

My Trips to  
**Arab Countries**  
Fathi Habashi



# My Trips to Arab Countries

Volume derived from



**Fathi Habashi**

Department of Mining, Metallurgy, and Materials Engineering  
Laval University, Quebec City, Canada

2015

## The Book

The present volume is derived from *De Re Metallica. A Metallurgist on the Move*, which is a diary of the trips the author has undertaken during his professional career. He visited many industries, universities, research centres, and museums and participated in many conferences. The book therefore reflects the state of extractive metallurgy since he left his home country Egypt and went to study in Vienna. *De Re Metallica* is in seven volumes fully illustrated mainly by coloured photographs. It includes a short history of the place visited and its main sightseeing sites. Volume 1 Egypt, Volume 2 Canada, Volume 3 United States, Volume 4 Latin America, Volume 5 Asia [in two parts], Volume 6 Europe [in two parts], and Volume 7 Russia & other countries. Total number of pages was 5500.

Since these volumes could not be separated and therefore they will not be available to many readers, I decided to split the book into selected 29 small units, each representing one country or a group of countries closely related geographically. The present volume is one of these volumes.



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*To Nadia,  
Hani, and Hatem  
with love*

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## Preface

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*De Re Metallica. A Metallurgist on the Move* is a diary of the trips the author has undertaken during his professional career. He visited many industries, universities, research centres, and museums and participated in many conferences. The book therefore reflects the state of extractive metallurgy since he left his home country Egypt and went to study in Vienna. The book is in seven volumes fully illustrated mainly by coloured photographs. It includes a short history of the place visited and its main sightseeing sites. Volume 1 Egypt, Volume 2 Canada, Volume 3 United States, Volume 4 Latin America, Volume 5 Asia [in two parts], Volume 6 Europe [in two parts], and Volume 7 Russia & other countries. Total number of pages was 5500.

Since these volumes could not be separated and therefore they will not be available to many readers, I decided to split the book into selected 28 small units each representing one country or a group of countries closely related geographically as shown below.

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1	Arab Countries	Jordan, Kuwait, Morocco, Syria, Tunis
2	Austria	
3	Australia & Southeast Asia	Australia, Cambodia, Indonesia, Malaysia, Philippines, Thailand, Vietnam
4	Balkans	Albania, Bosnia, Bulgaria, Croatia, Greece, Romania, Serbia, Slovenia
5	Baltic Countries	Latvia, Lithuania, Poland
6	Brazil	
7	Canada	
8	Caribbean	Cuba, Puerto Rico, Venezuela
9	Caucasus	Armenia, Azerbaijan, Georgia
10	Central Asia	Afghanistan, Kazakhstan, Mongolia, Uzbekistan
11	Central Europe	Czech Republic, Slovakia, Hungary, Switzerland
12	Chile and Argentina	
13	China	
14	Egypt	
15	England and France	
16	Germany	
17	Iberian Peninsula	
18	India	
19	Italy and Vatican	
20	Japan and Korea	
21	Low Countries	

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22	Mexico	
23	Middle East	Iran, Turkey
24	Peru and Bolivia	
25	Russia	
26	Scandinavia	
27	South Africa	
28	USA	

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I hope in this way the book will available to a large number of readers.

*Fathi Habashi*

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# Chapter 1

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## Jordan

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Figure 1.1: Flag of Jordan.

## INTRODUCTION

The kingdom is named after the River Jordan, which is derived from Aramaic Yarden meaning “down-flowing.” This refers to its flow down to the Dead Sea.

## HISTORICAL

### Ancient history

In antiquity, Jordan was a home for several ancient kingdoms including: the kingdom of Edom, the kingdom of Moab and the kingdom of Ammon. Throughout history, parts of the country were laid under the control of

some regional powers including Pharaonic Egypt during their wars with the Babylonians and the Hittites. At times it was controlled by the Persian and Greek empires.



**Figure 1.2:** Map of Jordan and her neighbours.

The Nabataean Kingdom was one of the most prominent states in the region since the decline of the Seleucid control of the region in 168 BC. The Nabataeans were of Arabian ancestry who controlled the myrrh and frankincense trade route (Figure 1.3). These gums, now called Olibanum (from the Arabic al-luban), are extruded from the bark of certain trees growing in south Arabia and Somali Land give fumes with pleasant smell when burned in temples and was used by the Romans during cremation. The Nabataean Kingdom was finally annexed by the Roman Empire in 106 AD. Nabataean civilization left many magnificent archaeological sites at Petra (Figures 1.4–1.5).

With the decline of the Eastern Roman Empire, Transjordan became controlled by the Christian Ghassanid Arab kingdom, which allied with Byzantium. In the 7th century, Transjordan became a part of the Islamic Empire. In the 11th century, it became a battlefield for the Crusade wars which ended with defeat by the Ayyubids. Jordan suffered also from the Mongol attacks which were blocked by Mameluks. It became part of the Ottoman Empire in 1516.

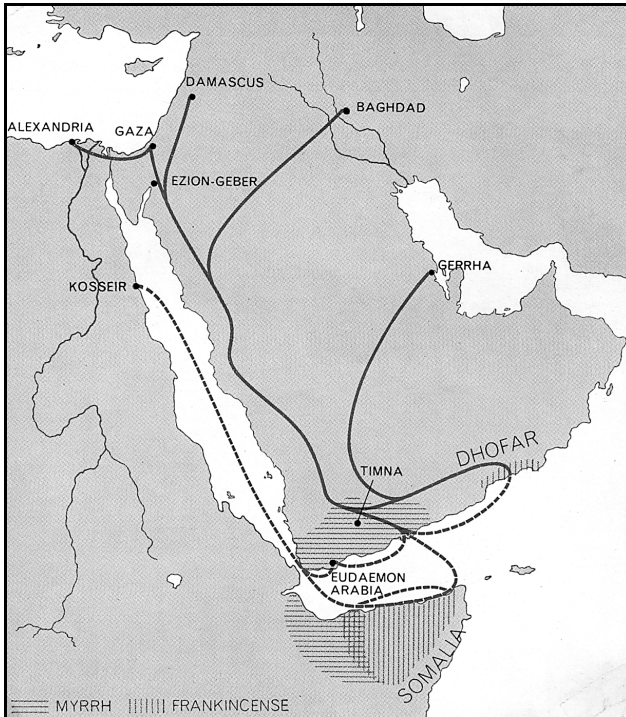


Figure 1.3: The Incense Road.

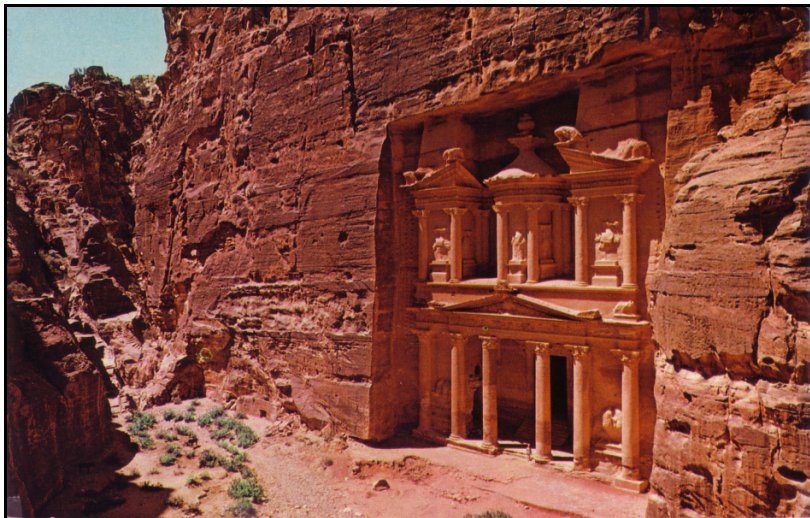


Figure 1.4: A Nabataean building carved in the mountain.



Figure 1.5: Details of the Nabataean building.

## Hejaz Railway

The Hejaz Railway (Figure 1.6) ran from Damascus to Medina, through the Hejaz region of Saudi Arabia, with a branch line to Haifa on the Mediterranean Sea. It was a part of the Ottoman railway network and was built to extend the line from Istanbul beyond Damascus to Mecca. It got no further than Medina due to the interruption of the construction works caused by the outbreak of World War I. Damascus to Medina is 1 300 km.

The main purpose of the railway was to establish a connection between Constantinople, the capital of the Ottoman Empire and the seat of the Islamic Caliphate, and Hejaz in Arabia, the site of the holiest shrines of Islam the destination of the Hajj annual pilgrimage. Another important reason was to improve the economic and political integration of the distant Arabian provinces into the Ottoman state, and to facilitate the transportation of military forces.

The railway was started in 1900 at the request of the Ottoman Sultan Abdul Hamid II and was built with German advice and support. The Berlin to Baghdad Railway was built in the same time. The railways were interrelated and aimed to strengthen the authority of the Empire over Arab provinces.

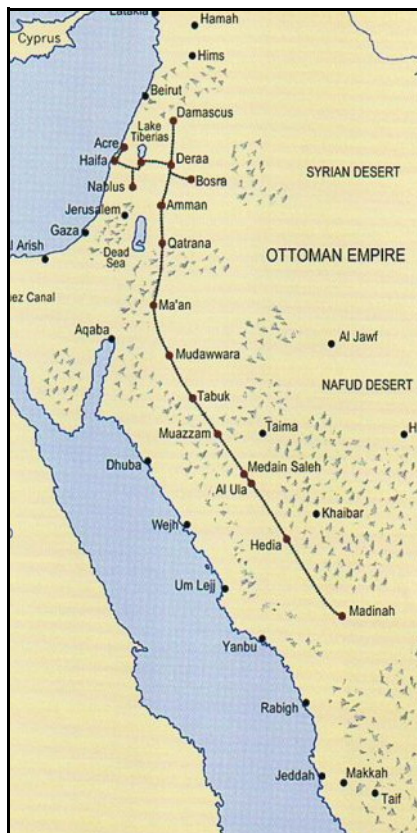


Figure 1.6: The Hejaz Railway.

## Modern history

Before World War I, Hussein bin Ali (1854–1931) (Figure 1.7) of the Hashemite clan ruled the Hejaz along the Red Sea on behalf of the Ottoman sultan. The Hashemite refers to those belonging to the Banu Hashim, a clan within Prophet Muhammad's Quraish tribe. During World War I, the British appealed to him for assistance in the conflict on the side of the Triple Entente. Hussein demanded recognition of an Arab nation spanning from Aleppo in Syria to Aden in Yemen as well as approval for the proclamation of an Arab Caliphate of Islam. The Great Arab Revolt against Ottoman control took place in 1916.

During World War I, Hussein bin Ali rebelled against the Young Turks in Istanbul. After the collapse of the Ottoman Empire, Jordan was founded in 1921 as the Hashemite Emirate which became in 1922 under the British

Mandate for Palestine known as Transjordan. In 1924, when the Ottoman Caliphate was abolished, Hussein bin Ali further proclaimed himself Caliph of all Muslims. He ruled Hejaz until 1924, when, defeated by Abdul Aziz al Saud (1876–1953), he abdicated the kingdom titles to his eldest son Ali.

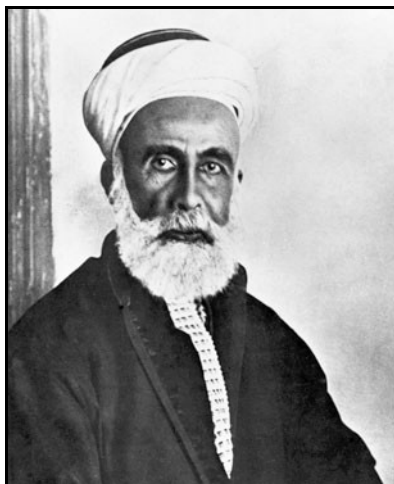
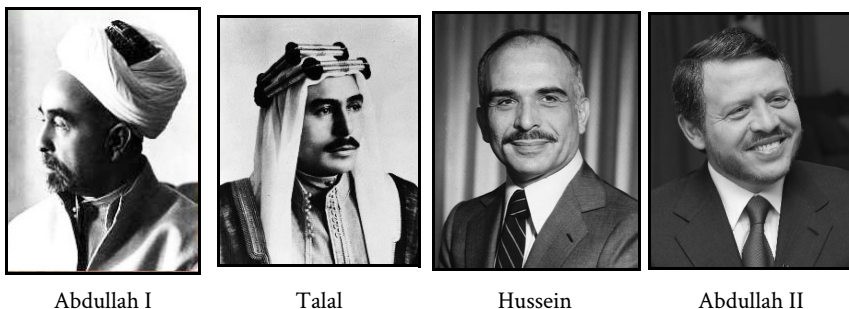


Figure 1.7: Hussein bin Ali (1854–1931).



Figure 1.8: Map of modern Jordan.

In 1946, the Hashemite Emirate became an independent state known as the Hashemite Kingdom of Transjordan (Figure 1.8). After capturing the West Bank area of Cisjordan during the 1948–49 war with Israel, Abdullah I (1882–assassinated in 1951) took the title King of Jordan and Palestine, and he officially changed the country's name to the Hashemite Kingdom of Jordan in April 1949. Abdullah I was succeeded by son Talal (1909–1972) who abdicated one year later in 1952 in favour of his son Hussein (1935–1999). At present the Kingdom is ruled by Hussein's son Abdullah II (Figure 1.9)



**Figure 1.9:** Rulers of Jordan.

**Table 1.1:** Trips to Jordan.

Dates	City	Purpose of visit
February 2005	Amman	Jordan Magnesia Company
May 2005	Amman	Jordan Magnesia Company
	Petra	Cultural visit
April–May 2013	Irbid	Visiting University, Roman ruins
	Petra	On way to Aqaba
	Aqaba	Visit phosphate industry

## AMMAN

In the 13th century BC, Amman was called Rabat Amon by the Ammonites. It was later conquered by the Assyrians, followed by the Persians, and then the Macedonians. Ptolemy II Philadelphus, the Macedonian ruler of Egypt, re-named it Philadelphia. The city became part of the Nabataean kingdom until 106 AD when Philadelphia came under Roman control. Modern Amman has a Roman amphitheatre (Figures 1.11–1.15).



**Figure 1.10:** Radisson Hotel, where I stayed in 2005, was a terrorists' target in 2006.



**Figure 1.11:** View of Amman showing the Roman amphitheatre.



Figure 1.12: Roman amphitheatre, 2005.



Figure 1.13: Roman amphitheatre, 2005.



Figure 1.14: Amman Museum, 2005.



Figure 1.15: Amman Museum, 2005.

## **Dead Sea**

The Dead Sea (Figures 1.16–1.17) is about 420 m below sea level. The sea is divided into two basins, separated by a land bridge. Both basins are about 16 km wide. The northern one is about 64 km long; the southern one, about 16 km long. The maximum depth, which exceeds 405 m is in the northern basin. The Jordan River, entering from the north, is the only river that enters the sea. Diversion of water from the Jordan River for irrigation has caused the sea to shrink. Because it loses water only by evaporation, the Dead Sea has a high salt content. There is virtually no life in the sea, except for bacteria and algae. Potash, magnesia, magnesium, and bromine are extracted from the water on industrial scale.

## **Arab Potash Corporation**

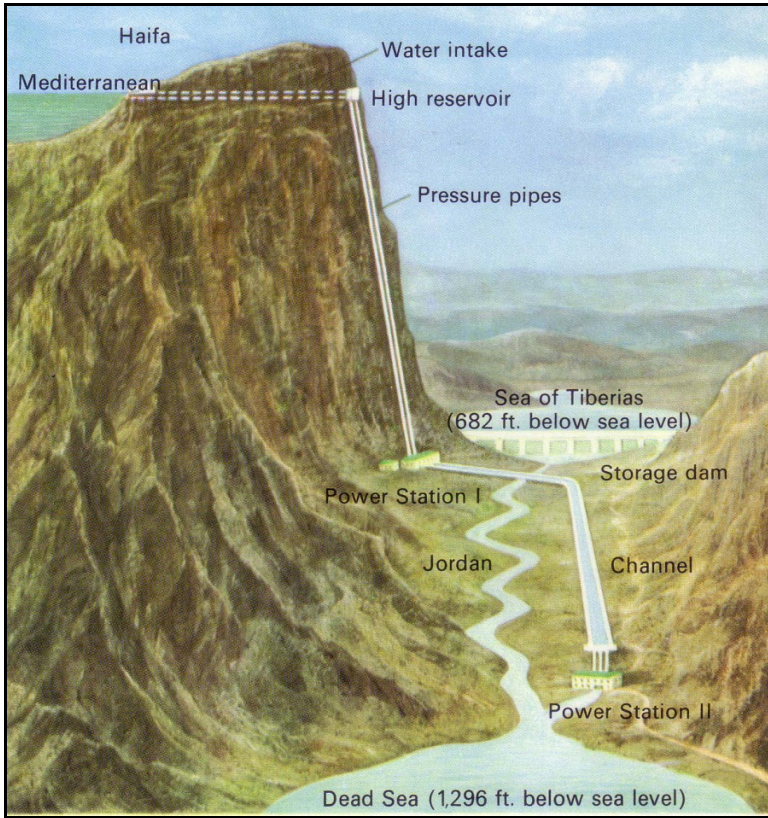
Arab Potash Corporation formed in 1956 operates a potash facility on the Dead Sea at Safi with a production capacity of 2 million t/y (Figures 1.18–1.19). The processing plant is located 110 km south of Amman and 200 km north of Aqaba. The site is basically a solar evaporation pond system of an area of 131 km<sup>2</sup>. The project began in 1976 with tests and experiments to determine the parameters of various technologies in a hostile environment.

Construction began in 1979 and was completed in 1982. About 117 km of seepage proof dykes were built. These were more than 8 m wide 16 million cubic metres of earth material was displaced. Potash production began in 1983. The initial plant was built to a capacity of 1.2 million tons of product. This was expanded in the late eighties to handle 1.4 million tons and modifications were undertaken in the solar ponds accordingly. A second plant with a capacity of 0.4 million t/y based on a new technology was built in 1994 bringing the total production capacity to 1.8 million tons. The Potash Company employs over 2300 personnel and has offices in Amman, Safi, and Aqaba.

## **The solar ponds**

The process commences at the brine intake pumping station located on the Lisan Peninsula where four intake pumps with a capacity of approximately 20 m<sup>3</sup>/second deliver more than 300 million tons per year of Dead Sea Brine through a 1-km pipeline. The brine then flows to the first of a series of salt ponds, which has the highest solar evaporation rate in the system.





**Figure 1.17:** Proposed project for generation of hydroelectric power from the Mediterranean Sea to Dead Sea.



**Figure 1.18:** Arab Potash Corporation.

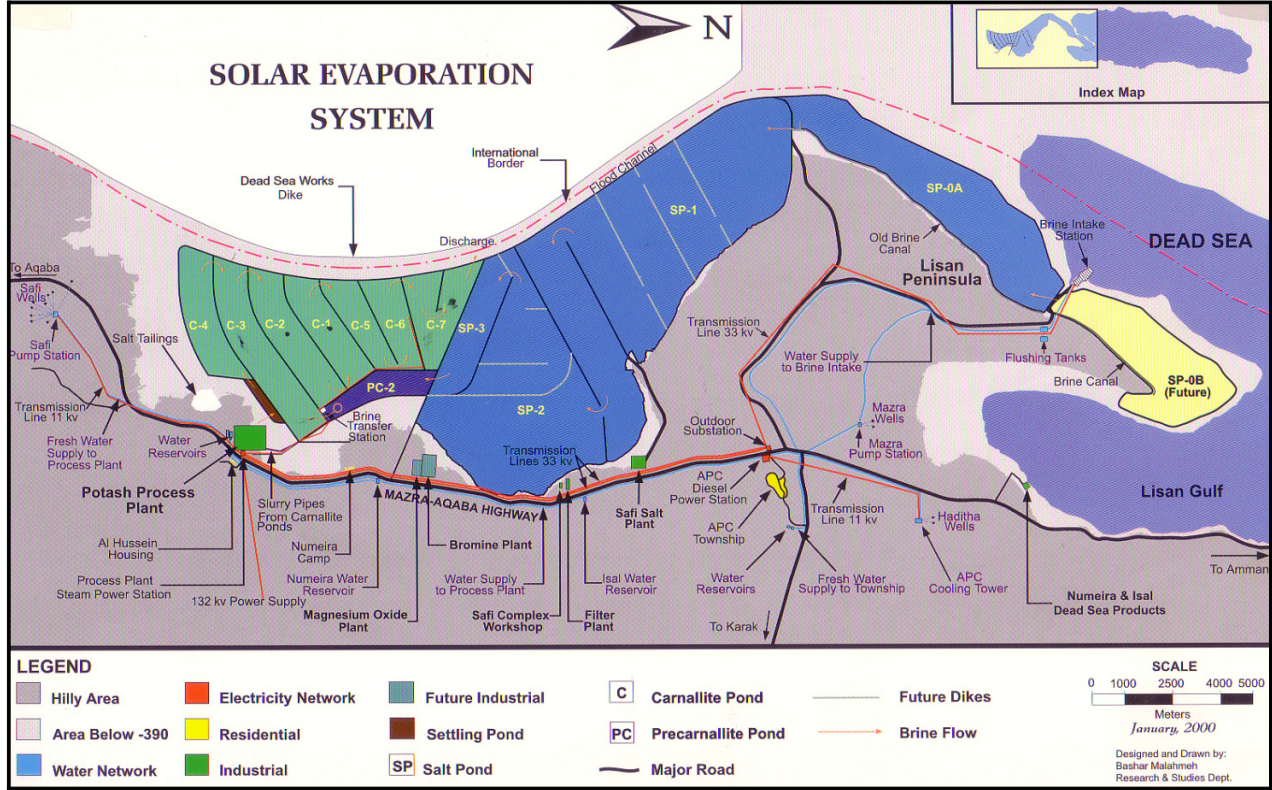


Figure 1.19: Solar evaporation system.

The Salt Pond performs the initial concentration of Dead Sea Brine, which has a density of about  $1.23 \text{ g/cm}^3$  and is ten times as salty as sea water. Due to the high evaporation rate in this pond, most of the sodium chloride is deposited and the density of the brine increased to about  $1.3 \text{ g/cm}^3$ . At the end of the salt ponds, the brine is transferred to the pre-carnallite pond PC-2 by gravity flow. This pond acts as a control of the brine composition. The density of the brine is further increased at this stage reaching  $1.303 \text{ g/cm}^3$  in PC-2 and about 2% KCl concentration. The last seven ponds finalize the evaporation process by the precipitation of carnallite ( $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ ) through series flow from C-4 back to C-7. Brine from pond C-7, which now contains about 0.3% potassium chloride and has an average density of  $1.340 \text{ g/cm}^3$ , is then discharged back to the Dead Sea.

