

THE OCCURRENCE AND  
EXPLOITATION OF LIGNITE  
IN THE LEBANON.

BY

JOHN COULTER, B.Sc. (Eng.), Rand.



RELIEF MAP OF THE LEBANESE MOUNTAINS.

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JOHN COULTER. B.Sc.(Eng).(Rand).

A Thesis presented for the Degree of  
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June, 1944.

## PREFACE.



THE OCCURRENCE AND EXPLOITATION OF LIGNITE  
IN THE LEBANON.

PREFACE.

The following treatise on the Lignites of the Lebanon is the result of investigations carried out by the writer on behalf of the Middle East Supply Centre for the British Government, in Syria and the Lebanon during the latter part of 1942, and during 1943.

The original object of such investigations was to find a fuel suitable for military, railway, industrial and domestic consumption, as a substitute for imported coal, with a view to saving shipping space.

Prior to 1930, Syria and Palestine together, imported annually about 60,000 tons of coal, while Egypt imported 1,000,000 to 1,500,000 tons, mostly from Britain and South Africa. In recent years the requirements of imported coal have lessened due to the increased use of oil as a fuel. Nevertheless, these requirements still occupied a fair amount of shipping space, and it was only in view of the need to save this space that the investigations were carried out, although it was realised at the outset that from the pre-war standard, few of the known deposits would be economically worth exploitation.

Beyond local hearsay, few detailed descriptions were known or recorded of lignite occurrences in the Lebanon, the subject being only briefly referred to in any geological accounts of the country.

After a short time, however, it was decided to further the work, both from a geological as well as a

mining aspect, and to give civilian owners and exploiters the benefit of such investigations, and any other material assistance possible. The scope of the work, therefore, became much more widespread.

These investigations on the lignite occurrences, their exploitation and their utilisation were carried on for over a year, except for a period of three months, during which the writer was occupied in reporting on the occurrence of Lead, Aluminium, Kaolin, Fireclay, Fullers' Earth, Barium, Bitumen, etc., also with a view to their substitution in war-time industries in the Middle East.

The author gratefully expresses his indebtedness to Lieut. R. Borchers and Lieut. G.C.L. Clarke, M.A. of the 42nd Geological Section, S.A.E.C. U.D.F.: to M. Louis Dubertret, Ing. Civil des Mines, Chef de la Section Géologique, Beirut, and to M. Just Frank, Mechanical Engineer to the Société de Briquetage des Matières Combustibles, Beirut, whose willing assistance proved of great value.

J.C.

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LIST OF LIGNITE OCCURRENCES.

The following is a list of the Lignite Occurrences in the Northern, Central and Southern Lebanon, most of which have been visited. They are listed from North to South. The Map References are to the 1 : 50,000 Sheets, Levant Grid, and are given in the usual manner, namely, Eastlings - Northlings.

| <u>Name of Place.</u>  | <u>Map Reference.</u> | <u>Nature of Occurrence.</u> |
|------------------------|-----------------------|------------------------------|
| EL AARBE PROSPECT      | 1770.2722             | Prospect with Adits.         |
| EL AARBE MINE          | 1695.2615             | Prospect with Adits.         |
| BELAHISS               | 1697.2614             | Developed Prospect           |
| BLACUZA-NORTH PROSPECT | 1707.2584             | Prospect with Adits.         |
| QNAIOUER. BELOW.       | 1688.2583             | Prospect with Adits.         |
| BLAOUZA MINE           | 1711.2580             | Producing Mine.              |
| BLAOUZA-WEST PROSPECT  | 1720.2575             | Prospect with Adit           |
| BEIT MENDER. UPPER.    | 1676.2575             | Prospect with Adit.          |
| QNAIOUER. ABOVE        | 1687.2572             | Prospect                     |
| BRISSIETTE             | 1717.2560             | Occurrence                   |
| MAZRAAT BENI A'SAAB    | 1652.2559             | Developed Prospect           |
| BECHARRE MINE          | 1766.2555             | Producing Mine               |
| QADICHA. UPPER         | 1777.2549             | Prospect with Adits          |
| BQAA KAFRA             | 1761.2548             | Occurrence                   |
| HADET. LOWER           | 1686.2542             | Prospect with Adits          |
| HADET. UPPER           | 1686.2535             | Prospect with Adit           |
| DOUAIR                 | 1705.2526             | Occurrence.                  |
| DOUMA                  | 1634.2513             | Occurrence                   |
| TANNOURINE             | 1656.2476             | Prospect with Adits.         |
| BKARTA PROSPECT        | 1573.2434             | Prospect                     |
| BKARTA MINE            | 1573.2433             | Developed Prospect           |
| EL MOURADA             | 1610.2427             | Prospect                     |
| EHMEJ EAST             | 1562.2426             | Prospect with Adits          |
| EHMEJ WEST             | 1552.2423             | Prospect.                    |

