the border pillars; and Section 5 (Articles 32 and 33) deals with the final clauses (descriptions.) The protocol has a provision stating that there will be a joint inspection of the whole length of the border by teams from both countries every five years. But the inspection may be postponed whenever both parties agree. Apart from this, if one side requests a joint inspection of any part

of the border, and the other side consents, there will be a joint inspection as deemed necessary.

Although the safeguarding of the border was taken care of by both sides, only in May 1977, 14 years after the first border protocol had been signed, did the first Joint Border Inspection Committee inspect the border pillars. The committee was assigned the task of maintaining damaged pillars and reconstructing missing pillars, at their original positions.

Under the auspices of this committee, six joint survey teams were deployed in the fields. Apart from maintaining the damaged border pillars, the teams worked to re-establish lost and missing pillars on the basis of previous coordinates and description cards. The joint survey teams also numbered each pillar, and updated the 1-kilometer wide strip-maps on both sides of the borderline at a scale of 1:50,000. Thus, the joint survey teams completed the task assigned to them in about one-and-a-half years without facing any obstacles and difficulties. The Joint Border Inspection Committee drafted the second boundary protocol on the basis of the first Nepal–China Border Inspection work. The protocol was signed by both countries on January 20, 1963.

The Second Boundary Protocol-1979

A joint Boundary Inspection Committee was formed in May 1977 with the aim of jointly inspecting the condition of the boundary pillars along the Nepal–China boundary and repairing and reconstructing the damaged pillars. To this end, both sides dispatched six teams in the field. They drew maps in accordance with the results of the joint inspection, and the boundary line between the two countries was marked correctly on the maps.

After the formalities were completed, the Second Nepal–China Boundary Protocol, along with the maps included, was signed on November 20, 1979 in Kathmandu by the Nepalese Foreign Minister, K.B. Shahi, and the Chinese Foreign Minister, Huang Hua. After the signing, both sides expressed satisfaction with the job completed by the Joint Border Inspection Committee, and it was also taken as an example of the good neighborliness and the peaceful co-existence between the two countries. The charter, thus, renewed the First Boundary Protocol signed in Beijing on January 20, 1963, and established itself as the Second Boundary Protocol between Nepal and China.

Despite various border agreements, border treaties, and border protocols signed between Nepal and China, some people living at or near the frontier faced difficulties because of the scarcity of pastureland to graze animals like sheep, mountain goats, donkeys, mules, yaks, and consequently they were forced to cross the borderline to graze them. To control this irregularity in the border, a joint meeting between Nepal and China decided on the 'cross-border pasture of the frontier people' on September 30, 1983, thus allowing inhabitants from both sides to take their animals across the border for grazing during certain periods of the year. This decision allowed the people of the Humla, Mustang, Sindhupalchowk, and Dolakha districts of Nepal to cross the boundary, which was authorized by certain Village Development Committees (VDCs) and to take their cattle to the Burang, Jhongba, and Nyalam provinces of the Tibetan Autonomous Region of China for grazing at the assigned places. Arrangements were also made for people from the Burang province to cross the border, thus allowing them pasture facilities at certain VDCs of Darchula, Bajhang, and Humla of Nepal. Provisions for the number of cattle, the duration of the grazing period, and compensation for al-

lowing the use of pastureland were also made. Provision was also made that if anybody kept more than the allotted number of cattle in another country's territory and for a longer period, then a certain percentage of the cattle would be confiscated and the remainder would be forced to leave the area within a specified period. A joint decision was also made stipulating that the concerned country would have to develop pastureland within its own territory within five years. People living in the frontier areas were prohibited from hunting, collecting herbs, collecting fodder, harvesting bamboo, and engaging in black marketing, and if anyone was found guilty in indulging in such illegal activities, action would be taken against them under the law of the country where such incidents occurred.

The Third Boundary Protocol-1988

After ten years of the joint border inspection, both countries felt that it was time to make another border inspection. Thus, the first meeting of the second Nepal–China Joint Border Inspection Committee was held on February 28, 1988 in Beijing. The main task of the joint committee was to carry out a joint inspection of the borderline, maintaining the damaged or collapsed border pillars, re-constructing the lost or missing border pillars, and constructing new border pillars. During the course of the survey, the committee was assigned the task of preparing an updated map by keeping a record of the newly constructed and maintained border pillars, as mentioned in the border maps under the previous protocol, and documenting and preparing the final draft of the second China–Nepal joint inspection.

Five joint inspection and survey teams were assigned to work on 79 border pillars in the border areas under the joint committee. The joint teams, in a three-month period, repaired 13 border pillars and reconstructed 7 others in a period of three months.

They also found border pillars 57 and 62, which were not found in 1979, and constructed border pillar 33, 37, and 38, which had not been constructed earlier. The maps of the areas, where the new border pillars were constructed, were drawn at a scale of 1:20,000.

