

In the Blacuza Mine region local volcanic affects have produced complications in the vault structure. The main problems presented by this area are a major fault having a throw of about 100 feet (30 metres); its parallel subsidiary faults faulting at right angles to this, and volcanic intrusions.

The conclusion of the Jurassic era was marked by earth movements which were accompanied by considerable volcanic activity. The purple-red volcanics that rest directly on the Jurassic Limestone and are such a noticeable feature of the district, were probably extruded at this time. In the period of quiescence that followed, the carboniferous shales were deposited. Sedimentation then alternated with repercussions of volcanic activity. Sometimes the volcanics formed superficial deposits, sometimes they were intruded into the Sedimentary rocks. A study of the coal deposits in the Blacuza area lends credence to the theory that the formation of coal is a degree of metamorphism from carboniferous shales, produced by heat and/or pressure which accompanies volcanic activity, and faulting.

2. The Region Adjacent to the Blacuza Mine Region.

This area lies to the north-west of the area discussed above, and is separated from it by only 325 feet (100 metres) of ground, which contains no topographical or geological discontinuity. It extends parallel to and below the Blacuza-Ehdine road from the promontory near which the road turns north, (Map Reference 1707.2584), to where it turns north-east (1707.2586) a distance of about 270 yards (250 metres).

The rocks on the south side of the area are confluent with those in the Blaouza Mine area. They dip to the north and thicken in the same direction. To the north and west of the area, vulcanicity is increasingly apparent and in the neighbourhood of the fault the state of the rocks may be described as chaotic. This fault has a strike along its magnetic bearing of 60 degrees, (nearly parallel to the main fault in the Blaouza Mine area); an almost vertical hade and a throw of 130 feet (40 metres) down to the north-west. The line of the fault has served as a pipe through which successive lava flows have been intruded into the overlying rocks.

Again in this area the purple-red volcanics lie directly on the Jurassic Limestone. The lie of these beds in the south of the area and the thickening northwards of the overlying sedimentary beds, both suggest that the area formed part of a basin of sedimentation.

In this basin, shales (and later Nubian Sandstone), were deposited, interbedded with occasional lavas and volcanic ashes. There is no evidence for the existence of the volcanic pipe beneath, during this time, although it is possible that it existed then. During the post-Cretaceous earth movements that threw up the vault of which these rocks form part, faulting naturally occurred within regions of instability, such as could result from heavy sedimentation. Accompanying or shortly following this faulting, basalts were forced up this plane, which was widened in transit, bending upwards on both sides the edges of the purple-red volcanics, isolating a part of them; continuing up the fault plane, and intruding into the overlying rocks. The route thus established was used repeatedly by successive lava flows which may be separately recognised. For the

most part these are of blue-grey or green-grey amygdaloidal basalt, weathering brown and spheroidally, to give a nodular kidney appearance. Some of the older lavas are darker, denser and veined. A blue basalt with a columnar fracture, and more recent than the others, can be recognised by the way it cuts across them and fingers out into the Nubian Sandstone.

From observations there is no doubt that the carboniferous shales occur at some depth in the terraced area, and conditions resemble those in the best coal-yielding area at the Blaouza Mine.

3. The Region Adjacent to Becharré Mine on the North-West.

This area lies adjacent to the Mine, and includes the band of Upper Jurassic rocks, about 550 yards (500 metres) long, extending from the mine on the east to the bridge on the hairpin bend on the west. (Map Reference 1767.2553 to 1772.2556).

On the basic Jurassic Limestone platform, rest alternating layers of black columnar basalt and purple-red volcanics (tuffs and lavas: some ashes). Near the top of these volcanics the coal bearing shales appear, thinning from the mine area, where they are about 4 feet (1.25 metres) thick, with about 28 inches (70cms) of lignite, to the stream on the west where the bed outcrops as a thin layer about 12 inches (30 cms) thick with one inch of lignite. Only a layer of tuffs and ashes, sometimes one and sometimes the other, separates this bed from the Jurassic Terminal Limestone above.

In this area, both the overlying volcanics and the coal-bearing beds, have suffered erosion. The strata have a roughly north-south strike and a dip towards the east that varies from 0 to 10 degrees in the mine area. At certain points the volcanics are seen to have an intense vertical fracture along their line of strike and are step faulted. These facts, together with the lie of the volcanics, where they can be seen to outcrop in a nearby gulley, and the dips of the rocks on either side, indicate the presence of a monoclinal fold beneath the gulley overburden.

