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2. The contributions are classified into the following categories :

(*i*) **Papers** which contain the results of an original investigation mainly on Pakistan, principally on West Pakistan not exceeding 10,000 words.

(*See inside of the back cover.*)

Pakistan Geographical Review

Volume 17 JANUARY, 1962 Number 1

WEATHER AND CLIMATE OF PAKISTAN

SIBTE NABI NAQVI AND M. RAHAMATULLAH

THE two wings of the country, East Pakistan and West Pakistan lie at the eastern and western ends of the Indo-Pakistan Sub-continent and are separated from each other by a distance of over 1,000 miles. Being parts of a major climatic region dominated by the south-west monsoons in the summer and a reversed wind circulation in lower layers of the atmosphere in winter, the two wings have certain climatic affinity in a broad sense, but when looked at in some detail, they present a unique contrast for a country of the size of Pakistan. East Pakistan with its annual rainfall of 60″ to 140″ is definitely humid and tropical, while most of West Pakistan is arid or semi-arid where in some parts the annual rainfall is as low as 3″ to 5″ and does not exceed 30″ anywhere in the plains. The climate of the two wings will therefore be discussed separately. However, the climatic charts of normal pressure, wind, temperature and rainfall for January, April, July and October representing typical months of each season in the two wings are given for both the wings together.

EAST PAKISTAN

Climatic Classification

East Pakistan is situated between 20°N and 27°N and it is as much in the tropics as outside. According to Koppen's classification the climate of Chittagong, Noakhali and parts of Tippera and Bakarganj districts is of the tropical rain forest type and the rest of the delta and the area in and around the Dacca district are of the tropical savanna type. The rest of East Pakistan falls in subhumid mesothermal type with dry winter.

According to Thornthwaite's classification the districts of Chittagong, Chittagong Hill Tracts and Sylhet and the northern tip of the Dinajpur district are perhumid. The districts of Khulna, Faridpur, Jessore and Kushtia are subhumid of C_2 type and the rest of the country is humid of B_1, B_2, B_3 and B_4 type.

Both these classifications inspite of their variations give a fairly good idea of climate in relation to vegetation, but from the point of physical climatology they are not quite satisfactory. Till such time that a physical basis related to thermodynamic and hydrodynamical parameters is decided we must know the actual climatic conditions. From this point of view the year in East Pakistan can be divided into four well marked seasons—Cold weather

season (December to February), Norwester and hot weather season (March to May), Monsoon season (June to September), and Retreating monsoon season (October and November).

Cold Weather Season (December to February).

The winter season is of a short duration and is very pleasant with the daily mean minimum temperature of about 55°F. It is only rarely that the minimum temperature goes down to 45°F. Low pressure systems moving from the west do reach the region sometimes in this season, but their effect is not well marked except for the occurrence of mist or fog and extension of a mild cold wave in the rear of western disturbances. Occurrence of fog in such cases is generally limited to the northern districts where the minimum temperature may go down to 40°F or a little less. Dinajpur has recorded the lowest temperature of 34°F, while Bogra has

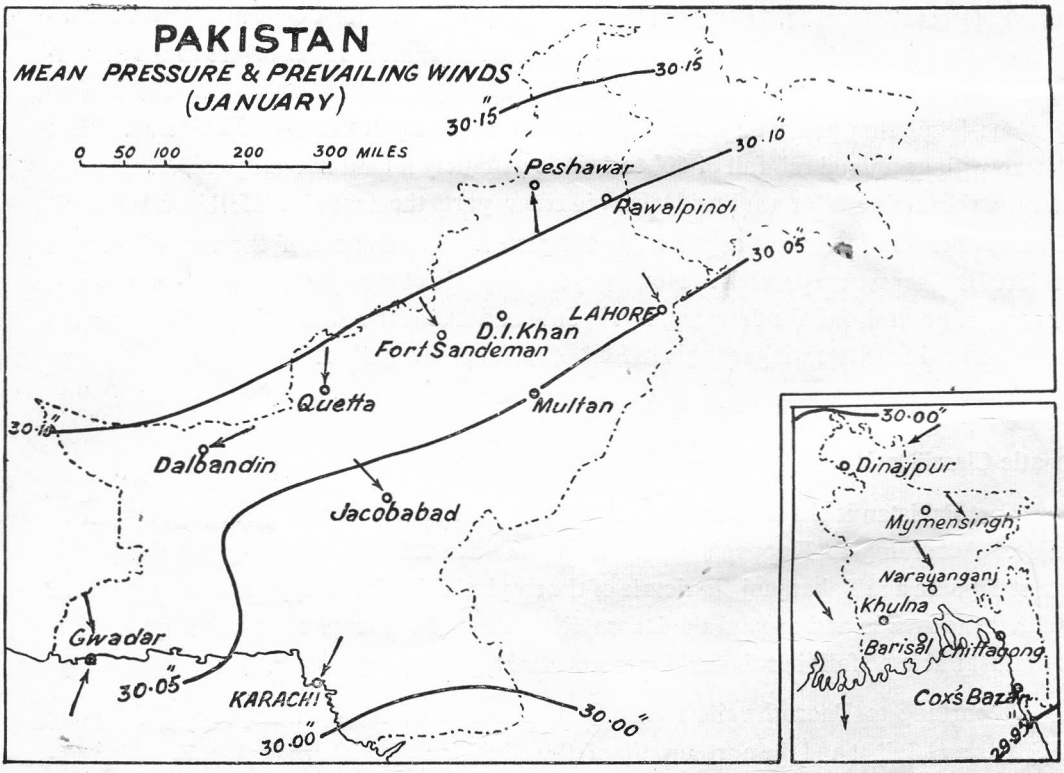

Fig. 1*a*.

recorded 39°F. Rainfall is usually less than 1″ in December and January. But in February rainfall in most of the districts is between 1″ and 2″. This is usually received in association with the lows that form over the central parts of India on a subtropical front in the region (Naqvi 1950), or as secondaries of the western disturbances moving across a northern track. The occurrence of radiation fog and haze in the morning are, however, common in the southern maritime districts from Faridpur to Chittagong, and more frequent in the central area as represented by Dacca and Narayangang where on an average the fog occurs on 11,

10 and 7 days in December, January and February respectively. In the northern districts of Dinajpur, Bogra and Mymensingh fog usually occurs in association with the western disturbances for 1 or 2 days in each winter month as already stated. The typical conditions of pressure, wind direction and temperature for the month of January, representing this season, are given in Figures 1 (*a*) and 1 (*b*).

Norwester or the Hot Weather Season (March to May).

The mean daily maximum temperature rises by about 10°F in March under the influence of increasing solar radiation. In April a seasonal trough of low pressure is formed over the region extending from the Utter Pradesh to Chota Nagpur and adjoining areas in India to the west of East Pakistan. The seasonal trough goes on intensifying as the season advances and under the influence of this pressure system moist southerly winds begin to penetrate into East Pakistan and adjoining parts of India. They are particulary well marked in the afternoons. Under suitable alignment of upper winds the latent instability condi-

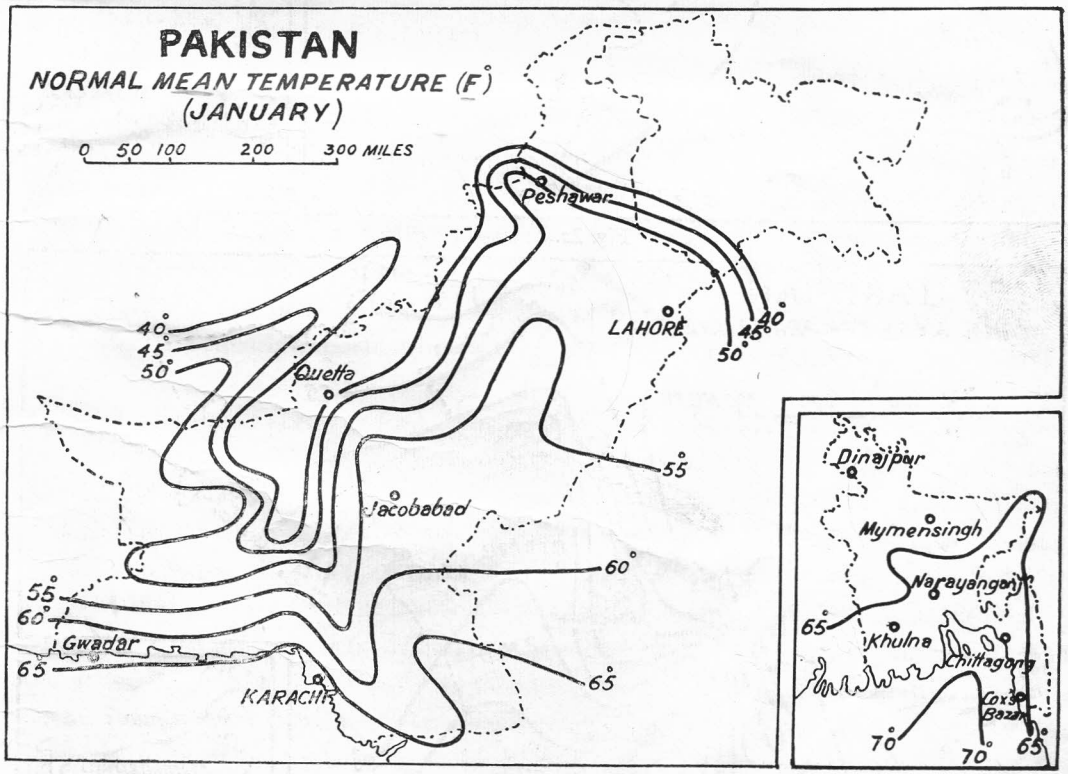

Fig. 1*b*.

tions are disturbed by slightest trigger action resulting in violent thunder squalls called "Norwesters" or "Kal-Baisakhis". They sometime assume tornadic intensity and move for north to south or northwest to southeast causing severe damage to everything that comes in their way.