The second session of the Joint Border Committee was held in Kathmandu in August 1988 to evaluate the work of the joint survey teams. The session assessed the statistics and the report presented by the joint survey teams, and some minor technical problems were resolved in a cordial manner. In addition, the final document of the China–Nepal Second Joint Inspection Committee was prepared after a discussion. The document, termed the China–Nepal Third Boundary Protocol, was signed by Shailendra Kumar Upadhyaya, the Foreign Minister of Nepal and by Qian Qichen, the Foreign Minister of China in the presence of the Chinese Prime Minister Le Peng on December 6, 1988.

The Fourth Boundary Protocol

It was decided in a joint meeting held on November 30, 2004 to form a Nepal–China Joint Technical Committee (JTC) to inspect the border and to prepare the Fourth Boundary Protocol. As a result, the third joint inspection and border survey commenced on May 9, 2005. The joint teams inspected, repaired, and maintained a total number of 99 pillars and markers. The most interesting work of this period was to erect pillars 37 and 38 on the delineated position, which had been left pending during the last inspections. It filled the blanks left by the two previous joint surveys. Another important achievement was identifying border marker 57 and pillar number 62, which were not found during the first and second inspections.

Figure 7: *GPS surveying.*

During the third inspection, all the pillars and markers were measured, and each one's location was accurately confirmed with the help of an advanced GPS technique. Exact coordinates to the nearest centimeter of all border markers have thus been established.

Simultaneously, 57 sheets of border maps at a scale of 1:50,000 were prepared digitally by using GIS. This technology has been adopted to facilitate the implementation of joint survey works. Digital data have been created at various layers of the GIS, such as the latitude, longitude, and height of the markers, the contour terrains, water bodies, settlements, and greenery. The total length of the measured Nepal–China boundary line is 1,439.18 km.

In accordance with a joint agreement, China is responsible for determining and mapping the boundary survey, whereas Nepal is responsible for the inspection and confirmation. Notably, the present joint inspection committee has been working since 2005. However, the work has not yet been completed in order to sign the Fourth Boundary Protocol. If we look back at the work of previous Boundary Protocols, the initial border demarcation work was completed within two and a half years, from 1961–62. Similarly, the first and second joint boundary inspections were completed in two and one-year periods from 1977–1978 and 1988, respectively, and the protocol was duly signed.

However, the third joint committee has been working for more than seven years. All technical works, including preparation of digital strip-maps have been completed. 57 sheets of border maps were prepared, using GPS technology.

But a few issues have not yet been resolved. The first one refers to the location of the newly found boundary marker 57. The second refers to the so-called dual heights of Mt. Everest. As far as the height of Everest is concerned, China proposed to report it as 8,844.47 meters, as the rock height, thus declaring a height decrease of 3.53 m. They established the new height in May 2005, deducting the thickness of the ice on the top

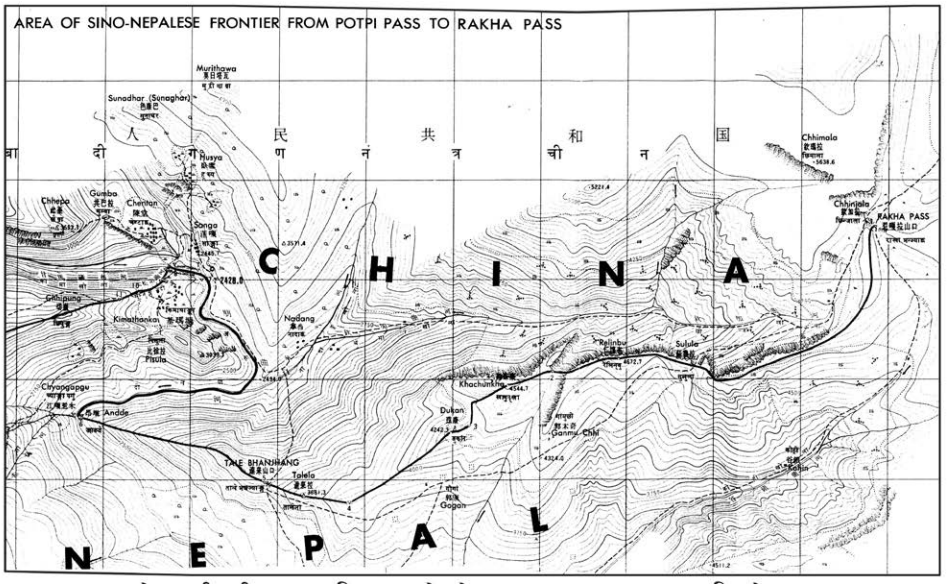

Figure 8: *Nepal–China boundary map.*

of Everest. Nepal is neither willing to accept the lowered height, nor the new height of 8,850 meters determined in 1999 by the US National Geographic Society.

During the joint discussions, China proposed to write on the map two heights of the peak of the Everest: the Chinese height (8,844 m) without the thickness of ice, and the traditional Nepali height (8,848 m) with the ice. Nepal hesitated in accepting the Chinese proposal. This is one of the reasons why the duration of the joint boundary committee has been prolonged.

