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ZARGHUN MOUNTAIN AND THE WATER SUPPLY OF QUETTA

BY

Dr. H. CROOKSHANK,

Director, Geological Survey of Pakistan.

The Zarghun massif about 15 miles N. E. of Quetta rises at Loe Nekan to 11,725 feet and is the highest mountain in Baluchistan. Unlike most massifs it is basin shaped and all the high peaks rise on the rim of the basin.

In very many cases peaks owe their dominating height to something hard and tough in the rocks which form them which is not found in lower peaks in the same area. Loe Nekan is formed of coarse Siwalik conglomerate which must be broken down fairly rapidly by frost and snow in the winter and hot suns in summer. It certainly seems to be a much weaker rock than the massive impermeable limestone of Jurassic age which forms all the other high peaks of the Quetta area notably Murdar Ghar 10,448 feet, Takatu 11,336 and Chiltan 10,483. If it were a question of speed of weathering it should be much lower than these peaks.

Moreover, it is certain that Loe Nekan was once much lower than the surrounding limestone mountains because the conglomerate there is formed of boulders of Jurassic, Cretaceous, and Eocene limestone washed down from the surrounding limestone mountains. In fact, the Loe Nekan conglomerate must have originally been formed in a fairly deep valley in the mountains of this part of Baluchistan. How then has it been raised to its present lofty position? I submit that it has reached this by uplift in comparatively recent times. Seeing that there is no trace of glaciation in the Zarghun basin as there would be at a much lower height in the Himalayas, I consider that Zarghun was probably raised up after the last great glacial period in the Himalayas. The alpine flora which must have colonized the Himalayas after this glacial period probably never colonized Zarghun because the mountain has only recently been elevated to a height at which such plants could grow. Certain it is that in spite of its height the mountain has been colonized by common Baluch hill plants and not by alpmes such as grow **at** 11,000 in the Himalayas. There are no rhododendrons or heathers, no strawberries or brambles and no conifers except the juniper which is almost universal at high level. Nor do I think the absence of these typical Himalayan families can be attributed to

climate. The rainfall north of the main Himalayan Range is often much lower than in Baluchistan and the temperature and humidity not very different, yet this does not prevent the hardier Himalayan types flourishing.

The uplift of this mountain may have been brought about by folding or vertical uplift or by both.

The basin has been folded but not at all to the same extent as the surrounding limestone mountains. It is much faulted too, but no thrust planes are known such as are so commonly seen in other parts of Quetta district, notably in the valley between Zarghun and Takattu.

This folding has no doubt raised Zarghun markedly, but I very much doubt whether folding alone is responsible for raising the mountain above all the surronding peaks as these must also have been raised by the same folding. I think there must have been vertical uplift also on a considerable scale in very recent times. Such differential uplift might be due to the slightly lower gravity of a valley filled with gravel between massive limestone ranges. If this be the true explanation, it is remarkable that such a narrow feature as a valley between two mountain ranges could be floated up higher than the mountains in a period which cannot exceed 5 million years and probably does not exceed 50,000 years.

The seismic illstability of the zones on either side of Zarghun may well have been induced by the rapidity of this movement.

The uplift of Siwalik conglomerate to nearly 12,000 feet is probably unique in the Indo-Pakistan area. I wrote to my co-professionists in Calcutta about tbis and gOLsome interesting replies. There are apparently conglomerates high up on Kailas near the headwaters of the Sutlej. These are even higher than those of Zarghun but the[f~ is no certainty that these conglomera tes are Siwaliks.

The Karewas of Kashmir which extend in places almost up to the same height as Loe SOl' are perhaps more comparable. These too are said to owe their present height to rapid uplift in recent times.

Most of the Siwalik conglomerates are however found at elevations between 1,000 to 5,000 feet along the southern margin of the Himalayas.

THE ZARGHUN BASIN AS A SOURCE OF WATER.

Zarghun is of considerable importance as it is the catchment area for the Urak Tangai, a stream which supplies water to the fertile Uyak valley and also much of the water used in Quetta.

The Urak: stream is perennial and dashes along crystal-clear and sweet

among the boulders fallen from its high rocky walls. Helped by the dampness along its banks all sorts of moisture loving plants such as orchids, maidenhair and equisetum flourish, and there is a dense growth of trees and bushes many of which like wild r)se, cherry, and clematis blossom luxuriantly. Cliffs which would be impressive even in the mighty Himalaya rise on all sides and sometimes from gloomy gorges only a few feet wide and rising almost vertically for many hundreds of feet. No more attractive valley exists in all Baluchistan.

The rocks in the catchment area are mainly conglomerates of upper Siwalik age. These rocks dip inwards all all sides and form a natural basin the highest peaks of which mostly occur on the irregular lip of the basin. The conglomerates are thick bedded and massive and appear to be only slightly permeable. Included among them are a few beds of clay and sandstone. These are often associated with the springs which feed the Urak Tangai. Whether the presence of impermeable clay beds brings the water to the surface or whether the sandy clay beds are more permeable than the conglomerates and act as channels through which water flows to the surface I cannot say.

The centre of the basin is undergoing rapid erosion, and is a network of huge cliffs cut in the conglomerate by river erosion. The water entering the conglomerate at the rim of the basin finds its way down dip slopes, gets into fissures and cracks and re-appears as springs all over the basin. There does not appear to be any special horizon where springs are common. Some are seen 11,000 feet up near the rim of the basin but they also occur here and there down to about 7,000 feet near the mouth of Urak Tangai.

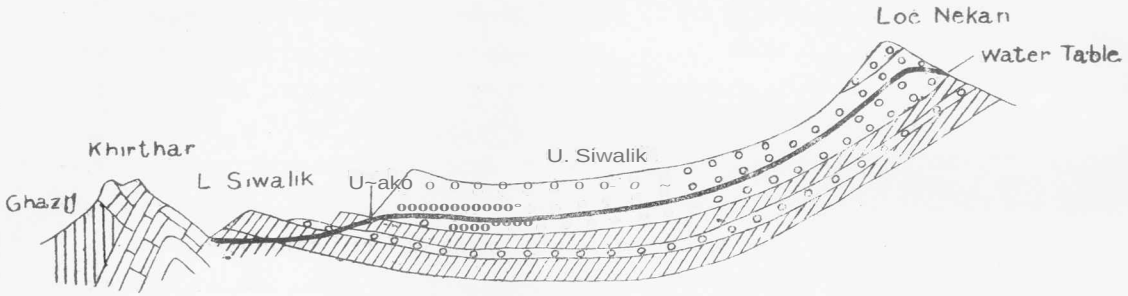
Below this basin of coarse conglomerate one sees in the Urak valley thick beds of red clay inter-stratified with conglomerate. These beds are lower Siwaliks and probably stretch right round and under the basin. They lie with marked unconformity on much older and more intensely folded Nari and Khirthar beds. The Naris where present are mostly sandstones. The Khirthars are white nodular limestones forming a conspicuous ridge surroundmg thE: Siwalik basin.

Now if the upper Siwalik conglomerates which form the Zarghun Massif were highly permeable one would expect much of the rain and snow which falls on them to sink to the bottom of the basin. Here it should re-appear above the thick red and presumably impermeable clays of the lower Siwaliks- in numerous perennial springs.

Actually there are ;,;ome springs at this horizon but they are neither large nor numerous. Most of the springs are scattered at different horizons in

the upper Siwalik conglomerates. I consider that the rainfall on Zarghun finds its way into the rocks through numerous faults (many of which can be seen) and fissures, but that little of it filters down to the junction of the upper and lower Siwaliks. Most of it finds its way to the surface, where sandy porous beds are cut by the gorges carved in the basin by recent erosion, and thereafter becomes a part of the run off passing through the Urak Water Works.

It is possible that there is a reservoir of untapped water lying in the lowest part of the basin which could be tapped and might even be fit for artesian bring.



If, as I think probable, the upper Siwalik conglomerates are almost impermeable and only allow water to pass through fissures it would be difficult to recover much water from such a basin. There is a chance, however, that at the junction of the upper and lower Siwaliks there might be a comparatively good aquifer.

To take water from such an aquifer might possibly in the long run lower the general level of the supposed underground reservoir and leave the situation at Urak no better than it was before. If such a result should ultimately be brought about, it would be relatively easy to replenish the underground water by a small dam to hold up surplus flood water below the junction of the Kuchnai and Loe Daras.

I favour an experimental boring near the Urak Water Works so placed that the lower Siwalik red clays would be encountered some 300 feet below the surface. I am not prepared to say that it would be a success but in review of the importance of more water at Urak, it should be given a trial.

As the upper Siwalik conglomerates appear to be impermeable except at fissures and faults the possibility of a small dam to impound flood water coming down the Urak Tangai deserves some consideration. There are two water works. This place could be made accessible by a hill road or wire places where such a dam could possibly be constructed. One is just below the junction of the Kuchnai and Loe Daras about 21 miles above the existing

ropeway from Urak. It would have the great advantage over other reservoirs that no new pipe lines to take the water to Quetta would be necessary. This is a mere suggestion as without survey it would be impossible to say what the possible storage here would be but there seems no insuperable difficulty from a geological point of view. The valley here is not very wide. Coarse and fine aggregate would be available on the spot.

The other possible dam site lies at the top of the gorge where the Loe Dara turns N.E. before leaving sheet 34 N/3. The gorge here is only about 8 feet wide and could very readily be dammed to a height of say 75 feet. Above the gorge the valley is narrow, but for half a mile or so seems rather flat. One mjght be able to construct a small deep storage tank which would be subject to little loss from evaporation as it is surrounded by cliffs which shelter it both from wind and sun. Such a tank would enable the Loe Dara to be kept at a constant level much higher than the low water level to which it sometimes sinks at present. The geology of this dam site seems quite good. The chief objections would be that a dam here would not capture the whole of the water in the Urak Tangai and that it would involve a rather long service road. On the other hand the gorge is very narrow, and coarse and fine aggregate would be available on the spot, so that the amount of material to be carted up to the dam site would be small and might even be handled by mules or donkeys along the existing path.

Although the river does not appear to carry much detritus, it is possible that in big floods it would do so. Such detritus would tend to fill up either of these proposed reservoirs and give them a limited life. This would have to be investigated before construction was considered.

Another objection to the construction of a reservoir in the Urak valley is that there already exists a reservoir at Hannah lake for collecting the surplus water from Urak. This leaks badly and at best supplies water in good years to the low lying parts of Quetta. There is a proposal to pump concrete at high pressure into the foundations of the dam forming this reservoir. This would be costly and might not stop all the leakage. At best it would only supply water to a limited area in the lower part of the Quetta Cantonment. It is at least possible that the construction of a new reservoir over the Urak Tangai to regulate the water at Urak Water Works would be as cheap as the repairs to Hannah lake, and weuld have the added merit of making it possible to distribute the extra water all over Quetta without any addition to the present system of supply.

A STUDY IN THE FRAGMENTATION OF HOLDINGS IN WEST PAKISTAN

BY

A. H. JAFRI

Being an agricultural country, land is of prime importance in the economy of West Pakistan. Agricultural industry occupies a high place in public estimation, as the ownership and possession of land gives a sense of independence and honour and a person having it, commands the means not only of producing food but of securing any thing he may require in exchange, because the demand for what he produces is great..

Cultivable area per head of popUlation in West Pakistan is less than one acre, which is divided into small and uneconomic holdings, due to various laws of inheritance. Moreover the wrong allotments of land to refugees also became a cause of fragmentation (as map 2 shows) owing to hasty allotments. It has not only created difficulties for the allottees but also hampered the development of otherwise fertile land. The holdings have so greatly been sub-divided that there is not enough work on the farms for the cultivators, nor there is other work to which they can turn their hands. This is the condition in the old settled areas of West Pakistan. On the other hand, as pointed out by Wattal, there are sparsely populated areas awaiting development as the soil is inhospitable only due to scarcity of water*.

Pressure on land does not allow it any rest and the fertility, exhausted by continued cultivation, is generally not been restored by the use of manures, as many of the materials which ought to be used as manures are being utilised for other purposes and are thus wasted. The most common example is cow-dung, which can easily be turned as manure but is utilised as the cheap alternative of firewood.

* Taken from V. G. Kala, Indian Economics, Vol. 1, p. 100.

'U8OIVI510N | S.. FR AGMENTATION OF HOLD'MtS IN TEHSIL PAI< PATIAN Din. MONTGOMERY

Economic Unit.

The most efficient and economic unit of agricultural production varied widely from one branch of agriculture to the other. Sometimes it is beneficient when the unit of cultivation is larger. As in the case of wheat or cotton, as the cost of cultivation becom!'s lower, supervision is more effective and the efficiency of technique of cultivation can be materially improved. On the otl-.er band a relatively smaller unit can be utilised with marked success in those brancbes of agriculture as in the case of fruit, and vegetable growing etc. where individual care and attentirlTI is milch needed.

An economic unit embraces only the unit of cultivation-farm ,actually under plough and not the amount of land owned by a person. Its utility is two fold, firstly as a source of income and secondly as a field of activity for its occupier.*. From this stand-point an economic unit of cultivation is one which provides its occupier with an income which is sufficient to ensure for him and his family an efficient standard of living and which affords full employment for him. Thus an economic unit will differ with the size of the family, its capital resources and the technique of cultivation employed. It will also fill\.tuate from country to country. From the stand-point of national dividend the ideal size of the unit of cultivation is that which secures maximum efficiency in production. It is that size under which the different factors of production can be employed to the greattst advantage so that costs are reduced to the minimum and returns are maximised. But this theoretically ideal size of an agricultural holding may not be socially and economically desirable under certain cIrcumstances. It may accentuate inequality in the distribution of wealth and lead to large scale unemployment

Small holdings as compared with the theoretically idl'al units of cultivation involve waste of land. This waste, however, can be minimised by adopting a suitable agricultural policy and promoting mutual understanding and cooperation among the cultivators. In any case economic size of a unit of cultivation has to be determined after a careful study of the socio-economic conditions of the country as a whole and also of the different families.

The existing average sizes of holdings in three provinces of West Pakistan are as below:

Size of holdings both of tenants and owners.t

Punjab ... 5 acres.

• R. D., Tiwari, Indian Agriculture, p. 52.

t Report of L.R.C., 1!J38.

Sind ... (varies with seasons) roughly 6 to 7 acres in Kharif and 7 to 8 acres in Rabi..