List of Lignite Occurrences.

| <u>Name of Place.</u> | <u>Map Reference.</u> | <u>Nature of Occurrence.</u> |
|-----------------------|-----------------------|------------------------------|
| AALMATE MINE          | 1554.2418             | Producing Mine.              |
| AALMATE PROSPECT      | 1554.2418             | Prospect                     |
| NADAA TORZAYA         | 1543.2415             | Prospect                     |
| AABBOUD               | 1525.2403             | Prospect with Adit           |
| KARTABA PROSPECT      | 1603.2398             | Prospect                     |
| KARTABA MINE          | 1610.2393             | Producing Mine               |
| MEYROUBA              | 1553.2337             | Developed Prospect           |
| BZEBDINE              | 1502.2147             | Prospect with Adits          |
| ARSOUN                | 1484.2134             | Prospect with Adits          |
| MERJLAYA MINE         | 1454.2104             | Producing Mine               |
| MDEKHEN               | 1435.2096             | Prospect with Adits          |
| MAR YOHANNA           | 1456.2094             | Old Mine                     |
| OUADI CHANROUR        | 1355.2086             | Old Prospect                 |
| AARAMOUN              | 1297.2018             | Prospect with Adits          |
| ABEY MINE             | 1294.2010             | Producing Mine.              |
| AIN TRAZ              | 1354.1994             | Prospect with Adit           |
| ABEY PROSPECT         | 1320.1970             | Occurrence                   |
| DJEZZINE-SAIDA. ROAD  | 1328.1796             | Occurrence                   |
| AITOULI NORD          | 1328.1785             | Producing Mine               |
| AITOULI SUD           | 1329.1778             | Producing Mine               |
| PETIT MRAH            | 1329.1776             | Developed Mine               |
| GERMAN WORKINGS       | 1321.1776             | Old Mine                     |
| GRAND MRAH            | 1327.1773             | Producing Mine               |
| OUADI CHARHOUR        | 1322.1758             | Developed Prospect           |
| ZEHALTA MINE          | 1319.1749             | Producing Mine               |

The Cedars of the Libanon.



In a picturesque mountain setting, enveloped in snow, at an altitude of some 6,200 ft, stand the ancient cedars of the Libanon. Once covering extensive areas, today the largest group only numbers about 400 trees, the oldest being about 1500 years. They reach a height of 40 ft. and a diameter of 12 ft.



The cedar is highly prized and today is held in great esteem by the Maronites. Its incorruptible wood, (for its bitter smell keeps the worms away), was used in the First and Second Temples in Jerusalem, and many other sacred buildings in the whole Near East.



## THE LIGNITES OF THE LEBANON.

### I. INTRODUCTION.

Although the investigations carried out and here described took place mainly in the mountain ranges of the Lebanon, it is considered that a brief reference to Syria and the Lebanon, as a country, will be useful.

Syria and the Lebanon, if regarded as one state, were from 1920 until 1944, called the French Mandated Territories of the Levant. Together they form the most important succession of the former Ottoman Empire. Their joint territory amounted to 78,165 square miles (202,500 sq. kms.) before the Sanjac of Alexandretta was ceded to Turkey in 1939. The total area to-day is 75,270 square miles (195,000 sq. kms).

