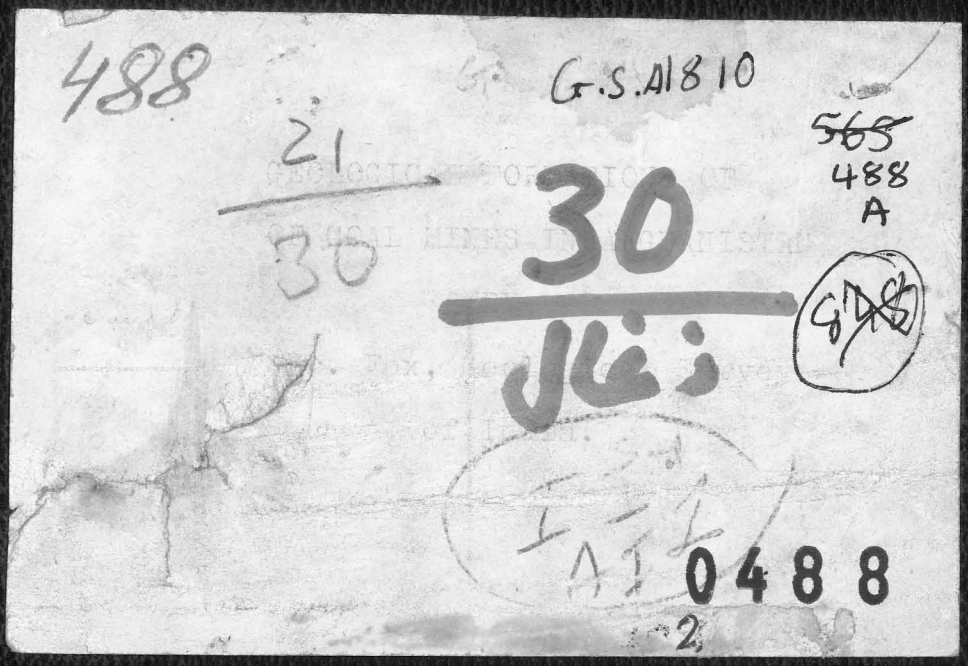
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THE PROSPECTS FOR COAL MINING IN AFGHANISTAN

by

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Under the orders of the Government of India, Foreign and Political Department, I was sent on deputation to Afghanistan for two months, from the 30th April to the 30th June, 1936. My services were placed at the disposal of the Government of Afghanistan in answer to a request for a mining engineer to assist with advice in opening up coal mines in certain places in Afghanistan. I must record the kind assistance I received from Mr. Mitchell, Assistant Secretary, N.W.F.P., Civil Secretariat, Peshawar, in regard to my journey to Kabul; and to Major Hay, the Councellor, Major Lancaster, the Military Attache, and Captain Galloway, the Secretary, at the British Legation in Kabul, on several occasions when I received open handed assistance and kindness from them.

H.B.M.'s Envoy Extraordinary and Minister Plenipotentiary in the Court of Afghanistan,

K.Fraser Tytler, C.M.G., the British Minister to the Court of Afghanistan in Kabul, for his never failing help, advice and generous hospitality throughout the period of my deputation.

I had the pleasure of seeing and discussing my proposed work with His Excellency Faiz Muhammad Khan, the Minister for Foreign Affairs, shortly after my arrival in Kabul. My tour programme was finally controlled by His Excellency Mirza Muhammad Khan, the Minister for Commerce, and I am indebted to him for the generous arrangements made for me by Agha Muhammad Isan who was deputed to accompany me and be my assistant. This man did his work entirely to my satisfaction. While on tour I had considerable assistance from the Governor in Chief of Badakhshan in Khanabad and the places I visited -

Narin

Narin and Ishkamish in his territory. I received similar attention from the Governor in Chief of Afghan Turkistan at Mazar-i-Shariff and the Dara Yusuf country. Finally I had the privilege of interviews with His Royal Highness Sardar Muhammad Hashim Khan, the Prime Minister of Afghanistan, and heard from his lips of the urgency and importance for obtaining adequate supplies of coal for Kabul. I am aware that the Prime Minister had often, after a long day's work and late at night, enquired after my comfort when I was on tour. These and other gracious acts, and the kindness of the people everywhere in the country places, made my duty one of the most pleasant a man could desire.

Part I : Resume of information available in 1936.

1. The occurrence of coal and lignite in Afghanistan has been known for over a century from the published reports of European travellers. In some of these accounts mention is actually made of efforts to open up the coal seams with a view to developing coal mines (collieries). Notwithstanding these efforts, and the fact that coal would prove a very valuable fuel in a land in which wood is not abundant and where the winter is severe, no successful colliery has yet been established anywhere in Afghanistan. It is well-known that the country has often been subject to civil war and other internal disturbances, and it is only in the past few years that a sense of security, under good government, has come to the people and produced a desire for progress.

2. It will be of interest to review the discoveries of coal in Afghanistan and the countries on its borders. As fa back as 1872, while attached to the Persian Boundary Commission, Dr. W.T.Blanford of the Geological Survey of India visited the coal mines near Hir in the Elburz mountains nort of Teheran ($35^{o}40'$: $51^{o}25'$). He noted the excellent quality

o

of the coal, the high inclination and moderate thickness of the seam, and by the discovery of identifiable plant fossils he was able to determine the Oolitic (Jurassic) age of the coal-bearing strata. About a dozen years later Mr., then Captain, C.L.Griesbach, also of the Geological Survey of India, accompanied the Afghan Boundary Commission through Khorassan and Afghanistan.

3. C.L.Griesbach found that the Elburz coal-bearing strata extended across Khorassan, where coal has been found in several localities within a radius of twenty miles of Meshed (36°17' : 59°36'), into Afghanistan. The Jurassic coal measures are evidently well developed in Afghan Turkistan as Griesbach recorded several thick seams of coal, one of excellent coal, in the lonely country of Dara Yusuf in the ~~valley~~ valley of Shisha Wallang or Chahil Duktaran. He was even able to estimate reserves of 50 million tons in one seam only six feet thick in an area of 9 square miles. With the information available from Blanford's work on the Persian side and the results of surveys by Russian geologists beyond the Oxus, Griesbach was able to suggest that all these coal measures were laid down in one great basin in the Mesozoic era.

4. About thirty years after Griesbach's traverses the question of ascertaining the mineral resources, especially the coal occurrences, of Afghanistan received the attention of the Amir Habibullah Khan, and as a result he engaged Dr. Walter Saise of the East Indian Railway collieries, Giridih, to advise on the development of coal mines in the Lataband Pass, about 20 miles east of Kabul (34°30': 69°10'), and Faragard, in Ghorband, nearly 40 miles north-west of Kabul behind the Paghman range. Dr. Saise's report appears to have been lost, but it is believed that he gave unfavourable opinions in both cases - that the material of Lataband

was

was of poor quality and little utility, and that the lignite of Ghorband was unattractive from the point of view of insufficient quantity for mining. It should be stated that both the occurrences examined by Dr. Saise are in strata of Upper Tertiary age in which workable coal seams are relatively rare.

5. Mr. H.H.Hayden, later Sir Henry Hayden, was temporarily transferred to the Amir's Government from the Geological Survey of India about the time that Dr. Saise was making his investigations in Afghanistan. Hayden was engaged on mineral surveys for the Amir Habibullah Khan, and thus examined the Tarakai exposure east of Khurd Kabul, 12 miles south-east of Kabul. He pronounced the carbonaceous material there useless for fuel. He also visited Paragard and explored the country as far as Gaoparan in that area, and reluctantly expressed the view that the prospects for thicker seams, and continuous seams, likely to contain large reserves of good workable coal, were not promising. Hayden also crossed the Hindu Kush into Saighan and studied the Jurassic coal-bearing formation, which he named the Saighan series, in several places. He found coal in these beds at many localities including those of Ishpushta and Barfak north of Doab-i-Mekhzarin.

6. Unfortunately the outcrops of coal, in the Saighan series, which Hayden inspected were disturbed and the coal in a crushed condition, so that he was of the opinion that the seams would be variable in thickness and inclination and consequently difficult to mine. It must be remembered that like all geologists in new country, Hayden was obliged to draw his conclusions almost entirely from surface evidence. No borings were put down and all exploratory work was almost superficial. Nor was he able to cross into Afghan Turkistan to see Shisha Wallang. Notwithstanding these handicaps

Hayden had proved the coal measure, his Saighan series, to be still an important formation as far east as the Bamian-Kunduz river, and he made a valuable collection of plant fossils.

7. The plant fossils found by Griesbach and Hayden established beyond all doubt their floral identity with the fossil plants found in Fergana and thus proved that the coal bearing formation of Afghanistan, north of the Hindu Kush, was almost certainly laid down in a vast basin which included the coalfields of Russian Turkistan and those of Northern Persia. It is remarkable that no equivalent coal-bearing formation has been identified in eastern Afghanistan south of the Hindu Kush. The limit of the great northern Jurassic (Oolitic) coal basin appears to have been in what is now the mountain ranges of the Hindu Kush and Koh-i-Baba. In this belt of country all the strata older than the Miocene have been very severely crumpled and twisted, and the coal measures can just be recognised in the confused and variegated rocks in Bamian, a few miles beyond the ruins of Zohak, on the south side of the valley, leading up to those of ancient Goolgoola. No geologist has examined the upper valleys of the Helmand or the valley of the Hari Rud; so we do not know what formations are present there.