NWFP ... 7 acres.

According to the Royal Commission there are four problems of fragmentation to be dealt with :*

(a) The sub-division of holdings of right holders.

(b) The sub-division of holdings of cultivators.

(c) The fragmentation of holdings of right holners.

(d) The fragmentation of holdings of cultivators.

In fact these are merely different phases of the same problem. The problem is essentially one of uneconomic units of cultivation. In 'Vest Pakistan the units of cultivation are uneconomic not merely a~ compared with the theoretically ideal units but also from the stand-point of the size of the farmer's family and his capital resources.

The problem of sub-divi8ion and fragmentation has received a good deal of attention and attempts have been made to tackle it with varying degrees of success. In the voluntary consol;dation scheme the Punjab Government secured striking results in tackling this problem on a purely voluntary basis through the agency of couperative department. .

According to this scheme cooperative officials carryon steady propaganda and educate the masses to the advantages and usefulness of the scheme. The Royal Commission's Report on Agriculture reads, "it is only where the cooperative spirit is strong that success is hoped for.. To bring the scheme to a successful conclusion careful education in its advantages and unending patience in attending every grievance and objection are called for. Failures of many months painstaking work may be brought to naught by the recalcitracy and obstinacy of one individual and even when the object is gained progress is slow"·t

The progress in consolidation has been slow. It is difficult to obtain very good results where everyone has to be satisfied and all conflicting interests Ie c~mciled. Technical difficulties too abound and behind all this is the peasant's passionate love oj his land.

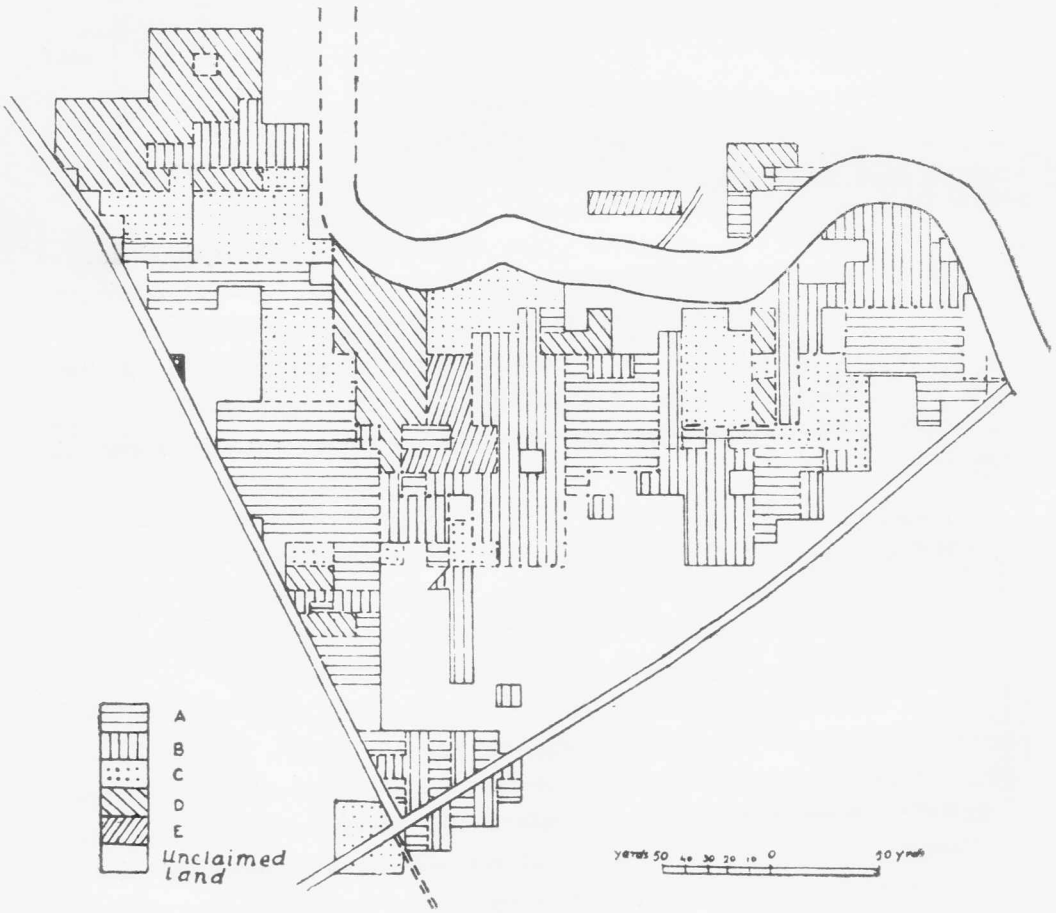
Inspite of all these difficultie;, it is essential to secure an immediate and effective solution of the problem of sub-division and fragmentation of holdings.

* Royal Commission on Agriculture Report, para. 118.

i Ibid, para 124.

FRAGMENTATION DUE TO WRONG ALLOTMENT OfCUL TIV~BLE WASTE THING AND RAISINGHWALA

OIST~IC"T \.AWORE



In this direction the experience gathered by the Cooperative Consolidation Societies is fairly encouraging. But an exclusive reliance on the cooperative spirit will cause undue delay. Agreeing with R.D. Tiwari,* the Provincial Governments should appoint special consolidation boards composed of trained economists, experienced revenue officials and agricultural specialists so thlt there should be hedlthy coordination amongst the various aspects of the consolidation work. It should be a permanent body and should be empowered to prevent a refractory minority from delaying an otherwise useful scheme of consolidation. There should be legal restriction to prevent sub-division and fragmentation of a consolidated holding in future and the division of produce but not the division of land, should be allowed among the heirs.

Consolidation of holding will undoubtedly help raise the farm income but frequently even a consolidated holding may not be an economic unit. Therefore after the existing holdin(2s have been consolidated, the boards will have to study thp problem of providing economic units of cultivation improving the conditions of land in order to make the holdings into economic units. Along with the consolidation of holdings the state will have to find alternative sources of employment by developiTlg large and small scale industries. In fact a comprehendve policy of economic,planning "ill have to be adopted to absorb the displaced population. In short our ability to find alternative avenues of employment will determine the provisions of new economic units of cultivation.

Mechanisation.

The man behind the plough is poor and generally illiterate. His poverty and illiteracy have disabled him from taking advantage of development and improvements in agricultural technique. He, therefore, continues to stick to his old methods and these methods are admirably wited for his simple agricultural economy. In other advanced countries improved methods of agricultural production have been in practice, which have made greater use of mechanical appliances and thus reduced the cost per unit of output. The cultivator in Pakistan with his primitive methods has to compete in the international market for the disposal of his produce with those of more efficient farmers and finds his margin of profit rapidly declining. The income of our farmers has received a serious setback as the prices are determined by the cost of production of more efficient producers. This has further added to our farmer's poverty. He finds himself in a vicious circle from which

* Indian Agriculture, p. 93.

unaided escape is difficult to effect.. An improvement in the agricultural conditions of West Pakistan can be secured only by suitable changes, though gradual, in the technique of agriculture so as to enable our cultivators to compete on equal terms with farmers of other cvuntries in the international market.

The mechanisation is much needed both for intensive and extensive type of agriculture, but the suggestion for suitable changes in the light of recent developments are often neglected. "Our atl empls to teach the natives of India" said Cotton, "are based upon forgetfulness of the essential elemt·nts of the case (mechanisation). The native cultiva lors are too poor to be able to adopt the scientific improvements which English experience suggests. They are told to plough deeper, to do more than scratch the soil.. But it is forgotten that the cattle with which they plough are incapable of deep ploughing "*

The Pakistani cultivator is badly in need of improved implements. The slow progress made in the farm mechani~;ation is due to:

(a) Scarcity of monetary resources and lack of large holdings.

(h) Lack of appreciation of the usefulness of machinery.

(c) Ignorance and lack of education (especially on the technical sUe.)

These conditions are intensified by the extraordinary cheepness of manual and bullock-power with the result that only a very small fraction of the agricultural population utilises improved implements. The intensive propaganda and demonstration can only remove the disability of ignorance with which our cultivators generally suffer. But a more formidable obstacle to the extensive use of improved im;:>lernents, that has got to be over-come, is the poverty of the agricultural population and their fragmented and uneconomic holdings. The problem of finance anJ holdings must be tackled together, as the problem of finance will vary with the size and nature of agricultural holdings.

As long as the holdings are fragmented and uneconomic the cultivation will not be able to purchase improved implements or make an effective use of them. The provincial governments should, therefore, give a bold lead in this direction. The local boards should be encouraged to raise sufficient loans for the purchase and supply of these implements. The boards should distribute these implements amongst the village Panchyats on the basis of careful

*Henry Cotton, New India, p. 99.

investigation of the nature and size of agricultural holdings in the village, the area under cultivation and the number of cultivators who cannot afford to purchase these implements. The agriculturist should pay for the use of the implements at a rate, which will, in the long run, cover the cost of the implements, reasonable rates of interest on the investment and the cost of repair. The village Panchyats should collect the rates charged at the time of harvest. This method of finance will bring improved implements within the reach of most of the cultivators. At the same time, efforts should be made to consolidate the holdings. Once agricultural holdings are consolidated the financial difficulties involved in the provision of improved implements will become less onerous. On similar lines power machinery can be introduced slowly as, at present, it is "entirely outside the perview of a small cultivator and the only hope of placing it within his reach is by cooperative efforts." *

HYDROGRAPHIC CONTROL OF KASHMIR ON PAKISTAN

BY

K. U. KUREISHY.

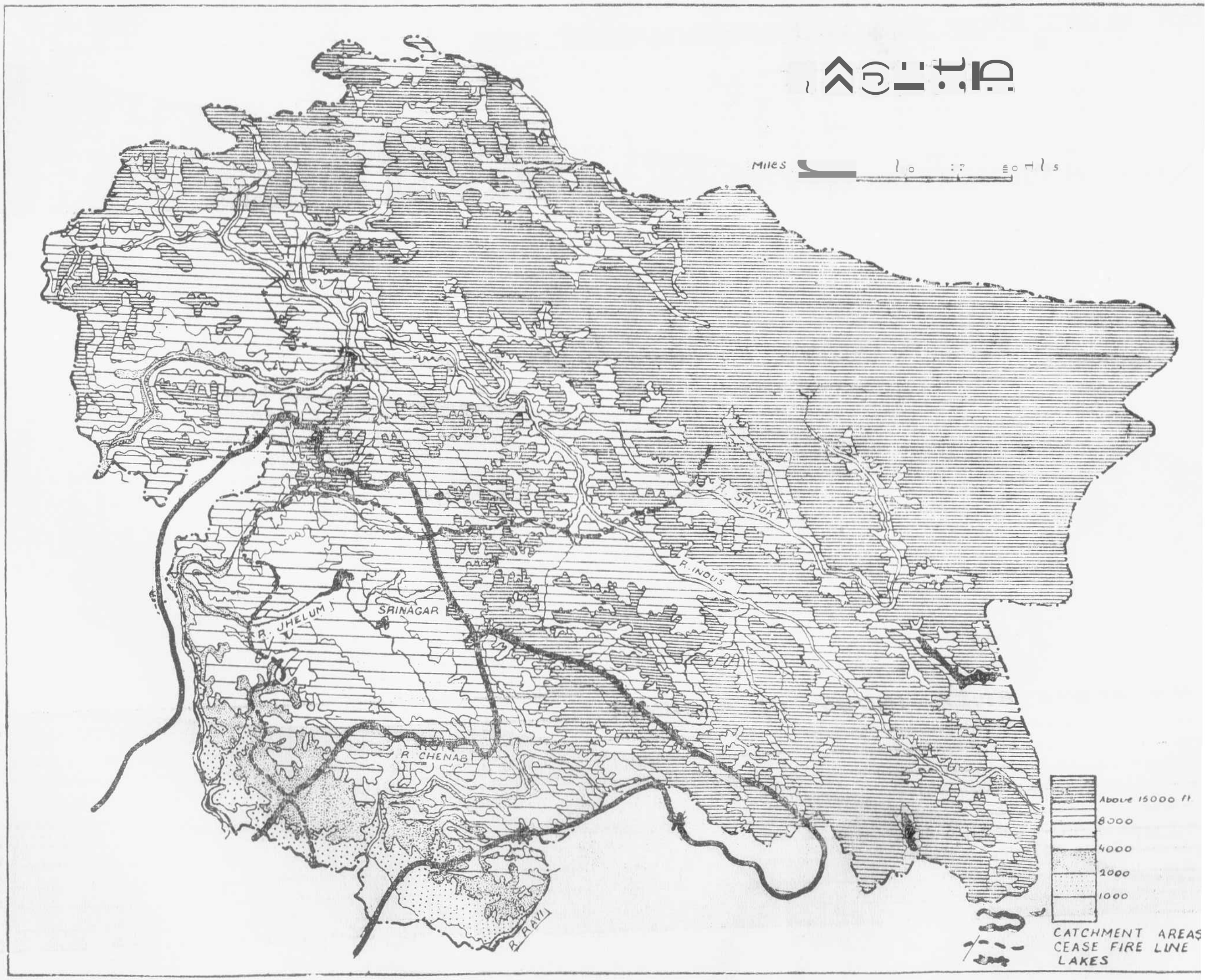
"Two-thirds of the entire water supply (of the Indus plain) originate in Kashmir" according to David Lilienthal, formerly the Chairman of T. V. A.

Three important rivers of West Pakistan *viz.* the Indus. the Jhelum and the Chenab have their upper courses in the state of Kashmir. . Out of these the Indus occupies a unique position in being of the first order of magnitude in the rivers of the sub-continent on the basis of the extents of the mountainous areal drained by them. (The Himalayan area included in the catchment basin of the Indus is 1,03,800 sq. miles followed (nly by the Brahmaputra the catchment area of which is 99,200 sq. miles in the Himalayan mountains. The Indus is a trans-Himalayan river (and only abaut 62,720 sq. miles of its mountainous area is contained in Kashmir). Its basin is bf'st described as a 'high level' one. Having its chief source in southern Tib;ot (31 °_]5' N and ~ll0 40' E approx) it, for a distance of about 180 miles, clings to the inner margin of thp easterly continuation of the Ladakh range. ~ear Thangra it pierces through the range and occupies the trough north of t he Ladakh range for a distance of about :300 miles till it recrosses the range near Skardu and again finds its position on the inner flank. The general trend of the river co·)tinues to be roughly south-edst to north-w.>st in keeping with the direction of the Himalayas. A sudden change in its directi.m, as also in the direction of the mountains, is noticeable after the river has skirted alOund the pivotal height.s of Nanga Parbat. Hereafter it flvws in *a* south-westerly riirection for a long distance.