Brine returned from the plants is fed to an individual pond C-4 to improve the recovery of potash in a closed system. Carnallite production capacity from this system is about 10 million t/year. The precipitated carnallite in ponds C-1 to C-7 contains 84% carnallite and 16% sodium chloride. The average thickness of the carnallite deposit is approximately 30–50 cm. This bed is harvested as a slurry from beneath the brine and delivered to booster pumps on the dikes and then to the Refinery through steel pipes. Six floating tracked Harvesters are utilized to gather the carnallite. These Harvesters are capable of floating in one metre of brine. Control equipment installed on Harvesters provides precise movement for optimum recovery.

## Hot leaching plant

The carnallite slurry is dewatered and decomposed with water in two stages of agitated tanks. The resulting solids are potassium chloride and sodium chloride, a mixture known as sylvinite. It is dewatered and washed. The resulting cake is conveyed to the sylvinite processing stage.

### *Sylvinite processing*

The sylvinite cake is leached using four agitated tanks in a two-stage process. Heated brine, returned from the crystallization process, is used for leaching the potassium chloride. The hot brine, now saturated with potassium chloride is clarified in a thickener. The thickener overflow is pumped to the crystallization process, and the underflow slurry containing sodium chloride crystals is dewatered, re-pulped with waste brine and pumped to tailings.

The hot brine from the thickener overflow, which is saturated with sodium and potassium chlorides, is cooled successively in a six-stage vacuum crystallizer system from  $95 \text{ }^\circ\text{C}$  to  $45 \text{ }^\circ\text{C}$ . Upon cooling, potassium chloride decrease in solubility, and crystallizes under controlled conditions.

Potash slurry from the last stage crystallizer is directed to the product hydro-cyclones where partial dewatering takes place. The underflow of the cyclone is sent to centrifuges for further dewatering. The cake from the centrifuges is conveyed to rotary dryer to remove the last traces of moisture. The product is sent to a fluidized bed cooler and then to the screening system, while the dust is collected in cyclones.

The product from the dryer or cooler goes to the screening section where it is segregated into two product grades Standard and Fine. An anti-caking agent is added to all products in carefully controlled amounts to minimize the natural tendency of potash to agglomerate during storage and shipment. Free-flowing products are thus ensured to facilitate handling by the customer. To ensure clean environment and to minimize Potash losses as dust bag filtration units and cyclones are installed.

### *The cold crystallization plant*

The cold crystallization plant is independent of the hot leach facility. It is operated under ambient temperature and therefore requires less energy. Carnallite slurry is first beneficiated by wet screening to separate the high grade carnallite fraction, which is about one quarter of the solids. This high-grade carnallite is fed directly to the cold crystallizers. Wet screen undersize slurry is mixed with brine discharge from the cold crystallizer's overflow, which is at or near saturation, in a tube reactor. When solar pond brine mixes with crystallizer brine in the reactor, crystallization of carnallite occurs as the brine mixture equilibrates. Slurry from the reactor is densified in the thickener. The overflow is returned to the evaporation ponds.

### *Flotation*

Carnallite thickener underflow is beneficiated by a flotation technique in which sodium chloride is floated and pumped to the tailings area. Flotation cell sink slurry is settled in a thickener. Flotation thickener overflow is used as make-up brine to the flotation cells and the excess is pumped to the evaporation ponds. Flotation thickener underflow is dewatered in centrifuges. Centrifuge cake (fine carnallite) is conveyed to the cold crystallizers and the effluent is recycled to the flotation thickener.

### *Crystallization*

Coarse and fine carnallites are decomposed in a two-stage crystallizer in the presence of water. Potassium chloride crystals are formed in the crystallizers. Crystallizer discharge slurry is wet screened to remove large particles. Screen oversize is pumped to the tailings area along with flotation overflow slurry. Screen undersize is directed to the leaching area.

### *Cold leaching*

In order to remove adhering high magnesium chloride brine from the crystallizer product, two-stage leaching and dewatering centrifuges are used to ensure the required 0.7% maximum  $\text{MgCl}_2$  content in dry product. Second stage centrifuge cake is dried to 0.1% moisture content in a co-current, rotary dryer. The product is then cooled in a rotary cooler by a counter-current stream of atmospheric air. Dry product is separated into two fractions in the screening area: Standard and Fine.

### *The industrial potash plant*

Industrial-grade potash is the premium form of potassium chloride (99.2% KCl min.). The plant utilizes the hot crystallization process, where precise control over product purity and crystal size can be archived. De-bromination of the hot saturated liquor takes place to reduce the bromine content of the final product to 200 ppm.

## **Subsidiaries**

Arab Potash Corporation has several Dead Sea-area affiliates and subsidiary projects, including:

- *Jordan Magnesia Company*, founded in 1997, dedicated to the production of 60 000 t/year of magnesium oxide and magnesium hydroxide.
- *Numeira Mixed Salts and Mud Company*, founded in 1997, producing “mixed salts” and “Dead Sea Mud” for the cosmetics industry.
- *Kemira Arab Potash Company*, founded in 1998 as a joint venture with Kemira Agro of Finland, produces 150 000 t/year of potassium nitrate fertilizer and 75 000 t/year of dicalcium phosphate animal feed supplement.
- *Jordan Bromine Company* is a joint venture with Albemarle Holdings Company of the United States, dedicated to produce bromine and bromine derivatives, including 50 000 t/year of bromine; 25 500 t/year of tetrabromo bis phenol-A used as a flame retardant; 40 000 t/year of calcium bromide, which is used in the oil drilling industry; 10 000 t/year of sodium bromide, used in photography; and 2 500 t/year of hydrogen bromide.
- *Jordan Safi Salt Company* produces 1.2 million t/year of industrial salt and 32 000 t/year of table salt, and operates a port facility in Aqaba in the south of Jordan.
- *Nippon Jordan Fertilizers Company*, a joint venture along with ZEN-NOH, Mitsubishi Kasei, Asahi and Mitsubishi Corporations, produces 300 000 t/year of NPK fertilizer and diammonium phosphate fertilizer and operates a port facility in Aqaba. It began production starting 1997.

## Jordan Magnesia Company

The office of the Jordan Magnesia Company is in Amman (Figures 1.20–1.22). The magnesium oxide plant was designed to produce refractory grade magnesium oxide and magnesium oxide (known as caustic magnesia) for other applications such as fire-retardants. Raw material is the brine from Dead Sea containing 90 g/L magnesium, 30 g/L calcium and some harmless impurities except 100 mg/L boron is harmful and must be removed from the circuit.

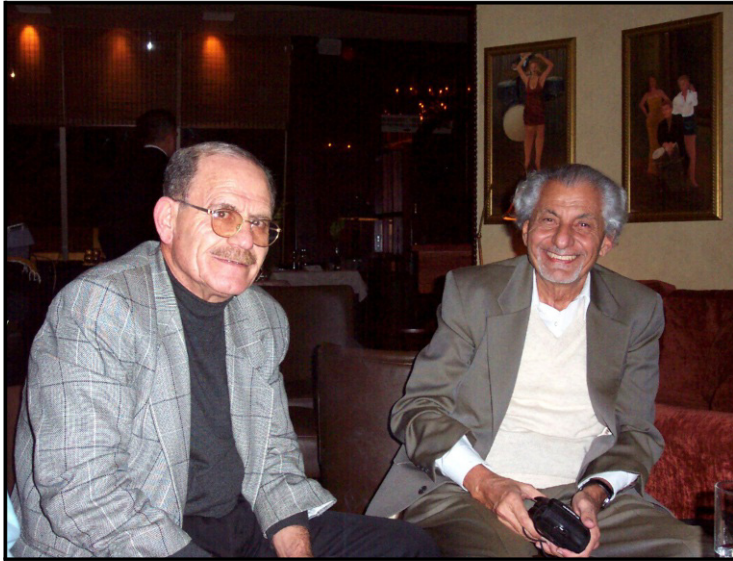


**Figure 1.20:** Jordan Magnesia Company office in Amman, 2005.

The process involves calcination of limestone, slaking the lime to produce calcium hydroxide which is used to precipitate magnesium hydroxide from the brine. Magnesium hydroxide is then filtered, washed, dried, and calcined at high temperature to produce MgO product (Figure 1.24).

- Traces of boron present in the brine is said to be harmful and that it must be removed before precipitating the magnesium hydroxide. This is conducted using ion exchange resin Purolite S 108. There are three columns 4.5 m diameter each containing 3 m<sup>3</sup> of resin. Usual operating loss of resin is estimated at 5%.

- Water used in the slaking of lime is carefully treated so that it does not contain carbon dioxide to avoid forming calcium carbonate in the product hence loss of efficiency of slaking.



**Figure 1.21:** Issa Gammoh, Vice President, 2005.



**Figure 1.22:** Issa Gammoh [right] hosts dinner to consultants. Philip Lloyd from Cape Town in South Africa is 2nd from left. Photo by Fathi Habashi, 2005.

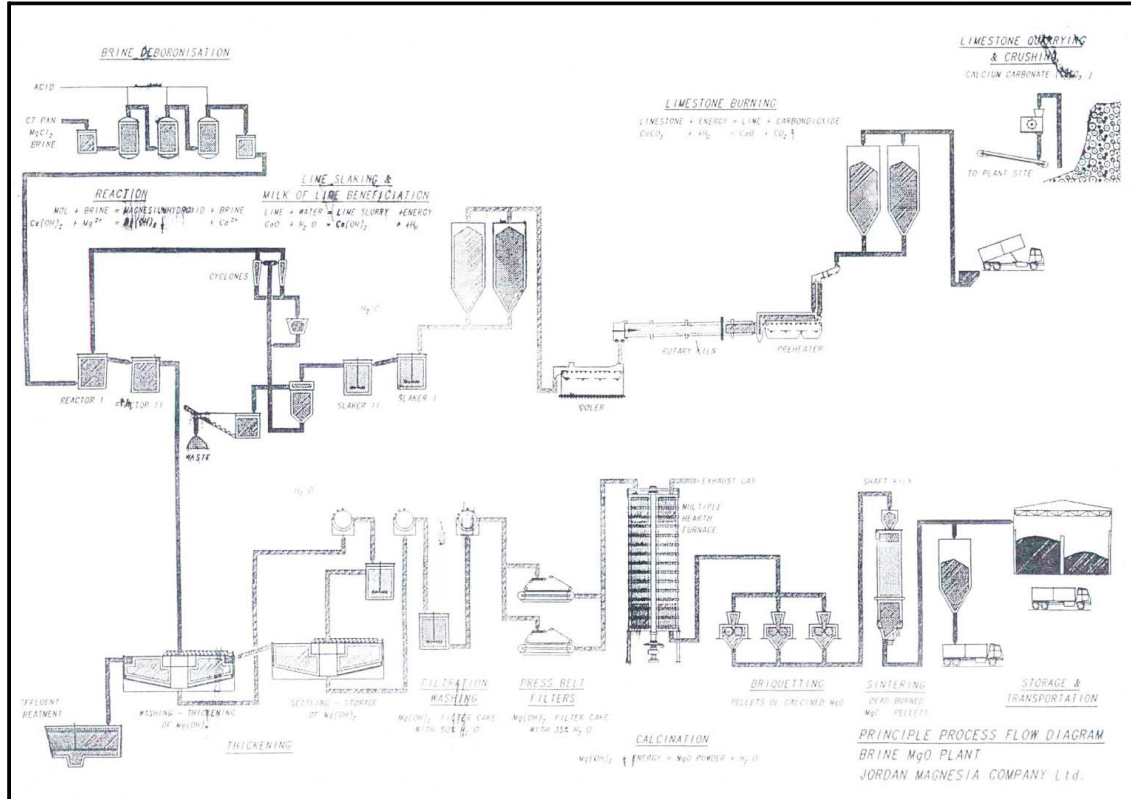
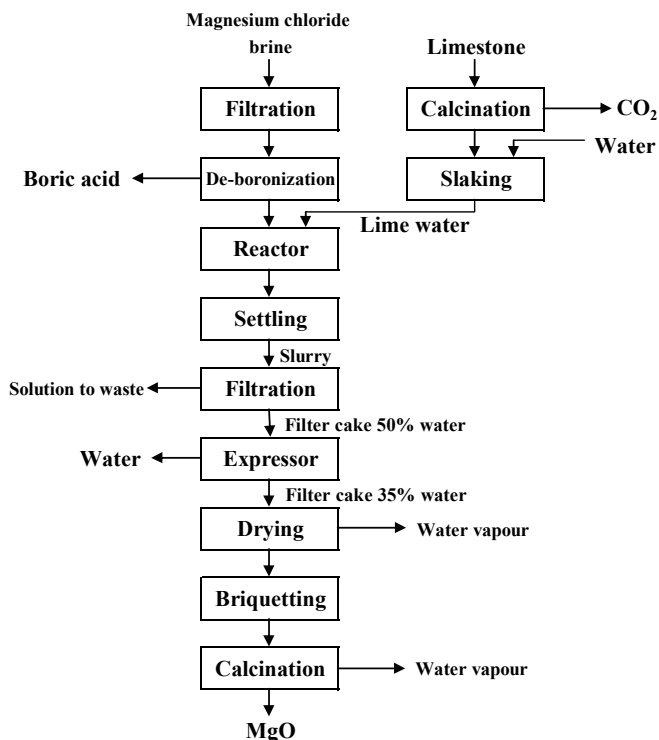


Figure 1.23: Magnesium oxide plant.

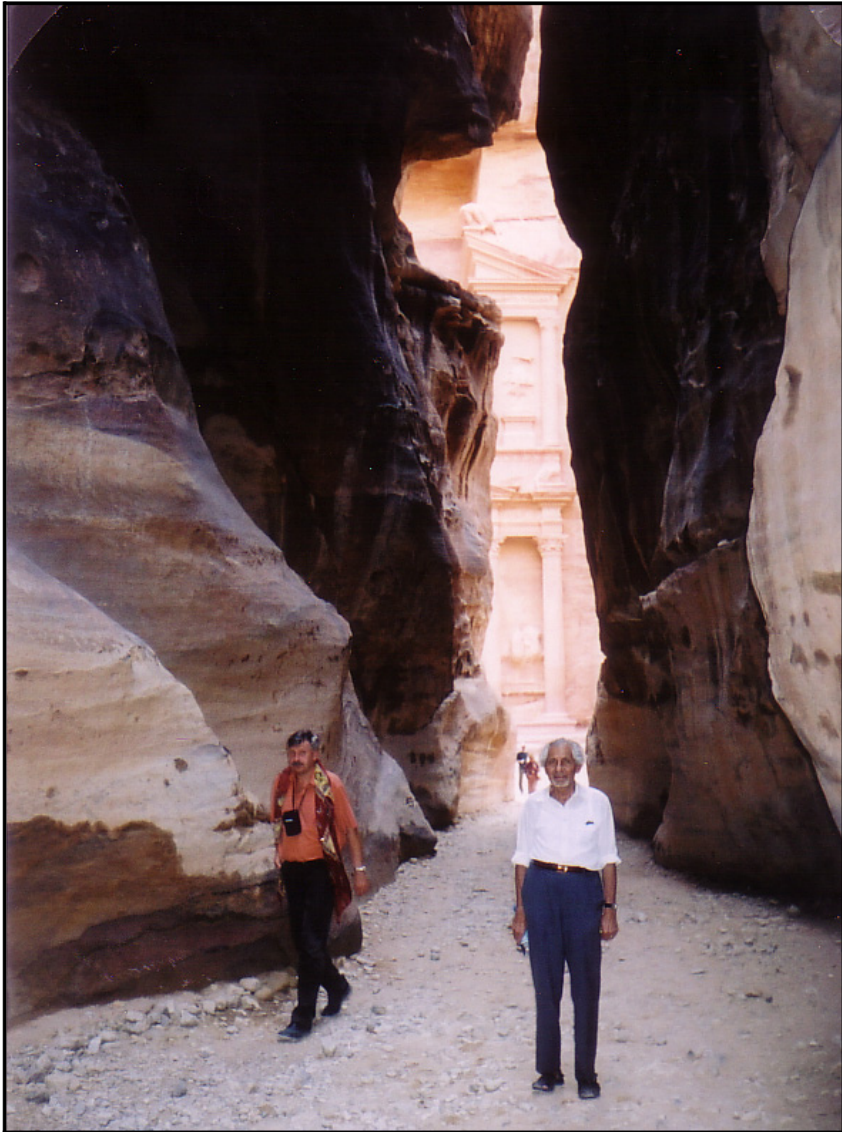


**Figure 1.24:** Production of magnesium oxide from brine.

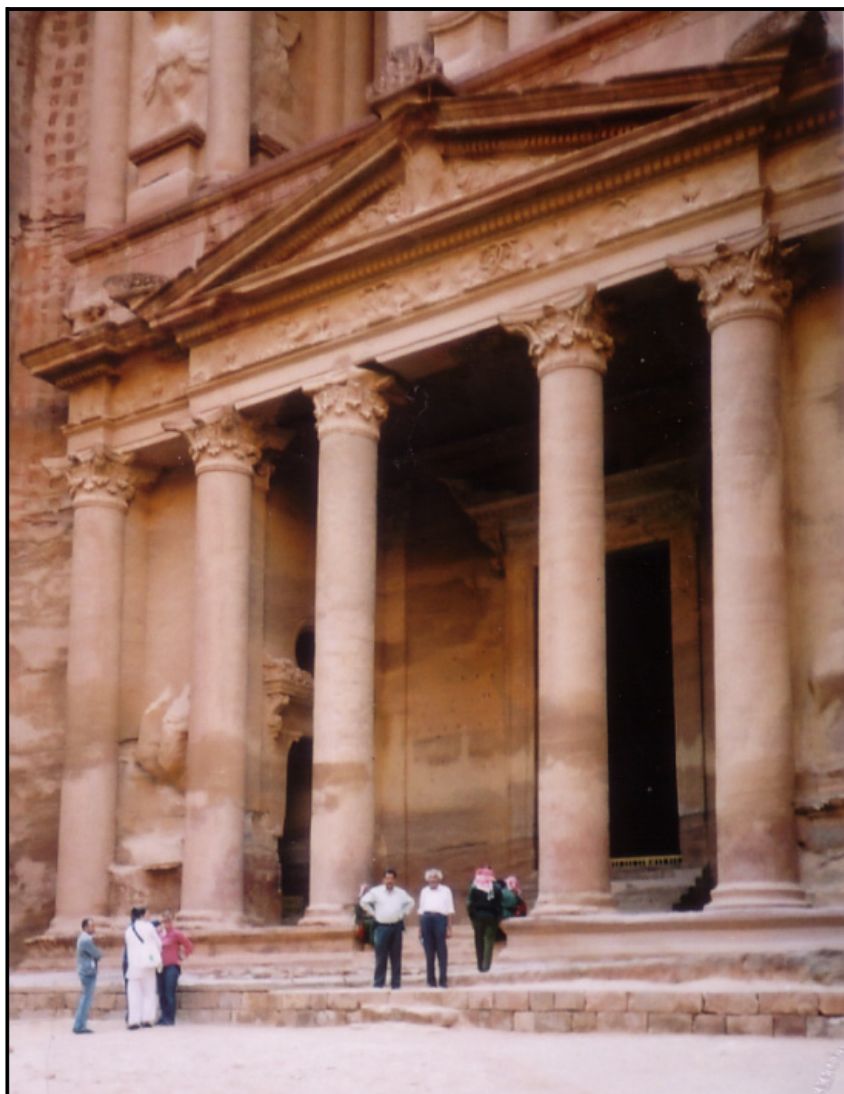
- One should avoid at all times crystallization of magnesium salts to avoid undesirable clogging of nozzles in the ion exchange beds or other delicate equipment in the system. This is done by either maintaining a certain temperature of the brine or its dilution to a certain level.
- The filter cake of magnesium hydroxide must be of as low as possible in moisture content to save fuel in the subsequent drying step. This is usually done by having an effective filtration system.
- The filter cake should have a large particle size to facilitate filtration and washing. A fraction from a previous batch of magnesium hydroxide is added in the reaction vessel containing the brine on which the lime water is added. Thus magnesium hydroxide precipitates on the seed present resulting in a precipitate of a large particle size which settles rapidly in the thickeners and will be easy to wash on the drum vacuum filters.
- Magnesium oxide produced at the plant had a bulk density of 3.39 g/mL and analyses in %: 97.9 MgO, 1.9 CaO, 0.1 SiO<sub>2</sub>, 0.05 Fe<sub>2</sub>O<sub>3</sub>, 0.06 Al<sub>2</sub>O<sub>3</sub>, and 0.0018 (= 18 ppm) B<sub>2</sub>O<sub>3</sub>, which compares favourably with magnesium oxide produced by other manufacturers.

## PETRA

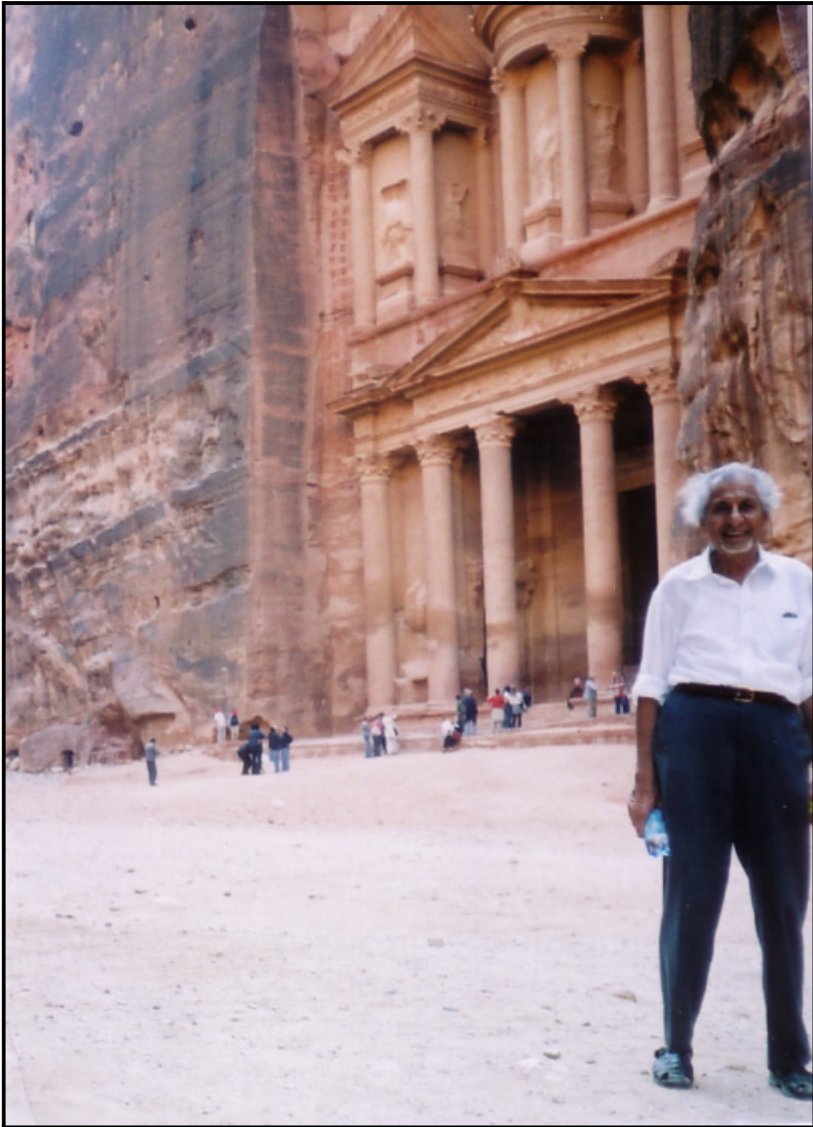
Petra is a magnificent archaeological site left by the Nabataean civilization about 270 km south of Amman (Figures 1.25–1.33).



