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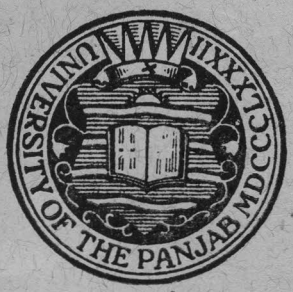

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CONTENTS

OROGRAPHY AND DRAINAGE OF THE POTWAR PLATEAU

BY

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POTWAR is the name of the country lying between the Soan river and the northern slopes of the Salt Range in the north-west of Western Punjab. Currently, however, the name has been applied comprehensively to the whole undulating region lying between the Indus and the Jhelum and stretching from the Salt Range northward to the foot-hills of the Himalayas. The Potwar, thus, embraces the major portions of Attock, Rawalpindi and Jhelum Districts and the northern tract of Khushab Tahsil of Shahpur District.

Sometimes referred to as the Rawalpindi Plateau in older records and also as the North-West Table-land of the Punjab, the Potwar Plateau covers an area of about 11000 square miles. It extends from 32′ 23″ N. to 33′ 48″ N. latitude and from 71° 37′ E. to 73° 46′ E. longtitude. Physiographically the Potwar marks the border of the Indo-Gangetic plains province but its geologic position is characterised by the close proximity of the mobile Himalayan belt to the northern rim of the Indo-Pakistan land mass of which the Salt Range is an advance outpost. This position accounts for most of its physiographic and geological peculiarities.

To the geographer, the Potwar affords an extensive field of observation and study. Within this compact region there is a wide variety of orographic features, an interesting climate, a very close inter-relationship between land forms and the biological response and finally a most illuminating interaction between man and his environment. It is an attractive hunting ground for geologists. The reasons are threefold :

(*i*) Excellent rock exposures due to arid climate.

(*ii*) Unique opportunities for the study of stratigraphy (exposed strata contain unmetamorphosed, fossiliferous sediments ranging in age from Cambrian to Recent).

(*iii*) Deposits of salt, petroleum, gypsum and coal.

An outstanding structural feature is the synclinal formation of the plateau. The Soan basin which covers most of the Potwar is a geosyncline, over 100 miles long and 30 to 40 miles wide. The Soan is the relic of a much older and larger river which was once continuous with the Indus and possibly connected it with the Ganges and Brahmaputra.

The mineral wealth of the Potwar gives new emphasis to the study of this area for the part it may play in the growth and development of the West Punjab where it is the only region of mineral importance.

The Potwar Plateau is bounded on the north by the Kala-Chitta Range crossing the Attock and Rawalpindi districts from east to west from Indus to near Golra. At the eastern end of the Kala-Chitta Range about five miles further north, another range rises to form the Margalla Hills. This and the Sub-Himalayan hills right up to the Jhelum constitute the northern boundary of the Potwar area.

The Salt Range, extending in an irregular arc from a few miles south-west of Jhelum to the Indus River at Mari Indus forms a relatively abrupt scarp to the Potwar area in the south.

The Indus and the Jhelum rivers are natural and well-marked boundaries to the west and east respectively.

The area thus bounded is the Potwar Plateau. With a height averaging from 1500 to 2000 feet and scarcely any plateau-like scarped edges, the application of the term plateau would sound arbitrary. Many geologists, among whom H. D. Terra and T. T. Paterson are prominent, prefer to call this area a peneplain on account of the leading part played by erosional and depositional processes in shaping its relief. On the other hand, the height of the area, its enclosure by mountainous ranges in the north and south and above all its topography which fluctuates within a few hundred feet quite justify the application of the term 'Plateau'. Coupled with the fact that this term

carries the stamp of tradition and long usage we may well subscribe to it.

In the following account, the bounding ranges towards the north and south have been included. They merge so naturally in the region and have such deep and far-reaching affinities with it, both topographical and geological, that their exclusion would render the account far from satisfactory.

The Potwar plateau may be clearly divided into three natural units :—

1. The northern Ranges and Ridges.
2. The Soan Basin.
3. The Salt Range.

The Northern Ranges and Ridges.

Prominent among these are the Kala-Chitta and Margalla Ranges the whole of which fall within the compass of this study. Further east, the continuations of the parallel spurs which constitute the mountain system of Rawalpindi district can be included as the northern border-hills of the Potwar. Of these the lowest and the most easterly, the Utrina Ridge, also falls within the region, being quite apart from the main Himalayan mountain system. South of the Utrina Ridge, there runs along the bank of the Jhelum a ridge of rough sandstone hills which may be termed the Jhelum bank Ridge. These form the Northern hilly border of the Potwar and may now be considered in trun.

Most important of these is the Kala-Chitta Range. Starting from the bank of the Indus this wall of hills is shaped like a rough wedge with its base resting on the Indus and gradually tapering as it proceeds eastwards till it dies away within three miles of the western extremity of the Margalla Range. Its breadth at its base is 12 miles and it is 45 miles in length. The range is formed of two portions which are of a different character and appearance and also explain the nomenclature (Black and White Range).

The south-western portion is formed of very dark sandstone which is originally purple in hue but has been

almost blackened by exposure to wind and water. On account of this predominantly dark appearance, this section is called "Kala Pahar" or black mountain. Extending along the southern side right from the Indus it stretches for 35 miles and has an extreme breadth of 4 miles.

The Chitta or white hill constitutes the main protion of the range and runs its entire length on the northern side. Its breadth at its base on the Indus is 8 miles. This portion is formed of white nummulitic limestone, hence its name. Out crops of dark sandstone are occasionally found here and there.

The range is composed of sharp steep ridges with deep valley between them. Ranging between 1,500 to 3,000 feet in the main, the greatest height attained by these hills is 3,521 feet within four miles of the Indus. Many of the peaks lie between 2,000 and 3,000 feet. Some valleys are quite broad *i.e.*, the ones occupied by Ganda Kas and Kali Dilli hamlets. The hills are much lower towards the east. Here they are rolling ridges rather than hills. But the general surface is throughout broken and irregular.

The Margalla Range rises gradually a few miles north of the eastern extremity of the Kala-Chitta Range and attains a height of 2,490 feet. Further east, 15 miles from north-west of Rawalpindi, it is crossed by the Margalla Pass. It rises again and continues in a north-easterly direction. It maintains a height of above 3,000 feet which rises to a maximum of 5,266 at a point right on the West Punjab, N.-W.F.P. Border. Several peaks are above 4,000 feet. The ranges rise suddenly from the level plain below and derive from the steepness of its sides a somewhat impressive appearance. The Margalla Range is a continuation of a spur of the Hazara Hills and terminates on the east at the Kurang River.

Eastwards lies a continuation of the Charihan Spur which in the Rawalpindi Tehsil is a long, narrow strip. It finally degenerates into lines of sharp rocks starting up suddenly from the surrounding level country. An extension of the Patriata Spur, a long narrow ridge which carries the Thamair Rakh, may also be included. Here

the northern boundary is the Murree Tehsil boundary. The Thamair Rakh ridge has a maximum height of 3,178 feet. Further east the Kotli Spur is broken through by the Soan which passes through a wild and picturesque gorge terminating at Pharwala. Across the Soan, the ridge continues in the bare and forbidding rockey ridges of Kirpa and Bhambartar. Between the boundary of the Murree Tahsil and the town of Kahuta lies another hilly section with an average height of over 2,500 feet. East of Kahuta the Utrina ridge separates the Potwar from the Himalayan system. This is nowhere more than 3,800 feet in height, The Jhelum bank ridge which is situated to the south of it is about 3,000 feet higher than sea level and gradually diminishes in height till it loses itself in the low hillocks south of Bagham.

The Soan Basin.

South of the bordering ranges and ridges towards the north and extending right up to the northern slopes of the Salt Range lies this undulating tract drained principally by the River Soan and its tributaries. Occasionally referred to as Soan Syncline (on account of its synclinal shape) this region is on an average about one thousand feet higher than the alluvial plains to the south of the Salt Range. It varies in height between 1,000-2,000 feet except for a few ridges of bare rock which rise higher. Some of these are often mere vertical walls, rough, jagged, and narrow, there is only one mural ridge of any considerable size, Khaire Murat (sandal-shaped), which runs south-westwards from the neighbourhood of Rawalpindi. This is about 24 miles long and reaches to a maximum height of 1,500 feet above the adjacent country. The general slope of this region is towards the west and the Soan descends from a height of over 1,800 feet where it emerges into the plateau below Pharwala to less than 900 feet where it discharges its contents into the Indus. The tract is very much broken up by innumerable deep ramifying ravines called "Khaderas" which are a result of destructive erosion of the rain water, giving the area a typical tableland topography. These extend rapidly as is attested by the isolated remnants of the neighbouring level areas included among them.

The descent from the mountainous portion in the north is accomplished through a tract which is hilly and sub-

montane in character. This is not homogeneous in character since only detatched parts can be really termed hilly and it is usual to find stretches of more or less level fertile country in an area described as "broken and hilly throughout." In the Rawalpindi district this transitional region extends in a great horse-shoe from west to east. An area more jagged and rough than the neighbouring tracts is the Kharora, extending from the western border of the District to the Rawalpindi Cantonment, south of Margalla range. The underlying rock is frequently exposed particularly in ravines, and the area has an average height of 1,800 feet. A high ridge of rock runs across this circular tract for many miles in a north-south direction, ending near the Rawalpindi Cantonment. The ridge is a sandstone rampart tilted vertically on the ground, some 40 feet high and only a few feet thick. This is known as a Chir-Phar Ridge or the split hill.

The tract along the Murree foot-hills is termed as Kaccha and has a Mue submontane character. The Kandhi extends from Rawalpindi to Kahuta.

The general characteristic of this tract is the low hills and outcrop of rocks from the Murree Hills on the north and thus is reflected in the name Kandhi or bank referring to the foot-hills of the Himalayas.* Barring a comparatively level plain in the west, sandstone ridges run across the region from the hills of Murree and Kahuta, splitting up the country into valleys and plateau ravines and gullies scar the country into a desolate waste south of Rawalpindi. Further east lies the Kahru ilaqa named after the inhabiting tribe, hilly in nature and composed of pebble ridges occasionally rising into prominent hills. The hills are low towards the south and consist of sandstone. This ilaqa is the most rugged portion of the submontane tract.

The valley of the Soan in this region deserves separate notice. It is a narrow strip of pebbly alluvial hills. South of the Soan, however, the pebbly ridges are less frequent and the country merges into the main part of the Soan basin.

In the Attock district, the submontane region is largely absent for the reason that there are no mountains

* Rawalpindi Gazetteer, page 6.

towards the north. Only minor ranges are seen. The Narrara or Makhad Hills south of the Kala-Chitta Range hardly deserve to be called hills being only an agglomeration of pebble ridges on the bank of the Indus and nowhere higher than 1,822 feet. Their general trend is from east to west. This is a very bleak, bare and wild tract.

The Khaire Murat ridge is the most important of the resistant walls of limestone and sandstone which rise above the Soan Basin. Geographically, it may be said to be a continuation of the Chir-Phar Hill in Rawalpindi. Beginning on the border of the Attock district, it rises abruptly from the plain or either side and attains to a height of over 3,000 feet. It runs in a south-westerly direction for about 24 miles, a steep, dreary, impassable barrier and dies away in a series of small spurs running to the bank of the Soan river. Its strata are vertical, largely contorted due to extreme dislocation.

Southwards of this transitional zone lies the vast expanse of the Soan valley, a wilderness of ravines in most parts, cut by torrents and divided into fantastic shapes. This is a plateau by virtue of its height and although there are fertile tracts in between torrents and along the Soan and its main tributaries, a wild fretwork of small ravines and gullies gives the country a very broken and rugged appearance.

The valley of Soan itself consists of a broad and sandy bed flanked by wide stretches of rich alluvial loam with villages clustering closely along the banks. The land on both sides is however scoured by the deep beds of the mountain torrents which descend from the Salt Range or from the northern ridges. Prominent among these are Sil River, Bhianwalia Kas, Janai Kas and Lei Nala from the north and Ankar Kas, Wahn Kas, Kundwali Kas, Gambhir Kas, Paneand Kas and Panehara Kas from the south. The general aspect of the terrain is bleak, dry and stony. The innumerable ravines that have no order or method, wind and intersect over the region, cutting it up into a net work. The ravines are of various sizes and depths. Sometimes they are scoured out of sandstone rock underlying the soil while sometimes they are deep fissures in the loamy surface. Generally, these have no names or the name is different at different places. The

larger ravines which receive surface drainage and carry water after rain are known as Kas or Kassi according to whether they are large or small. The smaller ravines have no torrent bed and are scoured out by surface drainage alone. These are known as "bhura" or dry ravines.

Each area between two torrents has an arch-like surface, descending steeply towards the channel on either side. Near the large torrents the slopes are abrupt and the surface more rugged and dreary. The underlying rock always crops out at the water-shed which shows that it is not very far from the surface throughout the entire plateau. Wherever the ground becomes broken up, the overlying soil is almost entirely washed away by rain-water unless specially banked up. This erosive destruction of the soil by rains is the outstanding problem of agriculture. In some instances the lands near the torrents are the best which is the case only when the stream runs in a more open channel. Unfortunately such areas are neither very numerous nor extensive.

All the characteristics of aridity and bleakness common to the region culminate in hills near the Indus which extend from the Soan to the Reshi in the north and rise to a height of 2,000 feet.

The Soan basin is the most extensive and typical section of Patwar and constitutes the Potwar proper. It has as area of 7,000 square miles.

The Salt Range

The Salt Range forms the southern boundary of the Potwar and is topographically the most interesting section of the whole region. Rising abruptly from the low plains on the south it forms a precipitous escarpment overlooking the "Thal". Its eastern end lies in close proximity to the Jhelum. After running parallel to the course of the river in a south-west direction and at a distance from it nowhere greater than 12 miles, it takes a sudden turn north-westward opposite the town of Khushab. It now gains in elevation which culminates in the peak of Sakesar (4,992 feet)—Thence onwards it dwindles speedily to a low narrow ridge and turns more towards the north till it crosses the Indus near Kalabagh.

The Range starts in two almost parallel series of hills, the northern one known as Bakrala Ridge and the southern one as Tilla Hills. The latter has a continuation in hillocks of Batali Daer, which run right up to the Jhelum. Near the river, they are locally known as the Lehri Hills. They have the characteristic Salt Range aspect of being generally scarped on the southern side and sloping rather gently towards the north. They have, however, undergone slight lateral displacement. The average height of both Bakrala ridge and Tilla Hills is about 2,500 feet. The highest peak of the former is Sar (3,031 feet) and that of the latter Jogi Tilla (3,200 feet). Between them they enclose the uplands lying mainly in Jhelum Tehsil which go locally by the name of Khuddar or country of ravines, "a *name certainly well-deserved, the surface of the whole tract being broken and distorted in a way which it is hard to realize without seeing it." Its average height is 1,200 feet. Whatever the superficial differences between this tract and the flanking uplands of the Salt Range, the two areas are nevertheless essentially homologous. Only in Khuddar, the peculiar hydrography and lower level has resulted in incessant and excessive Denudation.

The Barkala ridge merges beyond the Ghora Gali Pass into the great mass of Diljabba which rises abruptly out of the plain country of Lundi Patti. The Tilla hills terminate sharply on the Bunha torrent. They continue boyond in the Wah hills which rise very steeply. They continue southwards for some distance but turn abruptly towards the north-west near the town of Jalalpur. They now swing round in a giant sweep to the northward till they reach the village of Phadial. This whole region has obviously been subjected to great upheavals as these abrupt turnings indicate. Further west, the range attains a height of 3,701 feet in the peak of Chel. The range now proceeds in a west south-west direction.

In Tehsil Pind Dadan Khan, the Salt Range again assumes its peculiar aspect running in two parallel lines of hills separated by a distance of five miles or more inner distance. Each of these hills consists of a number of parallel ridges which have a tendency for looped formation. At intervals of about 10 miles the two series of hills merge in a knotted mass. They then again separate and run

* Jhelum Gazetteer, page 7.

parallel. This is observable throughout the range as also in its separate components, though less regularly. The two parallel ranges have a height from 2,500 to 3,700 feet and enclose a number of plateaux, fairly level and having an elevation of 2,000 to 3,000 feet. Towards the south the range descends abruptly to the Jhelum valley showing a monotonous series of parched and barren slopes. Northwards it slopes more gradually towards the Soan Basin. The eastern end of the Salt Range has a decidedly subdued and tame topography but westwards, as the Limestone rocks become prominent, the range looks rugged and aggressive with lofty cliffs and deep narrow gorges.