The second reason is concerned with the locations of the recently found boundary marker 57. It should be located on the tip of the snowy Himal at a height of 5,738 m. However, it was found at a location slightly inside Nepal with reference to what was previously presumed. The map, which was prepared during the previous inspections without depicting marker 57, shows the borderline slightly north of this marker. If the borderline runs through this marker, there may be a question of approximately six hectares of land located on the Nepali side, which is barren and steep, and which has no use. According to the media, Nepal claimed that the marker was not established in an appropriate place. The Chinese side countered that it was not moved from its original position, and that it was at the same point where it was originally established during the demarcation in 1962.

This may be one of the reasons leading to the incomplete status of the remaining issue of the third joint inspection. However, the joint field survey team submitted its field report, in which it mentioned the GPS coordinates to the Ministries of Foreign Affairs in July 2009, in the respective countries.

Both agreed upon a five-day joint boundary committee meeting on February 1, 2012 in Xian, China to settle the outstanding issues. This committe was also expected to prepare the groundwork for the signing of the so-called Fourth Protocol of Nepal–China

boundary maps. However, this meeting was cancelled by Nepal. The final agreement regarding the remaining open issues between the two states and the signing of the Fourth Protocol have been delayed; both sides are still waiting for an appropriate meeting.

6.2 Nepal–India Boundary Documentation

The Joint Technical Committee (JTC) demarcated 97 percent of the total 1,880 km-long Indo–Nepal border line within a period of 26 years –1,240 km as a land boundary and 640 km as a river boundary. There are 57 rivers, streams, rivulets, and brooks that act as Border Rivers. The main rivers are Mahakali, Narayani, Mechi, Rapti, Ghongi Uriya, Jamuni, Arrah, and others. 182 strip-maps were prepared at a scale of 1:15,000, covering half a kilometer on each side of the border line. The JTC delineated 8,853 boundary pillars, including Junge masonry pillars, on the maps, 873 of which are main and 7,680 are subsidiary pillars. It is notable that 3,227 subsidiary pillars are yet to be constructed on the ground. Half of these pillars under construction are in the river sectors. The numbering of the border pillars began from east to west, in a few segments.

182 strip-maps have been primarily signed jointly by the Surveyor General of India and the Director General of the Survey Department of Nepal on December 19, 2007. India is exerting pressure on Nepal to sign these maps by the plenipotentiaries of both countries. But Nepal is of the opinion that it would not suite international practice to sign incomplete documents. Thus, the maps will be signed after the completion of all boundary issues, since the maps will be the only attached document during the signing of the Boundary Protocol.

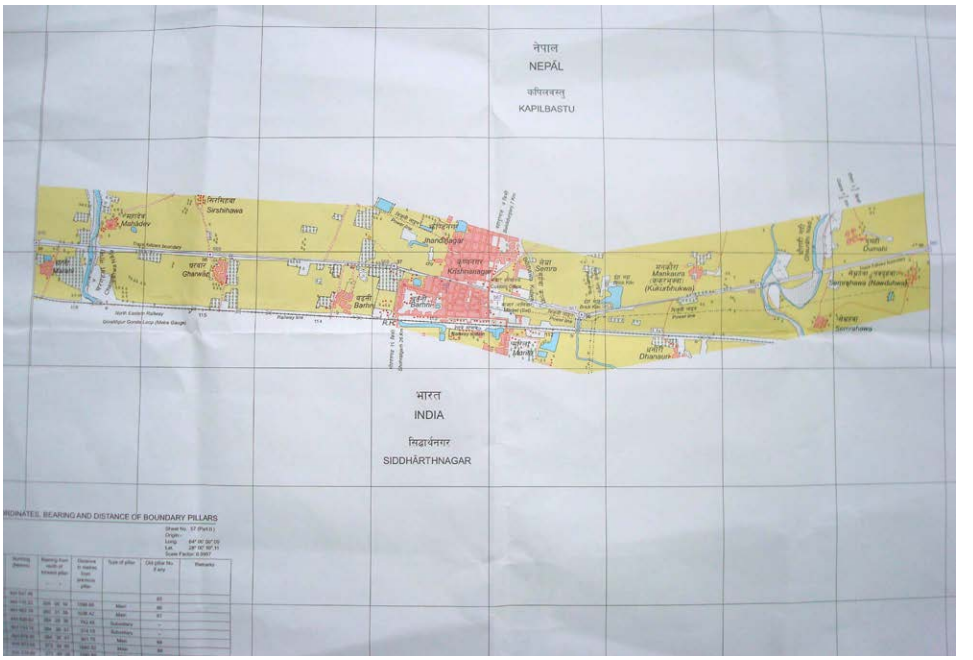

Figure 9: *Nepal–India boundary map.*

Figure 10: *Mt. Everest.*

6.3 Examples of Interesting Special Cases

The case with China regarding its claims concerning Mt. Everest and the two cases of Kalapani and Susta with India will be discussed next.