Such a complex course together **with** the high perched position of its basin does not allow the river to remain economically manageable for useful purposes. Other factors limiting its usefulness in its stretch through Kashmir are:

(1) The steep gradient of the river course.

(2) The more deeply incised valley.



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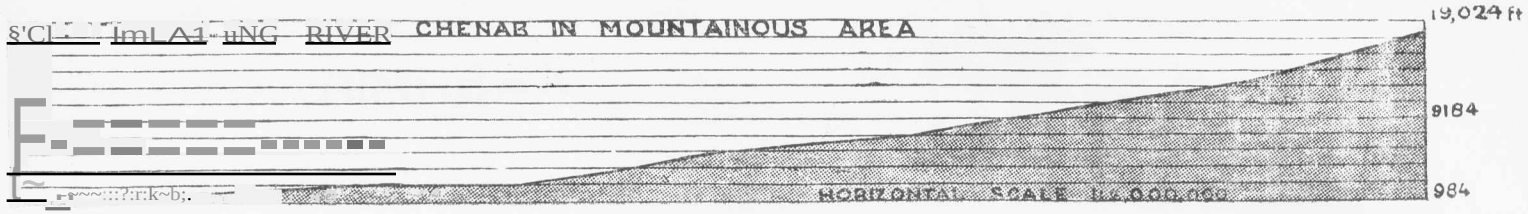
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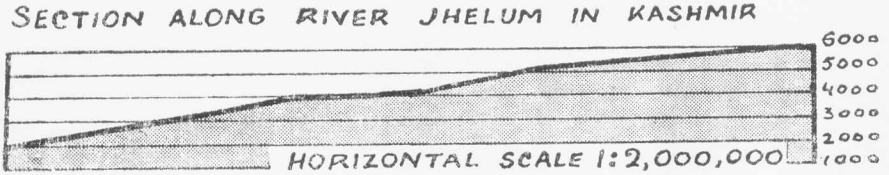
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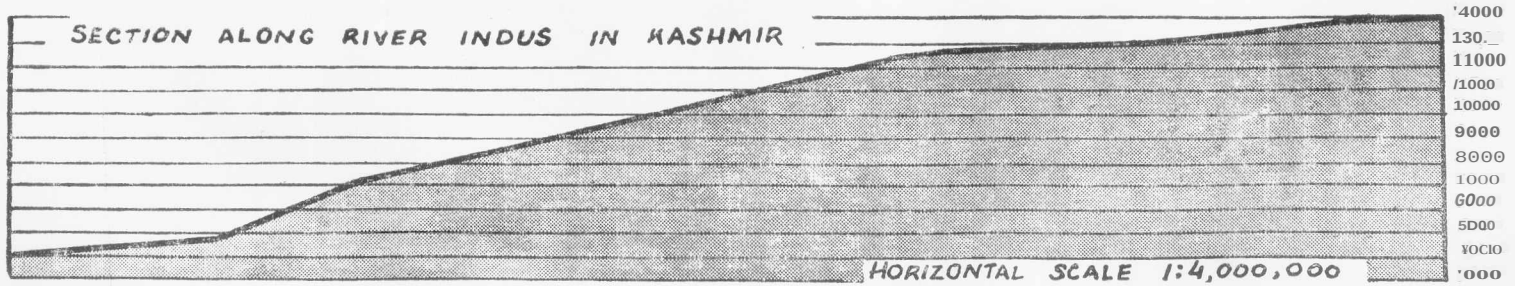
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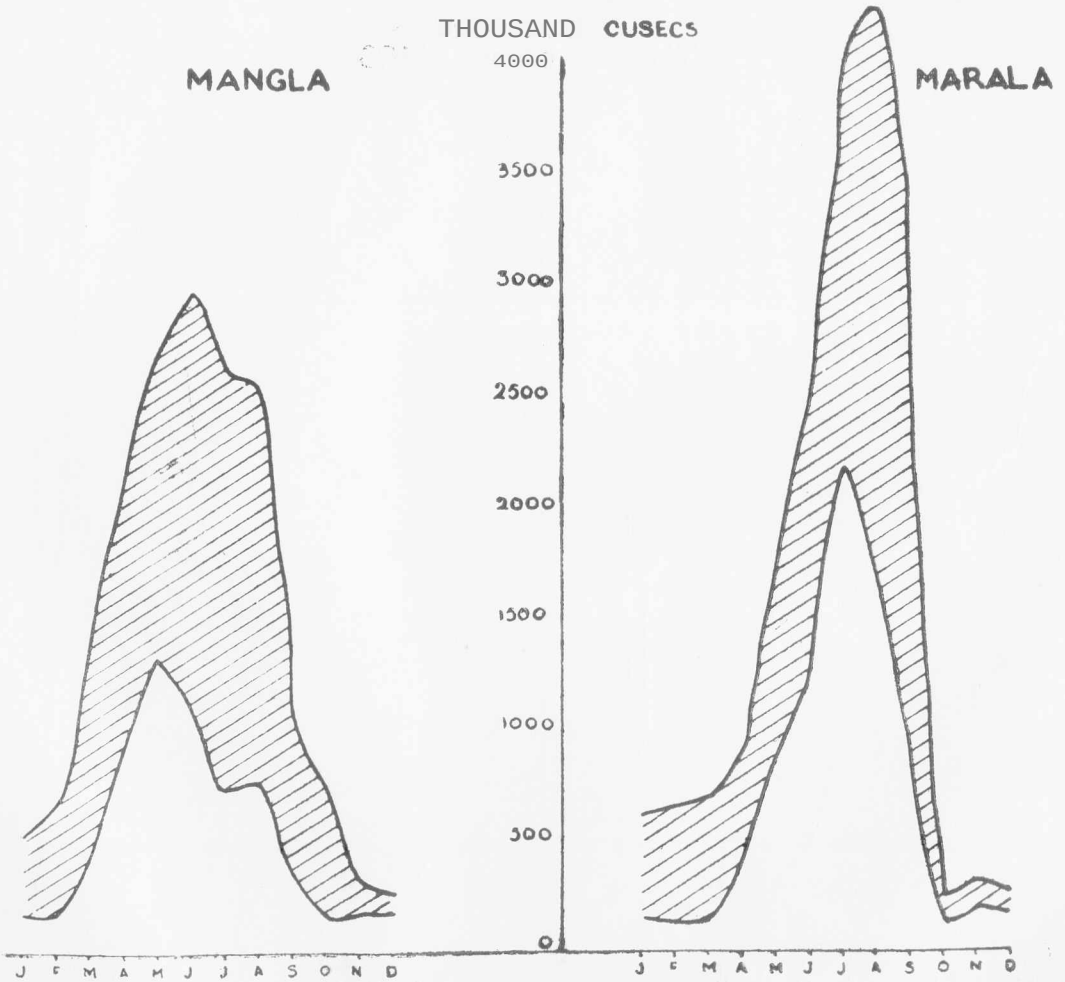
(3) Its effective scpara tion from the other rivers of the two Pun jabs thus decreasing the possibility of di version of its water into other channels and

(4) Its comparatively greatcr amount of water after it is joined by the Kabul river whicb has the largest catchment basin (35,000 sq. miles) of all the remaining five affllJents *viz.* Shyok (13,000 sq. miles), Gilgit (10,000 sq. miles) Zaskar (10,000 sq. miles) Dras (5,000 sq. miles) and Shigar (5,000 sq. miles). The Kabul, however, joms the Indus outside the state territory.

The Indus being far away from the Monsoon influences and hence above its varying regimes is fed mostly with snows. According to Burrard, one of the authors of Geography and Geology of the Himalayan Mountair.s and Tibet, the feeder glaciers of the Indus are "larger than those of any other mountains outside the polar regioni." These are, however, divided into two main groups *viz. (i)* the Karakoram group and the Hindu Kush group. Most of the water supply of the Hindukush group of glaciers is received by the Indus outside Kashmir. The gauge data of the river is available at only one pt.. in Kashmir *viz.* Skardu. Other points for which these figures are obtainable are Indus-Kabul confluence and Kalabagh where discharge figures are also avaiJabl~. For the purposes of ascertaining the fluctuations in the volume of water in the ri ver these stations are very distantly dispersed. No data is available for a point where the river leaves Kashmir territory and enters Pakistan proper. Nevertheless, it is quite well known that the variations in the discharge ot the Indus are enormous. The effect of seasonal fluctuations is, at times, accentuated by t1:e temporary damming of the river course by glaciers or landslips and the sudden release of water after the barrier is overcome resulting in heavy floods. Such floods are quite numerous. Still the chances of taming the river inside the state territory are not bright. It may, therefore, be concluded that the Indus in Kashmir cannot be much utiliscd for useful irrigation or flood control ;chemes for Pakistan.

In case of the Jhelum and the Chenab the control of Kashmir 0·1 Pakistan is more complete than the mere cradling of their upper courses as is manifest in case of the Indus. The Jhelum is entirely a Kashmir river as cent per cent of the 13,000 sq. miles of its catchment area in mountains is within the terri. torial confines of the state. The famous vale of Kashmir having a length of about 90 miles and a width of about 25 miles is an oval shaped trough but-

ABSOLUTE MA)C.\MUM AND MINIMUM MONTHLY D.SC~ARGES
19~-50



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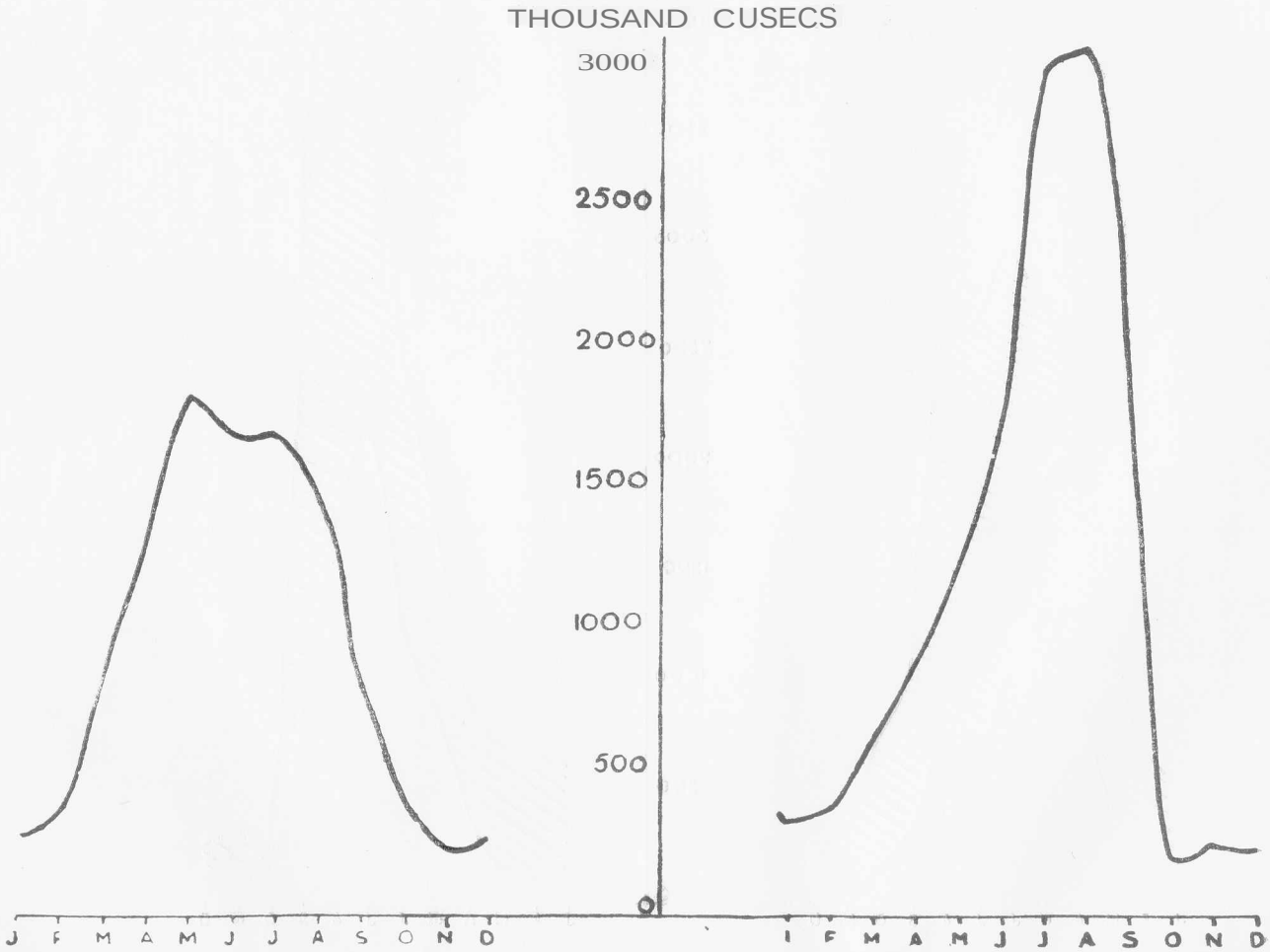
1841-50



tressed by the Great Himalayas and the Pirpanjal being about 75 miles in width frum crest to crest. The one important fact about the longitudinal profile of the Jhelum is that its gradient is much steeper bef0re it reaches the neighbourhood of the Wular Lake below which the fall perceptibly decreases. Between Baramula and Muzaffarabad the fall is of the order of about 33 ft. in a mile while that from Muzaffarabad to near Mangla it is further reduced to 21 ft. a mile. Below Baramula the river occupies a deep and narrow gorge across the Pir Panjal and pursues a more or less straight course for a distance of about 20 miles upto Uri. The depth of the gorge (Basmagul) is about 7,000 ft. and the walls of the defile (at places 70 ft. wide) are precipitous to the extent of perpendicularity. At and below Muzaffarabad the river is joined by the Kishanganga and the Kunhar respectively and follows the southerly direction of the affluents in place of its previous westerly course. Before reaching Mangla the river begins meandering freely.