The same general arrangement is traceable westwards as the range enters the Shahpur district, west of a junction of the two parallel ranges near Sodhi, they open out considerably and run at a distance of 16 miles across. They again narrow down to meet in the Sakesar hill. The ranges enclose high-lying valleys as usual, the most important of which is that of the Sun. This lies immediately to the east of Sakesar, with a length of 14 miles and breadth of 4 miles.

West of Sakesar, a remarkable feature is that the direction of the whole range change abruptly from south-west—north east to north-west north. This occurs following a sudden contraction for a distance of nine miles. It now loses greatly in height, the average being only 1,727 feet. The width is about two miles or less. Beyond the narrow part the range expands into the Tradian Hills reaching to within a few miles of the Indus and having a maximum width near Swat of 8 miles which diminishes as the Indus is approached. The average height of the Tradian hills is 3087 feet with the highest point at Tradian (3477'). The Punjab Salt Range terminates in a few salt hills of which Mari Hill near Kalabagh is most important.

The series of Plateaux enclosed by the parallel ranges from the Jhelum westwards up to Sakesar is very notable, these forming the only habitable areas in an otherwise dreary and barren region. These plateaux are, from east to west, the eastern plateau (Khuddar country), Danda Plateau, Kahun Plateau, Malot Plateau, Nurpur Plateau and the Sun or Western Plateau.

The range is traversed by three or four principal passes situated near either end. In the extreme east the Bakrala pass in the ridge of the same name carries the Grand Trunk Road and is situated at a height of 1,400 feet. The Ghora Gali Pass near Diljabla is a gorge of the Bunha river situated at a height of 1,309 feet. The long pass of Choa Saidan Shah following the deep valley of that name carries an old route from Pind Dadan Khan northwards. The last of these passes is from Namal to Musakhel above the right bank of the impassable Musakhel ravine.

Throughout its length of 152 miles, the Salt Range has been considerably influenced by flexure and fracture, the two prominent results of disturbance. Its aspect is everywhere typical, showing steep declivities and lofty escarpment cliffs towards the vast plains and deserts towards the south, but descending by gentle undulations towards the plateau to the north.

Drainage.

The drainage system of the Potwar is simple in pattern, all streams finding their way either to the Indus on the west or to the Jhelum on the east. The watershed lies towards the east, starting from the Narar plateau and passing through Kahuta, Mandra and Chakwal. Occurring over the Nili Hills it makes the eastern end of the Salt Range as well as the Khuddar country drain towards the Jhelum. The rest of the Potwar Plateau discharges its waters into the Indus mostly through the Soan which is the most significant local stream. The Indus and the Jhelum are the main hydrographic features of the region.

The Indus fringes the Potwar on the west and is a very large and powerful stream. It enters the region as a mighty river after having received the Kabul above Attock and the Haro twelve miles below. It cuts its way through the plateaux and the intervening ranges through a deep narrow canyon, running swiftly with occasional rapids. At Makhad the Soan brings in most of the drainage of the Potwar. It emerges from the gorge near the salt-built town of Kalabagh and spreads out in an open network of channels over an alluvial fan. Southwards it spreads out to a maximum breadth of 13 miles. The river is navigable right up to Attock. With a total

catchment area of 103,800 square miles mainly in the Himalayas, the mighty river has a copious flow throughout the year. There is a considerable difference in the summer and winter discharges. In August, it has a maximum discharge of 1,000,000 cusecs, the lowest being 9,000 cusecs which is reached late in winter.

As compared to the Indus, the Jhelum is a smaller river. It rises in Kashmir at Verinag and flows for about 250 miles as a racing rapid torrent hemmed in by precipitous rocks and lofty mountains. Eight miles above the town of Jhelum from which it takes its name it debouches from the hills and becomes a braided river. Sandy islands called 'bels' stud its wide bed. The Kahan joins the river below Sadr Cantonment and the Bundha below Darapur bringing the drainage of the eastern part of the Potwar. It then continues a south-westerly course. Its maximum discharge at the peak of the rainy season is 600,000 cusecs which dwindles down to a minimum of 4,000 cusecs in winter. The river is subject to occasional destructive floods. It is navigable conveniently up to Jhelum and is used for floating timber from the forests up in the mountains.

The Soan is also known as Swan or Sohan, the principal local river of the Potwar and rises just below Murree in the village of Musiari. Flowing due south between the Murree and Patriata ridges, it follows a tortutous way through picturesque valleys. It then cuts through the Narar Spur, making a magnificent and rocky gorge one mile in length, emerging below Pharwala into the plains. Above Pharwala it is just a mountain torrent with a narrow boulder strewn bed. Further down it spreads over a wide bed only a small portion of which it fills when not in flood. The stream is everywhere fordable except at times of flood when communications are completely cut. It is a turbulent stream with a complicated network of ravines stretching back for miles on either side. Its banks are wild and steep flanked by sandstone cliffs and ridges of pebbles. It is notorious for its treacherous quicksands throughout its course in the plateaux. In Rawalpindi district the principal tributaries are the Ling River on the east which brings the drainage of the whole mountainous portion of Kahuta, and the Kurang and the Leh on the west. The former collects the drainage of the Murree

foot-hills and parts of Margalla range. The Leh rises in the Margalla range and drains the country lying to the north of Rawalpindi. In Jhelum district the Soan flows in a south-westerly direction. The Khunala, the Dhrab, the two Ghabirs, the Draggar, the Ankar and the Leti are the prominent 'kases' or torrents of note which all descend from the Salt Range. To their east is a notable series of feeders, the Karahi, the Bhagneh, the Sauj and a fourth stream all of which join the Soan at Dulla which has earned the name of Panchnad (five waters). They all have high, steep banks and wilderness of ravines on their sides. Occasionally as in the case of the Ankar Kas, the valley widens giving a prosperous well-drained tract.

In Attock district, the Soan follows a westerly course and receives the drainage of all the country south of the Khaire Murat Ridge. Among its tributaries to the north is the Fatehjang Sil, draining the southern slopes of Khaire-Murat as well as the country towards its south. The Wadala is the fourth stream which joins the Soan at Dulla (the local Panchnad). It is a confusing fretwork of ravines, on its upper reaches in Rawalpindi but broadens out into a wide sandy channel. The Pindigheb Sil (no connection at all with the other Sil) is the only tributary of any importance in this district. It originates in western Khaire Murat, receives drainage from a multitude of small streams which cover a very large area. The Tallagang Tehsil to the south is drained by numerous Kases all flowing north-west. The principal streams are the lower courses of the streams already mentioned in connection with the Jhelum district. They are all fringed by the confused mass of ravines and gullies which characterise the whole region.

The Jhelum drainage system consists mainly of three torrents—the Kanshi, Kahan and Bunha, apart from a multitude of minor "kases". The Kanshi rises in the Kahru Ilaqa and flows south, receiving numerous small tributaries on the west. All of them have high banks with sandy or stony beds. The Kahan drains the centre and east, Jhelum Tehsil. It starts at Domali from a confluence of numerous branches flowing down from the Nili Hills. Piercing through the Tilla ranges it enters the Jhelum below Sadr Cantonment. The Bunha issues out on the north side of the Salt Range. After receiving

the entire drainage of the eastern part of the Chakwal Tehsil, it flows through the Ghora Gali pass across the west of the Khuddar country. It then sweeps through a gap in the Tilla hills and immediately below spreads into a broad, sandy waste which is being extended yearly by its torrential floods. Here its bed is more than two miles across.

The Reshi is a minor stream draining the Kala-Chitta on the south. The northern slopes of the Kala-Chitta and Margalla ranges drain into the Haro River while the southern slopes of the Salt Range discharge their waters principally into the Nilawan and the Kas Kaula.

The upper courses of all these streams display a typical youthful character, the Indus through its gorge, the Jhelum up to its debouchment into the plains, the Soan above Pharwala flow through young valleys where vertical erosion is more prominent. In their lower stages they are mature, meandering streams. With the exception of the Jhelum and ot the Soan to a lesser extent, the innumerable streams are hill torrents with swift, rushing courses through narrow, steep-sided valleys. The drainage could in one sense be termed dendriatic since far from getting simplified, further dessication of the soil results in over-elaboration of drainage courses. It is interesting to consider Wynne's belief that the drainage is antecedent in character. "It" (the drainage), he writes, "is distinguished for its cross country character, preferring in many cases to intersect the hilly or mountainous ranges rather than Soan, the most considerable local stream rises in the hills of Murree not very far from the Jhelum yet wanders away westwards to the Indus by a part of the Plateau which itself sends its affluents to the Jhelum River through the ridges of the Salt Range." He cites some other instances and concludes, "These peculiarities of the drainage indicate that its course was initiated more directly by agencies of elevation than by atmospheric weathering..... The directions of the streams were decided by much older contours than those that now exist at the surface."

Lakes. Among the hydrographic features of the Potwar, lakes also figure. In the centre of the Salt Range in the Sun Valley which lies between the two parallel components of the range, the surplus drainage collects in

the Achhali lake (Kahen) locally called the "Samundar". The area of the lake averages 2000 acres, rsing to over 2500 acres in years of heavy rainfall and dwindling with the dry season. Its water is salty. A few miles further east is the Khabakki lake the area of which also varies with seasons and rainfall, its highest being 595 acres and lowest 146 acres. The corresponding figures for a smaller lake at Jahlar are 84 and 44 respectively. These are also salt lakes. There are other hollows at Khutakha, Pail, Bhadrar, Mardwal, Ugali and Shakarkot which are apt to be flooded. These lakes are in Shahpur district.

Close to the northern slope of the Salt Range in Jhelum district lies the Salt lake of Kallar Kahar about a mile across and four feet deep when full. It is remarkable that wells situated within a short distance of these salt lakes yield good, sweet drinking water showing they do not influence the underground water.

There are no lakes in Rawalpindi and Attock districts, only large marshes. The Hatti in Attock is generally known as "Jhil" and is over 600 acres in extent. The much smaller marsh in Rawalpindi district is the Khanna Jhil which consists of two small components of insignificant size.

LAND UTILIZATION SURVEY IN PAKISTAN: ITS IMPORTANCE IN OUR NATIONAL PLANNING: SCOPE AND METHOD

BY

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THE problem of a Land Utilization Survey is growingly attracting the attention of all who wish that land in any country shcuild be used by the inhabitants in the most scientific and economic way. This consciousness is a new one and in a country like Pakistan the meaning and scope of the subject needs elucidation.

Technically speaking the survey aims at studying how the inhabitants of a certain area are using or, for the matter of that, misusing the land at their disposal. The surveyor is interested not only in those parts of the land which are positively being used but also in those portions which are negatively utilized being left unproductive or unheeded. The chief aim in the survey is to get a precise picture of the local trerestrial environment. This question of land utilization is one directly arising from the growing consciousness in man to be scientifically informed of his immediate environment so that he may make adjustment or readjustment between himself and the physical setting for a proper security and progress. Naturally, in its emphasis on human adjustment to the natural environment, land utilization is predominantly a geographical problem and deserves the special attention of the Geographer.

Land Utilization Survey involves a threefold process. Primarily it requires a survey of any area on the spot with minutest details as regards land use and secondly the mapping of the details on large scale maps with such cartographical methods as may render their study easy and interesting, and thirdly a geographical interpretation of the maps correlating the present nature of land use to the physical setting and human conditions of the area, *viz.*, orographic structural, hydrographic, climatic, edaphic and social and cultural conditions. The interpretation will emphasise the proportion of land devoted to various uses and will dilate on the possibility and advantage of altering

these proportions in order "to secure a due balancing of the varied needs of all sections of the community."

The Importance and Advantages of such a Survey in Pakistan

1. There is a growing desire for the rationalization of agriculture in Pakistan so that every area of land should be properly utilized. By agricultural rationalization is meant the scientific cultivation of land. Certain areas may be continuing to grow food crops on them for a long time but it may be more economic and profitable to grow cash crops on them. Again, there may be poor fields now devoted to coarse grains. The same may profitably be utilized for grazing grounds supporting a healthy animal population and bringing a better livelihood to the people inhabiting the area. Likewise certain cultivated areas may be devoted to market or fruit gardens. But a haphazard reorganisation may prove risky. Unless we have land utilization maps giving an exact knowledge of the variety of uses to which the land is devoted we cannot carry on proper agricultural reorganisation.

If we look at the superintending Qanungo's Area Statement of any district we come across certain details about land use, but it is rather pathetic that such facts are mere undistinguishable jumble of items. The facts are too generalised and give no exact or specific information; for instance, under the head "Barren Land" we have a column "otherwise barren". This is not only uninformative but is rather misleading. In the column 'Culturable land' we have a sub-column 'Groves' which is too inadequate to inform whether they are orchards or market gardens or any other tree growth. They give no idea of land use. Similarly under the same head there is a column of "culturable waste." This again is inexpressive. Unless we have land-use maps we can form no idea of exactness or location. Consequently even if these facts in the Area Statement were correctly designated and elaborated the purpose of agricultural reorganisation remains unserved unless they are shown specifically on maps of land-use.

2. The Government have been conducting a country-wide propaganda of the "Grow more food". The ignorant agriculturist is baffled by such a catchword. He asks the

question, 'I am cultivating every piece of land, how to grow more'? And he is not at fault. To start such a campaign without making a survey of the present utilization of land (and then being able to conclude precisely the upper limit of cultivation) is like putting the cart before the horse.

3. The present position of Pakistan *vis a vis* population is unique. Our population is continuously on the increase and the standard of living being very low, the population problem is at present intimately related to food production. If we are able to grow more food there can be no menace of a growing population.

4. The country has another important problem concerning cattle and fodder crops. The inevitability of a healthy cattle population for a sound economic basis is being repeatedly emphasised. The cattle in Pakistan, however, have in general no permanent grazing grounds allotted to them. The farmer is not inclined to realize that those plots which yield a poor food crop can more profitably be devoted to fodder crops or grazing grounds for his cattle which may in turn produce better means of his livelihood. Certain semi-barren areas with irregular grass cover may be exploited for the growth of fodder crops or be devoted to permanent grass. But such an exploitation is difficult unless we make a survey and get a record of present land-use on paper and on maps.

5. The problem of afforestation as a step towards the improvement of our environments and for the various economic advantages that it carries is engaging general attention. Most of the forest resources of undivided Punjab have gone to the East Punjab and the question of Kashmir is still undecided. A carefully prepared plan for afforestation is necessary. But without a land-use survey it will not be possible to estimate the proportion of such areas which can be brought under afforestation schemes. Such areas as village wastes ravines, abandoned river beds and hilly slopes may be given to afforestation but we have no idea of such land unless we make a land-use survey.

6. As a measure of changing environment the land-use maps have a great historical value. If we make a land utilization survey now the maps will be a sort of "snapshot" picture of an area of a particular time. Ten years hence or some such period we can have another

"snapshot" picture of the same area. By comparison we shall be able to know how and where changes in land use have occurred. This comparative study of maps supplemented by an examination of the geographical environments *viz.*, relief geology, climate, and soil will give a correlated study of change in our local environment and proper readjustments can be made in the future utilization of land. Thus with land-use maps at our disposal we shall not have to depend only upon statistics, sometimes difficult to interpret, but shall have definite information as to any alteration which may have taken place in each parcel of ground.

A good deal has been said about the need and importance of a land utilization survey in our country. It remains to be suggested how this should be achieved.

Scope and Method

Dr. Dudley Stamp, Research Professor of Geography in the University of London, has been conducting a land-utilization Survey of the United Kingdom. Nine volumes covering 5801 pages have already been published together with numerous relevant maps.

Professor Buck has conducted Sample Surveys in Land Utilization in China. In Britain "the primary purpose of the Survey is to make a complete record over the whole of the Britain, of the use to which the land is put at the present time." The Survey of China is a generalised thing. We could combine the work done in these countries with modifications suitable for our needs and conditions.