The Case of Mt. Everest

Nepal and China signed the Sino–Nepal Boundary Agreement in Beijing on March 21, 1960 to form a joint border committee to demarcate the border between Nepal and China, to carry out a survey of the border, to erect border pillars, and to prepare a draft for the border treaty. Returning to Kathmandu, the Prime Minister of Nepal had a press conference on April 3, 1960 and disclosed, off the record, that Mt. Everest lies in the area claimed by China. China argued that Everest belongs to China but Nepal rejected that claim. The claim over Everest was considered something new during the Prime Minister's visit to Beijing. Since Nepal rejected it outright, there were no further talks.[15] But it was not known how much area of Everest was claimed by China.

PM Koirala said that there could be talks regarding China's claim over Mt. Everest during the visit of Chinese PM Chou En-Lai to Kathmandu. He also hoped that the claim over Mt. Everest and other border disputes could be resolved using the working procedure of the border agreement.

China said that the Tibetan name of the peak as Chomolugma had been in use for a long time. In reply, Nepal said that the Nepali name is Sagarmatha. According to the Chinese, that name was recently coined. During the talks in Beijing the two parties just exchanged maps. The Chinese maps, which were drawn on the basis of Chinese history, show the mountain within Chinese territory, whereas the Nepalese maps, which were drawn on the basis of Nepalese history, show the mountain on the boundary line

15 Risal, Bhairab, Patrika Weekly, September 2–8, 1999, p. 8.

between the two countries. At that time, PM Koirala made the point that Nepal had always regarded this mountain as its own. Chairman Mao Tse-tung, when he received PM Koirala, expressed the view that they could follow the Nepalese delineation, which shows the mountain on the boundary line, with the northern half of the mountain belonging to China and the southern half of the mountain belonging to Nepal. Following Chairman Mao Tse-tung's talks with PM Koirala, the government of Nepal has long maintained this attitude.[16]

Before his visit to China, PM Koirala consulted with the noted historian Baburam Acharya. Acharya told him that his studies a long time ago had found that the Nepali name for Everest was 'Sagarmatha' and that it was recognized at the governmental level in 1956. Although Acharya had named the peak Sagarmatha in 1938, Nepal could not make this point to the Chinese because the name was formally recognized nearly three decades ago.

According to Baburam Acharya's research and investigation, Sagarmatha was formed by the combination of two words Sagar and Matha. He had maintained that the word Sagar is the transformation of swarga (heaven) in Vedic and Sanskrit letters, and that it is in use in Nepali language. For instance, the Nepalese people say "Sagar Dadhyo" when the western horizon appears to glow at sun-set time and it is always remembered by local inhabitants. Similarly, Math or Matha signifies the sky or the head, the tallest part of the body. In summary, Sagar denotes the heaven or sky and Matha is the head or crest. In this way, Sagarmatha means 'the head reaching up to the sky.' Thus, it becomes pertinent and meaningful to call the peak as Sagarmatha in Nepali language, since it is the highest mountain in the world.[17]

Friendship Peak

China might have claimed Mt. Everest because Nepal failed to present a map, made by Nepal, satisfactory to China, and its original Nepalese name for the peak in a convincing manner. Still, Nepal kept on saying in a meek tone that Sagarmatha belongs to Nepal. This was also the reason that Chairman Mao Tse-tung accepted that Chomolungma and Sagarmatha were the same peak and agreed to the borderline according to the map presented by Nepal. He had also suggested to abandon the different names used in the two countries and outside such as Sagarmatha / Chomolungma / Mount Everest; and rather, to call the peak 'Friendship Peak' as a symbol of friendship between Nepal and China.

In the meantime, the Chinese PM Chou En-Lai paid a three-day-visit to Nepal to strengthen Nepal–China relations and to resolve the issue of Everest. In this connection the Chinese prime minister said at a press conference on April 28, 1960 that 'Mount Everest belongs to Nepal'; thus, the Everest issue was resolved at once.[18]

In a reply to a correspondent who asked why China had given up regarding its claim over Everest, PM Chou En-Lai said that PM Koirala had provided maps and supporting documents to China supporting the claim. China studied and examined the maps at political, technical, administrative, and diplomatic levels; and the government of China reached a conclusion that those maps are genuine. Therefore, he said that Everest belongs to Nepal.

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16 Bhasin, Avtar Singh (1994), Nepal's Relation with India and China Documents 1947–1992 Vol–II: 1264.
17 Acharya, Baburam (2003), China Tibet and Nepal (in vernacular), Kathmandu, p. 250.
18 Risal, Bhairab, Patrika Weekly, September 9–15, 1999, p. 8.

Accordingly, the northern face of Everest belonged to China and the southern face to Nepal. The highest portion with the terracing slope is on the side of Nepal. Any climber reaching the peak cannot stand on the steep slope on the Chinese side, but rather on the sloping terraced portion of the peak, which is on the Nepalese side. So Mt. Everest is considered to be in Nepal.

