

GOVERNMENT OF MEGHALAYA



सत्यमेव जयते

MINERALS FOR INDUSTRIAL USE

**Directorate of Mineral Resources,
Meghalaya, Shillong**

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Mineral Map of Meghalaya (1 inch=16 miles).

(i)

INTRODUCTION

The need for a composite compilation of information on the various mineral deposits available in the State of Meghalaya, both from the point of planning for further investigations as also from the point of providing requisite basic information for future mineral-based industries that could be set up in the State, has been felt for a long time. This booklet on "Minerals for Industrial use" is a result of this long-felt need.

The data contained in this booklet have been taken from both the published and the unpublished reports of the field investigating agencies like the Geological Survey of India, the Directorate of Geology and Mining, Government of Assam as well as the State's own newly formed Directorate of Mineral Resources. Some other publications, brochures available on the subject have also been consulted.

Coal, limestone and clay being the major minerals of the State have been given rather elaborate treatment in view of their economic importance. They are therefore given a chapter each. A lot of investigation work is yet to be carried out in the case of the other minerals mentioned in the subsequent chapters of this booklet. A shelf of mineral investigation projects to be undertaken by the Directorate of Mineral Resources has already been drawn up for the Fifth Five-Year Plan to enable the State to know in detail what it is worth in terms of mineral resources.

Considering the semi-technical nature of the subject matter dealt in this booklet, and the comparatively short time in which it has been produced, it is all too likely that some minor errors and mistakes may have crept in. Suggestions for improving upon the material of the booklet will be gratefully accepted.

CHAPTER 1

COALFIELDS

The Tertiary coal deposits of Meghalaya, belonging to Eocene age, are to be found mostly on the southern slopes of the State. The main characteristics of the coal obtained here are its low ash content, high volatile matter and also high calorific value; however it suffers badly from its comparatively high sulphur content. The coal is mostly sub-bituminous in character.

Due to the inconsistent nature of the coal seams, coupled with complicated geological structures in certain areas, it is rather difficult to ascertain the actual reserves of the deposits. The inferred reserves, as estimated from time to time, are however indicated under the description of each deposit.

The Laitryngew and Cherrapunjee coalfields have been worked out rather extensively over a number of years in the past, mostly by local people in the form of cottage industry. The vast coal deposits of Garo Hills, however, have yet to be opened up due to the fact that the areas of its occurrence have been, until very recent times, inaccessible to the outside world.

A. KHASI HILLS

1.1. Laitryngew Coalfield—

This coalfield covers an area of 31 sq. kms. from Sohrarim to Upper Cherra, along the Shillong-Cherra road side and the coal occurs in the Cherra sandstone of Lower Eocene Age.

There are three coal seams of unequal thicknesses in the area. The topmost seam is sporadic in occurrence being present only in two hillocks—one south-west of 31/2 m. p. and the other a little north-west of 27 m. p. on the Shillong-Cherra Road. The thickness of the bottom seam varies from 0.75 to 1.4 metres with an average thickness of 0.8 metres. The middle seam varies from 0.15 to 0.36 metres with an average thickness of 0.36 metres.

The interval between the two seams varies from 4.6 to 11.2 metres. Overburden of the middle seam varies from 6.0 to 12.18 metres while that of the bottom seam varies from 12.0 to 45.0 metres. The coal-overburden ratio for the bottom seam ranges from 1:12 (minimum) to 1:45 (maximum) while for the middle seam it ranges from 1:18 (minimum) and 1:36 (maximum).

Taking an average thickness of 0.9 metres for the bottom seam and 0.36 metres for the middle seam and a conversion factor 0.72 cu. m. to a tonne of coal, the reserves of the bottom seams are 2,308,966 tonnes and that of the middle seam 429,173 tonnes, thereby bringing the total reserves of coal in the area to about 2.7 million tonnes.

Laitryngew coal analysis shows the following results—

Ash	11.5 per cent.
Volatile Matter (V. M.) ...	41.2 „
Fixed Carbon (F. C.)	45.9 „
Sulphur (S)	—
Calorific Value (C. V.)... .. in B. Th. U/lb.	12,710
Caking Properties	Caking.

Drilling investigation for proving these deposits was done in 1963-64 in one part of the field only, Mawkma village.

1.2. Coalfields around Cherrapunjee—

These areas mainly contain two seams of coal with extremely variable thickness from 0.3 to 2.7 metres. They are being worked in several localities for a long time and in Mawmluh area the lower seam has almost been worked out. Reserves of coal estimated by Geological Survey of India in 1953-54 from different parts of the field are as follows—

- (a) Lower Cherrapunjee ... 1,290,000 tonnes for the lower 0.9 metre to 2.7 metres seam for 1.10 sq. kms.
- (b) Upper Cherrapunjee ... 1,425,000 tonnes for the lower 0.9 metre to 1.2 metre seam for 1.20 sq. kms.
- (c) Area north of Cherra ... 780,000 tonnes for the lower 0.9 metre to 1.2 metre seam for 5.66 sq. kms.
- (d) High ground between 27th milestone and 4,843 peak. 2,010,000 tonnes for the lower 1.2 metre seam for 1.28 sq. kms. and 20,000 tonnes for the upper 0.3 metre seam for 0.05 sq. km.
- (e) Hill to the west of 4,843 peak. 115,000 tonnes for the lower 0.3 metre seam for 0.29 sq. km.
- (f) Sohrarim-Mawkma-Laitlyndop-Ryngimawsaw area. 10,000,000 tonnes for the lower 0.45 metre seam for 18.17 sq. kms. and 3,220,000 tonnes for the upper 0.3 metre seam for 8.2 sq. kms.

The total reserves of the above fields come to about 19 million tonnes.

1.3. Laitduh Area—

In the Mawkyrdup hill, south-east of Laitduh village, a coal seam of 0.92 metres thick (average) occurs in the Lakadong sandstone at a height of about 60 metres from the base of the Mawkyrdup hill. The area lies to the west of Laitryngew.

The coal is generally dusty, but lump coal is also found. The coal contains specks of pyrite and fossil resin. The coal seam occupies an area of 125,800 sq. ms. and has an estimated reserve of 129,600 tonnes.

Two bore holes were drilled for proving these reserves in the 1971-72 field season.

1.4. Mawbehlarkar coalfield—

In Mawbehlarkar area, preliminary investigation shows that one coal seam of average 1.00 metre thickness covers an area of 100,000 sq. ms. with an overburden of sandstone and soil of 5.00 metres thickness.

The total estimated reserve is calculated at 0.12 million tonnes. Analysis of the coal shows the following results—

Moisture	...	...	...	3.9 per cent
Ash	...	...	...	2.9 „
Volatile Matter	...	...	...	45.1 „
Fixed Carbon	...	...	...	48.1 „
Colour of the ash	...	...	...	Light chocolate.

1.5. Mawlong coalfield—

This field lies south of Cherrapunjee, some 25 kms. on the Cherra-Shella Road. A 0.9 metre thick coal seam encountered within 8 sq. kms. of area contains nearly 9,000,000 tonnes of coal.

The proximate analysis of the coal from this area shows the following results—

Moisture	...	...	...	4.10 per cent
Ash	...	...	...	7.94 „
Volatile Matter	...	...	...	35.92 „
Fixed Carbon	...	...	...	51.74 „
Sulphur	...	...	...	3.46 „
Calorific Value in B. Th. U/lb.	...	...	...	12,190
Caking Properties	...	...	...	Non-Caking-

1.6. Bairang coalfield (Wahlong)—

Geological investigation over an area of 14 sq. kms. around Bairang on the Cherra-Shella Road reveals the presence of a thin coal seam over an area of 1.4 sq. kms. below road level. The coal belongs to Lakadong sandstone stage. The thickness of the coal seam with the intervening shale and sandstone varies from 0.8 metre to 3.8 metres. There are three thin coal seams within this horizon. Of them the lowest coal seam is the most consistent in its horizontal disposition; its thickness varies from 0.3 metre to 1.0 metre with an average thickness of 0.56 metre. The total reserve for this coal has been calculated at 707,692 tonnes.

The coal analysis is as follows—

Ash	Volatile	Fixed Carbon	
1.4	29.7	27.6	} Air dried basis.
to	to	to	
35.27	34.00	55.0	

The average thickness of the overburden is 15.00 metres. In view of high overburden factor and thinness of the coal seam it may not be possible to recover this coal deposit.

1.7. Mawsynram Coalfield—

Coal in Mawsynram area occurs at Rangsockham, Jathang, Mosingi and Lumbidon. Of these, only Rangsockham coal has been investigated for its economic potentiality.

Rangsockham is located at a distance of 3.2 kms. north of Mawsynram. Two seams of coal are separated by a band of arkosic sandstone of one meter thickness. The lower seam varies in thickness from 0.6 to 1.2 metres. The upper seam is about 30 cms. thick in average thickness. The coal varies in thickness from 22 to 45 cms. in the other places mentioned above.

The expected reserve of Rangsockham coal is 45,300 tonnes. The expected reserve for upper seam is calculated at 8,120 tonnes. Taking into account the average thickness of workable deposit at Rangsockham to be 60 cms. the total reserve becomes 32,000 tonnes.

Only the bottom seam of Rangsockham coal has been analysed. The result of analysis are as follows—(Air dried basis)

Moisture	...	...	...	6.98	per cent
Volatile Matter	...	...	...	34.90	„
Ash	...	...	...	13.90	„
Fixed Carbon	...	...	...	44.22	„

Sulphur	...	...	...	1.99 per cent
Calorific Value	...	...	...	10,546 B. Th. U/lb.
Caking Index	...	...	...	—

The coal is non-caking, friable and dusty. Nodules of pyrite, often upto 5 cms. in diameter, are present in the coal. The rank of the coal is sub-bituminous.

1.8. Langrin Coalfield—

The Langrin coalfield is situated in the south-western extremity of the Khasi Hills and extends over a large area from Kynshiang (Jadukata) river in the east to Maheshkhola river in the west. The eastern extension of the coalfield is upto Goabari and Barsaura. The southern boundary is more or less a straight line from Barsaura in the east to Mangokhor (on the bank of Maheshkhola river) in the west. The Um Mawblei river and its tributary Um Bytit river flowing from west to east, form the northern boundary of the coalfield, though exposures of coal are found further north near Nongjismir village in the Um Mawblei river section. Although the Maheshkhola river is the western boundary of the coalfield, the field extends further westwards and is exposed in the Pendengru-Balphagram area.