8. Griesbach was of the opinion that the coal measures of Northern Afghanistan were of the same geological age and related to the great Gondwana (Damuda) coal formation in India. In his day some geologists believed the Damuda coal-bearing beds to be of Jurassic age and to be underlaid by greenish splintery shales of glacial origin (the Talchirs). Griesbach had found similar shales in various places in Afghanistan and they occur in the Khaiber Pass and near Loe Dakka and are now known to be of Triassic age. The Talchir glacial beds are of Upper Carboniferous age and the

Damuda

Damuda coal measures (Barakar to Raniganj series) are of Permian age. Their plant fossils are quite different from those of the Saighan series - they are a distinctive flora. The following table of strata will explain the differences clearly:-

8. Succession of fossiliferous Geological Formations:-

Groups of Strata.	Systems in Afghanistan and India.		Age in years.
Kainozoic or Tertiary era.	Recent and Pleistocene.	Lignite of Tarakai and Lataband Dahangai.	1 million.
	Pliocene and Miocene.	Coal of Ghorband. Period of great earth movements.	12 "
	Oligocene & Eocene	Uplift of sea floor begins. (Coal and petroleum in (Baluchistan and Punjab. (Volcanic eruptions in India.	24 "
Mesozoic or Secondary era.	Cretaceous	Marine limestone of Bajgah and Red Beds of Barfak.	48 "
	Jurassic	((Saighan (Coal) Series. (Coal measures of Elburz, (Fergana and Dara Yusuf.	72 "
	Triassic	Volcanic eruptions of Doab. Marine shales of Doab-i-Mekhzarin.	96 "
Palaeozoic or Primary era.	Permian	(Productus limestone of Punjab. (Gondwana (Damuda) coal seams (of the Indian Peninsula	160 "
	Carboniferous	(Fusilina limestone of (Shambal gorge. (Talchir glacial beds of (India. (Coal measures of England (and Europe and U.S.A.	280 "
	Devonian	Doubtfully present in Chitral and Afghanistan.	320 "
	Silurian, Ordovician, Cambrian	Not yet recognised in Afghanistan.	480 "

Archaean and unfossiliferous sedimentary rocks of great antiquity.

9. In the above geological table of strata it will be seen how new the lignites of Tarakai, Lataband and Ghorband are when compared with the Eocene coal measures of Baluchistan and the Punjab. The petroleum of Persia, the Punjab

and

and of Assam and Burma also generally occurs in the Eocene or Lower Tertiary beds. Workable coal is rare in the Upper Tertiary formation and none are known in India. The Jurassic coal measures of Northern Afghanistan, of Russian Turkistan and Northern Persia do not appear to occur south and east of the Hindu Kush, and appear to belong to a basin quite distinct from those in India in which other Jurassic strata were laid down during the same geological period over 72 million years ago. Again when the Permian coal measures (Damuda formation) of Gondwanaland were being accumulated in wide river valleys in the Indian region there was an open sea northwestwards from the Punjab Salt Range over Eastern Afghanistan. Finally, it is seen that when the great coal measures of Europe were laid down in a warm climate in extensive lakes there was sea over parts of Afghanistan, while the Indian region was buried under great sheets of ice somewhat like Greenland is today.

10. From the information given in the preceding paragraphs, and particularly in the Geological Table in paragraph 8, it is evident that by a curious series of unfortunate circumstances in past geological ages no strata containing extensive seams of coal appear to have been laid down in eastern Afghanistan. And it seems quite definite that no coal seams at all, equivalent to the Lower Gondwana coal measures of India, were ever deposited in any part of ~~Gond-~~ Afghan-istan ~~wana~~. The Jurassic coal measures of northern Afghanistan were part of a region of extensive deposition which included Turkistan and Northern Persia and evidently did not extend far south or south-east of the Hindu Kush. With these facts in mind it seems a waste of time to discuss the possibilities of finding extensive coal measures in eastern Afghanistan. The scattered lake deposits of Pleistocene and perhaps Upper Tertiary age are unlikely to contain valuable coal

seams

seams, but it is possible that in some areas where conditions were relatively favourable local deposits of lignite may occur, as at Lataband and in Ghorband, which may for a time prove useful for local use if found in workable amount and of good quality.

Part II. - Description of Coal occurrences visited in 1936.

11. During my tours in Afghanistan in connection with the coal occurrences which it seemed necessary to visit and examine, I made investigations at the following places:-

(a) Lataband Dahangai, about 3 miles west of Ziarat Seh Baba, below the new direct road westwards through Samuch Mulla to Butkhak and to Kabul. (Map 38 F, 2, B and C).

(b) Tarakai, east of Khurd Kabul, 3 miles south-west of Khak-i-Jabar, on the motor road to Haft Kandao (Map 38 F, 3 B).

(c) Kushi in Logar valley about 12 miles east of Pul-i-Alam on the road southward from Kabul to Gardez (Map 38 F, 4 A).

(d) Serai Khwaja about 20 miles along the road northward from Kabul to Istalif and Charikar (Map 38 F, 2 A).

All the above are in the Siwalik-like Pleistocene to Pliocene deposits and only (a) is worthy of further attention as will be shown presently.

(e) Faragard, and Gaoparan, about 4 miles southwest of Siah Gird in Ghorband near junction of Yakh and Saidan Daras (Map 38 B. I. D.).

This occurrence is also in Upper Tertiary deposits, but they are more consolidated and are thought to be of Miocene age.

(f)

(f) Ishpushta, roughly the hillside north of the Kotal Sabz Ishpushta but south of the Ishpushta stream about 35°20' : 68°5' (Map 38 A. 3 A).

(g) Barfak: the coal locality is in the slope immediately below the Kotal-i-Khak about halfway between Ishpushta and Barfak (Map 38 A, 3A).

(h) Narin lies nearly 50 miles south of Khanabad in the valley below the pass of Jabardagh or Tawa Shah and the coal exposures are roughly 4 miles up the valley above a fork (the Soniab ?) (Map 37 H. 4A).

(i) Ishkamish lies roughly 20 miles in a direct line south-south-east of Khanabad, but the coal exposure is about 10 miles away to the north-east down the Kotal-i-Chall towards the Chall river on the way to Khanaka and Namakab. Six miles beyond Namakab are the salt mines. (Map 37 H. 3 A).

(j) Shisha Wallang or Chahil Duktaran in the Dara Yusuf country and approximately 18 miles from Deh (35°57' : 67°15'). (Map 33 M. 2 B).

(k) Chail on the route leading from the Shisha Wallang valleys over the Kotal Shanbashak and Kotal Bala Gali to the Sabz Kotal and Kara Kotal and so via Madar to Bajgah in the Namard valley (Map 33 M, 2. C).

12 (a) The lignite of Lataband Dahangai outcrops across a saddle about a mile N.N.W. of the Z of Ziarat Seh Baba (Map 38 F. 2. C) and three hundred feet below the new motor road. The clays and marls with the lignite overlie Nahan-like sandstones and underlie sandstones with conglomerates. The strata dip W.S.W. at about 10° and strike N.N.W. The lignite is fully five feet thick, but has three or four shale bands of a total of 15 inches, so that barely 4 feet of fair quality lignite remains for sale. Analyses of the

samples

samples collected in 1936 show:

	A. Picked specimen.	B. Sample No.2.	C. Sample No.3.
Moisture ...	11.44	11.26	10.04
Volatile matter	30.66	24.43	25.34
Fixed carbon	26.08	20.02	21.16
Ash ...	31.82	44.29	43.46
Caking Property	nil	nil	nil
Specific Gravity	1.579	1.778	1.783

The average sulphur percentage is nearly 2.50 and this renders the fuel very unattractive for household use. It is exceedingly friable and rapidly falls to pieces when exposed to dry air. The outcrop has been proved for over 600 yards by adits. In these the exposed coal surface is covered with fine silvery hair-like needles of epsomite (Epsom Salts, i.e. magnesium sulphate). The lignite could perhaps be worked to a depth of 400 yards if very great care is exercised and the voids are filled with stone. Water will be met with and pumps are therefore necessary. The strata are weak and so roof protection will require heavy timbering. The total quantity of lignite optimistically available may be taken as about 250,000 tons of which rather less than a half might be despatched for use. It is a question whether material of this poor quality and small quantity which can hardly be used for any other purpose than brick-burning will be worth the expense that must be faced in its extraction. Its only advantage is that it will be within 25 miles of Kabul and close to a fair motorable road.

13. (b) The carbonaceous material of Tarakai is exposed about a quarter of a mile east of the hamlet of Talu Khel, roughly 3 miles south-west of the rest house at Khak-i-Jabar ($34^{\circ}23'$: $69^{\circ}29'$). It is associated with soft limestones

and

and calcareous shales and is about 10 feet thick including several impure bands. The strata are gently inclined to the north-west and evidently underlie thick beds of sub-recent conglomerates. There is a distinct odour of crude petroleum in the carbonaceous material when freshly dug, and one limestone band contains Planorbis-like fossils which have been identified as Gyraulus convexinsculus, Hutton. An analysis of a picked specimen of what I considered good material gave moisture 7.54 per cent., volatile matter 15.46 per cent., fixed carbon 6.62 per cent., ash 70.38 per cent. and a specific gravity of 2.13. The material can only be classed as carbonaceous clay and if it ever proves of value it will be for its clayey material and any petroleum that may be distilled from it. It is worthless as a fuel.

(c) The people who took me to see Kushi (34°2':69°12'), which is on similar soft Pleistocene material as Tarakai, could not find the exposure, but it was thought to be a few inches thick and of small extent. This locality need not be considered as a coal occurrence again.

(d) Serai Khwaja (35°45' : 69°7') is if anything a more ridiculous exposure than Kushi, and can be safely dismissed as not worth ~~for~~ further consideration as a coal or lignite occurrence. There are several other such exposures of a few inches of black shale in these Upper Tertiary beds in and around the Kabul valley. It is a waste of time to treat them seriously.