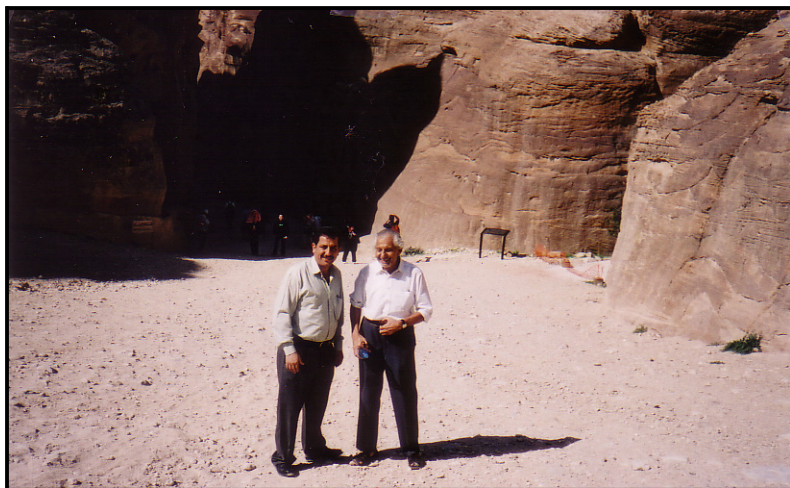
**Figure 1.25:** The entrance to Petra, 2005.



**Figure 1.26:** The archaeological site, 2005.



**Figure 1.27:** The archaeological site, 2005.



**Figure 1.28:** Guide Gehad from Jordan Magnesia Company, 2005.



**Figure 1.29:** The archaeological site, 2005.



**Figure 1.30:** View of Petra from the top of the mountain, 2013.



**Figure 1.31:** Meeting Prof. Hani Nawafleh [extreme left] from Ma'an University. On the extreme right is the Manager of the Hotel Oscar, a cousin to Nawafleh, 2013.



Figure 1.32: Hotel Oscar.



Figure 1.33: Leaving the Hotel Oscar, 2013.

## METALS FROM ORES

Incidentally, my book *Metals from Ores. An Introduction to Extractive Metallurgy*, published in 2003 was translated into Arabic by Dr. Mohammad Al-Harabsheh, Department of Mining Engineering, Al-Hussein Bin Talal University in Ma'an in 2011 (Figure 1.34). Al-Harabsheh moved to Irbid in 2012 (Figures 1.35–1.36). Dr. Al-Harabsheh got the King Abdallah ben Abdel Aziz Award for his translation shared with Prof. Wald Abdel Aziz Khalifa from Cairo University (Figure 1.37).

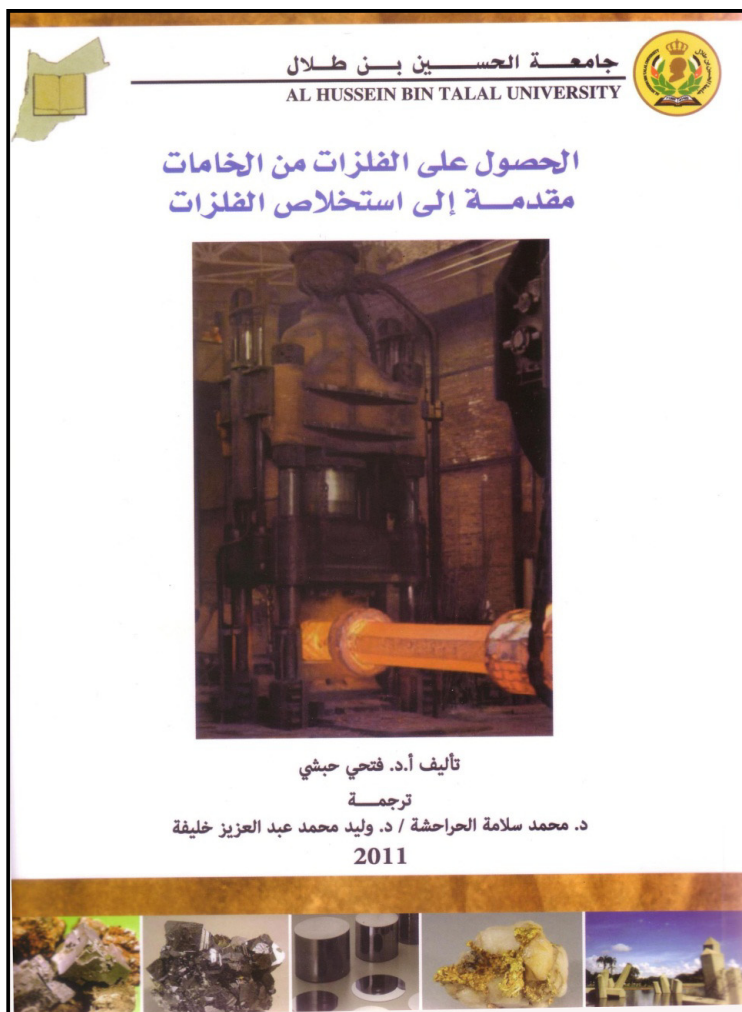


Figure 1.34: Front cover of the Arabic translation of *Metals from Ores*, 2011.



**Figure 1.35:** With Mohammad Al-Harabsheh and his children at home in Irbid, 2013.



**Figure 1.36:** The Jordanian delicious food at Al-Harabsheh home in Irbid, 2013.



Figure 1.37: King Abdallah ben Abdel Aziz in 2011.

## IRBID

In the Hellenistic period, Irbid, then known as Arabella, was a major trade centre. Before the advent of Islam, Arabella was famous for producing some of the best wines in the ancient world. After the Muslim conquests, it came under the rule of the Muslim Empire, the city became known as Irbid, and shifted from wine to olive oil production. Wheat was also an important product in the area. Irbid is the second largest city in Jordan after Amman and is located about 70 km north of Amman. The Irbid region is also home of Jordan University of Science and Technology and Yarmouk University.

## Jordan University of Science and Technology

The Jordan University of Science and Technology (abbreviated JUST) (Figures 1.38–1.44) is a state-supported university established in 1986. It has 20 000 undergraduate and 1 600 graduate students, comprises 12 faculties and 55 departments. Host: Dr. Mohammad Al-Harashseh from Nottingham University in Great Britain, now in Chemical Engineering Department in JUST. Lecture delivered: Metal Industry Today. Progress and Problems.



**Figure 1.38:** Entrance of the University.



**Figure 1.39:** Entrance of the University, 2013.



**Figure 1.40:** Mohammad Al-Harabsheh at the entrance of the University, 2013.



**Figure 1.41:** Dr. Khalil Ali Halhouli, Chaiman of Chemical Engineering Department.



**Figure 1.42:** Dr. Abdel Rahman Tamimi, who studied at the Chemical Engineering Department, Cairo University.



**Figure 1.43:** With some Chemical Engineering students.



Figure 1.44: Farewell dinner at the University Restaurant.



Figure 1.45: Yarmouk River, a branch of Jordan River.

## Battle of Yarmouk

Irbid is notable for being close to the site of the decisive Battle of Yarmouk, fought along the banks of the Yarmouk River roughly 30 km north of the city. The battle lasted for six days in August 636 and was waged between the army of Khalid Bin Al Waleed (592–642) during the Islamic Caliphate of Umar and the Byzantine Empire during the rule of Heraclius. Khalid Bin Al Waleed entered Syria coming from Iraq through the desert. It set the stage for the beginning of the expansion of the Islamic Caliphate. The Yarmouk River is the natural border with Syria (Figures 1.45–1.48).



Figure 1.46: Marking the way to the Battle of Yarmouk.

## Jerash

Jerash (Figures 1.49–1.53) is 15 km south of Irbid. It was founded by one of Alexander the Great's generals in 331 BC who settled there aged Macedonian soldiers (*γερασμένο*s means aged person in Greek). In AD 90, Jerash was absorbed into the Roman province of Arabia. The Romans sponsored and built numerous temples and other public buildings. The imperial cult, the worship of the Roman emperor, was a very common practice throughout the Empire. The Emperor Hadrian visited Jerash in AD 129–130. The Arch of Hadrian was built to celebrate his visit (Figure 1.54). The Persian invasion in AD 614 caused the rapid decline of the city. However, it continued to flourish during the Umayyad Period.



**Figure 1.47:** Monument marking the Battle of Yarmouk.



**Figure 1.48:** Monument marking the Battle of Yarmouk.



Figure 1.49: General view of the old city of Jerash.

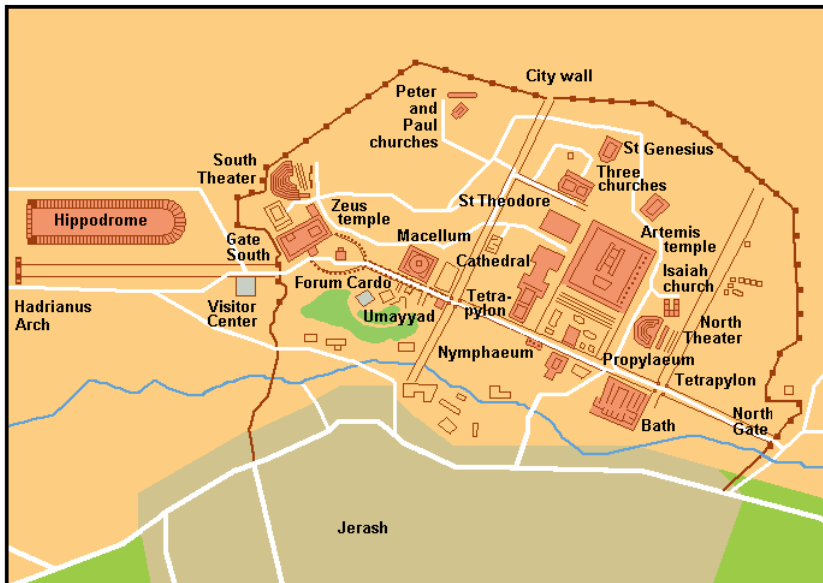


Figure 1.50: General plan of the old city of Jerash.



**Figure 1.51:** With Mohammad Al-Harabsheh in Jerash.



**Figure 1.52:** With Mohammad Al-Harabsheh in Jerash.



**Figure 1.53:** The amphitheatre in Jerash.

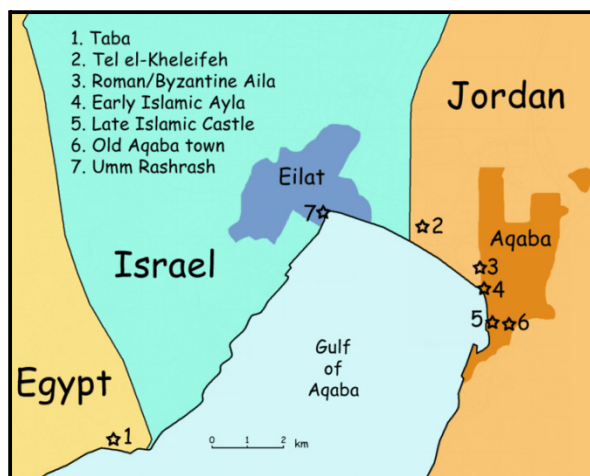


**Figure 1.54:** Hadrian Arch.

A strong earthquake in 749 AD destroyed large parts of the town, while subsequent earthquakes along with the wars and turmoil contributed to additional destruction. Its ruins remained buried for hundreds of years until they were discovered by German Orientalist Ulrich Jasper Seetzen (1767–1811) in 1806. Seetzen studied medicine but was interested in the East. He toured the Dead Sea area. From Egypt he went by sea to Jidda and reached Mecca as a pilgrim in October 1809. After his pilgrim he converted to Islam and changed his name to Hag Moses. In Arabia he made extensive journeys which he documented in his writings.

## AQABA

Aqaba (Figures 1.55–1.58) is a Jordanian coastal city situated at the northeastern tip of the Red Sea. The city is the country's only sea port. It was a centre of the Edomites, and then of the Arab Nabataeans, during the first century BC. Around 106 AD, Aqaba was one of the main ports for the Romans. Soon after, it came under the rule of the Islamic Caliphate.



**Figure 1.55:** Map showing Aqaba and its neighbours.

During the 12th century, the Kingdom of Jerusalem controlled the area and built a fortress which remains relatively well-preserved today. The Crusaders fortified the small island now known as Pharaoh's Island, near the shore of Sinai, now lies in Egyptian territorial waters about 7 km west of Aqaba. By the beginning of the 16th century, the Mameluk dynasty had fallen into decline. The port of Aqaba quickly regained its importance after the Ottomans built the Hejaz railway that connects the port to Damascus and Medina. After World War I, Aqaba was ceded to the British protectorate of Transjordan in 1925. In 2000, the Aqaba Special Economic Zone Authority was established.



**Figure 1.56:** The view from my hotel room.



**Figure 1.57:** Details of the mountains in the region.



**Figure 1.58:** Intercontinental Hotel.



**Figure 1.59:** Dinner with host Dr. Muhammed Adnan Hararah [left], Commissioner for Environment and Health Control and Dr. Mohammad Al-Harabsheh [right].

## **Ben Hayyan International Laboratories**

Ben Hayyan International Laboratories (Figures 1.60–1.61) were established in 2007 with the aid of European Union to support Aqaba Special Economic Zone Authority to attract and facilitate investment and trade to

the zone, improve the quality of life of the people, while sustaining the environment and ensuring food safety of all foodstuff imported to Jordan via the zone. It includes physical, chemical, and microbiological services.



**Figure 1.60:** Ben Hayyan International Laboratories.



**Figure 1.61:** Visit to Aqaba International Laboratories. Director: Dr. Aiman Oklat, a graduate of University of Malaysia [left].

## Jordan Phosphate Mines

Jordan Phosphate Mines Company (Figures 1.62–1.65) was founded in 1949 and its main offices in Amman. The company operates 3 mining facilities:

- Russeifa, 15 km north of Amman, commencing in 1935
- Hassa and Al-Abiad 135 km south of Amman commencing in 1962 and 1979
- Eshidiya, 125 km northeast of Aqaba commencing in 1989



**Figure 1.62:** Jordan Phosphate Mines Company.

The Aqaba complex produces fertilizer and chemicals, including:

- Sulfuric acid 1 200 000 t/year
- Phosphoric acid 350 000 tonnes per year
- Diammonium phosphate 650 000 tonnes per year
- Fluorosilicic acid 25 000 t/year. The HF gases escaping from the concentration lines are also absorbed by water to produce fluosilicic acid, which is used as raw material in the aluminum fluoride plant.
- Aluminum fluoride 14 000 tonnes per year (Figure 1.66).



**Figure 1.63:** Fertilizer production plant.



**Figure 1.64:** On my right is Yousef S. Hijazeen, Manager of Jordan Phosphate Company. Second from left is Muhammed Adnan Hararah.

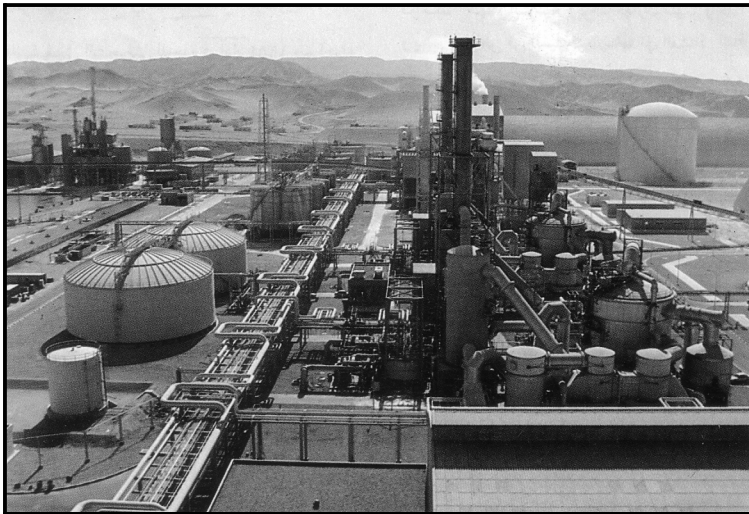
Ammonia is imported from Egypt and sulfur from different countries [6 500 t/day]. Phosphogypsum is disposed of by staking.

- Dust containing  $V_2O_5$ : 12 t/year
- Gypsum: 2 million t/year
- Silica: 5 000–6 000 t/year

It employs approximately 1 000 persons.



**Figure 1.65:** Photos of the ruling family in Jordan.



**Figure 1.66:** Aluminum fluoride plant.

Consumption of raw materials in phosphoric acid pant:

- Phosphate rock 185 t/hour
- Sulfuric acid (98.5%) 92 m<sup>3</sup>/hour
- Water 200–350 m<sup>3</sup>/hour

Consumption of raw materials di-ammonium phosphate plant:

- - Phosphoric acid (49%) 2 200 t/day
- - Anhydrous ammonia (99.5%) 1 000 t/day

Consumption of raw materials aluminum fluoride plant:

- Aluminum hydroxide 24 000 t/year
- Fluorosilicic acid 22 t/year

Water consumption in m<sup>3</sup>/hour:

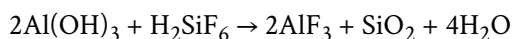
- Phosphoric acid unit 200–350
- Sulfuric acid unit 15–20
- Aluminum fluoride unit 20–30
- Di-ammonium phosphate unit 15–20
- Steam generation unit 50
- Make-up water 15

Fuel consumption:

- Fuel oil 2 040 t/month
- Diesel 10 t/day

### *Production of aluminum fluoride*

Aluminum fluoride is produced by the reaction:



The aluminum fluoride emanating from the belt filter flows into a crystallizer in which aluminum fluoride trihydrate crystals ( $\text{AlF}_3 \cdot 3\text{H}_2\text{O}$ ) precipitates. These crystals pass into calciners at 550 °C where anhydrous aluminum fluoride  $\text{AlF}_3$  is produced. Silica produced is very pure and is stockpiled because there is no market. [solubility in water of  $\text{AlF}_3 \cdot 3\text{H}_2\text{O}$  is 5.6 g/L at 0 °C, 0.67 g/100 mL at 20 °C, at 25 °C equals 0.559 g/100 mL].

Lecture delivered: Pollution problems in the phosphate industry. Engineers from Kemira Plant in Aqaba were present. Kemapco has a plant production capacity of 150 000 t/year of potassium nitrate and 75 000 t/year of dicalcium phosphate. Since Feb. 1st 2007, The Company has been 100% owned by Arab Potash Company. The company was originally established under the name Kemira Arab Potash Company Ltd. (Kemapco) as a 50:50 joint venture set up in Jordan in 1999 between Kemira (Finland) and Arab Potash Company (Jordan).

# Chapter 2

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## Kuwait

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<b>Iraq–Kuwait War</b> .....	50	<b>University of Kuwait</b> .....	51
		<b>Bazaar</b> .....	52

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**Figure 2.1:** Flag of Kuwait.

### INTRODUCTION

Kuwait (Figures 2.2–2.3) lies on the north-western shore of the Persian Gulf. The name is derived from the Arabic *akwat*, the plural of *kut*, meaning “fortress built near water.” The country has a population of about 3.5 million in 2012. Historically, the region was the site of a major port for trade between Mesopotamia and India. In the 4th century BC, Alexander the Great colonized an island off Kuwait’s coast known today as Failaka.

The first permanent settlers in the region came from Bani Khalid tribe of Nejd who in 1756 elected Sabah bin Jaber as the first Emir of Kuwait. Trade consisted mainly of pearls, wood, spices, dates and horses. By the 19th century, Kuwait came under the influence of the Ottoman Empire. In 1899, it entered into a treaty with the United Kingdom that was prompted by fears that the proposed Berlin–Baghdad Railway would lead to an expansion of German influence in the Persian Gulf. However, soon after the start of World War I, the British declared Kuwait an independent principality under the protection of the British Empire.



Figure 2.2: Kuwait on the Persian Gulf.



Figure 2.3: Detailed map of Kuwait showing the Failaka Island.

After World War I, Kuwait emerged as an independent sheikhdom under the protection of the British Empire. Kuwait's large oil fields were discovered in the late 1930s. After gaining independence in 1961, the state's oil industry saw unprecedented growth.

## IRAQ–KUWAIT WAR

Kuwait was a close ally of Iraq during the Iran–Iraq War [1980–1988]. It had heavily funded the war against Iran which resulted in hostile Iranian actions. However, after the war, the relations between the two countries deteriorated. Iraq was not in a financial position to repay the US\$14 billion it borrowed from Kuwait to finance its war and requested Kuwait to forgive the debt. Iraq argued that the war had prevented the rise of Persian influence in the Arab World. In the meantime Kuwaiti overproduction of petroleum kept revenues down for Iraq.

During late 1989, several meetings were held between the Kuwaiti and Iraqi leaders but they were unable to solve the problem between the two. In 1990, Kuwait was invaded and annexed by neighbouring Iraq. The seven month Iraqi occupation came to an end after a military intervention by United States-led forces. Kuwait's infrastructure was badly damaged during the war and had to be re-built.

## KUWAIT CITY

Kuwait City (Figure 2.4) is the capital of Kuwait, located on the shore of the Persian Gulf. It has a population of 2.38 million in the metropolitan area.