In Britain where the people are more educated and have developed a high sense of discipline and patriotism by the voluntary co-operation of the public and the collaboration of the Ordnance Survey an intensive Land Utilization Survey has been possible. In Pakistan technical hands will be difficult to get while financial difficulties and lack of voluntary co-operation may create difficulties and hamper our work. So the Government will have to play an effective role in the organisation of the Survey. If the Government takes interest in a Land-Utilization, Survey, it could be undertaken. We shall need the co-operation of the educational institutions, Qanungos, Amins and Patwaries.

Conclusions

From what has been said above it will be clear that a land-utilization survey will serve a very useful purpose in our national planning and is in fact the only correct and realistic approach to the proper solution of our varied problems. It is, therefore, suggested that the Government of Pakistan may be advised to establish a Directorate of Land Utilization Survey of Pakistan with similar Directorates for the Provinces. The Directorate shall arrange for the training of personnel for a short period. We may have to appoint some regional Inspectors to supervise and co-ordinate the work. We may begin with simple surveys in selected regions and gradually expand the work to include the whole country. No permanent Surveyors will be required as the work can be done with the help of Geography teachers in various colleges.

A Map Section equipped with Cartographers and Draftmen well versed in map-drawing shall have to be attached to each Committee or Directorate to do the mapping. Necessary arrangements shall have to be made for the printing of these maps and reports. But the information collected in the field can be made immediately available for the work of planning without waiting for the printing of the reports.

A study of the environmental conditions including the type of land and the nature of soils, climate, hydrology and water supply (including the height of the watertable) should also be carried out along with the Land Utilization Survey. The Survey may also include the study of the population, its social and economic structure, the possibilities for the location of new towns and industrial sites and the conditions and extent of the resettlement and the rehabilitation of the refugees. The opportunity may also be utilized for the collection of some statistical data like the dates of sowing and harvesting, the number of cattle, ploughs and cart. The Survey should be carried on both in the Kharif and Rabi seasons. It will help us in making a better estimate of the conditions of land and the fluctuations of the water-table.

POLITICAL AND ECONOMIC ASPECTS OF KASHMIR

BY

MISS MUZAFFARI QURESHI, M.A.

THE twin State of Jammu and Kashmir was the largest in area amongst the native States in undivided India. It comprises four divisions :—

I. Jammu Province—divided into five Wazarats :—

(1) Jammu proper, (2) Udhampur, (3) Kathua, (4) Riasi, (5) Mirpur.

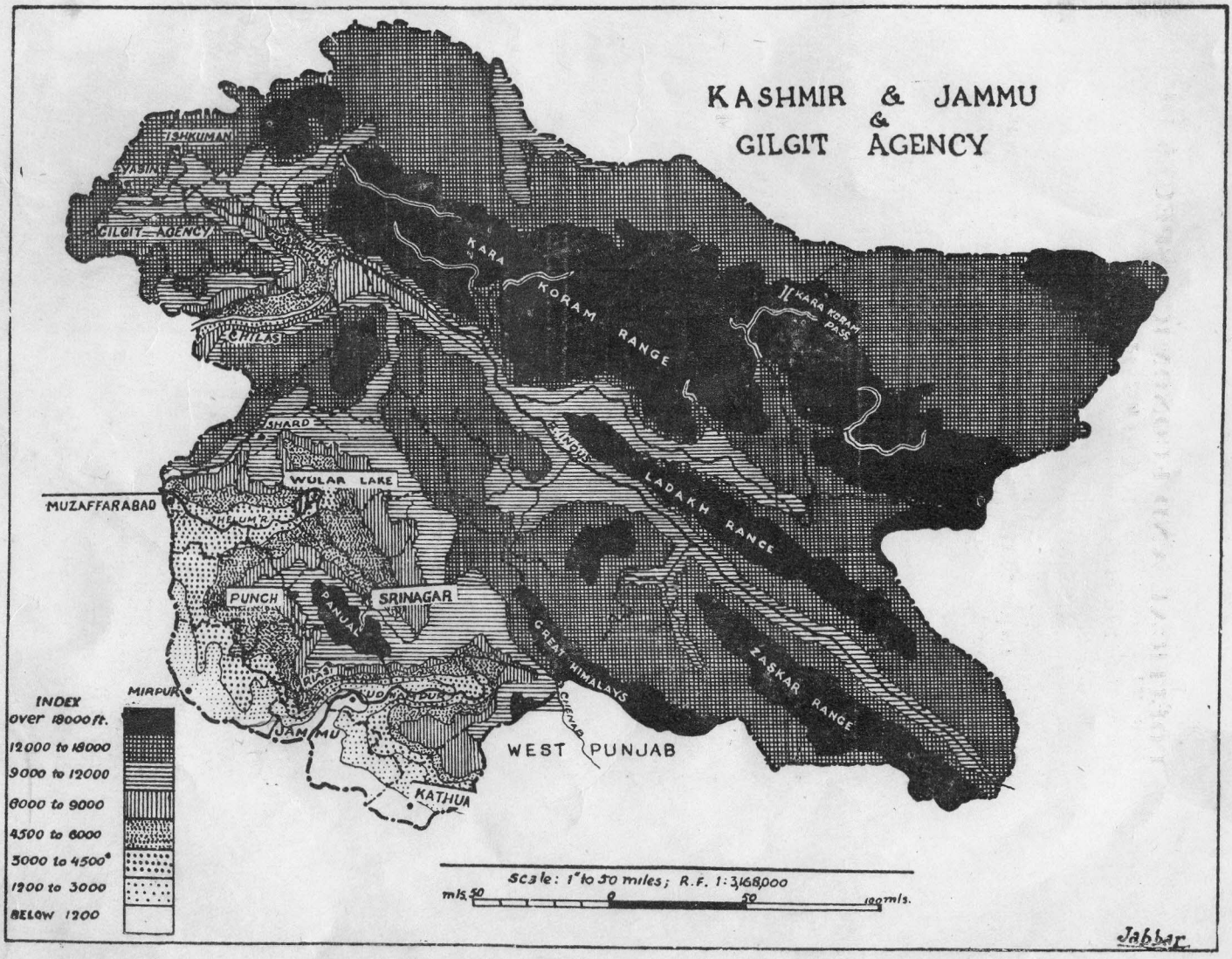
II. Kashmir Province :—Divided into three Wazarats :—

(1) Southern Division, (2) Northern Division (3) Mazaffarabad.

III. Ladakh.

IV. Gilgit.

Early records of the history of Kashmir tell us that it was ruled successively by the Hindus, Buddhists, and Huns till 1128. Then came the first Muslim invasion of Khan Dalcha in 1128 who perished in the passes on his return from Kashmir. Ramchand, the Commander-in-chief, thus retained some authority in the valley with two soldiers, Rainchan Shah (Tibetan) and Shah Mirza from Sawat. Rainchan Shah embraced Islam and became the first Muslim King of Kashmir. He died after a short reign of $2\frac{1}{2}$ years. Shah Mirza succeeded him and assumed the title of Shams-ud-Din. In 1394, Sultan Sikandar became the King. He is known by the name of "But-Shikan." It was in his reign that the inhabitants of the valley were infused with the spirit of Islam which they accepted later on. In 1420, Zain-ul-Abidin succeeded him, but his successors proved weak and their supremacy declined. In 1586 Kashmir was finally conquered by Akbar and remained under the Mughal rule for a long time. It was due to the Mughals that Kashmir was developed. Lovely, pleasure gardens were planted, canals and waterways were dug and beautiful buildings and


KASHMIR & JAMMU
&
GILGIT AGENCY
ISHKUMAN
YASIN
GILGIT AGENCY
GILGIT
CHILAS
KARA KORAM RANGE
KARA KORAM PASS
SHARD
WULAR LAKE
MUZAFFARABAD
JHELUM R.
PUNCH
PANJAL
SRINAGAR
LADAKH RANGE
GREAT HIMALAYS
ZASKAR RANGE
MIRPUR
JAMMU
KATHUA
CHENAB
WEST PUNJAB
INDEX
over 18000 ft.
12000 to 18000
9000 to 12000
6000 to 9000
4500 to 6000
3000 to 4500
1200 to 3000
BELOW 1200
Scale: 1" to 50 miles; R.F. 1:3,168,000
mls. 50 0 50 100 mls.
Jabbar

serais were constructed which greatly enhanced the natural beauty of Kashmir.

Following the decline of the Mughal Empire in 1751, Kashmir became served from Delhi. In the following years, it came under the Afghan rule. In 1819 Kashmir passed into Ranjit Singh's hands. By 1820 Gulab Singh had established his position as the local Raja of Jammu, in token of his services to Ranjit Singh. But, when the war between the Sikhs and the British broke out, Gulab Singh kept aloof and came into the scene only at the Treaty of Sabraon in 1846. According to this treaty the British sold to him the 'Happy Valley' of Kashmir for the paltry sum of Rs. 75 lakhs only. Thus without the knowledge and consent of the Kashmiris of whom 78% are Muslims, Kashmir passed into the Dogra Thraldom. It is against this unnatural serfdom that Kashmiris are fighting today.

Looking at the situation of Kashmir we find that it extends from 32° 17′ N to 36° 58′ N and 72° 26′ E to 80° 30′ E having an area of 84,471 square miles and a population of 4,021,000 souls (1941). Lying to the N. E. of West Pakistan, it is the largest of all the States in Indo-Pakistan. On the north it contacts with the Chinese and Russian Turkistan, on the east by the Chinese Tibet, on the south by Punjab and on the west by N.W.-F.P. and Yaghistan. Thus it is surrounded by the territories of five great powers *viz.*, Russia, China, Afghanistan, Pakistan and Hindustan. Contiguity of its frontiers with these countries make Kashmir of great strategic and political importance.

In order to consider the economic aspects of Kashmir we have to resort to its geographical set-up. The physical and climatic features are important, not only from the point of view of affecting the type of natural resources, but also in themselves directly they are the basis of a very important industry, that is, the Tourist industry. Kashmir may, thus, adequately be called the Switzerland of the East. The attractiveness of both these countries as ideal holiday resorts is indubitable.

Kashmir is unique in its picturesque beauty, presenting widely varying types of scenery, *e.g.*, the parallel

ranges of mountains, rising one after another, and reaching enormous heights, together with their glaciers and snows, extensive valleys at such high altitudes as 5,000 feet and numerous lovely lakes from which the rivers descend—Rivers without which the Punjab would have been nothing but a part of the vast desert stretching from the Sahara to the Gobi.

In relief Kashmir is an almost entirely mountainous region with a strip of level land along the Punjab border, and three main parallel ranges of mountains, *viz.*, the Pir Panjal, the Great Himalayas and the Karakoranis. The mountains belong to the Himalayan Region, the N. E. part of the State lies on the Tibetan Plateau, while the south forms part of the sub-Himalayan region. Physically the State may be divided into three parts:—

1. The part to the south of the Pir Panjal Range, is the lowest part representing a strip of the plain which is contiguous with the great level plain of the Punjab. It is 900 or 1000 ft. above the sea.

The Part between the Pir Panjal and the Great Himalayan Range.

2. The Pir Panjal mountains mark the northward boundary of the plains referred to above. They stretch from over Ravi in the south-east to the Jhelum in the north-west. There are three chief divisions of the range running more or less parallel to each other:—

(*a*) The first ridge on the south begins with a height of 100—200 ft. above the plains and reaches an altitude of 2000/3000 ft. above sea-level. On this ridge the Jammu City is built.

(*b*) Next comes a tract of rugged country which includes various ridges running parallel to the first one with long, narrow valleys between them. These ridges are 3000—4000 ft. high while the valley floors have commonly an altitude of 2000 ft. This and the outermost ridge is the region of the Outer Hills. On the south side these hills are barren but on the north side forests abound.

(c) After the Outer Hills, the tract of the Middle Mountains is reached, with altitude between 8000—10,000 ft. and covered with pasture or forest. These hills run in ramifications divided by equally ramifying valleys. Some of the valleys are as low as 2,500 ft. Next we come to the Vale of Kashmir. This is an outstanding feature of Kashmir occupying a section of the Jhelum valley, the Pir Panjal mountain rise steeply in the south of the valley, while on the north are the great Himalayas. The altitude of the vale is between 5000 and 6000 ft. It is a flat-bottomed depression about 100 miles long and 50 miles wide. It is different from most of the mountain valleys in being much broader and occupied by a lake—the Wular Lake. Srinagar, the principal town of Kashmir, is situated on the Jhelum which drains this valley.

After the vale of Kashmir lofty ranges follow called the Great Himalayas. These mountains first rise to rocky heights and then to the region of perpetual snow. This great chain of snowy mountains running south-east to north-wast divides the drainage of the Chenab and Jhelum rivers from that of the higher branches of the Indus. Its summits vary from 27,000 ft. down to 15,000 ft. The glorious peaks of Harmukh (16,890 ft.) and Nanga Parbat or Diyaviir (26,660 ft.) are situated in this range and are visible from Gulmarg.

3. The Part lying to the South of the Karakoram Range.

Beyond the Great Himalayan range there is a broad tract of mountainous country having high altitude. It is the north-western part of Tibet. Ladakh and Baltistan are divisions of it, and Gilgit also belongs to it physiographically. The mountains vary in height from 17000-22000 ft. Here lies the part K2, the second highest in the world being 28,278 ft. high. In the south-eastern part are the high-level flat valleys from 1—5 or 6 miles in width at elevations of 14000-15000 ft. From there north-westward, their height descends, and they become narrower, enclosed by lofty mountains up to the height of 5000 ft. In a few places there are tablelands surrounded by mountains, the most remarkable being the Deosai Plateau (12000-13000 ft.) and the Lingzi thang.

Then follow the Karakorams which are high mountains forming the frontier of Kashmir in the north. This range is continuous with the mountains on the north of Tibet and on the west they join the Hindukush mountains which separate Badakhshan from Afghanistan.

Climate.

As the elevations vary from 1200 ft. at Jammu, 5000 ft. in the Vale of Kashimir and 25000 to 26000 ft. on the highest peaks, the State presents an extraordinary variety of climatic conditions. On the whole the climate is invigorating. The local variations of temperature depend chiefly upon situation in a valley or on the crest of a mountain range, elevation, and amount of winter snowfall. The temperature ranges from the subtropical summer heat of Jammu, to such an intensity of cold as keeps perpetual snow on mountains. The variation is so great that in the lower parts the poor go almost unclad while in the higher, sheepskin coats are wanted for protection against the cold. In places the people are shut in by snow for 7 months in the year.

The element of moisture gives another variety to the climate. Based on these considerations, Kashmir can be divided into four climatic zones :—

1. The region including the outer Hills and the middle Mountains :

Here periodic rains prevail. The Jammu Province shares also the tropical heat of the Punjab.

2. The Vale of Kashmir :

The periodic rains do not reach here but there is enough rainfall for all crops except rice for which irrigation is required. The vale is behind the front ranges of the Himalayas and its climate differs materially from that of the plains. At Srinagar which lies in the centre of the Vale (5250′) the mean January temperature is 31 F. The warmest month is July, with the high mean temperature of 73 F. Thus the range of temperature is very large—42 F. a common feature of such enclosed basins. The air is alwaye damp, the mean monthly relative humidity ranging from 71% to 82% and is highest in the cold months. But the annual rainfall is comparatively small, only 27

inches. The driest months are October, November, and December, each of which has less than 2". The other months have about 3 inches each. The maximum precipitation is in the early months of the year and is derived from the winter depressions. The four months from Jan, to April have 14 inches, while the four months of the summar monsoon, June to Sept., have only 8". The summer monsoon does not give much rainfall beyond the outer ranges of the Himalayas. Most of the winter precipation is in the form of snow. Thus it is more influenced by Western disturbances than by the Monsoons.

3. Astor with some parts of Gilgit and Baltistan :

A semi-Tibetan climate. No crop can be raised without irrigation and the hillsides are for the most part bare. Rainfall is light, about 6 inches in the year and the air is dry and bracing. The snowfall is often considerable except in Gilgit. The snow is of great importance to the village as it provides water for irrigation. The cold is bitter, most of the rivers freeze and form natural roads. The climate in spring and autumn is mild but in July the heat in the villages along the Indus is very severe, though cool, compared with the climate of northern parts of Western Pakistan.