The Chinese Prime Minister also informed the press that the Nepalese Prime Minister had told them that historically anyone who climbed Mt. Jolmo Lungma/Sagarmatha from the south had to secure a visa from Nepal, whereas anyone who climbed the mountain from the north had to obtain a visa from the Chinese Government. He said that the Chinese had agreed to these terms.

The peak of Mount Everest

From the peak of Mt. Everest the slopes go down towards three different directions. One slope declines to the west; a second slope declines towards the northeast; and a third slope declines towards the south. The western ridge is long and steeply slanted. The northeastern slope appears to be very steep as a cliff, and the southern slope, which is less steep, bears a considerably gentler decline and is a little more comfortable than are the other two. The western and southern ridges act as the international borderline between Nepal and China. The northeastern slope lies completely on the Chinese side. The northern face of the ridge is more dangerously steep than the western and southern ones. In comparison with the others, the southern side located towards Nepal is less steep for climbing.

Year	Country	Name	Height in meters	Remark
1852	India	SIR GEORGE EVEREST, RADHANATH SICKDHAR, TEJBIR BUDHATHOKI, Survey of India*	8,840.07	±3 m Peak was named as XV
1907	India	SIR BURRAD, Survey of India*	8,883.36	
1922	India	DE GRAFF-HUNTER, Survey of India*	8,863.85	
1954	India	B.L GULATEE, Survey of India*	8,848.00	
1975	China	WANG WANGCHUK, Chinese Survey Team*	8,848.13	± 0.35 m
1987	Italy	PROF. A. DESIO, Milan University*	8,872.00	
1993	Italy	PROF. A. DESIO, Milan University*	8,846.00	
1999	USA	WASHBURN, National Geographic Society*	8,850.00	±2 m
2005	China	Y. CHEN , Chen Bangzhu, State Bureau of Surveying and Mapping**	8,844.43	Rock Height ±0.21 m
2011	Denmark	RENE FORSBERG, National Space Institute (DTU) ***	8,848.90	Preliminary results ±0.10 m

* www.nepalhomepage.com/himalaya/sagarmatha.html
** www.explorersweb.com/everest_k2/news.php?id=821
*** www.thehimalayantimes.com/fullTodays.php?…Everest+going…grea.

An important issue about the peak of Everest regarding climbers is that there is a 2 m by 2.3 m sloping terraced area, on the southern side of the demarcating line that follows the water-parting ridge. That piece of sloping terraced area lies on the Nepalese side. The Chinese side of the borderline is almost vertical. Anyone conquering Mt. Everest from the northern Chinese side cannot set foot on the peak without stepping on that sloping terraced area on the Nepalese frontier, and no one can remain standing on the water-parting ridge of the borderline. This sloping terraced area of the world's highest summit, which is located on the Nepalese side of the borderline, links the summit with Nepal. That sloping terrace with the highest peak cannot accommodate more than seven or eight people at a time.

Various surveying organizations have challenged the nominal height of Everest. The known height used to be 8848 m. On October 15, 2005, however, the Chinese State Bureau of Surveying and Mapping declared that 'The elevation of Mt. Everest's summit is 8844.43 m.

Preliminary results of a survey being jointly undertaken by the National Space Institute (DTU) of Denmark and the Department of Survey (DoS) of Nepal obtained a height of 8,848.9 m in the World Height System, 90 cm higher than the current official value of Nepal. The margin of error is about 10 cm. In connection to height determination, the geoid of Nepal was measured through an airborne gravity survey in December 2010. The Himalayas are the most rugged gravity field on the planet, and one of the goals of the 2010 AD 35,000 feet high airborne survey was to determine a revised height of Mt. Everest. Scientists think Everest is growing higher by about 4 mm every year due to an uplift caused by the Indian tectonic plate pushing northward.

Regarding the history of measurement of the height of the Everest, the followings are the different measurements made by various institutions:

Case Study of the Kalapani-Limpiyadhura Issue

Kalapani-Limpiyadhura is located at the northwestern corner of Nepal, where the frontiers of Nepal, India, and China meet. This area is situated in the eastern part of the Kali River, as drawn on the historical maps published before 1860. According to the Treaty of Sugauli, the Kali River is the western boundary of Nepal with India. The boundary of the Kali river is delimitated by Article 5 of the treaty. It states "*the Rajas of Nepal renounces for himself, his heirs, and successors, all claim to or connection with the countries lying to the west of the river Kali and engages never to have any concern with those countries or the inhabitants thereof.*" Hence, the origin of the Kali River should be the northwestern border corner of Nepal with India and China as a tri-point.