**Figure 2.4:** Observation towers in Kuwait City.

## University of Kuwait

Visit to Kuwait City took place in October 1980, after attending the Conference on Complex Sulfides held in Rome, at the invitation of Prof. Mohammed Fahim (Figures 2.5–2.7) at the Chemical Engineering Department, University of Kuwait. The University was established in 1966 to include College of Science, Arts, and Education and College for Women. More colleges were added and in 1974 College of Engineering and Petroleum and in 1977 College of Graduate Studies. Today the university has practically all disciplines. It was observed that the number of girl students was much more than boys. The reason given was that boys are allowed to study abroad but not girls. Lecture given: “The use of autoclaves in the metallurgical industry.”



**Figure 2.5:** Prof. Mohammed Fahim, originally from Alexandria, studied at University of Waterloo in Canada.



**Figure 2.6:** Faculty of Engineering & Petroleum.



**Figure 2.7:** Department of Chemical Engineering.

## **Bazaar**

The striking in the bazaar was the number of shops selling gold articles (Figures 2.8–2.9).



**Figure 2.8:** Gold bazaar.



**Figure 2.9:** Gold bazaar.

# Chapter 3

## Syria

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<b>Ottoman rule</b> .....	57	<b>Aleppo</b> .....	69
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1932–1958  
Independence



1958–1961  
United Arab Republic



1962–1963  
Unity of Egypt broke down



1963–1972  
Ba'ath party coup d'État



1972–1980  
Joined Egypt and Libya to  
form the Federation of Arab  
Republics



1980–present

**Figure 3.1:** Flags of Syria.

### HISTORICAL INTRODUCTION

#### Early history

Syria was one of the most ancient civilizations. The Syrians traded with the cities of Sumer, Akkad, and ancient Egypt. The country flourished through the early second millennium BC until occupied successively by Sumerians, Egyptians, Hittites, Assyrians and Babylonians. Canaanites, Arameans, and Phoenicians. Eventually, c.550 BC, the Persians took Syria as part of their empire. This ended with the conquests of Alexander the Great in 333–332 BC. Syria was then incorporated into the Seleucid Empire. The

capital of this Empire (founded in 312 BC) was situated at Antioch, now in Turkey and called Antakya (Figure 3.2).

The Roman general Pompey captured Antioch in 64 BC, turning Syria into a Roman province. The city of Antioch was the third largest city in the Roman Empire, after Rome and Alexandria. With the decline of the empire in the west, Syria became part of the Byzantine Empire in 395.



**Figure 3.2:** Map of modern Syria showing × = Antakya [Antioch], [Tadmur = Palmyra].

### Arab Conquest

In 634–640, Syria was conquered by Khalid Ibn Al-Walid, resulting in the region becoming part of the Islamic empire. In the mid-7th century the Umayyad dynasty ruled the empire from the capital Damascus. The Islamic

empire expanded rapidly and at its height stretched from Spain to India and parts of Central Asia. In the mid-8th century, the Caliphate collapsed amid dynastic struggles, regional revolts and religious disputes. The Ummayyad dynasty was overthrown by the Abbasid dynasty in 750, who moved the capital of empire to Baghdad. For periods, Syria was ruled from Egypt, under the Tulunids (887–905), and then, after a period of anarchy, the Ikhshidids (941–969). Northern Syria came under the Hamdanids of Aleppo. The Byzantines captured Antioch and Aleppo in 969. Syria was then conquered by the Seljuk Turks (1084–1086). After a century of Seljuk rule, Syria was conquered (1175–1185) by Saladin, founder of the Ayyubid dynasty of Egypt.

## The Crusades

During the 12th–13th centuries Syria was a battle ground with the Crusaders and parts of Syria were held by Crusader states. Krak of the Knights (Figure 3.3) is a Crusader castle 40 km west of the city of Homs, close to the border of Lebanon. The Hospitallers built it between 1140 and 1170. In 1271 it was captured by the Mamluk Sultan Baibars.

In 1260, the Mongols briefly swept through Syria but were conquered by the Mamelukes of Egypt. In 1400, Timur Lenk, or Tamerlane, invaded Syria, defeated the Mameluke army at Aleppo and captured Damascus. Many of the city's inhabitants were massacred, except for the artisans, who were deported to Samarkand.



**Figure 3.3:** Krak of the Knights.

## Ottoman rule

In 1516, the Ottoman Sultan Selim I conquered Syria after defeating the Mamelukes at the Battle of Marj Dabiq near Aleppo. The Ottomans fostered a peaceful coexistence amongst the different sections of Syrian society for over four hundred years. During World War I, French diplomat François Georges-Picot and British diplomat Mark Sykes secretly agreed on the post war division of the Ottoman Empire into respective zones of influence. In 1918, Arab and British troops advanced into Syria and captured Damascus and Aleppo.

## French mandate

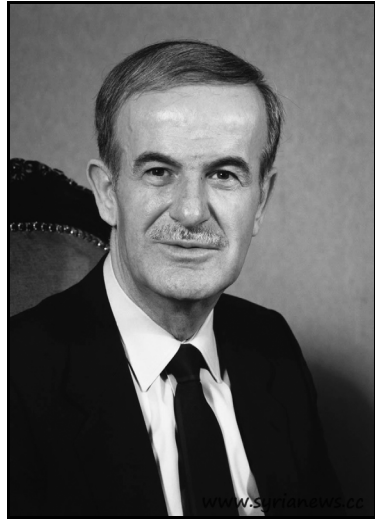
In 1920 Syrian National Congress proclaimed Emir Faisal I of the Hashemite family as king of Syria. However, his rule ended after a few months when French troops took control of Syria and forced Faisal to flee. Later that year Syria–Lebanon came under a French mandate, and Palestine under British control. Nationalist agitation against French rule by Sultan Al-Atrash in the Druze Mountain in 1925 was suppressed in 1926. In 1936 France agreed to Syrian independence although maintained military and economic dominance. With the fall of France in 1940 during World War II, Syria came under the control of Vichy Government until the British and Free French occupied the country in 1941 and Syria proclaimed its independence.

## Modern history

From 1949 to 1954 Syria was governed by the military until the nationalist leader Shukri Al-Quwatli (1891–1967) (Figure 3.4) became president in 1955. The appeal of Egyptian President Gamal Abdal Nasser's leadership in the wake of the Suez Crisis created support in Syria for union with Egypt on February 1, 1958. However, discontent with Egyptian dominance led elements opposed to the union to seize power on 28 September 1961. Frequent military revolts, civil disorders, and bloody riots characterized the 1960s. In 1963, a group of military and civilian officials of the Ba'ath Party assumed control of the country. Syria aligned itself with the Soviet bloc. Opponents of the regime were harshly suppressed. Public support for the regime declined sharply after the 1967 Six-Day War, when Israel destroyed Syria's air force and captured the Golan Heights. On 13 November 1970, Minister of Defense Hafez Al-Assad (1930–2000) (Figure 3.5) seized power in a bloodless military overthrow.



**Figure 3.4:** Shukri Al-Quwatli (1891–1967).



**Figure 3.5:** Hafez Al-Assad (1930–2000).

## DAMASCUS

Damascus (Figure 3.6), Dimashq in Arabic, was chosen as the capital of the Umayyad Caliphate in 661. After the victory of the Abbasid dynasty in 750, the seat of Islamic power was moved to Baghdad. Damascus saw a political decline throughout the Abbasid era. During Ottoman rule, the city decayed completely. Today, it is the seat of the government.

### Citadel

The citadel (Figures 3.7–3.9) dates to the Ayyubid period while incorporating parts of the older Seljuq fortress. Extensive repairs in response to sieges and earthquakes were carried out in the Mameluk and Ottoman periods. A monument to Salah Al-Din Yusuf Ibn Ayyub (1137–1193) (Figure 3.10) is located next to the citadel. Salah al-Din is better known in the West as Saladin; he was a Kurdish Muslim, who became the first Sultan of Egypt and Syria, and founded the Ayyubid dynasty. He was buried in Damascus.

### National Museum

The National Museum (Figures 3.11–3.14) has very rich collection. It has some 5 000 cuneiform tablets. There is a large statue of the King of Mari that dates from around 2500 BC. Mari city is situated on the right bank of

the Euphrates River in what is now Syria. Archaeologists unearthed a palace that contained nearly 300 rooms. It contained numerous wall murals and hundreds of small objects, diplomatic correspondence and reports sent in from all parts of the country, and historical archives and letters.

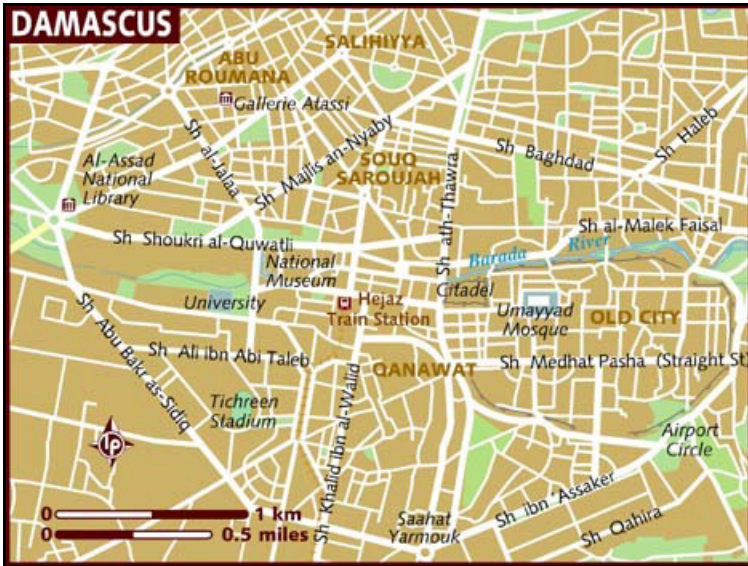


Figure 3.6: Map of Damascus showing Umayyad mosque, the citadel, and the National Museum.



Figure 3.7: Damascus citadel.



**Figure 3.8:** Damascus citadel.



**Figure 3.9:** Damascus citadel.



**Figure 3.10:** Monument to Salah Al-Din next to the citadel.



**Figure 3.11:** National Museum.



**Figure 3.12:** National Museum.



Figure 3.13: King of Mari at the National Museum.



Figure 3.14: Mortuary statues from Palmyra.

## Bazaar

Al-Hamidiyah Souq is the largest market in Damascus located just beside the citadel, ending in the large Umayyad Mosque plaza entrance.



Figure 3.15: Bazaar.

## Mosque

The Grand Mosque of Damascus (Figures 3.16–3.17), known as the Umayyad Mosque, was built in 715 on the site of a Christian Cathedral which in turn was a Roman temple. The tomb of Saladin stands in a small garden adjoining the north wall of the mosque.



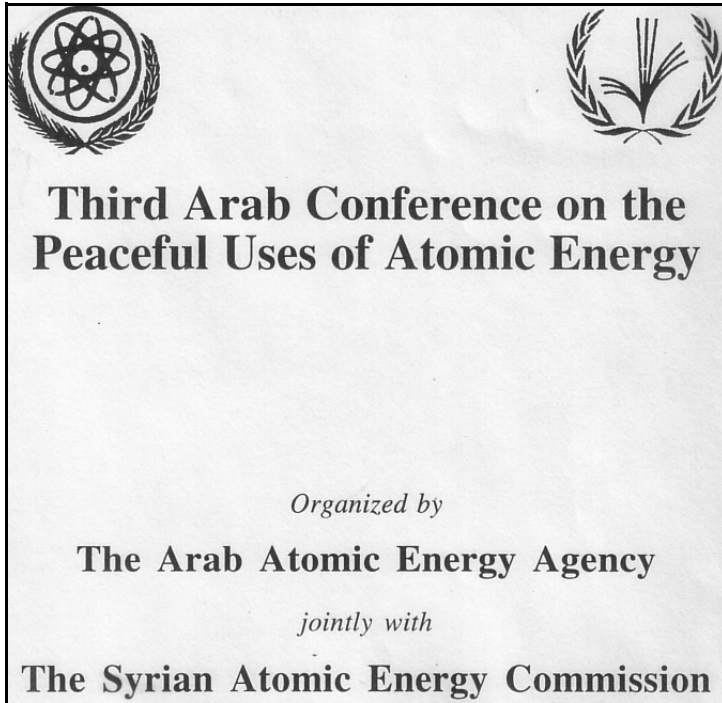
**Figure 3.16:** The Grand Mosque of Damascus.



**Figure 3.17:** The Grand Mosque of Damascus.

## **Peaceful Uses of Atomic Energy**

The Third Arab Conference on the Peaceful Uses of Atomic Energy was held in Damascus December 9–13, 1996. Paper presented: “The Recovery of Uranium and Rare Earths from Phosphate Rock.”



**Figure 3.18:** Cover to conference program December 9–13, 1996.



**Figure 3.19:** Conference badge.

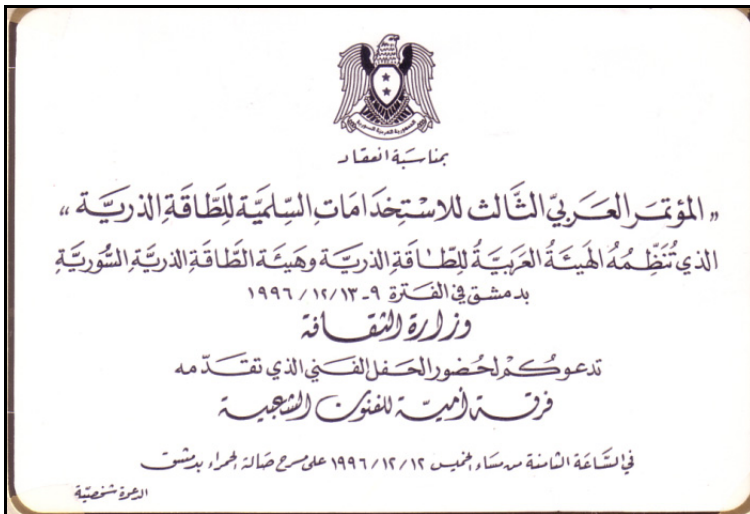


Figure 3.20: Invitation.



Figure 3.21: Invitation.



**Figure 3.22:** Egyptian colleagues.



**Figure 3.23:** Syrian colleagues.

## ALEPPO

Aleppo, Halab in Arabic, 310 km north of Damascus, is the largest city in Syria. It was a prosperous city since it was located at the end of the Silk Road. In 944, it became the seat of an independent Emirate under the Hamdanid prince Sayf Al-Daula and enjoyed a period of great prosperity. The city came under the control of Saladin of the Ayyubid Dynasty in Egypt starting from 1183. In 1260, it was taken by the Mongols under Hulagu then by the Mameluk leader Qalawun. In 1400, the Mongol-Turkic leader Tamerlane captured the city and finally it became part of the Ottoman Empire in 1516 and the capital of Syria. It was the third largest city in the empire after İstanbul and Cairo. However, when the Suez Canal was inaugurated in 1869, trade was diverted to sea and Aleppo began its slow decline.

The Citadel (Figures 3.24–3.26) is a large fortress 50 m above the city, dates back to the first millennium BC. Many of the current structures date from the 13th century. The Citadel had been extensively damaged by an earthquake in 1822.



**Figure 3.24:** Aleppo citadel.



**Figure 3.25:** Aleppo citadel. Photo by Nadia Habashi, 1996.



**Figure 3.26:** Aleppo citadel. Photo by Nadia Habashi, 1996.

## Hamdani park

Abu Firas Al-Hamdani (932–968) (Figures 3.27–3.28) was an Arab poet, a cousin of Sayf al-Dawla, and a member of the noble family of the Hamdanids, who were rulers in northern Syria and Upper Mesopotamia during the 10th century. He served Sayf al-Dawla as provincial governor as well as court poet.



**Figure 3.27:** Al Hamdani park.



**Figure 3.28:** Monument to Abu Firas Al Hamdani.

The Hamdanids were a branch of the Banu Taghlib, an Arab tribe resident in the area of the Jazira (Upper Mesopotamia) since pre-Islamic times. They controlled Mosul and its region until the late 9th century, when the Abbasid government imposed firmer control over the province. Family members intermarried with Kurds. Sayf al-Dawla's court at Aleppo was the centre of a cultural life including poets like Al-Mutanabbi and the philosopher Al-Farabi. Sayf al-Dawla's final years were marked by military defeats and the region became a Byzantine tributary.

## TADMUR/PALMYRA

Palmyra (Tadmur in Arabic) (Figures 3.29–3.31) was an important city located in an oasis 215 km northeast of Damascus. It was a caravan stop for travellers crossing the Syrian Desert. Though the ancient site fell into disuse after the 16th century, there is a newer town of the same name next to the ruins.



**Figure 3.29:** Palmyra/Tadmur.

Zenobia (240–275) (Figure 3.32) was Queen of the Palmyrene Empire in Roman Syria. She led a revolt against the Roman Empire. By 269, Zenobia had expanded the empire, conquering Egypt and expelling the Roman prefect. She ruled over Egypt until 274, when she was defeated and taken as a hostage to Rome by Emperor Aurelian. A year later, Palmyra was destroyed and the inhabitants slaughtered.



**Figure 3.30:** Palmyra/Tadmur.



**Figure 3.31:** Palmyra/Tadmur.



**Figure 3.32:** Coin depicting Queen Zenobia (240–275).

In the 6th century, Palmyra's defences were rebuilt by Emperor Justinian and a few Byzantine churches were built, but most of the city remained in ruins. In 634, Palmyra was taken by the Arabs under Khalid Ibn Walid in the name of the first Muslim caliph, Abu Bakr. A castle was built on top of a mountain overlooking the oasis. In 1089, a major earthquake destroyed what was left of Palmyra.

## CULTURE

Damascus was full with murals, statues of President Hafez Al-Assad, and slogans praising his achievements (Figures 3.33–3.38). Even the conference banquet was a show devoted to praise the president (Figure 3.39).



**Figure 3.33:** One of the many murals showing President Al-Assad and his two sons. Damascus, 1996.



**Figure 3.34:** Hafez Al-Assad statue.



**Figure 3.35:** Hafez Al-Assad statue.



Figure 3.36: Hafez Al-Assad statue.



Figure 3.37: One of the murals showing President Al-Assad.

## أسديات

لأنك سيد كل الرجال  
معك نسير الي الجد يقاهر المستحيل

الأسد قائدنا والباسل قدوتنا  
البعث طريقنا والأسد قائدنا

آمال أمة وعقريه قائد  
حافظ الأسد وسام علي صدر الأمة

25 ربيعاً عطاء سرمدي

سلاما أيها الأسد سلمت ويسلم البلد  
وتسلم أمة فخرت بآتك فخر من تلد

عطاء وبناء وبقاء  
أنت في السلام سلام  
قائدنا الي الأبد... الأمين حافظ الاسد

حافظ الأسد: كل الحب والولاء والوفاء  
للأب المعطاء  
المحامي العربي الأول للأمة العربية

بطل الحرب والسلام والمدافع بصلاية عن حقوق الأنسان

قائدنا الي الأبد... سورية الأسد  
ولأوننا الي الأبد للقائد العظيم حافظ الأسد

الي الأبد يا أسد  
حاديا للفاقلة ورائد المسيره وقائدنا الي الأبد

كنت الأمل وستبقي المثل  
قائدنا بالدم نغديه ووطننا بالعرق نبنيه  
المناضل العربي الأول

حافظ الأسد... استحضار التاريخ  
واستشفاف المستقبل

نفخر ونعتز بأمة أنت قائدها  
ياصانع المجد والحضارات والمعجزات

بورك شعب أنت حافظه  
وبوركت أمة أنت أسدها

Figure 3.38: Samples of slogans in the streets praising the president.



**Figure 3.39:** Closing ceremony show of the conference in praise of President Al-Assad.

# Chapter 4

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## Morocco

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**Figure 4.1:** Flag of Morocco.

## INTRODUCTION

In Morocco the rivers originate from Atlas Mountains and direct to the Atlantic Ocean while El Rif Mountains are in the north (Figure 4.2). Western Sahara was a Spanish colony and was occupied by Morocco in 1976 although the occupation is not recognized worldwide.



**Figure 4.2:** Morocco Atlas Mountains and rivers.

## HISTORICAL INTRODUCTION

### Ancient history

The Phoenicians built cities on the coast of the Mediterranean in the 12th century BC and up the rivers of the territory that is now Morocco. By the 5th century BC, Carthage had extended its hegemony across much of North Africa. By the 2nd century BC, several large Berber kingdoms had emerged. After the fall of Carthage the area was annexed to the Roman Empire. Mauretania Tingitana was a Roman province coinciding roughly with the northern part of present-day Morocco. By the 2nd century AD, the Roman Empire had gained control of the entire North African coast from Morocco to Egypt. Volubilis (Figures 4.3–4.4) is an archaeological site in Morocco situated near Meknes between Fez and Rabat features the best preserved Roman ruins in this part of northern Africa. Around 278 AD

Romans moved their regional capital to Tangier and Volubilis started to lose importance.



**Figure 4.3:** Ruins in Volubilis.



**Figure 4.4:** Ruins in Volubilis.

Christianity was introduced in the 2nd century and gained converts in the towns and among slaves. In the 5th century, the region fell to the Vandals, Visigoths, and then the Byzantine Empire. During this time, however, the Berber in the high mountains remained unsubdued.

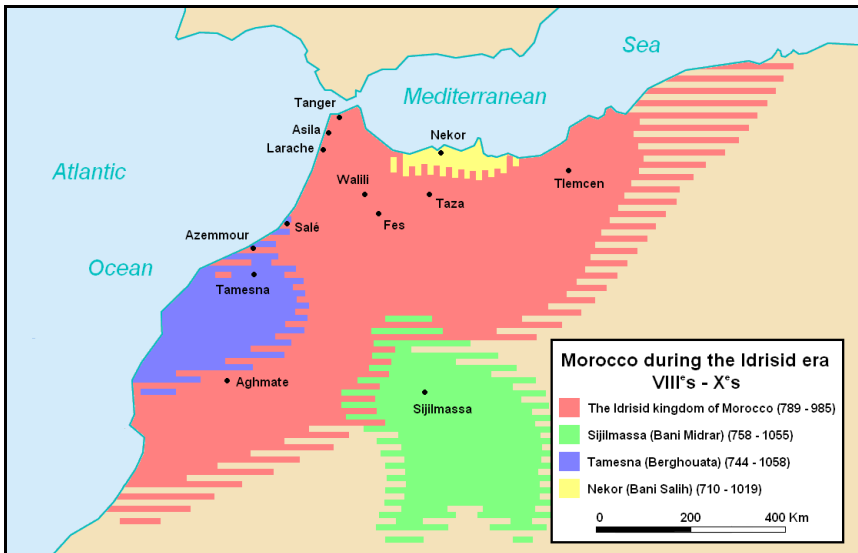
## **Arab Conquest**

In the 7th century, the Arabs conquered northern Africa and introduced Islam, which gradually spread southward into the neighbouring

region. Under the orders of the Umayyad Caliph in Damascus a Muslim Berber general Tariq ibn Ziyad led an army from the north coast of Morocco and conquered the Visigothic Hispania in 711–718 AD. In 740 the Berber revolted and seceded. The Abbasids who overthrew the Umayyad were able to re-impose Arab rule on North Africa with the exception of Morocco which was fragmented into a small independent Berber states. Also an attempt to take Al Andalus from the Umayyad failed.