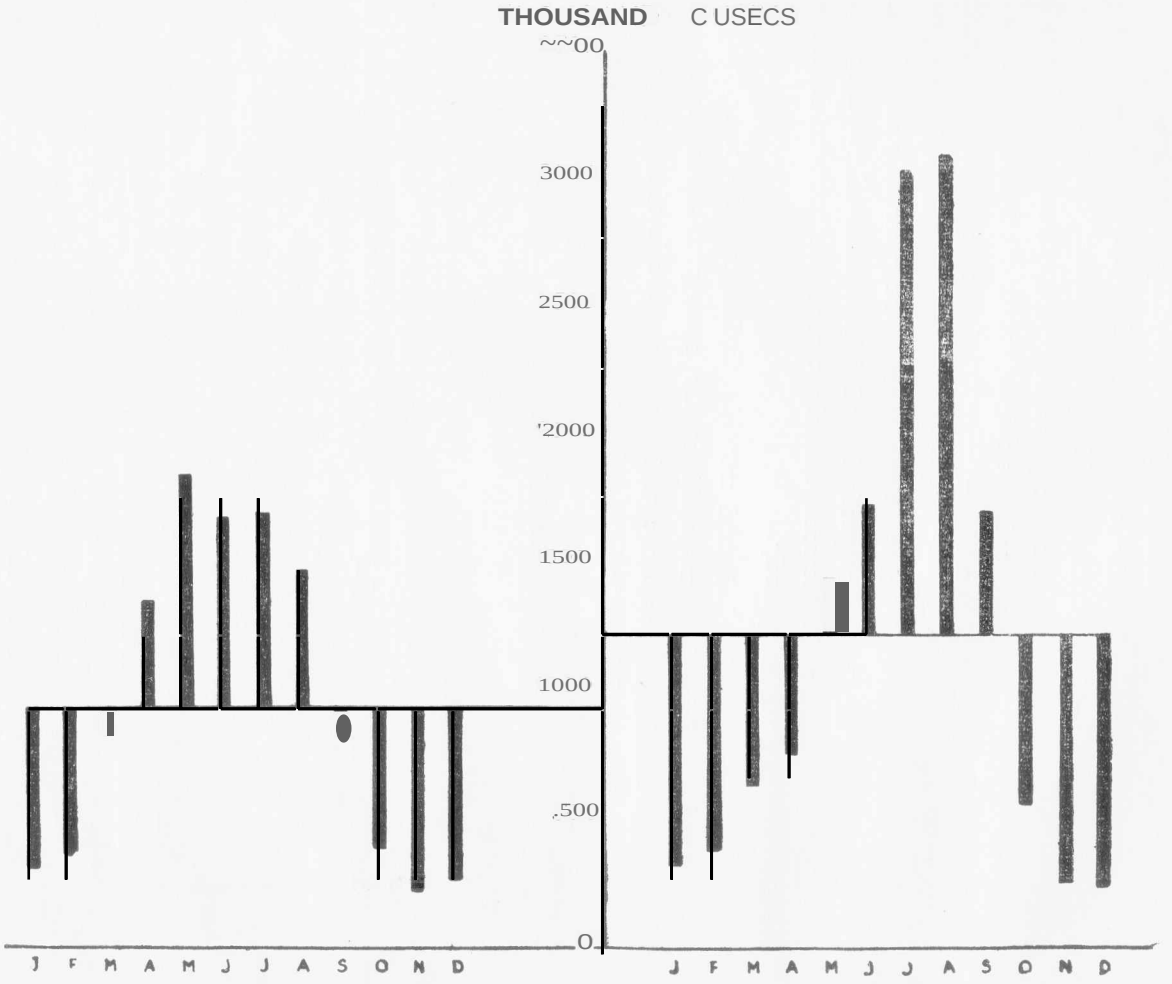
Statistics about the daily and monthly discharges of the river are available for Mangla which is situated within the state just at the foot of the foot-hills (Part of the territory containing the headworks of the upper Jhelum Canal was given to British Indian on lease at the time of the construction of the said canal). The average value of monthly discharges here is more than 9 lakh cusecs. Separate figures for different months are as below :-

1941 to 1950.

January	... 2,90,734	May	... 18,46,444	September	... 8,07,344
February	... 3,51,036	June	... 16,89,461	October	... 1,92,602
March	... 8,20,005	July	... 16,90,026	November	... 2,29,005
April	... 13,40,730	August	... 14,75,937	December	... 2,71,226

These figures reveal that the amount of water in the river is least in the months of November, December and January. From February onward it goes on increasing steadily upto May which is the peak month with an average of more than 18 lakh cusecs. From May to August the decrease in the volume is not so well marked. Afterwards, however, the decrease is much greater and continues unabated upto November. On the whole the increase and decrease coincide with the inflow and the recession respectively of the rain bearing Monsoon winds. The mean annual difference between the maximum and minimum discharges is 16,17,439 cusecs and the absolute difference between the maximum and minimum discharges for the 10 years ending December, 1950, is 28,30,528 cusecs. The maximum discharge for the period is more than 1,800% of the

DEVIATIONS FROM AVERAGE MONTWLY DISCHARGES 1941-50



millImum. The graph, under the caption "absolute maximum and minimum monthly discharges" reveals that the difference between the maximum and minimum values augments during the rainier half of the year from May to September. The hydrograph showing the minima is comparatively less irregular than the one showing maxima signifying that there are greater fluctuations in the maxima from month to month than in the minima. All this leads us to an important conclusion about river Jhelum and it is that the main problem in its connection is of storing of water at the time of plenty for the months of scarcity. It is difficult to evaluate with certainty how much water goes waste which could be fruitfully utilised in a thirsty land like ours on account of the inadequacy of storage arrangements for the preservation of excess water at favourable times. A very rough idea can be formed in the light of the commonly quoted but unauthentic and certainly too conservative an estimate that only about 20% of the waters of the Indus basin, as a whole, is at present utilised for irrigation purposes.

A study of the graph entitled "deviations from the average monthly discharges" tells that in case of both Jhelum and Chenab rivers for seven months of the year the volume of water is less than the average. For the five months from April to August the quantity is more than the average in case of Jhelum. The excess water of the surplus months can, therefore, obviously be saved with a view to utilise it in useful purposes and to eliminate its destructive role in the form of floods by constructing dams and reservoirs at suitable sites. Under this impelling necessity a survey of the river course with the purpose of locating such site or sites is, therefore, most essential..

The Jhelum is a "secure" river in case of Kashmir's accession to Pakistan firstly because no part of its upper reaches is outside the state and secondly because although its catchment basin coalesces as it does with that of the Chenab for a sufficiently long distance there is no danger spot along the common divide where one of the main arteries of the two systems comes any closer to the other. The possibility of the diversion of its water to the neighbouring system is, therefore, out of question.

The third river of Kashmir *viz.*, the Chenab deserves even greater attention. From near its two sources of Bhaga and Chandra about Rara Lacha pass (16,047 ft.) to Ashmur where it leaves the mountains the average fall of the river is about 39 ft. a mile. The fall of the Chandra from its source to itlD confluence with Bhaga at Tandi is about 75 ft. a mile while from here to

Kishtwar, where the river carves out a gorge through the Pir Panjal, its 34 ft. a mile. Again the fall between Kishtwar and Akhnur is 26 ft. a mile. The river originates in the Indian Himalayas and flows through them for a sufficiently long distance before it enters Kashmir. About 3,500 sq. miles of its total catchment area lies in Bharat..

The average monthly discharges at Marala where the Chenab almost just emanates froIR the mountainous stage is 11,25,242 cusecs. The monthly figures are as follows :

1941-50

Jan.	...	3,22,282	May	...	12,26,674	Sept.	... 16,92,633
Feb.	...	3,65,513	June	...	17,22,893	Oct.	... 1,94,428
March	...	6,22,947	July	...	30,35,298	Nov.	... 2,44,322
April	...	7,50,382	Aug.	..	30,92,041	Dec.	... 2,33,4R4

The amount of water in this river is least in the months of October to December. It increases onward uptil July and August.. August is the peak month with an average of more than 30 lakh cusecs. The decrease commences from September and is rapid. The increase and decrease in the volume of water is not wholly dependent upon Monsoon influences. The mean annual difference between the maximum and minimum discharges is 28,97,613 cusecs and the absolute difference during the ten years is more than 40 lakh cusecs. It signifies that the absolute maximum discharge is as much as 30 times that of the absolute minimum for the period. The difference augments during the rainier half of the year from May to September. Fluctuations in the maxima from month to month are greater than in case of minima.

Comparison of the Jhelum and the Chenab.

There are some obvious differences of volume and behaviour of the water-fiow of the two rivers. The average monthly volume of water in the Chenab is more than that of the Jhelum by about 3lakh cusecs. The months receiving less than average volume of water are October to April instead of September to March as in case of Jhelum. The deviations from average discharge are more conspicuous in case of the Chenab. Discharges of the Jhelum at Mangla are more directly influenced by Monsoon rains than by the glacial supply of the mountains. The same fact is partially borne out by the lesser length of the river in the mountain stage. It also appears that the volume of water is at least more in the upper most course of the Chenab as compared to that of the Jhelum. It becomes a very vital consideration in

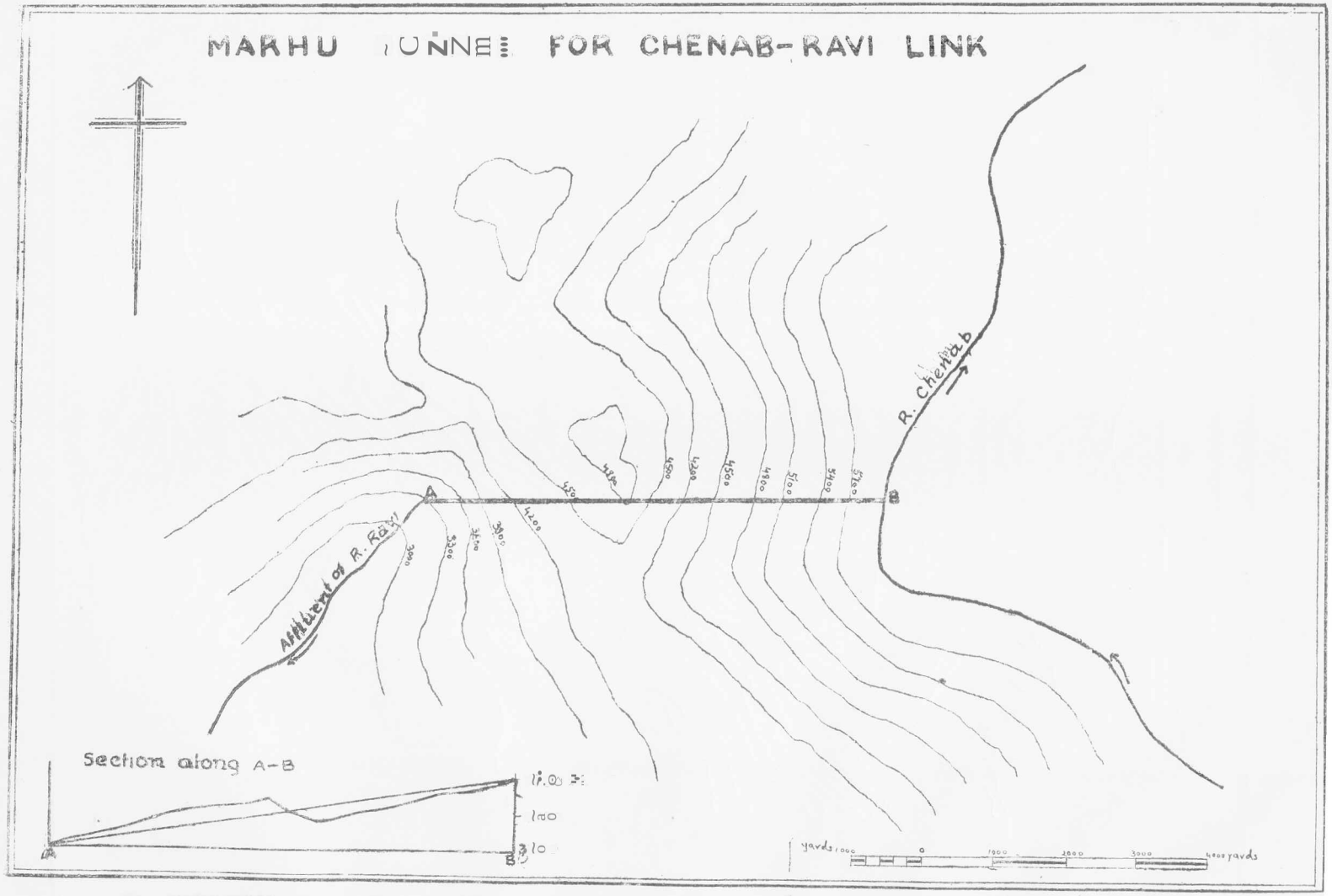
connection with any possibilities of the diversion of water from the river In its early stages.