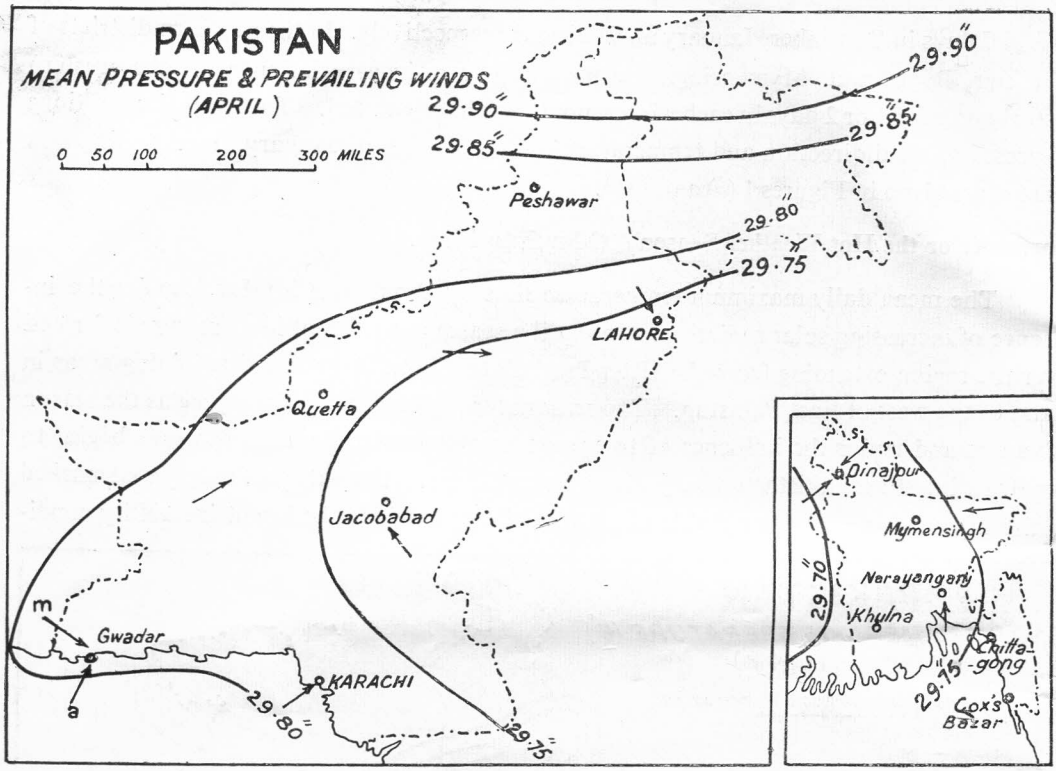
PAKISTAN
MEAN PRESSURE & PREVAILING WINDS
(APRIL)
0 50 100 200 300 MILES
29·90"
29·85"
29·80"
29·75"
29·70"
Peshawar
LAHORE
Quetta
Jacobabad
m
Gwadar
a
KARACHI
Dinajpur
Mymensingh
Narayanganj
Khulna
Chittagong
Cox's Bazar

Fig. 2*a*.

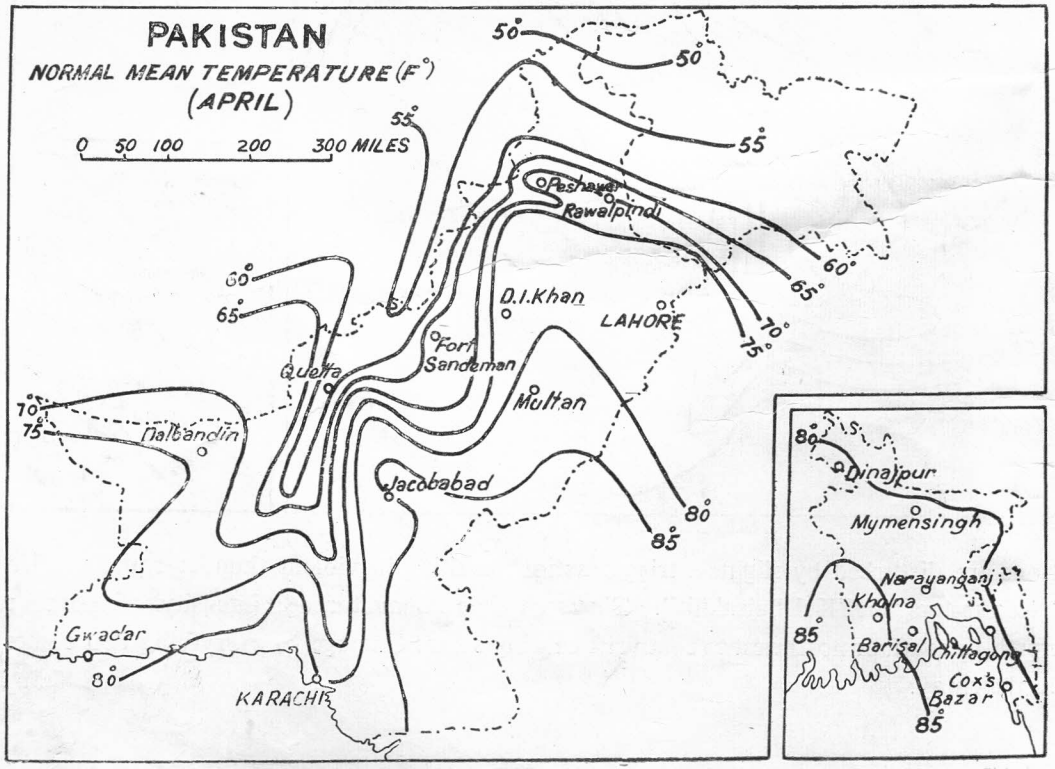
PAKISTAN
NORMAL MEAN TEMPERATURE (F°)
(APRIL)
0 50 100 200 300 MILES
50°
55°
60°
65°
70°
75°
80°
85°
Peshawar
Rawalpindi
D.I.Khan
LAHORE
Fort Sandeman
Quetta
Multan
Nalbandin
Jacobabad
Gwadar
KARACHI
Dinajpur
Mymensingh
Narayanganj
Khulna
Barisal
Chittagong
Cox's Bazar

Fig. 2*b*.

April and May are the hottest months in East Pakistan ; the northern districts are comparatively hotter still. At Bogra the mean daily maximum temperature is 96°F in April, the mean of the highest temperature recorded in April of different years is 105°F, while the highest ever recorded temperature is 110°F. In the maritime districts like Noakhali, Chittagong and Bakerganj the maximum temperature is usually below 90°F and rarely exceeds 100°F.

The hot season is often broken up by spells of thunder storms which are accompanied with a fair amount of rainfall. At Narayangang (near Dacca), the mean monthly total rainfall in April and May is 5·4″ and 9·6″. Similar is the case with other places in the region. Tropical depressions and storms which form over the southwest or Central Bay of Bengal reach the Ganges delta and the Chittagong Coast, and sometime cause losses of life and property. The typical climatic conditions for April representing this season are given in Figures 2 (*a*) and 2 (*b*).

Monsoon Season (June to September).

The monsoon advances rather rapidly over the Bay of Bengal and is heralded over the land by a series of thunder squalls. The monsoon current over the Bay of Bengal is controlled not only by the pressure pattern over the Indo-Pakistan Sub-continent but also by the Arakan Yumas in the East, the Himalayas in the North and the Khasi-Jantia Hills projecting vertically in the path of practically saturated monsoon air mass coming from the Bay of Bengal. The monsoon is deflected towards the Gangetic plains under the combined effect of the trough of low pressure and the orographic features. These, while influencing the flow pattern are equally important in respect of distribution of rainfall.

Heavy rainfall occurs in East Pakistan when the monsoon trough intensifies or orientates in a north to south direction roughly along 85° East. Very heavy rain is, however, received in association with fresh pulse of monsoon pushed northwards by trpoical depressions and storms which sometimes move as low pressure waves from the Far East or otherwise develop and intensify in the Central Bay of Bengal in September and in the North Bay in June, July and August. In June and September they occasionally move towards East Pakistan after recurvature over India or the Bay of Bengal and cause heavy rainfall. In July and August the depressions and storms are not very intense and move away northwestwards. The heavy rains are due mainly to convergence and orographic uplift of the nearly saturated monsoon air-mass over the delta on the windward side of the Khasi-Jantia hills and the Himalayas.

The monsoon effects the southern districts of Chittagong and Noakhali towards the end of May or the beginning of June. It usually takes about a week in establishing itself over the whole province.

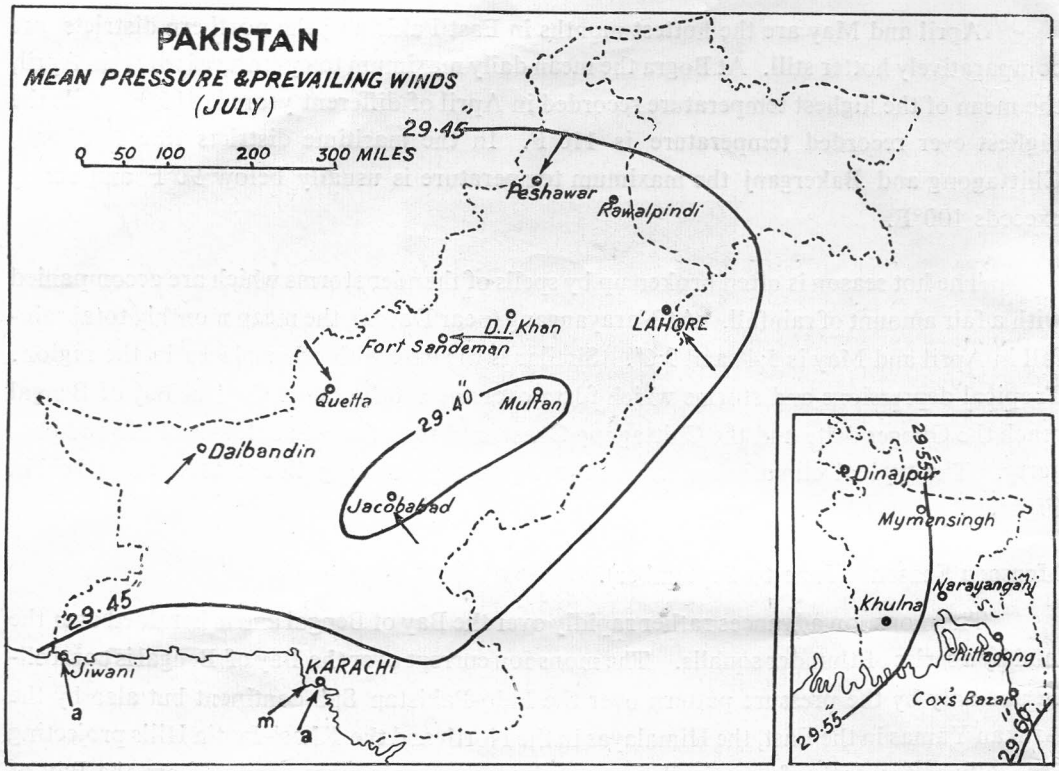
PAKISTAN
MEAN PRESSURE &PREVAILING WINDS
(JULY)
0 50 100 200 300 MILES
29·45"
Peshawar
Rawalpindi
D.I.Khan
LAHORE
Fort Sandeman
Quetta
29·40"
Multan
Dalbandin
Jacobabad
29·45"
Jiwani
KARACHI
a
m
a
29·55"
Dinajpur
Mymensingh
Narayangahi
Khulna
Chittagong
Cox's Bazar
29·55"
29·65"

Fig. 3*a*.