14. (e). The coal of Ghorband also occurs in Upper Tertiary strata, but here, about 4 miles south-west of Siah Gird (35°1' : 68°52'), the beds are thought to be of Miocene age. They are more compact and also more disturbed than those of the Lataband area, and consist of conglomeratic sandstones and shaly sandstones with two thin seams of coal.

Only

Only the upper seam, which is eleven feet above the lower and separated from it by shales and sandstones, was worked at the Faragard mine. This locality is at the confluence of the Saidan and Yakh Daras (Map 38. B. I. D.) and is best approached up the valley from the north from the motor road in the main Ghorband valley which is barely 3 miles away. The strata at Faragard strike north-north-east and dip east-south-east at about 12°. The beds are cut off by a strong north-east fault to the north and are cut by a strike fault, trending nearly east to west, to the south, but merely dropping the strata 30 to 40 feet southward. The upper or Faragard seam is in two sections - a top section 8-inches thick of strong brown woody coal, then a shale band of one to two inches, and then the bottom section of black coal somewhat badly sheared and 12-inches thick. There is shale both in the floor and the roof, but the roof shales are followed by strong sandstones, so heavy timbering will not be required if stone packing is employed. The quality of the coal is seen from the analyses given below:-

	Faragard Seam		Rahim Khel	Gaoparan Coal	
	Top Section 8 inches	Bottom Section 12 inches	3 inches	Upper seam (picked)	Lower seam 9 inches
Moisture	3.18	4.18	6.08	7.44	9.85
Volatile matter	32.66	40.46	32.66	40.08	41.65
Fixed carbon	29.94	36.88	28.22	43.16	35.94
Ash ...	34.22	18.48	33.06	9.32	12.56
Caking property	nil	nil	nil	nil	nil
Specific gravity	1.534	1.487	1.666	1.380	1.469

A considerable amount of coal has been taken from the Faragard mines, but the inclines are full of water to the dip and to reopen the workings will require a little pumping. However owing to the strike fault below it may be advisable

to

to begin work from the lower inclines on the south side of the fault. As no borings have been put down in the Faragard area it is advisable as early as possible to prove the continuity and condition of the seams in depth.

This Miocene coal was also found and worked for a time on the slopes above the right bank of the Saidan Dara south of Kachi Khel. It is said that the seam here was 30-inches thick, but now all the workings have collapsed and no exposure of coal is visible. Coal was also found up the slope on the right bank of the Yakh Dara above Faragard at Rahim Khel, but here the section only shows 3-inches of coal and not as much ~~more~~ as was reported. The strata are seen to be dislocated by small sharp faults at each of the exposures visited, while the dips also vary from place to place in the stream section although a south-easterly dip is most general. The Tertiary strata are quite extensive along the southern side of the Ghorband valley and Hayden had indicated the presence of coal in the basin of the Parsa Dara, in the vicinity of a locality known as Gaoparan, roughly 5 miles west-south-west of the Faragard. Exploration had disclosed two seams lying almost horizontal at Gaoparan, but notwithstanding a somewhat better grade of coal the seams are disappointing. The upper seam is interbanded with shale and the lower seam is only 9-inches thick, and the manner of their occurrence would render mining both difficult and expensive.

15. I visited the Faragard area twice. The first time in a normal investigation while in quest of good reserves of coal and with the data obtained by Hayden in my possession. I then found myself in complete agreement with him that Faragard and Ghorband generally could not be expected to contain a coalfield of first rate importance to Afghanistan. My second visit was after an interview with the Prime Minister, H.R.H. Sardar Mohammad Hashim Khan,

when

when it had been impressed upon me that coal to an extent of roughly 25,000 tons a year for three years was urgently desired. I, therefore, re-visited Faragard to see how this three year supply could be arranged for with the least delay and least expense. I found that the supply might perhaps be met from Lataband and Ghorband and that the output from the Faragard mine depended entirely on the resourcefulness of the mining engineer, but the work would prove expensive. There are only 20-inches of coal which means roughly 2600 tons per acre and this will necessitate extensive workings and as many miners actually digging coal as possible. Ten acres of workings extracting 100% of the coal would meet the demands of the Prime Minister, but 20 acres would probably be required and it is not certain whether the Faragard seam has even this extent.

16. (f). The coal outcrops of Ishpushta are barely 8 miles from Doab-i-Mekhzarin (35°17' : 68°) where the new motor road to Mazar-i-Sharif emerges from the defiles of the Bamian-Kunduz river north of the Hindu Kush. The Jurassic Saighan series outcrops along the west side of the valley and follow it north-eastwards from Doab through Barfak to Tala (35°24' : 68°15'). The strata incline (dip) north-westwards at 12° to 20° and are remarkably soft and irregular in the hill-sides. The Ishpushta seams are exposed in a steep-sided glen where the old road, camel track, descends from the Kotal Sabz Ishpushta to the Ishpushta stream. The outcrops were carefully examined by Hayden who drew attention to the excellent quality of the coal in a seam over 13 feet thick and who found the coal crushed and very friable and the seams irregular and contorted. Hayden's analyses and those of samples taken from thinner seams in the same locality are given below:-

P.T.O.

	Hayden's 13 foot seam.		Samples taken in 1936.	
	Sample	Picked	I	II
Wassergehalt Moisture	8.40	9.00	9.00	7.20
Flüchtige Bestandteile Volatile matter	30.10	30.33	31.70	32.00
Anstehende Kohle Fixed carbon	56.00	58.17	55.00	58.64
Asche Ash	5.05	2.50	4.30	2.16
Coking property	nil	slight	nil	nil
Sulphur	0.68	0.35	..	..
Specific Gravity	..	..	1.536	1.457.

17. The high moisture content suggests that the beds are greatly weathered and it is thus possible that the disturbed condition of the outcrop might be due to 'creep' of the soft rock down-hill on the steep slopes. Hayden has discussed the manner of exploration fairly fully and I agree with him that superficial coal and the hill-sides generally are best left alone as slips are sure to occur. The method of development will have to be by long adits driven from suitable places in the valley below in an upward gradient to meet the coal seams within the hill-side. The direction of the adit must be towards the northwest for the shortest distance to the coal seams, but the lower the entrance of the adit is below the level of the coal outcrops the longer will be the drivage before the seams are encountered. However, it is hoped that by undertaking the expense of such a drivage not only will the coal be found in its best physical condition, but that the working can be done without further drainage arrangements. If the strata associated with the coal seams, both those above and below the seams, are strong the need for a large quantity of timber will not arise, and at the outset it should be insisted that stone-packing will be used for supporting the roof where the coal is removed.

18. (g). After crossing the Ishpushta valley the old track leads up to the Kotal-i-Khak and then down a long valley which joins the river a mile or so south-west of

Khaki - Pass

of Barfak. On the way down from the Kotal-i-Khak coal outcrops are again seen where the Saighan series are cut into by steep-sided glens. One of these coal outcrops was 18 feet but thinned away on each side and contained similar friable (crushed) coal to that of Ishpushta. There seems no reason to doubt the continuity of the seams below ground between Ishpushta and Barfak, and this is supported by the regular manner in which the rock formations strike as shown in the accompanying photograph I. The quality of the coal is in every way similar to that of Ishpushta, and the associated strata are also in the same soft, weathered condition. The method of working will have to be the same - a long adit in fairly low ground driven on a gentle upward gradient into the hillside in a north-westerly direction to strike the unweathered seams. To me it seems unnecessary to estimate quantities of coal, because if the measures are continuous, as I think they are, and the coal of the quality given in para. 16, then every foot thickness of a coal seam in one acre of ground will hold about 1500 tons of coal - a 6-foot seam would hold 9,000 tons per acre.

19. My attention was drawn to certain coal outcrops beyond Barfak on the way to Tala and also near Tala where a seam evidently caught fire some years ago and attracted attention as a heavenly, or otherwise, phenomenon. Hayden has drawn attention to one such exposure a short distance beyond Barfak where in a section 10 feet thick containing alternations of shale and coal, quite unsuitable to work, there is one good band of coal 44 inches thick. This seam gave samples which yielded the following analyses:

	Average of 44-inch seam.	Middle of 44-inch seam.
Moisture	7.70	6.00
Volatile matter	42.97	44.29
Fixed carbon	31.86	48.19
Ash	17.47	1.52
Caking property	slight	feebly
Sulphur	2.86	..

The horizontality of the seam and the character of the associated beds led me to suspect this occurrence to be an Upper Tertiary coal, and this conclusion is supported by the composition and by the high sulphur percentage. It belongs to the same class as that of Lataband and Ghorband and may be useful for local use below Tala and up the Paiandeh valley, but the full extent has yet to be determined in due time by boring. This does not mean to imply that the deposit is of considerable importance. I think it is Tertiary coal and will suffer from the same draw-backs as the material from Lataband though this is of much better quality where the samples were taken by Sir Henry Hayden.

20. (h). Narin ($36^{o}5'$:$69^{o}6'$) lies about 50 miles almost due south of Khanabad from which it can be reached by motor car by the road through Sarai Shora, Koshai Lakhman, Tangi Murch, Akchishma and the pass of Tawa Shah. The coal outcrops are about 4 miles up the valley to the east toward Yaram. Several seams, tilted at high angles, are seen trending N.N.W. to S.S.E. where they are sheared. Higher up the hillside the coal measures are seen again with smaller inclination, 30^{o} to 40^{o}, and a north-easterly strike. At first the exposure of the highly inclined seams with crushed coal suggest very poor prospects for any large quantity of coal, but the presence of the upper exposure, more accessible and easier to prove by boring, makes the Narin coalfield worthy of notice. The strata in which the coal seams occur belong to the Jurassic (Saighan series) beds and this fact lends support to the belief in a continuity of the seams. And seeing that Narin is about 100 miles east-north-east of Doab-i-Mekhzarin the presence of coal measures to the south and west may be expected.