## Idrisid Dynasty

Morocco became a haven for many rebels and refugees from the Arab empire. Among these was Idris ibn Abdallah (745–791) who, with the help of the local Berbers, founded the Idrisid Dynasty in 780 (Figure 4.5). His son Idris II (791–828) erected a new capital at Fes and made Morocco a centre of learning.



**Figure 4.5:** Morocco during Idrisid era [788–974].

Berber rebels erected the settlement of Sijilmasa (in southeast Morocco) and traded with the gold-producing African Empires in the south. In the early 900s, the Fatimids from the east invaded Morocco, sacking both Fes and Sijilmasa and the country fell into anarchy.

## Almoravid dynasty

In the 11th century the Berber Almoravid [Arabic: المرابطون Al-Murābiṭūn] took control of the country as well as Al-Andalus from the

Umayyad and founded Marrakesh in 1062 by Youssef Ben Tashfine as their capital city (Figure 4.6).

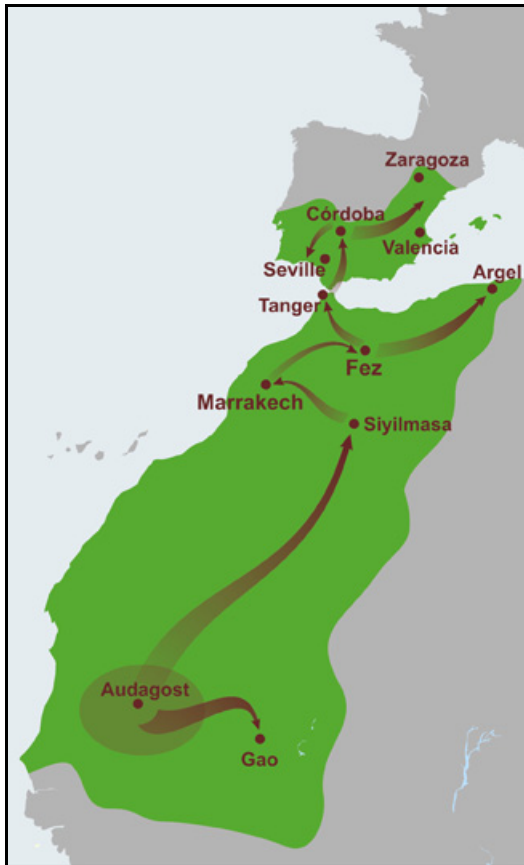


Figure 4.6: Almoravid Empire [1040–1147].

## Almohads Dynasty

In 1212, another Muslim Berber tribe, the Almohad [Arabic الموحدون Al-Muwaḥḥidun, the Unifying], defeated the Almoravids (Figure 4.7) and continued to rule until a revolt of population.

## Marinid

In 1215, the Marinid [Arabic بنو مرين] leader Abu Yusuf Yaqub (1259–1286) from Fes captured Marrakech and took control of most of the Maghreb towards the end of 1268 (Figure 4.8). In 1340 the Marinids were

defeated by a Portuguese–Castilian coalition and had to withdraw from Andalusia. Ceuta (Sebta) was conquered by the Portuguese in 1415, taken by Spain in 1580 while Melilla was taken by Spain in 1497.



Figure 4.7: Almohads Dynasty [1147–1268].

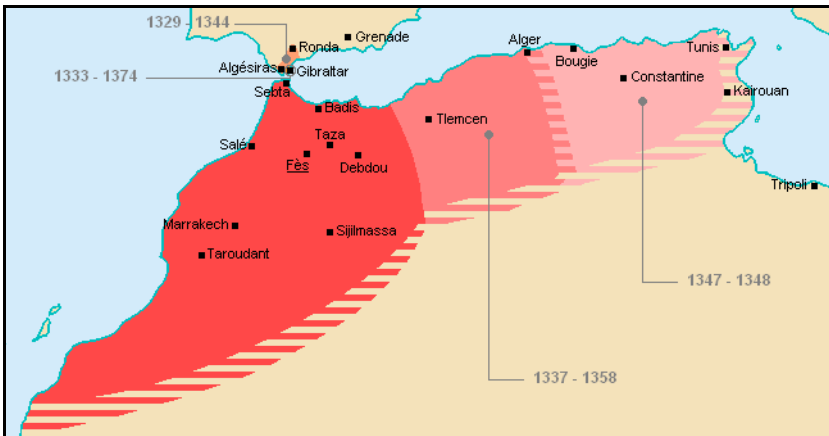


Figure 4.8: Marinid Dynasty [1269–1465].

## The Saadis [1549–1654]

Mohammed Al-Sheikh was the first Saadi sultan of Morocco [السعديون]. They claimed descent from Prophet Muhammad through the line of Ali ibn Abi Talib and Fatima Zahra (Muhammad's daughter). Following his murder in 1557 there was a power struggle among his sons. When Abdallah Al-Ghalib took control, two of his brothers Ahmad Al-Mansur and Abd Al-Malik had to flee to the nearby Regency of Algiers and to Constantinople. Abdallah Al-Ghalib was succeeded by Abu Abdallah Mohammed. After exile for 17 years Abd Al-Malik claimed the throne with the help of the Ottomans.

The expansion of the Ottomans in North Africa represented a threat to the Portuguese trade in the region. That is why the deposed Moroccan Sultan Abu Abdallah Mohammed allied with the King Sebastian of Portugal to help him recover his throne. On August 4, 1578 the Battle of Ksar el Kebir, also known as Battle of Three Kings, was fought in northern Morocco between the army of the deposed Moroccan Sultan with his ally the King of Portugal, and a Moroccan army under Abd Al-Malik. With the defeat of Portugal and the death of the three kings, Ahmad Al-Mansour Al-Saadi (1549–1603) (Figure 4.9) became the new Sultan.

Under his rule Morocco consolidated power. He built the Badie Palace [Arabic: قصر البديع] (the Marvellous) in Marrakesh (Figure 4.10). The building of the palace was financed by a ransom paid by Portugal after the battle. The Koutoubia minaret is still standing (see later).



**Figure 4.9:** Sultan Ahmad Al-Mansour Al-Saadi (1549–1603).



**Figure 4.10:** Remains of Badie Palace in Marrakesh.

## The Alaoui Dynasty

After the death of Al-Mansur, the country was divided among his sons. In 1666 the sultanate was reunited by the Alaouites who are the current Moroccan royal family (Figure 4.11). The dynasty is named after Moulay Ali Cherif who became Prince of Tafilalt in 1631. He claimed to be a descendant of Prophet Muhammad through Hassan ibn Ali. His son Al-Rashid was able to pacify the country.

## European colonization

As the Portuguese began their explorations in the 15th century, accurate information about Africa began to reach Europe. Through accounts of travellers, Europeans learned of scholarly centres in the desert, trading cities, and the gold-rich empires. When many Moors were expelled from Spain most of them settled in the Rif. Since then, the Rif has suffered numerous battles between Berber kingdoms, Spain, and Portugal. In 1415, Portugal invaded Ceuta (Sebta), and in 1490 Spain invaded Melilla.

There was a period of peace afterwards, but war between Spain and Morocco broke out again in 1859 in Tetouan, where Morocco was defeated. The Spanish–Moroccan conflicts continued in the 20th century under the leadership of Muhammad Ibn Abd al-Karim al-Khattabi, the Berber guerilla leader. The French invaded Morocco in 1912 and established a protectorate. She then gained control of large parts of northern and western Africa, as well as the vast area between western and central Africa known as French Equatorial Africa. Morocco achieved independence in 1956.



Figure 4.11: A chart in a hotel showing the Royal family tree. Photo by Fathi Habashi.

## Ifni and Spanish Sahara

Ifni was a Spanish province on the Atlantic coast of Morocco, south of Agadir and across from the Canary Islands founded in 1476 (Figure 4.12). The Spanish were expelled from the area in 1524 by the Berbers. There was a short war with Morocco in 1859 which resulted in the territory and its town of Sidi Ifni to be ceded to Spain in 1860. In 1957 the territory was occupied by Morocco.



**Figure 4.12:** Ifni and Spanish Sahara.

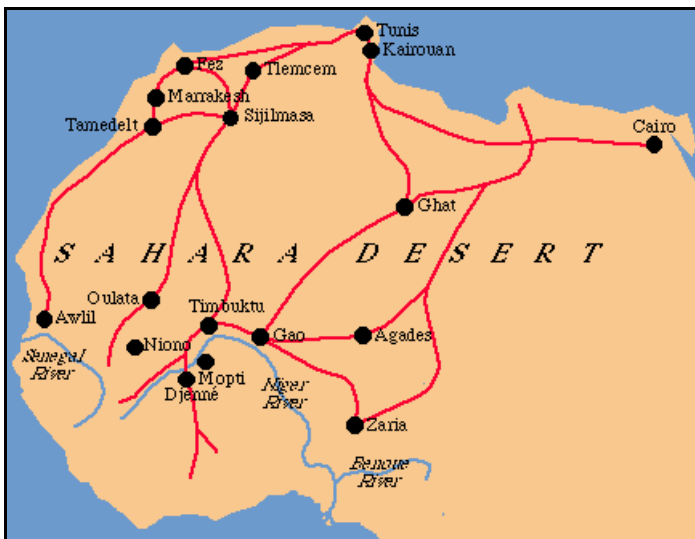
Since 1884, Spain formed the province of Spanish Sahara south of Morocco. There were many uprisings and that in 1956–1958, initiated by the Moroccan-backed Army of Liberation, led to heavy fighting. Upon Spain's withdrawal in 1976, Morocco took over Saguia el Hamra while Mauritania took control of Río de Oro. The Polisario Front, a nationalist organization [from the Spanish abbreviation of Frente Popular de Liberación de Saguía el Hamra y Río de Oro] working for ending Moroccan occupation, proclaimed the Sahrawi Arab Democratic Republic [SADR] and waged a guerrilla war against both Morocco and Mauritania (Figure 4.13). After repeated strikes

at the iron mines of Zouerate, Mauritania withdrew its forces in 1979 and proceeded to recognize SADR. Morocco immediately annexed the area evacuated by Mauritania.



**Figure 4.13:** Flag of Sahrawi Arab Democratic Republic.

Morocco built an approximately 2 700-km-long sand wall running about three metres in height, with bunkers, fences, and landmines through Western Sahara and the south eastern portion of Morocco to act as a barrier between the Moroccan-controlled areas and the Polisario-controlled section of the territory that lies along its eastern and southern border. All major settlements, the capital El Aaiún, and the phosphate mine at Bou Craa lie far into the Moroccan-held side. Since 1979, the Polisario Front has been recognized by the United Nations as the representative of the people of Western Sahara. Algeria has shown an unconditional support for the Polisario.



**Figure 4.14:** Map showing ancient trade routes in western Sahara Desert. Sijilmasa no longer exists.

## Trade Routes

European products arriving at the north coast of Africa were carried by donkeys through the coastal lands, converging at inland centres, principally Sijilmasa (now known as Tafilet), Marrakesh, and Ghadames, and returning to the coast with products brought across the desert from the south (Figure 4.14).

**Table 4.1:** Visits to Morocco.

Dates	City	Purpose
May 27–June 8, 1995	Marrakesh	Reminex
	Casablanca	Phosphate Research Department
March 3–28, 1997	Marrakesh	Reminex
	Tangier	Cross by ferry to Spain [Cádiz, Seville]
March 12–April 2, 1999	Marrakesh	Reminex
	Tangier	Cross by ferry to Spain [Alhambra, Córdoba, Escorial]
January 23–30, 2000	Marrakesh	Reminex [later to Côte d'Azur]
March 31–April 8, 2001	Marrakesh	Reminex [later to Lisbon]
September 23–30, 2007	Marrakesh	Reminex
	Rabat	University Mohammed V Mohammadia School of Engineering
December 13–21, 2013	Agadir	Fourth Conference on Water, Waste, and Pollution
April 27–May 1, 2014	Marrakesh	13th Arab International Mineral Resources Conference

## MARRAKESH

The original name of the city of Marrakesh was “Morkach,” which gave its name to Morocco. Situated between the mountains of the High Atlas and the Sahara desert, Marrakesh buildings are all in red. Jemaa el Fna is the city centre. Marrakesh was founded in 1062 under the leadership of Yusuf ibn Tachfine, first ruler of the dynasty Almoravid. It became the capital of the kingdom where many mosques and madrasas (Koranic schools of theology) were constructed. Marrakesh grew rapidly and became a cultural, religious, and commercial centre for the Maghreb and black Africa (Figure 4.15). The walls were built to protect the city (Figure 4.16–4.17).



**Figure 4.15:** General view of Marrakesh.



**Figure 4.16:** Marrakesh city wall.



**Figure 4.17:** Marrakesh city wall.



**Figure 4.18:** Marrakesh palm trees.

The city was seized by the Almohad in 1147. The irrigation system of the city was upgraded to supply the palm trees and large gardens. In 1269, the clan of nomadic Merinid captured Marrakesh and the city declined and lost its status as capital in favour Fez. In the early 16th century Saadien Sultan Mohammed Al Mahdi, re-located the capital of the kingdom in Marrakesh. At the end of the 17th century, the successor to the Alawite dynasty

Saadians. Sultan Moulay Ismail, a contemporary of Louis XIV. He moved the capital to Meknes.

The Koutoubia mosque, the symbol of Marrakesh, was built at that time on the ruins of the palace Almoravid. The minaret is 77 m high (Figure 4.19). It was completed under the reign of the Almohad Caliph Yaqub al-Mansur (1184 to 1199).



**Figure 4.19:** Koutoubia minaret.



**Figure 4.20:** Hotel Tafilalet, 1995.



**Figure 4.21:** Hotel Marrakech, 1997.



Figure 4.22: Hotel Marrakech.



Figure 4.23: Hotel, 1997.



**Figure 4.24:** Hotel Kenzi Farah, 2014.



**Figure 4.25:** Hotel Kenzi Farah, 2014.



**Figure 4.26:** New airport, 2014.



**Figure 4.27:** Entertainment, 1995, with host Dr. Ismail Akalay and his wife.



**Figure 4.28:** Entertainment, 1995. Photo by Fathi Habashi.



**Figure 4.29:** Dr. Ismail Akalay and family at home. Daughters: Ablah, Aicha, and Kenzah. Photo by Fathi Habashi, 1995.

## REMINEX

Reminex, acronym for Recherche Minérale et Exploration, was founded in 1985 as a research and development department for exploration

and engineering projects for ONA, acronym for Omnium North Africa. ONA is a multidisciplinary group and one of the most active players in the development of Morocco since 1928. The Group invests in many sectors of the economy, e.g., in mining, sugar, fats and dairy products, deep sea fishing and fish farming, financial activities, super markets, and the motor industry.

The Group employs more than 18 000 people, of whom 1 450 are in the Mining Pole known as Managem (Arabic for mines), which was launched in 1992, with the opening of the Guemassa mine. Its activity consists of mining, concentrating, and marketing concentrates of copper, zinc, and lead, metallic silver and metallic cobalt, fluorspar, and arsenic oxide. Reminex includes chemical and mineralogical laboratories, quality control, and environmental research located at Hajar, while the engineering offices are located at Casablanca. A committee was formed in 2000 to evaluate research. Host: Dr. Ismail Akalay, Director.

Hajar , le 30 Mai 1995	
<b>ORIGINE :</b>  CELLOLE RESSOURCES HUMAINES	<b>DESTINATAIRE :</b>  <b>TOUS SERVICES : - CMG          REMINEX          TECHSUB</b>
<b>Réf : N° 86/1B/SE/95.</b>	
<b>Objet : CONFERENCE</b>	
<p>Il est porté à la connaissance de l'ensemble du personnel du site de Hajar qu'une conférence intitulée "<i>Métallurgie extractive : développement et problèmes</i>" sera animée par le professeur FATHI HABASHI de l'université LAVAL de QUEBEC, dans la salle de projection de Guemassa le Jeudi 01 Juin 95 à partir de 9 h.</p> <p>Vous voudrez bien en prendre note.</p>	

Figure 4.30: Announcement for lecture, 1995.

**REMINEX / CRV**

Le 05 Mars 97

**NOTE D'INFORMATION N°13/97**

Monsieur Fathi Habachi de l'université Laval de Québec animera les séminaires suivants selon le planning ci-dessous :

*1<sup>ère</sup> Semaine*

Mercredi 05 Mars 1997 à partir de 10 h :  
« Les Métaux et l'industrie métallurgique »

Vendredi 07 Mars 1997 à partir de 10 h :  
« Les Minéraux et l'industrie minière »

*2<sup>ème</sup> Semaine*

Mercredi 12 Mars 1997 à partir de 10 h :  
« La Valorisation des minerais »

Vendredi 14 Mars 1997 à partir de 10 h :  
« La Métallurgie extractive du Nickel et du cobalt »

*3<sup>ème</sup> Semaine*

Lundi 17 Mars 1997 à partir de 10 h :  
« La Métallurgie extractive de l'Or »

Mercredi 19 Mars 1997 à partir de 10 h :  
« La Mécanisme de dissolution des minéraux »

— Direction Valorisation

PO 

Copies : MM. LAROU  
OUIFA  
HAJJAM  
Melle. AGUHAZ

**Figure 4.31:** Lectures, 1997.



**Figure 4.32:** Reminex engineers, 1997.



**Figure 4.33:** With engineer Intissar Benzakour [extreme right] at home, 1997.



Hajar, le 16 mars 1999

**Note d'Information**

Réf : CR/AD/NL/005/99

Objet : *Planning des conférences animées par M. Fathi Habashi*

Des conférences vont être animées par M. Fathi HABASHI au cours de cette semaine. Les thèmes traités sont :

« **La Cinétique des procédés métallurgique** » prévue pour le **Mercredi 17 mars** 1999.

« **La précipitation dans l'hydrométallurgie** » prévue pour le **Jeudi 18 mars** 1999.

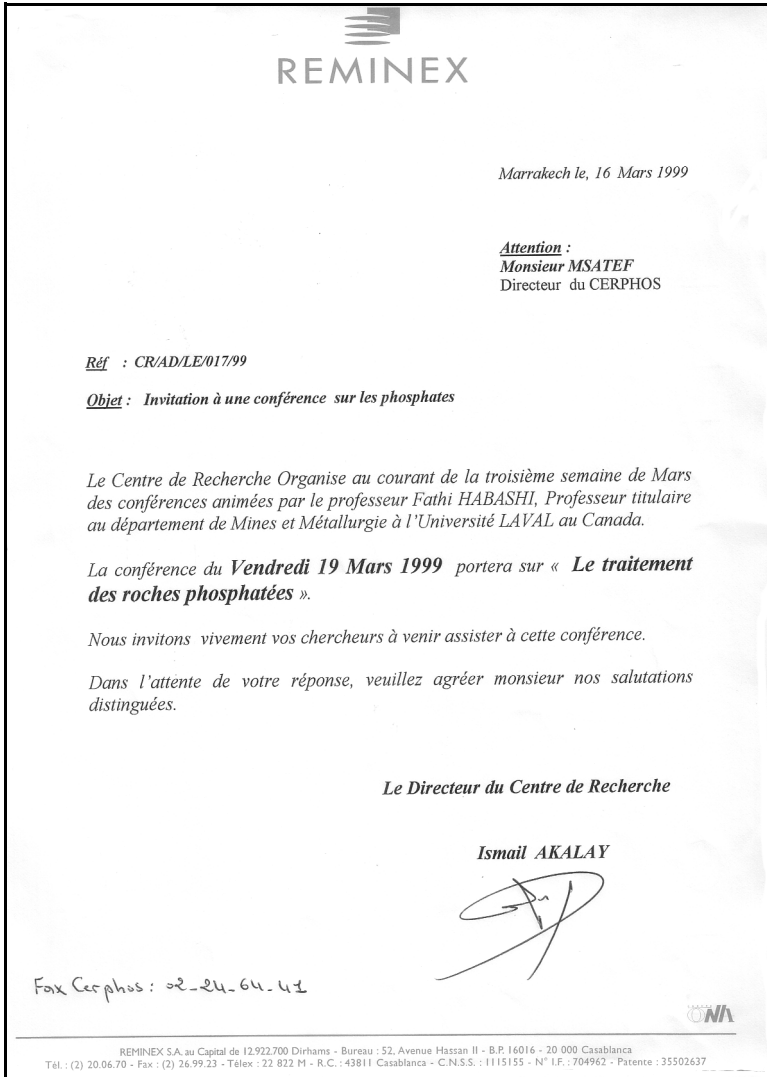
« **Traitement des roches phosphatées** » prévue pour le **Vendredi 19 mars** 1999.

Lieu : salle de réunion du Centre de Recherche.

Heure : 13 h

Ben Bouziane

**Figure 4.34:** Lectures, 1999.



**Figure 4.35:** Phosphate lecture, 1999.



**Figure 4.36:** Committee meeting 2000. From left: Yakob M. Shneerson and his interpreter [Research Institute GIPRO-NICKEL, Saint Petersburg], Ali Benbachir [Univeristé Mohammed V, Rabat], Fathi Habashi, Douglas Flett [Consultant, UK], Prof. Robert Brochot [France].



**Figure 4.37:** Research staff at Reminex, Marrakesh 2007.

## Cadi Ayyad University

Cadi Ayyad University [جامعة القاضي عياض] (Figures 4.38–4.39) also known as the University of Marrakesh, is one of the major universities of Morocco established in 1978, named after Qadi Ayyad ibn Musa (1083–1149), who was born in Ceuta (Sabtah), then belonging to the Almoravid Empire. He was the great imam of that city, a law scholar, and later a high judge in Granada. Host: Professor Abdelmounaime Bouhafid. Meeting Dean Abdelkader Mokhlisse.



Figure 4.38: Cadi Ayyad University.



Figure 4.39: Commemorative stamp for 30th anniversary foundation of Cadi Ayyad University.