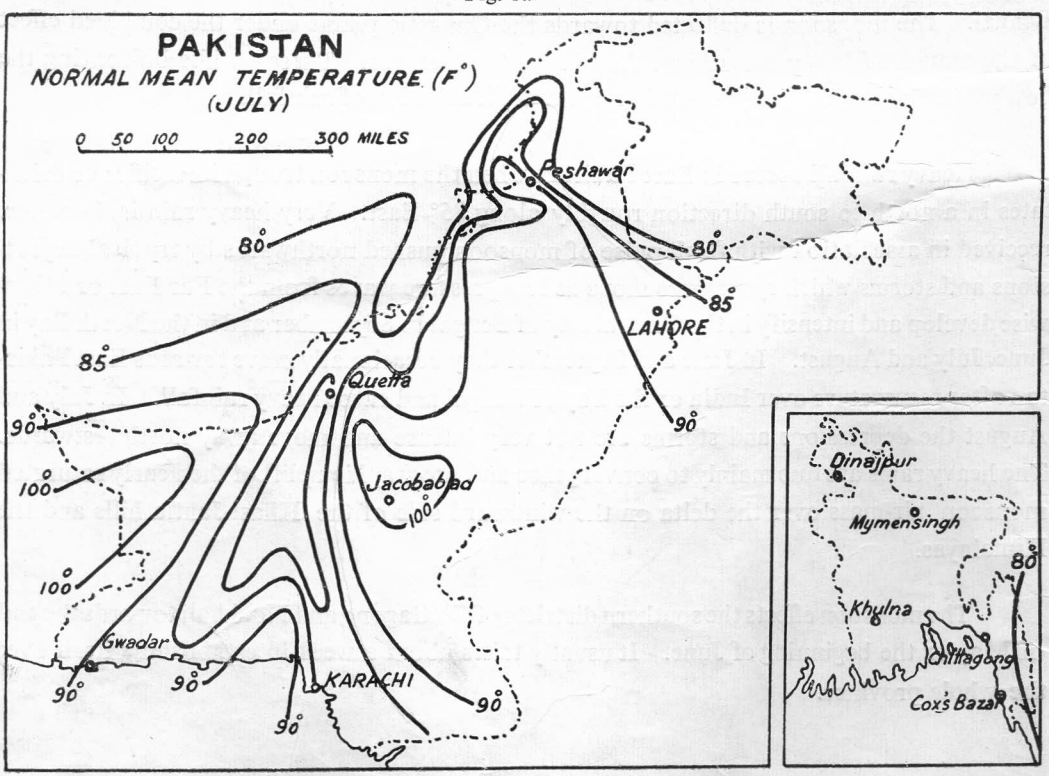
PAKISTAN
NORMAL MEAN TEMPERATURE (F°)
(JULY)
0 50 100 200 300 MILES
Peshawar
80°
80°
85°
LAHORE
85°
Quetta
90°
90°
100°
Jacobabad
100°
100°
Gwadar
90°
90°
KARACHI
90°
90°
Dinajpur
Mymensingh
80°
Khulna
Chittagong
Cox's Bazar

Fig. 3*b*.

Monsoon rains even in East Pakistan are not of an uninterrupted nature. Spells of heavy rains alternate with period of light rain. The bulk of rainfall occurs in a few heavy falls. Rahamatullah (1955) in his "study of rainfall over Chittagong Coast during 1955" has found that heavy rainfall of 3″ or more occurred only on 14 days in the year but was responsible for 57 per cent. of the total annual rainfall for Chittagong.

Most of East Pakistan lies in flood plains of the Ganges, the Brahamaputra, Testa and the Surma rivers and vast areas are flooded as a normal routine every year. This determines the economic pattern of agriculture in the region and provides conditions favourable for production of some of the best varities of jute in the world. While this is normally a boon, it becomes a calamitous ban in the years of high floods.

In connection with floods it must be noted that their severity is not much intensified by local heavy rain, but by heavy rainfall in the Eastern Himalayas outside the province. Sometimes actually when there is a break in monsoon over the plains and the Arabian Sea branch of the monsoon joins with the Bay branch in Eastern Himalayas to cause heavy rain in the upper reaches of the Brahamaputra. The rivers in East Pakistan are tidal upto regions quite deep in the heart of the country and the floods in the monsoon season are much affected by the conditions of piling of sea water at the head of the Bay of Bengal and the state of tide when a flood peak reaches the tidal region. The typical pressure, wind and temperature pattern of July representing this season is given in Figures 3 (*a*) and 3 (*b*).

Post Monsoon Period (October and November).

The monsoon starts withdrawing from East Pakistan by the middle of October, but it is completely withdrawn only by the end of that month. With retreat of the monsoon the ITF moves from the North Bay to the Central Bay of Bengal by the end of November. Tropical depressions and storms form over the ITF in the Central Bay of Bengal during this period. Some of these intensify into severe cyclonic storms with a core of hurricane winds and on recurvature reach East Pakistan from the southwest. They are occasionally associated with high storm waves which cause heavy loss of life and property. The Bakarganj cyclone of 1876 was one of the most destructive on record when over a hundred thousand people were drowned over the low lying area along the Meghna estuary. Recently two cyclonic storms which hit Bakarganj, Noakhali and Chittagong districts on 10th and 31st October 1960 were of the same type. Besides the storm waves these cyclonic storms from the Bay of Bengal bring moist winds into East Pakistan which cause 5″ to 7″ of rain in October and 1″ to 3″ in November in different parts of the region.

The distribution of pressure, wind direction and temperature for the month of October which is the representative month of the season is given in Figures 4 (*a*) and 4 (*b*).

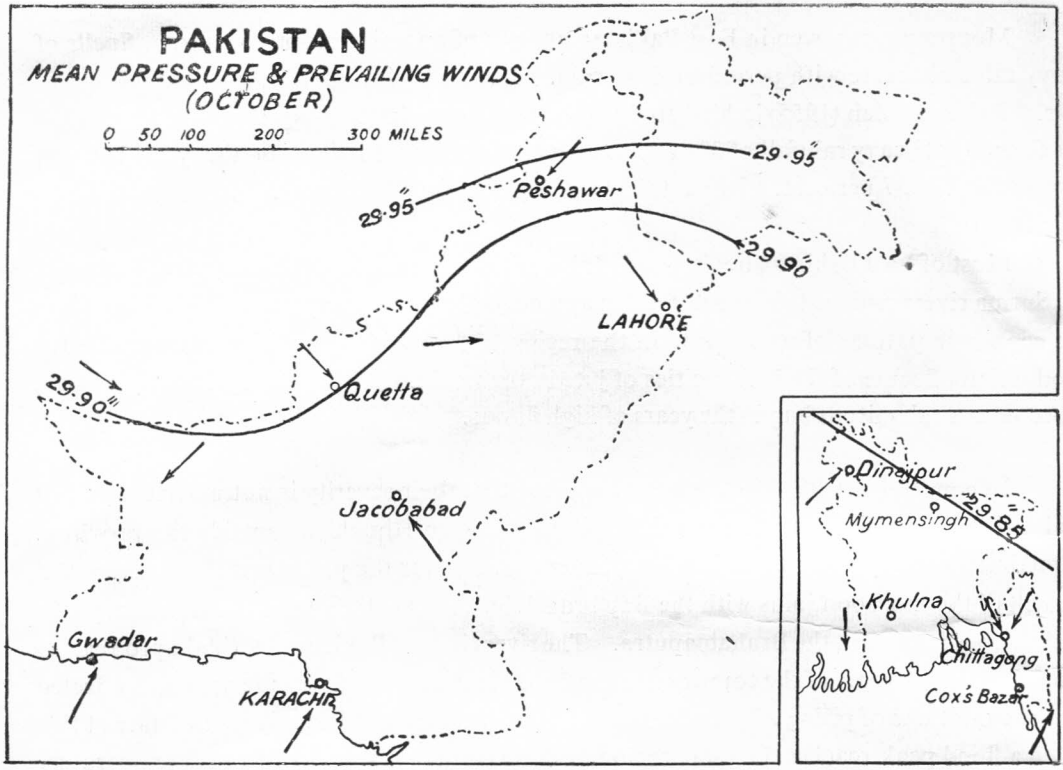
PAKISTAN
MEAN PRESSURE & PREVAILING WINDS
(OCTOBER)
0 50 100 200 300 MILES
29.95"
29.95"
29.90"
29.90"
Peshawar
LAHORE
Quetta
Jacobabad
Gwadar
KARACHI
Dinajpur
Mymensingh
29.85"
Khulna
Chittagong
Cox's Bazar