The coal seams are found in the Tura-sandstone of Lower to Mid Eocene Age, which is overlain by Siju Limestone and Kopili shale. Although seven coal seams are reported to occur in the area, all the seams are not exposed in one geological section. The most well exposed section is found in the western part of the area around Nongchikoid and Umtongkut villages, where coal seams are exposed in the Um Bytit river and Um Nongchikoid stream sections. Other exposures of the coal is found mainly in the following areas (i) Barsaura-Goabari area, (ii) east of Khonjoy in Wah Rangah stream, (iii) Nongplu-Nongjion area, (iv) West of Soling in Maheshkhola river, (v) West of Borsaura in Kalagui and Chari stream sections.

The reserves of coal are estimated area-wise, considering the different coal seams. Only four of the seven seams are considered for the estimation of reserves here.

- (i) The reserve of coal around Barsaura and Goabari areas is 2.26 million tonnes, taking thickness of the four seams as 0.60 m., 1.21 ms., 0.90 m. and 1.16 ms. respectively.
- (ii) In Nongplu—Nongjion area, four seams of coal ranging in thickness from 0.80 m. to 1.55 ms. are found within 35 metres of formation and the reserve of the coal is estimated at 20 million tonnes, taking the average thickness of 3 metres for the seams.
- (iii) In the Soling area, coal of 2 metres thickness is exposed in Maheshkhola river section. The reserve is estimated at 4 million tonnes.

- (iv) In the central part of the area, coal is exposed in Wah Rangah stream. The total average thickness of the several coal seams is taken to be 6.4 metres. The reserve is estimated at 0.35 million tonnes over an area of 40,000 sq metres.
- (v) Two seams having a total thickness of 2.85 metres are found in a stream near Nangmawli. The reserve of this coal is estimated at 4 million tonnes over an area of 1 sq. km.
- (vi) In the area north of Nongmaharu, two seams of coal of 1.10 metres and 1.40 metres in thickness are exposed in the Um Mawblei river section. The reserve of the two seams over an area of 1 sq. km. is estimated at 4 million tonnes, taking the average thickness of the two seams as 2.85 metres.
- (vii) In the western part of the area, coal seams are exposed continuously in the Um Bytit river section from south of Nongmen to Nongchikoid and also in the south of Nongchikoid. Another exposure is found continuously from north to south in the western part of the Um Tongkut village. Two horizons of this coal are considered—one seam of 0.50—2.5 metres in thickness is found in the upper horizon while in the lower horizon, three seams ranging from 0.40 to 3.12 metres in thickness are found. The reserves of coal for the Nongchikoid—Umtongkut areas are estimated at 11 million tonnes, for the upper horizon and 13.1 million tonnes for lower horizon. The total reserve comes to 24.1 million tonnes.
- (viii) Near Nongjismir, one seam of 0.80 metre thick coal is found and another seam of 0.50 metre thick is found in Kushang area. Both the areas are situated in the northern most part of the coalfield. The reserve for these areas is estimated at 1.40 million tonnes.

The total reserves of the above mentioned deposits come to 60.11 million tonnes. The coal is generally of high moisture, low ash and high sulphur and is weakly to medium caking.

The proximate analysis of the coal is given below:—

Moisture %	...	...	...	1.9 to 6.9
Ash %	...	...	...	2.7 to 9.2
Volatile Matter %	...	...	...	40.9 to 56.6
Fixed Carbon %	...	...	...	34.3 to 49.2
Total Sulphur %	...	...	...	3.0 to 4.2

1.9. East Darranggiri coalfield—

This area lies on the border of Khasi Hills and Garo Hills district. The major part of the coalfield lies in Garo Hills District and is known by the name of West Darranggiri coalfield which is described elsewhere in this note.

Even though this area is seemingly large, it is less important than the western portion, as here the coal bearing rocks have been disrupted and cut up by later erosion into small blocks. Over a greater part of the area examined, two consistent coal seams were noted. The lower seam is the main workable one, as compared to the coal of the upper seam which is brownish and tough, with a resinous lustre. The following are the different areas of the East Darranggiri coalfield where coal occurs:—

1. Jangkhe, <i>i. e.</i> hill 1737'	...	(25°23' : 90°48')
2. Mermelsaram...	...	(25°24' : 90°48')
3. Rengdim—Agalghithim	...	(25°22' : 90°50')
4. Nabru	...	(25°21' : 90°48')
5. Holwang. <i>i. e.</i> hill 1975'	...	(25°21' : 90°47')
6. Kylas or Chutmang, <i>i. e.</i> hill 3365'	...	(25°18' : 90°45')
7. Baljong	...	(25°18' : 90°42')
8. Dogring	...	(25°17' : 90°43')
9. Asilgaon Hill.		

The average thickness of the lower seam is about one metre, but at places larger thickness have been noted. The total reserve of various patches having a total area of 21 sq kms. are expected to be 31.5 million tonnes. The proximate analysis of the coal seam is given below:—

	I	II	III
1. Moisture—%	8.42	7.70	4.84
2. Volatile Matter—%	37.14	36.84	41.40
3. Fixed Carbon—%	46.10	51.34	50.02
4. Ash—%	8.34	4.10	3.74
5. Sulphur—%	2.21	3.00	2.42
6. Calorific value B. Th. U/lb.	11,000	12,225	12,325
Sample I—collected from Rongthok nala.		(25°23' : 90°47')	
Sample II—collected from Mace-chasuarum Nala.		(25°22' : 90°48')	
Sample III—collected from Rongal.		(25°23' : 90°49')	

B. GARO HILLS

1-10. West Darranggiri Coalfield—

This is the most important and easily accessible and exploitable coal deposit in Garo Hills. The area is connected by the Dudhnai-Nangwalbibra road. Nangwalbibra is situated at a distance of 91 kms. from Dudhnai, which lies on the Gauhati-Goalpara National Highway No.37, at a distance of 110 kms. from Gauhati.

During 1957-59 seasons. Geological Survey of India carried out wide-spaced drilling and mapping in this field. 12 bore holes were drilled in the field which covers an area of 46 sq. kms. Only one coal seam ranging in thickness from 1.5 to 3.3 metres was found persistent over the entire coalfield. Taking an average thickness of 2.2 metres, G. S. I. estimated a reserve of 125 million tonnes of coal in this field. Afterwards Directorate of Geology and Mining, Assam carried out intensive drilling (1964-65) over 2.9 sq. kms. area of this field and proved a reserve of 7 million tonnes of coal for the main seam—having an average thickness of 1.8 metres. In 1971-72 and 1972-73 the Directorate of Mineral Resources, Meghalaya carried out intensive drilling in another block (Rongkhandi) of the West Darranggiri field and proved a reserve of 2.2 million tonnes over an area of 0.84 sq. km. for a seam having an average thickness of 2 metres. The Directorate of Mineral Resources is still continuing its investigation by drilling in one of the blocks of this field for subsequent economic utilisation.

A coal mine at Nangwalbibra is being developed by the Assam-Meghalaya Mineral Development Corporation with a view to supplying coal to the 5 MW Thermal Power Station of Assam State Electricity Board at Nangwalbibra. At present this Colliery produces about 3,000 tonnes of coal per annum.

In the mining hill where the colliery has been started, the coal bearing area is 1.49 sq. kms. and the average thickness of coal is taken to be 1.5 metres, though the seam ranges in thickness from 0.3 m. to 3.3 metres. The reserve of this block is estimated to be 3 million tonnes.

The coal from West Darranggiri coalfield shows extremely low ash content ranging from 1.3 per cent to 10.2 per cent and the Calorific value ranging from 5730—6535 Kcal/Kg. The total Sulphur content varies from 1 per cent to 3.5 per cent and the fixed carbon varies from 44.9 per cent to 47.1 per cent. The volatile matter content ranges from 39.6 per cent to 43.0 per cent. The moisture content is 6.9 per cent to 12.5 per cent.

The screen analysis of coal from Nongwalbibra area was carried out by the Coal Survey Station, Jorhat and the result is given below—

Screen analysis and ash of screen fractions Nangwal seam

Size in m.m.	Weight	Ash per cent
102—76	8.9	2.2
76—51	17.6	3.0
51—25	20.5	4.0
25—13	21.4	5.6
13— 6	8.7	5.1
6— 3	9.7	4.9
0.42—0.21	1.6	7.1
3—0.42	9.3	9.6
0.21—0.15	0.7	9.3
0.15—0.08	0.8	11.4
—0.08	0.8	11.3

Unlike most of Assam Coal, the Nangwalbibra coal produces 47.0 per cent of material above 25mm. The proportion of dust (below 0.42mm.) is low, being only 3.9 per cent. The material below 3mm. size have higher ash compared to the ash of the coarser fraction.

The yield per tonne of r. o. m. coal of Nangwalbibra, by low carbonisation at 600°C (Grey-King-Assay) as worked by Jorhat Coal Survey Station is given below—

1. Coke	...	...	639 Kg.
2. Tar	...	...	160 Lt.
3. Liquor	...	...	85 Lt.
4. Ammonia	...	...	0.7 Kg.
5. Gas	...	...	118.4 cu.m.

1.11. Rongrenggiri coalfield—

The Rongrenggiri coalfield is located on the Simsang river about 19 kms. east of Arbela and 40 kms. to the south-west of Darugiri. The Tura sandstone covering nearly 64 sq. kms. of area on the North of Simsang river contain a couple of thin coal seams. One of them is upto 1.00 metre in thickness. A fault trending north-south forms the eastern boundary of the Rongrenggiri coalfield. The thickness of the seams in the eastern part is not known, but the thickness of overburden is expected to be of the order of 91—120 metres which will affect the economics of working. The details of this deposit are not yet known.