## Arab Mineral Resources Conference

The 13th Arab International Mineral Resources Conference (Figures 4.40–4.41) was organized by *Arab Industrial Development & Mining Organization*. The Headquarters of the Organization is in Rabat. About 40 people working there. Conference organizer: Engineer Munir Abusbia, Director of Mineral Resources Department. About 400 from different Arab countries [except Syria] attended, mainly geologists. Papers presented:

- Advances in the Extractive of Gold from its Ores
- Hydrometallurgy and the Phosphate Industry

Conference Proceedings was available at the conference. A meeting was held with engineers from Office Cherifien de Phosphate.



Figure 4.40: Conference flyer, 2014.



Figure 4.41: Conference badge, 2014.

## CASABLANCA

Casablanca (Arabic: الدار البيضاء, al-Dār al-Bayḍā', the "White House," original name in Berber: Anfa meaning hill), is Morocco's modern metropolis and chief port (Figure 4.42). It was used as a port by the Phoenicians and later the Romans. In the early 15th century, the town became a harbour for pirates leading it to be targeted by the Portuguese, who destroyed the town in 1468 and built a military fortress in 1515. An earthquake destroyed most of the town in 1755. The French took control of town in 1907. Casablanca is home to the Hassan II Mosque (Figures 4.43–4.45). Its minaret is the world's tallest at 210 m.



**Figure 4.42:** Casablanca.

## Phosphate Research Centre

Phosphate Research Centre known by the acronym CERPHOS which stands for the French name Centre d'Études et de Recherche des Phosphates Minéraux, was founded in France in 1947 then moved in 1975 to Casablanca. The centre is a subsidiary of Office Chérifien des Phosphates, a state-owned corporation founded in 1920, a leading exporters of phosphates, phosphoric acid, and fertilizer phosphate in the world. Host: Ismail Smani, Director, and Driss Msatef, Assistant Director.



**Figure 4.43:** Hassan II Mosque.



**Figure 4.44:** Hassan II Mosque.



**Figure 4.45:** Hassan II Mosque.

## RABAT

During the French administration of Morocco, the country's capital was moved from Fez to Rabat (Figures 4.46–4.52). It is situated on the estuary of a river facing the Atlantic Ocean and is the seat of the Royal Family.



Figure 4.46: Railway station.



Figure 4.47: Main street in Rabat.



**Figure 4.48:** A view of the city.



**Figure 4.49:** City wall.



**Figure 4.50:** City wall.



**Figure 4.51:** City gate.



Figure 4.52: Mausoleum Mohammed V.

## Mohammed V University


Mohammed V University was founded in 1957 as the first university in Morocco and was named after the King of Morocco (Figure 4.53–4.55) who was exiled by the French from 1953–1955 during the French Protectorate then successfully negotiated Morocco's independence. Host: Professor Ali Benbachir.




Figure 4.53: King Mohammed V (1909–1961).



Figure 4.54: With professors at the university.





## Faculté des Sciences de Rabat

### Université Mohammed V Agdal

*Laboratoire d'Electrochimie - Corrosion*

Le professeur Fathi Habashi de l'Université de Laval, département des mines, métallurgie et génie des matériaux, Québec, Canada donnera une conférence intitulée

*New look at periodic table*

**Jeudi 27 Septembre 2007**  
à 10H30  
**Amphi Belmahi**




Figure 4.55: Lecture at University Mohammed V, 2007.

## Mohammadia School of Engineering

Mohammadia School of Engineering in Agdal [a suburb of Rabat] was founded in 1959 by the King Mohammed V as Morocco's first polytechnic (Figures 4.56–4.57). It is the largest institution of higher education in technology in Morocco. Since 1981 the school combined academic and military education on the model of *École Polytechnique* in Paris. Director: Driss Bouami (Figure 4.58). Host: Professor Lahsan Sbai (Figure 4.59).



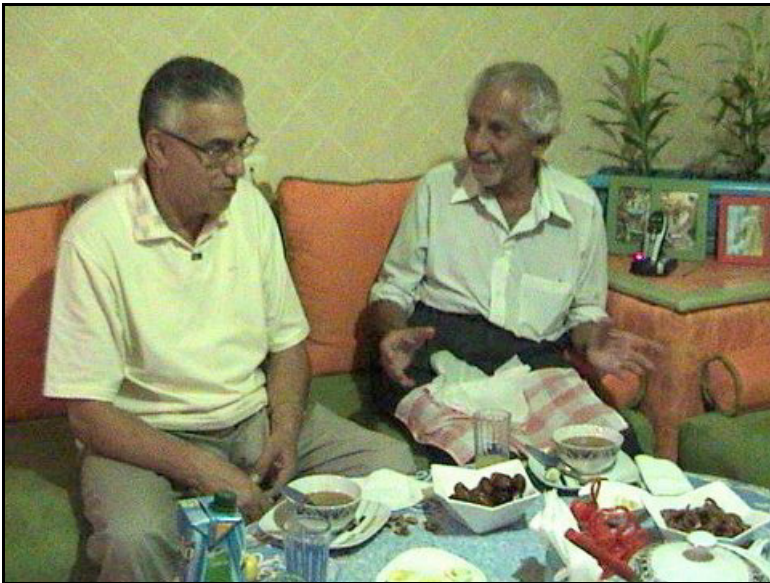
**Figure 4.56:** View of the Mohammadia School of Engineering.



**Figure 4.57:** View of the Mohammadia School of Engineering.



**Figure 4.58:** Driss Bouami, Director.



**Figure 4.59:** Ramadan with Prof. Lahsan Sbai at home.



Figure 4.60: Faculty members.



Figure 4.61: Archaeological Museum.

## Archaeological Museum

The Archaeological Museum (Figures 4.61–4.62) opened in 1932 and contains a collection of archaeological artefacts found in Morocco including objects from pre-Roman and Roman civilizations as well as a number of Hellenistic-style bronzes.



Figure 4.62: Archaeological Museum.

## TANGIER

Tangier, home of the Arab traveller Ibn Batota (1304–1377) (Figure 4.63) [also written Ibn Battuta], known as Tanja by the Berber, was founded by Carthaginian colonists in the early 5th century BC. Tangier came under Roman rule in the course of the 1st century BC. In the 5th century AD, Vandals conquered and occupied “Tingi” and from here swept across North Africa. Tangier came under Arab (Umayyad) control in 702. When the Portuguese, started their colonial expansion by taking Ceuta in 1415, their rule lasted until 1662, when it was given to Charles II of England as part of the dowry from the Portuguese Infanta Catherine of Braganza, becoming English Tangier. Sultan Moulay Ismail of Morocco seized the town in 1684.

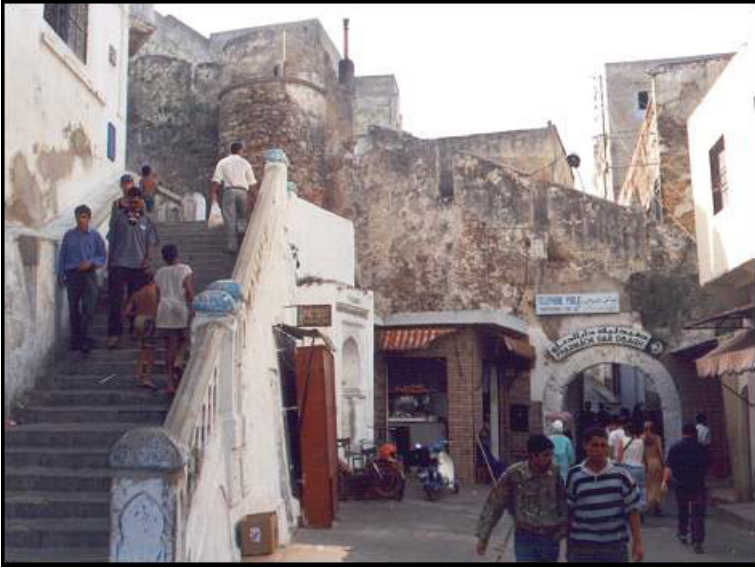


Figure 4.63: Ibn Batota (1304–1377).

The cave of Hercules, 15 km from the city, is believed to be where the Greek hero Heracles [Hercules for the Romans] had slept. He is famous for his strength and for his numerous adventures. He used his superhuman strength to smash through a mountain and by doing so he connected the Atlantic Ocean to the Mediterranean Sea and formed the Strait of Gibraltar. One part of the split mountain is Gibraltar and the other is either Monte Hacho in Ceuta or Jebel Musa in Morocco. These two mountains taken together have since then been known as the Pillars of Heracles. They have received much attention by artists after Columbus discovered America in 1492 [see Gibraltar]. Until then the navigation outside of the pillars had been limited to coastline navigation.

The city was increasingly coming under French influence, and it was here in 1905 that Kaiser Wilhelm II triggered an international crisis that almost led to war between Germany and France by pronouncing himself in favour of Morocco's continued independence. In 1912, Morocco was partitioned between France and Spain, the latter occupying the country's far north and a part of Moroccan territory in the south, while France declared a protectorate over the remainder.

Tangier was made an international zone in 1923 under the joint administration of France, Spain, and Britain. Spanish troops occupied Tangier in 1940. The territory was restored to its pre-war status in 1945 and joined with the rest of Morocco following the restoration of full sovereignty in 1956. Tangier is Morocco's second most important industrial centre after Casablanca (Figures 4.64–4.73).



**Figure 4.64:** The old town “Medina.”



**Figure 4.65:** View of Tangier.



Figure 4.66: View of Tangier.



Figure 4.67: View of Tangier.



Figure 4.68: Al Minzah Hotel.



Figure 4.69: Al Minzah Hotel.

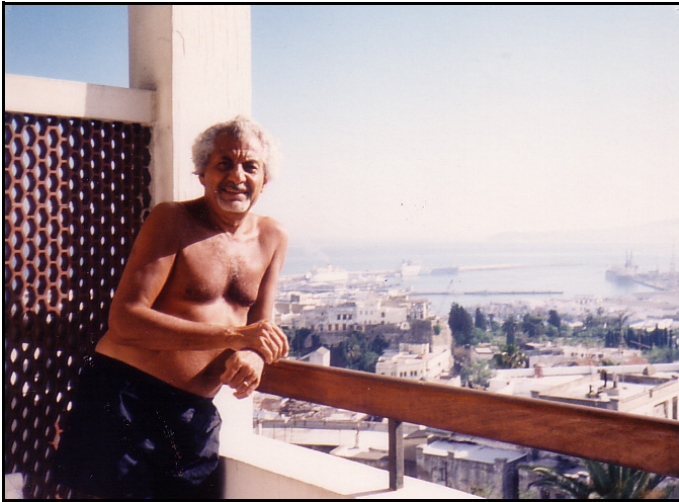


Figure 4.70: Tangier port from hotel room. Photo by Nadia Habashi, 1995.



Figure 4.71: Map of Tangier.



**Figure 4.72:** Boat to Algeciras in Spain.



**Figure 4.73:** From Tangier to Algeciras by boat.

Since 2000, FRS Iberia and FRS Maroc have been operating year round fast ferry sailings across the Strait of Gibraltar between Spain and Morocco. The Main FRS route between Tarifa and Tangier is the shortest seaway between the two continents is 13 km and takes 35 minutes. In addition, FRS also connects Algeciras with the ports of Ceuta and Tangier. There are ferry services from Andalucía to Morocco (Figure 4.74).



Figure 4.74: Ferry services from Andalucía to Morocco.

## THE MINERAL INDUSTRY

The Mining Pole of ONA, known as Managem (Arabic for mines), was launched in 1992, with the opening of the Guemassa mine (Table 4.2).

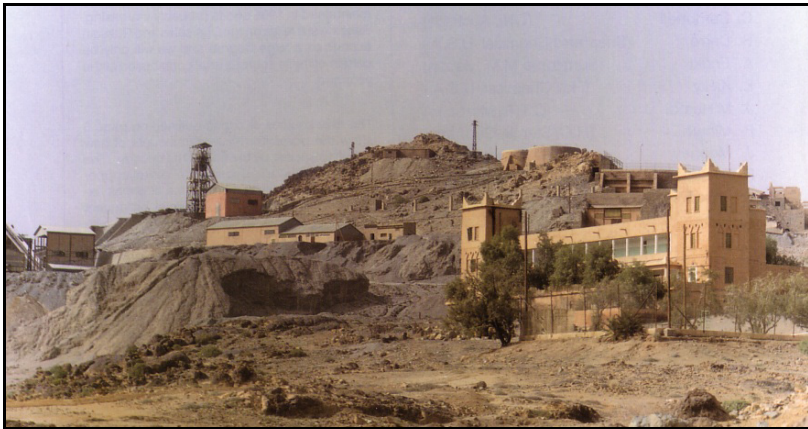
Table 4.2: Historical summary of metallurgical operations of ONA.

Date founded	Deposit and Plant location	Operator	Abbreviation	Work force	Products	T/Y
1927	<i>Bou-Azzer</i>	Tifnout Tiranimine Company	CTT	90	Cobalt arsenide concentrate Silver	5 000 15
1992	<i>Bou-Azzer /Hajar</i>	Bou-Azzer Cobalt Metallurgy	CMBA	?	Cobalt Arsenic oxide Cobalt compounds LiCoO <sub>2</sub> Co(NO <sub>3</sub> ) <sub>2</sub>	900 800
1969	<i>Imiter</i>	Metallurgical Company of Imiter	SMI	420	Silver Mercury SO <sub>2</sub> (AgNO <sub>3</sub> )	200
1974	<i>Al Hammam</i>	Mining Contracting Company	SAMINE	252	Fluorite	120 000
1988	<i>Hajar</i>	Guemassa Mining Company	CMG	260	Concentrates of: - Copper sulfide - Zinc sulfide - Lead sulfide - Pyrrhotite	20 000 150 000 30 000
1989	<i>Bleida</i>	Mining Society of Bou-Gaffer	SOMIFER	?	Copper sulfide concentrate Cement copper	10 000 Closed in 1998
1996	<i>Akka</i>	Akka Gold Mining	AGM	?	Scheduled for 2001	

## Cobalt

Morocco produces about 900 tonnes of 99.99% cobalt per year. Exploration for cobalt began in the late 1920s apparently because of reports of a rose-coloured product being sold in Marrakech as a rat poison. This product turned out to be a mixture of natural cobalt arsenides. The most important deposit was at Bou-Azzer, 260 km south of Ouarzazate. (Figure 4.75).

Between 1933 and 1982, these deposits yielded 55 000 tonnes of nickel and 15 tonnes of gold, the cobalt concentrates being sent to abroad for refining. When production ceased in 1982, the Compagnie de Tifnout Tiranimine, abbreviated CTT, continued to explore for new deposits and in 1987 new cobalt veins averaging 1.5% cobalt were found and production restarted. A silver deposit was also discovered in 1988 in the district. Annual capacity: 5 000 tonnes of cobalt concentrate analysing 60% As, 10% Co, and 1–4% S, and 15 tonnes of silver. The cobalt deposits are associated with the serpentinite massif.



**Figure 4.75:** Bou-Azzer mine [courtesy Reminex].

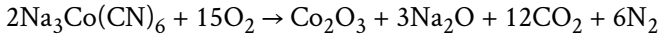
### *Concentrate*

The concentrate obtained by gravity separation and flotation analysed 10% Co as cobalt arsenide (skutterudite,  $\text{CoAsS}_3$ , and safflorite,  $\text{CoAsS}_2$ ), was earlier exported, now it is roasted in fluidized bed for arsenic oxide recovery and leaching the residue for electrolytic cobalt recovery at CMBA plant.

### *Tailings*

Tailings accumulated over the years have undergone natural oxidation to arsenates erythrine  $\text{Co}(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$ , and oxide hydroxide, heterogenite

CoOOH analysing 0.4% Co. The tailings also contain 1 g/t gold and 7 g/t silver. They were agglomerated with cement addition then leached in heaps using sodium cyanide solution. The solution was evaporated in solar ponds and the yellow crystals of sodium hexacyano cobaltate,  $\text{Na}_3[\text{Co}(\text{CN})_6]$ , obtained analysed 6.4% Co, 0.8% Ni, 0.9% Cu, 100 ppm Ag, and 13 ppm Au. The yellow cake was then calcined at 700 °C for 12 hours to yield a product containing 7.5% Co:



After washing with water and drying, the product analysed: 44.28% Co, 5.6%Ni, 4.8%Cu, 10.1% Fe, 0.05% Ag, and 0.01% Au. The dried product was dissolved in dilute  $\text{H}_2\text{SO}_4$ , cobalt extracted by Cyanex 272 at pH 5–5.5, stripped by  $\text{H}_2\text{SO}_4$  at pH 4, then electrolysed to produce cathodes 99.995% Co (Figure 4.76). The process was replaced later by sulfuric acid leaching, purification, and electrowinning (Figure 4.77). Sixty thousand tonnes of tailings are treated annually by this process. Silver ore is floated and treated by cyanidation.

## Silver

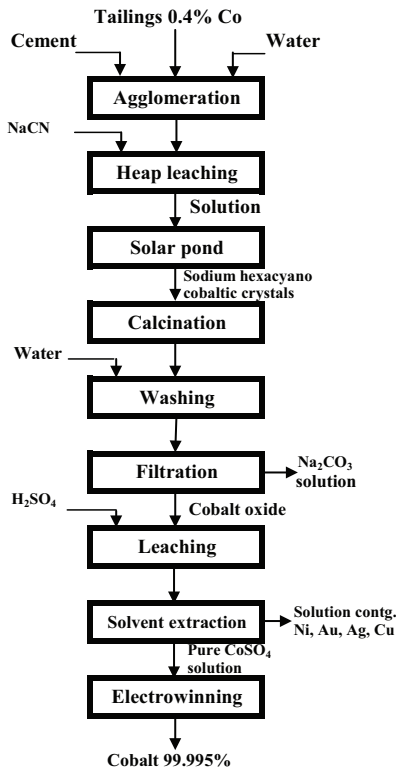
The Metallurgical Company of Imiter, SMI, exploits the silver deposit at Imiter, 150 km to the east of Ouarzazate, on the north of Jabl Saghro. The deposit has been mined since the 8th century. Since 1984, expansion projects increased the plant capacity to 250 000 tonnes of ore and 200 tonnes of 99.7% silver. A gravity concentrate containing native silver and sulfides rich in silver is smelted. The tailings undergo secondary grinding before cyanidation followed by precipitation by zinc. The gravity concentrate is combined with cement silver then heated at 700 °C to remove mercury before smelting with borax. The metal is then refined by the injection of air in the presence of lead, to collect the impurities in the form of lead oxide.

## Polymetallic sulfides

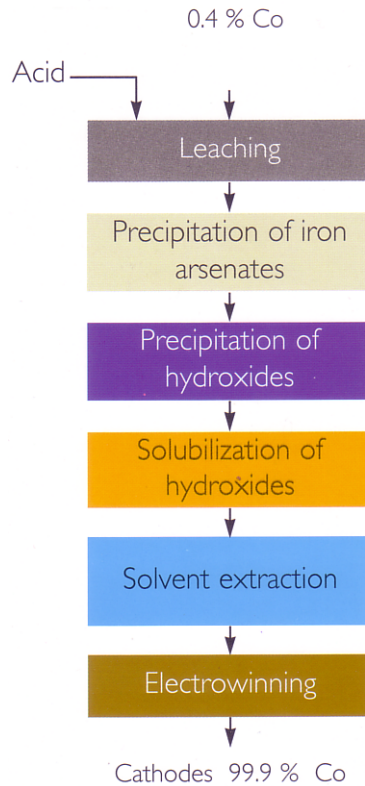
The Guemassa Mining Company, CMG, exploits the polymetallic Hajar deposit containing 10.5% Zn, 3% Pb, 0.3% Cu and 60 g/t silver. Products which are shipped to European markets, are:

- 150 000 tonnes of zinc concentrate, 54% Zn
- 30 000 tonnes of lead concentrate of 68% Pb
- 20 000 tonnes of copper concentrate 30% Cu.

The deposit is situated 35 km to the South of Marrakesh, on the northern edge of the High Atlas at an altitude of 800 m.



**Figure 4.76:** Reminex process for cobalt recovery, 1995.



**Figure 4.77:** Cobalt from tailings, 1997.

## Copper

Société Minière Bou-Gaffer, SOMIFER, exploits the copper deposit at Bleida situated 80 km south of Ouarzazate in the Anti-Atlas Mountains at an altitude of 1 300 m. The deposit contains 5–8% Cu on top of another layer containing 1–3% Cu. The oxide copper layer on the top was exploited by open pit while the sulfide by underground. The copper oxide operation started in 1990 and closed in 1998. The ore was vat leached by  $\text{H}_2\text{SO}_4$  and copper was recovered from solution by cementation with scrap iron. The sulfide is enriched by flotation to a concentrate containing 65 to 70% Cu. Concentrate production 10 000 t/year is presently exported, but plans are under way for local processing to metal.

## Gold

Akka Gold Mining, AGM, exploits since 1998 the gold deposit located in South Morocco on the Iouriren site approximately 280 km east from Agadir. The ore contains 10 g/t gold, is concentrated in Knelson cells to a concentrate containing 3 kg/t, which is melted to get impure gold ingots. The tailings are floated to get a concentrate containing 30 g/t gold which treated in a cyanidation, charcoal-adsorption, and electrolysis circuit, while the flotation tailings containing 0.2 g/t gold are rejected.

## Zinc oxide

Zinc oxide is produced by pressure leaching of zinc sulfide concentrate in sulfuric acid and NaCl in presence of oxygen at 160 °C. After filtration to remove the gangue minerals and elemental sulfur the solution is purified, then zinc is precipitated as hydroxide or carbonate, calcined to 99.95% purity with surface area 50 m<sup>2</sup>/g.

## Fluorspar

SAMINE, has been mining the fluorspar deposit of Al Hammam, situated 45 km to the southwest of the town of Meknès since 1974. In 1989 an expansion project took the plant capacity up to 120 000 tonnes.

## References

- I. Akalay, "Lixiviation acide des oxydes de cuivre de Bleida," pp. 597–607 in *Proceedings XV World Mining Congress*, edited by R. Mañana, Madrid, Spain 1992.
- I. Akalay, "Récupération du cobalt à partir des haldes de Bou-Azzer," *Ind. Minéral – Mines & Carrières – Les Techniques* 71, 79–82 (1989).
- I Akalay, I. Benzakour, and K. Benslimane., "Production de cathodes de cobalt de haute pureté par un procédé marocain."
- A. Khalil, K. Benslimane. I. Benzakour, and I. Akalay, "Production of Zinc Oxide from Zinc Sulfide Concentrates by a Hydrothermal Process," pp. 18–26 in *Zinc and Lead Processing*, edited by J. E. Dutrizac et al., published by Canadian Institute of Mining, Metallurgy, and Petroleum, Montreal 1998.