The Lebanon itself, formerly a part of Syria, was made a state in 1920 and was governed by France under Mandate from the League of Nations. On the 1st January, 1944, self government was granted to the Lebanon. Its boundaries are the Mediterranean on the West, the Anti-Lebanon mountain range on the East, and Palestine on the South. The area is 3,925 square miles (10,170 sq. kms); the population is over 862,000, with Beirut as the capital.

In all the countries of the Near East, the population is of great diversity, but - except perhaps Palestine - none presents such an extraordinary mixture of people, races and creeds, as does Syria and the Lebanon.

## Introduction.

In addition to representatives of the three great Monotheistic religions, Moslems, Christians and Jews, there are remnants and splinters of empires and religions long lost and forgotten - Yezidis, Assyrians, and many more; the total number of religious sects being twentyseven.

The country dates back to the legendary foundation of Tyr (Syr or Sour) in the year 2760 B.C. Since that date until modern times, more decisive battles of the Near East were fought in Syria than anywhere else.

It is a curious paradox that whenever this country, a crossroads for immense historical forces, was left to its own devices, it inevitably fell to pieces. The variety of its geographical configuration and its astounding mixture of peoples, languages and races are the main factors that make a united Syria almost an impossibility. In consequence the country has twice been the administrative centre of immense empires, usually as a province of a great power.

In view of its past turbulent history and entire lack of co-operation between the inhabitants of the country, brought about by religious, political and family feuds, it is extremely doubtful if Syria and the Lebanon will ever present a united front and develop without outside assistance and guidance. More doubtful still is the establishment of any large industries on account of the indolent nature of the peoples of these parts. In common with many other small countries of weak constituency, the natural resources of the country were left undeveloped, the imported article being given preference.

Introduction.

The mainstay of Syrian as well as Lebanese economy is agriculture which gives not only employment to the majority of the population, but also supplies the basic and raw material for the greater part of the local industries which are to a large extent of the "cottage type". It also furnishes the purchasing power for the imported goods in as much as about 75 per cent of all exports are agricultural products.

In this connection the availability of water is of importance. Syria and the Lebanon possess a fairly large number of rivers which carry water all the year round in contradistinction to the numerous wadis (watercourse) which are filled with water only in winter after heavy rainfall. Though almost all the rivers are unfit for navigation, their importance is immense as they permit the cultivation of agricultural land, and in most cases the generation of electric power.

Indeed in the Middle East, where the first condition of human habitation and of successful agriculture is the availability of water, the function of rivers as a means of transport, is far inferior to that of a source of water. In that part of the world it is therefore usual to measure the importance of rivers by the flow of water per second and not by the amount of traffic or other considerations. The lakes in Syria are few in number and small in size.

Lying between the 33rd and 38th degree of north latitude, Syria and the Lebanon may be regarded as possessing a generally temperate climate of the Mediterranean type. Sea and desert are the main determining factors, the former making for a stable and moderate climate, the latter radiating heat in summer and cold in winter.

Introduction.

As regards temperature, in the coastal regions the average winter temperature is about  $54^{\circ}$  to  $59^{\circ}$  F. ( $12^{\circ}$  -  $15^{\circ}$  C). with a minima of  $37^{\circ}$  to  $39^{\circ}$  F. ( $3^{\circ}$  -  $4^{\circ}$  C). In the summer the average temperature reaches  $82^{\circ}$  F. ( $28^{\circ}$  C.) with a maxima of  $98^{\circ}$  -  $104^{\circ}$  F. ( $37^{\circ}$  -  $40^{\circ}$  C.). In the coastal mountains the winter is much colder and snowfalls are usual. In the interior the continental climate causes cold winters and hot summers. The average winter temperature lies between  $43^{\circ}$  and  $46^{\circ}$  F. ( $6^{\circ}$  and  $8^{\circ}$  C), but spells of icy weather below freezing point are frequent; frost down to  $-15^{\circ}$  C. has been registered. In summer the average temperature in the interior is  $86^{\circ}$  to  $89^{\circ}$  F. ( $30^{\circ}$  to  $32^{\circ}$  C), and seldom reaches more than  $118^{\circ}$  F. ( $48^{\circ}$  C).