Fig. 4*a*

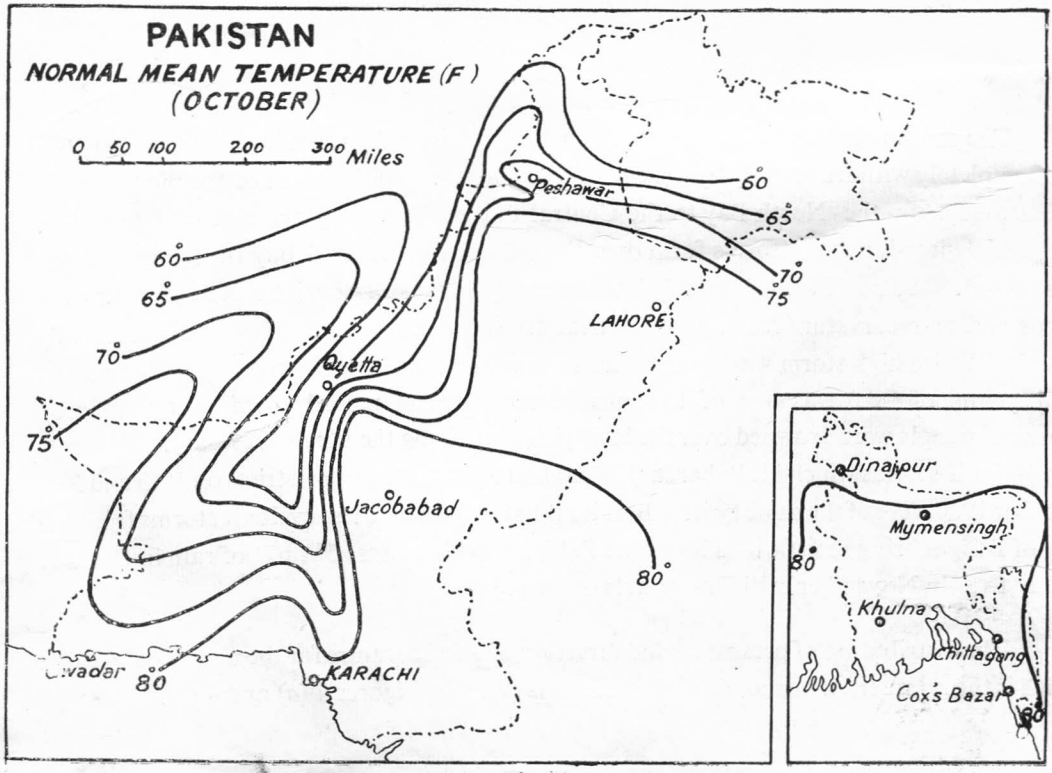
PAKISTAN
NORMAL MEAN TEMPERATURE (F)
(OCTOBER)
0 50 100 200 300 Miles
Peshawar
60°
65°
70°
75°
LAHORE
Quetta
Jacobabad
80°
KARACHI
Dinajpur
Mymensingh
Khulna
Chittagong
Cox's Bazar

Fig. 4*b*

WEST PAKISTAN

Climatic Classification

West Pakistan extends from 24° N to about 37° N. Its western border lies close to 62°E, its northeastern border extends to about 74½° E, while Kashmir extends to 80° E. To the north of West Pakistan lie the lofty mountainous ranges of the Pir Panjal, the greater Himalaya and the Karakoram ranges. The Sulaiman mountains are in the northwest, while Koh-i-Taftan and then lower ranges in continuation of the Namak-sar desert beyond them lie to the west, between Pakistan and Iran. These physical features have a great bearing on the climatology of the area in so much as they not only modify rainfall and temperature pattern of West Pakistan, but also greatly influence the general circulation of the atmosphere in the Sub-continent.

According to Koppen's classification the climate of West Pakistan falls under the group of dry climate and the five climatic types are as follows.

1. *Tropical semi-arid steppe climate* with dry winter. This includes Karachi, Hyderabad and southern Khairpur divisions. The mean annual temperature is above 64·4° F.

2. *Tropical arid or desert climate* with average annual temperature about 64·4° F and dry winter. This includes southern Kalat and the Indus plains from Lahore, Rawalpindi and D. I. Khan divisions to northern half of the Khairpur division.

3. *Cold semi-arid or steppe climate* with dry summer. This includes hilly regions of southern and central Kashmir, Peshawar, D. I. Khan, Quetta and northern half of Kalat division.

4. *Snow forest climate* with the average temperature of coldest month below 26·6° F, warm summer with mean temperature of the warmest month above 50° F but under 71·6° F (22° C). It includes northern mountains of the tribal area and parts of Kashmir.

5. *Tundra climate* with average temperature of the warmest month below 50° F, but above 32° F. It comprises of the eastern and northern parts of Kashmir including Laddakh, Baltistan, Gilgit and northern Chitral.

On the basis of Thornthwaite's classification West Pakistan falls under 6 types.

1. *Semi-arid Tropical :* A small area of Hyderabad division falls under it.

2. *Semi-arid Mesothermal :* It covers northern Kalat, Quetta, and parts of Rawalpindi and adjoining Kashmir area.

3. *Taiga :* It includes most of D. I. Khan, Peshawar, and the tribal areas of the northwest and central and western Kashmir.

4. *Arid Tropical :* It includes southern Kalat, northern Hyderabad, and Khairpur division.

5. *Arid Mesothermal :* It includes Bahawalpur, Multan and parts of Rawalpindi division.

6. *Tundra :* It includes northwestern part of Kashmir.

Pakistan Meteorological Department, under its arid zone research programme, started observations of evaporation from open pans to get a better understanding of the processes of the exchange of heat and moisture in the lower layers of the atmosphere. Thornthwaite's formula was used to compute evapotranspiration losses for all the stations having climatic normals, a map of evapo-transpiration for West Pakistan was prepared. Naqvi and Qyaum Hamid (1957) computed the values of potential evapotranspiration, water surplus and deficiencies and the Water Balance Maps were prepared on that basis taking the recharge depth to be 10cm. According to them West Pakistan can be divided into three distinct regions *viz* :

(*i*) *Arid Plains :*

Covering the plains of Indus where the monthly and annual rainfall is always less than the evapotranspiration. The temperature in summer months goes upto 115° F —120° F and sometimes higher.

(*ii*) *The High Altitude Desert and Arid Sub-montane regions :*

Here the monthly total rainfall is slightly more than the evapotranspiration in two or three months. In all other months there is water deficiency.

(*iii*) *High Altitude Semi-arid Lands :*

These cover parts of Quetta, the northern districts of Peshawar division and Kashmir, where there are periods of distinct water surplus in winter and spring.

The Water Balance map of West Pakistan with the three divisions mentioned above is given in Figure 5.

Ahmad (1951) has suggested the classification of West Pakistan by taking the local physiography into account and divides the country into four major regions. They have been further classified into minor regions and sub-regions. The major regions are :—

1. *Tropical Coastlands (Arid Marine) :* It comprises the southern coastal area.

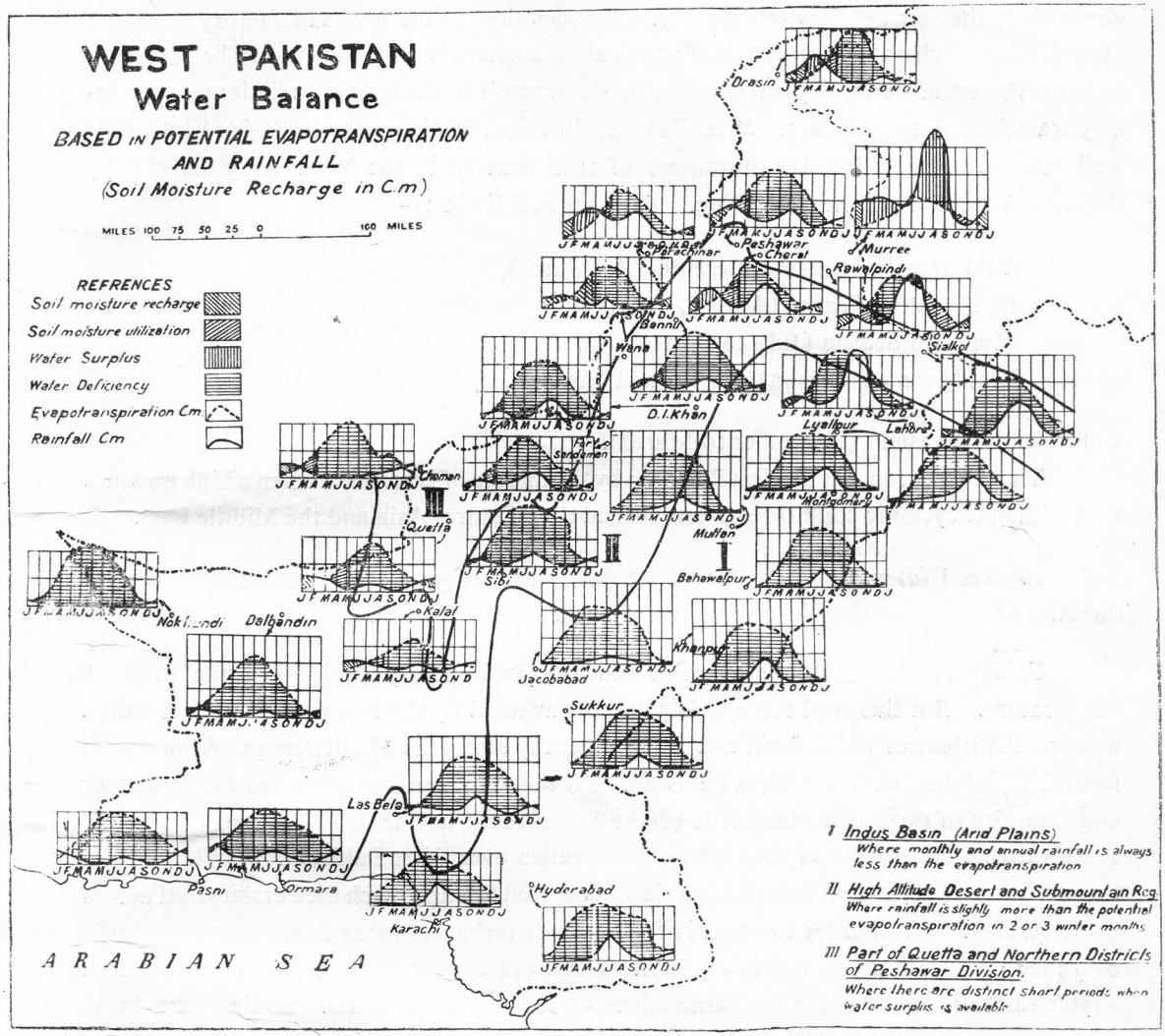

Fig. 5

2. *Sub-Tropical Continental Lowlands :* It is characterised by high summer temperature and late summer rains. It includes the whole of the plains of West Pakistan except the coastal lands.

3. *Sub-Tropical Continental Highlands :* With cold snowy winter, general winter and spring rains. It comprises of the mountainous area to the north and west of the Indus plains.

4. *Chaghai—Kharan (Very Arid) :* It covers northwest Baluchistan.

The classifications given above are of course helpful in understanding the variations of the climatic factors of temperature and rainfall, but from the point of view of physical

climatology they are not very satisfactory. Till such time that a more satisfactory system of classification of climate on the basis of physical parameters is evolved it would be necessary to know the actual meterological conditions which result in the type of variations of climatic parameters as actually met. West Pakistan like East Pakistan can be divided into four well marked seasons, but the durations of these seasons in the West Wing are slightly different from those in the East Wing. They are as follows :—

Cold Weather Season (December to March),
Hot Weather Season (April to June),
Monsoon Season (July to September),
Post Monsoon Season (October and November),

Cold Weather Season (December to March).