Analyses of two samples of the Narin coal from separate

separate seams in the highly inclined strata gave:-

	Lower Thick Seam 20 feet	Upper Thick Seam 15 feet
Moisture	9.56	10.88
Volatile matter	31.38	30.26
Fixed Carbon	56.72	47.00
Ash	2.34	11.86
Caking property	nil	nil
Sulphur	..	..
Specific Gravity	1.489	1.572

21. As already stated the strata at this exposure are nearly vertical, the dip is 80°. The uppermost beds, if no overfolding is involved, are towards the hillside and the section seen is of considerable interest. From the top there are -

Soft sandstones and shales

Upper Coal Seam	Coal	9 feet	
	Shale	1 "	6 inches
	Shaly coal	6 "	
Sandstone		9 "	
Shale		3 "	
Shaly Coal		6 "	
Sandstone		21 "	
Shale		18 "	
Lower Coal Seam	Coal	8 "	
	Shale	3 "	
	Coal	12 "	

Other thin bands of sandstones and shales and at least two further important coal seams occur in the slopes and low spur to the west between the coal outcrop above and the main valley. The coal is exactly like that of Ishpushta and Kotal-i-Khak - powdery when handled but there is no question of its excellent quality. In taking the sample only the coal and not the shale was included. The sample errs on the side of being too good, but the high moisture content indicates weathered material. Even now with some care in working and carefulness in selection fair quantities of good coal

could

could be obtained in a powdery form, which might be used with some suitable binder, perhaps cow-dung, for local use.

22. (i). Ishkamish (36°26': 69°10') lies 25 miles southward of Khanabad by a motorable road via Sarai Shora, and the road southward from Ishkamish through the beautiful valleys of Flole and Akchishma and down the steep descent from the Kotal Tawa Shah, is also motorable to Narin 30 miles away. The coal outcrop of Ishkamish is 12 miles away to the north-east down the northern slope of the Kotal-i-Chall and in a ravine near the bridle path which leads to the bridge over the Chall Dara on the way to Khanaka and via Namakab to the famous salt mines - fully 10 miles beyond the Chall bridge. The exposure shows about 70 feet of carbonaceous shales, with roughly 2 feet of coal, associated with greenish shales and trappoid clays and sandstones which strike north-north-west to south-south-east and dip at about 45° to the east-north-east. The beds are greatly buckled and folded, and resemble the Triassic beds of Doab rather than the Saighan series — although these Jurassic strata evidently do show up in the cliffs of the south bank of the Chall river. In the road section along the cliff face the beds are very like the Saighan series and trend almost east and west and dip southward into the cliff sides. A proximate analysis of a sample of coal taken from the seam in the ravine on the northern slope of the Kotal-i-Chall gave:-

Kotal-i-Chall (Ishkamish) coal
20-inch seam.

Moisture	...	3.30 per cent.
Volatile matter	...	22.48 " "
Fixed Carbon	...	52.34 " "
Ash	...	21.88 " "
		Does not cake.
Specific Gravity	...	1.527

As seen by these results the coal is of relatively inferior quality

quality, and its thinness, together with the disturbed condition of the beds render the occurrence only of interest for small supplies, say for boiler firing, should coal be required at the mines of Namakab. I understand a new and direct road is being made from Khanabad direct to the salt mines of Namakab. It would be a small additional expense to continue the road to the Chall river, but the decrepit wooden bridge over this torrent will have to be replaced if coal or salt is to be taken over. The climb from the Chall river to the Kotal-i-Chall is very steep but this is barely 2 miles and may mean 4 miles of road. A mile below the Kotal-i-Chall is Samandab from where it is possible to motor the 9 miles into Ishkamish even now when the weather is fair.

23. (j). Shisha Walang (35°42' : 67°23') comprises a series of valleys which converge on and discharge their drainage through the gorge of Chahildukhtaran in the Dara Yusuf country of Afghan Turkistan. The name Shisha Walang appears to be quite locally used and was not known to His Excellency Gul Ahmad Khan, the Governor of Afghan Turkistan, nor to the officials of the Mazar-i-Sharif district. The coal locality had been discovered and described by Mr. C.L. Griesbach half a century ago and so it was easily found with all the assistance I received from the Governor and officials. It seems necessary to describe the route as Sir Henry Hayden did not visit it during his investigations in Saighan and Kamard 30 years ago, although he arrived within a long days march of it when at Ah Khorak. Shisha Walang is 70 miles due south of Mazar-i-Sharif (36°42' : 67°6'), but the road journey is over 105 miles. It is best done by motoring westwards via Deh Dadi to Pul-i-Imam Bakri (36°38' : 66°55'), 12 miles, and then motoring south along the left, west, bank of the Dara Band-i-Baba via Bodna Kala, 10 miles, and Buinakara, 16 miles, to Pul-i-

Pul-i-Barak, 9 miles, and crossing the river there to the east bank, i.e. 47 miles from Mazar-i-Sharif. From Pul-i-Barak a bridle path leads by Bala Kishindih, 10 miles, over the hills to Chapchal in a defile, 19 miles, and so upstream by Dehi, 7 miles, and Dara Yusuf (Kala Sarkari), 6 miles, eastwards into the Chahar Aolia valley, 4 miles, and then southward into Shisha Walang, 12 to 14 miles.

No Jurassic rocks are seen on the march until the Chahildukhtaran gorge is actually traversed, when the Cretaceous limestones, seen repeatedly - Kafir Kala tangi (36°33' : 66°57'), Pul-i-Barak (36°12' : 66°50'), Chapchal (36°2' : 67°11'), Dehi (35°57' : 67°15') and other places - overlie the Jurassic plants with marked discordance (see Photograph II). Southwards from the Chahildukhtaran gorge the Saighan (Jurassic) beds) series are well-exposed up the valleys, but the strata are buckled and twisted and, consequently there is considerable irregularity in the inclination and lie (dip and strike) of the beds. Coal seams are exposed in almost every steep-sided glen about 2 to 2½ miles southward from the gorge, and although some of the very thick seams, over 20 feet, have shaly coal, others over 10 feet thick have excellent coal. The following analyses are of samples collected from seams in side valleys south of the fork in the valley which leads up to the Kotal Shanbashak and up which a path leads to a deserted site known as Darwaza:

Coal samples from Darwaza area, Shisha Walang, 2½ miles S.S.E. of gorge.

	A 20-foot seam.	B Thick seam.	C near Darwaza.	D Picked coal
Moisture	6.02	3.60	11.78	5.56
Volatile Matter	29.77	19.06	29.00	35.12
Fixed Carbon	48.96	20.90	34.66	56.56
Ash	15.25	56.44	24.56	2.76
Caking property	nil	nil	nil	nil
Specific gravity	1.458	1.888	1.596	1.344

24. Agha Muhammad Isan, who had collected the samples C and D above, found that the local inhabitants have a story of some European who came half a century ago and found coal in a glen since named Jhari Soktha (place of burning), and that 30 years ago a large stock of coal was dug out and after stacking there finally despatched to Kabul. We visited the place which is in a glen off the valley which opens south-west from the point of Koh-i-Chahilduktaran and about 3 miles from the gorge. I found no evidence of a burnt-outcrop of coal, nor of any large coal stack, but coal had undoubtedly been stocked and there was a cliff section in which several coal seams are exposed. This is evidently Griesbach's special discovery (see Photograph III) as the beds dip gently into the hill, and the seams are slightly obscured by fine scree which slips down the face of the cliff. However, the beds are not undisturbed throughout the section as buckling and arching is visible just to the left of the view photographed (see sketch section). Samples were taken from the exposures A, B, C and D, different seams all over 6 feet and up to 12 to even 25 feet thick, as shown in the sketch. The analyses are given below:

Coal Samples from Jhari Soktha, Shisha Walang, 3 miles S.W. of gorge.

	A 10-foot seam	B Isan's thick seam	C Griesbach's coal.	D Isan's small seam.
Moisture	5.44	6.32	2.00	5.88
Volatile matter	32.50	33.26	35.12	32.56
Fixed Carbon	56.20	56.52	56.58	58.52
Ash	5.86	3.90	6.30	3.04
Caking property	nil	nil	cakes strongly	nil
Specific Gravity	1.372	1.367	1.300	1.360

The excellence of the coal from all four outcrops is evident. It was not possible to take complete sections as the cliff face was friable and the full thickness of the

seams

seams was not ascertained, but all are of workable thickness.

25. Attention is drawn to the strongly caking character of the coal of sample C from Jhari Soktha which I have called Griesbach's seam, and I venture to predict that all these coals, including those of Ishpushta, when opened up in an unweathered condition, will prove to have good caking properties. In composition they resemble the high volatile coals of the Raniganj (Upper) series of the Damuda coal measures of India, and these, as in the case of the Dishergarh seam, when the moisture content is below 3 per cent. and the ash content roughly 10 per cent. or under, are strongly caking long-flaming coals. Griesbach had estimated (at a million tons per foot thickness per square mile) over 50 million tons of coal in 9 square miles in a single seam 6 feet thick, but did not indicate the precise area. Presumably it is the area behind the cliff section shown in Photograph III and the Sketch i.e. towards the west towards the main Dara Yusuf valley about Dahan-i-Tor ($35^{o}42'$: $66^{o}17$). That there must be an immense amount of good coal in the Shisha Walang area cannot be denied, but I am not prepared to estimate the quantity of readily workable coal in any area over one square mile without a detailed geological survey supplemented by boring.