The rainfall in the coastal region amounts to 19" to 36" (500 - 1000 mms) and as almost everywhere in the Middle East it is concentrated during the winter months. In the interior it varies from 3" to 9.5" (80 - 250 mms) per annum.

The humidity at the coast during summer is from 70 to 80 per cent. During the winter the humidity in the interior is equal to and higher than that of the coast, reaching in some parts such as Deir-ez-Zor, 80 per cent in July. During a "Khamsin" (hot desert wind), the humidity may fall to less than 10 per cent, making conditions well nigh unbearable.

With regard to industries in Syria and the Lebanon, handicrafts, based on skill and the production of native goods, possessing a secure clientele and no European competition, had a glorious past. During the last thirty years, however, the establishment of customs frontiers with Turkey, Iraq and Palestine, following the partition of the Ottoman Empire, the change in consumers' taste and a variety

Introduction.

of other reasons have brought about a decline in the production of goods produced by artisans and traditional workshops, accompanied by much unemployment.

Modern industries have been established during the past ten years, and especially since the outbreak of war in 1939, but the volume of employment does not cover the loss suffered by the decline of the old forms of production.

The transition from artisan production to machine production is difficult on account of the necessary capital which the artisan does not possess, and the capital-owning classes, mostly landlords, have neither the experience nor the inclination to invest their money in industry. A further handicap of modern Syrian industry is the lack of mechanics and technical experts and the unavailability of spare parts and repair shops. Furthermore, accessory materials and tools necessary for production, which are easily available in a country with an all round developed industry, are often missing. In addition, financial institutions for industry are non-existent, and if credit is procurable, the rates of interest are high.

The existing industries, both old and modern, mostly produce consumer goods (textiles, shoes, furniture, soap, perfume, foodstuffs, cigarettes, matches, etc.) as well as other products which have a local market (cement, pipes, etc.) Industrial exports are small with the exception of goods sent to Palestine.

As a whole the capacity of the Syrian and Lebanese industries is considerable and it must be admitted that the progress made during recent years, especially when assisted and guided by the military authorities, has been noticeable. Prior to the War, foreign capital (mostly

# Introduction.

French) and returning emigrants as well as immigrants have contributed much to the development of modern factories.

The heavy expenditure which was necessary for the erection of electric plants was undertaken mostly by French capital, which holds most of the important concessions. The installed horse-power of all electric plants at present is about 45,000.