The cold season sets in West Pakistan by the middle of December when a high pressure area with anti-cyclonic conditions is established over Central Asia and the Middle East.

Figures 1 (*a*) and 1 (*b*) represent the distribution of pressure, temperature and wind directions for the month of January which is typical of cold season.

This period is characterised by fine weather, low humidity and large diurnal range of temperature. But this cool serenity is generally affected by the low pressure waves called western disturbances which form and move generally along the Mediterranean front across Iraq, Iran, Afghanistan and West Pakistan. As the winter season advances the frequency and intensity of these disturbances is generally increased and their courses go on shifting southwards. In some cases they induce secondaries over West Pakistan. While at times the low pressure areas start from Abyssinia and the Red Sea and reach the Persian Gulf across Saudi Arabia. These latter two types of Western disturbances cause fairly widespread rain over the region with occasional heavy falls. Due to these disturbances West Pakistan has a winter rainfall season which is characteristic of the middle latitudes. In the Indus basin the amount of rainfall is not large as compared to the amounts received during the monsoon period. In Quetta Kalat Division, however, more than 75 per cent. of the total annual rainfall is received in this season. Winter rains, though small in quantity are vital for the crops and their variability is large and that creates years of marked scarcity and plenty.

These western disturbances which cause all this precipitation are extratropical in nature, and have at times well marked warm and cold fronts associated with them. The cold waves in their wake extend to the whole of the Indus basin and far beyond. In these cold waves minimum temperatures below freezing point with frosts are reported even from plains. In some extreme cases minimum temperature as low as 24°F has been reported from Rawalpindi, 25° F from Peshawar and 29° F from Lahore. Along the Sind Mekran Coast, however, the minimum and maximum temperature during the winter season are of the order of 55° F to

75° F. But further inland these usually range from 40° F to 65° F. Over the hill stations snow falls are common and sometimes very low temperatures are recorded. At Drosh (4709 ft.) the lowest temperature of 10° F was recorded on 16th January 1906, while at Quetta (5490 ft.) the lowest temperature recorded was minus 3°F on 21st December 1929. Murree which is a popular summer resort of West Pakistan has mean daily minimum and maximum temperature of 31° F and 45° F respectively in January. The lowest minimum temperature recorded at Murree is 12° F.

Hot Weather Period (April to June).

The pressure falls rapidly on advent of summer and the seasonal trough of low pressure begins to appear over the Indo-Pakistan Sub-continent in April, (Fig. 2 *a* and 2 *b*) and both the wings of Pakistan come in its grip, but the air masses which dominate the two wings in this period are very much different from each other. The northerly air over West Pakistan keeps the mornings and nights generally pleasant but the increasing insolation makes afternoons fairly hot.

In this season the western disturbances move in northerly latitudes and cause thunderstorm over the hills and dust raising winds over the plains. The cold waves in the month of April and hail storms in April and May cause wide-spread damage to fruit crops along the north west frontier. As the hot season progresses the area of highest day temperatures comes over West Pakistan from the south and some of the highest day temperature of Indo-Pakistan Sub-continent have been recorded in May and June when the hot weather continues unabated for days together with the mean daily maximum temperature ranging from 105° F to 115° F, while temperature of 120° F or above are not uncommon. Jacobabad (Sukkur Division), Sibi (Quetta Division) and Turbat (Kalat Division) are the hottest places of the Sub-continent, the highest recorded temperature at Jacobabad in May and June being 126° F and 127° F respectively.

West Pakistan is characterised by extreme continentality in hot season, like the winter. The mean daily range of temperature is of the order of 30° F. Relative humidity in May and June varies from about 50 per cent. in the morning to about 25 per cent. or less in the afternoon, and at many stations it is even less than 20 per cent.

While the interior is blazing hot in May and June, the area along the Sind-Mekran Coast enjoys the pleasant sea breeze in the afternoons which keeps the maximum temperature down to about 95°F. However, when the trough of low pressure appears in the north Arabian Sea or over Sind Kathiawar Coast the sea breeze over the Indus delta is stopped and hot desert winds from Rajasthan blow over the Hyderabad and Karachi divisions. Temperature shoots upto 110° F and above and the sultry weather along the coast is most uncomfortable. Temperatures as high as 116° F have been recorded at Karachi (Drigh Road). Such heat waves, however, do not last for long and it is the mild climate of Karachi which has been a factor in the development of this city during the last few decades.

Any description of climatology would be incomplete without a brief reference to the climate of hill stations, which are health resorts of Pakistan during summer. Murree is of course the queen of the hill stations and is very much crowded. In June which is the hottest month in Murree, the mean daily maximum and minimum temperatures are 80·7 °F and 60·5° F respectively. Once in a while Murree too gets a hot spell when the maximum temperature shoots upto 90° F. It is affected occasionally by cold waves when the minimum temperature may go down to 51° F.

Quetta is another hill station which people from Sind and Karachi usually frequently visit during the hot seasons. July is the hottest month in Quetta with mean daily maximum and minimum temperatures of 94° F and 65° F respectively. In May and August the daily maximum temperatures are of the order of 92° F. But unlike Murree maximum temperatures of above 95° F are not infrequent in Quetta during June, July, and August. Temperature as high as 103° F has been recorded at Quetta during the hot season.

The weather is usually dry in West Pakistan. The total rainfall of the season at different stations in the plains varies between 1″ to 3″ and is of the order of 4″ to 5″ in the submontane districts. In Kashmir and Peshawar Division the total rainfall of April and May forms an appreciable percentage of the annual total. This is received generally in association of western disturbances which now move in northerly latitude and are occassionally associated with storms of dust, thunder and hail. Sometimes, though very rarely cyclonic storms from the Arabian Sea affect the Sind-Mekran Coast and are associated with tidal bores and short spells of heavy rain.

South West Monsoon (July to September).

The establishment of the southwest monsoon over the Indo-Pakistan Sub-continent is the result of weakening in the general circulation in the northern hemisphere and northwards shift of the westerlies as modified by the local circulation over the Indian Ocean during the months of May and June. Besides the northward shift of the westerlies, these changes include the intensification of the subtropical anti-cyclones over the south Indian Ocean. The SE Trades of the Southern Hemisphere cross the Equator towards the end of May and under the combined influence of the coriolis force and the peculiar orography of East Africa assume a southwesterly direction. It is during this period that the heat low over the Indo-Pakistan, gets firmly established and induces the northward shift of the southeast trades.

The Arabian Sea branch of the monsoon current passes over the Western Ghats, crosses over to the Deccan Peninsula and Central part of India to meet the Bay of Bengal current coming direct from equatorial region in the south. These two branches of the monsoon meet the intertropical convergence zone or I T F. The position of the I T F fluctuates considerably over northern India and East Pakistan. A series of tropical depressions and storms form over this front over the head of the Bay of Bengal and move in a northwesterly

direction until they reach the central parts of India or Rajasthan. Here some of them recurve north and northeastwards and cause heavy rainfall in the catchment areas of the Indus basin, rivers causing high floods in them. Others move straight towards the west and cause widespread and locally heavy rainfall in Khairpur, Hyderabad and Karachi divisions, over the Kirthar ranges and sometimes even in the Quetta Kalat Divisions. Some of the depressions emerge into the northeast Arabian Sea, intensify and affect the Sind-Mekran Coast and sometime even the Gulf of Oman.

The rainfall belt moves north or south alongwith the I T F or the depressions and storms. The most even distribution of rainfall over northern half of the Indo-Pakistan area including the Indus basin occurs when the I T F lies east to west roughly along latitude 25°N. Rainfall increases towards the north if the axis orientates northwards and a western disturbance is moving across the extreme north of the country at the same time.

The southwest monsoon current pushes westwards across the Gangetic plain and reaches West Pakistan towards the beginning of July and establishes there by the middle of the month.

The Arabian Sea branch which begins affecting the Sind-Mekran Coast by the end of June is able to produce only stratus clouds because the development of clouds is checked by the presence of an inversion layer about 1,500 feet to 2,000 feet high. If, however, the meterological situation leads to convergence of air in upper layers the inversion is broken down and thunderstorm occurs. This usually takes place in association with a depression over North Arabian Sea or the adjoining land area.

Figures 3 (*a*) and 3 (*b*) represent the distribution of temperature, pressure, and wind direction for the month of July which is typical of the monsoon period.

Monsoon rainfall as stated earlier is greatly influenced by the position of I T F and the orography overland. This mainly depends on the eastern depressions which form in the North Bay of Bengal in July and August and usually move northwestwards through India. The monsoon depressions are generally not deep and usually fill up after moving inland for a few hundred miles. But occasionally they are deep and develop into tropical cyclones, sometimes they move right upto Rajasthan and then recurve northwards bringing very heavy rains and floods in the northern parts of West Pakistan as already stated. At this stage the contribution of the Arabian Sea branch of the monsoon in producing rainfall is not inconsiderable.

The strength of the monsoon current increases from June to July ; it then remains steady and begins retreating towards the end of August, but occasionally it continues active even in September when some of the highest floods of the Indus basin have been recorded.

Post Monsoon Period (October and November).

From the middle of September to the middle of November is the transitory period in which the monsoon condition gradually change over to those of the winter. The retreat of the monsoon from North Arabian Sea is marked by the disappearance of the stratus clouds over the Sind-Mekran Coast and the general rise in day temperature over the Coastal belt in September. In October the maximum temperature is of the order of 94°F—99°F all over West Pakistan, while the nights are fairly cool and the minimum temperature remains near about 60° F. In the month of November both maximum and minimum temperatures fall by about 10°F and the weather becomes pleasant. By the middle of November the high pressure area begins to establish over West Pakistan with typical winter conditions.

The transitory period in West Pakistan is characterised by lack of any active systems either moving from the East or the West. October and November constitute by far the driest months all over the plains of this wing.

The distribution of pressure, wind direction and temperature for the month of October which is representative of post monsoon period is given in Figures 4 (*a*) and 4 (*b*). In Figure 6 is given the annual rainfall of West Pakistan.