4. Parts of Gilgit, Baltistan and Ladakh :

The region has scanty population between altitudes of 9000-12000 ft. Below 9000 ft. there are impassable gorger, and above 12000 ft. the climate precludes agriculture. The mean armospheric pressure at Leh (11500 ft.) in the Upper Indus valley is about 20 inches. Mean annual temperature is about 41 F. Jan. Mean 17 F. while the four winter months have a mean below 32 F. The lowest temperature on record is —19 and the mean daily minimum in Jan is 90 F. The temperature rises rapidly as summer sets in. In July the mean temperature is 63 F. and mean daily maximum is 78 F. Thus the range of temperature is very wide Precipitation is remarkably scanty, the total for the year being only 3 inches, and no month has over $\frac{1}{2}$ inch. The maximum is in summer, July and August having half inch each. There is a secondary maximum in winter. The mountains round-about have a much heavier fall, and snow sometimes lies deep even in the valley in winter. Mean relative humidity is low, about 40% from May to November. In the winter months

at rises to 70%. The air is thus usually dry and always bracing.

Land Utilization.

Of the total area which is equivalent to 54,061,440 acres estimates of only 80,28,712 acres are given according to village papers. Of this 18,70,030 acres are under forests, 27,15,873 acres are not available for cultivation, 10,36,387 acres are other cultivated land excluding current fallow, 274634 acres are current fallows and 2,131,386 acres cover the net area snow.

Forests.

One of the greatest heritages of Kashmir is her richly endowed forests covering an area of 1,870,030 acres bringing an income of half a crore of rupees annually. These forests produce all the timber that is locally used, and is exported in large quantities to Pakistan. The principal species of timber are deodar, blue pine and fir. Exploitation of these forests is economical, because the trees are gregareous. Also the cost of transport is small because of the presence of rivers which float the logs from the forests down to the Panjab, and even to the sea at Karachi. Large timber yards are maintained at the town of Jhelum in the West Punjab.

Besides timber, an important product of the Kashmir forests is the medicinal plants. Amongst the most valuable of these medicinal plants is Kuth or Costus of which Kashmir is regarded as the original home. Besides Kuth there are others not used only by the herbalists but also in the Western medicines as pepperment and eucalyptus.

Numerous industries can be based on these forests but in their respect Kashmir has had a very late start. The possibilities of a match factory which could easily compete with any standard matches, seems to have struck people only lately. Thus only one factory exists at Baramula. A resin and turpentine factory has also been established. Pine resin used to be exported to places outside Kashmir where it was converted into turpentine

During recent years a new industry, that of the manufacture of willow goods, has come into existence and

is now fairly well established. Numerous varieties of manufactured goods are prepared, as chairs, sofas, teapoys, baskets, vases, trays etc.

Agriculture.

The importance and type of agriculture varies with altitude and climate. There are 2,131,386 acres under cultivation. Of this total Baramula leads accounting for 18·6 per cent. of the cultivated land. Srinagar accounts for 17·1 per cent, Jammu, 11·6 per cent, Mirpur 11·5 per cent, Puneh 9·5 per cent, Udhampur 8·2 per cent, Kathua 6·9 per cent. Riasi 6·5 per cent, Muzaffarabad 6·05 per cent, Ladakh 3·3 per cent, Chinani 3 per cent, and Bunji 2 per cent. These figures suggest the outstanding importance of Baramula and Srinagar in agriculture which together account for about 36 per cent, of the total. Next in importance come the districts lying in the Outer Hills and adjacent to the submontane tract of the Punjab. In the rest of Kashmir, *i.e.*, Ladakh and Gilgit, agriculture is only of local importance. The Kashmir Valley has accordingly been designated as the "cultivators' paradise"— the most fertile land.

Principal Crops.

Rice covers an area of 511,557 acres *i.e.*, 24 per cent.. of the total cultivated area. Srinagar and Baramula bad in average under rice. Production is far in excess of local needs, and thus large surplus quantities are exported. Kathua alone (fourth in average) exports 150,000 maunds of rice annually.

Maize comes next in importance though occupying larger area, 779,669 acres, 26·4 per cent of the cultivated land. Punch leads in production and is followed by Baramula and Muzaffarabad. The best soil is reclaimed swamp and enormous crops are raised in good years from the black peaty land which lies along the banks of Jhelum. Manures are applied only in the high villages where very fine crops of maize are grown. Elsewhere the very system of harvesting, that is leaving the stalks in the fields to rot thus, renders it unnecessary.

Wheat occupies an area of 5,28,296 acres *i.e.* 24·7 per cent. of the total cultivated. Mirpur and Jammu lead in acreage. As a rule Kashmiris are not very fond of wheat.

Barley contains an area of 57,078 acres *i.e.*, 2 per cent of the cultivated land. The most important state is the Udhampur which accounts for more than $\frac{1}{3}$ of the total acreage under barley. Next in importance comes Jammu.

Bajra is another important crop, from the point of view of acreage, occupying an area of 107,033 acres, 5% of the cultivated Jammu leads in acreage.

Industrial or Cash Crop.

Oil-seeds cover an area of 119,332 acres, 5·5% of the total cultivated land. They are of a great commercial value as a trade staple. The Kashmiris use it for cooking as well as for lighting. The chief oil-seeds are linseed, rape-seed, and sesamum—Baramula and Srinagar leading in all.

A certain amount of cotton is grown over an area of 24.358 acres (1% of cultivated land). The most important districts are Mirpur, Jammu and Kathua.

Sugarcane covers 6,733 acres, chiefly in Kathua and Jammu. The Saffron of Kashmir is an article of world fame. It is used as a condiment.

Fruits and vegetables have a combined acreage of 8658 acres, leading districts being Jammu and Srinagar.

Kashmir is a country of fruits. The indigenous apple, pear, pine, mulberry, currant and strawberry are grown in abundance in most parts of the valley. The Kashmir fruit is famous all over the world for its delicacy, flavour, and deliciousness. Walnuts of about 16 kinds, almonds of over 40 varieties, grapes, and numerous kinds of apple and pear represent the variety of fruits grown in the State. The only hinderance in the development of an important and profitable trade in fruit is the distance of Kashmir from the railway line. Mulberries grow wild everywhere, and are of great value on account of the silk industry. Amongst dry fruits almonds and walnuts are well known and their best varieties are grown.

Minerals.

Kashmir has sufficient mineral resources. Gold is washed from the sands of the rivers at Gilgit, Kirgil and

Skardu. Some of the precious stones as the Sapphires are considered to be the finest in the world. Crystal, jade, rubies and sapphires are all found in the State. The Kashmiris are adept in cutting stone and preparing ornaments with them, all being manufactured at Srinagar. The State authorities do not allow any scientific survey of this mineral wealth, but with a proper exploitation many other valuable ores can be found. The most noteworthy minerals discovered so far are bauxite, coal, copper, fullers earth, gold, lignite, talc, and zinc. There are indications of the commercial possibilities of developing the gold-bearing area.

Coal and iron deposits are found in the Riasi Tahsil. There is a mine of Sapphires at Padar. Salt in a crude form is dug up in Ladakh and is also obtained from the salt lakes there. Sulphur is mined at Purga in Ladakh and Chromium has been discovered in Dras valley.

Hydro-electricity.

There are three hydro-electricity schemes.

1. The waters of the Jhelum are harnessed a mile above Bunijar, about 14 miles from Baramula, and 15 miles from Srinagar. The headworks are situated $6\frac{1}{2}$ miles from the power-house at Mohora. These works have a capacity for carrying water sufficient for the generation of 15000 k. w. Two transmission lines run side by side for 21 miles from Mohora as far as Baramula, at which one terinates. The other continues to Srinagar for another 24 miles. The Baramula installation was originally utlized for dredging the river and for drawing the swampy countryside to render it suitable for cultivation. At Srinagar the line terminates at the silk factory where power is supplied for driving the machinery for lighting and heating.

2. The Muzaffarabad Hydro-electric installation utilizes a tributary of the river Kishangang. It serves the towns of Muzaffarabad and Domel.

3. The Jammu Hydro-electric installation. It has fine generating sets. One is driven by diesel oil engine and the remaining four are driven by water turbines. In addition to these, many schemes are in prospect in the zone of the Outer Himalayas.

Industries :—

Like the Japanies in the Far East, the Kashmiris are proverbially famous for works of art. These consist mostly of handicrafts like woollen, textiles, embroidery, work in silk and wool, hand-woven carpets, wood-carving, and metal works. These cottage industries have proved to be the very basis of the large scale establishments of to-day, which are divided into two groups :—

(1) Those owned by the State Durban amongst which the perennial establishments include two printing presses, one Silk Mill, and three miscellaneous. The seasonal ones are two turpentine and rosin factories, and four miscellaneous.

(2) Other factories include five perennial silk mills, four woollen carpets, and shawl weaving, three woollen mills, one chemical, two printing and book-binding etc., one carpentry and cabinet-making, one miscellaneous wood-work, one tannery. Besides these there are three seasonal woodwork factories and one miscellaneous.

The hand-woven carpet industry, and the silk industry are of world fame.

The abundance of mulberry trees, suitable elevations, and favourable climate have been responsible for the development of sericulture. This industry is the largest in the state, and the silk factory of Srinagar is the largest of its kind in the world. It brings in a large revenue to the State.

The hand-woven carpet industry is also one of the largest in the State. The annual production of carpets is valued at about 30 lacks of rupees. The trade is mostly with America and Europe.

Thus we see that nature has endowed Kashmir with varied resources and raw materials, which, when fully developed, can make Kashmir one of the richest countries of the world.

LEATHER TANNING INDUSTRY IN INDO-PAKISTAN

(Continued from Vol. III)

BY

SHYAM SUNDER BHATIA, M.A.

Production of Skins :—

The skins are derived mostly from two animals—the goats and the sheep.

Goat Skins:—The annual production of goat skins in Pak-India is estimated at 274·9 lakh pieces. Of these about 85 per cent. consist of slaughtered and 15 per cent. of fallen skins. U. P. ranks first in the production contributing about a fifth of Pak-Indian production.

ANNUAL PRODUCTION OF GOAT SKINS.*

Region.	Annual Production (in Lakhs).		Total.	Percentage of Indo-Pakistan Production.	Goat Population (in Lakhs).
	Slaughtered.	Fallen.			
Kashmir ...	2·4	0·7	3·1	1·1	6·8
Punjab ...	15·6	3·1	18·7	6·8	68·5
N.W.F.P. ...	5·7	Neg.	5·7	2·1	9·2
Sind ...	4·7	1·6	6·3	2·3	15·9
Rajputana .	14·1	7·2	21·3	7·8	70·0
W. States ...	6·2	1·2	7·4	2·7	13·5
C. I. States ...	3·8	0·9	4·7	1·7	7·1
Bengal ...	29·6	Neg.	29·6	10·8	57·6
Bihar ...	26·0	2·8	28·8	10·5	58·7
Orissa ...	3·0	0·3	3·3	1·2	6·0
Assam ...	1·2	0·3	1·5	0·5	7·6
Eastern States ...	5·8	2·3	7·1	2·6	10·5
Bombay ...	13·9	4·9	18·8	6·8	24·4
Madras ...	19·7	0·2	19·9	7·2	67·3
Hyderabad ...	14·3	2·0	16·3	5·9	33·7
Mysore and Travancore ...	3·9	Neg.	3·9	1·4	14·4
C. P. ...	9·1	2·2	11·3	4·1	17·6
U. P. and States ...	41·1	12·1	53·2	19·4	80·7
Other Areas ...	13·1	0·9	14·0	5·1	19·4
Total Indo-Pakistan ...	233·2	41·7	274·9	(100)	579·0

*Report on Marketing of Skins in India (1943), p. 5.

The goat skin production of Pak-India is undoubtedly the largest in the world* and it has been calculated that India and Pakistan account for nearly one-third of world's production of goat skins. In estimating the importance Pak-Indian goat skins, it is interesting to note the opinion of the Hides and Cess Enquiry Committee. The Committee opine† "As regards goat skin Pak-India's position is somewhat stronger. Her production is estimated to be about one-third of the world's, and even though her share of world's production of goat skin is only a little higher than her share of world's production of hides and kids, experts generally agree that her position in the world's markets is stronger in the case of goat skins than it is in the case of hides."

Sheep Skins.

The annual production of sheep skins in Pak-India is estimated at 170·8 lakh pieces. Of these about 85 per cent. consist of slaughtered and 15 per cent. of fallen skins.

ANNUAL PRODUCTION OF SHEEP SKINS.‡

Region.	Annual Production in Lakhs pieces.		Total.	Percentage of Pak-India Production.	Sheep population (in Lakhs).
	Slaughtered.	Fallen.			
Kashmir ...	3·6	1·0	4·6	2·7	17·1
Punjab ...	11·5	3·6	15·1	8·8	58·3
N.W.F.P. ...	5·3	Neg.	5·3	3·1	8·4
Sind ...	1·2	0·7	1·9	1·1	7·3
Rajputana ...	9·0	4·7	13·7	8·0	53·2
U. P. and States ...	13·7	3·3	17·0	10·0	22·0
W. States ...	5·0	0·5	5·5	3·2	14·5
C. I. States ...	0·4	0·2	0·6	0·4	1·6
Bengal ...	3·5	Neg.	3·5	2·0	5·0
Bihar ...	2·5	0·5	3·0	1·8	11·0
Orissa ...	0·7	0·1	0·8	0·5	3·6
Assam ...	Neg.	Neg.	Neg.	...	0·4
Eastern States ...	1·1	0·7	1·8	1·1	4·7
Bombay ...	13·8	4·2	18·0	10·5	21·1
Madras ...	38·7	1·2	39·9	23·4	118·8
Hyderabad ...	13·0	4·1	17·1	10·0	59·4
Mysore and Travancore ...	6·8	0·2	7·0	4·1	28·4
C. P. ...	1·6	0·7	2·3	1·3	4·3
Other Areas ...	13·3	0·4	13·7	8·0	19·7
Total Pak-India ...	144·7	26·1	170·8	(100)	458·8

*Tewari : Journal of the Bombay University, Vol. VI, part IV, Jan. 1938.
†Report of the Hides and Cess Enquiry Committee, para 22.
‡Report on Marketing of Skins in India (1943), p. 7.

Madras produces the largest number of sheep skins contributing about one-fourth of Pak-Indian production while U. P. contributes 10 per cent. The production of sheep skins is 170·8 lakhs which is about 38 per cent. of the total goat and sheep skin supply in Pak-India.

ANNUAL PRODUCTION OF SKINS.*

Type	Annual Productions (in lakhs)		Total	Percentage of total Pak-Indian Production.
	Slaughtered	Fallen		
Goat skins ...	233·2	41·7	274·9	61·7
Sheep skins ...	144·7	26·1	170·8	38·3
Total ...	377·3	67·7	445·7	100
Percentage ...	(84·8)	(15·2)	(100)	

The production of skins depends upon the population of sheep and goats as well as the meat-eating population. The areas of high skin production coincide with densely populated areas.

The distribution of sheep and goats is governed by various geographical factors among which rainfall and topography are the most important. These animals thrive better in mountainous areas than in plains. Further, it has been observed that large number of sheep and goats are found in tracts with extensive uncultivated areas including forests. Rainfall also affects the distribution of these animals. In areas of heavy rainfall, they do not thrive well.

The highest number of sheep and goats are found in areas having 43-56 per cent of wasteland and 30-40 inches of rainfall. In Assam 77 per cent of wasteland supports only 42 animals per thousand acres of wasteland becase of a heavy rainfall of over hundred inches.

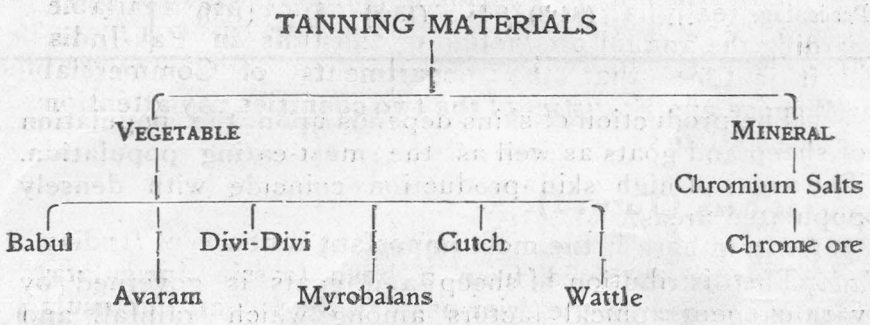
Taking the hides and skins together the province of Madras produces the largest number of pieces in the whole subcontinent. As regards quality, skins are better than hides and it is interesting to note the opinion of the Indian

* Compiled from Report on Marketing of Skins in India (1943).