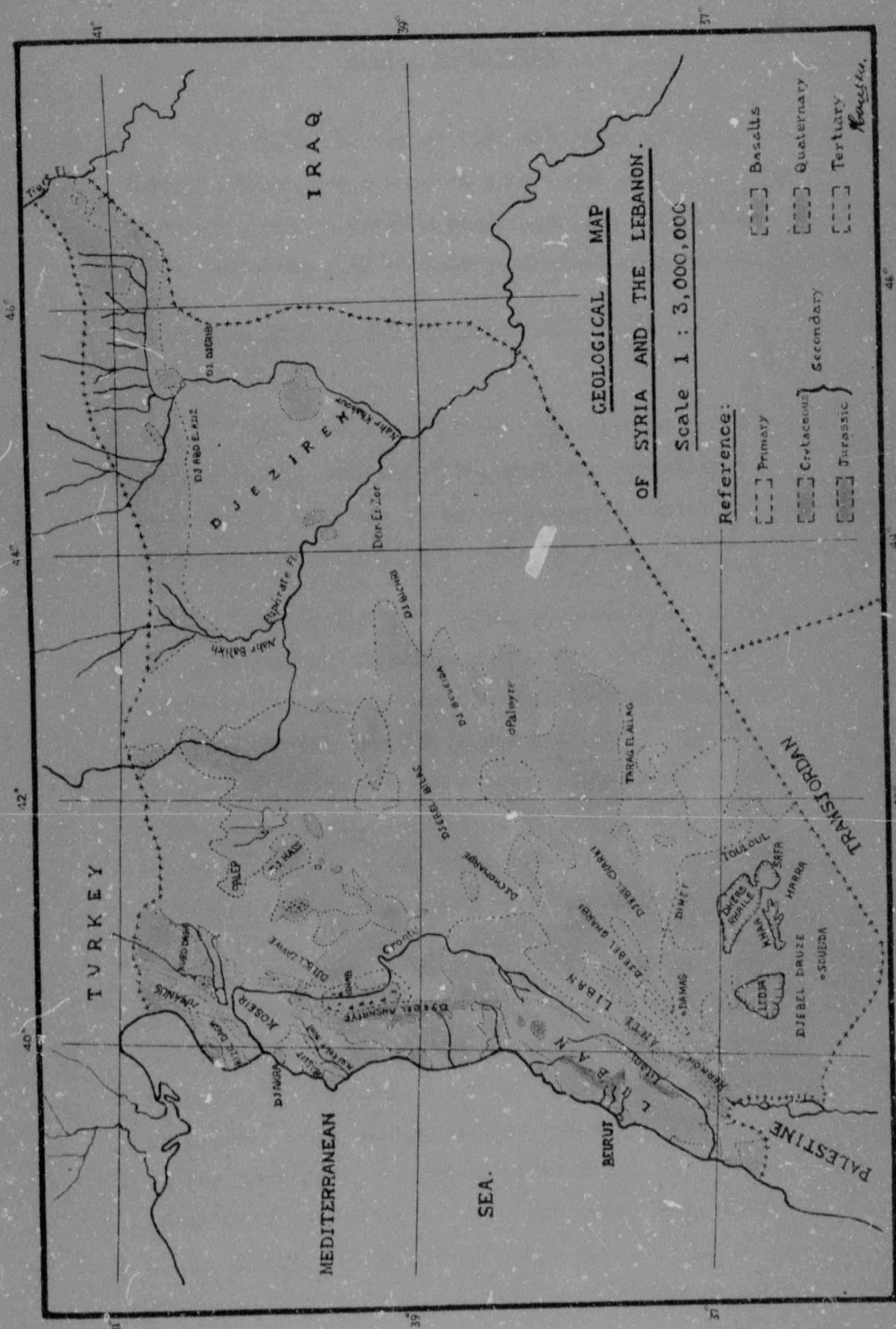
However, as an offset to any development of Syrian and Lebanese industry during war-time, comes the dark cloud of inflation. In pre-war days, this land was one of the cheapest in the world to live in; to-day it is one of the most expensive. Since the outbreak of war, the cost of living index figure has increased from 100 to over 500.

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SECTION II.

OUTLINE OF THE GEOLOGY OF SYRIA AND THE LEBANON.

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## II. OUTLINE OF THE GEOLOGY OF SYRIA AND THE LEBANON.

### ROCK FORMATIONS.

In the course of time the rocks of Syria and the Lebanon, which are connected with those of the African Continent, have undergone many important movements. In these parts the site of four geological eras can be traced.

#### GEOLOGICAL ERAS OF THE TWO COUNTRIES. (Fig 1 & 2)

##### 1. Primary Era.

The formations of the first period are scarcely visible in the Lebanon. The earliest formation, geologically, appears to be the Jurassic, which is widespread and forms the nucleus of the coastal masses.

In Syria, this period contains but little in the way of vertebrate fossils, except those of fish and amphibians. From geological observations it would appear that the formations of this era are hardly visible except in the Kizil Dag and the Amanus; consequently nothing is known of the Syrian formations at the different periods of the first era, of which there were five:- Pre-Cambrian, Silurian, Devonian, Carboniferous and Permian.

The rocks of eruptive origin at Kizil Dag and the Amanus, formed by basic rocks, are not clearly dated. The Cambrian seen on the east bank of the Dead Sea does not appear in this country. In the Amanus chain the Silurian is found; the Devonian is associated with the Carboniferous in the same chain and Djebel Abdel Aziz. The Permian, which is not visible, follows, geologically speaking, immediately upon the Carboniferous system. It is chiefly characterised by the development of reptiles and the appearance of new cephalopod molluscs of the ammonite family.

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