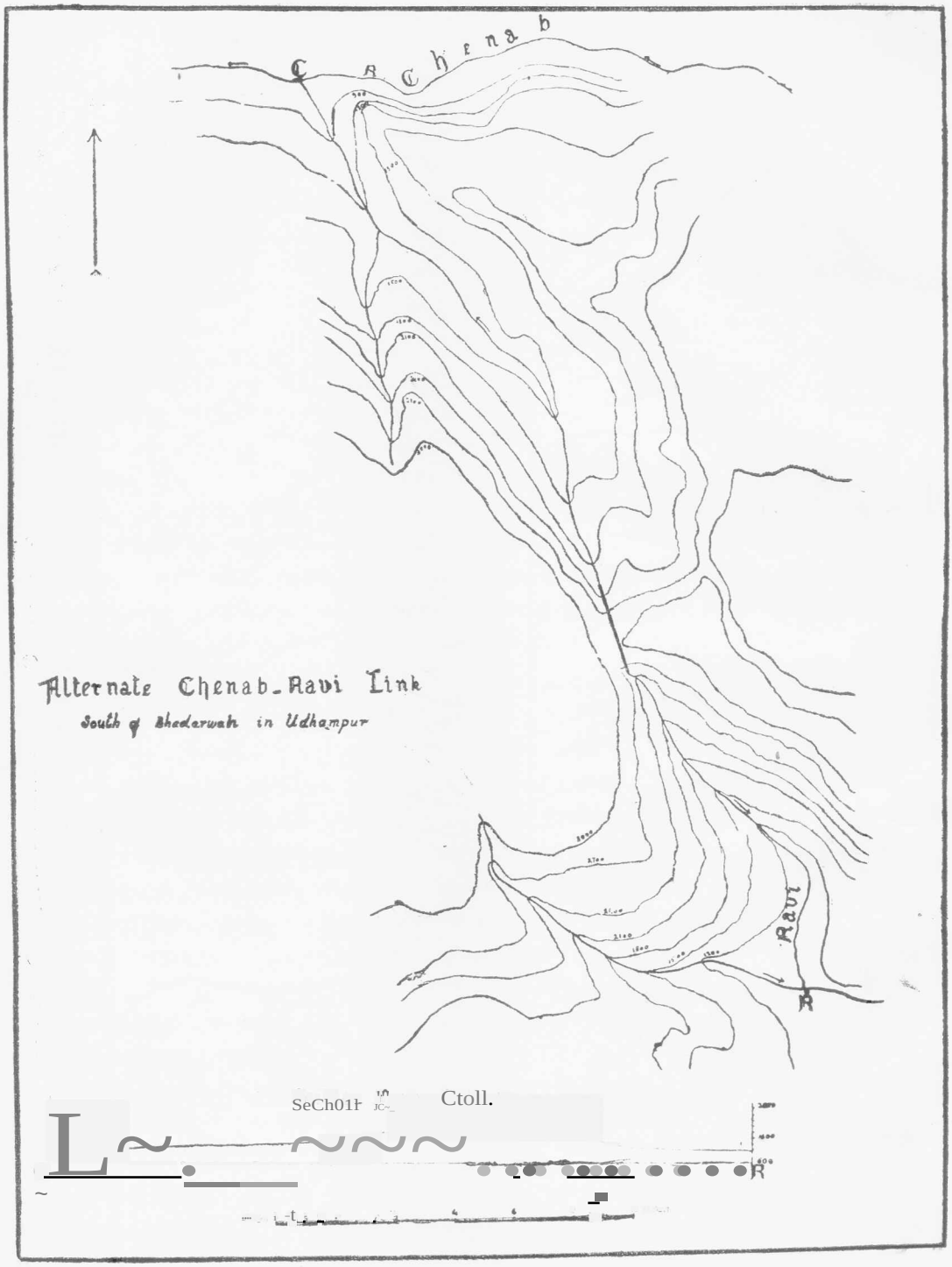
A study of the fluctuations of river discharges together with that of its catchment area brings into eminence two main problems connected with river Chenab. These are *(i)* storage of water and *(ii)* considerations of the possible diversion of wal er to India. As has already been indica ted, the necessity of proper storing of water is even more important than in case of the Jhelum as the fluctuations and hence the percentage of wastefulness of water is greater.. The search for good storage sites requires thorough investigations of the river's course from engineering point of view. The sites have, however, to be preferably searched not far downward from the point on the longitudinal profile of the river which marks the beginning of a smoother course. The storing of quite large volumes of water becomes possible here as the valley widens out to form a broader basin. Climatic considerations also favour such a choice. Also the very purpose of conservation is defeated if such a site is to be located at a point above which so much of the water has already been lost through seapage) evaporation, etc. At the same time it is economical to construct dams in a hilly country at points where valley cross-sections are more or less triangular in which case the cost of construction of dams is cheapest and the dimension of masonary work is least.

One of the most suitable of such points is located at Dhangarh near Riasi in Kashmir.. The place fulfils all the apparent conditions of the construction of a dam and a lake above it.. The construction of a dam here was in long term planning stage in pre-partition days.

The question of diversion of water makes one put ones figure all two points on the common water divide of the Chenab and the Ravi shown by crosses on the map of Kashmir showing catchment areas. One of these is located south of Bhadarwah in Udhampur, Kashmir.. Here two affiuents of the Chenab and the Ravi in their natural process of beheading have come very close to each other. The distance between the sources of the two is only about 3 miles. The real difficulty, however, arises on account of the differential levels of the Chenab and the source of the said Ravi tributary. This source is about 1,700 ft. higher than the bed of the Chenab at point C on the map. The disparity of levels can be overcome as is manifest from the section from C to R only after the damming of the Chenab thus raising its level and the tunnelling of much longer distance than the one which exists between the afore said two sources

MARHU TUNNEL FOR CHENAB-RAVI LINK

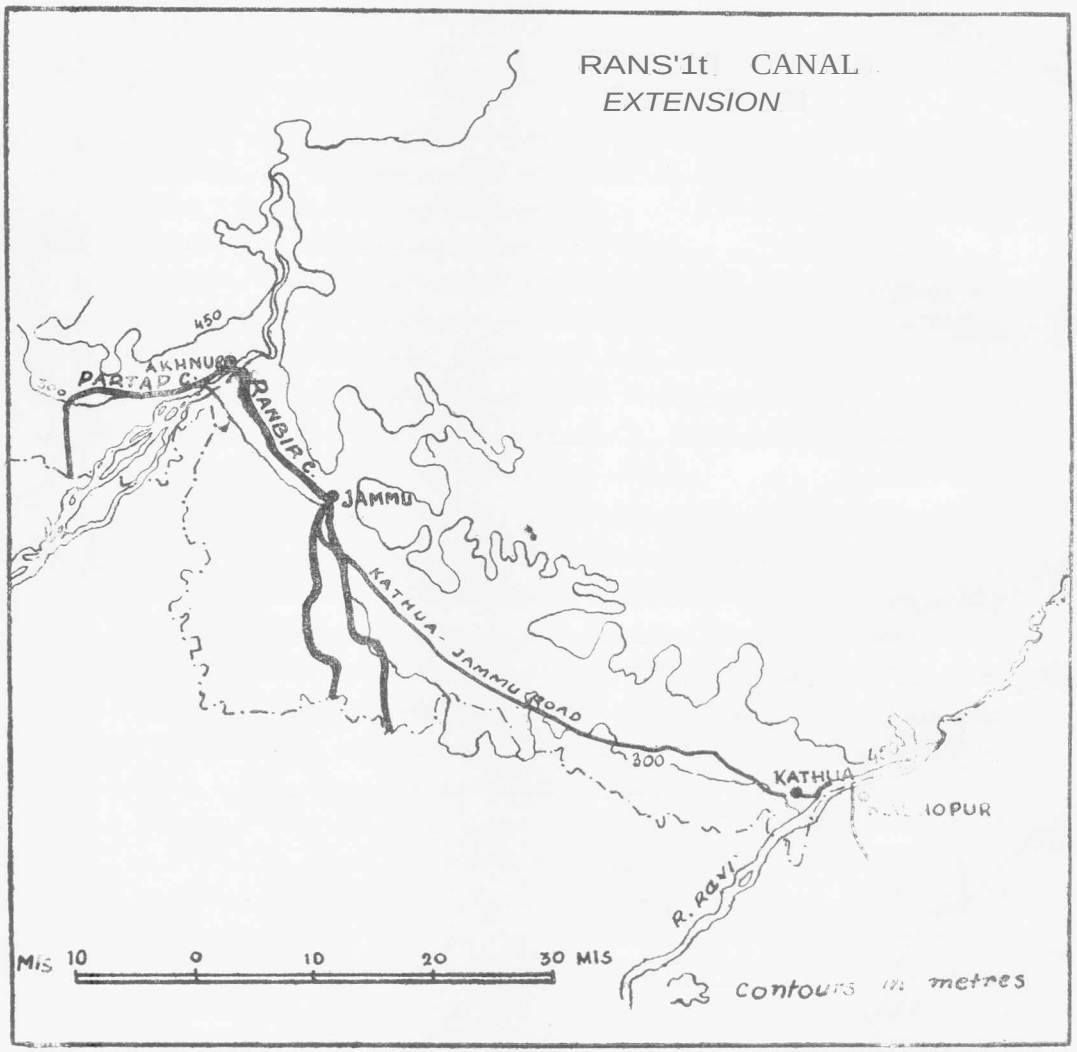



Chenab
Ravi
Alternate Chenab-Ravi Link
South of Bhaderwah in Udhampur
SeCh01r
Ctoll.

of *the* tributaries. The engineering difficulties and the financial implications, though not worked out, appear to be quite prohibitive. The only point in favour of the selection of this site in comparison to the other one is that of greater volume of water which may perhaps not be commmsurate with the expenditure to be incurred.

The second proposition that of Marhu tunnel (Approx. Lat. 32°48' Nand long 76°22'E) east of Tisa and northwest of Kund Bara is one of the old scheme and is financially more feasible. The distance between points A and B on the map is only about one mile and 6 furlongs. The slope is not in the reverse direction as in the previous case. The land slopes with irregularities from the Chenab tn the tributary of the Ravi from about 5,700 ft.. to 3,300 ft.. The highest point of a part of the intervening territory is about 4,800 ft. as is exhibited from the section. It is to be noted that the site of the proposed Marhu tunnel is located in Indian territory outside Kashmir which implies that this scheme can be brought into execution irrespective of India's hold on Kashmir or not.. The volume of water which can be diverted in this way is a subject for investigation. On any showing, it is much less than in the other case.

Anotller possibility of diversion of the Chenab water into the Ravi also exists. Although it involves carrying of water over longer distances, it appears to be more easily workable in view of the nature of terrain and is more profitable in regard to the volume of water that can be diverted. Parts of Chenab water flow into Partap canal and Ranbir canal emanating from that river at Akhnur.. Out of these two the Ranbir canal flows south-eastwards to Jammu. The height of Akhnur above sea level is 1138 ft, while that of Jammu is 1029 ft.. Near Jammu the canal bifurcates into two branches flowing southwards. Now, the same canal can be extended south-e 3stwards from Jammu to a point on the Ravi south-east of Kathua. The level of Kathua is 105t ft. *i.e.*, slightly higher than that of Jammu but levels of 984 ft.. or even less are met with south of the former town. Such an extension of the Ranbir canal will not deviate much from the general alignment of the Jammu-Kathua road although some difficultites will arise in maintaining the level of the canal into the Ravi. A comprehensive levelling of the area involved can give a clearer picture.


RANS'1t CANAL
EXTENSION
450
AKHNUR
PARTAP C.
RANBIR C.
JAMMU
KATHUA - JAMMU ROAD
300
KATHUA
R. RAVI
MIS 10 0 10 20 30 MIS
Contours in metres

The twin problem of floods and soil erosion demands a thorough investigation and effective controls *in* our country. The past history of floods (when the positive deviation is greater than twice the mean) reveals that west Pakistan is one of the most flood stricken regions of the sub-continent. From the year 1875, to 1944, N.W.F.P. witnessed 9 floods, Punjab (P) 8 and Sind 11. As compared with it, Punjab (I) had 10 floods in this period while other parts of India experienced much less number of floods ranging from 1 in Chota Nagpur to 9 in eastern U.P. For N.W.F.P., Punjab and Sind, taken together, it can be said that, on an average, every 9th year is a year of floods although, as usual, these have no well marked periodicity as 1878, 1882, 1892, 1908, 1914, 1916, 1917, 1929, 1933 and 1944 have been important flood years.

The causes of natural floods include excessive rainfall, profuse melting of snow and the temporary damming of a river by ice etc., resulting in a heavy run-off after the barrier is removed. The character and behaviour of rivers with respect to the carrying capacity of channels, their erosion and silting, geological structure of the basin and the absorbing capacity of the soil of the basin before the incidence of floods, are all important considerations in a rational study of the problem of floods. These considerations become all the more important in the upper reaches of the rivers. The problem of flood control and flood forecast in Pakistan, therefore, requires a continuous study of these conditions in Kashmir and the remedial measures should preferably be taken there.

DISTRIBUTION OF POPULATION IN PAKISTAN

BY

Prof. QAZI S. AHMAD

The distribution of population of a country is governed mainly by agricultural, commercial and industrial possibilities and resources. In an agricultural country like Pakistan it bears a very close relation to agricultural resources. The extent of agricultural lands and intensity and type of cultivation depends upon a variety of environmental and economic factors, principally topography, soil, climate, water-supply, forest cover and the area available for cultivation, the type of holdings, the amount of capital for investment and the system of tenure etc.

Density.