Trades Enquiry Committee. The Committee opine,* "Owing to the prejudice against killing cattle, most of the hides are from animals which have died of old age or disease, whereas skins are from goats and sheep slaughtered for food, and Pak-Indian skins therefore occupy a better relative position in the world's markets than Indo-Pakistan hides."

The Tanning Materials :—

Pak-India is very rich in tanning materials. They are classified according to their source of origin. The materials commonly used are derived from the vegetable and the mineral kingdoms. The following table gives the materials which are most used and which really matter for an industry, though numerous local tanstuffs are available.



Babul Bark.

The bark of the tree Acacia Arabica, known as Babul bark, constitutes the most important material of Indo-Gangetic plain. The tree is indigenous to Sind, Rajputana, Berar and the Central Provinces, Gujarat and the Northern Deccan.

It is also cultivated and grown throughout the drier parts of Pak-India but not in the extreme north-west of the Punjab where the winter cold is too severe. The babul forests are situated in Sind, Gujarat, Berar (Central Provinces) and Madras. The largest forests are found in Sind. In the Hyderabad and Jerruck Divisions of Sind, they cover one hundred and seventy thousand acres. The tannin present in the bark varies considerably and may attain to 20%, but the average content of the bark

* Imperial Institute: Report on Hides and Skins, p. 86.

delivered to the tanneries is about 12 per cent.* The leather made from babul bark possesses firmness and durability to a high degree but exhibits harshness and is dark-coloured. The vast supplies in the neighbourhood of Cawnpore though exhausted now, were mainly responsible for the start of tanning industry there. Sometime back, Cawnpore tanneries used 500 thousand maunds of bark annually. But today, due to better methods of mixed tanning, Babul bark is not used as much as previously. In West Punjab, however, the bark is used largely unmixed. It is estimated† that about sixty-four thousand maunds of kikar bark are consumed annually in the tanneries around Multan, 53 thousand maunds in Kasur and 15 thousand maunds around Lahore; these are among the more important tanning centres in the West Punjab.

It is really a pity that no statistics are available regarding the annual production of tanstuffs in Pak-India and it is time that the departments of Commercial Intelligence and Statistics of the two countries pay attention to these statistics.

Avaram bark (Turwad).

Avaram bark is the most important tanbark of Indian Union. It is obtained from a bush (cassia auriculata) which is common in the drier parts of the Indian Peninsula from Ajmer and the Jumna river southwards, covering large areas in the Deccan.‡ It is common on dry, stony hills in open places and in scrub forests; it occurs also on black cotton soil and on laterite near the sea-coast.

The use of the bark which contains 20% tannin is confined to Southern India. The greater part of the collected bark is consumed in Madras. In fact the success of tanning industry in Madras is regarded as almost entirely due to the peculiar qualities of avaram bark and to the fact that supplies in the past have been available at a low price. During the World War I the enormous demand for the bark consequent on the increased output

*Pilgrim and Fraymouth: Indian Tanstuffs and their Tannage, (Bulletin No. 1, Govt. Tannin Research Factory, Maihar).

†Anand: Tanning Industry in the Punjab, p. 11. (The Board of Economic Enquiry Punjab, Publication No. 61).

‡Troup: Silviculture of Indian Trees, vol. II, p. 373.

of South Indian tanneries caused many areas to be stripped in a grave manner. The consumption, then, in the tanneries was estimated at 80,000 maunds per month. Unfortunately no recent data is available but it is considered that the wild avaram bark available for collection is sufficient to meet the requirements of the industry.

Divi-Divi (Libi-Libi).

Divi-divi is the name applied to the pods of a tree, 'caesalpinia coriaria.' It is a tree of foreign origin and was introduced into India in 1834. By the end of the last century it became fully established not only in the districts of North and South Arcot and South Kanara but also in Mysore and Coorg.*

The pods contain on an average from 40 to 45% of tannin. The pods are generally blended with other materials to get better results. Divi-divi is one of the least costly of tanning agents, the plants bearing enormous quantities of seed-pods.

Myrobalans.

The myrobalans† of commerce consist of the dried fruits of species of Terminalia, chiefly terminalia chebula. They are one of the principal tanning materials produced in India and Pakistan. The tree is found throughout Pak-India chiefly in deciduous forests extending into forests of comparatively dry types.‡ The chief areas of production are situated in the forests of Hyderabad, Mysore, Kolhapur and the Deccan States, and of the provinces of Madras, Bombay and the C. P. Five different varieties are known, which are named after the districts where they are marketed :

(*i*) Bhimlies from Bimlipatam in Madras;
(*ii*) 'Rajpores' from Bombay;
(*iii*) 'Jubbulpores' from Jubbulpur in C.P.
(*iv*) Vingorlas from Bombay forests;
(*v*) 'Madras Coast.'

*Choudhry: "Divi-Divi" (Bull. No. 26, Indus. Deptt. (Madras), p. 1.
†Imperial Institute : Report on Myrobalans, p. 41.
‡Troup : Silviculture of Indian Trees, Vol. II, p. 511.

Of these Bhimlies and Jubbulpores are the best. Different varieties yield varying amounts from 25 to 38% of tannin.

India produces enormous quantities of myrobalans. No data are available as to the total production but the following figures of export of myrobalans and myrobalan extract do give an idea of the huge production :—

EXPORT OF MYROBALANS AND MYROBALAN EXTRACT.*

	Years Quantity & Value	1935-36	36-37	37-38	38-39	39-40
Myrobalan Nuts.	Quantity (thousand maunds)	2074	1765	2002	1708	1688
	Value (Lakh rupees)	46.7	37.1	44.3	40.0	42.4
Myrobalan Extract.	Quantity (thousand maunds)	58.8	84	112	61.6	114.8
	Value (Lakh Rs.)	4.2	5.8	7.4	4.0	7.0

Wattle Bark.

It is a material of foreign origin. Its use was not known in India before the World War I. It has since then gained favour with the Indian tanners due to its being one of the richest tanning materials. Its cultivation has been successfully introduced in South India. Its cultivation is likely to be extended in the Plains and the Nilgiris where the conditions for its growth are most suitable. But at present the demand far exceeds supply, and wattle is imported in huge quantities. South Africa has been the main source of supply of wattle bark and extract and about 840 thousand maunds† were being imported into Pak-India annually from 1939 to 1944.

Cutch‡

'Cutch' is a name applied to solid tanning material obtained by concentrating an aqueous extract of the heart-wood of Acacia catachu (the 'Katha' tree). The

*Annual statement of the Sea borne Trade of India (1940), Vol. I, p. 556.

†"The Tanner," August 1946, p. 28.

‡Imperial Institute : Tanning Materials of the British Empire, p. 50.

tree is found throughout the greater part of Pak-India, except in the most humid regions and is characteristically gregarious * For the preparation of Cutch, the wood, preferably the heartwood, of the tree is cut into small chips and boiled. The liquid is then separated and boiled further till it attains the consistency of syrup. It is now allowed to cool and it forms a brick-like mass. It contains 60 per cent of tannin. As a tanning material cutch is not very satisfactory as the leather produced is harsh. It can however be blended with other tanning materials. About 70 thousand maunds are being exported annually.

MINERAL TANNING MATERIALS.

Chromium Salts.

Chromite or Chrome iron ore, a naturally occurring mineral, is the starting-point of all chromium compounds, hence we consider Pakistan and India's wealth of this ore. The ore occurs† in Baluchistan, Mysore, the Singhbhum district of Bihar and the adjoining Eastern States. The Baluchistan deposits occur in ultra-basic rocks of Upper Cretaceous age, along the hills bordering the Zhob valley and the upper part of that of the Pishin river. The chief mines are near Hindubagh in the Zhob valley. The Mysore deposits, too, occur in the ultra-basic rocks at many places in the Shimoga, Hassan and Mysore districts. The chromite deposits of Singhbhum lie in the Jojohatu area, west of Chaibasa.

The following figures show the distribution of production for the years 1936-38:—

CHROMITE PRODUCTION IN INDO-PAKISTAN.‡ (IN TONS)

Areas	1936	1937	1938
Bihar	7,053	7,678	5,194
Eastern States	21,344	26,400	16,969
Baluchistan	21,089	27,709	21,892
Mysore State	...	520	94
Total for India and Pakistan ...	49,486	62,307	44,149

*Troup : Silviculture of Indian Trees, vol. II, page 447.

†Brown : India's Mineral Wealth, p. 137.

‡Statistical Abstracts for British India (1940), p. 578.

At present the mines in the Singhbhum district are largely worked out and produce only 1,500 tons per year*. The production from the Mysore State has suddenly jumped up and the mines produced 1,500 tons per month during 1941. The chromite production from all areas was estimated at 50,000 tons in 1943.

Lime.

Lime is derived from limestone which is a mineral of wide geological and geographical distribution in Indo-Pakistan (reaching its maximum attainments in the rocks of the Cuddapah and Vindhyan Systems) and hence there is an abundance of this mineral. The most important of the good quality limestones are†:

(*i*) Katni limestone	(Lower Vindhyan)
(*ii*) Maihar limestone	(Upper Vindhyan)
(*iii*) Bisra limestone	(Cuddapah)
(*iv*) Chela limestone	(Khasi Hills)
(*v*) Sylhet limestone	(Kirthar)
(*vi*) Wardha Valley limestone	
(*vii*) Dalli limestone	

The West Punjab production comes mainly from the Attock, Jhelum and Rawalpindi districts. The total annual production of limestone is estimated to be about three million tons.‡

SALTS**

In Indo-Pakistan Salt is derived from three sources—the sea, the waters of lakes of enclosed drainage, and from beds of rock salt.

*Indian Economy Today and Tomorrow (1946), p. 110.

†Indian Geog. Jour., vol. 8, p. 243.

‡Indian Economy Today and Tomorrow (1946), page 108.

**Christie: Salt in India; "Capital" vol. 83, Ind. Indust. Suppl: p. 37.

Salt from Sea-water.

Most of the salt is manufactured in Bombay and Madras by direct evaporation of sea water. A large amount is also made in Sind at the Mauripur works, near Karachi where conditions for rapid solar evaporation are ideal. In Bombay, the salt factories are mainly within thirty miles of the city. In Madras, the salt factories are confined to the eastern side of the Presidency, where they are scattered all along the coast.

Lake Salt.

Salt is also made from subsoil and lake brines. Sambhar, the largest of the salt lakes of Rajputana, alone contributes about a sixth of India's salt production. The lake covers an area of about 90 square miles in the rains but often dries up completely in the hot weather. Christie has suggested that the muddy bottom down to a depth of 12 ft. contains at least 50 thousand tons of salt. Most of the salt in this part is brought in as fine dust from the sea by the prevailing air currents of the hot season.

Rock Salt.

About 12 per cent of the Indo-Pak subcontinent's production is represented by rock salt, and 85 per cent of this rock salt comes from Pakistan mainly from the mines of the Punjab Salt Range, the remainder from Kohat in the N.W.-F.P. Some salt is also obtained from Mandi State in the East Punjab. In the Mayo Mine at Khewra, Jhelum district, there are four seams known as Buggy, Sujowal, and Upper and Lower Pharwala Seams. The maximum thickness of the first is at least 150 feet, of the second about 50 feet, of the third 70 to 80 feet and of the fourth 120 feet. In estimating the reserves of the Mayo Mines, Mr. Gee suggests* that a total minimum reserve of about four million tons of rock salt can be regarded as a safe estimate though the ultimate total reserve will be found to be far greater than this amount. The present output of the Mayo Mine is about fifty lakhs of maunds annually which is about 66 per cent above the pre-war average output.†

*E. R. Gee : "Reserves of Rock Salt in Mayo Mine, Khewra" Rec. Geol. Surv. Ind., vol. 65, pages 65-66.

†Lamba, Punjab Geog. Review, vol. 2, p. 34 (1947).

The rock salt of the Kohat district occurs in beds of great thickness. At Bahadur Khel the salt beds extend over four miles, with a breadth of half a mile. The visible thickness of salt exposed is about 1,000 feet, while two hills, about 200 ft. in height, are entirely composed of salt. The resources of this region are practically inexhaustible. The output of the Jutta quarries alone is nearly 15,000 tons annually. At this rate, says Mr. Gee*, the reserve available is sufficient for a large number of years—probably at least half a century.

The annual production of salt in India and Pakistan from all sources is given below.†

Years.	Production in thousand tons
1936-37	1871
37-38	1807
38-39	1873
39-40	1935

*E. R. Gee : "Salt Mine at Jutta, Kohat," Rec. Geog. Surv. Ind vel. 68, page 46.

†Statistical Abstracts for British India (1940), page 826.

MINERAL WEALTH OF THE NORTH-WEST FRONTIER PROVINCE

BY

MIRZA ANWAR BEG, CHAIRMAN, DEPARTMENT OF CHEMISTRY, ISLAMIA COLLEGE, PESHAWAR.

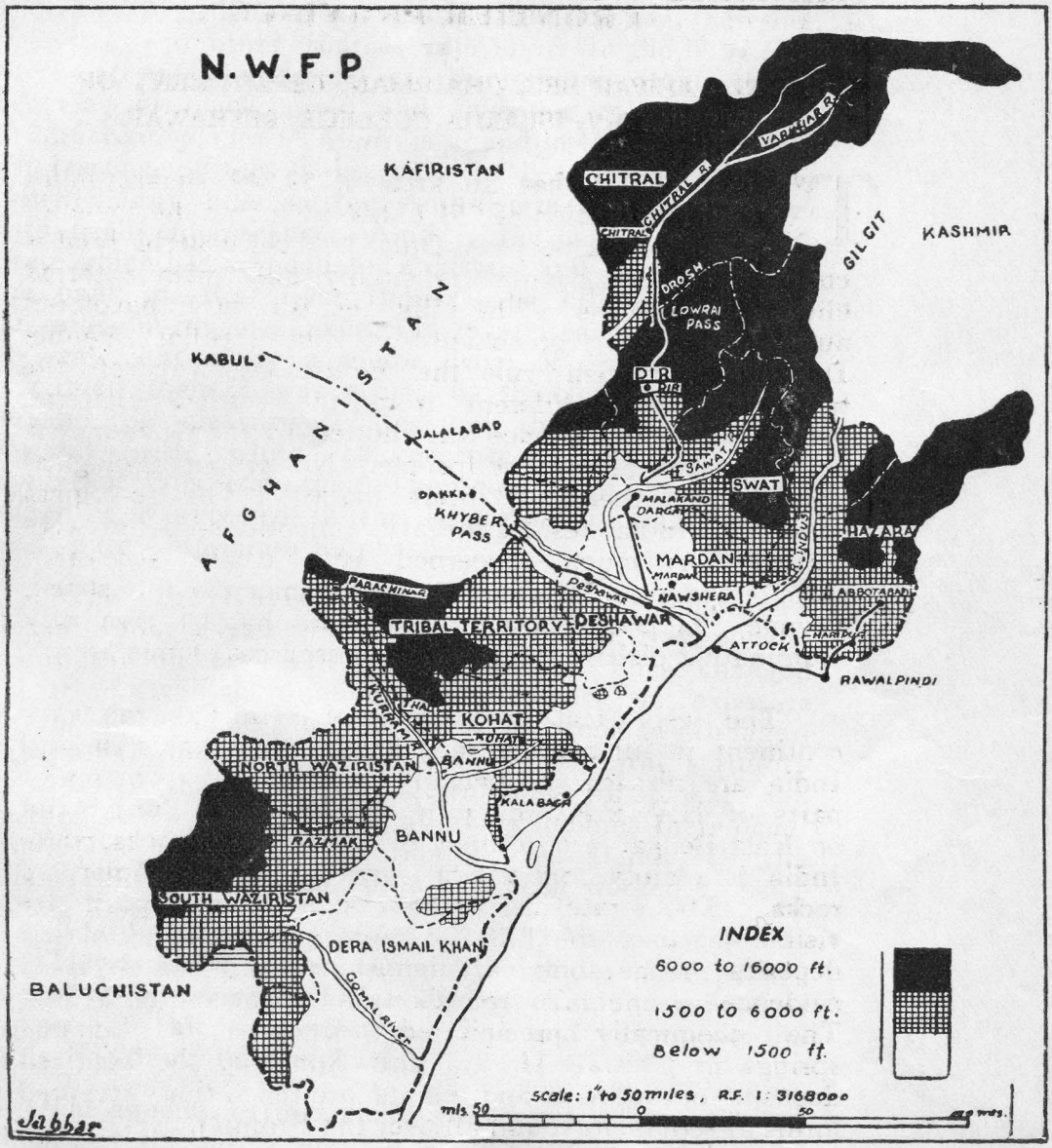
THE N.-W.F.P. has an area of 39,249 square miles with a population of *54,15,666 including the agencies and the tribal people. Only 39·2 per cent of land is cultivated and the country is mainly hilly with extreme climatic conditions. The hilly area is mostly unexplored and forms the homeland of the tribal people During the British rule the political set up of the tribal area was different from the settled districts. Little, if any, interference was allowed by the Government or was tolerated by the people. No proper geological survey has, therefore, been made. The geological survey of India besides the above-mentioned policy were perhaps very much concerned with easily accessible parts of India. The hurried tours by men like Grieshach, Wynne, Tipper, Masson, Fox etc. hardly give any illuminating picture of the mineral resources of this area.