The river is known as Kali at the upper reaches, Mahakali in the middle portion, and Sarjoo or Sharda or Gogra or the western branch of Gogra where it comes down to the plain area. The origin of the Kali River has not yet been demarcated. There is a controversy and much debate regarding determining the point of origin of the Kali River, whether it originated from Limpiyadhura (5,532 m), Lipulek (5,098 m), or an artificial pond (4,571 m). The second debate is with regard to the location of Kalapani, whether it is located in Nepal or India. This is an issue of national interest, and has raised much outcry in Nepal since October 1996.

Regarding the determination of the origin of the Kali River, there are three different opinions: One opinion, of scholars in Nepal and which is based on historical documents,

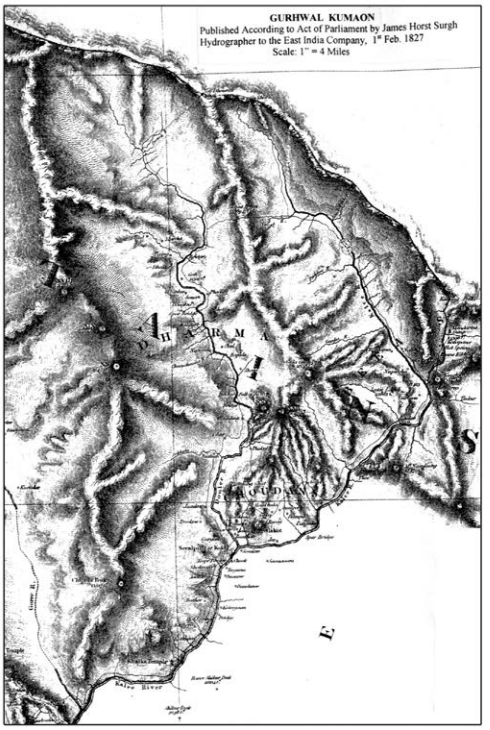

Figure 11: *1827 map of the area.*

old maps, and hydrological facts, considers Limpiyadhura as the origin of the Kali River in the Treaty of Sugauli. A second opinion, of the Government of Nepal, considers the nearby Lipulek pass as the origin of the Kali River. The third, of the Indian team of the Nepal–India Technical Level Joint Boundary Working Group, considers the origin of the Kali River at a small pond, near the temple of Kali, which is located south of Kalapani and further south of the Pankhagad stream.

A description of the origin of the river is not mentioned in the treaty. It was not necessary to make a description of the river at that time, because there was no controversy and there was only one river that was known as Kali. In order to come to a certain conclusion, one has to study the historical documents and old maps from the time of the treaty, and to study the hydrological facts.

On the historical maps of 1827, 1850, 1856, and on other maps, the river, the origin of which is at Limpiyadhura is called the Kalee; it was delimited by the Treaty of Sugauli, as the western borderline of Nepal.

Kalapani itself is located east of the Kali River, an area which, according to the Treaty of Sugauli, is considered territory of Nepal.

As far as maps as evidence are concerned, there are many pre-1860 maps, depicting the origin of the Kali River at Limpiyadhura 16 km northwest of Kalapani. These 1860–1880 maps maintain the geographical position of the Kali River and the location of Kalapani, but the name Kali was changed to Kuti and then to the Kuti Yangti River. On post-1880

maps the name of the river, which originated from Limpiyadhura, was changed to Kuti Yangti and a river flowing from the nearby Lipulek Pass was called the Kali River, causing Nepal a loss of almost 310 square km of land, west of the Lipu River.

A 1879 map of the Survey of India shows the borderline further east of this area and toward the river, and shows the northern origin of the border at an artificially formed pond, then, along one and a half km along a rivulet. This cartographic presentation shows Kalapani on the Indian side, making Nepal lose an additional 62 square kilometers of territory.

Since 1962 India has maintained armed forces at Kapalani. During the war with China, the Indian Army built permanent structures with bunkers in the area of Kalapani, east of the Kali River. On June 9, 1998 the PM of Nepal claimed that Kalapani is within the territory of Nepal as depicted on the maps of 1850 and 1856, published by the Survey of India. He said that the dispute needs to be resolved by carrying out a comprehensive study of all historical documents and proofs.

The issue of Kalapani was mentioned during visits of senior Indian officials to Kathmandu (the Indian PM in June 1997 and the Indian Minister of External Affairs in September 1999) who forwarded the issue to the joint boundary working group. But the issue has not been resolved at the technical level in spite of the instructions.

The Kalapani issue was raised during the meeting of the Nepal–India Boundary Joint Working Group on July 17, 1998. Nepal proposed to take the maps of 1827, 1850, and 1856 as the working materials to be used by the joint survey teams. The Indian side rejected these maps as irrelevant and unscientific. Instead, they claimed that the maps prepared during 1879 and 1928/29 must be taken as the basic working materials to the field. In countering this claim, Nepal stated that those maps are baseless. The meeting ended with no decision. The issue of Kalapani-Limpiyadhura should be resolved amicably on the basis of maps from the treaty of the Sugauli era.