1.12. The Coalfields between Tura and Siju (Hidden Coalfield)—

Several coalfield exposures are seen along the southern flank of the Tura Range from Tura to Siju. Songmong from a strike length of 58 kms. At least two coal seams occur in this field. Possible reserve of coal in the field is 1000 million tonnes as indicated by C. S. Fox of G. S. I. It is, however, doubtful how much of this can be economically exploited as the coal seams are likely to be at great depth. Detailed geological survey of this field has been taken up by G. S. I. only in recent years, and about 66 sq. kms. of the area has been covered. The following are the findings of G. S. I. as per the latest publication—

Siju Coalfield—A detailed examination of accessible nala-sections and foot tracts has shown that the 1.8 metre thick seams, which is exposed in Simsang gorge near Siju-Songmong is in all possibility continues over a strike length of 19.3 kms to the West of Simsang, but the decrease in thickness is noticed while proceeding in that direction. At Rakmanggiri (25°23' : 90°31'), the thickness of the seam becomes only 60 cms. There was no means of ascertaining the behaviour of the seam in that direction of the dip. This could only be confirmed by drilling.

The average thickness of the seam is about 1.4 metre for a length of 6.4 kms. between Siju-Songmong and Dapsi Garogithim (25°22' : 90°38'). Further west of this area, the average thickness of the coal seam is taken to be 76 cms. for a length of 14.4 kms. Thus the estimated reserve of coal for the area between Siju-Songmong and Dapsi-Garogithim for 3.2 kms. down the dip, assuming an average thickness of 1.4 metres will be about 26 million tonnes. The estimated reserve for a similar area between Dapsi-Khosgiri (25° 23' : 90°38') and Table Nala (25°24' : 90°29') assuming an average thickness of 76 cms. will be 45.7 million tonnes. The recent estimation of probable reserve of coal in Siju coalfield by G. S. I. is 125 million tonnes, assuming the lower coal seam to be 1.5 metres thick, along a strike extension of .11 kms. (from Simsang river to Barsaura), with a depth of 300 metres. The analysis of coal from Siju coalfield is given below—

1. Moisture	...	...	3.30 %
2. Ash per cent	...	...	4.16 %
3. Volatile Matter	...	...	38.58 %
4. Fixed Carbon	...	...	53.36 %
5. Sulphur	...	...	1.8 %
6. Calorific Value	...	...	12,450 B.Th U/lb.
7. Caking Properties	...	...	Caking.

1.13. Pendengrew—Balphakramfield—

The deposits occur in the south-eastern extremity of the Garo Hills. A few miles south of the area, a road parallel to the deposit runs from Baghmara eastward towards Maheshkhola and Balat.

The coalfield extends over an area of about 13 sq. kms. G. S. I. has carried out some investigations in the field in recent years.

Workable reserves of coal can be expected in the southern limb of monocline in the area roughly bounded by—

- (1) Bolphakram
- (2) A point 1.6 kms. north-east of Chimetap.
- (3) A point 1.6 kms. NNE. of Sijubari.
- (4) A point 1.6 kms. west of Athambing.
- (5) A point 1.6 kms. north-west of Athambing.

In aggregate, the area of the coalfield is of the order of 3.9 sq. kms. and the average thickness of main coal seam of the area is about 1.8 metres. The reserve of coal expected is about 9.1 million tonnes.

C. JAINTIA HILLS

1.14. Lakadong Area—

The area can be approached by a fair weather road from Khlichriat which is situated 32 kms. from Jowai along Jowai-Badarpur road. The area is divided into two coalfields as follows—

- (i) *Umlatdoh Coalfield*.—Preliminary investigation has shown that a coal seam, about 0.3 metre to 2.13 metres in thickness extends over an area of 1.04 sq. kms. The coal seam is not ununiformly thick and continuous and thins out within a short length. Over-burden is hard quartzitic sandstone which varies from 4 metres to 8 metres in thickness.

The general strike of the coal seam is N 60° E—S 60° W with a southerly dip ranging from 5° to 10°. The coal is of hard lump variety with carbonaceous shale parting ranging from 0.25 to 1.00 metre in thickness. The analysis of the coal shows the following results—

Fixed Carbon	...	...	...	44.76 to 59.86 per cent
Volatile Matter	...	...	...	29.68 to 38.50 „
Ash	...	...	...	2.25 to 24.70 „
Moisture	...	...	..	0.44 to 0.86 „
Sulphur	...	...	...	3.40 to 4.96 „
Calorific value in B. Th, U/lb.	...	...	...	10,250 to 13,500 „

Taking into consideration the average thickness of the coal seam to be 0.50 metre the possible reserve of coal over an area of 1.05 sq. kms. of is the order of 470,000 tonnes.

- (ii) *Pamsaru Coalfield*—A 0·31 to 1·15 metre thick coal seam is exposed in the southern part of the Pamsaru Plateau, about 1·62 kms. to the north-east of Umlatdoh village, associated with Lakadong sandstone over an area of 0·50 sq. km. approximately. A seam of 1·10 metre thick has been traced over a strike length of 300 metres on the south-western flank of the plateau, close to the Umlatdoh-Pamsaru foot tract.

In addition to the above, there is a large area, covering nearly 2·00 sq. kms., in the rather inaccessible northern part of the plateau where coal seam ranging from 1·50 metres to 3·50 metres in thickness exposed in a few scarp faces and sink-holes.

The maximum thickness of the coal seam encountered in the area is 3·50 metres thick, exposed along a cliff face in the cut-off central portion of the plateau. It, however, thins down within a short distance when traced along the periphery of the plateau.

1·15. Coal deposit of Bapung area—

At Bapung, coal occurs in the Therria sandstone stage of Palaeocene age and is exposed on both sides of the Jowai-Badarpur road. Bapung is situated at a distance of 24 kms. from Jowai Town along Jowai-Badarpur road. Two seams of coal are encountered in the area. The main seam (lower) ranges from 0·3 metre to 0·9 metre in thickness and occupies an area of 7·2 sq. kms. and the average thickness of the seam is taken to be 0·46 metre. The upper seam is thin, the thickness is only 0·30 metre. From the preliminary investigation carried out in 1962, the probable reserve of coal is estimated to be 7 million tonnes over an area of 7·2 sq. kms. In 1963, drilling was done in two selected blocks near Bapung village and 14 bore holes were sited over an area of 0·31 sq. km. The thickness of the seam encountered in the various bore holes ranges from 0·31 metre to 0·91 metre, average being 0·40 metre. The measured reserve of coal proved by drilling in the two blocks is estimated at 1,18,000 tonnes over an area of 0·31 sq. km.

In 1971-72, investigation of coal was done in the adjoining areas around Bapung and Pamira villages. The coal seam encountered in the area ranges from 0·30 to 1·20 metre in thickness and the average thickness is taken to be 0·50 metre. The coal bearing area is 11·73 sq. kms. which include the area mentioned above. The probable reserve of coal is estimated at 7·6 million tonnes. Considering 25 per cent as working loss, the total reserve of coal comes to 5·7 million tonnes. The coal is good having low ash and low moisture content, but the sulphur is high about 4 per cent to 7 per cent. The proximate analysis of coal is given below—

(Average of four samples)

Moisture	...	...	...	2·6 per cent to 3·1 per cent
Ash	...	...	...	2·6 per cent to 7·87 per cent
Volatile Matter	...	...	...	41·8 per cent to 44·3 per cent
Fixed Carbon	...	...	...	46·9 per cent to 50·0 per cent
Calorific Value	...	...	...	7,015 to 7,490 K. Cal/Kg.
Sulphur	...	...	...	4·7 per cent to 7·1 per cent
Character of coal	...	...	...	Bright to Dull coal.

1.16. Jarain and Tkentalang area—

On preliminary investigation a thin coal seam of 10 cms. to 45 cms. has been encountered along the road cuttings from Jarain to Mawpang. The seam is not persistent and generally pinching out within a short distance. The average thickness of the seam is less than 0.30 metre.

In the area around Tkentalang, about 3 kms. north of Jarain, there are two coal seams, the top seam being 10 to 15 cms. thick and the bottom seam is 0.30 to 1.00 metre thick. The coal is bright and hard lump coal but the coal of the Jarain area is soft and friable.

The coal from Tkentalang area shows the following analysis results—

Moisture	...	...	...	...	...	1.6 %
Ash	...	...	...	...	...	4.4 %
Volatile Matter	..	...	...	...	...	48.1 %
Fixed Carbon	...	...	...	...	...	45.9 %

Probable reserve of coal over an area of 28,99,680 sq. ms. comes about 1.1 million tonnes.

1.17. Sutnga—

In Sutnga area, there are two coal seams, the top one being only 10—20 cms. thick and the bottom seam varies in thickness from .30 to .60 metre and the vertical interval between the two seams is 3—5 metres.

The coal of the Sutnga area shows the following results—

Moisture P. C.	Ash P. C.	Volatile Matter P. C.	Fixed Carbon P. C.	Character of Coal	Colour of Ash
1.3	6.3	42.8	49.6	Bright coal	Light Brown
2.3	2.2	42.4	53.2	Bright coal	Brown
7.0	9.7	32.9	51.4	Brownish coal	Brown

In Sutnga area, the total reserve of coal is 0.65 million tonnes over an area of 160,579 sq. metres, taking the average thickness of the bottom seam as 0.45 metres.

1.18. Other Deposits—

There are a few other coal deposits which have been reported all over the State but have not been investigated upon so far. Preliminary indications are that these deposits may not be of large extent. However, they will be looked into in the course of time.

CHAPTER 2

LIMESTONE DEPOSITS

The southern slopes of the State of Meghalaya abound in limestone deposits of various grades and extent. Regionally, it can be said that a fairly continuous belt occurs right from western end of the State in Garo Hills, to the eastern end in Jaintia Hills, continuing further north-east into Mikir Hills of Assam. The developed sections are found in Therriaghat and Mawlong-Isamati areas of Khasi Hills, where four beds of limestone occur. In the Lakadong and Lumshnong areas of Jaintia Hills only three beds of limestone have been seen, whereas in the Siju area of Garo Hills only one bed is found to have developed. Total estimated reserves of limestone deposits of Meghalaya is of the order of 3,000 million tonnes.

The various limestone deposits which have been geologically investigated in some form or another are now described below—

A. KHASI HILLS

2.1. Cherrapunjee Deposit—

In the Mawmluh-Mawsmail Hills South of Lower Cherra, the deposit is of a composite nature made up of limestone in the upper part and dolomite in the lower part with a transitional zone of dolomitic limestone in between. The deposit has a reserve of 40 million tonnes of cement grade limestone. Out of this, 4.25 million tonnes in the Mawmluh hill and 7 million tonnes in the Mawsmail hill were proved by drilling. The Assam Cement factory situated at Mawmluh is extracting limestone from this Hill.