The hard banded tuffs and lavas have been unable to yield to this folding without fracture, which has been sufficiently intense to render them considerably more susceptible to erosion in the fold area than on either side. To a lesser degree, the same effect was produced on the overlying rocks rising above and to the south. Subsequent to the erosion which wore through the overlying Cretaceous and Jurassic rocks, calcareous scree, containing purple-red volcanic boulders partly slipped and were partly washed over the area where it now lies, particularly in the gulley.

4. The Bqaa Kafra Region.

This area lies between the Grid-lines 176 and 177. No evidence was found for believing that the coal development was sufficient to warrant further investigation, either in the Jurassic volcanic rocks, or in the Nubian Sandstone above, where thin outcrops of coal are present. The bedrock is well marked by calcareous scree and breccia, but although this does not preclude the existence of coal

deposits beneath, the evidence provided by the bedrock where it can be seen does not justify further investigation. The strata dip only slightly to the east and the area would appear to be on the edge of, or beyond the basin of sedimentation in which the Becharré coal was deposited, and to be more remote from the disturbances which effected this deposit.

There is certainly an abundance of volcanic rocks in the area, but a comparison of the thickness of these in wadis east and west of the area, indicates that they thin to the west, towards which direction the coal development decreases. West of Bqaa Kafra, recent calcareous deposits again mark the underlying structure, but in the wadi to the west of the village, the terminal Limestone rests directly on the purple-red lavas, and there is no trace of the carboniferous shales near the top of these lavas.

5. The Qnaïouer Region.

The village of Qnaïouer lies on a promontory of repeatedly down-faulted Jurassic and Nubian rocks, on the edge of the Qadicha valley, about 1.5 miles (2.5 kms) from Hadet, and is reached by a side track off the main road. (Map Reference 1688.2583)

In this area the main carboniferous shale bed outcrops in the volcanic rocks about 7 feet below their contact with the Nubian Sandstone. Occasional pockets occur at lower levels. From time to time attempts have been made at various places round the promontory to discover coal in the carboniferous shales, but of five such

sites examined, only one on the north side of the village, where there are three adits together, showed evidence of an appreciable amount of so called coal having been extracted.

A thorough examination round the mouths of these adits which held deep water, revealed no trace of coal approaching the quality of that being mined across the valley at Blaouza. It is worth noting that once again the shales appear to have been deposited in a basin of purple-red volcanics. The steep scarps of these volcanics directly underlie the Nubian Sandstone. There is no sign of later vulcanicity.

Other lignite occurrences in this circuit include El Aarbe, Belahiss, Hadet, Mazraat Beni A'Saab, Beit Mender, Douair, Upper Qadicha Valley, Douma, Brissiette, and above Qnaouer. The geological features are predominately similar. These occurrences are described in Section VII.