Case Study of the Susta Border Dispute

Another interesting case is Susta, which is situated to the east of the Narayani River in the mid-southern part of the Nawalparasi district in the area left over by the flood. On its west side flows the Narayani River, and it is surrounded by India on the north, east, and south by a curved boundary line. Owing to encroachment of a major portion of Susta VDC, the remaining area was merged with Tribeni VDC in 1980. Now it is called ward number 4 of Tribeni VDC.

The Susta area came within the Nepali territory when the British returned the Tarai region, from the Koshi River to the Rapti River, on December 11, 1816 instead of paying two hundred thousand Rs. annually, as per Article 4 of the Treaty of Sugauli. The demarcation of border pillars along the Susta borderline began in 1829, and in 1883–84–85 the border map was also prepared. The map shows the borderline being delineated from Tribenighat to Susta along the mid-current of the Narayani River. Where the borderline passes along the river to the south of Susta, the borderline leaves the river sector and turns west to catch the land boundary. Boundary pillars were constructed towards the west, bending from the Sagardinhi village. As a result, Junge masonry pillar number 1 was constructed at Sagardinhi and pillar number 2 was in Mangalbari. But no pillar was constructed along the river course. Since 1885, there has been a dispute between the two countries over a length of 24 km along the Gandaki River, from Tribeni

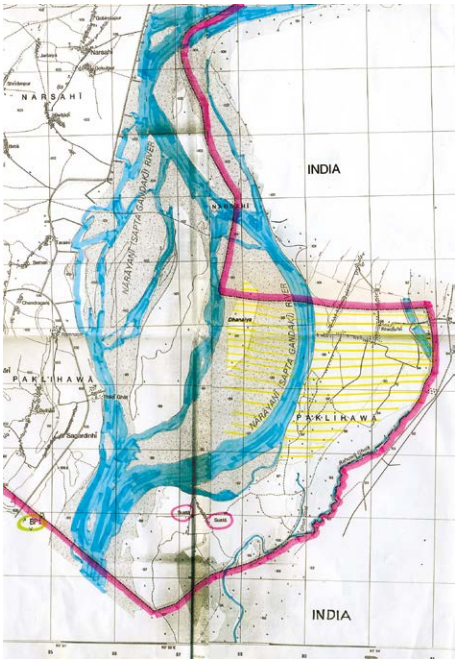

Figure 12: *Map of the Susta area.*

to Sagardinha, where the three places (Gorakhpur of Uttarpradesh, Champaran of Bihar of India, and Nawalparasi of Nepal) meet together.

The reason for the dispute

The change of course of the river is the main reason for the dispute in the Susta area. Other reasons are floods, cutting and clearing of jungles, and bad roads. The Narayani River – called Gandak in India – has been changing its course from east to west for hundreds of years. Every time the Narayani River, which separates India on the east and Nepal on the west, cuts its banks on the west, additional Nepalese territory gradually shifts into India.

Owing to a few big floods during the last two centuries, thousands of hectars of land, approximately 14,500 in total, have been encroached upon by the river floods from Nepal's territory. This complicated situation was also followed by criminal incidents that inflamed the dispute between the two countries. The Susta area is very fertile because of the alluvial soil brought by the river. In addition, there was a dense forest. The Indians came over to Susta to chop down the trees. They illegally transported the timber and wood to India. Later, they settled in the area because of the fertile land and the easy access from India. In time the number of Indian farmers and timber smugglers increased, outnumbering the Nepalese who had lived there for ages. There were 162 Nepali families in Susta until a few years ago. But the number of Indian families who settled there was more than 200. Since the area lies east of the river, the Indian population in that area claims that the area belongs to India. Indian nationalists have claimed the western flow of the Narayani River as the borderline. They have also drawn maps at the local level, accordingly. In such a map a portion of the Narashahi village is shown within In-

dian territory. Nepal, while preparing its map, has taken the river course of 1817 as the borderline. The topographical maps of that area prepared in 1992–93 show the course of the river as of 1817 as the borderline.

The shifting of the river course. Whenever the Narayani River finds a new course, cutting Nepal's territory on the west, India adopts the new course of the river as the boundary and claims the land left behind by the river as its own, and thus, it encroaches upon Nepal's territory. Nepal's stance is that the change in the course of the river should not be linked with the boundary line, and that the borderline should be maintained at the place where the river used to flow at the time of the treaty between Nepal and the British Government. India's position is that the borderline follows the changes of the river. This is the crux behind the dispute at Susta.

All attempts to solve the problem either by local officials or at the central government level have failed. Such an attempt failed even in 1972, when the relations between the two countries were warm.

The main cause of the conflict lies in the shifting of the course of the river. The second reason is that when the demarcation was made by the British Surveyors in this area, no pillar was erected on either side of the river. In addition, no border pillars were erected on the banks of the river during the boundary surveys of 1817, 1829, and 1883–85, and also not during the topographical survey of the Survey of India in 1922. This left room for the disputes along the river areas.