In the Mawsmail hill, there are two beds of limestone intervened by calcareous sandstone and shale. The bottom bed having a thickness ranging from 13.8 to 26.7 metres is of high cement grade with the exception of a band of 2.3 metres in average thickness of high magnesia limestone within this bed. The cement grade limestone is fine grained hard, compact, light to dark grey in colour. The top limestone is grey to brown in colour and is very impersistent in thickness (0.70 m. to 5.90 ms.) and also in lateral extent. Nineteen boreholes were sited to prove the reserve of this area. The composition of the limestone beds is as follows—

	Top Bed	Bottom Bed
CaO ...	44.33 per cent to 53.53 per cent	49.70 per cent to 53.00 per cent.
MgO ...	0.33 per cent to 4.21 per cent	1.06 per cent to 3.39 per cent.
R ₂ O ₃ ...	0.31 per cent to 2.17 per cent	0.49 per cent to 1.40 per cent.
A.I. ...	1.43 per cent to 12.39 per cent	1.06 per cent to 3.73 per cent.

In the Mawmluh hill, a maximum thickness of 25.5 metres of cement-grade limestone occurs in the upper part and 11 metres of pure dolomite is met in the lower part. The limestone is fine-grained, compact and lightgrey

to grey in colour. 17 boreholes were drilled in the area to prove the deposit. The maximum overburden met within the drilled area is 17 metres. The total reserves of limestone in the area of prospecting amount to 4.25 million tonnes and the weighted average composition is as follows—

CaO	...	...	50.41 per cent.
MgO	..	...	2.21 per cent.
Fe ₂ O ₃	...	...	0.48 per cent.
A.I.	...	...	2.79 per cent.

2.2. Laitryngew Deposits—

Isolated small outcrops of limestone are found near Umstew and Mawkma areas of Laitryngew. At Umstew, the limestone is exposed in the vertical scarp section. The band is 7.5 metres thick, is traceable for about 150 metres with an overburden of sandstone and thick shale. The limestone is high grade and has the following composition—

CaO	...	...	52.02 per cent. to 54.41 per cent.
MgO	...	...	0.15 per cent. to 2.25 per cent.
A.I.	...	..	3.0 per cent.

No reserve is estimated for the Umstew and Mawkma deposits. Preparation of lime by burning the limestone of Umstew area was done years ago.

2.3. Deposits of Mawlong-Ishamati-Shellia areas—

Five bands of limestone interbedded with sandstone beds are exposed in the stream sections and also along the Mawlong-Shellia road for a considerable distance.

The topmost limestone band known geologically as Prang limestone, has an average thickness of 60 metres (with a maximum of 93 metres at places) and occurs without overburden over an area of 13.75 sq kms. The thickness of the other bands found below the topmost one, are 12 m., 9 m., 21 m. and 71 m. respectively. The third limestone band from top is inconsistent in its lateral extent. The chemical composition, average thickness, total area of the deposit and estimated reserves of the bands are shown below—

I. Top band of limestone (Prang limestone).

(1) Chemical composition	CaO	...	51.91 per cent.
	MgO	...	0.62 per cent.
	R ₂ O*	...	1.04 per cent.
	A.I.	...	1.85 per cent.

(2) Average thickness	60 metres.
(3) Total area	13,752,206 sq. ms.
(4) Estimated Reserves	1,375 million tonnes.

II. Second band from top (Umlatdoh limestone).

(1) Chemical composition	CaO ... 52.96 per cent.
	MgO ... 0.43 per cent.
	R ₂ O ₃ ... 0.78 per cent.
	A.I. ... 1.04 per cent.
(2) Average thickness	12 metres.
(3) Total area	11,331,663 sq. ms.
(4) Estimated Reserves	226 million tonnes.

III. Third and Fourth bands from top (Umlatdoh limestone).

These two beds are considered together in view of the inconsistent thickness of the third bed. The intervening sandstone is calcareous in nature.

(1) Chemical composition	CaO ... 53.04 per cent.
	MgO ... 0.76 per cent.
	R ₂ O ₃ ... 1.03 per cent.
	A.I. ... 0.91 per cent.
(2) Average thickness	30 metres.
(3) Total area	11,331,663 sq. ms.
(4) Estimated Reserves	565 million tonnes.

IV. The reserves of the bottom-most band have not been estimated. This band belongs geologically to the Lakadong limestone and shows the following composition—

CaO	...	52.21 per cent.
MgO	...	0.53 per cent.
R ₂ O ₃	...	0.83 per cent.
A.I.	...	0.81 per cent.

2.4. The Therriaghat—Komorrah area—

The limestone beds interbedded with sandstone found in the Shella-Ishamati area also extend further eastwards upto Therriaghat. In the Therriaghat area, four limestone beds interbedded with sandstone attain a total thickness of 415 metres. Although no detail work has been carried out between Therriaghat and Ishamati area, a portion of the limestone deposit in the Komorrah was recently investigated, where in an area of 0.36 sq. km. a reserve of 14.26 million tonnes of limestone has been estimated for the upper two bands of limestone. The Komorrah limestone Mining Company is presently supplying limestone to Bangladesh from this deposit.

The Chemical analysis of the limestone of this deposit is as follows—

CaO	...	...	51.97 per cent.
MgO	..	...	1.46 per cent.
Fe ₂ O ₃	..	...	1.11 per cent.
A. I.	...	...	1.90 per cent.

2.5. Deposit of Pynursla area—

Limestone belonging to the Sylhet limestone stage is found to occur below the coal bearing sandstone of Langkerdem and Thangjinath coal-fields of Pynursla area, which is situated some 53 Kms. from Shillong along the Shillong-Dawki road. The limestone bed exposed in the southern flank of Langkerdem hill is thin, but attains a thickness of about 15 metres at Thangjinath, 8 kms. south of Langkerdem. No estimate of the reserve of the deposit is available. The limestone of the Langkerdem area is of good quality and was used for manufacture of lime by the local people.

B. JAINTIA HILLS

2.6. Lumshnong-Mynkre Deposit—

Lumshnong is situated some 125 kms. (78 miles) from Shillong on the Shillong-Jowai-Badarpur road and is about 80 kms. (50 miles) away from the Badarpur Railway Station in Cachar District of Assam. The limestone deposits are scattered from 68th Mile-Post to near the 84th Mile-Post towards south-west of Lumshnong along Jowai-Badarpur road (all the mile-posts mentioned here are distances from Shillong). The three beds of limestone interbedded with sandstone belonging to Sylhet limestone stage of Jaintia Series (Eocene), are found in the different localities of the area. The limestone extends over an area of 76.8 sq. kms. within Um Lunar and the Um Seshympa rivers. The lower bed (Lakadong limestone) is scattered over the area from the 68th to 78th Mile-Post. The middle bed (Umlatdoh Limestone) overlying the Lakadong sandstone is found scattered from 76th to 80th Mile-Post. The third bed (Prang limestone) is found exposed from 80th Mile-Post to 84/5th Mile-Post. This bed overlies the Narpuh sandstone and is overlain by Kopili stage. Several isolated outcrops of limestone lie scattered within the radius of a few kms. of Lumshnong and Mynkre.

An estimated reserve of about 652 million tonnes of limestone belonging to Prang limestone is found over an area of 4.80 sq. kms. with average thickness of 80 metres. Out of this area, an area of 1.5 sq. kms. has been mapped in detail, the reserve under which is estimated at 60 million tonnes.

The analysis of limestone based on 200 samples is as follows—

CaO	...	...	48.4 per cent to 53.68 per cent.
MgO	...	...	0.29 per cent to 0.98 per cent.
A. I.	...	...	0.88 per cent to 3.05 per cent.
R_2O_3	..	...	0.56 per cent to 4.80 per cent.

The reserves of high grade (both chemical and metallurgical grade) limestone have been estimated at 48 million tonnes in this area. The chemical analysis is given below—

CaO	...	...	50.0 per cent to 53.50 per cent.
MgO	...	...	0.55 per cent to 3.75 per cent.
SiO_2	...	...	0.25 per cent to 2.25 per cent.
Fe_2O_3	..	..	0.25 per cent ...
Al_2O_3	...	...	0.25 per cent to 1.30 per cent.

2.7. Sutnga Deposit—

A narrow elongated outlier of the limestone resting over Therria sandstone is found exposed at Sutnga near the P. W. D. Inspection Bungalow. The limestone extends about 1.6 km. along ENE—WSW direction. About 2 million tonnes of limestone is estimated for this deposit over an area of 915 metres by 16 metres, and average thickness is taken to be 15 metres. The chemical analysis of the limestone is given below—

CaO	...	...	48.75 per cent to 53.09 per cent.
MgO	...	...	0.72 per cent to 3.47 per cent.
A. I.	...	...	1.08 per cent to 3.78 per cent.
R_2O_3	...	...	0.48 per cent to 5.40 per cent.

2.8. Nongkhlich Deposit—

The area falls south of Sutnga-Nongkhlich foot tract and is at a distance of 18 kms. from Khlichriat which is situated on the main Jowai-Badarpur road, at a distance of 35-40 kms. from Lumshnong. In the area, the limestone beds can be divided into three parts from bottom

to top according to the chemical composition. The composition of the lowest part which appears to be slightly higher grade than the middle and upper parts is as follows—

CaO	...	...	52.58 per cent.
MgO	...	...	0.88 per cent.
R ₂ O ₃	...	...	0.75 per cent.
A. I.	...	...	2.05 per cent.
S	...	...	0.03 per cent.
P	...	...	0.006 per cent.

The reserve of the lowest part of limestone with a thickness of 50 metres of high grade limestone has been estimated at 12 million tonnes. The middle part with a thickness of 30 metres is of blast-furnace to good cement-grade quality and its reserve is estimated at 3.5 million tonnes. The topmost part of the limestone bed is 20 metres thick and of cement grade quality and has a reserve of 0.5 million tonnes. The chemical analysis of these two parts of the bed is given below—

			Middle part	Upper part
CaO	...	...	50.07	46.00
MgO	...	...	1.28	1.67
R ₂ O ₃	...	...	2.68	8.00
A. I.	...	...	4.00	4.36

The total reserves of the deposit, considering all the three parts, therefore, worked out to 16 million tonnes.