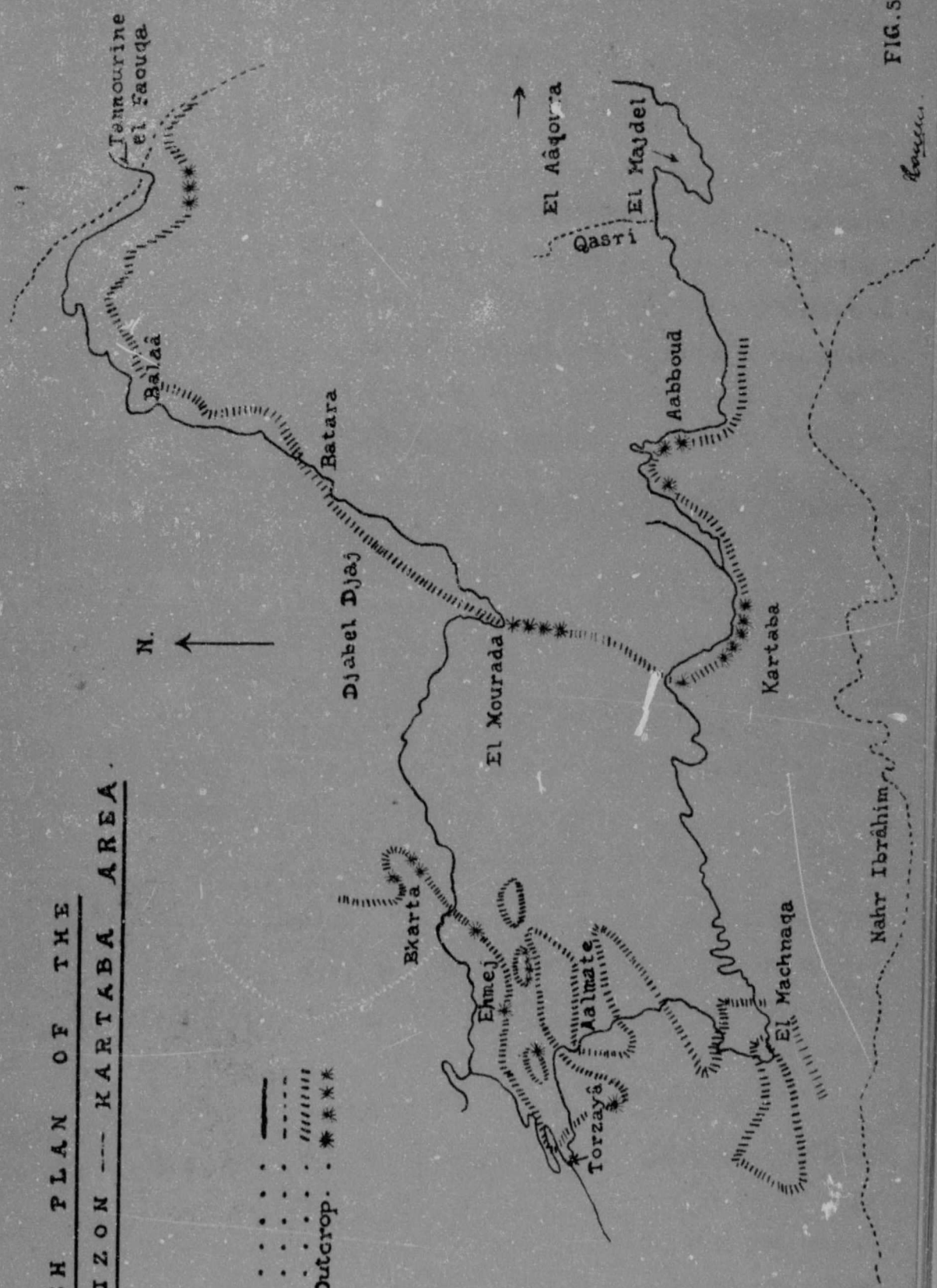
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SKETCH PLAN OF THE COAL HORIZON --- KARTABA AREA.

Reference: -

- Roads
- Streams
- Coal Horizon.
- Carbonaceous Outcrop.



B. THE KARTABA AREA.

The area covered is shown in Fig. 5. This plan also shows the approximate coal horizon and carboniferous outcrops. The coal horizon was traced from Kartaba to Jebel Jaj; from Belaa to Tannourine; and from Aalmate to Bkarta. The altitudes of this horizon varies from 2900 to 5200 feet, (900 - 1600 metres). The area is situated inland from J'bail and is accessible by fairly good roads. Climatic conditions during winter months render some of the deposits difficult of access.

The whole area may be sub-divided as follows:-

1. The Region around Kartaba Village.
2. The Coal Horizon between Kartaba and Tannourine.
3. The Aalmate Region.
4. The Coal Horizon between Bkarta and Ibrahim Gorge.
5. The Region around Bkarta.

1. The Region around Kartaba Village.

Around the village of Kartaba the coal seam is once more found in a basin of purple-red volcanics of the Jurassic, and it is associated with a considerable mass of volcanics rocks, including spheroidally weathered basalt, similar to that found above the coal seam at Blaouza.

The basin extends for about 220 yards (200 metres) along the outcrop, round the promontory of volcanic rocks on which the village of Kartaba is built, (Map Reference 1610.2393). The dip, where visible, is always away from the outcrop. It would appear that the greater part of the basin remains, and lies beneath the village; at one

time this must have been one of the largest lignite deposits in the Lebanon, containing six to ten thousand tons. The seam itself is thick and of fairly good quality. It was worked extensively by the Germans during World War No. 1.