The geological formation of Indo-Pakistan sub-continent is interesting and reveals that Pakistan and India are already geologically demarcated. The major parts of N.W.F.P., the hilly parts of West Punjab and of East Bengal are formed of sedimentary rocks, while India is mainly formed of igneous and metamorphic rocks. The stratification of the sedimentary deposits are visible all over the hills. Layer upon layer of elastic deposits in the form of sandstone and shales is in evidence in the hills from Golra to Kohat and N.W.F.P. The chemically precipitated deposits of sulphur springs in Chitral, Hazara and Kohat or the fossilized deposits of animals and plants are the various accepted forms of sediments found all over the Frontier.

Aluminium Salts and Alum.

The important sources of the common Alum are Alunite, Alum Shales, Bauxite and Cryolite. Up till 1947, Bauxite has been the principal ore in the market

* 1941 Census Report.


N.W.F.P
KÁFIRISTAN
CHITRAL
CHITRAL R.
VARPHAR R.
GIL GIT
KASHMIR
DROSH
LOWRAI PASS
DIR
KABUL
AFGHAN-STAN
JALALABAD
SWAT
SAMAR KHEL
MALAKAND DARGAI
KHYBER PASS
HAZARA
MARDAN
NOWSHERA
ABBOTABAD
PARACHINAR
PESHAWAR
TRIBAL TERRITORY
ATTOCK
HARIPUR
RAWALPINDI
KOHAT
BANNU
NORTH WAZIRISTAN
KALABAGH
RAZMAK
SOUTH WAZIRISTAN
DERA ISMAIL KHAN
BALUCHISTAN
GOMAL RIVER
INDUS
INDEX
6000 to 16000 ft.
1500 to 6000 ft.
Below 1500 ft.
scale: 1" to 50 miles, R.F. 1: 3168000
mls. 50 0 50 mls.
Jabbar

because of its abundant supply from C. P., Bhopal, Bombay and Madras. There are extensive deposits of Bauxite also in Kashmir. Little attention has, therefore, been paid to other sources of Alum. In the N.W.F.P. there is an abundance of bituminous alum shales, occuring in black, grey and lavender colour varieties at different places. Alum is found in the form of white efflorescence on the shales only to be washed away by rains. Many hills in the Amb State are covered over with such efflorescence. Amb is the captial of the Amb State which has acceded to Pakistan and is situated by the bank of the river Indus in a hilly area about 60 miles north of Taxila. It is approachable from the Railway Station by a motor drive of 3 hours. When I arrived there I was struck by the clean, shining beds of sand, the clear river-water and the surrounding hills covered with white efflorescence. In summer this exudation falls from the top and goes down into the river. When it was tested in the laboratory it was found to be of pure Aluminium Sulphate.

When the Khyber Railway was being constructed several tunnels had to be drilled and bluish, grey, powdry heaps grow up as a result of the cuttings. These changed colour to whitish aluminous efflorescence on exposure to air. The same Alum shales hills extend to Mullagori tribal area, which is also the site of the beautiful, statutory marble in the Khyber. Down south in Kohat and further down to Kalabagh all along the area there occur this black coloured Alum Shales. At Dandi (District Mianwali) and Kalabagh, Alum had been worked up since a long time.

These Alum shales contain sulphides and pyrites mixed up in stones. These oxidise to sulphuric acid on exposure to air and moisture. The acid decomposes the shales to Aluminium sulphate.

The aqueous extract yields a thick colloidal mass from which it is difficult to prepare good crystals. The mass, however, is an excellent material for sizing the Textiles or the paper.

Antimony.

The only commercial ore of antimony is Antimonite and Stibnite found in Chitral and in Kurram Valley.

Antimonite is a greyish heavy mineral which must be sufficiently pure—*i.e.*, above 40%—to be of economic value. In Chitral the ore is rich but the inaccessibility of high mountains add much to the transport difficulties. In Chitral the ore had been mined at 4 different places, in Bakhtoli, Ludku, Tureku and Mulekhu and was sold to a Bombay firm for smelting purposes.

Chitral is like a closed box--in fact, a treasure-box of minerals, enclosed on all sides by almost vertical mountains of great height. Branching off from Naushera on the main railway line 41 miles further on, you reach Dargai—the Railway terminus. From here you take to road and the hills. Passing 40 miles through the Malakand Agency—famous for its Hdyro-Electric Power Station—you reach a place called Chakdara from where you start for an arid drive of 90 miles to Dir State. At Dir you change for pony ride for an uphill 20 miles climb along a river to cross 12,000 ft. high Lowari Pass—the Chitral border. After crossing the peak of the Pass you walk, ride or slide—about 10 miles down—to a place called 'Ishrat'. At this place the deep pine forests end and there starts a motorable road to Drosh and then to Chitral altogether a drive of about 50 miles from Ishrat. Situated in the Pamirs south of Hindu Kush, having the well known summit of Tirichmir 25,263 ft. the Chitral State has an area of 4,000 sq. miles. This State is a storehouse of minerals like Asbestos, Arsenic, Cinnabar, Dolomite, Copper, Gold, Manganese, Mica, Sulphur, Lead, Iron Ochres etc. A new road is being constructed from Dir. This road when completed will open up the country.

Arsenic.

Chitral has long been known for its Arsenical ores. It occurs as the trisulphide of Arsenic in beautifully yellow clear crystalline flats called Orpinent. There are several mines mostly occurring in the Tirich valley and the Ludku valley and at other places of great heights. The Mine at Wizmich is 16,000 ft., Moghon Zom 15,000 ft. and Aligot is 13,000 ft. high. The Mines occur in the Calcareons Shales and in Limestone almost metamorphosed to Marble. Usually the ore is classified into three grades according to its purity, the first grade obtaining almost 4 times the value of the third grade.

There are indications of these ores at other places in the State. A careful search will certainly reveal new deposits of this ore.

The District of Hazara is not only rich in the mineral wealth but also in forest products of great economic value. The samples of minerals that I have been able to collect promise of many valuable ores not yet investigated.

Mica.

For some time Mica was worked up at Giddarpur rather unscientifically. Deeper digging and scientific treatment will reveal bigger sheets of better quality. It is a clear muscovite at some places and at other places it is in fragments mixed with lot of gangue. In Chitral, a hillside was ablaze in the sun and presented a glorious spectacle at the top. The samples collected showed well formed bigger sheets capable of perfect cleavage for thin laminæ. At another place ruby coloured mica was obtained. Mica is of economic importance and needs thorough investigation.

Strontium Salts.

There are big deposits of marble-like stones in Nambal Hills and also similar marble-like stones at a place called Lora in Hazara. The surface is perfectly smooth and the cleavage is always in smooth surfaces. On analysis the former was found to be Celestite-Strontium Sulphate and the latter Strontionite. It appears that the whole range is dotted with good deposits of strontium salts.

Sulphur.

Sulphur is a much needed article for the manufacture of Sulphuric acid. In Chitral round-about Ludku valley there are deposits of dried up Sulphur. This element is chemically precipitated out of several kinds of Sulphides like those of Arsenic, Antimony, Iron etc. found occurring all over the area. These Sulphides are either oxidised to sulphates as in the case of Aluminium sulphate from shales or are reduced to sulphur by the presence of Carbonaceous rocks. The crude, native sulphur obtained from this sulphur earth was of above 99·5 per cent.

purity similar earth was also received from Hazara, but was of impurer quality. Combined Sulphur, particularly as Sulphides, is extensively found at several places of the N.W.F.P. In Chitral near the Afghanistan border, near Arkari valley there are vast areas containing Pyrites. Sulphur is found in the district of Kohat near Banda Daud Shah and also near Nakbandi, in D.I.K. at Damuda and in the form of Pyrites in Mardan district. Sulphur from Baluchistan is a potential source and that combimed with these sources from N.W.F.P. should solve the sulphur problem of Pakistan. At several places there are pits where sulphur used to be mined and are in neglect now.

Iron.

Iron occurs in variously combined forms at several places in the hilly areas. Several samples of black, earthy lumps, varying in softness, were obtained from Kohala, Bakot, Sherani and Sirban hills in district Hazara. A simple analysis showed them to be oxides of iron and manganese. These lumps, however, are under investigation and may prove to be valuable. It is very much like Hæmatite containing manganese. In many cases the iron is in reduced condition. Bajaur is well known for its iron and small works used to produce a quality of iron that was much prized for its purity. I have obtained the sample of iron sand available in the beds there and it is well worth working up. Iron also occurs at Bannu, Chitral and Waziristan. At several places there are small iron works and if all the material be worked up scientifically it is bound to yield satisfactory results.

The district of Kohat is another hilly tract with Sufed Koh and Surghar Ranges running all along the north with some off-shoots running down towards Rawalpindi. This area is another store-house of valuable rocks and minerals. Quartz, Dolomite, Gypsum, Manganese, Petroleum shales, Sulphur are found.

Gypsum.

There is an inexhaustible quantity of fine quality Gypsum some of which is in the form of selenite and the remaining occurs as anhydrite. In Kohat Gypsum is found

in beds of about 200 ft. thickness in an area of about 1,000 sq. miles. In Hazara at Bijore, in D. I. K. at Paniala or at the southern end of Khasore range, huge beds of Gypsum up to about 500 ft. thickness are present.

Rock Salt.

Similarly the district of Kohat possesses immense quantities of Rock Salt. At Bahadur Khel the salt is mined and exported to Afghanistan and the tribal areas. This salt is darker in colour and comparatively less pure than Khewra Salt.

Steatite.

Huge deposits of soapstone occur in tehsil Naushara and in Hazara. It was mined and exported to Delhi and Bombay. Pure quality in white colour is available although slightly coloured varieties are also found at different places.

Ochres.

Red, black and yellow ochres are present in the States of Amb, Chitral and Swat. The Khyber has soft red ochre in great quantities.

Marble.

Marble of excellent quality, beautifully translucent in thin sheets is available in the Mullagori area, in Khyber Hills and in Maneri (Swabi) Hills. In quality it equals the well known Jodhpur marble. There is also a beautiful striated variety most suitable for ornamental work and building purposes.

Limestone.

Pure limestone is abundant all over the province. A sample of limestone was sent to me from a ridge between Swabi and Jahangir which was found to be 98·4 per cent pure. Similar quality of limestone is available from Cherat—Mardan, Swat, Khyber, Kohat, D. I. Khan, etc. and is excellent for cement manufacture.

Coal.

Coal occurs at various points. It is, however, difficult to give the extent of deposits with any exactitude. The

coal obtained from Kohat is good but contains sulphur in it. Sulphur is undesirable for factory work. Cherat has some deposits but the ash contents are high. Sample from Khyber are unsatisfactory. Coal from Hazara is lignitic having small organic matter.

Petroleum.

Petroleum shales occur all along the hilly portion from Rawalpindi to Kohat and further on. At certain places springs having sufficiently oily water are found. This oil is very often used by the villagers for burning purposes.

This is a sketchy account of the mineral resources of N.W.F.P. It is quite evident that the province has, since the creation of Pakistan, ceased to be a neglected area. It may, therefore, be well anticipated that the province is going to play an important role in the mineral supply of the country.

RASUL HYDEL-*CUM*-TUBE-WELL PROJECT

BY

MISS JAMILA NIGHAT

Electricity has gained such a popularity that it is impossible for a progressive nation to go without it. Its uses and services cover a vast field, and are so well-known that it is no use dilating upon them here.

In the Indo-Pakistan sub-continent the Punjab was primarily an agricultural province and as such had always lagged behind in industrial development. Coal was the chief source of producing power and was brought from over a thousand miles. Whatever little oil was produced at Attock was converted into petrol and was used in transport purposes.

In spite of the inadequate resources of hydel power, a number of small or medium-sized installations existed in the Province. A small hydro-electric unit of about 400 k.w. capacity existed at Renala Khurd on the Lower Bari Doab Canal. This enterprise was undertaken by Sir Ganga Ram in about 1914, but was subsequently taken over by the Provincial Government. It was essentially a lift Irrigation Project and remains the same up till now. Similarly one hydro-electric power plant was functioning at Chabba to supply power to Simla.

Such was the position of electrical undertakings in the Punjab, when soon after the First World War, the Government of India decided to carry out hydro-electric survey of the whole of India. Its object in the Punjab was to investigate the possibilities of developing cheap hydro-electric power on the rivers and streams in their upper reaches. Eventually "Uhl River Project" commonly known as Mandi Hydro-electric Scheme was approved and work started on it in 1926. It was completed in more than seven years and started working in March, 1933. As part of their post war development programme, the Government envisaged undertaking hydro-electric schemes. Of these the following three schemes were initiated in 1946.

1. Rasul Hydel-cum-Tube-well Project.
2. Nangal Subsidiary Scheme.
3. Bhakra Dam Project.

Of these three schemes that were under contruction at the time of partition only one *i.e.* the Rasul Scheme is now left in the West Punjab. Bhakra and Nangal have gone to the East Punjab. Before partition Rasul Scheme was intended to play the role of an augmentative factor in an already existing or a future vast grid supply system but now it is the only scheme which can supply the bulk of power to West Punjab.

The existing supply from Mandi Project is scheduled to be completely cut off from September 30, 1951. Even now the West Punjab has to pay at a heavy rate for what little supply it is getting from it. From these facts we can imagine the gravity of the situation facting us and picture to ourselves the importance of speeding up the completion of our own hydro-electric schemes.

The Rasul Scheme (the biggest eterprise of its kind in the West Punjab) was originally scheduled to be completed by the end of 1948, but the partition has impeded its progress greatly. Apart from the difficulties experienced in replacing the proper personel who have left for India the most disturbing factor has been the non-availability of the appliances that were expected to be received from there. However, other sources are being tapped and it is hoped that the West Punjab Government (assisted by the Centre) will be able to speed up its completion.

History :—As its very name implies this scheme is intended to serve the dual purpose of the supply of electrical energy for industrial and lighting purposes.

2. The working of the Projected Tube-wells.

Our canal irrigation system is unique in the whole world. In spite of its magnificient achievements it suffer from certain grave disadvantages and one of these is "water logging". The Punjab Irrigation Department has been continuously experimenting to devise means to eradicate this fast spreading menace. The problem has always been how to drain off the excess water in order to lower the water table.

In 1945, the Irrigation Department prepared the Rasul Project in its present form and it was put before the Punjab Government for consideration. It was approved and the work was started in the latter half of the same year.

The Project provides for the development of 22,000 kilowatts, of electrical power at Rasul from a fall between the Upper Jhelum Canal and the Lower Jhelum Canal and its utilization in the following manner :—

1. The operation of 1,800 tube-wells to be installed along the main channels of the Upper Jhelum Canal, the Lower Jhelum Canal and the Lower Chenab Canal.

2. The supply of electric energy for industrial purposes and for lighting 28 towns in the Districts of Shahpur, Jhelum, Gujrat, Gujranwala, Sialkot, Sheikhupura, Lyallpur and Jhang.