2.9. Lakadong Deposit—

A huge deposit of limestone is found in the Lakadong area as an outlier. Geologically speaking, the limestone belongs to the Lakadong limestone of Sylhet limestone Stage of Eocene Age. The limestone conformably rests on sandstone of Therria stage of Palaeocene age. The coal-bearing Lakadong sandstone is conformably overlying the Lakadong limestone. Umlatdoh limestone occurs above Lakadong sandstone. The limestone deposit covers an area of 26 sq. kms. in between the Hari and Prang rivers. The lower and middle bands of limestone are exposed around Umlatdoh and extends upto Lama village towards south.

No details regarding thickness, extent and reserve of this limestone are available. Analysis of limestone shows the following compositions—

		Per cent
CaO	...	53.06
MgO	...	1.00
A. I.	...	0.90
R ₂ O ₃	...	0.48

2.10. Syndai Deposit—

This area lies at about 40 kms. SSW of Jowai and can be approached from Jowai by the Jowai-Dawki Road. The deposit forms a narrow belt continuing without break along the road from 10 km. ahead of Jarain to a little south of Syndai. An approximate estimation of the reserve is about 1 million tonne. The composition of five samples ranges as follows—

		Per cent
CaO	...	45.38 to 52.52
MgO	...	0.40 to 1.12
A. I.	...	7.86 to 20.70
R ₂ O ₃	...	1.16 to 5.14

2.11. Nongtalang Deposit—

An outlier of Sylhet limestone occurs around Nongtalang, covering an area of about 10 sq.kms. Analysis of two samples of limestone shows the following composition—

		Per cent
CaO	..	46.33
MgO	...	3.51
A. I.	...	9.07

No details regarding thickness, extent and reserves of this limestone are available.

C. GARO HILLS

2.12. Darrang-Era-Aning Deposit—

This deposit of limestone is situated near Nongwalbira and extends from Darrang-Era-Aning in the east, to Patbargithim in the west and covers an area of 1.94 sq.kms. There are two beds of limestone intervened by a sandstone bed. The Upper limestone bed found around Pathargithim is

argillaceous and is interbedded with calcareous shale partings. The average thickness of the upper band is 15 metres and that of the lower band is 3 metres. The CaO content of the upper band varies from 40 per cent to 48 per cent and that of the lower band from 48 per cent to 51 per cent. The reserves of both the beds of Pathargithim area comes to 38.3 million tonnes in an area of 1.4 sq.kms. Maximum overburden in this deposit is 8 metres.

In Darrang-Era-Aning, the limestone covers an area of 0.54 sq.km, and the reserve for both the beds is estimated at 8.8 million tonnes. The average thickness of upper and lower band is 10 metres and 2 metres respectively. The CaO content of the upper band varies from 42 per cent to 49 per cent and that of the lower from 48 per cent to 51 per cent. The deposit has no overburden except a thin mantle of soil cover.

2.13. Deposit Siju-Artheke—

The area lies on the south-eastern part of Garo Hills north of Baghmara. The limestone is exposed in both banks of the Simsang river. The limestone is generally of very good quality and some bands are of chemical grade. The chemical analysis shows that the CaO content ranges from 47.32 to 54.00 per cent, A. I.—0.44 per cent to 3.13 per cent and MgO, Fe_2O_3 and Al_2O_3 are fairly low. The total estimated reserve of this limestone is placed at 165.00 million tonnes over an area of 1.6 sq.kms., taking an average thickness to be 60 metres, though the maximum thickness is found to be as much as 90 metres in some places.

2.14. Deposits in Tura—

The limestone deposit scatters over an area of 100 sq.kms. occurring near Tura which has been mapped geologically (in the scale of 1 : 126, 720). The limestone occurs with the intercalation of shale bed. The maximum thickness is about 5 metres and an individual band is found upto 1.7 metres. The quality of limestone is very poor. The estimation of reserve is not available.

2.15. Other Deposits—

Other deposits of limestone occurring in Rongrenggri, Dapri, Garugiri, east of Andogiri have not been investigated in detail. They are understood to be of poor quality.

CHAPTER 3

CLAY AND KAOLIN DEPOSITS

Various white clay deposits are known to occur all over the State ; however all the deposits have not been examined in detail. These clays which are suitable for ceramic and refractory purposes, occur in Tertiary formation of Eocene age. The other deposits which are associated with Archaean crystalline rocks, formed as a result of weathering of granite gneiss, granite and pegmatites are mainly impure gritty Kaolin or China clay. The Tertiary sedimentary white clays and lithomarges occurring at the base of Eocene rocks are more important as these are relatively thick and extend over large areas ; the reserve of such clays all over the State amounts to a few hundred million tonnes.

Some thin beds of fine clays associated with Eocene coal are also found in various parts of the State.

A. KHASI HILLS

3.1. Cherrapunjee Deposit—

This clay deposit is found on a small ridge at a distance of half a km. east of the Circuit House at Cherrapunjee. The clay bed of this deposit forms an intercalation in the Cherra sandstone of Lower Eocene age. It overlies a fine-grained white sandstone followed by coarse-grained sandstone. The clay bed does not exhibit any bedding ; it is sandy and plastic. Three colours of clay are found namely white, brownish-red and greyish-white. The overburden varies from 1 metre to 6 metres in thickness. The chemical analysis shows the following results—

		Per cent
SiO ₂	...	77.75
Al ₂ O ₃	...	14.86
Fe ₂ O ₃	...	2.39
CaO	...	0.28
MgO	...	0.44
TiO ₂	...	3.50

The proved reserve of this deposit, taking an area of 146,667 sq.ms. and an average thickness of 8.12 m., comes to 210,417 tonnes. The analysis shows that the clay is quite suitable for use in the manufacture of cement.

3.2. Mahadek Deposit—

The deposit lies near Mahadek on the Cherrapunjee-Shella road. The clay bed belongs to Langpar stage of Cretaceous age. The deposit is divided into two parts—one on the north side of Mawblang-Shella road and another on the south side. The clay beds are interbedded with alternations of shale and sandstone. The weighted average chemical composition of this clay for the both blocks are shown as follows—

			North Block	South Block
SiO ₂	...	...	64.78 per cent	63.34 per cent
Al ₂ O ₃	..	...	16.78 "	18.51 "
Fe ₂ O ₃	...	...	5.24 "	5.60 "
CaO	...	...	Nil	Nil
MgO	...	...	0.09 "	0.41 "
TiO ₂	...	...	0.98 "	1.00 "
Alkalies	...	...	3.51 "	3.63 "
Sulphur	...	...	0.14 "	0.14 "

The estimated reserve for north block, taking an area of 36,085 sq. ms. and an average thickness of 2.60 ms., comes to 160,000 tonnes. And for south block, taking an area of 28,761 sq. ms. and an average thickness of 3 metres, it comes to 140,000 tonnes. The total reserve will thus be 300,000 tonnes. The clay is suitable for use in the manufacture of cements.

3.3. Sohrarim Deposit—

At several places in the vicinity of Sohrarim along the Shillong-Cherrapunjee road, clay is found as pockets and patches in the sandstone. Three deposits of clay are found, one near Sohrarim and the other two at 24th Mile-Post (38.4 km.) and 22/2 Mile-Post (35.6 km.) from Shillong. The deposit near Sohrarim is mainly sandy clay. After washing the crude clay 15 per cent of clay can be recovered. The chemical analysis of the washed clay is given in the Table below.

The probable reserve of the clayey sandstone is estimated at 6 million tonnes over an area of 111,042 sq. m. taking the thickness to be 30 ms. But only 15 per cent of clay can be extracted by washing from this clayey sandstone.

The thickness of the clay bed found near 24th Mile-Post, ranges from 1.2 to 1.8 metres. The clay occurs at two isolated patches measuring 900 sq. ms. and 1,800 sq. ms. The reserve is estimated at 7,155 tonnes.

The third deposit near 22/2 Mile-Post contains a reserve of 1.1 million tonnes of clay over an area of 71,981 sq. ms, taking the average thickness of 9 metres.

Chemical analysis of samples of the three deposits yield the following results—

	Sohrarim Deposit	24 P. M. Deposit	22/2P. M. Deposit
SiO ₂ ...	46.94 per cent	67.02 per cent	54.24 per cent
Al ₂ O ₃ ...	37.58 "	20.42 "	31.22 "
Fe ₂ O ₃ ...	1.46 "	2.02 "	2.42 "
MgO ...	0.65 "	0.62 "	1.01 "
CaO ...	0.43 "	0.28 "	Nil
Na ₂ O ...	0.12 "	0.37 "	Trace
K ₂ O ...	0.11 "	2.04 "	4.14 "
TiO ₂ ...	0.66 "	0.96 "	0.26 "
L.O.I. ...	12.60 "	6.60 "	7.16 "

The clays from these three deposits are found to be suitable for earthen ware, ceramic-ware and stone-ware pipes and tiles.

3.4. Umstew Deposit—

A clay bed of 1 metre thick is found interbedded with sandstone exposed at 29/4 Mile-Post on Shillong-Cherrapunjee road. The clay deposit occupies an area of 37,625 sq. metres and the reserve is estimated at 61,722 tonnes. The chemical composition of this clay is as follows—

SiO ₂ ...	53.70 per cent
Al ₂ O ₃ ...	25.94 "
Fe ₂ O ₃ ...	8.76 "
CaO ...	Trace
MgO ...	0.12 "
TiO ₂ ...	1.70 "
L.O.I. ...	9.60 "
Alkalies ...	0.18 (By difference)

3.5. Mawphlang Deposit—

The Kaolin rocks of this deposit occur as isolated outcrops in an area extending for nearly six kilometers in length from Mawngap in the south to Laitjem in the north and about one kilometre in width from Mawpreng in the east to Kreit in the west. The deposits are found as small as patches, scattered all over the area, individual outcrops varying from 175 sq. ms. to 1,550 sq. ms. in area. The Kaolin rock is medium to coarse-grained. It consists mainly of Quartz and Kaolin minerals with occasional small flakes of white mica. The rocks is compact and does not crumble into powder or disintegrate on addition of water as other raw Kaolin rocks do. The reserve of this deposits has been estimated at 500,000 tonnes. The percentage of recovery of Kaolin after-washing comes to 22 per cent, out of which Grade I (fine) is 16 per cent and Grade II (coarser) is 6 per cent. The chemical analysis of the Grade I clay is as follows—

SiO ₂	...	...	...	49.03 per cent
Al ₂ O ₃	...	...	...	35.79 „
Fe ₂ O ₃	...	...	..	0.35 „
CaO	...	...	...	Trace
MgO	...	...	...	Trace
K ₂ O	...	...	...	0.57 „
Na ₂ O	...	...	...	0.16 „
L.O.I.	...	...	...	13.93 „

The Kaolin is suitable for the manufacture of China-ware, porcelain ware, etc. This Kaolin compares favourable with the Cornwall Kaolin of Great Britain. A few potteries were manufactured from this Kaolin as test-case and they were found to be of high quality.