About 0.5 mile from Kartaba Church in a north-west direction, and at an altitude of 3740 feet (1150 metres) (Map Reference 1603.2398), and about 220 yards (200 metres) below the road, 320 yards (300 metres) east of Qadi-el-Kafir, a carbonaceous outcrop may be seen. A test adit driven into this bed for about 10 feet revealed a 6 feet thickness of shales, with three stringers of coal, none of which was more than 0.5 inches in thickness. The rocks dip into the hillside at about 10 degrees to the north-east. No estimation could be made of the lateral extent. The shales, however, occur in what appears to be a basin of the purple-red volcanics, and are overlain by the blue-gray spheroidally weathered basalts which are commonly associated with the North Lebanon deposits.

At Aabboud (Map Reference 1625.2403) about 1.25 miles (2 kms) north-east of Kartaba on the El Majdel road, an adit has been driven for about 30 feet (10 metres) in a carbonaceous band, in an east-west direction, revealing a thin stringer of lignite one inch in thickness. About 10 inches (25 cms) of grey shales overlie this lignite. These shales contain fossils of fern-like flora, one of which was measured to be about 10 inches long. The rock sequence is the same as at Kartaba.

East of Aaboud near Mrhaziri, the Jurassic rocks pass underneath the Lower Cretaceous. In order to ascertain whether the deep gorge of Nahr Qasri might again cut into the Jurassic volcanics, a reconnaissance of 1.5 miles up into this gorge revealed the stream to cut through Neocomanian rocks, and as much as 200 feet (60 metres) of black pillar basalts, but the purple-red volcanics were never exposed. At the top of the pillar basalts, a carbonaceous shale sometimes outcrops, but there is no reason to believe this to be coal-bearing.

2. The Coal Horizon between Kartaba and Tannourine.

Ouadis El Kafir, Ech Chaharim, Batara and El Kurm form a line northwards from near Kartaba to Tannourine and Tahha, slightly to the west of which runs a major fault in the Jurassic rocks with a downthrow to the east. In the neighbourhood of this fault, often in the wadis themselves, the purple-red volcanics outcrop and as evidence elsewhere in the Northern Lebanon, forms the basin in which the lignite has been deposited. A reconnaissance along this line, which constitutes the western margin of the Jurassic arch which traverses this area from S.S.W. - N.N.E., revealed a promising carbonaceous outcrop only in the wadi that rises in the El Kafir mountains and runs northwards to the village of El Mourada, at an altitude of 5400 feet (1650 metres) (Map Reference 1610.2427). Here a coal-bearing shale bed can be traced for 440 yards (400 metres). This deposit is likely to be extensive, but El Mourada is uninhabited in the winter time due to the intense cold and snow.

The effect of the fault on the rocks on the down-throw side has been to drag them into a vertical or nearly vertical position, and the shales lie in this attitude. The best exposure lies about 220 yards (200 metres) from the hairpin bend in the road at El Mourada, up the wadi. An attempt has been made here to extract the lignite by means of a T-shaped adit, the long arm of which cuts across about 23 feet (7 metres) of nearly vertical shales, and the short arm runs along a bed of lignite 12 inches (30 cms) thick. Close examination was prevented by water in the adit, and the weathering of exposed coal.

A selected sample gave a value of 11,190 B.T.U.s (6600 cal/kilo) with ash 14.8 and sulphur 5.1 per cent.

The circumstances in which the coal occurs are not unlike those prevailing at the Upper Mine at Hadet Joubbe (Section VII). In both occurrences the carboniferous beds are extensive and outcrop steeply inclined to the major faults along the eastern margin of the Jurassic arch. The main difference is that at El Mourada, the inclination is considerably greater than at Hadet.

North of El Mourada, in Ouadi Chaharim, fragments of lignite and carbonaceous matter occur in the Neocomanian.

Further north lies another lignite prospect at Tannourine-el-Faouqa, at an altitude of 4710 feet (1450 mts), (Map Reference 1660.2486). In winter time this prospect is reached by foot across the mountains from Belaa, 2.5 miles (4 kms) west of Tannourine.

The Sources and Nature of the Lignite Occurrences.

The prospect itself, lies 0.5 mile south of Tannourine and is reached by a precipitous path.

There a bed of shales, lying between the purple-red volcanics (beneath), and the hard grey basalt (above), has been traced by at least nine adits along the south face of Ouadi Tannourine for about 440 yards (400 metres). The shales are grey but contain thin veins of poor quality coal, with a value of only 6660 B.T.U.s (3700 cals/kilo). It is impossible to work the deposit during the winter months.