From the evidence of the wide extent of the Saighan (Jurassic) series in Northern Afghanistan, and the fact that I have myself seen the exposures at Shisha Walang and at Ishpushta and as far afield as Narin, and the final evidence of the excellence of the coal in my own samples from these places, I feel certain that large reserves of workable coal will be found. It would be best to make a road over the hills from Shisha Walang to Dahan-i-Tor and complete the motor road northward from Dahan-i-Tor through Dara Yusuf to Pul-i-Barak, and so connect with Mazar-i-Sharif in

in one direction, and also to open a road southward by way of Saighan to Bamian or into Band-i-Amir to Kala Jafir in the opposite direction. The objective in both cases being the construction of a railway southwards from Kilif on the Oxus on the Russian frontier to join with another from Kabul to Herat, linked with the Indian border through Jalalabad and the Lataband. However, before this can be even considered, perhaps it is essential that a sufficiently large quantity of coal be proved by careful geological mapping and boring in the Dara Yusuf country. I have little doubt that this could be done quickly and that other unsuspected areas of workable coal would probably come to light during the same investigation.

26. (k). Chail (35°38' : 67°34') lies in a deep valley round the sides of which, both towards the Sabz Kotal (Kotal-i-Sauzak) to the south-east and the Kotal Bala Gali to the west, the Cretaceous limestone occur and have in places slipped down the slopes below where greatly weathered coal-bearing strata occur. These coal measures are tilted at variable angles and being soft and friable will be subject to landslips if important excavations are made in them without elaborate protection. For these reasons I consider the coal occurrence in the Chail glen are unattractive in spite of the fact that coal seams do occur on the west side of the valley below the road down from the pass of Bala Gali. The Saighan series continue south, up the Chail valley and are seen, still in a disturbed condition but without good coal seams, on the western side of Chail lake. Coal seams are, however, exposed on the way from Chail lake to the Sabz Kotal, Kotal-i-Sauzak of Hayden (35°35' : 67°39'). One seam immediately below, south of, the bridle path is exposed in a stream barely one and a half miles east-south-east of Chail lake. It is over 6 feet thick, strikes north-west and dips south-west at

at 60°. The analysis is given below. Hayden found the best seam of his tour in this vicinity, Kotal-i-Sauzak, in a 10-foot seam to the left of the road (he was coming from Ao Khorak). His coal gave the analysis B below:-

IV

	A. 6-foot seam Sabz Kotal	B. 10-foot seam Kotal-i-Sauzak
Moisture	11.14	7.20
Volatile Matter	33.22	29.41
Fixed Carbon	46.34	61.10
Ash	9.34	2.29
Caking property	nil	Slight
Sulphur	?	0.49
Specific Gravity	1.469	?

These may be from the same seam. My sample was from a stream bed and thus the high moisture is fully accounted for. The area in question is very difficult of access and was the limit of Sir Henry Hayden's exploration. The Sabz Kotal or Kotal-i-Sauzak appears to be the boundary of Dara Yusuf in Afghan Turkistan and Kamard and Saighan in Kabulistan.

27. (1). As Khorak (35°33' : 67°41') lies in an open valley through which the Saighan series are exposed from the saddle of Sabz Kotal to beyond where the road from Chail turns south for the Pas Kucha Kotal. The lower part of the beds containing the coal seams occur on the northern side of the Ao Khorak valley and are disturbed and broken and weathered, but the higher strata dip steadily southward. Presumably the lower beds beneath these, say in the Jindikol side-valley up which the road from Chail passes, will also be undisturbed though at some depth. It will be a point to prove by boring how deep the coal seams lie at Jindikol, halfway from Ao-Khorak-i-Bala and Pas Kucha, and also their quality. Hayden took a sample from a crushed

6-foot seam below Ao Khorak and the analysis of this gave:-

	Coal, 6 feet seam, one mile east of Ao Khorak
Moisture	7.20
Volatile Matter	30.26
Fixed Carbon	38.10
Ash	24.94
Caking property	nil
Sulphur	0.87

Although this analysis looks unattractive it is to be remembered that the coal measures comprise more than one seam and that in places where the strata are contorted it is the best coals which crush most easily. Furthermore, the Saighan coal seams are known to occur at Ishpushta and west of Doab-i-Mekhzarin, and Sir Henry Hayden found them on both sides of the river below Hajar village (35°21':67°31'). He found coal shales in this vicinity and did not then think a boring necessary to see if better seams occurred below. Hajar is over 16 miles due south of Chail lake, and the Hajar valley opens eastwards through Kamard and ultimately joins the Kunduz-Bamian river at Doab-i-Mekhzarin. Hayden also recorded the occurrence of thin coal seams in Saighan near Khwajaganj (35°12' : 67°45') at Delchi (35°11' : 67°45') and again in Begal (35°11' : 67°30') about Khargin Dara (35°12' : 67°27'). In these two cases the coal found was both thin and poor in quality from the evidence of the exposures seen. Finally it is to be remembered that the country to the west has not been explored.

Part III. - The Mineral Resources of Afghanistan.

28. Coal: The most important mineral for Afghanistan is coal. In the preceding pages it has been made clear that so far as eastern Afghanistan is concerned no extensive deposit of good quality coal of workable thickness has been, nor appears likely to be, found south of the Hindu Kush. On the other hand it has become equally clear that there is an extensive coal-bearing formation with thick seams of good coal north of the Hindu Kush, but that in most of the exposures seen the coal is so crushed and disturbed as to be unworkable. The recorded exposures of these good coals are relatively few in a very large area in which the coal-bearing strata is known to occur, so that it seems unduly pessimistic to give up hope of finding these thick seams of good coal in an undisturbed condition. It is not sufficient to visit isolated areas at considerable distances apart and from the data secured deduce where workable conditions may be expected. It is necessary to search the country by geological surveying and so unravel the behaviour of the various rock formations and to decipher the structure in which the strata now occurs. By so doing it will be possible to trace the coal measures clearly and, I have little doubt, locate some area where the conditions for working are relatively attractive.

When it is remembered that one foot of coal over (or under) one square mile of area represents a million tons and that a 10-foot seam in the same area will be 10-million tons, it seems difficult to believe that in a stretch of 100 miles and a width of several miles, where several seams of 10 feet and more have been seen, a few workable areas with considerable reserves will not be found. Griesbach estimated 50 million tons in one seam in 9 square miles in the Shisha Walang area, but this still requires proof that it is all workable. However, the potentialities seem very

gre-

great and there is no doubt that, if the beds were not folded, the exposed and hidden coalfields of Afghanistan would hold workable supplies computed at several thousand million tons. From the geological data collected by Griesbach, Hayden and myself, I feel confident that the severe folding has been restricted to certain definite and narrow zones. It would follow that outside these belts of folding the coal measure strata will be less disturbed and the problem is to find such areas of coal seams at a workable depth.

29. Iron Ore: Sir Henry Hayden and others have discussed the iron-ore occurrences briefly and it would appear that the chief iron ore belt lies south of the Hindu Kush and follows a strike oblique to the axis of this range. There seems to be a convergence in strike from some deposits near Kalu (34°40' : 68°2') south of Zohak in the Bamian valley, through Ghorband and Ashawa (35°5' : 69°10') to near Parwan or Jabul-us-Siraj (35°7' : 69°14') and on north-eastward into the Panjshir valley. I can say very little about the iron-ore belt as I did not see any very great workable deposit in the lower Ghorband valley, near the first bridge from the Kohistan end, where the motor road to Bamian from Kabul crosses it. As I made the crossing no less than four times and still did not see what I would consider attractive deposits the good occurrences must be in lenticular deposits within the hill-sides away from the road. Hayden himself remarks that - "The masses and bands of hematite would yield large quantities of ore, which could be obtained at comparatively little cost. At the same time no individual deposit appears to be very extensive. Information as to the quality of the ore must await the results of complete analysis".

The conglomerate bed of the Red rocks seen under the ruins of Kala-i-Zohak contains pebbles of hematite of excellent quality, but the quantity of ore is relatively small. Incidentally this occurrence shows that the main hematite bearing

bearing rocks were subject to erosion in Upper Cretaceous time so that a very large amount of iron-ore must have been removed and swept away. However, a great deal definitely remains in the iron-ore belt indicated. One large outcrop was located by Sir Henry Hayden a mile up the small stream that flows into the Ghorband river near the first bridge 4 miles above Matak where the river debouches from the gorge. The bed strikes north-east, with the enclosing slates and limestone, and dips 80° to the south-east. It continues for 200 yds. and is 50 feet wide. Assuming a depth of 100 feet this deposit alone will contain about half a million tons. This is not a large quantity so that other deposits must be located and tested. Furthermore, it is much more satisfactory to work from one great deposit rather than shift the source of supply frequently. This is specially necessary in country where transport is difficult. For this reason attention must be given to the supposed immense deposits on the range north-east of Kalu (34°40' : 68°2'), and to the north of the Kotal-i-Hajigak (34°38' : 68°4').

30. <u>Lead-ore</u> or Galena: The lead mine of Faranjal (35°1' : 68°41') was not working when I passed through the Ghorband valley, but it has been described by Hayden. The lead ore occurs in brecciated (broken and re-cemented) limestone, but no survey of the mine appears to have been made and so it is impossible to estimate the trend of the ore. Smelting operations, using charcoal, were conducted locally in small open hearth furnaces capable of working a charge of about 10 lbs. of ore. Hayden also mentions occurrences of galena 3 miles east of Lolinj (34°55' : 68°38'); at Chilan (34°56' : 68°43') in the Parza valley; near the head of the Chap Dara in Bamian; and at the head of the Khorak valley in Kamard. He says, however, that the Chap Dara and Chilan occurrences are trifling and

and of no economic value.