3.6. Other Deposits—

Clay is sometimes seen to occur in association with Cherra sandstone in Khasi Hills. It also occurs as an alteration product of the feldspar in the gneisses and granites. Some patches were found around Laitlyngkot, Laitkseh, Nongryngkoh, Myntraing and Kharkor river section.

B. JAINTIA HILLS

3.7. Thadlashkein Kaolin Deposits—

The Kaolinised rock occur around Thadlaskein, about 10 km. north-west of Jowai. The Kaolin rocks occur near the granitic outcrops. Here 188 Nos. of Kaolin outcrops, covering an area of 9.04 sq. kms. have been counted taking 2.5 metres as the average thickness, the reserve is estimated to be 33,000 tonnes of crude clay. The analysis result is not available.

3.8. Larnai Clay Deposits—

Dark grey plastic clay are reported to occur near Larnai. The clay have been derived from the weathering of Khasi greenstone. It is rich in silica and oxide but poor in alumina. About 5,000 tonnes of plastic clay are available in this deposit. Analysis show the composition as follows—

SiO ₂	...	...	...	52.83 per cent
Al ₂ O ₃	...	...	...	11.02 „
Fe ₂ O ₃	...	...	...	12.98 „
CaO	...	...	...	6.75 „
MgO	...	...	...	0.59 „

3.9. Other Deposits—

In several places in the Sutnga and Shangpung, occurrences of fine and pure white Kaolin have been reported. The flat bedded clay may possibly represent a highly altered product of the underlying granite rock.

C. GARO HILLS

Garo Hills contain the most extensive and enormous deposits of white clay which are of economic value. A very conservative estimate reveals that the probable reserve of crude clay from the deposits of Garo Hills are about 74 million tonnes.

3.10. Deposits around Tura—

Tura town rests on Kaolinised granites and gneisses and on the basal clayey Tura sandstones. Deposits of good clay occur in the northern part of the town. Since many of the deposits are located within the limits of the town, mining and quarrying can be done only in limited areas.

(a) *Tura-Dalu Road Deposit.*—This deposit of clay is located near the 2/4 milestone on the Tura-Dalu and occurs within the basal part of the Tura sandstone which is mainly coarse to medium-grained, hard to friable and ferruginous. The lithomargic clay bed has considerable extension and an average thickness of 2 metres. The probable reserves of crude clay in this deposit, taking an area of 24480 sq. ms. (204 ms. \times 120 ms.) and an average thickness of 2 metres with 1:1 overburden, would be about 1 lakh tonnes.

(b) *Tura-Garobandha Road Deposit.*—A number of small detached occurrences of the Tura sandstone upto the 5th milestone (8 kms.) on the Tura-Garobandha road are highly ferruginous, current-bedded and coarsegrained with interbedded shales and occasional lithomargic clay beds at the base are noted. Estimation of the reserve of the deposit has not been done.

(c) *Tura-Town North Deposit.*—This deposit occurs near Chandmari playground between milestone 2/2 and 2/4 on the Tura-Rongram road. The clay bed is overlain by the loose and friable sandstone. The clay is white compact and massive in nature. The overburden will be about 6 metres. The deposit extends over an area of 15000 sq.m. (250 \times 60 m.) and has an average thickness of about 3 metres. The probable reserve is of the order of 64,000 tonnes.

(d) *Tura-town West Deposit.*—This deposit occurs around the "Kala-Azar" hospital area. The clay horizon is underlain by a bed of sandy clay and weathered gneisses and overlain by buff coloured sandstones. The clay is compact, hard and has slight ferruginous stains externally. The average thickness of the overburden will be around 7 metres. The probable reserve of crude clay in this deposit, taking an area of 216000 sq. ms. (480 ms. \times 450 ms.), with the average thickness of 2 metres would be around 6 lakhs tonnes.

(e) *Lower Chandmari Deposit.*—The deposit occurs on the eastern side of the Lower Chandmari area. Here the clay is underlain by a lateritic bed and overlain by the friable sandstones. The clay is not so hard. The thickness of overburden is 7 to 9 metres. The probable reserve of crude clay, taking an area of 49500 sq. ms. (550 ms. \times 90 ms.) with a thickness of 3 metres would be about 2 lakh tonnes.

(f) *Deposit near Chandmari Government High School.*—This deposit underlies the Chandmari Government High School and extend upto the new Roman Catholic church. Here the clay is underlain by weathered granite and overlain by a very thin band of hard ferruginous rock and then by loose friable sandstone. The clay occurs in two bands separated by a bed of clayey sandstone. The probable reserve of crude clay, taking an area of 16500 sq. ms. (550 ms. \times 30 ms.), with an average thickness, of 2.5 metres would be of the order of 60,000 tonnes.

(g) *Tura Rongram Road 'A' Deposit.*—This deposit occurs between the 5/3th and 6th milestone on the Tura-Rongram road. The clay bed is disturbed and highly fractured, though the clay itself is very hard and compact. The overburden will be around 8 metres in average thickness. Taking an area of 123424 sq. ms. (812 ms. \times 152 ms.) and average thickness of clay as 2 ms., the probable reserve of crude clay in this deposit comes to 3½ lakh tonnes.

(h) *Tura-Rongram 'B' Deposit.*—This deposit occurs between 6/2 and 7th milestones on the Tura-Rongram road. Here the clay is underlain by a loose, friable bedded sandstone and overlain by a buff coloured sandstone. At the base of the hard and compact lithomargic clay, there is a thin band of black resinous shale. The clays are highly iron-stained, hard and compact. The maximum thickness of overburden will be about 7 metres. The probable reserve of clay from the deposit, taking an area of 101080 sq. ms. (665 ms. \times 152 ms.) and an average thickness of 3 metres, would be around 4½ lakh tonnes.

3.11. Rongchugiri-Rajabala road—

Only one isolated deposit of good quality white clay has been located in this area, about 2 kms. from the Rongchugiri-Phulbari main road junction on the Rajabala road. The clay bed in this deposit can be divided into three separate horizons, namely (i) lower clay horizon with sandy material, (ii) middle hard oolitic clay zone and (iii) upper sandy ferruginous clay zone. The clay zone is overlain by a pebble bed and the thickness of overburden would be about 4 metres. Taking an area of 127500 sq. ms. (425 ms. \times 300 ms.), and the average thickness of clay as 4 metres, the probable reserve of clay would be 7 lakh tonnes.

3.12. Rongrim-Rongchugiri Road Deposit—

A number of detached outcrops of the Tura sandstone with thin lithomargic clay beds occur between Rongram and Rongchugiri. The reserve estimation of this deposit has not been done. Ceramic test of this clay give promising results.

3-13. Rongrenggiri-Khera Deposit—

This is an extensive deposit and perhaps the largest exposed in the district. An area of about 40 sq kms. around Rongrenggiri is occupied by the Tura sandstone. At the base of the Tura sandstone, occurs a very thick bed of hard, white lithomargic clay ranging in thickness from 4 metres to 9 metres. The clay bed contains disseminated pyrite nodules. The lithomargic clay bed has a strike length of 8 kms. and width of 3 kms. The overburden ranges generally from 5 to 6 metres. The probable reserve of clay, taking an area of 24 sq.kms. and an average thickness of 4 metres, and deducting 50 per cent loss of lensing out and erosional feature, would be 68 million tonnes.

3-14. Songsak Deposit—

A detached deposit of lithomargic clay associated with small outliers of the Tura sandstone occurs within the Songsak Government Reserve Forest. The clay is white, hard, well-bedded and has external ferruginous stains. The general overburden in this deposit is less than 3 metres. The estimated reserve of clay, taking an area of 410850 sq. ms. and average thickness of 2.0 metres, would be 0.88 million tonnes. Ceramic test of this clay gave promising results. Chemical analysis is as follows—

SiO ₂	...	...	...	...	44.43
Al ₂ O ₃	...	...	...	...	36.63
Fe ₂ O ₃	...	...	...	...	4.10
TiO ₂	...	...	...	...	3.75
CaO	...	...	...	...	0.56
MgO	...	...	...	...	Trace
K ₂ O	...	...	...	...	0.03
Na ₂ O	...	...	...	...	0.06
L.O.I.	...	...	...	...	13.31

3-15. Darugiri Deposits—

Two main deposits, which can be easily worked, have been located near the road which runs from Darugiri to Nangwalbibra.

(a) *Darugiri North Deposit*:—This deposit occurs near the junction of the Darugiri-Songsak and Darugiri-Nangwalbibra roads. The lithomargic clay bed occurs below a thin cover of coarse-grained ferruginous sandstone and is underlain by weathered granite-gneiss. The overburden is about 1 metre thick. Taking an area of 21840 sq. ms. (182 ms. × 120 ms.) and an average thickness of 1.8 metres, the probable reserve will be 56,000 tonnes.

(b) *Darugiri South Deposit*:—This deposit is located about 150 metres south of the one just described above. The lithology and other characters are similar. The overburden is very thin. The probable reserve of clay, taking an area of 21280 sq. ms. (152 ms. \times 140 ms.) and an average thickness of 1.8 metres, would be 54,000 tonnes.

3.16. *Khobal Deposit*—

This deposit is situated a little east of Khobal village, which is on the main Darugiri-Nangwalbibra road. The lithomargic clay has an average thickness of about 3 metres. The average thickness of overburden is about 2 metres. The probable reserve of clay, taking an area of 50,000 sq. ms. (300 ms. \times 200 ms.) and an average thickness of 3 metres, would be 250,000 tonnes.