3. The Aalmate Region.

At about 0.5 mile up from the Nahr-el-Fidar, from the bridge by which the Torzaya - Aalmate road crosses the stream, on the north side of the valley, the Aalmate Mine is located. The altitude is only 3110 feet (950 metres) (Map Reference 1554.2418); it is reached by a footpath. The coal-bearing beds with some overlying Neocammanian, occur as an outlier in the Jurassic Limestone, against which they are downfaulted towards the north. The shales and coal rest in a basin of purple-red volcanics, and are overlain by some 6 to 9 feet of grey basalt.

Three clearly defined grades of carbonaceous matter are found here, practically superimposed on each other. Over the width of the two uppermost layers, about 30 inches (75 cms), an average value from samples was 7560 B.T.U.s (420 cals/kilo). There is approximately 1700 tons of reserve in the two uppermost seams, and this may increase towards the south-west.

4. The Coal Horizon between Bkarta and Ibrahim Gorge.

An examination failed to reveal any carbonaceous outcrop between the Nahr Ibrahim and Aalmate. The likely coal horizon between Aalmate and Ehmej appeared to be more promising. Four prospects were examined in this area.

(a) Nadaa Torzaya Prospect I.

Map Reference 1543.2415. Altitude 2920 feet (900 metres). About 440 yards (400 metres) by road, across the Ouadi Fidar, below Torzaya, and 100 yards north of the road, a test adit has been driven 15 feet into an outcrop of shales in an outlier of coal-bearing beds. These shales are at least 3 feet thick and contain traces of coal and much pyrites. Further investigation might prove fruitful.

(b) Nadaa Torzaya Prospect II.

Map Reference 1541.2408. Altitude 2440 feet (750 metres). Below the Church at Torzaya, on the south side of Ouadi Fidar, about 66 yards from the stream, a bed of carboniferous shales outcrops over a distance of at least 30 yards. An adit had been driven into this outcrop, but has since fallen in. It is reported to be about 32 feet long and to have exposed 36 inches of shales similar to those at Aalmate Mine middle seam.

(c) West Ehmej Prospect.

Map Reference 1552.2423. Altitude 3580 feet (1100 metres). This prospect lies in the wadi to the west of Ehmej village. Here traces of coal are exposed in an outcrop of shales 18 inches (45 cms) thick.

Small scale prospecting in the neighbourhood has proved unfruitful, possibly because the test adits have not entered far enough. West of this prospect along the coal horizon, there are indications that prospecting might prove successful.

(d) East Ehmej Prospect.

Map Reference 1562.2426. Altitude 3740 feet (1150 metres). At this point an adit has been driven 66 feet into a 36 inch band of shale which resemble the middle seam at Aalmate Mine. The dip of the rocks is about 3 degrees north west. The quality of the shales shows no appreciable change along the adit, and does not appear to be sufficiently good to warrant mining operations.

5. The Region around Bkarta.

Bkarta Mine lies 440 yards north of the Ehmej-el-Mourada road. Map Reference 1573.2433. It is situated at an altitude of 4230 feet (1300 metres) and is reached by a footpath that leads uphill along the purple-red volcanics, 1400 yards from Ehmej village.

The coal lies in a deposit of black basalt, and is distinctive in that it occurs some feet below the purple-red volcanics. The actual outcrop is masked by terracing. However, pits have revealed the outcrop at various places over 440 yards. The occurrence lies along the western margin of the Jurassic arch, and the structure in the neighbourhood is more than usually complicated by intense folding (and possibly faulting) along a N.E. - S.W. axis. The limits of the lens are defined on the east and south, but the extent of the

west and north is speculative. A sample revealed a Calorific Value of 7740 B.T.U.s (4300 cals/kilo).

About 330 yards (300 metres) to the north-west of the mine entrance, coal-bearing beds of shales are in evidence. Here the coal occurs in several thin seams, separated by shales and containing much pyrites, but it is of good quality. Moreover, the outcrop is of sufficient length to justify hopes of finding a fair sized lens behind.

C. THE MEYROUBA AREA.

This area is concentrated on the steep western slope of the Lebanon (Map Reference 1553.2337) at an altitude around 5000 feet (1500 metres), close to the village of Meyrouba. It is reached by road from the coastal town of Djouni.