3. The supply of Power to the West Punjab Grid to the extent of 5,000 kilowatts.

Supply of Cheap Power.

Heavy expenditure on Hydraulic Works is usually the most serious obstacle in the development of Hydro-electric Power. Fortunately in the case of the canals, at Rasul only small and relatively inexpensive additions and alterations are required to harness the fall and hence power will be generated at a cheap rate.

Advantages.

The construction of this Project will be a great boon to the economic life of the Province and will add substantially to its revenue. The relevant features of the scheme are summarized below.

1. The increase in the revenue of the Province is expected to be as follows :—

(*a*) from Water rates and land revenue—47 lakhs.

(*b*) from Crown Waste land rates—18 lakhs.

(*c*) from Charges for industrial and lighting uses—29 lakhs.

2. (*a*) The Water pumped by the 1,000 tube-wells to be installed under the Project will support approximately 7,12,000 acres of crop per

annum. The Project would, therefore, be of great benefit to the West Punjab from the point of view of food production.

(*b*) Within the area served by the Project, the amount of water pumped from the tube-wells would in time lower the water-table considerably and thus tend to eradicate the menace of water-logging.

(*c*) The supply of cheap electric power for the Industrial development of the Province. Initially the Project will supply about 15,000 kilowatts for this purpose (it may be decreased with the coming in of more tube-wells).

This will relieve the shortage of industrial power in the Province till such time as the Mianwali Hydro-electric Scheme, the Mangla Hydro-electric Scheme and the other sources of power are developed.

DESIGN & BRIEF DESCRIPTION OF THE WORKS

Available Power.

At Rasul, the Upper Jhelum Canal runs within a short distance of the Lower Jhelum Canal. The full supply level of the former canal at the point of off-take is 789·00 ft. and this can always be maintained by means of regulators at Khakhra which is a couple of miles down stream. The full supply level of the Lower Jhelum Canal varies between 701·40 ft. and 707·2 ft. Thus the maximum head available is 87·60 ft. and the minimum 81·80 ft. The Kaplan turbines at Rasul Power House will be designed to work at these heads.

The minimum possible supply during winter is 1,330 cusecs and during the rest of the year 4,000 cusecs, which will normally be available. Power from the erected heads at Rasul will amount to :—

(*a*) 24,000 kilowatts at the maximum head of 87·60 ft. during summer with a discharge of 4,000 cusecs.

(*b*) 8,000 kilowatts at the minimum head 81·80 ft. with the minimum discharge during winter.

The Rasul Power Station has been designed for the installation of two Kaplan turbine alternate sets each capable of generating 11,000 kilowatts.

Linking up with the existing Grid.

The transmission lines under the Project were designed so as to link up with the Uhl system at Shalamar Receiving Station near Lahore through 132 kilowatts Transmission Lines. This link would have enabled an interchange of power between the Rasul and the Uhl system. This was a very important feature of the planned economy of the pre-partition Punjab and would have resulted in many economic and technical advantages. The security of the supply of electrical energy would have improved as electricity would have been generated at two different Power Stations interconnected with a grid but after the partition of the Punjab the conditions have changed to such an extent that it has become impossible to work according to the previous scheme *i.e.* linking up with a Grid. Anyhow the Rasul Project will now provide the much needed duplicate supply to Lyallpur for covering the industrial load, for maintaining satisfactory voltage regulation and for continuity of supply to the important textile mills.

Utilization of Rasul Power.

(*i*) The electricity generated at Rasul will supply power to 1,800 tube-wells each designed for a discharge of 2 cusecs located as follows :—

(*a*) 900 tube-wells in Jech Doab made up as follows:—

350 in the Upper Jhelum Canal area and 550 in Lower Jhelum Canal area.

(*b*) 900 tube-wells in the Lower Canal area.

(*ii*) Power to the following 28 towns in the northern Punjab for lighting and industrial purposes.

	Town	Districts
1.	Gujranwala	Gujranwala
2.	Eminabad	,,
3.	Kamoke	,,

	Town	Districts
4.	Muridke	Gujranwala.
5.	Ghakhar	,,
6.	Qila Didar Singh	,,
7.	Hafizabad	,,
8.	Subhaki	,,
9.	Sodhra	,,
10.	Wazirabad	,,
11.	Pindi Bhattian	,,
12.	Khangah Dogran	Sheikhupura.
13.	Karh Balochan	,,
14.	Sangla Hill	,,
15.	Chak Jhumra	Lyallpur.
16.	Chiniot	Jhang.
17.	Jalalpur Jattan	Gujrat.
18.	Kunjah	,,
19.	Lalamusa	,,
20.	Gujrat	,,
21.	Jhelum	Jhelum.
22.	Malikwal	Shahpur.
23.	Bhulwal	,,
24.	Sargodha	,,
25.	Bhera	,,
26.	Shahpur Sadr	,,
27.	Jhawarian	,,
28.	Kalra.	,,

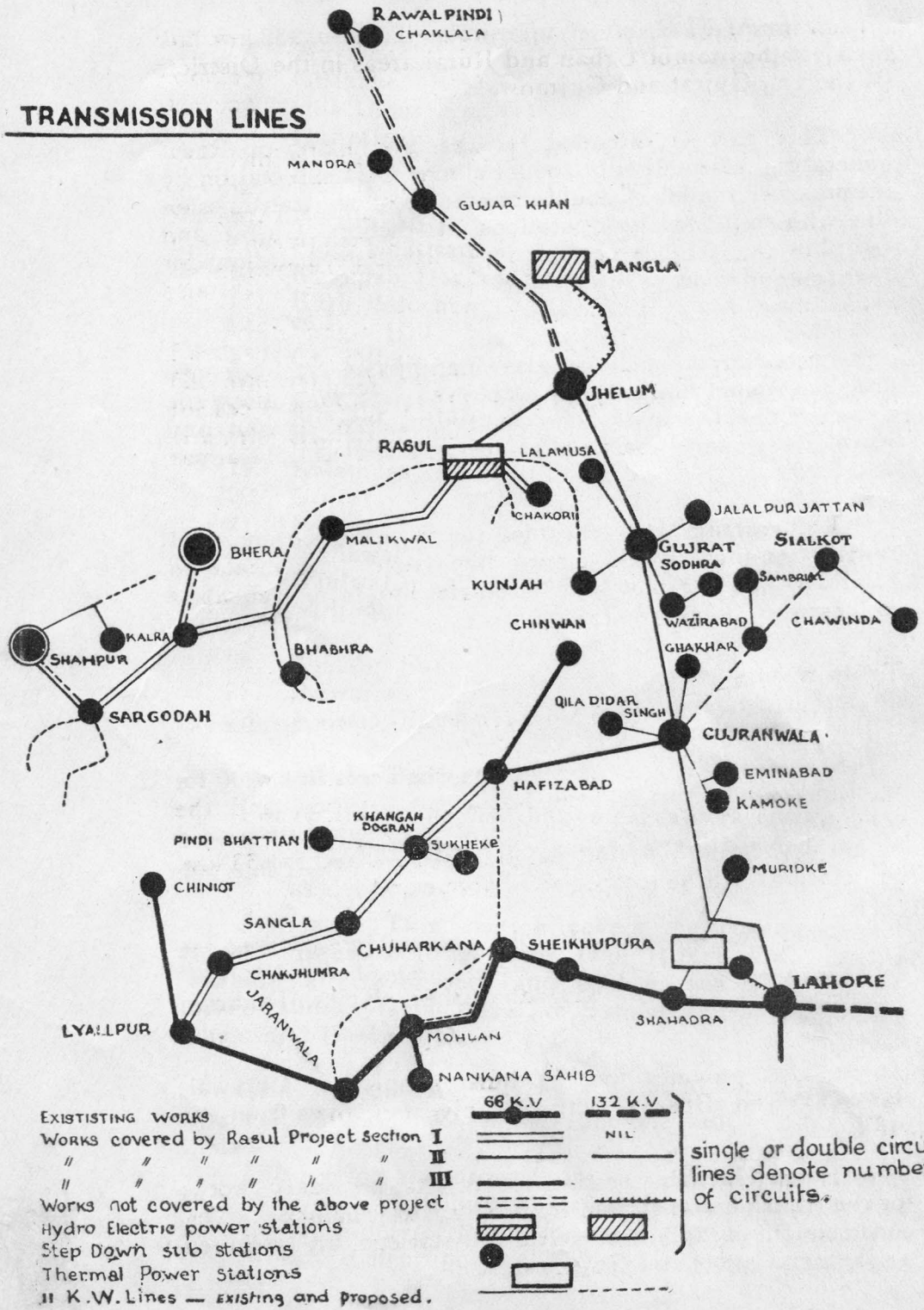
Sections of the Project.

For recording the distribution of capital outlay on a regional basis the Project has been divided into 3 sections :—

Section I. This section covers the construction of Rasul Power Station with two 11,000 k.w. Kaplan Turbine alternater sets and 66 k.w. and 33 k.w. transmission lines from Rasul to Sargodha, Shahpur Sadr, Bhera and Bhabhra.

Grid sub-stations will be constructed at Malikwal, Bhulwal, Sargodha, Bhera and Shahpur Sadr.

This section also provides for the erection of 11 k.w. and 400 volts distribution main-substation and service lines for the supply of Power to 900 tubewells in the Jech Doab area and electrification of towns in Shahpur District.


TRANSMISSION LINES
RAWALPINDI
CHAKLALA
MANORA
GUJAR KHAN
MANGLA
JHELUM
RASUL
LALAMUSA
CHAKORI
JALALPUR JATTAN
GUJRAT
SODHRA
SIALKOT
SAMBRIAL
MALIKWAL
BHERA
KUNJAH
WAZIRABAD
CHAWINDA
CHINWAN
GHAKHAR
KALRA
SHAMPUR
BHABHRA
SARGODAH
QILA DIDAR SINGH
GUJRANWALA
EMINABAD
KAMOKE
HAFIZABAD
KHANGAH DOGRAN
PINDI BHATTIAN
SUKHEKE
MURIDKE
CHINIOT
SANGLA
CHUHARKANA
SHEIKHUPURA
CHAKJHUMRA
LAHORE
JARANWALA
SHAHADRA
LYALLPUR
MOHLAN
NANKANA SAHIB
EXISTISTING WORKS
Works covered by Rasul Project Section I
// // // // // // II
// // // // // // III
Works not covered by the above project
Hydro Electric power stations
Step Down sub stations
Thermal Power stations
11 K.W. Lines — Existing and proposed.
66 K.V
132 K.V
NIL
single or double circuit lines denote number of circuits.

Section II. Rasul—Gujranwala—Lahore, 132 k.w. link for electrification of Urban and Rural areas in the Districts of Jhelum, Gujrat and Gujranwala.

This part is intended for the interlinking of Rasul generating station with the Shalimar Grid sub-station by means of 128 miles of double circuit 132 k.w. transmission line with step-down grid stations at Jhelum, Gujrat and Gujranwala. The necessary local distribution stations for the supply of power to the towns in this area are also included.

Section III. Gujranwala—Hafizabad—Lyallpur 66 k.w. line supply of power for Tube-well Pumping along the Lower Chenab Canal and electrification of Urban and Rural areas and in the Districts of Sheikhupura, Lyallpur and Jhang.

This section also provides for the construction of 93 miles of 66 k.w. double circuit line from Gujranwala to Lyallpur and Chiniot and a single line from Hafizabad to Chinwan.

Transmission.

(Please refer to the Figure for details of connections).

Section I. This section covers the necessary work for the transmission system from Rasul to Shahpur, and the construction of 66 k.w. Grid sub-stations would be required at Malikwal, Bhulwal, and Sargodha-Bhera and the 33 k.w. sub-stations will be located at Shahpur and Bhera.

Local Distribution : The following will be electrified :—

Malikwal, Bhulwal, Sargodha, Bhera, Kalra, Jhwarian Bhabhra.

It also provides for the bulk supply to Bhulwal, Sargodha and Bhera electric supply companies from the grid system.

Section II. This section covers the necessary works for the transmission system from Rasul to Shalimar. The construction of 132 k.w. Grid sub-stations are required at Jhelum, Gujrat and Gujranwala.

Local Distribution : This section provides for the works covered by the local distribution at the following towns :—

Eminabad, Muridke, Kamoke, Gakhhar, Qila Didar Singh, Wazirabad, Jalalpur Jattan, Kunjah, Lalamusa, Sodhra, Jhelum, Gujrat, Gujranwala. It will also provide the necessary bulk supply to the electric supply companies operating at Gujranwala, Gujrat and Jhelum.

Section III. This section covers the necessary works for the transmission system from Gujranwala to Lyallpur, Chinwan, Hafizabad and Marh Balochan. It also provides for the supply to the Hafizabad Electric Supply Co., Ltd., from the Grid System.

RECLAMATION OF THE THAL

BY

(MISS) KHALIDA HAQ NAWAZ

THE Thal Irrigation Project estimated to cost about Rs. 155,000,000 aims at converting 1,8000,000 acres of land, presently lying dry fallow or barren, into a land of increment. The Project has already been partially materialised. It has begun to play an effective role in resettling of refugees. To the homeless and the landless the irrigated parts of the Thal region bear the significance of a "land of promise." Considerable progress has already been made in this direction. About twenty-three Chaks—an area of twenty-five thousand acres—have already been founded. Each settler is provided with ten to fifteen acres of land. About four thousand acres have been allotted to the minority community—the Christians who are already cultivating the land. The drinking-water problem, which attains an acute form in some parts of the region, is being obliterated by sinking deep tube-wells. A Hydro-electric Project will supply cheap electricity to the inhabitants of this area in the near future.

History of the Project.

The idea of constructing a perennial canal from the River Indus at Mari to irrigate the Doab between the Indus and the Jhelum is said to have been first conceived during the sixth decade of the nineteenth century.

Between 1873 and 1917, with the exception of the Sind Sagar Colonization Bill, nothing tangible was done to further the Project. In October, 1901, Sind Sagar Colonization Bill was passed into law by which the Government became entitled to three-fourths of the total "Shamilat" area of about 1,931,543 acres in the Bhakkar and Leiah Tehsils for bringing canal water to this Doab. Nearly two million acres of land were granted to villagers, at the time of the first regular settlement of 1877-78, as grazing grounds, on the condition that a grazing revenue of Rs. 24,677 a year was paid. The people held no rights to cultivate this land, which in fact was given to them in trust until the area could be colonized like other Doabs.

Certain projects were prepared in the years 1917-1919 and 1924. Then a project was prepared in 1936. The Anderson Water Committee allowed a maximum withdrawal of 6,000 cusecs for the Thal, limiting the main supplies in January and December to 2,000 cusecs ; in February and March to 3,600 cusecs and in November to 5,600 cusecs. It is this water which formed the basis of the 1936 Project.

Immediately after the completion of the Haveli Canal and the Trimoo Headworks the construction of the Kalabagh Barrage and the Thal Canal was taken up. The Kalabagh Headworks is situated on the Indus at Daudkhel and the Thal Canal is to have a maximum capacity of 10,000 cusecs to irrigate the Sind Sagar Area. The first estimate was sanctioned in May, 1939, and the work was started immediately. Unhappily the outbreak of World War II in September, 1939, compelled the cessation of work on this project. Construction was resumed, however, as part of the post-war schemes. The headworks of the canal at Kalabagh has been completed and the work on its irrigation channels is in progress.

The headworks has been designed in accordance with the latest hydraulic researches.