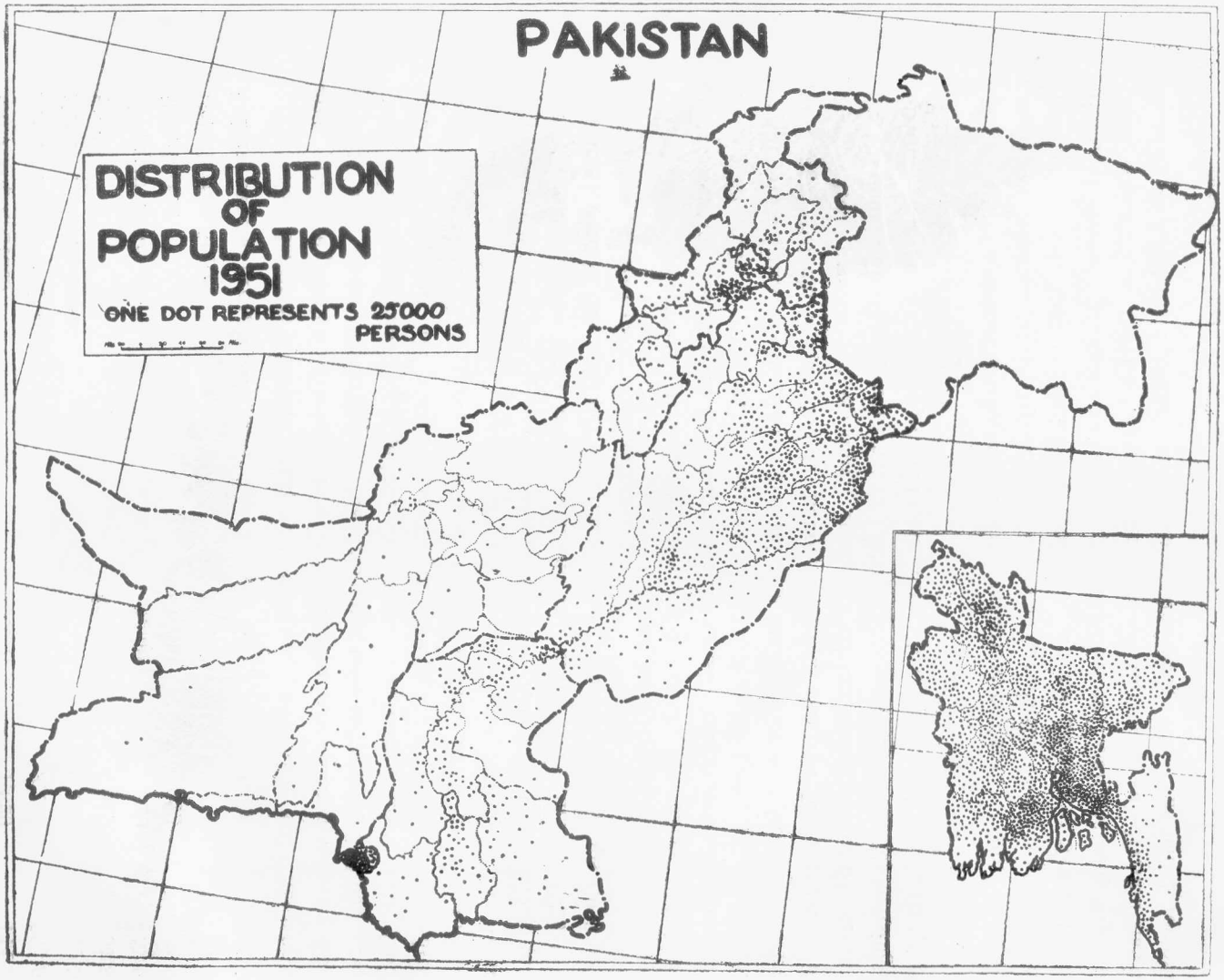
The relation of man to land, between the numbers of population and the extent of land they inhabit is called the density. It is the number of persons per unit area *D-PjA.* In this paper an attempt has been made to examine the density of population in the various parts on the basis of figures of the census of 1951. An analysis of these figures is bound to be of great importance in our young country in the formation of national policies, economic and social planning.

The total area of Pakistan* is 3,65,907 sq. miles with a population of 7,56,87,000 which gives a density of 206.9 per sq. mile. In West Pakistan, with an area of 3,11,406 sq. miles and a population of 3,35,68,000, the density is 10S while in East Pakistan, with an area of 54,501 and a population of 4,21,19,000 the density is 772.8.

TABLE, FIGURES OF DENSITY BY PROVINCE AND STATES

Provinces and States.	Area (Sq. Miles).	Total persons	Persons per sq. miles.
Pakistan ...	3,65,907	75,687	206.9
East Bengal ...	54,501	42,119	772.8

* Excluding Kashmir and Junagarh.


PAKISTAN
DISTRIBUTION
OF
POPULATION
1951
ONE DOT REPRESENTS 25000
PERSONS

Punjab	...	62,987	18,814	298.7
Bahawalpur State	...	)5,918	1,820	114.3
N.W.F.P. settled Distts.	...	13,815	3,239	234.5
N.W.F.P. Tribal areas	...	27,242(2)	2,460	90.3
Sind	...	50,443	4,619	91.6
Khairpur State	...	6,050	320	52.9
Baluchistan	...	52,900	622	11.8
Baluchistan States	...	81,239	556	6."
Federal capital area, Karachi	...	812	1,118	1,3i6.9

These densities state the relation between the population and the whole area. But the population is dependent for its food on the cultivated land. The average area under foodcrops in the triennum 1946-49* was 2,02,11,000 acres which is less than one-sixth of the total land area. The average area under food and cash crops for the same triennums was 4,49,09,000 acres which is one-fifth of the total area. This gives a density of 980.4 and 1,297.8 persons to the sq. miles on food and cash crops acreage respectively. In West Pakistan the density per sq. mile of the area under food crops is 1,255.5, and per sq. miles of the area under food and cash crops 858 In East Pakistan the density works out 1,333 per sq. mile of the area under food crops 1,093 per sq. mile of the area under food and cash crops.

The most obvious fact of the distribution is its unevenness. This is particularly marked in West Pakistan where the density ranges from 6.8 persons to the sq. mile in Baluchistan States to 1,376.9 in the Federal Capital area. Within West Pakistan outside the Federal area it ranges from 2 in the district of Chagai Baluchistan to 780 in Lahore district. . In the Lahore Tehsil it reaches 1,671 persons per sq. mile. In East Pakistan it ranges from 58 persons per sq. mile in Chittagong hill tract to 1,504 persons per sq. mile in Mymensingh district. . In the Naryanganj and Munshi Ganj Tehsils the density rises to *1,809* and 1871 respectively.

Within a district there are great local variations of density. For example m West Pakistan while Hyderabad Taluka in the district of Hyderabad has a density of 834, that of Badin has only 69. In the districts if Muzaffargarh (Punjab) while Mli:lffrtrgarh has a density of 313 that of Leiah has only 67. In East Pakistan in the Chittagong district while the Sadr sub-division has a density of 1,109, Cox Bazar sub-division has only 67. The chief factors

* The crop wealth of Pakistan.

responsible for the variation of densities are productivity of the land depending upon the fertility of soil and availability of water in West Pakistan and fertility of soil and drainag~ of water in East Pakistan. It may however be noted that the relation between agricultural productivity and deniiity is considerably modified where the means of transport are well developed or where there has been great urban development.

Map No. 1 shows the density of population. The whole country is classified into seven divisions:

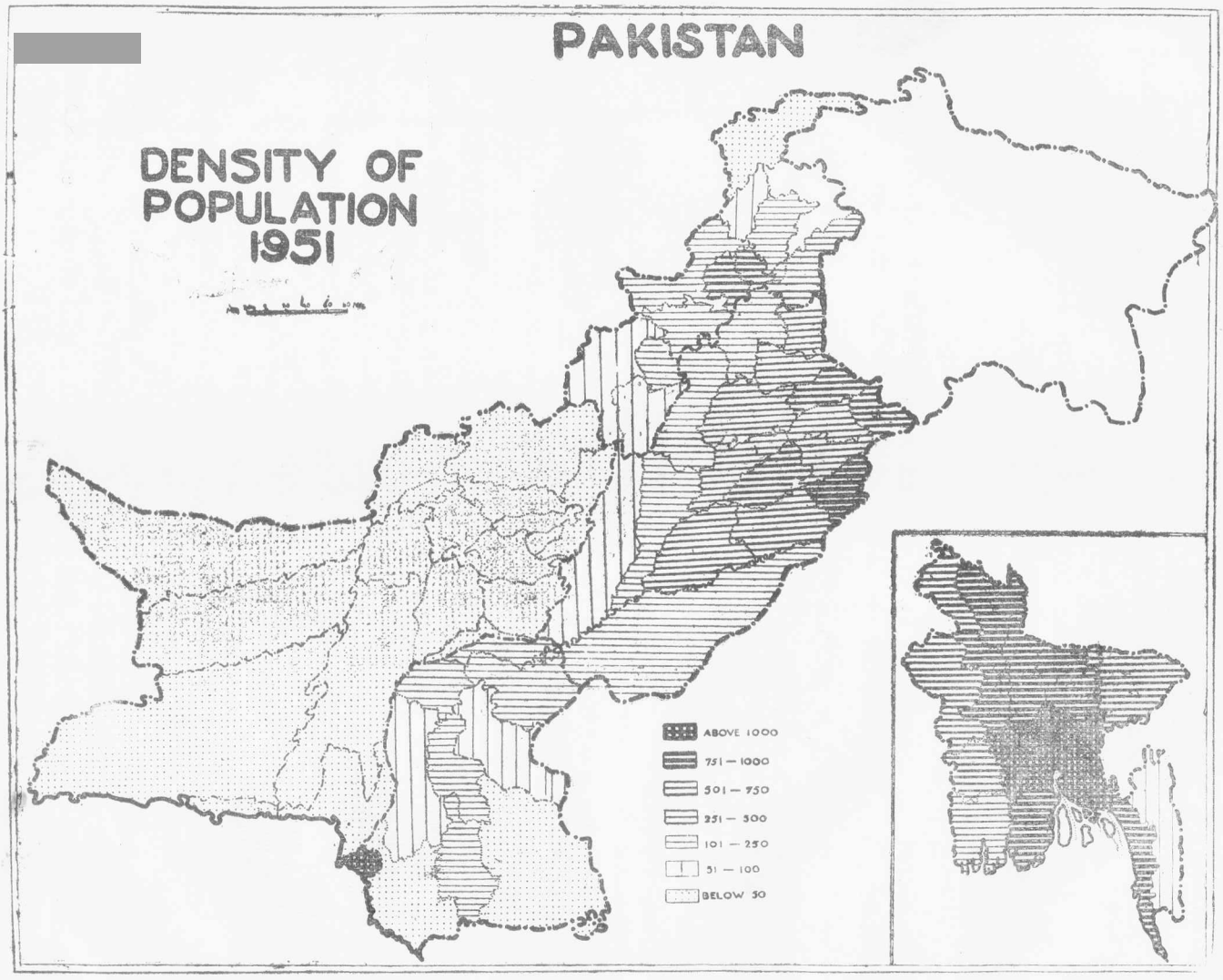
West Pakistan.

1. *Density over 1,000 persons per sq. mile* :-In West Pakistan the highest density of population (over 1,000) is found in the federal area. This is ob\iously due to the great urban commercial and industrial development of Karachi.

2. *Density of 7[)0-1,000* :-Next stands the district of Lahore (density 780) for the same reason. Though the rainfall is inadequate it is compensated by a good system of canal irrigation. Means of transpurt are well deve:oped. Lahore is one of the principal industrial regions of West Pakistan.

3. *Density of 500-750* :- -These densities are found in *(a)* sub-m mtane districts of Sialkot and Gujrat. and the district of Lyall pur in Punjab and the districts of Peshawar and Mardan in N. W.F P. These districts include some of the ıı ı)st fertile parts of West Pakistan. In the districts uf Sialkut and Gujrat the rainfall is quite heavy (about 30"). Besides the water-table i;" high and wells Cd.n be easily constructed for irrigation. The soil is very fertile. Again, these are old settled districts and here has been a historical evolution of the population. The population has cunsistently grown along the last seven hundred years. There has also been a tendency amongst the people to stay at home and to be as near their native town or village as possible. There are strong family ties. This is a common feature of both the rural and urban population which has checked large migrations of the people.

The district of LyalJpur is one of the early colonised districts. here there has not only been a great increase in the cultivated land and its productivity by irrigation and improved methods of farmmg on account 01 the researches at the Agricultural College Lyallpur but there has been quite a good industrial progress. Lyallpur is situated in the heart of the prosperous colony area and is an important commercial centre with a good development of textile industry,


PAKISTAN
DENSITY OF POPULATION 1951
ABOVE 1000
751 — 1000
501 — 750
251 — 500
101 — 250
51 — 100
BELOW 50

Peshawar and Mardan have high densities. Peshawar district has comparatively large urban population. Besides, it has not only the largest percentage of cultivable land in the province but also has highest proportion of the cultivated land which is irrigated. The soil is fertile. Quite a good number of persons depend upon sources other than agriculture. Peshawar is an entrepot for trade with Afghanistan and Central Asia. Another town Nowshera is developing into a great industrial centre. Mardan is also large fertile irrigated cultivated area.

4. Density 250-500 : -In this section fall *(a)* all the remaining canal colony districts comprising the districts of Montgomery, Multan, Jhang and Shahpur (excluding Tehsil Khushab) the irrigated district of Sheikhupura and Gujranwala and the northern district of Rawalpindi in Punjab *(b)* District of Hazara in N.W.F.P.

In the canal colony districts the soil is fertile. The growth of irrigation from canals has not only increased the cultivable area but also the yield per acre of the old cultivated lands. Large crops of wheat and cotton are obtained. These areas are not only surplus in food production but they also greatly contribute to the general income by cash crops including cotton and fruits.

Rawalpindi district in the potwar plateau shows a high rate of density mainly because of the large urban population and industrialisation. The city is also a great commercial centre and trades with mountain region in the north. The Tehsil of Rawalpindi has a density as high as 591.

Hazara in N. W.F.P. shows a high density of population inspite of the fact that a large part is mountainous and forested. This is partly due to good rainfall and partly because the climate is very healthy. Although the cultivated area is limited there are other special sources of livelihood. A large portion of the population subsists upon the heads of cattle and flocks of goat and sheep. In respect of the fact that the high density is based on resources other than soil or urban factor this district is somewhat different from others in West Pakistan.

5. Density 100-250 :-This section covers all the areas which have a density near about the mean of Pakistan as a whole as well as the mean of West Pakistan. It includes *(a)* most of the area of the Sind-Sagar Doab, in between the rivers Jhelum- Trimab in the east and Indus on the west, consisting part of the districts of Jhelum, Mianwali and Muzaffargarh and Khushab Tehsil of District Shah pur, *(b)* most of the trans-Salt . Range plateau of Potwar in Punjab

comprising mainly the di3trict of Campbellpur, part of the district of Jhelum in Punjab, *(c)* Bannu and Kohat districts, Khyber, Kurram Agency, Swat State and some other parts of Malakand Agency in N.W.F.P •• *(d)* the reverain districts of Sukkur, Upper Sind, Larkana, Nawabshah and Hyderabad in Sind, *(e)* District of Bahawalpur in Bahawalpur State. In Sind Sagar Doaba district with such df'nsities does Wlt give a very correct picture as its different parts present a varied environment. The Salt- Range runs across the middle of the district of]helum and towards the north of the districts of the Shahpur and Mianwali. Most of the Central portion of the district of Mianwali and the adjacent parts of the districts of Shahpur (Tehsil Khushab) and northern part of the district of Muzaffargarh (Kot Adu and Leiah Tehsil) constitute the ThaI Desert. The strip in the north along the south of the S'alt Range and along the east of the Indus is being irrigated by the new canals which are being constructed under the ThaI Project. Pastoral occupations combine with agriculture. Existence of large tracts of dreary wastes in the desert area and barnn lands in the Salt- Range keep the densities low. The saline efflorescence clothes the surface for miles. A large part of the area is covered with rolling sand-dunes, separated by narrow hollows, herds of camel which thrive on saline herbage and of cattle and flocks of sheep and goat are tended by a nomadic population. The extent of cultivated lands is limited and these exist in patches with corresponding variations in densities. The higher densities in such areas are responsiblf' · for giving a better picture of the districts as a whole.