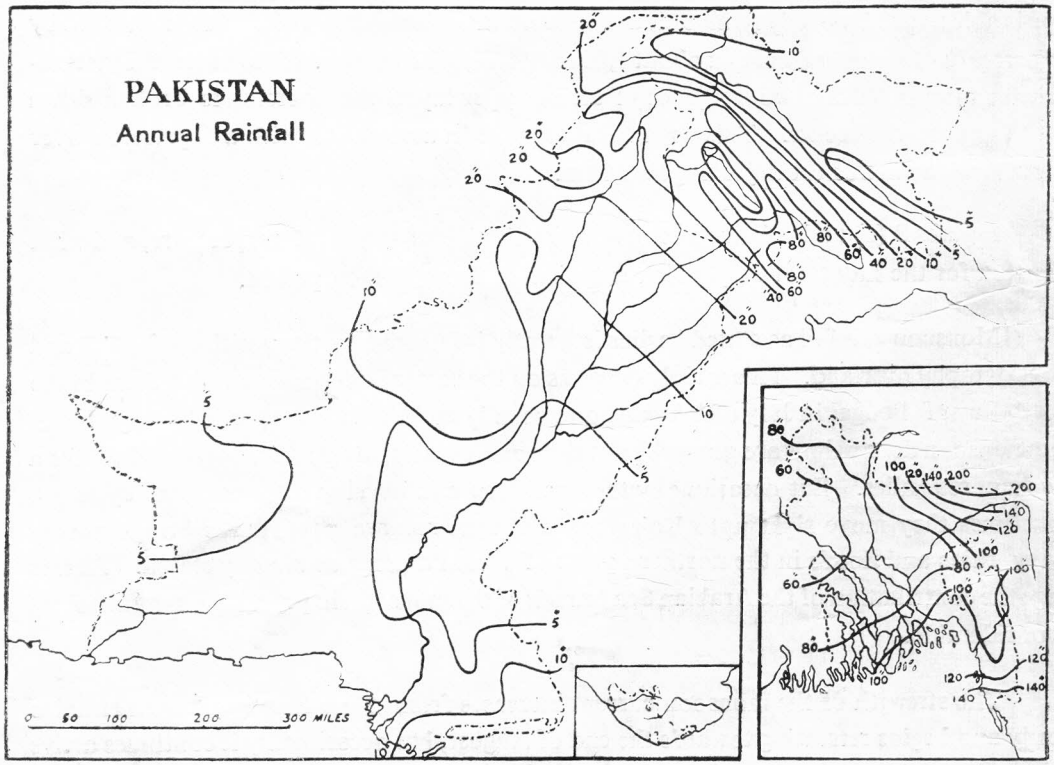

Fig. 6.

LONG RANGE FORECASTS OF SEASONAL RAINFALL

Correlation between the monsoon and winter rains of West Pakistan with preceeding weather conditions in other parts of the world has long been tried for the purpose of issuing long range forecasts. Inspite of vast irrigation works in West Pakistan variations of rainfall have far reaching repercussions on the economy of the country. This was so even in the days of British rule when the areas now constituting West Pakistan were considered to be the granary of the Indo-Pakistan Sub-continent. In fact one of the financial member of the Executive Council of British India had declared that the budget of the Sub-continent was a gamble in monsoon rainfall. Any pre-vision, however, was therefore considered extremely helpful in making estimates for the future. As a result the Directors of the Meteorological Service in the Indo-Pakistan sub-continent were required to give a forecast for rainfall during the winter and the monsoon season over the parts now constituting West Pakistan.

Seasonal forecast for monsoon rainfall were issued by Blanford as early as 1882. In the beginning they were based entirely on the fact that the late and heavy snowfall in the western Himalays was considered to be prejudicial to rainfall in the northwestern areas of the Indo-Pakistan sub-continent. Sir John Elliot made these forecasts much more elaborate without appropriate forecasting aids at his disposal. Consequently the forecasts issued by him sometimes became the subject of criticism in the press. But Sir Gilbert Walker put long-range forecasting on a sound footing by introducing the statistical techniques. After intensive and extensive examination of the World Weather Records Sir Gilbert found several factors to be significantly correlated with the monsoon rainfall of northwest India. Similar analysis had brought out the factors correlated with the rainfall in winter season in northwest India. These factors and those which had been used in the Indian Meterological Department before independence were examined de novo in the Pakistan Meteorological Department for areas constituting West Pakistan. The conditions favourable for rainfall in West Pakistan now used as indicators are given below :—

A. For the Monsoon period — June-September.

(*i*) South American Pressure (April-May) above normal.

(*ii*) Equatorial Pressure (February-May) below normal.

(*iii*) Panjab Mean Range temperature (April-May) below normal.

(*iv*) Western Himalayan snow accumulation (May) below normal.

B. For the Winter period — January-March.

(*i*) South American Pressure (November-December) above normal.

(*ii*) Western Rainfall (December) above normal.

Efforts are now being made to develop synoptic and other empirical techniques based on persistence and continuity of weather conditions to issue short period forecast of a week and long period forcast of one to three months ahead. These are being tried in the Weather Centres of this Service.

SETTLEMENTS IN A ZONE OF TRANSITION

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THE district of Mathura[1] (27°14′/27°58′N-77°17′/78°12′E) is an area of transition. It is an area usually obscured by the use of the general term—" The Indo-Gangetic Plain "—although it belongs neither to the Indus Plain nor to that of the Ganges (Fig. 1). Separated from the plain of the Indus by that of the Ghaggar, only the eastern half of M. D. falls in the Doab ; while its western boundaries correspond with the eastern limits of the Desert. The dry, scrub-covered foothills of

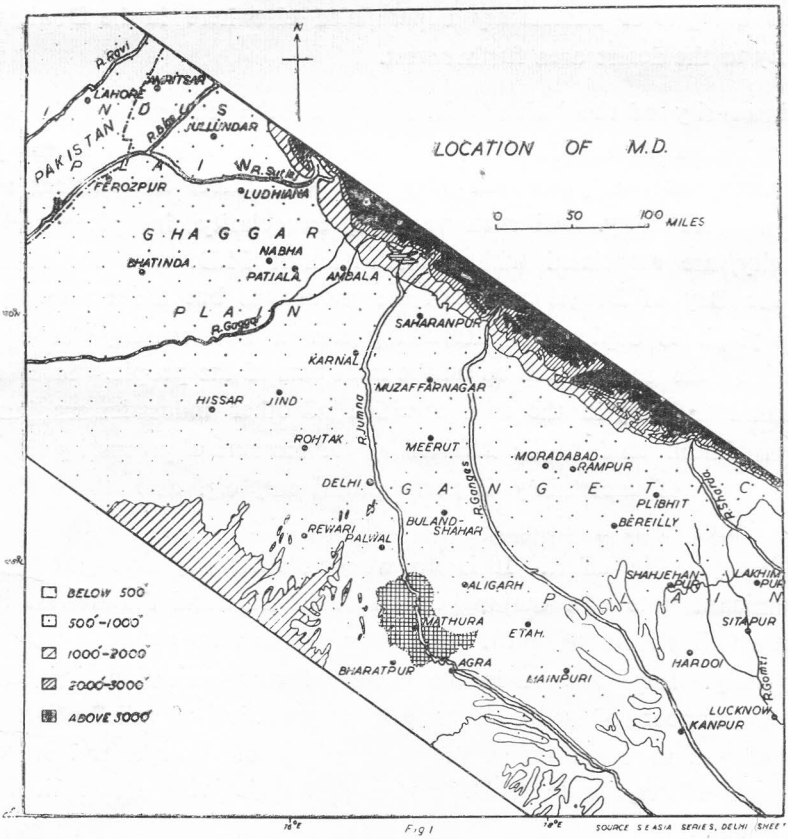


Fig 1

the Aravallis protrude through its western border. The area is therefore unique on account of its transitional nature. It resembles in some aspects one or other of the surrounding regions and yet the composite picture marks it out as a separate entity.

1. Henceforth M.D. (Thus, EMD for the area east of Jumna and WMD for the area west of Jumna).

The area also lies between Lahore and Lucknow. After having crossed the major passage over the Oxus/Indus watershed "people after people have passed into the plains of 'Hindustan,' whether impelled by desiccation in the steppe or by the political pressure of the constantly shifting fortunes of the central Asian war.... Horsemen, meat-eaters, mighty drinkers, they contrast strongly with the dark-skinned "snub-nosed Dasyus," the Dravidian heirs of Indus culture. From the millenial interaction of these two groups is woven so much of the rich tapestry of Hindu myth and probably also of the darker fabric of caste."[2]

The climate is also transitional in type, the summers with their very high temperatures, high diurnal range and frequent dust storms resemble those of the Great Indian Desert, while the winters with their clear skies are as bracing as those of the central and northern Gangetic Plain. The precipitation of the "rainy season" in WMD has a degree of uncertainty unparalleled elsewhere in the Doab, thus showing its affinity to the desert area further west.

The insecurity of the harvests is related to the uncertainty of rainfall. The total precipitation varies from year to year ; and, what is more, it is extremely localised often being heavy at one place and very light or almost non-existent at another, barely at few miles away. All such vagaries, irregularity in place and time and normal scarcity, are associated with the situation of M.D. near the extreme limits reached by the Bay of Bengal current of the monsoons but the resulting precariousness of crop yields is deplorable. Recurring famine and scarcity have left their indelible mark on the soul as well as on the traditions of the people. Since agriculture is the paramount industry in the area to which all other industries are but auxiliary, the entire population tends to be affected by the measure of prosperity of agriculture. Where the element of uncertainty is more prominent, e.g. as on the western border of M.D., initiative is at a discount and the general tendency of the people is to make the least possible effort. It is no wonder, therefore, that poverty continues to be the dominant note of a major portion of the tract and that almost insuperable obstacles thwart all efforts of uplift. But the conditions are never static ; they possess a dynamic quality. Improvements in the means of communication, irrigation canals, increase in the number of wells, systematic organisation of relief efforts for rural uplift, have allayed to some extent the dire effects of drought and scarcity. Still, despite, all such efforts, life in M.D. is more a struggle with nature than an enjoyment of her bounty.

The area is also one of change ; its hydrographic conditions have (perhaps) so varied through the ages that this once flourishing and populous country has now assumed an almost desert-like appearance. The ruins of ancient Mathura are still visible.