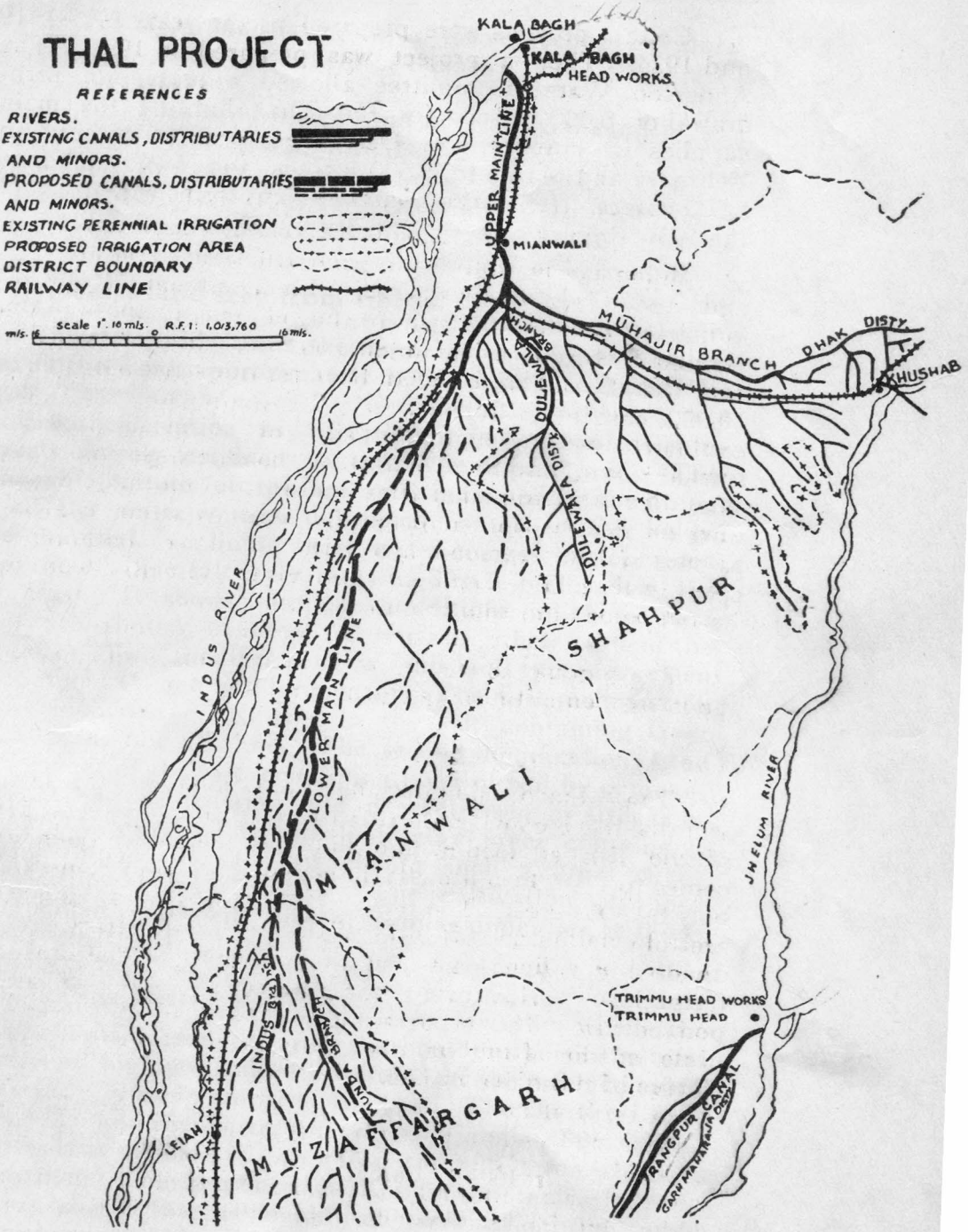
The Agricultural Aspects.

The western strip of the Thal is held to be fertile and this the project contemplates to irrigate. The total area of the villages within the proposed irrigation boundary comes to 119,031 acres, out of which fertile area commands only 89,506 acres. The western Thal contains a sufficient area of good culturable soil. The soil of this tract can be divided into five main classes according to the mode of formation, agricultural characteristics and irrigation possibilities. The topographical conditions of the various parts of the Thal are also clear from the very nomenclature of these five classes :—

1. (*a*) Patti land free from 'tibbas' (sand-dunes) lying over a salt-bearing soil which itself rests on alluvial sand.

   (*b*) Highly alkaline Patti land.

2. Patti land mixed with tibbas which occupy less than 40 per cent. of the area.


THAL PROJECT
REFERENCES
RIVERS.
EXISTING CANALS, DISTRIBUTARIES AND MINORS.
PROPOSED CANALS, DISTRIBUTARIES AND MINORS.
EXISTING PERENNIAL IRRIGATION
PROPOSED IRRIGATION AREA
DISTRICT BOUNDARY
RAILWAY LINE
Scale 1" 16 mls. R.F. 1: 1,013,760
16 mls.
KALA BAGH
KALA BAGH HEAD WORKS
UPPER MAIN LINE
MIANWALI
MUHAJIR BRANCH
DHAK DISTY.
KHUSHAB
QULEWALA BRANCH
QULEWALA DISTY.
INDUS RIVER
LOWER MAIN LINE
SHAHPUR
MIANWALI
JHELUM RIVER
TRIMMU HEAD WORKS
TRIMMU HEAD
RANGPUR CANAL
GARH MAHARAJA DISTT.
LEIAH
MUZAFFARGARH

3. Patti land mixed with tibbas occupying more than 40 per cent of the area.

4. Flat wind-blown sand over alluvial sand.

5. (*a*) Red clay containing salts.

(*b*) Hard red clay alkaline.

1. (*a*) **Patti land free from tibbas.**

The Patti soil forms the basis of a large part of the area in the Thal, approximately 3,36,000 acres in extent.

Such cultivation as at present exists on wells is almost entirely confined to this type of patti land. The permeable nature of the soil was indicated by the lining of all the water-courses delivering water to the fields. The material for lining these water-courses was obtained from the alkaline salt layer situated 3 to 5 feet below the soil crust. It shows that the conditions in these patti areas are similar to those present in other parts of the Punjab. Two modifications of this soil type have been encountered though not frequently. The first modification is the inclusion of Kankar in the salt containing layer which is highly alkaline. The second modification is the replacement of the salt containing layer of soil by compact clay alkaline in reaction and characterised by streaks of red iron oxide. This alkaline clay layer contains a certain amount of salt but not to such a great extent as does the typical 'Patti'. The cultivation of these two modified types will present similar difficuties as those of the typical patti.

(*b*) **Alkaline Patti.**

The Patti areas towards the southern portion of the Thal have a highly alkaline reaction at the surface and the surface is covered with Kankar. The characteristic shrub, when any shrubs are present, is 'Fana'. This shrub indicates that the land is unsuitable for cultivation without reclamation. The presence of Kankar on the surface of this soil shows that it is subject to wind erosion, and that the original surface soil has been removed exposing an alkaline layer containing Kankar. The alkaline patti area has 1,66,000 acres of land.

2. Patti land with tibbas less than 40 per cent.

The Patti land in such an area has the same characteristics as those already described. In addition the tibbas have been shown to rest on typical patti soil. The remarks given regarding the irrigation of patti soil free from tibbas, therefore, apply to this area as well. The return from irrigation of sandy areas will be extremely low. The area covers about 5,88,000 acres of land.

3. Patti land with over 40 per cent of the tibbas.

The area falling under this class has 6,36,000 acres of land. Owing to the difficulties of levelling and irrigation this area cannot be economically developed.

4. Flat wind blown sand over alluvial sand.

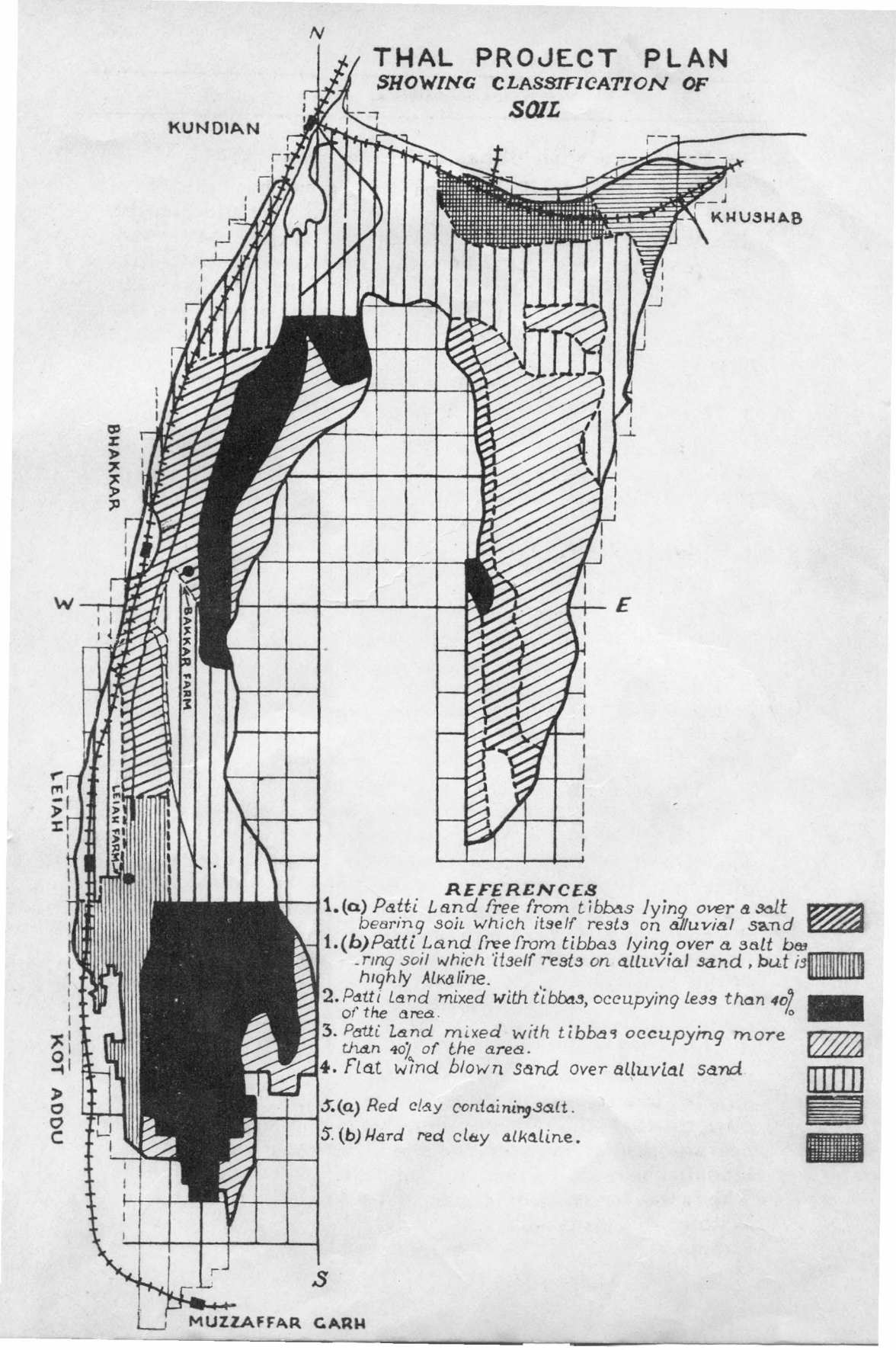
This area is confined to the north-western portion of the Thal. At present crops are almost entirely Barani in the Rabi season, little well irrigation being practised.

As no soil crust exists, material for lining the water-course is not available. The main difficulty to the irrigation of this area is the very low revenue that must be expected owing to the sandy nature of the soil.

The first difficulty in the development of this area is the difficulty of raising crops on soil of this type under the Kharif climatic conditions that exist. The second difficulty is the extremely low duty that would have to be received from soil of this nature. Another obstacle is that the soil has no retentive power for fertilizers nor is it, in itself, capable of supplying plant food. The total area of this type of land is 1,106,000 acres.

5. (*a*) Alluvium with a high clay content containing salts.

In proceeding westward from Khushab it becomes obvious that the alluvium gradually changes from a salt-bearing soil to an alkaline soil. Between Khushab and Hadali the salt-bearing soil appears to be predominant. The area bears poor crops and a small amount of grass. Within this area alkaline soils also occur to a small extent.


N
THAL PROJECT PLAN
SHOWING CLASSIFICATION OF
SOIL
KUNDIAN
KHUSHAB
BHAKKAR
W
E
BAKKAR FARM
LEIAH
LEIAH FARM
KOT ADDU
S
MUZZAFFAR GARH
REFERENCES
1. (a) Patti Land free from tibbas lying over a salt bearing soil which itself rests on alluvial sand
1. (b) Patti Land free from tibbas lying over a salt bearing soil which itself rests on alluvial sand, but is highly Alkaline.
2. Patti land mixed with tibbas, occupying less than 40% of the area.
3. Patti Land mixed with tibbas occupying more than 40% of the area.
4. Flat wind blown sand over alluvial sand.
5. (a) Red clay containing salt.
5. (b) Hard red clay alkaline.

It is noticeable that north of the Railway-line, where retention of flood water against the railway embankment occurs, the crops and grass appear to be much better than in the area immediately south of the railway-line. This difference in the two areas is so marked that it might lead one to think that they were different types of soil. Actually it is only a question of the differential supply of rain water to the two areas.

5. (*a*) **Alluvium with a high clay content and a high alkalinity.**

The area occupied by this type extends from Hadali to Gujrat. The soils are of a highly alkaline nature in this area and salts are also present. One point in favour of these soils is their high clay content. A further point of considerable importance in this area is the almost complete absence of any attempt at well irrigation. This is due to the saline nature of the subsoil water. It is almost impossible to obtain even drinking water from wells, the main source of supply being Kacha tanks which are filled during the monsoon period. The absence of suitable drinking water may present difficulties during the construction period.

Headworks.

The design of headworks at Kalabagh in the 1925 project was not adequate. The headworks of 1936 project has been designed in accordance with the latest hydraulic researches on the subject. The site has been shifted two miles downstream. The points in favour of this site are :—

(*a*) Facility of construction :—The width of the river at the site selected in 1936 is almost 3 miles. The bund of the headworks could be easily constructed leaving ample waterway for the normal floods.

(*b*) The railway line could be directly connected with Daudkhel Junction, thus saving a distance of about 6 miles in the carriage of materials.

The proposed water site is about 4,000 feet downstream of Pakki Shah Mardan. It has been designed to let pass

a maximum flood of 1,20,000 cusecs. The area proposed to be irrigated in the project, mainly comprises the following six assessment circles :—

(1) Pakka Circle of Mianwali Tehsil.
(2) Thal and Daggar circles of Bhakkar Tehsil.
(3) Thal and Jandi circles of Leiah Tehsil.
(4) Thal or Thal Chahi circle of Kot Adu Tehsil.

Out of the total commanded area of 1,448,347 acres, an area of 1,111,598 acres is found to be fertile while the area of inferior lands comes to 313,726 acres, leaving a balance of 23,033 acres as sterile or uncultivable land.

Alignment.

In the 1936-project the headworks of the canal has been shifted down by about two miles, thus avoiding the necessity of placing the canal in an awkward position for the first two miles. Further down also the alignment has been set back as far away from the river as was possible. It is claimed that by this arrangement a very much safer position for the canal has been obtained. Not only that less provision is required for protection against possible river attacks, but the actual risk of the canal being damaged by the river-floods in the future has been minimised. Three spurs constructed at suitable points which give a very efficient protection to the canal and keep the action of the river at a reasonable distance from the canal bank. The main upper line runs more or less parallel to the railway line up to Mianwali. Between Rakhri and Shahbazkhel the alignment of the Upper Main Line lies in a broken country. After crossing Mianwali the alignment follows a path parallel to the railway line till it curves to cross the railway line from Kundian to Khushab. Here it splits up into two parts. A branch of it turns towards east to Khushab and is named as Khushab Branch or Muhajir Branch. The other is called the Main Line Lower which runs parallel to the Indus River till it again splits up into two branches, the Indus Branch and Munda Branch.

So far the headworks and Upper Main Line are quite complete and are functioning satisfactorily. Muhajir Branch with most of its distributories is complete and irrigation is being practised on this branch with good results.

The construction of Lower Main Line has since been extended up to a length of about 40 miles, while the construction of the portion below has been started only recently.

Forecast of Irrigation.

Kharif Season	3,51,000 acres.
Rabi Season	6,99,300 acres.
	1,050,300 acres.

Financial Forecast.

The income will be in the way of Abiana, Land Revenue, realization from increase in value and rates of Crown Waste Land and realization from "grantee lands," to the peasants etc. such as Malikana, rent from temporary cultivation, proprietary rights etc. The return percentage will be about 3·08 in the tenth year after the completion of the project. The revised cost of the whole scheme was Rs. 13½ crores as estimated in 1944, but the revised cost is about 15·5 crores of rupees. It is expected to complete the whole scheme by the end of the year 1952-53.