The district of Campbellpur depenrls mainly on rainfall - which is good but the whole area is cut up by streams into rivers. Irrigation is Scarce except in a small belt along the Indus. The cultivated land is limited. Cattle are reared on the grass.

In N.W.F.P. the districts of Bannu and Kohat have densities of 181 and 112 respectively. Most of Bannu is fertile land but is only partially irrigated. Koha t is rugged. Though the rainfall is good the percentage of cultivated land is comparatively small.. The cantonments and the connected services contribute to its density which is just above the mean of West Pakistan There is a good development of hydro-electricity at Malakand. This along with the existence of trade routes *via* the Khyber and the Kurram makes the population quite dense for a mountain region. The Swat state has a density of 171 persons to the sq. mile. It has a good climate and rainfall. . There are numerous villages where cultivation is carried on.

In Sind the population is comparatively denser in the central riverain districts except Dadu and Tatta because of the irrigation from flood or perennial canals. Though the density as a whole varies from 132 in Sukkur to 176 in Hydera bad the actual distribution in various Taluka is very varied. Some Talukas which are well irrigated show quite a high density while those which are remote from the rivers and have little irrigation facilities are very low in density. Hyderabad Taluka shows the high density of 834 because it includes the city of Hyderabad.

6. Density 50·100 :-The rest of the large area of West Pakistan has a density lower than the mean. The density of 50--100 is found in the Trans-Indus sub-montane region of Dera Ghazi Khan in Punjab, the di~tricts of Dera Ismail Khan in N.W.F.P. together with mountainous regions of N. & S. Waziristan and the state of Dir at the two ends in the less accessible parts of the province *(b)* the sub-montane district of Dadu in Sind and the state of Khairpur.

In the Derajat the rainfall is under 10". The hill torrents have cut deep beds for themselves and the entire sub-montane belt is reamed at intervals by deep channels, being dissected into strips or blocks. Cultivation is precarious as it is mostly dependent upon rainfall and the extent of cultivated land is limited. Even drinking water becomes scarce in the dry season. On account of the difficulty of bridging the Indus these lands are cut off from the more advanced and populated parts of the plain. The Daman tract which occupies about three fourths of the area is bare plain generally barren covered with crops only in favourable season. For the same reason there is a fluctuating system of assessment. . In the hot season people have to leave their villages and camp with their cattle by the Indus.

7. Density less than 50 :- This division includes *(a)* the whole of Baluchistan *(b)* Chitral State in N.W.F.P. and the districts of Tharparkar and Tatta in Sind.

In the districts and states of Baluchistan the density varies from 2 to 19, only in the Quetta-Pishin district it reaches 40. The province consists of barren rugged mountains, arid deserts and stony plains. Water is scarce. Summers are very hot. In the north-west the rainfall is under two inches and dust storms blow practically throughout the year.. The cultivated patches are few and far between. They are dependent upon the supply of water from sub-terranean channels or Karazes. People are very much self-sustaining. They are

easy going and have an innate bias against congregating even in villages. Quite a large number of them are nomadic or semi-nomadic. In a village the number of the population is determined not by the amount of land but by the amount of water available for distribution.

In the north-eastern mountain area where some rainfall takes place in winter and the humidity is low the climate is very favourable for fruit gardens and fruit-canning industry. Quetta-Kalat region therefore supports a higher population only comparatively.

The Chitral state in N.W.F.P. has a density of only 18 persons to the sq. mile. This is obviously due to its location far in the Himalayan region, cut off from the rest of the country by mountain ramparts and connected with it by difficult mountain passes. The land available for cultivation is limited.

The district of Tharparkar in Sind has a density of 47 persons to the sq. mile. Most of its area is a saline desert unfit for cultivation. Numerous sand-hills cover its central and eastern part. Only in its western part cultivation is carried on with the help of water brought by canals. In this section the density is higher and reaches 240 in Mirpurkhas Taluka and 158 in Digri Taluka. The district of Tatta shows a density of 38 persons as a large part of it forms the marshy delta which is not available for cultivation. It goes down to 15 in Jati Taluka.

East Bengal.

In East Bengal, excepting the Chittagong hill tract the densities range from 432 persons per sq. mile in the Khulna district to 1,500 persons in Tippera. Not only is the rainfall abundant but it is spread over a longer period and the variability is the lowest in the sub-continent. The land is enriched by the yearly deposit of silt. The climate, the soil and the innumerable rivers, big and small, are all favourable to agricultural productivity. Excepting the Chittagong area and sunderbans the percentage of arable land to the total area generally exceeds 70 p.e. and over a large area exceeds 80 p.e. There is a large double cropped area. Plenty of water and high average temperature promote vegetative growth. Again, rice which is the chief food crop of East Bengal can support a much larger, population per unit area than wheat in West Pakistan, as the yields are higher and the consumption per head lower.

Another point is that a warm humid climate by leading to early maturity and reducing food requirements, encourages the growth of a dense population. Besides, the standard of living is generally low and thus a much larger number

may be:supported from the same area. in a warm climate the standard *of* human needs is also low and this helps in the growth of numbers. The influence of rivers is reflected in the greater concentration of population along their banks.

The relation of density of popula tion for each district and the quantity of rice and jute produced is given in diagrams. Although the relation is not very clear it may be said that generally speaking when the density is high the produce is also high. In some cases where the produce is comparatively low. as in Bogra and Pabna, the density is comparatively high. It may be due to lower standard of living, or the deficiency of food may be made up by the import of foodgrain from the surplus area. .....

1. *Density over 1,000 persons per sq. mile* :-Densities over 1,000 persons to the sq. mile are found in the four east central districts of Dacca, Faridpur, Noakhali and Tippera. These di~tricts lie in the active delta near the mouth of the Padma and .vleghna rivers and are benefitted to the full by the enormous am dUnt of fertile silt brought by these rivers. Land is extremely productive and cultivated acreage is high. The drainage is also very good and so these districts are very healthy. These districts, though profitted by the silt laden floods at the mouth of the rivers are sufficiently far enough from the sea to escape the damage done by cyclones and storm waves.

Dacca has a density of 1,492. Not only is the land so productive but also there has been a great industrial development. . Dacca-N aryanganj area forms the greatest industrial area of East Pakistan. High agri~ultural pro ductivity combined with great industrial aCliviity wuuld support great numbers and the density of tile district would be still much higher but for the inclusion of the Madhupur jungle area within its boundanes. Narayanganj sub-division has a density of 1869 and that of Munsrliganj sub-division 1871. In Munshiganj also the proportion of the population dependent on non-agricultural pursuits is fairly high.

The district of Tippera has a density of 1,500 persons to the sq. mile. H is based mostly on agricultural productivity and freedom from malaria on account of good dramage. About 100 to 140% of arable land is under rice and acreage under jute is high. There is a large double-cropped area along the river Meghna. In the Chandpur sub-division the density rises to 1548. This is partly due to the great facilities in river transport. . Faridpur has a density of 1952. This is mainly due to its location along the southern bank of Padma. Apart from Aman rice there is a very high acreage under jute.

in Noakhali the density is 1424 rising to 1564 in the Femi sub-division. Located at the mouth of the Meghan the agricultural produce is very high. Over most of the area the land under rice is 100-140 p. c. of the arable land. Not only is there a large crop of Aman (winter) rice but also of Aus (autumn) rice. Beside there is a large quantity of betel-nuts produced. Fishing is also an import an supplementary source of income in all these districts.

2. *Density 750-1,000* :-This division includes the districts of Mymensingh, Bogra, Pabna, Rangpur in the north and Baqarganj and Chittagong in the south along the coast on either side of Noakhali. Mymensingh has a density of 931. This is fairly high in consideration of the fact that a part of the area is covered by Madhupur jungle and the arable area is further reduced by a number of large bhils known as haors. Three of the important rivers Meghna, Brahamputra and Jamuna pass through the district, the banks of which provide valuable lands for the cultivation of rice and jute. Quite a large area is double-cropped. Apart from aman and aus rice most of the Boro rice of the province is produced in the eastern marshy tracts of the district traversed by the Meghna. There is a good crop of mustard seeds.

The districts of Pabna (869), Bogra (830) and Rangpur (792) lie along the western bank of the Jamuna. A broad belt of the territory along the river is intensely cultivated where jute forms an important crop. There is a large area under rice. Rangpur has most of the tobacco area of the province which is important in supplementing the income of the people.

Baqarganj is an important rice growing district and has large groves of cocoanut and arecanut palms. The density decreases toward the south and is comparatively low near the sea where the area has been reclaimed by the cutting of the sundarbans.

The Chittagong district has a density of 901 persons to the sq. mile. It rises to 1109 in the northern part in the sadr sub-division and falls to 502 in the south of the Cox Bazar sub-division. Besides the great port of Chittagong and its industrial area, the land is fairly intensively cultivated with rice and there is a large double-cropped area specially along the Karnafuli. The percentage of arable land to the total, however, is not high.

3. *Density;jJ) ;j0* :-In this division are included the three western districts of Dinajpur (544) Rajshahi (608) Kushtia (047) and Jessore (656) and the district of Sylhet in the Surma valley. All these districts have a density lower than the mean den'3ity (7172) of East Bengal.

The westeru districts are part of the old delta which is a land of dead or dying rivers. Many streams have silted up. They no longer bring the fertile silt or carry the surplus water with the result that they have become unhealthy and subject to malaria.

The comparatively lower density of Dinajpur is partly due to laterite occuring in some areas. It is not so fertile. Dinajpur also contains large stretches of waste-lands and jungles. In RajshalJi it is also partly due to the presence of numerous marshes and lakes. The Jessore district has suffered much on account of silting up of rivers and the climate is quite unhealthy.

Sylhet has a density of only 682 persons to the sq. mile. It contains extensive marshes called haor" which can be utilised only in cold wedther for catching fish, growing bora rice and grazing cattle. The gravelly soils in the sub-montane area also keep dowll the density.

4. Density 250-500 :-Khulna has a density of 432. This is the least populated district excepting Chittagong Hill TractS. The soutt,ern part of this area is covered by the sundar-bans and several dbtributaries and khals have silted up in the rest of the district. . The water is saline and even drinking water is scarce.

In the sundar-ban forest division the density is only one person to the sq. mile, the lowest in .I:'akistan.

5. Density under 250 :-The Chittagong Hill Tract has a density of 57 only, lowest fur a district in East Pakistan. This is due to the mountainous and for<:~ted nature of the country. The percentage of arable land is very low and there is practically nu double-cropped area .

Pressure of Population.

The correct idea of the pressure of population on land cannot be obtained by the figures of density of population which show the relation of the population to the total area per sq. mile, The pressure is, really speaking, on that part of the land which is under cultivation and yields a produce. The condition becomes still more serious when one takes into consideration the fact that 49'S per cent. of the total area is under food and cash crops, 37'3 per cent. of the total is under food crops which represents 75'1 per cent, of the cultivated area. Any further increase in the area under food grains out of the present cultivated land would further reduce the already low area under cash crops and then seriously endanger the process of industrialisation and the purchasing power of the country. In a good normal year there is a small

surplus of wheat and rice but the vagaries of rainfall in the sowing season as it happened in the current year, and the short or indifferent supplies of canal water on account of the attitude of India put still greater strain on our cultivated land. The present food resources depend not only on the extent of the land cultivated, bur, also on the intensity of cultivation in which adequate water supply is the main factor specially in West Pakistan.

The pressure of population can be relieved to a certain extent by the use of manures, by bringing into cultivation as much area as is possible ~.bi(h is lying uncultivated and which is classified as culturable waste. This again is not possible without water.. Where new canals can be built with an assured supply of water as in the ThaI area the work ,hould be taken up in right earnest.. But in the old canal irrigated areas where supplies are dependent- 011 the release of water from India a comprehensive programme for the construction of tube-wells should be followed.

The average cropped area in Pakistall for the triennum 1946-49 is ·~94, million acres which gives an average of 65 acres per head. Taking the two wings separately, the total cropped area in West Pakistetn is 248 million and in East Pakistan 24'6 million acres which gives an average of '74 acre per head for West and '58 for East Pakistan. The pressure is actually much great(r than is gathered from these figures because cropped area includes the area sown more than once and about 15 per cent of the seed dves nOL come to fruition. In other words the matured area is much less than the area sown.