2. Spate, O. H. K. *India and Pakistan*, London, 1957, pp. 27-29.

Lying in the shadow of the once 'Imperial' city of Delhi around which have revolved the destinies of India and which "for over two thousand years, since the far-off legendry battles of the *Mahabharata* epic"[3] has played the role of the cockpit of Northern India, the tract bore the brunt of the devastating upheavals of foreign invasions and internecine warfare. Agra, too, shared with Delhi the prestige of being the Moghul capital. There has hardly been any period during which M.D. remained unaffected by the major events affecting the history of the sub-continent. The great Aryan and Scythian swarms which in successive waves of migration left their arid

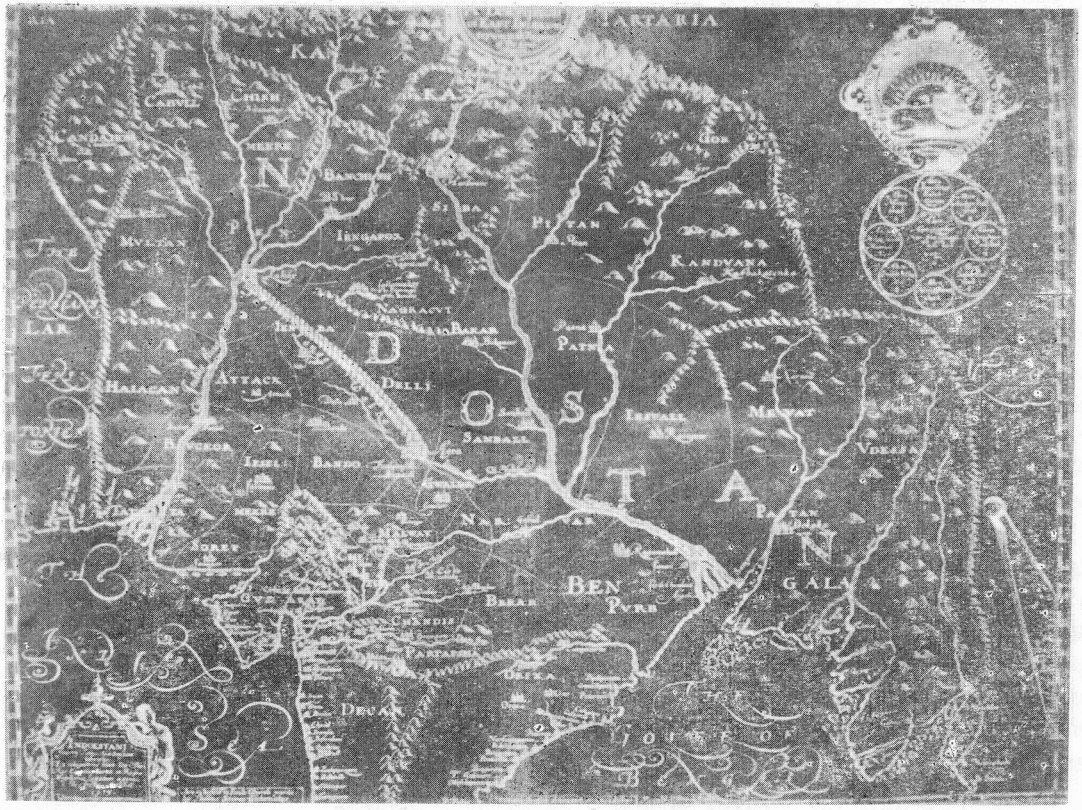


Fig. 2

plateaus for the fruitful plains of India, the conquering armies of Muslim invadors who came to found one of the greatest empires in 'Hindustan', the destructive herds of Tamur and Nadir Shah—all alike entered the lower Gangetic Plains across this area, choosing as they did the shortest and the easiest route from the north-western gateways of India to the plains of Hindustan. Evidence of the importance of this route during the 17th century is available in an early English map of the Moghul territories by William Baffin[4] (Fig. 2). This thoroughfare—the 'Long Walke' has at the one end the important city of Lahore and at the other Agra, the city of Taj,

3. Spate, op.cit., p. 32.

4. William Baffin was a navigator who was master's mate on the ship 'Anne' on which Sir Thomas Roe returned to England after his embassy to the Great Moghul. The map is based on information supplied by Roe to Baffin.

via of course Delhi, the key to supremacy of India. Even today 'Long Walke' is the quickest route by land from Delhi to the mountain passes of the north-west. The spirit of by-gone troubled days still prevails, however, among the Jats, Gujars and Meos of WMD to whom, "the restless life of the camp and the jungle has always appealed rather than the settled life of the farm and the village."[5]

The third reason is, therefore, that the cultural conditions of M.D. are especially interesting. As a result of the history of the area, we have today several communities, some pastoral, others mainly agricultural, carrying on their lives in close proximity with one another.

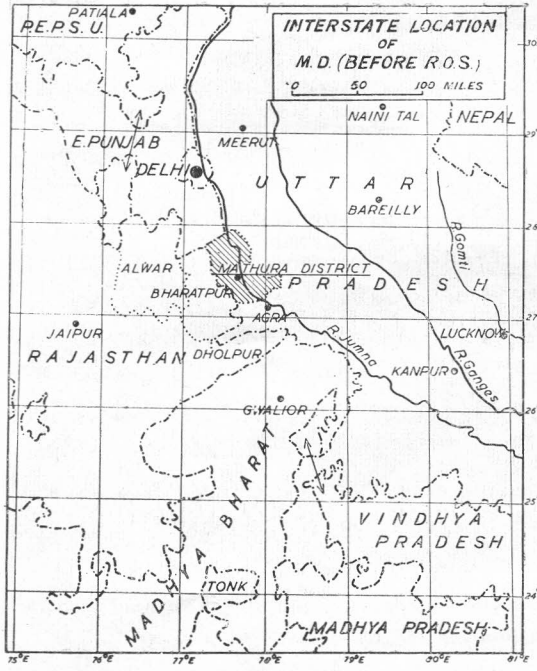


Fig. 3

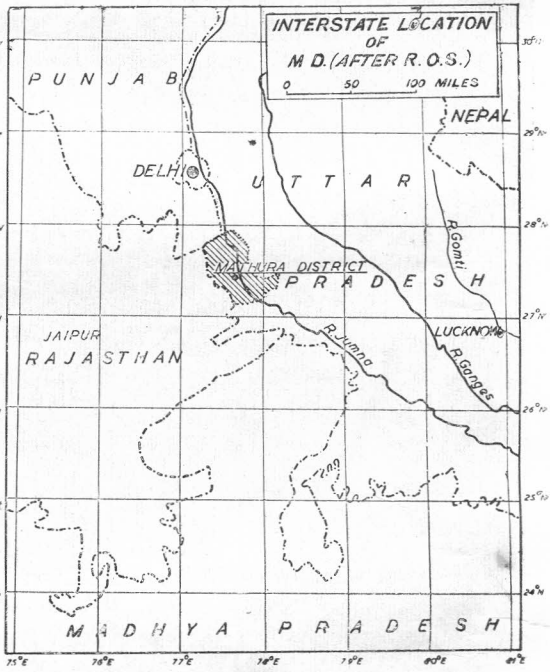


Fig. 4

Fourthly, the western boundary of M.D. has perhaps always been of strategic importance in the territorial structure of the country. Before the R.O.S.* three states of U.P., Bharatpur and Panjab met here while the area was within easy access from the states of Delhi, Dholpur and Madhya Bharat (Fig. 3). After the R.O.S. the inter-state location of M.D. does not appear to have assumed lesser significance; for still the western boundry of M.D is common with those of the states of U.P., Punjab and Rajasthan and still the area is within as easy reach of Delhi and the Madhya Pradesh states (Fig. 4). This inter state location of the area is significant in so far as the traffic in the restricted and licensed goods from one state to another has to be checked on the western border of M.D.

5. Darling, M.L.—*Punjab Peasantry in Prosperity and Debt*, Oxf. Uni. Press, 1925, p.41.

* Re-organisation of States in India, 1st Nov. 1956.

Apart from these factors of location which make M.D. an interesting area for study, its size is convenient for the purposes of intensive research work (area 1,467 sq. miles). One of the advantages of studying the socio-economic problems within the framework of a small area is that "we can better understand the inter-relationship between geographic, historic, economic, social....factors ; and above all it is possible to know better what these problems and changes mean to the people themselves.[6]

As a result of these factors of location, size and extent, M.D. gives a complete picture of transition in landscape and culture from east to west. Furthermore, it is perhaps essential to remark that convenience dictated the actual choice of an administrative rather than a natural unit, since by doing so the study could be placed upon a statistical basis.

A. Rural Settlements

(1) *Preliminary considerations.*

Since the area is essentially agricultural in outlook, the rural settlement forms predominate everywhere. The farming family ordinarily resides in a village and not in the midst of its fields. Therefore, the complete agglomeration of 500 to under 5,000 inhabitants rather than the isolated farmstead must be considered as the residential unit of the rural population. A village in M.D. is not just a collection of dwellings. It is a compact agricultural area with defined boundaries, usually 50-1,000 acres in extent. The owner of the tract often, and the cultivators nearly always, live in a central hamlet, where small shops, cottage industries, stables and the cattle enclosures are also located—man and beast in a most intimate contact. "The super-imposed features of the cultural landscape, viz. metalled roads, railways, canals and power-lines are still young compared with the age-long village, which has survived the viccissitudes of history. The former, therefore, have not yet affected the location of rural settlements though they may have contributed to their growth. This now holds good throughout the province...."[7]

In what follows, the word "village" is used in its more restricted sense, meaning thereby this central hamlet or residential focus and not the whole area to which the term applies for the census purposes.[8] In M.D. out of a total of 860 agglomerations, nearly 90% form communities of less than 2,000 persons. There is a well marked gap between the number of villages having a population between 2,000 under 5,000, and those between 5,000—10,000. A line of division could therefore be drawn between the agglomerations having less and more than 5,000 persons. This forms (generally) the basis of official classification of towns and villages.[9]

A look at the S. O. I.* sheets would indicate a remarkable uniformity in distribution of the rural settlements. The *Bangar* (upland areas) appears to be divided into roughly quadrangular large *mauzas* (Zones) ; the settlement sites (*abadi*) are located roughly in the centre of the quadrangle connected with one another by cart-roads. Groves are not prominent and frequently the village stands exposed on all sides. Most villages have ponds generally on their outskirts. These perennial sheets of water,

6. Lewis, Oscar ; *Life in a Mexican Village*. Uni. of Illinois Press, 1951, p. 26.
7. Ahmad, Enayat—*Settlements in the United Provinces of Agra and Oudh*, unpublished London Ph.D. thesis, 1948, p.71.
8. Census of India, 1951, U.P. Allahabad, p. 110.
9. Census of India, 1951, U.P., op. cit. p.150.

* Survey of India.

a few acres in extent, and the result of age-long excavation for building the village, are conspicuous in the whole of M.D., except along the river side where the soil is light. Thus three things, in general, are clear about these villages—compactness of settlements, absence of through-roads and the existence of at least one tank very near to the village site. The compactness of habitations is, probably, a measure of safety, security and co-operation; the absence of through-roads shows the self-sufficiency of each village unit and the existence of tank or tanks is a necessity imposed by the climatic conditions of the area.