## AGADIR

Agadir (Figures 4.78–4.81) is about 500 km south of Casablanca on the shore of the Atlantic Ocean, near the foot of the Atlas Mountains, just north of the point where the Sous River flows into the ocean. Destroyed by earthquake in 1731 and 1960, the city has been rebuilt. It is the largest seaside resort in Morocco. The majority of its inhabitants speak Berber as their mother tongue. In 1505, the Portuguese, who were already installed on the Moroccan coast, founded a trading post and a fort at the foot of the hill to

the sea. They were exposed to the hostility of the tribes of the region. In 1541, Sherif Saâdien Mohammed ash-Sheikh captured the fortress.



**Figure 4.78:** Agadir 2013, photo by Nadia Habashi.



**Figure 4.79:** Agadir 2013, photo by Nadia Habashi.



**Figure 4.80:** Agadir 2013, photo by Nadia Habashi. "God, Country, King."



**Figure 4.81:** Agadir 2013, photo by Nadia Habashi.

## Argan tree

The argan tree, *argania spinosa* (Figures 4.82–4.85), survives heat, drought, poor soil, and lives up to 200 years. It grows only in the southwest of Morocco between Essaouira and Agadir. The tree can reach heights of 8–10 metres. The roots grow deep in search of water, helping to bind the soil and prevent erosion. It originated in Argana, a village northeast of Agadir. The leaves are small, 2–4 cm long, oval with a rounded apex. The flowers are small, with five pale yellow–green petals; flowering in April. The fruit is 2–4 cm long and 1.5–3 cm broad, with a thick, bitter peel surrounding a hard nut which contains one (occasionally two or three) small oil-rich seeds. The fruit appears after the autumn rains. It ripens in spring and falls to the ground in June and July, at the beginning of summer. The fruits are under the trees to dry.

The trunk of the argan is often twisted, allowing goats to climb, feed on the leaves and fruit. When goats eat the fruit, the fleshy part is digested but the nut remains. Later, the nuts are collected by farmers to produce oil. The wood and nutshells are burned for cooking.



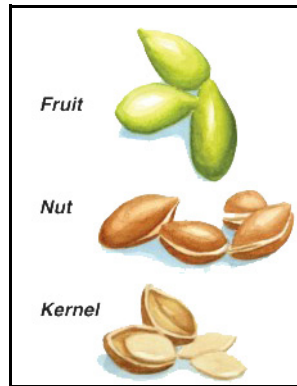
**Figure 4.82:** The argan tree.



**Figure 4.83:** The argan tree.



**Figure 4.84:** Fruit on argan tree.



**Figure 4.85:** The kernel supplies the oil.

### *Argan oil*

The fruits are separated from the pits, crushed to extract the seeds from which the oil is extracted. The fruits are first dried in the open air and then the fleshy pulp is removed. The flesh is usually used as feed for animals. Kernels are then roasted, ground, and pressed. The press cake remaining after the oil has been expelled is protein-rich and is frequently used as feed for cattle. Seven trees in full production are needed to obtain 1 litre of oil. The oil contains 80% unsaturated fatty acids.



**Figure 4.86:** Argan oil.

The production of argan oil is still mostly done by traditional methods. Argan oil can be used for cooking. The residue from the kernels after oil extraction is a thick chocolate-coloured paste called “amlou,” which is sweetened and served as a dip for bread in Berber households. Its flavour is similar to that of peanut butter.

## Souk El Had



**Figure 4.87:** Souk El Had.



**Figure 4.88:** Souk El Had.



Figure 4.89: Souk El Had.



Figure 4.90: Souk El Had with Ali Atbir and family, 2013.



Figure 4.91: Souk El Had with Ali Atbir and family, 2013.



Figure 4.92: Souk El Had with Ali Atbir and family, 2013.

## Beach Club Hotel

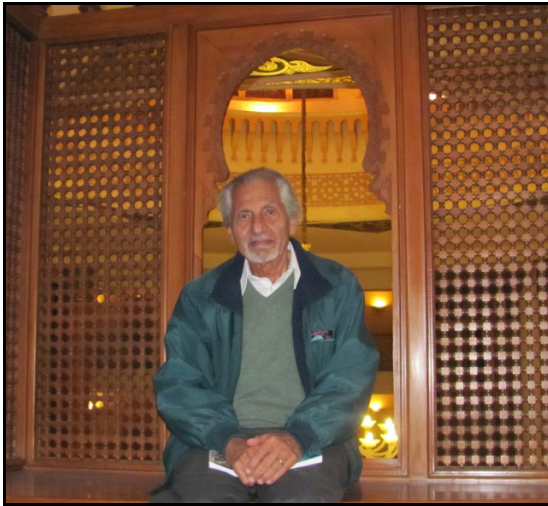


Figure 4.93: Beach Club Hotel.



Figure 4.94: Beach Club Hotel.



**Figure 4.95:** Beach Club Hotel.



**Figure 4.96:** Beach Club Hotel.



**Figure 4.97:** Beach Club Hotel.

## **Ibn Zohr University**

Ibn Zohr University was founded in 1989 and has today about 62 000 students. It is named after Abū Marwān Abd al-Malik ibn Zohr (1094–1162) (Figure 4.98), who was an Arab-Muslim physician, surgeon, a contemporary of Averroes and Maimonides. He was born in Seville and was regarded as the most renowned physician of Al-Andalus. His major work, *Al-Taysīr fil-Mudāwāt wal-Tadbīr* (Book of Simplification Concerning Therapeutics and Diet), was translated into Latin and Hebrew and was influential to the progress of surgery. He also improved surgical and medical knowledge. He fell out of favour with the Almoravid ruler, Ali bin Yusuf bin Tashufin, and fled from Seville. He was however, apprehended and jailed in Marrakesh in 1140. Later in 1147 when the Almohad dynasty conquered Seville, he returned and devoted himself to medical practice.

## **Conference on Water, Waste, and Pollution**

The Faculty of Sciences at Ibn Zohr University organized the Fourth Conference on Water, Waste, and Pollution on December 18–20, 2013 and took place in Beach Club Hotel (Figures 4.99–4.107).



Figure 4.98: Ibn Zohr (1094–1162).

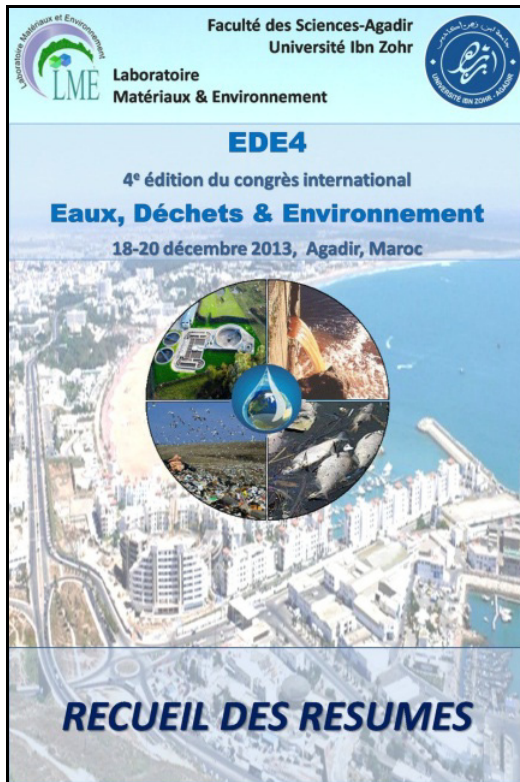


Figure 4.99: Book of Abstracts.

4<sup>ème</sup> édition du congrès international : Eau, Déchets et Environnement. Agadir, 18-20 Décembre 2013



**Fathi HABASHI**

Professeur émérite de la métallurgie extractive  
Université Laval, Québec, Canada  
[http://works.bepress.com/fathi\\_habashi/](http://works.bepress.com/fathi_habashi/)  
<http://pages.infinet.net/habashi/>

Fathi HABASHI, Professeur émérite de la métallurgie extractive à l'Université Laval à Québec, Canada. Il est né à Al Minia, Egypte le 9 Octobre 1928. Il est titulaire d'une licence ès sciences en génie chimique de l'Université Fouad Al Awwal [aujourd'hui appelée Université du Caire], diplômé docteur en "technologie de la chimie inorganique" à l'Université de Technologie de Vienne. Il est professeur honoraire à l'Université Technique d'Oruro en Bolivie et a reçu des doctorats honorifiques de l'Institut des Mines, Saint-Pétersbourg en Russie et l'Université technique nationale de Lima, au Pérou. Il est membre de l'Institut canadien des mines, de la métallurgie et du pétrole, et a reçu la médaille d'argent. Il était titulaire de la bourse du gouvernement canadien à Ottawa (1960-1962), a enseigné à Montana School of Mines [maintenant Montana College of Mineral Science & Technology] (1964-1967), a travaillé au Département de la recherche métallurgique extractive de Anaconda Company Tucson, Arizona, avant de rejoindre l'Université Laval en 1970.

Habashi a été professeur invité à un certain nombre d'universités étrangères, un conférencier invité à un certain nombre d'institutions, et consultant pour le Programme de développement des Nations Unies pour le projet de mines de latérite nickélicifère cubaine. Il est l'auteur de Principes de la métallurgie extractive en 4 volumes, un certain nombre de manuels scolaires et le Manuel de la métallurgie extractive en 4 volumes.

**Figure 4.100:** Page 9 of Book of Abstracts.



Figure 4.101: Opening ceremony.



Figure 4.102: Participants at conference.



Figure 4.103: At the conference.



Figure 4.104: Participants at conference.



**Figure 4.105:** Participants at conference.



**Figure 4.106:** Prof. Abdelaziz Nait Ajjou, University of Moncton.

## **Sewage treatment plant**

Aerobic digestion is a bacterial process occurring in the presence of oxygen. The bacteria rapidly consume organic matter and convert it into carbon dioxide. Filtration of water in a large number of beds of sand 2 m deep. Disinfection of water by ultraviolet light to reduce the number of microorganisms for the later use of irrigation, etc.



**Figure 4.107:** Participants at conference.

## CULTURE

### Berbers

Berbers (Figures 4.108–4.109) are the indigenous people of North Africa west of the Nile Valley. They are not a homogeneous ethnic group. The first Arab military expeditions into the Maghreb, between 642 and 669 AD, resulted in the spread of Islam. When the seat of the caliphate moved from Medina to Damascus, the Umayyads in 670 sent an Arab army under Uqba ibn Nafi and established the town of Qayrawan in Tunisia and used it as a base for further operations. The Muslims who invaded Iberia in 711 were mainly Berbers, and were led by a Berber, Tariq ibn Ziyad. A second mixed army of Arabs and Berbers came in 712 to help the Umayyad caliph Abd Al-Rahman I in Al-Andalus, because his mother was a Berber.

In 750, the Abbasids, who succeeded the Umayyads moved the caliphate to Baghdad and appointed Ibrahim ibn al Aghlab as governor in Qayrawan. Al Aghlab and his successors, the Aghlabids, ruled independently until 909, presiding over a court that became a centre for learning and culture. Soon

after independence in the middle of the 20th century, the countries of North Africa established Arabic as their official language, replacing French, Spanish, and Italian. In Morocco, after the constitutional reforms of 2011, Berber has become an official language, and is now taught as a compulsory language in all schools.



**Figure 4.108:** Berber girls.



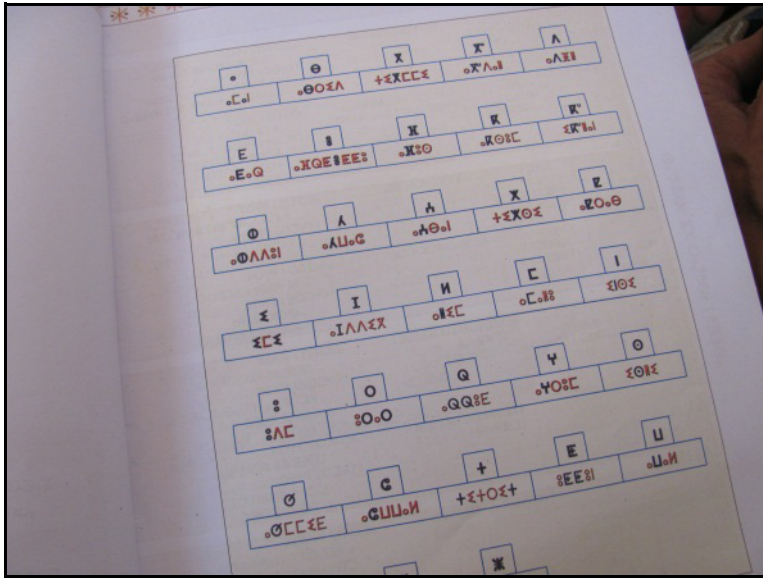
**Figure 4.109:** Berber jewellery.

## Language problem

After independence from France, all the Maghreb countries pursued a policy of Arabization, aimed at displacing French. Under this policy the use of the Berber languages was suppressed. This has been contested by Berbers and is now being addressed by introducing the Berber language in some schools and by recognizing Berber as a “national language” in Algeria, though not as an official one. In 2011 Berber language became an official language of Morocco alongside Arabic (Figures 4.110–4.111). The Berber languages and dialects were first written in the Tifinagh alphabet, later in the Arabic script. A modernized form of the Tifinagh alphabet was made official in Morocco in 2003. Algerians mostly use the Berber Latin alphabet. Mali and Niger recognize a Tuareg Berber Latin alphabet. Arabic script has been abandoned by Berber writers.



Figure 4.110: Student's book in Tamazight. Photo by Nadia Habashi, 2013.



**Figure 4.111:** Student's book in Tamazight. Photo by Nadia Habashi, 2013.

The Berber root *Mazigh* means “free man,” “noble man,” or “defender.” The term “Tamazight” was used by many Berber groups to refer to the language they spoke. Berber languages are a family of closely related languages and dialects indigenous to North Africa. They are spoken by large populations in Algeria and Morocco, and by smaller populations in Libya, Tunisia, northern Mali, western and northern Niger, northern Burkina Faso, Mauritania, and in the Siwa Oasis of Egypt. The total number of speakers of Berber languages in the Maghreb lies between 16 and 25 million. The vast majority are concentrated in Morocco and Algeria. The Tuareg of the Sahel add another million.

## Customs

The Berber have different customs (Figures 4.112–4.113).



**Figure 4.112:** Sitting on the floor with Professor Ali Atbir and family in Agadir. Photo by Nadia Habashi, 2013.



**Figure 4.113:** Eating on the floor with Professor Ali Atbir and family in Agadir. Photo by Nadia Habashi, 2013.

## Architecture

There is special architecture in Morocco characterized by the arches (Figures 4.114–4.130).



Figure 4.114: Architecture.



Figure 4.115: Architecture.

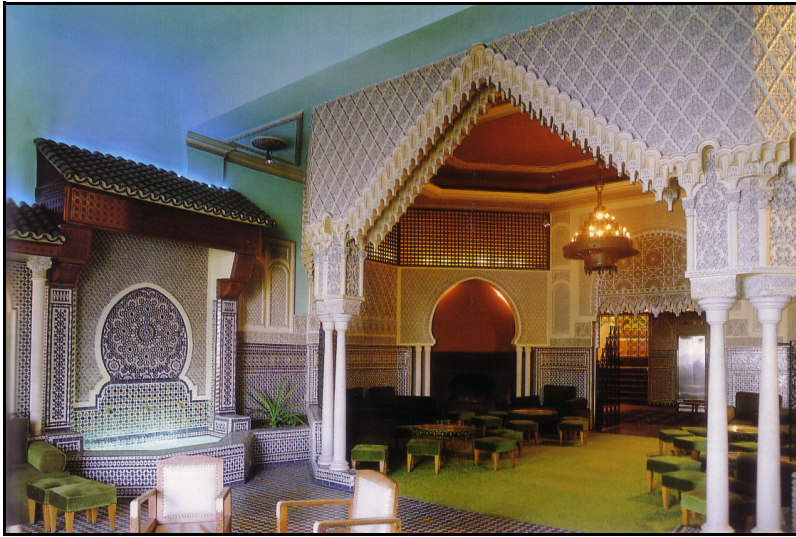


Figure 4.116: Architecture.

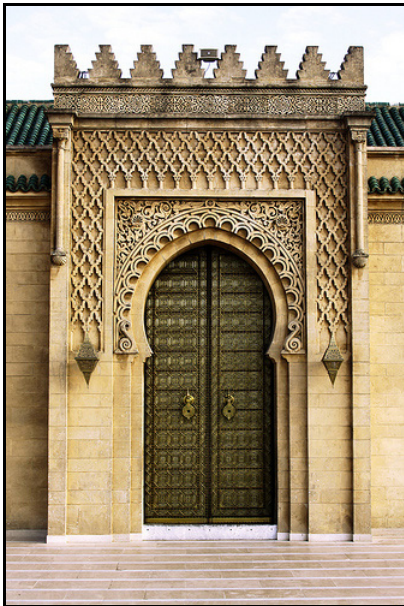


Figure 4.117: Architecture.



Figure 4.118: Architecture.



Figure 4.119: Architecture.



Figure 4.120: Architecture.



Figure 4.121: Architecture.



Figure 4.122: Architecture.

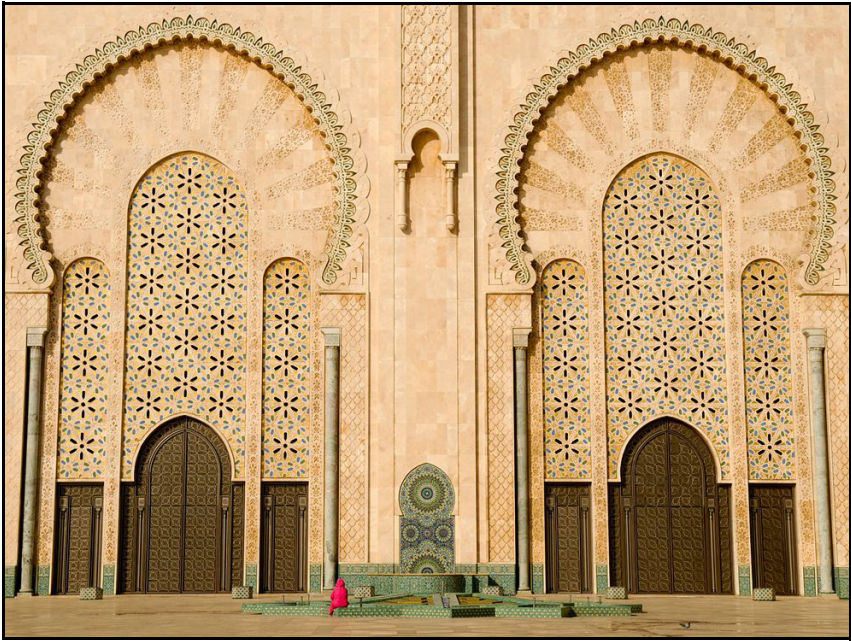


Figure 4.123: Architecture.

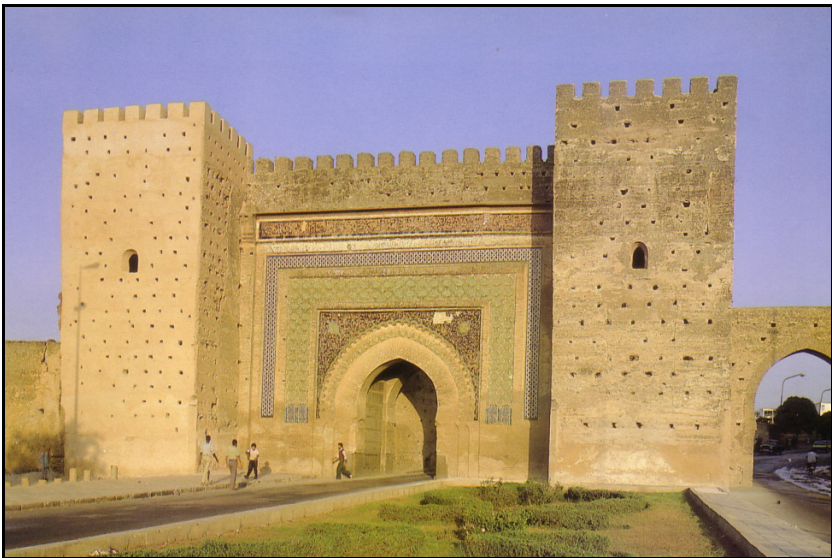


Figure 4.124: Architecture.



Figure 4.125: Architecture.

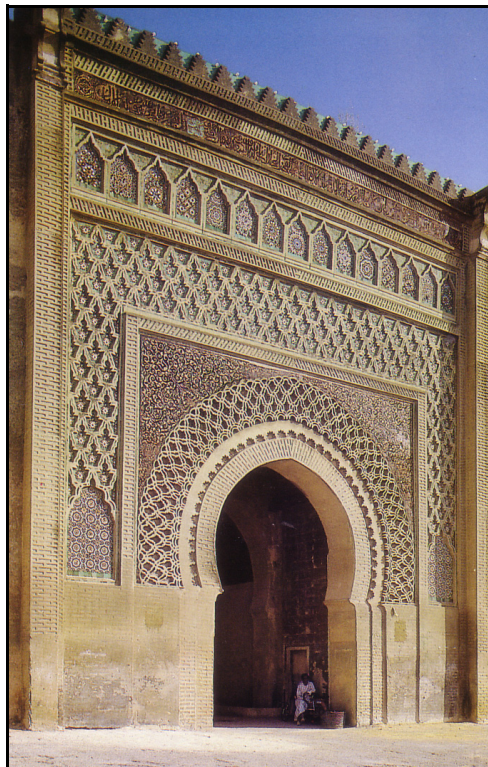


Figure 4.126: Architecture.

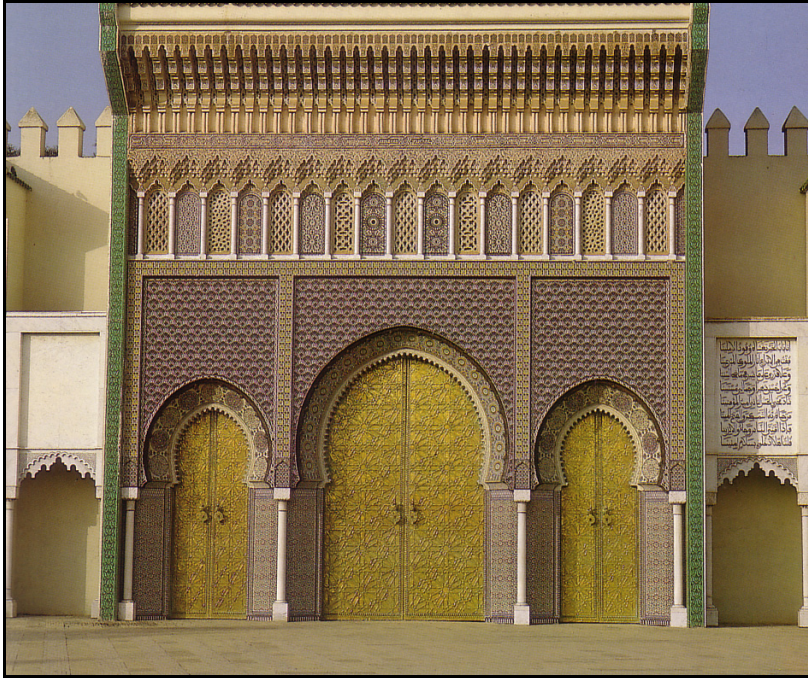


Figure 4.127: Architecture.