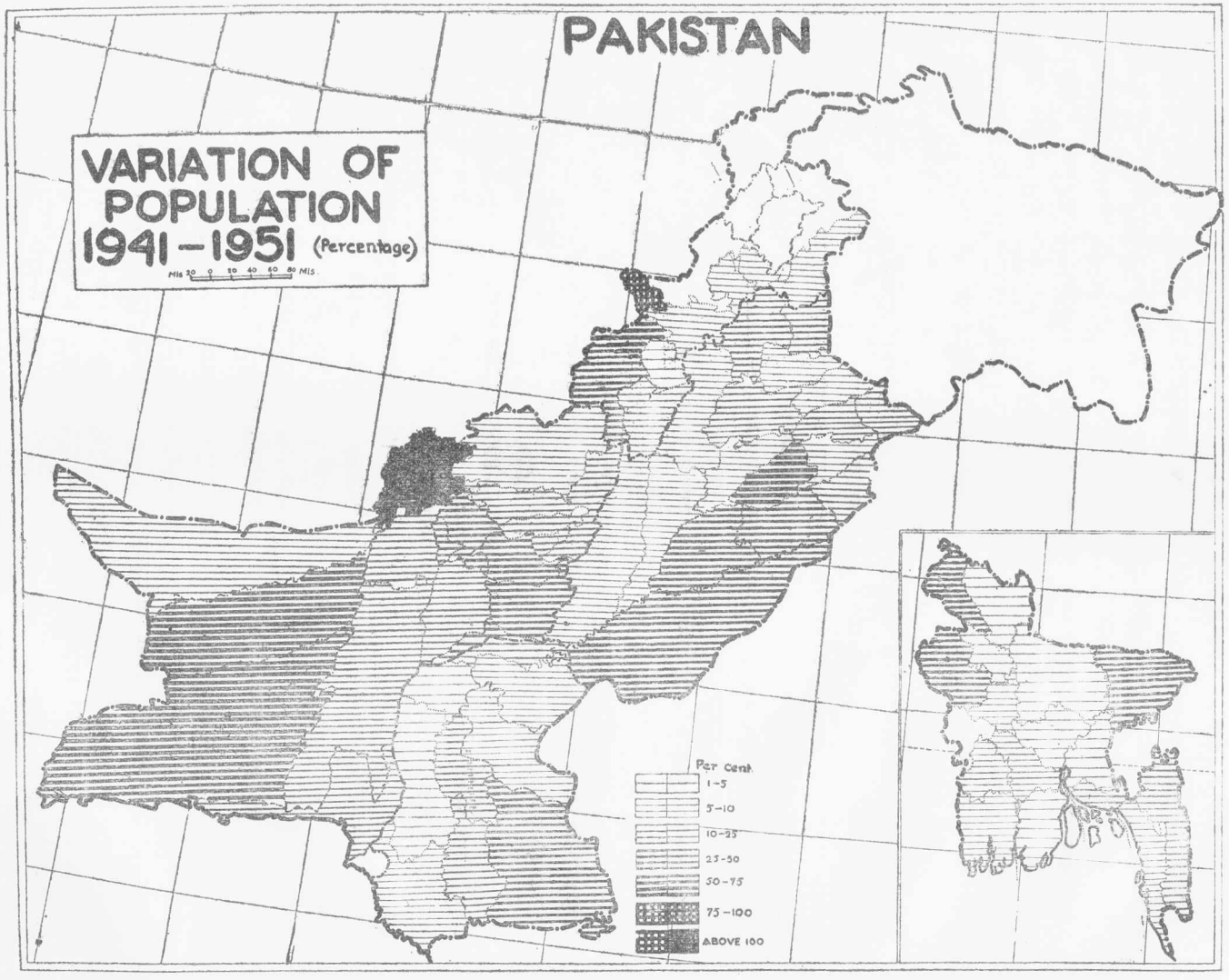
According to our present standard of living in rural areas about 1'5 acre, are required for each person It implies tha~ the present cultivated area can maintain only 32'9 millic'n persons This deficiency can be made up not only by increasing the cultivatic'U acreage or intensive or improved methods of farming but also finding alternative non-agricultural sources of income. /

VARIATIONS OF POPULATION SINCE 1941.

West Pakistan.

Map No.3 shows the percentage of variation of population in Pakistan since 1941. In West Pakistan the greatest percentage of increase has been *(a)* in areas where the density has been very low or (hI ill the districts bordering East Punjab and Rajisthan.

1. Increase over 75% :-Karachi heads the list in the increase of population. The population of Karachi city in 1341 was 3,59,492 in 1951, it was


PAKISTAN
VARIATION OF POPULATION 1941 – 1951 (Percentage)
Per cent
1–5
5–10
10–25
25–50
50–75
75–100
ABOVE 100

enumerated as 11,26,417 giving it an increase of over 313%. This is mainly due to the influx of refugees from all parts of India (5'43 lakhs).

The next greatest increase has taken place in the healthy fruit producing district of Quetta-Pishin. The population of this district in 1941 was 100,000. Here an absolute increase of only 113 thousand has given it such a high percentage (113%). Next to it comes the Kurram agency where an increase of only 75,000 persons has given it a percentagt: increase of 85'22. It may also be due to defective enumeration in 194,1.

2. *[ncrease* 52-75% :-North Waziristan has an increase of 52'38% and Lyallpur of 54.51%. Lyallpur is the m'lst populated district of West Pakistan. During the decennium 1941-51 it has grown both agriculturally and industrially. There has been a great influx of Mohajirs. The muhajir population alone is just a little short of the total population of the district in 194~. There has been an increase of 57 ~nd 21 thousand in the population of the states of iVIakran and Kharan but on acc::mnt of their small population the percentage increase works out to be 66'72 and 6~'63 respectively.

3. *Increase 25-50%* :-The section includes the canal colony districts of Montgomery, Multan in Punjab, the state of Bahawalpur, Tharparkar district, of Sind, S. Wazirisl.an, and a belt of hilly territory including Mari, Bugti. Sibi and Bolan in Baluchistan.

The Canal Colony districts, Bahawalpur and Tharparkar have been capable of ab~orbjng larR"r numbers on acC':mnt of agricultural development consequent on the increase of irrigation and partly on account of industrial development. The influx of refugees is also high in these area" except in Tharparkar. . The remaining areas have been thinly populated and even small absolute increase has reflected itself in a high percentage. Being largely inaccessible, it is also possible that their figures were inflated in the last census.

4. *Increases 10-25%:-This* section includes the sub-montane districts of Sialknt, the district of Lahore, Gujranwala, Shahpur, I{awalpindi and Attock in Punjab, the districts of Hyderabad and Nawabshah in Sind and Loralai and the adjacent eastern hilly part in Kalat and Sewan and Las Bela in Baluchistan.

The increase (24'36 %) in Sialkot has been mainly due to the addition of Shakargarh Tehsil of Gurdaspur after partition. In Shahpur (15.13), ~awabshah (17'8) and Hyderabad (17'25) it is partly due to canal irrigation and

in Rawalpindi it is partly due to industrial development. . In Gujranwala, immigration of refugees has been fairly high. In Baluchistan the increase is marked on account of previous low numbers. In Lahore (11.74) and Attock (10'04) the increase is just a little over the estimated natural increase in these parts (10%).

5 In the rest of West Pakistan including western districts of Mianwali, Dera Ghazi Khan, Muzaffargarh and Jhang, sub-montane districts of Gujrat and Jhelum and the district of Sheikhupura in Punjab, the settled districts of N. W.F.P., Mardan, Peshawar, Kohat and Bannu the districts if Zhob in Baluchistan, Sukkur, Tatta in Sind and the state of Khairpur the increase has been ten p c. These are not capable of absorbing larger number of population without further development. . The increase could be mostly ascribed to natural increase.

6. Decrease under 10 p. c. :- The only areas showing a decrease of population are the sub-montane districts of Larkana (2.1%) and Dadu (72%) in Sind, the district of Dera Ismail Khan (5.0:-\%) in N. W.F.P. and the tribal territory adjoining Hazara and Mardan districts (69.52% and 5 4%) in N.W.F.P.

The sub-montane districts of Sind, constituting the Kohistan of Sind, are very inhospitable and lack opportuniti.es of development. A number of people have migrated to the neighbouring central ri"erain areas which have been developed for irrigation.

In Derd. Ismail Khan a large area is a barren plain and water is scarce, cultivated land is small. and so the people have moved out to find opportunities elsewhere.

East Pakistan.

The prominent feature of the variation of population in East Pakistan is the general decrease except in Rangpur and Rajashahi in the north and districts of Khulna, Baqarganj, Noakhali and Chittagong in the south. The decrease of population may be explained partly by the migration of Hindus and partly by the infiation uf figures during the census of 1941, both by the Hindus and Muslims.

The decrease is highest in the districts of Sylhet (41%) and Dinajpur (28.34%) because parts of them have been sliced off and given to India. In the remaining districts of Tippera, Dacca Faridpur, Pabna, Bogra and Mymensingh tije decrease varies from 1.34% to 6.86%.

Another feature of the variation is the low increase in the remaining districts which is under 10% excepting the districts of Rajshahi (40.92%) and the Chittagong Hill Tract (17%) and Noakhali (15-56). The great increase in the district of Rajshahi has been due to incorporation in it of parts of Nadia district. . In Chittagong Hill Tract the increase is of only 42,000 persons which gives it an increase of 17% on account of its low density.

Greater increase in Noakhali may be partly due to its greater fertility. The increase in the remaining districts may be explained by natural increase.

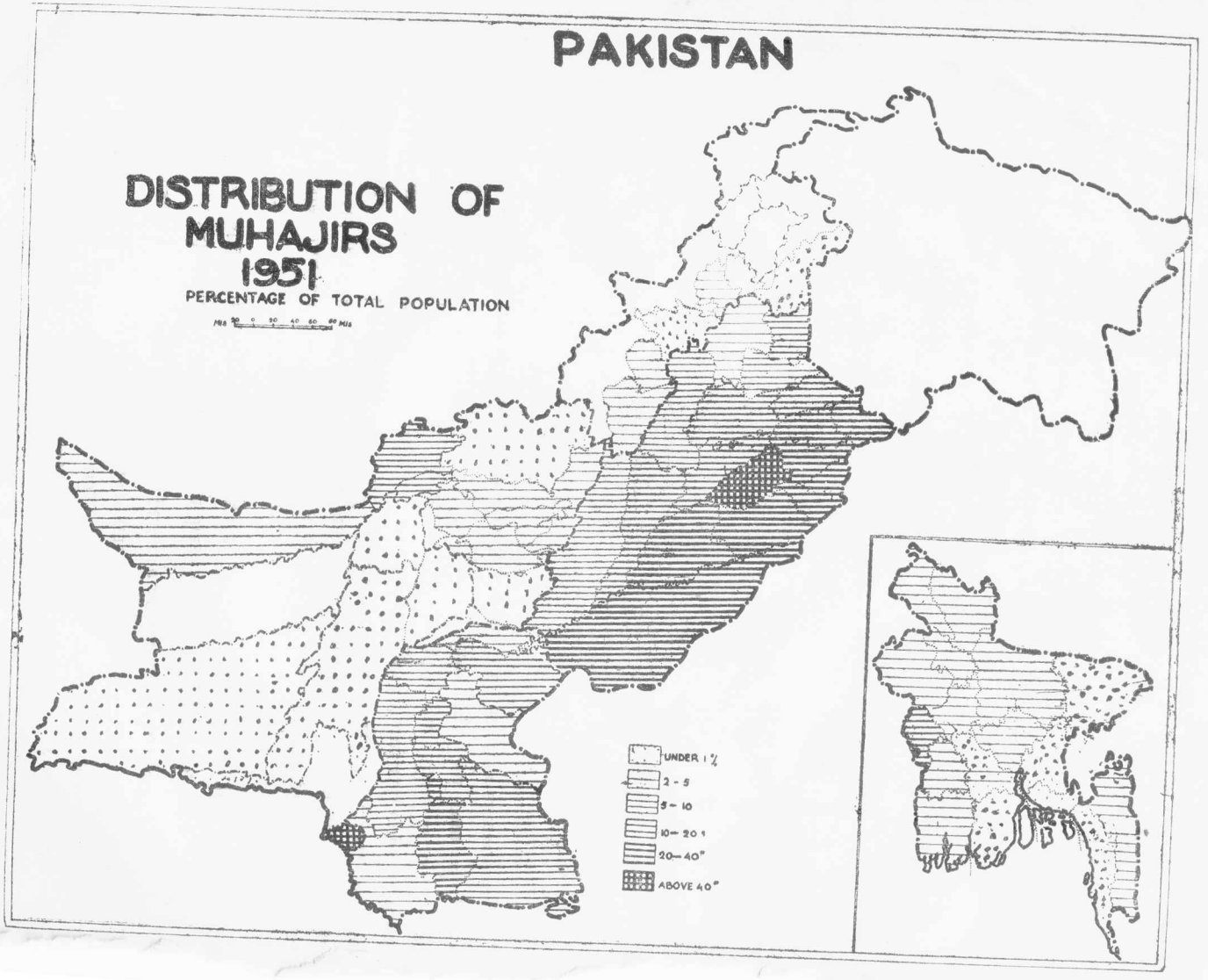
Distribution of Refugees.

Map No.4 gives the distribution of refugees. According to the census of 1951, there are 71,50,000 refugees in West Pakistan. There were 59,30,000 20.5 p.c.) non-Muslims in 1941 and 5,31,000 (20.9 p.c.) in 19:;1. This shows that of muslim entered West Pakistan in excess of non-muslims who migrated to lOt lakh India.

In East Pakistan there were 1,24,64,000 (27.3%) non-Muslim in 1941 ann 97,05,000 (23.2%) in 1951. There was thus a decreaSe of 37,59,000 of non-muslim population. The number of Muhajirs in 1951 was 7,01,000.

The largest number of Muhajirs are settled in Punjab. According to the census of 1951, they were 4,882 million which constitutes 68.3 p.c. of the total Muhajir population of Pakistan. Within Punj ab the largest percentage of Muhajir population is in the district of Lyallpur (47.56%). Eastern districts of Punjab, Sialkot, Gujranwala, Sheikhupura, Lahore, Montgomery, and Multan and the State of Bahawalpur stand next with 20-40 percent of Muhajir population. Located nearest to East Punjab and Rajasthan most of the persons migrating from India settled here. This block contains 84 % of the total Muhajir population of West Pakistan.

The muhajirs fanned out in diminished numbers towards the north, south and the west. The percentage diminishes accordingly. The density of population being very low in the west, the low percentage of Muahjir population implies very low numbers. They number only 39,000 in Dera Ghazi Khan. The entire N.W.F.P. has 51,000 of which the district of Peshawar alone contains 23,000. The whole of Baluchistan has 29.5 thousand Muhajirs. The small number of Muahjirs in these areas is not only due to the distance from India but also because of the small percentage of the non-Muslims who lived there and who migrated as a result of the partition. It was also partly due to the


PAKISTAN
DISTRIBUTION OF MUHAJIRS 1951
PERCENTAGE OF TOTAL POPULATION
UNDER 1 %
2 - 5
5 - 10
10 - 20 %
20 - 40"
ABOVE 40"

difference in the type of people, manner of living and lack of economic opportunities.

There are 5.6 lakh of refugees in the province of Sind, of which about quarter are in Hyderabad city, and the district as a whole has about 40 p.c of the total Muhajir population. This is due to the rail connection of Hyderabad with Rajasthan and Ajmer from which parts these refugees have come.

Nawabshah and Tharparkar each has 1-1.24 and 12.33 p.c. of Muhajirs who have settled mostly in the irrigated area. The lowest percentage is in Tatta 1.98.

Federal area of Karachi has as many as 5.14 lakh of refugees, 51.54 p.c. of the total population, highest for any unit both in respect of numbers and percentage. This is due to the large number of openings provided by the establishment of the new Muslim state and economic and industrial opportunities in the wake of the migration of non-muslim population. This is the most cosmopolitan city of Pakistan to which people have migrated from all parts of India. Comparative absence of provincialism has been another attraction.