The problem is awaiting a solution. A joint Border Commission was formed in 1929. Meetings of representatives of the governments of Nepal and Bihar were held in 1937, 1947, 1952, and 1953 to settle the dispute. An additional dialogue between the two governments was held on April 27, 1963[19], and later on. The Susta issue has been discussed in several meetings of the Nepal–India Joint Technical Boundary Committee, including the last one in December 2007. But there were no successful results and the dispute still awaits a solution.

7 LESSONS LEARNED

During the demarcation, although China had initially claimed Mt. Everest, it later recognized Mt. Everest as being in Nepal on the basis of a map and documents presented by Nepal. The process was conducted with deep friendship and cordiality between the two countries. The whole process of demarcation proceeded smoothly, based on the traditional principle of watershed and on the basis of mutual benefits, peace, and friendship. All issues related to border demarcation were solved to the satisfaction of both sides.

Note that the issue of Mt. Everest was resolved at the level of the prime ministers. There is no certainty that this issue would have been resolved so amicably if it was taken up at a lower level. A lower level does not have the authority to make such decisions and in such a case the issue could have remained unsettled. If a convoluted issue becomes a matter of prestige at the national and international level, it may get out of proportion and remain disputed.

The treaty of Sugauli between Nepal and British India failed to delimit clearly the Nepal–India borderline in many segments, thus leaving room for problems until today.

19 Shrestha, Hiranya Lal (1998) Indo–Nepal Relations, p. 57.

There were problems in demarcating the boundary line and in erecting border pillars at several places. The area of such disputed places is estimated to be around 60,650 hectares. In many of these areas, there are still claims, counter-claims, discussions, controversies and arguments from both sides.

There are still accusations regarding encroachment and disputes at 70 places along the Nepal–India borderline. The prominent areas have been identified as Kalapani-Limpiyadhura, Susta, Mechi area, Tanakpur, Sandakpur, Pashupatinagar, Hile Thori, and others. It is important that the boundary treaty and the delimitation should be detailed and clear as much as possible to mitigate boundary conflicts.

8 CONCLUSIONS AND RECOMMENDATIONS

The Height of Mount Everest

The third joint boundary inspection to sign the fourth boundary protocol between Nepal and China should be completed as soon as possible. The connection of the recently found boundary marker 57 to the borderline must be based on the boundary delineation and facts on the ground.

Technical skills must be used, and the issue should not be influenced by sentiments, simply because border demarcation and inspection is purely a technical job. To find a proper solution, both countries should act according to the spirit of the treaty and previous boundary protocols and maps. These issues should be resolved by higher authorities through diplomatic channels, since they have already been forwarded from the technical level. From the perspective of good relations, friendship, and mutual understanding between Nepal and China in all spheres, this type of minor border issue should be resolved in an amicable manner. The Fourth Boundary Protocol should be signed as soon as possible, sorting out the debatable items in due course.

Nepal and China should measure and determine jointly the precise height of the tallest mountain in the world. The height controversy should be settled once and for all.

Establishment of Nepal–India–China Tri-Junction Points

The total length of the Nepal–China boundary line demarcated so far is 1,439.18 km. The main boundary pillars erected along the boundary line are numbered 1 to 79 in serial order from west to east, with many reference pillars on both sides of the borderline. However, the tri-junction points on both the western and eastern ends of the borderline, where the Nepalese, Chinese, and Indian territories meet, have not yet been fixed. This is because an Indian representative was not present during the Nepal–China boundary demarcation. Nowadays, India and China have improved their relations. India–Nepal neighborly relations have been maintained for centuries. Nepal must formalize all its border issues through diplomatic channels, including the establishment of Nepal–India–China tri-junction points.

The western tri-junction point should be determined according to the maps and documents published by the Survey of India around the time of the treaty of Sugauli. Nepal has to convince its southern neighbor, India, and to invite its northern neighbor, China, to decide on a single platform for the finalization of the triple point, since this point is related to all three countries, and their joint presence is required.

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This FIG Publication elaborates on the process of boundary making, focusing on land boundaries between states and regarding the role of the surveyor in the process. Its purpose is to propose a comprehensive methodology for establishing a boundary making process between two states that wish to constructively and fairly settle their international boundary together. It begins with preparations for an agreement and continues with boundary delimitation, boundary demarcation, boundary documentation, and boundary maintenance.

The methodological part includes a model for initiating a boundary making process, an order of precedence of boundary definitions, and a model for the boundary chapter in a peace agreement. Part two includes practical cases. Many lessons can be learned from these diverse cases regarding disputes and regarding the models and mechanisms used for dealing with the issues. This FIG Publication may serve statesmen, international legal advisers and surveyors.

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This FIG Publication has been prepared under the framework of the FIG Commission 1: Professional Standards and Practice work plan for 2011–14. It is intended to promote the sharing of methodological knowledge and experience regarding delimitation of international boundaries and to promote peace throughout the world.

ISBN 978-87-92853-08-0