Copper ore: Hayden mentions a small copper ore deposit in the Kimchak valley in Ghorband, but considered it of no economic value. I visited a worthless copper ore deposit at Kalai Fatih about 3 miles north-west of Kot-i-Ashru where a German engineer appears to have found time to dig out 8 tons of rock carrying copper pyrites in two years. None of the material seems to have been concentrated or smelted, i.e. the expenditure was as usual in these circumstances a dead loss to the State. Hayden visited a similar deposit in this vicinity in the Konakhumar valley in Maidan - possibly the same occurrence as mine.

Gold: Griesbach had discussed the gold mines of the Qandahar area and Hayden refers to a mistake where pyrite was mistaken for gold in an occurrence of galena in the Parzø valley. I had no personal contact with any gold mine in the areas I visited.

31. Salt: Perhaps one of the most important minerals now being worked in Afghanistan is salt at the mines about 5 miles north of Namakab (36°36' : 69°27') barely 20 miles east of Khanabad (36°40' : 69°6') in Badakhshan. From here the blocks of rock-salt are carried on donkeys and sometimes on camels westwards to Khanabad and southwards through Ishkamish, and finally across the Hindu Kush to Bamian, Ghorband, and Jabul-us-Siraz (Parwan) for disposal in those markets. Some donkeys make the full journey to Kabul before their load of salt is disposed of. As the journey often takes more than a month, the price of the salt in Kabul is many times that charged at the mines. I visited these mines and it appeared to me that very large quantities of salt are available and that the mode of mining could be made considerably more efficient without any increase in the cost of extraction, and it is evident

evident that with the system of motorable roads now available and in process of construction the salt could be cheaply transported to any of the places mentioned above.

Gypsum: Hayden records the presence of large quantities of gypsum, and of the ornamental variety Alabaster, at Dasht-i-Safed and in the vicinity of Ishpushta. There appear to be several other localities where this mineral is found and a small trade in carved work is now established. The manufacture of Plaster of Paris was conducted with the local gypsum which seemed quite suitable for the purpose.

Serpentine: A handsome serpentine occurs near Balula and at the confluence of the Bamian river and the Shambal which flows in from Balula (34°52' : 68°5'). A small trade in the manufacture of beads for prayer necklaces is in existence and a few tons of serpentine have been brought through to Peshawar by lorry during the last few years.

Lapis Lazuli: The famous mines of Natural Ultramarine or Lapis Lazuli (called Lajward in Pashtu) occur in Yamgan, Badakhshan. The exact locality is in the vicinity of the confluence of the Kuran and Manjan rivers above Lajwar Shui (36°14' : 70°50') up the Kokcha valley 40 miles, roughly, south of Jurm (36°49' : 70°50') which is about 16 miles south east of Faizabad. The mines were not at work in 1936 but stocks had been accumulated in Kabul where a cutting and polishing factory is operating. The finest material is a splendid blue, but the selling price in Kabul suggests an exaggerated idea of the value of the stone. I did not visit the mines.

Sulphur: Sir Henry Hayden mentions that sulphur in considerable quantity is found in the hills on either side of the Kamard river at Dasht-i-Safed. The sulphur

occurs

occurs in small nodules in a shale band, which grades to a fetid limestone, overlying a thick bed of gypsum. Traces of sulphur occur elsewhere, as at the thermal spring near Sadmarda (34°20' : 68°42'), but this is deposited from the water and the quantity involved is thought to be small.

32. Limestone: Tufa and massive limestone occur in large quantities in eastern and northern Afghanistan. Practically all the stone lime made in the Kilns around Kabul is calcined tufa gathered from deposits in the vicinity. Little or no use has been made of the more massive limestone such as that of Jagdalak in which the rubies occur, or that of the fossil limestone of the Shambal gorge, or again the Cretaceous limestones which occur so extensively north of the Hindu Kush in Afghan Turkistan and elsewhere. Limestone for lime or cement manufacture could probably easily be arranged for almost any site chosen for such works. The failure of the cement plant at Kabul is not due to any fault in the raw materials, but to deficiencies in the plant erected for the manufacture of cement.

Marble quarries have been opened in places where suitable crystalline limestone is available as near Nazarabad (34°27' : 70°21') 6 miles west-north-west of Jalalabad, and again in places 20 miles south-west of Kabul, but in neither case is the demand regular enough for systematic working. The same remark applies to some of the fine-grained compact Cretaceous limestone north of the Hindu Kush. Some of this material would make excellent Lithographic stone.

33. The authors of "A Brief Survey of Afghanistan" (1313 A.H.S. 1934) give a mineral map of Afghanistan which shows almost a complete alphabetical list of minerals available in the country. Such items as Aluminium, Nickel,

Nickel, Silver, Tin and Zinc are largely imaginary or refer to amounts of scientific interest only. Further minerals such as Asbestos, Graphite, Mica and Soapstone require closer examination to establish whether the material is available in quantity of a marketable quality. Other minerals again such as Amythest, Beryl, Quartz, Ruby and Tourmaline belong to the class of gemstones and it is exceedingly doubtful if the Afghan material could ever sell in competition with similar jewels of foreign origin. Taken "by and large" as the Americans say, the actual mineral wealth of Afghanistan, as revealed in Museum specimens, in the bazars and in the ornaments of the people is relatively small. This does not mean that the mineral resources of the country are small, but the evidence establishing rich mineral occurrences has yet to be produced.

The first consideration of the minerals of any country is naturally that of the precious stones known to occur in it. In this case gemstones are an unlikely source of considerable revenue. The next group of minerals are those involving the more valuable metals - gold, silver, copper, lead and zinc - and here again the actual results so far have been disappointing. Salt stands out as a definite requirement and so the mines continue to produce cut blocks of rock-salt which are carried far and wide. Building stone and cement-making materials are available, but the greater proportion of the people either live in mud houses or in tents or similar portable shelters and even in caves at certain seasons in the higher ranges. Except at Kabul in a small way there is little evidence of a mineral industry involving the use in large quantities of coal, iron ore, limestone, sulphuric acid, and similar substances where iron and steel are made and cement and other products manufactured either for domestic consumption or export.

PART IV: - General Considerations of Survey.

34. The purpose of my deputation to Afghanistan was to give advice in connection with the development of a colliery in the Lataband Pass. This investigation was carried out on the 14th May, 1936, and my adverse opinion on the quality and quantity of the so-called lignite near Dahangai (Lataband) was verbally given to the Afghan Minister of Commerce in Kabul on the 16th May. The 15th May was a holiday in Kabul. On the 19th May I began a general tour of all the known coal localities on behalf of the Government of Afghanistan with a view to giving an opinion on each occurrence as regards development. This tour was undertaken with the full approval of the Government of Afghanistan who provided me with a guide-interpreter - Agha Muhammad Isan (see Photograph III) - and made all arrangements for these visits. Details of the various coal occurrences have been discussed in Part II of this report, where notice was drawn to the wide area in which the Jurassic (Saighan series) rocks had been found. Particular attention was given to the fact that these beds contained attractive seams of coal in places as wide apart as Shisha Walang and Narin - over 100 miles.

35. C.L.Griesbach had already focussed attention on Shisha Walang half a century ago, and Sir Henry Hayden, by a process of elimination showed that the hopes for large supplies of coal in Afghanistan, so far as he had been able to examine the country, lay north of the Hindu Kush. I think I have made it abundantly clear in the previous pages that in my opinion a quest for coal around Kabul and in eastern Afghanistan generally is simply a waste of time and money, and has been so ever since Sir Henry Hayden and Dr. Walter Saise visited Afghanistan 30 years ago. It is equally evident to me that the possibilities for finding a

a valuable workable coalfield in Afghan Turkestan or at any rate north of the Hindu Kush are definitely encouraging. It was not possible in the course of rapid traverses, without suitable maps, to work out the details of geological structure, but what I was able to discover indicated that the coal-bearing strata were not everywhere crushed by foldings also that by a very careful survey gently inclined beds, perhaps with hidden coal seams, might be found, and, subsequently proved by boring.

36. Although many areas in Afghanistan are geologically unknown and the whole country requires a careful examination by actual mapping yet a great deal of information is now available in regard to the mineral resources of the country. If I may judge from the data at my disposal - from various reports dating back a century, from the evidence of the minerals displayed in the Commerce museum, and from my personal observations and enquiries - I must reluctantly conclude that the mineral resources cannot be considered attractive. It is true a long list of minerals has been proved from various exposures, but when these are examined in detail they are often found to be optimistic reports quite misleading to a mining engineer. No occurrences of bauxite are known so that the reduction to aluminium with the abundant hydro-electric power resources of the country cannot even be considered. So far as I know chromite and manganese deposits of suitable quality and in sufficient amount are also not known and thus the hopes of electric smelting and the preparation of special steels belong to the realm of dreams. If petroleum may occur in Cretaceous strata there is a remote possibility of oil in one or two areas I visited, but if the petroleum of the Oxus basin is associated with Eocene strata then even these expectations must be greatly modified.

37. There cannot be any doubt regarding the vast amount of energy running to waste in the streams of Afghanistan, but, owing to the bare hillsides of the valleys in which the rivers run and the softness of the rocks, almost any shower of rain converts the streams into veritable rivers of mud. To cope with this silt and also to attain storage most hydro-electric sites will require expensive storage dams, and so the initial outlay may be higher than what may at first appear likely. In consequence of this the cost of the electric energy will be greater even to a nearby consumer, but if the hydro-electric works can be so located as to be certain of water, as at Jabul-us-Siraj (Parwan), then there may be the cost of a long transmission line to a large city or industrial area, as in the case of Kabul. However, water may yet be one of the greatest mineral assets for power purposes (as it already is for agricultural needs) that Afghanistan possesses. Questions of water storage for irrigation refer specially to sites for dams in some of the gorges in Afghan Turkistan where ideal conditions exist in several places - as at Tashkurgan and south-west of Mazar-i-Sharif.