3.17. *Dobu Deposit*—

This large deposit occurs around Dobu village. The clay are exposed at the surface and are underlain by a gritty to coarse-grained sandstone. The clays are massive, hard and white. The probable reserve of clay in this deposit, taking an area of 120,000 sq. ms. (1000ms. \times 120 ms.) and an average thickness of 1.8 metres, would be 300,000 tonnes.

3.18. *Nengkhra—Akawal Deposit*—

Around Nengkhra-Akawal village, several small isolated patches of the Tura-sandstone occur and are overlain by a highly fractured, moderately iron-stained hard clay bed. The clay bed is either exposed at the surface or capped by a thin mantle of medium-grained sandstone on soil. The probable reserve of clay, taking an area of 100,000 sq. ms (500 ms. \times 200 ms.) and an average thickness of 1 metre and after deducting 50 per cent loss due to erosional features, would be 70,000 tonnes.

3.19. *Nangwalbibra Deposit*—

Around Nangwalbibra, a thick sequence of the Tura sandstones has been observed over the weathered platform of older gneissic rock. An extensive deposit is present in the entire hill that falls between Rongkandi, Dingjamagithim and Nangwalbibra. The area reveals the presence of four beds of lithomargic clay ranging in thickness from 1.8 to 3.7 metres at the base of the Tura sandstone. These beds are separated by 1.5 to 2.10 metres sandstone partings. All the four beds are present uniformly throughout the area. The three main bottom beds of good quality clays have an aggregate thickness of about 7.6 metres. The overburden reaches a maximum of 3 metres at few places in northern portion of the area, but is between 9 and 12 metres in the rest of the deposit, taking an average aggregate thickness of 7.6 metres for the three lower beds of clay, the possible reserve of the Nangwalbibra deposit for an area of 325,200 sq. ms. would be of the order of 3.5 million tonnes, out of which easily minable reserve of good quality of clay is of the order of 90,000 tonnes.

The chemical analysis and ceramic test results of Garo Hills lithomargic clay indicates that the clays are suitable for use in the pottery and refractory industries.

The average chemical composition of Garo Hills clay is as follows:—

SiO_2	...	...	...	45.00 per cent
Al_2O_3	...	...	...	37.24 per cent
Fe_2O_3	...	...	...	2.26 per cent
TiO_2	..	..	...	1.36 per cent
CaO}	...	...	...	Negligible
MgO}	...	...	...	0.38 per cent

3.20. Kaolin Deposit of Darugiri—

Apart from the sedimentary clays, Kaolin also occurs in some places of Garo Hills. A deposit of Kaolin is found near Darugiri, on the main Darugiri—Nangwalbibra road. The Kaolinised granites are encountered on the road—cuttings between Darugiri and Nangwalbibra and the best exposures are found in between 61 and 63 milestones. Here five blocks of Kaolinised granites were delineated. Taking an area of 16,000 sq. ms. and upto a depth 30 metres, the tentative reserve would be 800,000 tonnes.

The chemical analysis of washed Kaolin of this deposit is as follows:—

SiO_2	...	..	...	46.37 to 53.08 per cent
Al_2O_3	...	...	...	35.55 to 41.53 per cent
Fe_2O_3	...	...	...	0.20 to 0.22 per cent
CaO}	..	...	...	0.19 to 0.44 per cent
MgO}	...	...	...	Trace
TiO_2	...	...	...	0.12 to 0.48 per cent
K_2O}	...	...	...	0.02 to 3.61 per cent
Na_2O}	...	...	...	0.22 to 0.60 per cent

CHAPTER 4

SILLIMANITE

4.1. Sillimanite Deposits of Sonapahar, Khasi Hills—

One of the best Sillimanite deposits in the world is found in the Sonapahar region of Western Khasi Hills. Geologically, these sillimanite deposits occur in association with corundum, within the quartz-sillimanite schist which forms a broad band that can be traced discontinuously over the area. The sillimanite group of rocks occur as detached remnants over the older gneissic complex separated by angular unconformity.

The major sillimanite bodies are small to moderate-sized lenses hardly exceeding 1 metre across with the exception of a few lenses in Lalmati which yielded some 40,000 tonnes of materials. Such lenses are found only in one or two other areas. The rest of the deposits is in the nature of float boulders. The largest massive sillimanite float boulder found so far was reported to weigh 300 tonnes.

The average composition of these deposits is as follows—

SiO ₂	...	...	35.00 per cent.
Al ₂ O ₃	...	...	62.28 per cent.
Fe ₂ O ₃	..	...	1.74 per cent.
TiO ₂	...	...	0.18 per cent.
MgO	...	...	0.13 per cent.
CaO	...	...	Trace.
Sp. Gravity	...	...	3.23

The high alumina and silica contents of this deposit makes this mineral a natural refractory material of great commercial value. Its accidental discovery in a London warehouse in 1922 was when the corundum mined from this area was found to be of not quite the hardness expected in an abrasive of that type.

Although the sillimanite mines in Sonapur have been worked for a long time by various companies and agencies, it is a pity that no serious assessment of the available reserves of this valuable mineral were undertaken; a start has been made only recently. Liberal estimates of

these deposits put them at about 2 million tonnes, whereas conservative estimates have put them at only 10 per cent of this figure. Already some 1½ lakh tonnes of the mineral have already been won so far.

A time may not be far off when one has to think in terms of beneficiation of the sillimanite-quartz schist available in plenty in the region.

4.2. Sillimanite Deposit at Dapsi-Tholegiri, Garo Hills—

Some minor occurrence of sillimanite has been reported at Dapsi Tholegiri in Garo Hills. The strike extension of sillimanite-quartz schist is limited to within a few metres, with a maximum of 18 metres. No strike-wise extension or any new occurrence have been found in the vicinity; nor is there any concentration of massive boulders within the schist band. Hence this deposit cannot be considered to have any economic significance.

CHAPTER 5

GLASS SAND DEPOSITS

5.1. Laitryngew Deposits—

The glass sand is found to occur at Laitryngew and Umstew areas of Khasi Hills. It is fine grained, white in colour and friable. The grains are angular in shape. Glass sands from Umstew and Laitryngew areas, on analysis, give the following results—

	Umstew	Laitryngew
SiO ₂	99.4 per cent	97.38 per cent to 99.10 per cent
Fe ₂ O ₃	0.12 per cent	0.13 per cent to 0.35 per cent
Al ₂ O ₃	0.21 per cent	0.60 per cent
TiO ₂	Trace	0.61 per cent
MgO	Nil	0.12 per cent
CaO	Nil	0.10 per cent
Alkalies	Trace	.....

This sand is quite suitable for manufacture of glass. After washing, it will be suitable for sheet glass too.

The deposits within an area of 3 sq. kms., covering Laitryngew and Umstew, are divided into 13 (thirteen) Nos. of small deposits, on the basis of overburden. The average thickness of sand band is 2.00 ms. and the bands covers an area of 0.62 sq. km. (considering all deposits). These deposits contain a reserve of 2.3 million tonnes of glass sand.

5.2. Shillong Deposits—

The friable quartzites near the old traffic gate to Jowai at Alugodam on the outskirts of the Shillong Town have been found to be fairly suitable for glass manufacturing. The best occurrences of these friable quartzites are seen along the Jowai road for about 400 metres from the traffic gate. Similar quartzites are also found at many places along the Jowai road and even in the Mawphlang road beyond Upper Shillong. Chemical analysis of these quartzites are not known.

5.3. Siju and Tura Deposits—

Other two deposits of glass sand are reported from Garo Hills, one from the east of Simsang river near Siju and another near Tura. These two deposits are from Tura sandstone. The sample collected from these deposits, give the following results—

	Siju	Tura
SiO ₂ ...	98.00 per cent	99.38 per cent
Al ₂ O ₃ ...	1.60 per cent	0.28 per cent
Fe ₂ O ₃ ...	Trace	0.037 per cent
TiO ₂ ...	..	0.085 per cent
CaO ...	Trace	Trace
MgO ...	Trace	Trace
Total Alkalies ...	...	0.09 per cent
L.O.I. ...	0.44 per cent	0.12 per cent

The reserve of these deposits has not been estimated yet.

CHAPTER 6

OTHER MINERAL DEPOSITS

The deposits described under this chapter relate to minerals which have been investigated in a preliminary way and for which a lot of more geological studies will be required before one can assess their economic significance.

6.1. Iron ore Deposits—

(a) **Aradanga Deposit**—In the Aradanga area of Khasi Hills, which is adjacent to Ranighat area (Habim) of Kamrup district, a small deposit of magnetite ore is found. The reserve of iron ore has been estimated at 125,000 tonnes, taking an area of 2769 sq. metres and an average thickness of 15 metres. In addition to this, the reserve of float ore in the area is estimated at 100,000 tonnes.

(b) **Nishangram Deposit**—Another iron ore deposit occurs at Nishangram, Garo Hills. There are two bands of quartz-magnetite rock associated with biotite and granite-gneiss in Nishangram Hill. The top band is found to extend for a strike length of 1400 metres, its average width being 15 metres. The second band is found to extend to 150 metres in strike length with an average width of 20 metres. The inferred reserve of magnetite quartz rock is about 6.5 lakh tonnes.

(c) **Athiabari Deposit**—Banded-magnetite-quartzite rock is found in Gharkar Hills, Athiabari, Garo Hills near the border of Goalpara, where 0.5 million tonnes of iron bearing rock is found.

(d) **Other Deposits**—More than a hundred years ago, small iron smelting furnaces were at work in various places in Khasi Hills, using the locally available ferruginous sandstones, lateritic material, ochreous segregations and the like. It is evident that the extent of such deposits is not large enough to be able to support a modern-day blast furnace.

Some quartz-magnetite rocks have been reported near Dobu and in the West of Chimagiri of Garo Hills.

6.2. Gold deposit—

Some gold has been reported to occur at Tyrsad, 8 kms south of Mawphlang, Khasi Hills. The gold is found disseminated in the Calc-Schist, as specks, stringers along the foliation and crack planes. The country rocks, quartz-amphibolite, carbonaceous slate mica-schist, are geologically of the Shillong Series. In the core samples, the gold is found in order of 0.8 gm/tonnes to 6.2 gms/tonnes. Traces of silver and copper are also found in some samples. The reserve of gold has not yet been estimated. More investigation by drilling is required to prove this deposit.