The seam, which is sub-bituminous, is situated in the volcanic tuffs of Jurassic Age. It is lenticular in its outcrops and has been traced over a considerable distance. The composition varies from sub-bituminous looking coal to a softer variety with a dull greasy colour and conchoidal fracture, to grey marl. It is of varying quality and possesses a great deal of pyrites.

Although the seam is fairly persistent, in some places folding and faulting have thinned it out and broken it up, with a consequent mixture with volcanic tuffs and marl. Apart from these effects, two larger faults play an important part, causing considerable downthrows in a southerly direction. The only workings in this area are at Meyrouba Mine which is situated 3 miles (5 kms) north of the village. The locality is barren with little water

beyond one small spring. The dip of the seam is, unfortunately, into the mountain, and this has prevented extensive exploitation. With adjustments in the mining policy, however, this deposit is well worth further development. On account of snow etc., it can only be exploited from April to November.

In the vicinity of the village of ... there are several small lignite deposits. In addition to the above there are several smaller lignite deposits which have not been explored.

The most important deposit in this area is ... all the deposits are reached by fairly good roads to within about 2-3 miles (3 km) of the actual occurrence. The lignite occurs from 100 feet up to 1000 feet (300-1000 meters) above sea level, and the area is not particularly affected by climatic conditions during winter months.

The essential distinction between the deposits ... is that the Central deposits lie in the continuation of the lower ... resting on top of the Jurassic. The ... is the fact that they are ... between the North and the Central is that the ... and the ... and the ... with the fact that they are ... in ... usually to ... within the ...

THE CENTRAL LEBANON.

General:

The line of demarcation between the Northern and Southern Lebanon lignite occurrences has been taken as the Meyrouba area. This Central Area stretches southwards to beyond the villages of Abey and Ain Traz. It includes such properties as Bzebdine, Arsoun, Mar Youhanna, Mdekhen, Merjlaya, Ouadi Chanrour, Aaramoun, Abey and Ain Traz. In addition to the above there exist numerous smaller occurrences which have not been examined.

The most distant deposit in this area is 37.5 miles (60 kms) from Beirut (i.e. Bzebdine). All the deposits are reached by fairly good roads to within about 2.5 miles (4 kms) of the actual occurrence. The altitudes vary from 1300 feet to 2600 feet (400 - 800 metres) above sea level, and the area is not seriously affected by climatic conditions during winter months.

The essential distinction between the deposits of the Central and those of the North, is that the Central occurrences lie in the sandstones of the Lower Cretaceous, resting on top of the Jurassic; with them are associated volcanics. In the North the deposits are all in the volcanics of Jurassic age. Another distinction between the North and the Central is that the occurrences in the Central Area are more compact and less difficult of access, and are therefore more easily dealt with. This, coupled with the fact that they can be worked all the year round in contra-distinction to those of the North, which can usually be worked for eight months in the year only, makes the Central Area of more immediate interest.

The Central Area may be divided into:-

1. The Region between Ras-el-Harf and Bzebdine.
2. The Region around Abey.

1. The Region between Ras-el-Harf and Bzebdine.

Situation and Topography. (Fig 6.).