38. The efforts of the devoted few, both Ministers of the Government of Afghanistan and others, who have given up their whole energy for improving the conditions in the country, command the respect of their neighbours in India, Persia and in Russia. They have to guide their people - a deeply religious, democratic and manly nation - with the utmost tact and wisdom to an appreciation of the benefits of progress. The dawn has already come in Afghanistan, where motor buses can run through the Shikari defile, though the Hindu Kush, safely and make the journey from beyond Mazar-i-Sharif to Kabul in under three days, and continue to Peshawar in two further days. Already the camel and the donkey begin to look out of date along the motor roads as a

a means for transport. The habit of stopping a bus by signal is as familiar now on the Afghan roads as it is in India, and it seems quite certain that the construction of railways along the main routes will meet with no other difficulties than those of the mountain sides and river crossings. With cheap and rapid transportation it will be impossible to make any real industrial progress in Afghanistan because the essential factor coal must be made available. Pittsburg, the Birmingham of America, developed into the great iron smelting centre it is today, simply because means were provided for the efficient transportation for 1000miles of the iron ores of Mesabi and Wisconsin to the coalfields of Ohio.

39. Mineral industries develop best in the vicinity of coalfields. This is especially true in the case of the heavy industries - iron-smelting and steel-making operations The fabrication of iron and steel products follow when these metals are available at small cost where fuel is also cheap and abundant. In the case of cement works it has generally proved more costly to take the limestone to the coal and so the fuel normally comes to localities where good limestones occur if cement is made. In Afghanistan the resources in limestone are inexhaustible from a practical point of view. Deposits of good quality hematite have been marked down in definite localities where large supplies can be cheaply worked. The only mineral of this trio about which an uncertainty exists in regard to an assured supply from a definite area of easily worked seams is coal. There is very good evidence for believing in the existence of large reserves of coal in Afghan Turkistan, but owing to its remoteness and the absence of maps, the coal occurrences require more detailed examination, both by geological surveying and proving by bore-holes, before a final opinion can be given as to the most suitable area for development.

Shisha Walang is probably the most attractive area we know of and Griesbach estimated over 50 million tons in 9 square miles in one seam 6 feet thick. This area probably holds at least three distinct seams each over 10 feet thick but I was unable to satisfy myself as to the area in which the seams could be worked in undisturbed strata.

40. I think I have now made it clear that there is every reason to believe that ~~existence~~ extensive coal-bearing strata occur in Afghanistan north of the Hindu Kush, and that large deposits of good workable coal may reasonably be expected if carefully looked for by geological mapping. It is my opinion that if the Government of Afghanistan intend to create iron and steel industries they must have railways and this means assured supplies of coal. If my understanding of the situation is correct then surveys along the proposed railway alignments must be carried out, and topographical maps of the region in which the coal-measures occur must also be made available. I think the expectations justify a serious and exhaustive geological survey of the Jurassic coal measure series in the area Dara Yusuf, Hajir and Saighan by Kamard into Haibak. The area is roughly 3600 square miles and could be rapidly surveyed by triangulation and plane-table and followed up by careful geological mapping. The geological survey spread over three field seasons of 6 months each should yield a map of considerable detail, but as the geological structure appears to be fairly simple it is almost certain that conclusions as to the location of coalfields would probably be arrived at much sooner. In this event the geologist could be diverted to other economic problems - e.g. sites for dams, advice on railway alignments, reserves of iron ore, etc.

41. Practically all topographical, geological and mineral surveys in Afghanistan have been carried out by

officials

officials of the Government of India, by European travellers or by experts engaged by the Afghan Government. After what I have seen regarding the useless exploration of the copper mine near Kot-i-Ashru, the failure of the Kabul cement works, and the inefficiency of Herr Baumgartner; and also after all I have read by German and other writers on the geology of Afghanistan (which is either based on the work of Hayden and Griesbach or is inaccurate), I am certain that enormous sums of money have been simply wasted on worthless work. My opinion is that if a serious attempt is to be made to develop the coal resources of Afghanistan the topographical and geological surveys should be made by British surveyors and geologists. In the case on which I am specially advising - an area of 3,600 square miles . southward from Dara Yusuf and Haibak to Kamard and Saighan - the topographical maps would be quickly made after a rapid plane table and trigonometrical survey of the area. It might might be quicker and even cheaper to carry out an aerial survey. If the former method seems suitable the Survey of India might perhaps be approached for the personnel. In the latter case the Air Survey and Transport Co. Ltd., Dum Dum, could do the work with great efficiency.

42. With regard to the services of a geologist for the tract indicated above, 3,600 square miles, I think a very careful survey of the whole tract would take 3 working seasons of 6 months each. But it is probable that a suitable area for boring and the development of a good coal mine will be discovered long before the entire area of 3,600 square miles is examined. Furthermore, as the geological structure is not complicated and two chief formations are involved - the Jurassic (Saighan) series and the overlying Cretaceous strata - the rate of survey might be faster than has been estimated by concentrating on the outcrops of the Jurassic rocks. To be quite safe it would be advisable

advisable to engage a geologist for 3 years. He could be selected in London by the Director, Geological Survey of Great Britain or secured from the Geological Survey of India. In both cases, and I think the latter more suitable, it would be wise to place the geologist under the control of the Government of India for pay and passages, etc., but for it to be understood that he was the servant of the Government of Afghanistan. In the winter months he could return to India and remain at the headquarters of the Geological Survey of India and devote his time to teaching two or three assistants from Afghanistan. This recess period might also be utilised for making visits to collieries, copper mines, mica mines, iron smelters, steel works, potteries, cement and paint works in Bihar and Bengal. The terms for the geologist can be arranged in accordance with the rules for pay and allowances, which excluding travelling expenses, would be of the order of £1500 a year.

43. The question of securing a boring expert would be easily dealt with if such a man was obtained in India and recruited with two or three assistants who are expert drillers. These men together with two sets of core-drills capable of boring to a depth of 600 feet should nominally be placed under the orders of the geologist. He would indicate where borings were required and in this way prove conclusively the depth, thickness and quality of coal seams in concealed strata. The boring machines would prove invaluable for other work such as obtaining water in the areas where alluvial deposits absorbed the surface waters or where the surface waters were unpotable. The Afghan Government already possesses a drill which has been found to be complete but which requires a more efficient crown for rapid drilling in hard rocks. This drill had lain unused for several years until inspected by myself and found to be more or less complete. It was put together and tested

tested by Mr. Rees, the Garage Superintendent of the British Legation at Kabul with the generous permission of the British Minister. By so doing, the British Minister had saved the Afghan Government purchasing a new drill for possibly Rs. 15,000.X

44. The question of communication and transport makes the Dara Yusuf region unattractive from the point of view of people in Kabul. At present the motorable roads are via Charikar and the Shiber pass to Bamian on the one hand and Mazar-i-Sharif via Doab-i-Mekhzarin and Haibak on the other. An extension southward is necessary from Pul-i-Barak via Chapchal and Kala Sarkari (Dara Yusuf), and a new road from the south via the Ak Robat pass and Hajir from Bamian. A better route to Kabul from Bamian than by Ghorband would seem to be by a new road via Zohak to Kalu and so over the Kotal-i-Hajigak to Gardan Diwal and so by the Unai pass eastward. Even by this shortest route, assuming a motorable road constructed, the distance from Shisha Walang to Kabul will be nearly 250 miles.X For a 5-ton capacity lorry the petrol consumption may be 5 miles per gallon or 50 gallons each way say 100 gallons or 900 lbs. of petrol as an excessive figure. Economy would be effective by using heavy oil in diesel engines, but still the carrying capacity of the lorries is small and the journey would take at least two days. For a delivery of 20 tons of coal a day roughly 20 lorries would be required, of which only 4 would be arriving each day. Some economy may be further effected by having steam-driven, coal-fired lorries of 5 to 6 ton capacity. They would probably require 3 lbs. of coal where 1 lb. of oil was suitable and each journey might require over a ton of coal, going and returning inclusive, so that less than 4 tons, in a 5 ton lorry, would be discharged in Kabul. This will mean a fleet of something nearer 30 lorries for a safe delivery of 20 tons

of

of coal a day in Kabul. The outlay will be in the neighbourhood of Rs. 4 lakhs Indian for the steam lorries for the supply of roughly 6,000 tons of coal in Kabul annually. It is difficult to estimate the working costs now as all the figures are merely tentative and subject to considerable modification by the lorry manufacturer and the vendor of crude oil for the diesel example. I think the subject of railway construction is thus worthy of consideration.

Part V. - The immediate need for fuel in Kabul.

45. After completing my tour of the coal occurrences of Ghorband and those north of the Hindu Kush with a view to arriving at a general conclusion regarding the potential coal resources of Afghanistan, I was favoured with an interview by the Prime Minister, H.R.H.Sardar Muhammad Hashim Khan, on the 17th June, 1936. His Highness had been kept informed of the conclusions I was obliged to come to after each examination of the places I had been taken to see, including those of Lataband (Dahangai) and Ghorband (Faragard). While satisfied with the possibilities of development at Ishpushta, Narin and especially Shisha Walang, the Afghan Prime Minister stated that the necessary exploration by geological mapping and by boring would take time. He was anxious about the present requirements and emphasised the necessity for a large supply of fuel for domestic purposes, for the burning of bricks and limestone for building materials in Kabul. The most pressing need was for coal for brick and limestone burning especially during the next three years. The annual requirements for Kabul and its suburbs were computed as -

(a) 8,000 tons of lime, at about Rs. 8/- (Indian) per ton at Kiln.