Figure 4.128: Architecture.

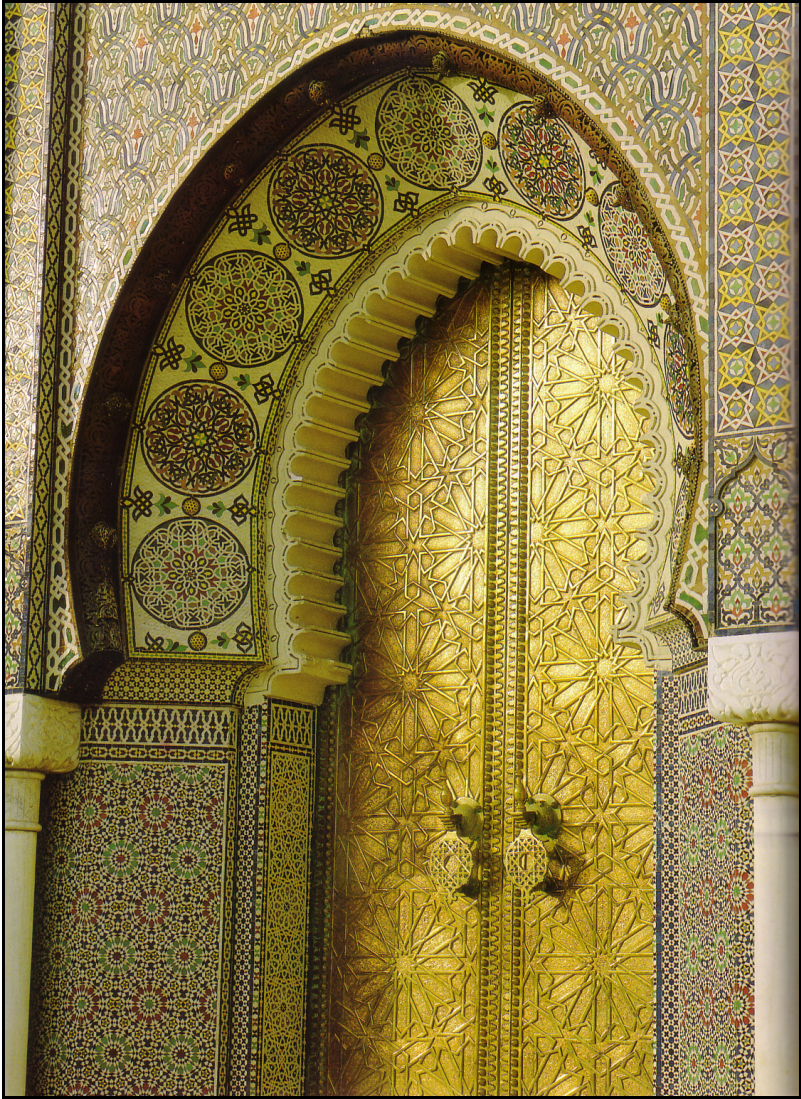


Figure 4.129: Architecture.



Figure 4.130: Architecture.

## Art

Art in Morocco is mainly geometrical designs (Figures 4.131–4.142).



Figure 4.131: Typical decorations.



Figure 4.132: Typical decorations.

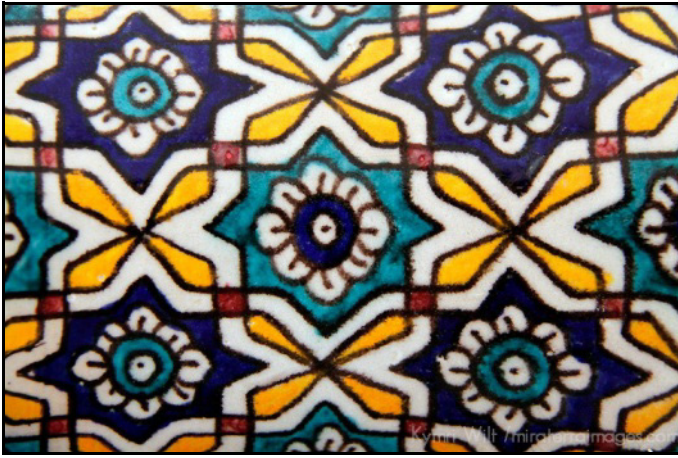


Figure 4.133: Typical decorations.



Figure 4.134: Typical decorations.



Figure 4.135: Typical decorations.

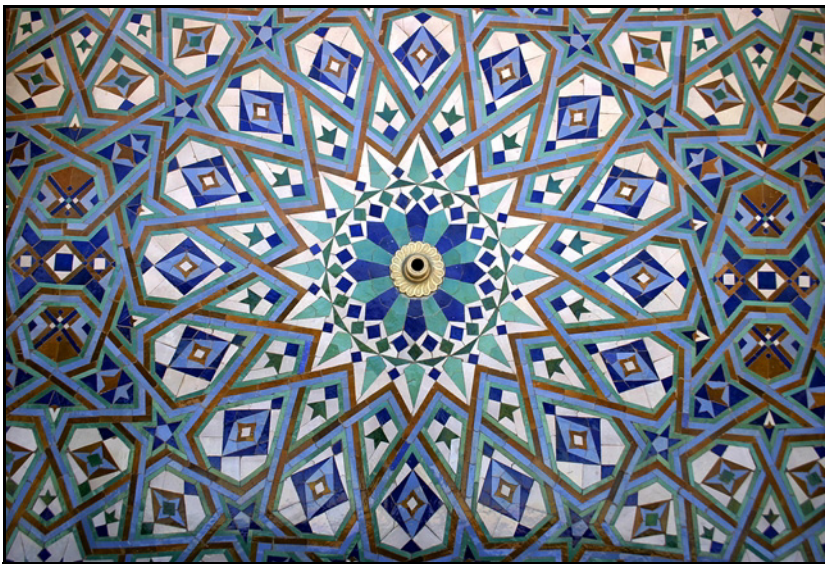


Figure 4.136: Typical decorations.

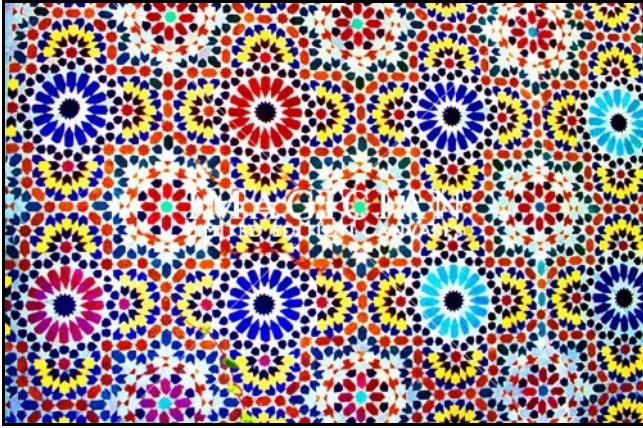


Figure 4.137: Typical decorations.

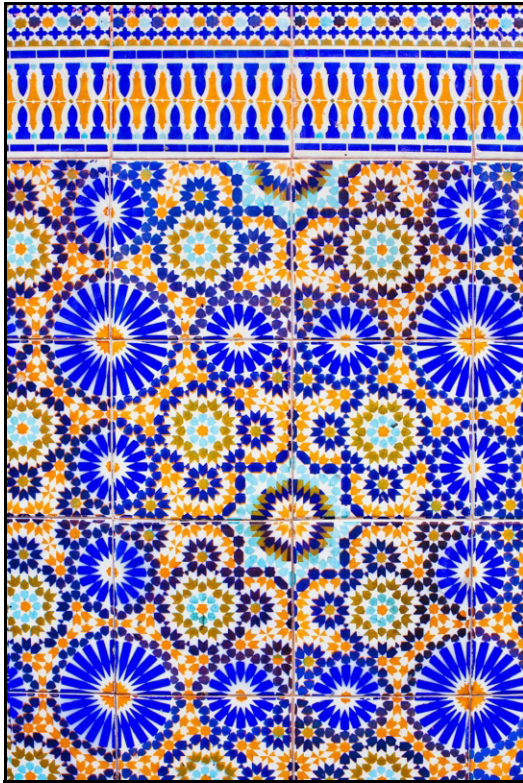


Figure 4.138: Typical decorations.



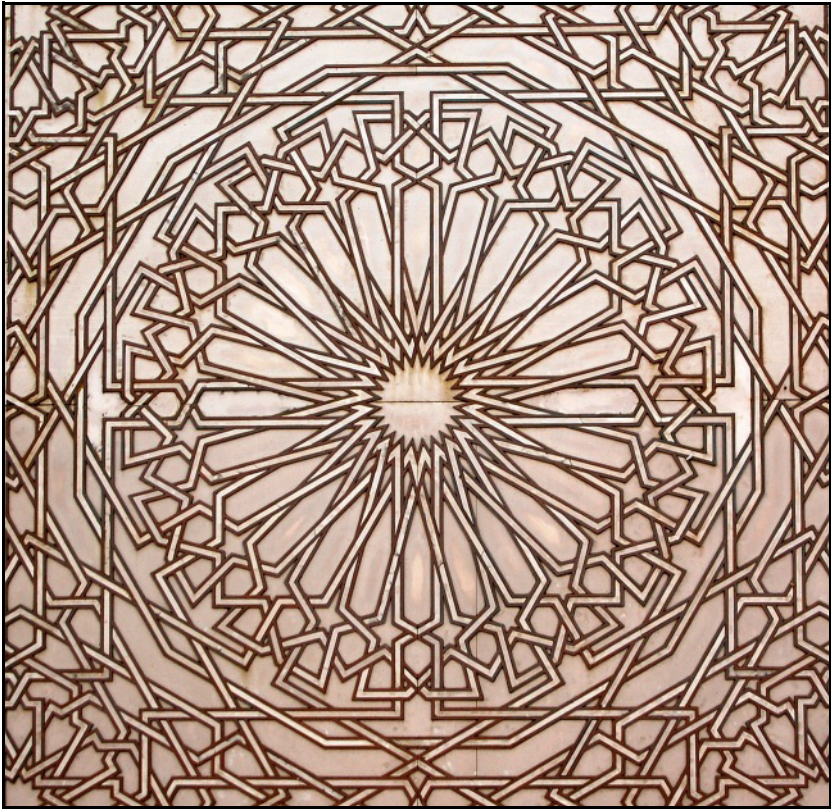
Figure 4.139: Typical decorations.



Figure 4.140: Typical decorations.



Figure 4.141: Typical decorations.



**Figure 4.142:** Typical decorations.

## Handicraft



Figure 4.143: Moroccan artisanat.



Figure 4.144: Moroccan artisanat.



Figure 4.145: Moroccan artisanat.



Figure 4.146: Moroccan artisanat.

## Couscous

Couscous is a traditional Berber dish of semolina (granules of durum wheat) which is cooked by steaming. It is served with a meat or vegetable stew. It is served throughout the North African cuisines (Figures 4.147–4.149).



Figure 4.147: Couscous.



Figure 4.148: Couscous.



**Figure 4.149:** Couscous.

# Chapter 5

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## Tunisia

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**Figure 5.1:** Flag of Tunisia.

### HISTORICAL INTRODUCTION

Recorded history of Tunisia begins with the arrival of Phoenicians, who founded Carthage and other North African settlements in the 8th century BC. Carthage (Figures 5.3–5.7) presently located outside Tunis became a major sea power. In 332 BC when Alexander the Great captured the east coast of the Mediterranean — including all the original Phoenician cities — Carthage and its colonies were left on their own. A hundred years later the great leader Hannibal Barca arose to lead Carthage against the rising power of Rome. He was defeated and Carthage was captured by the Romans in 146 BC.

The Romans ruled and settled in North Africa until the 5th century. When the Roman Empire fell, Tunisia was invaded by European tribes, including the Vandals. The Muslim conquest in the 7th century resulted in migration of Arabs and the dispersion of the Berber into the desert and in the mountains. Tunisia was assimilated into the Ottoman Empire since the occupation in 1574. When the Ottoman power started to weaken in 1705, the governors' authority [the Beys] increased. It became a French protector-

ate from 1881 until independence in 1956. President Habib Bourguiba (1903–2000), who had been the leader of the independence movement, declared Tunisia a republic in 1957.



Figure 5.2: Map of Tunisia.



Figure 5.3: Phoenicians Carthage.



**Figure 5.4:** Phoenicians Carthage.



**Figure 5.5:** Roman Carthage.



Figure 5.6: Roman mosaic in Carthage.



Figure 5.7: Roman aqua duct near Carthage.

## INDUSTRY IN TUNISIA

### Phosphate

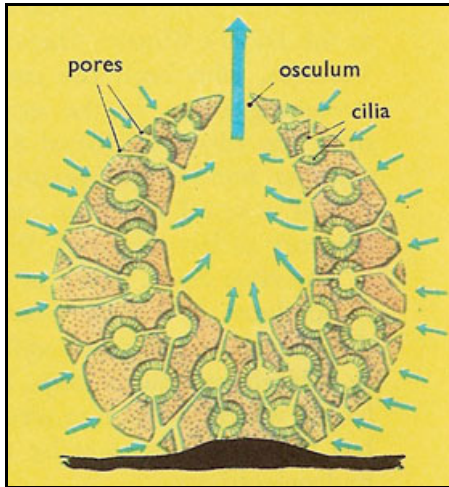
In 1885, while surveying the region of Metlaoui, a French amateur geologist discovered layers of calcium phosphates in the Northern hillside of Jebel Thelja. This discovery further revealed the existence of intensive phosphate formations south and north of the so-called Kasserine Island. In 1896, the Compagnie des Phosphates et de Chemin de Fer de Gafsa was founded. With over a century of experience in mining, upgrading, and marketing phosphates, the company is now the world's fifth largest phosphate producer.

## Sponge

Tunisia is the world's main sponge exporter. Sponges are animals of the phylum Porifera. They are multicellular organisms which have bodies full of pores and channels allowing water to circulate through them (Figures 5.8–5.9). Sponges do not have nervous, digestive or circulatory systems. Instead, most rely on maintaining a constant water flow through their bodies to obtain food and oxygen and to remove wastes. All sponges feed on bacteria and other food particles in the water. Unlike other animals, they lack true tissues and organs, and have no body symmetry.



**Figure 5.8:** One type of a living sponge.



**Figure 5.9:** Circulation of water in a living sponge.

The commercial sponge is the macerated and dried skeleton of a sponge. The commercial value of the sponges comes from their great internal surface, thus they can absorb water up to 20–35 times their weight. As soon as the sponge is collected it is kept for some time in the open air so that it dries. Then the sponge is put back into marine water until the black pellicle which covers the sponge can easily be taken off. Sponges are bleached to give them the desired yellowish colour (Figure 5.10).



**Figure 5.10:** Commercial sponge.

## TUNIS

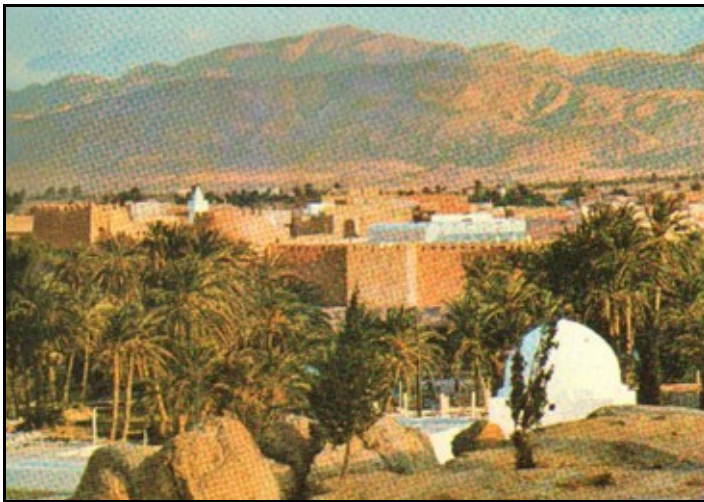
Tunis (Figure 5.11), the capital of Tunisia is situated on the Gulf of Tunis. It extends along the coastal plain and the hills that surround it. The old medina is found at the centre of the city: a dense agglomeration of alleys and covered passages. Carthage is the historic suburb.

## GAFSA

Uqba ibn Nafi conquered Gafsa in 688 (Figures 5.12–5.13), however he faced resistance from the Berbers. Gafsa was converted to the Muslim and Arabic culture completely by the Bani Hilal in 1050. Phosphate mines were discovered in 1886, and Gafsa today is home to one of the largest mines of phosphate in the world.



**Figure 5.11:** View of Tunis.



**Figure 5.12:** General view of Gafsa.



Figure 5.13: A street in Gafsa.

## UNIDO Round Table

In November 1985 United Nations Industrial Development Organization with headquarters in Vienna, organized a Round Table Discussion on Phosphates. The conference took place in Gafsa at the offices of Compagnie des Phosphates de Gafsa in Gafsa (Figures 5.14–5.20). The program included visits to the phosphate industry in Metlaoui, and Gabes, as well as to the Roman ruins in Sbeitla, and other cities in Tunisia including Tozeur, and Kairouan.

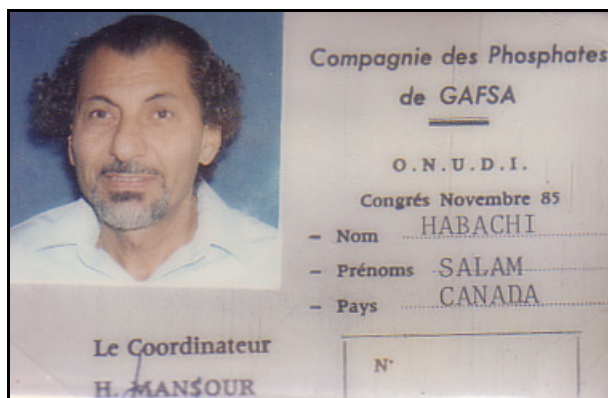
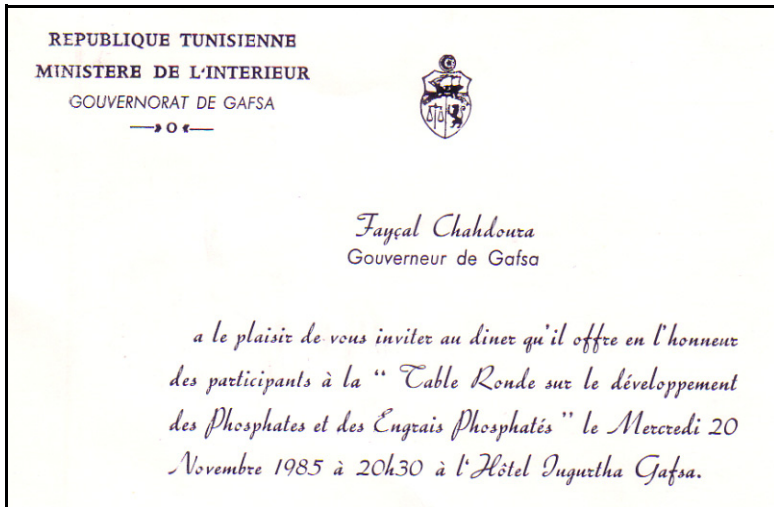


Figure 5.14: Identification badge.



**Figure 5.15:** Invitation.



**Figure 5.16:** Governor of Gafsa.



**Figure 5.17:** Conference banquet with young ladies chemical engineers from Kuwait.



**Figure 5.18:** At home of Engineer Mohammad Daly. Photo by Fathi Habashi, 1985.



**Figure 5.19:** Dinner in the desert with musicians, 1985.



**Figure 5.20:** Dinner in the desert with musicians, 1985.

## SHEITLA

Roman ruins are abundant in Tunisia. Sheitla is near Gafsa and its visit was part of the conference program (Figures 5.21–5.22).



**Figure 5.21:** Roman ruins in Sheitla.



**Figure 5.22:** Roman ruins in Sheitla.

## TOZEUR OASIS

On the way to visit the mines at Metlaoui (Figures 5.23–5.24), a stop was made at Tozeur oasis (Figures 5.25–5.26), about 100 km southwest of Gafsa. It produces dates that are exported. The visit was part of the conference program.



**Figure 5.23:** Visit to phosphate mine and beneficiation plant. Photo by Fathi Habashi, 1985.



**Figure 5.24:** Visit to phosphate mine and beneficiation plant. Photo by Fathi Habashi, 1985.



Figure 5.25: Tozeur oasis.



Figure 5.26: Tozeur oasis.

## KAIROUAN

Kairouan (Figures 5.27–5.28) was founded by the Arab general Uqba ibn Nafi around 670. Its mosque (Figures 5.29–5.30) became an important centre for Quranic learning, thus attracting Muslims from various parts of the world.



Figure 5.27: Kairouan.



Figure 5.28: Kairouan city walls.



Figure 5.29: Kairouan mosque.



Figure 5.30: Kairouan mosque.

## GABES

Gabes is the centre of chemical industry in Tunisia. It has cement plant, brick manufacture, oil refinery, and ammonium nitrate. Ammonia is imported from France. The oxidation unit is a 6.5 m diameter reactor — the largest in the world [1985]. It contains 9 platinum–platinum rhodium gauzes as catalysts and oxidizes 250 tonnes of ammonia per day. Nitrogen oxides produced are absorbed in a single tower, 67 m high and 2 m diameter containing 39 perforated screens. The plant was designed by Creusot-Loire Enterprise.

## CULTURE

Ibn Khaldoun (1332–1406) (Figure 5.31), the Arab historian, was born in Tunis. In 1384, he emigrated to Egypt to become a great judge. He died in Cairo. During the reign of Habib Bourguiba statues were constructed in every town (Figure 5.32).



**Figure 5.31:** Monument to Ibn Khaldoun (1332–1406).



**Figure 5.32:** Habib Bourguiba (1903–2000), a lawyer on a horseback.

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