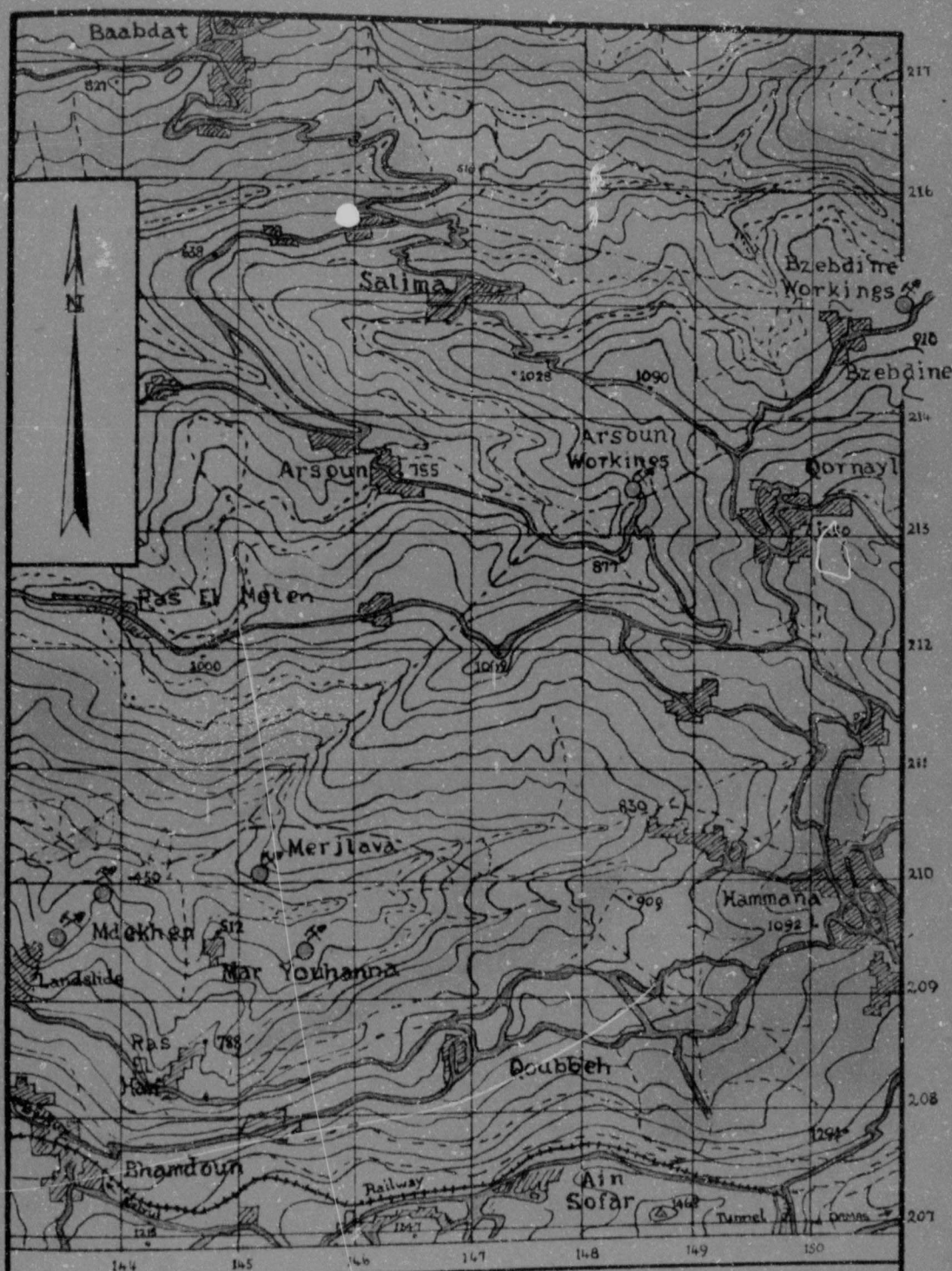
Roughly speaking, the workings inspected are located within an area from 0.5 to 7 miles (1 - 11 kms), North - East of the village of Bhamdoun, on the main Beirut-Damascus road. Bhamdoun is 15 miles (24 kms) from Beirut. Ras-el-Harf is situated immediately North-East of and below Bhamdoun, and also connected to Beirut by a direct road through Araya.

The area is mountainous, deeply dissected by three roughly parallel, east-west wadis, and well served by hard roads, although the lignite workings are not always close to these roads. The Beirut - Damascus narrow gauge railway (metre gauge) passes along the high ground through Bhamdoun and Ain Sofar. The area is well timbered and water is plentiful.

Geology:

The relevant rock formations in the area are the reddish-yellow Nubian sandstones, containing the lignite horizon, and associated volcanics (basalt). These sandstones rest on the yellowish colitic limestones on top of the Jurassic. These yellow limestones rest in succession on the thick masses of grey-blue limestones of the Upper Jurassic.

FIG 6



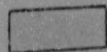
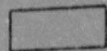
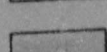
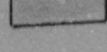
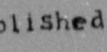
SKETCH MAP OF

RAS - EL - HARF VICINITY

Showing Location of :-

MERJLAYA
MAR YUHANNA
MDEKHEN
ARSOUN
BZEBDINE

REFERENCE :

-  Nubian Sandstone
-  Cretaceous, with volcanics & Lignite horizon.
-  Top of Jurassic.
-  Yellow Oolitic Limestone.
-  Upper Jurassic.
-  Blue-grey Limestone.

GENERAL GEOLOGY taken from unpublished maps by L. Dubertret.

Scale 1:50,000.

Amur

Author Coulter J

Name of thesis The occurrence and exploitation of lignite in the Lebanon 1944

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