(b) 50 million bricks, at about Rs. 7/8/- (Indian) per 1000 at Kiln.

a limited period if the mine was managed by a first class colliery manager. The question is whether the large percentage of sulphur, 2.5 per cent., in the fuel would affect the bricks and lime and render these products unsatisfactory for good buildings. On visiting the brick and lime kilns in and around Kabul it was quickly seen that the kilns which used wood fuel could not be adopted for coal without absolute reconstruction. It was also discovered that a continuous type of coal-fired brick kiln had been constructed and used when Ghorband coal was available a few years ago. The kiln was abandoned and could not be restarted without Indian workman so that I was unable to carry out a test with Lataband lignite. No such test appears to have been made previously and I have not since heard if any trial has been made. Data of this kind are not easy to obtain except by trial, but on theoretical grounds the sulphur would combine with iron compounds and cause fusion at somewhat low burning temperatures. Also in the presence of calcareous matter the sulphur would combine with lime to form gypsum in the form of 'plaster of Paris'. It is evident that in the one case the bricks may fuse in burning while in the other case the lime made by burning limestone with a high sulphur coal may be quick setting. These defects do not appear very serious and it was for this reason I thought that the Lataband lignite might be used, while available, for brick-burning in continuous kilns and separately for lime burning in specially designed kilns.

48. The subject of limestone and cement deserves separate notice. At present a tufa limestone is burnt for lime in the Kabul valley. The kiln employed is of the circular, squat, shaft-type using brushwood and camel thorn largely as fuel in the basal portion or hearth of the kiln. Above this on a grid arch blocks of the limestone are placed and

could be best carried out by the manufacture of a reliable cement, not necessarily Portland cement, and that all construction be carried out in concrete instead of with indifferent bricks and relatively poor lime. I saw the derelict cement factory at Kabul and was prepared to go into the matter of its failure if provided with the plans and files, as I had little time to go into the question section by section in the works without details. There is no reason why a fair quality cement should not be made very cheaply from local materials and the available fuel to provide the concrete necessary for the building requirements of Kabul. For special work imported Portland cement will of course be necessary as is the case at present. I made enquiries why the cost of imported Portland cement at Kabul should be Rs. 170/- per ton while it is only Rs. 47/- at Quetta, and found that the price included an item of Rs.40/- which should not exist and could be rectified by enquiry. As regards the remaining Rs. 123/-, I should imagine the price F.O.R. Peshawar might be quoted at Rs. 63/- and that it is a matter of transportation economy to reduce the remaining Rs. 60/- very considerably for a distance of 200 miles of which over 160 miles is in Afghan territory.

50. All the suggestions made in these concluding paragraphs are put forward with a view to meeting the requirements of Kabul as expressed by His Highness Sardar Muhammad Hashim Khan, the Prime Minister of Afghanistan. And I would add that as a further measure of assistance I offered, while in Kabul, to obtain through friends in the Jharia and Raniganj coalfields not only advice on mining and boring plant, but also the men to work them. I have since been assured that it will be possible to provide one or two colliery mining engineers, several under officials and skilled miners or mechanics including drillers, as well as experienced brick-makers and lime-burners. I made it clear that

that such men should be specially chosen and of particularly high moral character, and that their future re-employment in India would be influenced by their behaviour during their period of contract. Also such men engaged in India would, allowing for the special conditions of their employment, draw salaries comparable to those of equivalent standing in Afghanistan. In conclusion I must add that it must not be forgotten that these are make-shift suggestions to tide over a short period of three or four years while Kabul is being re-built and a new industrial regime is being established. It must, however, be clearly understood that in the meantime steps must be taken to prove and develop those potentially large coalfields to which attention has been drawn in this report. It may even be necessary, as in many other countries, to encourage the natural growth of the heavy industries in the coalfields, and not be blind to the facts presented by trying to establish such works in and about Kabul. The construction of railways seems a fundamental matter, as without cheap transportation it will not be possible to establish any large industry on economic and profitable lines. In Afghanistan there are possibilities for electrifying the railways with power from hydro-electric sources, but it is certain that cheap coal must be a dominating factor in the industrial development of Afghanistan and no such coal appears likely to be found within a radius of 150 miles of Kabul.

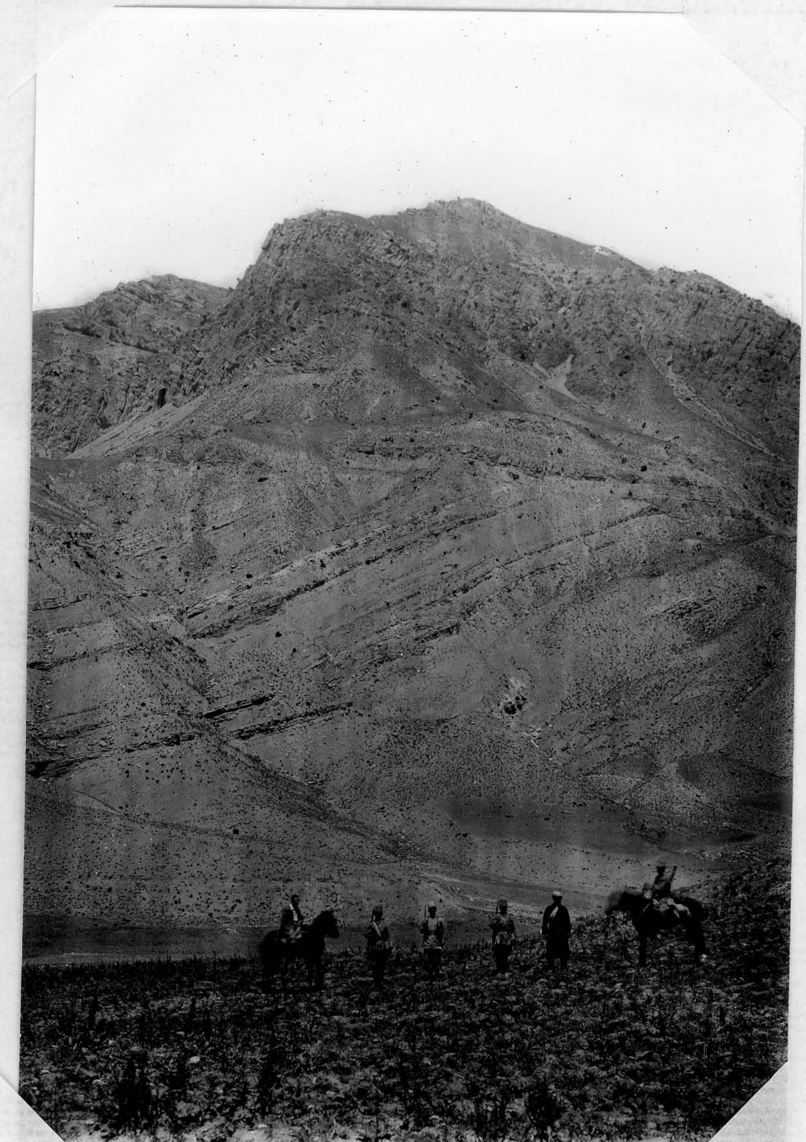
Cyril S. Fox
18. September, 1936.

Photograph I.

View from Ishpushta looking north-east to Barfak along the strike of the coal-bearing Saighan series.

تصویر ۱

منظره از اشپشته که به سمت شمال شرق تا برفک بموازات سمت لایه‌های زغال‌دار سیغان امتداد دارد.



Photograph II.

View looking north-west immediately south of the Chahildukhtaran gorge and showing the Cretaceous rocks unconformably overlying the Jurassic coal-bearing strata.

تصویر ۲

منظرهٔ شمال مغربی نقطه‌ایکه قریب به جنوب دهانهٔ چهل دختران واقع است و سنگهای کرتاسین را

که بالای طبقه ذغال‌دار ژوراسیک قرار دارد نشان میدهد

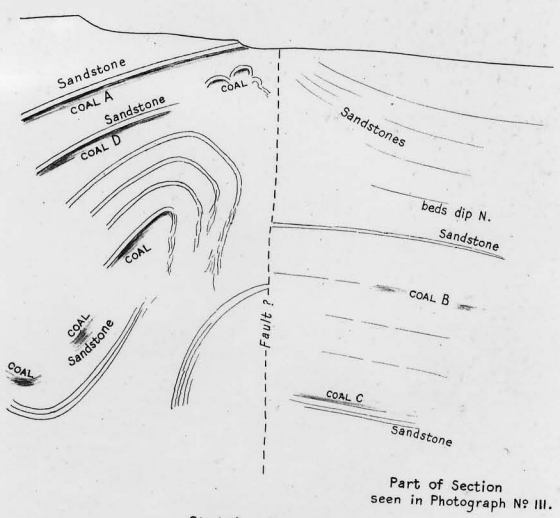
Photograph III.

Cliff with coal seams at Jhari Soktha in Shisha Walang. The two men on the slope are standing at points B and C from which samples were taken.

تصویر ۳

تپه سنگلاخی که بمقام جهاری سوخته در شیشه ولنگ رگه‌های ذغال سنگ در آن معلوم میشود - دو نفر که

در نشیب آن بمقامات (ب) و (ج) ایستاده‌اند از اینجا نمونه‌های ذغال گرفته شد



Sketch of cliff face
view looking N.W. (height of cliff 600 feet)

Sketch of Jhari Soktha cliff showing twisted coal measures. Coal samples were taken from A, B, C, and D. The positions of C and D are also seen in Photograph III where the two men are standing one below the other.

رسم تپہ سنگلاخی جو شکستہ طبقات سنگین دنداں را نشان میدہد۔ نمونہ ہای دندان از طبقات ا۔ ب۔ ج۔ د گرفتہ شد۔ طبقات ج و د نیز در تصویر ۳ دیدہ میشود کہ در آنجا دو نفر یکی عقب دیگر ایستادہ اند۔