6.3. Gypsum deposit—

Gypsum has been reported in Mahendraganj, Garo Hills and occurs as minute crystals in the gypsiferous shale. The concentration of gypsum in this shale is found to be very low and is only 0.07 per cent. No reserve of gypsum is estimated so far.

6.4. Quartz-Feldspar deposits—

(a) *Tura Deposit*—Quartz and Feldspar bearing pegmatite veins are found to occur in the Pre-Cambrian rocks in and around Tura, Garo Hills. Twenty-two pegmatite veins have been located in the area. These occur as concordant masses within the Pre-Cambrian schists and gneissic country. The thickness of these veins varies from 0.15 m. to 5 ms. Of the 22 pegmatite veins, two are of fairly good in thickness (upto 5 ms.). The indicated reserve of the two minerals are as follows—

Quartz	...	907 tonnes.
Feldspar-	...	1714 tonnes.

(b) *Hahim Deposit*—Another occurrence of pegmatite vein rich in feldspar and quartz is encountered on the bank of Gijang river, near Hahim, Kamrup district (Assam) but the area of occurrence is within the Khasi Hills, Meghalaya. In this area, the estimated reserve of the two minerals are as follows—

Quartz	...	6070 tonnes.
Feldspar	...	5730 tonnes.

In another pegmatite vein, adjacent to this area, the reserve is estimated as—

Quartz	...	13500 tonnes (approx.)
Feldspar	...	16000 tonnes (approx.)

Quartz and feldspar are required in the manufacture of low tension insulators and ceramic-wares.

6.5. Copper, lead and zinc deposits—

A multi-metal mineralised zone was recently reported at Umpyrtha on the northern fringes of Meghalaya (approachable *via* Gauhati and Ranigodam). Mineralization occurs in the form of dissemination, specks; etc confined to a narrow zone, in the form of several distinct bands within a section. The ore-bearing rocks are lensoid in shape and are apparently disposed along the trend of foliation.

One particular lens has given a tentative reserve of a mere 0·1 million tonnes with respective percentages of Zinc, Copper and Lead at 2·83 per cent, 1·35 and 0·40 per cent, the total metal content being 4·58 per cent.

The economic importance of these indications is being assessed.

6.6. Phosphate Deposit—

Phosphate rocks are reported in Rewak (Kopili Shale) of Garo Hills and Jaintia Hills. Around Siju of Garo Hills, a phosphatic zone is seen to occur at the contact of Siju Limestone and Rewak shale. Chemical analysis of samples collected from this area, indicate a very low phosphate contents in the shale ranging from 0·78 per cent to 2·30 per cent. Sporadic occurrence of phosphatic nodules is observed in the shale, some of which show upto 30 per cent of phosphate. But the concentration of such nodules in the shale is very low. No reserve is estimated.

6.7. Building Stones—

Various types of building stones of good quality are available all over the State. Among these, mention can be made of the coarse granites found around Myllem as well as around a number of places along the northern scarp of the plateau on the border of Goalpara, Kamrup and Nowgong districts of Assam. Quartzites and slates are also found in several places around Shillong.

The hard, greenish to black Khasi greenstones found in the southern parts of the Shillong Plateau as well as the Sylhet trap rocks are useful as high-grade road metals. A ferruginous and friable stone referred to as laterite has also proved suitable for road dressing.

Coloured sandstones of various quality and shade are found in plenty all over the State. They are used for masonry in the form of bricks, slabs and posts.

CHAPTER 7

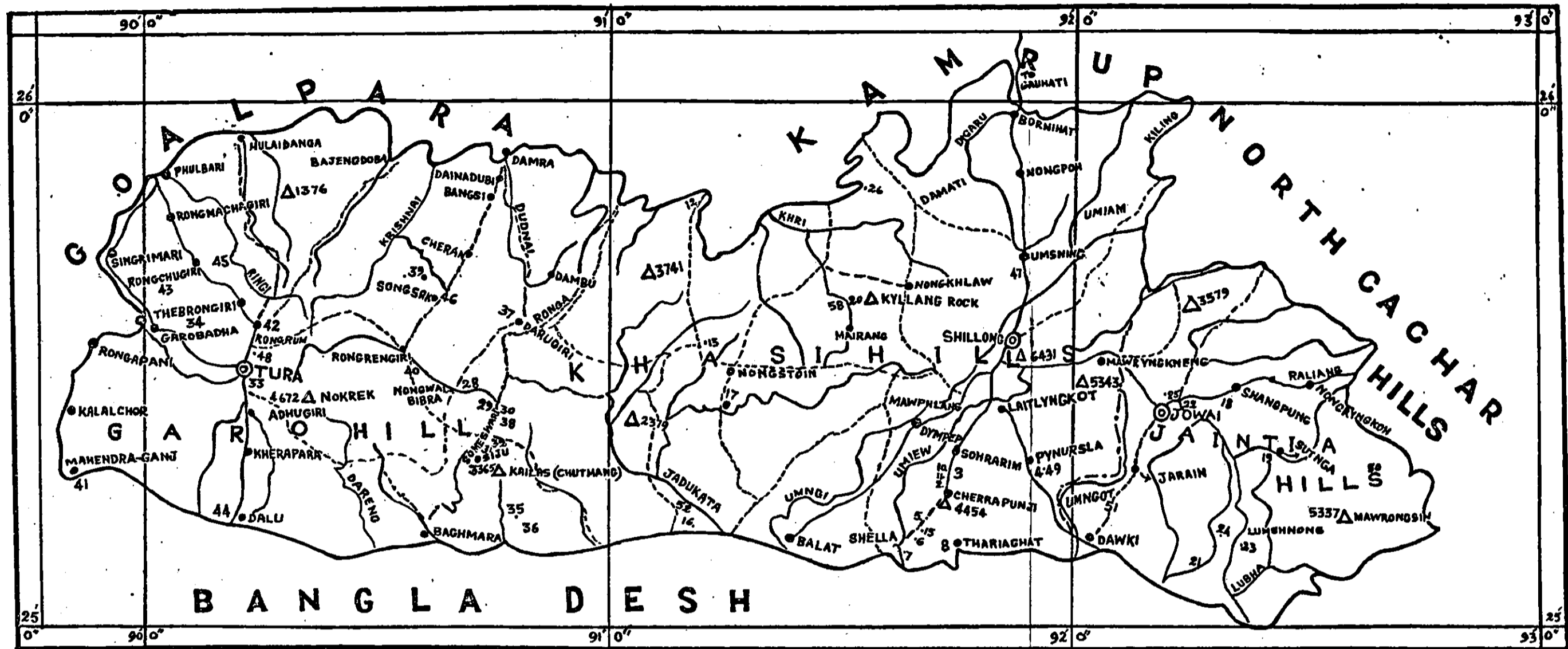
MINERAL OIL

Seepages of crude oil (petroleum) in association with bubble-discharge of natural gas have been known to occur in a number of places in the southern slopes of the plateau in the Tertiary rock formation.

The Oil and Natural Gas Commission of the Government of India has been investigating these slopes for oil for a number of years now. Test drilling of Baghmara structure in Garo Hills was done recently; the testing results obtained from Baghmara well No.1 did not, however, show any commercially exploitable hydrocarbons. More test drillings are expected on the Gopinath-Kila and Dewali structures of Garo Hills and the Khasimara area of Khasi Hills.

MINERAL MAP OF MEGHALAYA

SCALE:- 1 INCH = 16 MILES OR 1:1013760



MINERAL INDEX AND PLACES OF OCCURRENCE

LIME STONE (Ls), COAL (C), CLAY (Cl), COPPER (Cu), IRON-ORE (Fe), SILLIMANITE (Si), PYRITE & PYRRHOTITE (Py), QUARZITE & GLASS-SAND (Qz), GOLD (Au), KAOLIN (Kn), FELDSPAR (F), OIL & GAS (OL), GYPSUM (GM), LEAD (Pb), ZINC (Zn) CORUNDUM (Co),

1. MAWPHLANG Kn, Au, C,	19. SUTNGA C, Cl, Ls,	37. DARUGIRI Ls, Cl,
2. CHERRAPUNJI C, Ls, Cl,	20. UMRILIANG C,	38. {DARRANG-ERA-
3. LAITRYNGEW C, Qz, Py,	21. LAKADONG C, Ls,	{ANING Ls,
4. PYNURSLA (PYNURSLA) .. C, Ls,	22. BAPUNG C,	39. ANOGIRI F,
5. MAWLONG C,	23. LUMSHNONG C, Ls,	40. RONGRENGIRI C, Cl, Ls,
6. ISAMATI Ls, Cl, C,	24. MYNKRE Ls,	41. MAHENDRAGANJ. .. GM,
7. SHELLA Ls,	25. THADLASKIEN.. .. Kn,	42. RONGRAM Cl,
8. THERRIAGHAT Ls,	26. UMPYRTHA Cu, Pb, Zn,	43. KARAIBARI C,
9. MAWSYNRAM C, Ls,	27. MASIMPUR Qz,	44. DALU Cl,
10. MAWKMA Ls, C,	28. NONGWALBIBRA.. .. C, Cl, Ls,	45. RONGCHUGIRI Cl,
11. UMSTEW Cl, Ls, Cts,	29. WEST DARRANGIRI .. C,	46. SONGSAK Cl,
12. HAHIM F, Fe, Cu, Qz,	30. EAST DARRANGIRI .. C,	47. NONGSPUNG Fe,
13. SONAPAHAR.. .. Si, Co,	31. SIJU SONGMONG .. C, Ls,	48. CHISUKGIRI F,
14. LAITLYNGKOT.. .. Kn,	32. SIJU ARTHEKA Ls,	49. THANJINATH Ls, C,
15. MAHADEK Cl,	33. TURA Cl, F, Qz,	50. NONGKHLIEH Ls,
16. LANGRIN C, Ls,	34. GARO BADHA Qz, GM,	51. SYNDAL Ls,
17. NONGSTOIN F, Si,	35. BALPHAKRAM.. .. C, Ls,	52. CHERAGAON Ls,
18. SHANGPUNG Cl,	36. PENDENGGRU C,	

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