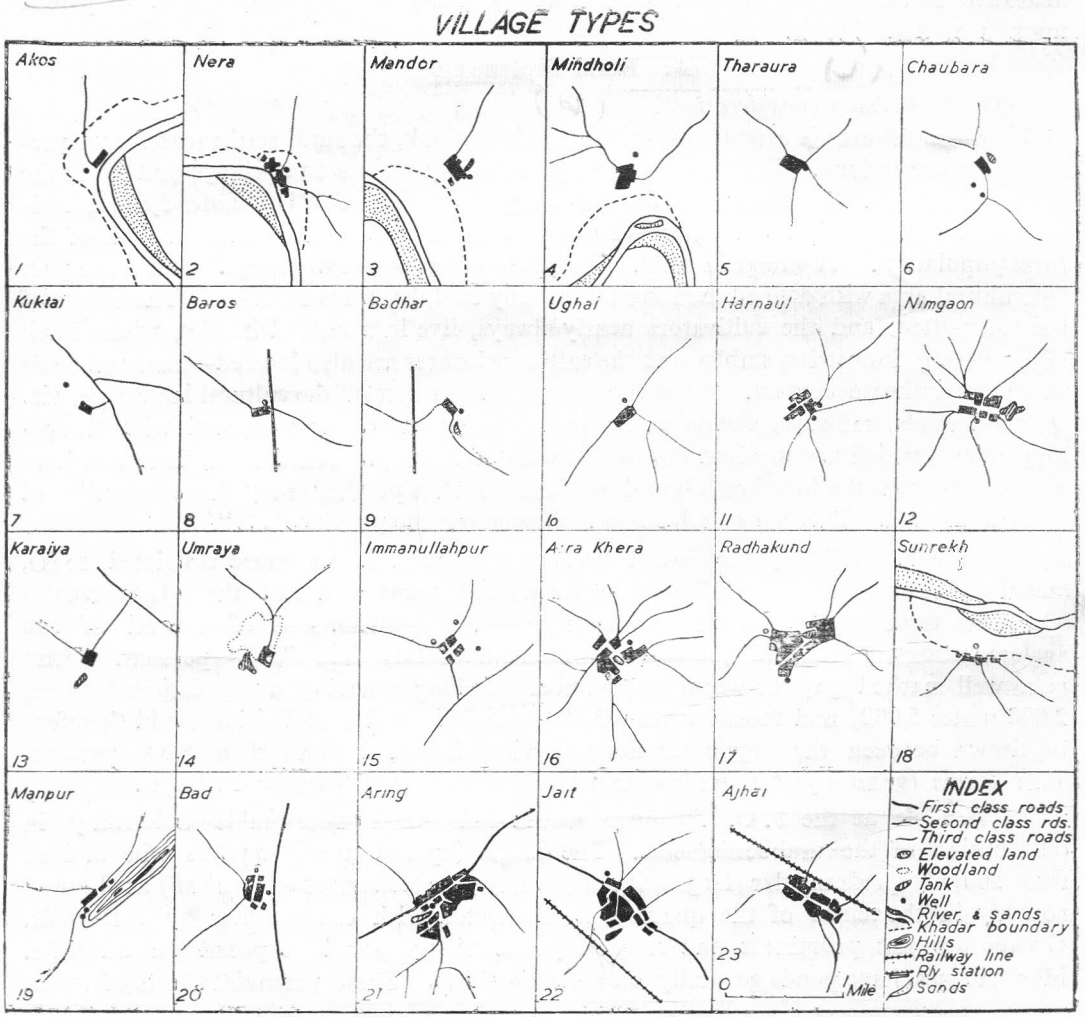


Fig 6. Source: SOI one inch to a mile sheets

Influences, however, of natural aspects, resulting in minor variations can be seen. Most of the Jumna *Khadar* (low land) is covered with tamarisk and thatching grass and is subject to annual inundation. Permanent settlements are in the midst of the cultivated lands in the low lying areas which are liable to floods (Fig. 6. 1 & 2). These

villages are in a constant danger of losing cultivation by diluvial action and are small in size. In contrast with the small alluvial settlements of the *Khadar*, those situated on the old river banks are large and immune from the highest floods (Fig. 6, 3 & 4). These bluffs on the margin between two different tracts are favourable sites in as much as they afford advantages of unirrigated cultivation and abundant grazing in the *Khadar* below.

In WMD, however, the sites are generally perched on hillocks. "They have thus a fort-like appearance. They were constructed in this form.....in the days when the country was harried by the Jat and Maratha marauders."[10] Ahmad calls them 'strong-point' villages.[11] Spate writes, "In the arid west this is enforced partly by the paucity of water-points, partly by the needs of defence.....villages are on hill tops or spurs, often stockaded...."[12] Apart from these special villages, in most parts of the district the villages resemble those to be found throughout the western U.P.[13] They generally consist of a single compact site which when viewed from without is a mud-walled enclosure ; inside is a small courtyard surrounded by two rooms or thatched sheds.[14]

(2) *Factors contributing to the settlement-types.*

Two broad types of settlements are easily recognisable in M.D.—(*a*) Compact Settlements, and (*b*) Fragmented Settlements.

(*a*) *Compact Settlements.*

(*i*) *Uniformity of relief and soil fertility*—The compact settlement "will be found, as an ancient feature, chiefly on lands which were fertile from the beginning."[15] Broadly speaking there is no irregularity in the relief to cause diffusion of resources. The general sameness of scene has fostered a sense of community. Though there are variations in the nature of soils from region to region, and even within the limits of the same *mauza*, the general productivity of the soil in most parts of the plain is more or less uniform and this fertility has enabled a large number of peasants to live together in compact sites.[16]

(*ii*) *Depth of watertable*—In the areas of deep watertable owing to the difficulty and cost of construction the number of wells is restricted. The population, therefore, has to cluster in compact villages round the

10. Drack-Brockman, D.L.—*Muttra—A Gazetteer* Allahabad, 1911, p. 78 (Henceforth D.G.)
11. Ahmad, E., op.cit., p.76.
12. Spate, O.H.K., op.cit. p.171.
13. D.G., pp.77-78.
14. For interesting details, see Spate, op.cit., pp.171-2.
15. Demangeon, A.—*Agricultural Systems and Schemes of Population in Western Europe*, The Geographical Teacher, Vol. 13, 1925-26, pp. 199-205.
16. For a fuller account see the work of Ahmad Enayat, op.cit., pp.69-175.

water source. Further, "the collective buildings of dams and irrigation channels for the storage and distribution of rain water....have promoted the evolution of compact villages."[17]

(*iii*) *Co-operation in agriculture*—It is asserted that communal cultivation was present in the Doab in the past.[18] According to Demangeon, "the compact village may be held to imply the existence at least at the origin of some form of communal cultivation."[19] Whether communal cultivation existed or not, there does exist at present a considerable extent of mutual co-operation in the agricultural activities. The village *bhaichara* may be compared to what Fawcett calls *hacienda* "where all the workers of a large estate....live near to one another."[20]

(*iv*) *Fragmented holdings*—As a resultant of the present tenancy regulations, the fields are scattered and each heir has a strip of land of each type to his share. "While the scattered field system equalises opportunities for all, its successful utilization is co-existent with the centripetal force afforded by the compact village."[21] All paths and tracks across the fields which for each cultivator lie scattered like autumn leaves, lead to that village which is the meeting ground of all. Residing in the central cluster, the villagers are at the minimum economic distance from their scattered fields. The easy transport of plough, cattle and carts to and from the scattered plots probably has provided facilities for the compact settlements.

(*v*) *Clan solidarity*—In U.P., the villages are found mostly by agricultural tribes, clans and castes, forming close communities.[22] Commenting on the size of the mauzas, Baille observed that in the villages of Agra division (of which M.D. was then a part) "the soil is in general owned by strong caparcenary bodies of the peasant proprietor type all assisting in the cultivation or management of the much subdivided villages.[23] Such caparcenary bodies are the Jats, Gujars, Meos and Rajputs whose clan solidarity has held them together in compact sites.[24] All these communities still have their stronghold in M.D.

17. Mukerjee, R.K.,—*Man and His Habitation*, London, 1940, pp. 33-4.
18. Ibid,—*Land Problems in India*, London, 1933, pp.13-18.
19. Demangeon, A.,—op.cit., p.200.
20. Fawcett, C.B.,—*The distribution of Rural Settlements* The Geographical Journal, 1939 (Feb.), p.180.
21. Mukerjee, R. K.—*Man and His Habitation*, Ibid p.62.
22. For detailed treatment see Baden Powell, B. H.—*The Indian Village Community*, 1896, Chap. VI, pp.225-287.
23. Baille, D.C.,—*Census of Indie* 1891, *Vol. XVI, The N. W. Provinces and Oudh*, 1894, p.103.
24. After Turner, A.C.,—*Census of India* 1931, *U.P.*, Vol. XVIII, Pt. II, Tables, 1933, pp.499.548.

(*vi*) *Social and economic ties*—The division of labour based on the caste heirarchy seems to afford certain facilities to the occupants of a compact settlement. "The social gatherings in the centre of the village, usually under some shady tree or near the temple; the mutual rejoicings on festivals, the gatherings of neighbours after the day's work near the well in summer, and round the fire in winter, when tales are told and talks of field and crops engaged ; all these have contributed their influence in the direction of compact settlements."[25]

(*vii*) *Religion and superstition*—There are strong superstitions about sites among all castes. A new site for a house is avoided as far as possible owing to the fear of its proving inauspicious. Houses can be built on a new site only after the sanction of the priest has been obtained. The village gods are supposed to reside on the outskirts of the village. "The *deohar* or village gods form a very distinct group, to whose honour in almost every village, petty offerings are made at the appointed season at the maunds (*than*) sacred to each in almost every village in the Province."[26]

(*viii*) *Insecurity in the past*—The nature of insecurity in the past seems to have affected the settlements in M.D. In the western parts of the area the villages are larger and more compact as compared to EMD. The nature of disturbances in the WMD have been pointed out earlier. The battles and the troop movements meant a danger to the peasants in the form of trampling of crops, looting of property and cattle, loss of honour and life. In order to defend themselves villagers congregated in compact settlements often surrounded with the mud walls. The danger was from the Jats and Marathas—"All was fish that came to a Maratha net, and the smallest cultivator was not below the notice of their plunderers."[27]

(*b*) *Fragmented Settlements.*

(*i*) *High water-table*—Comparatively better rainfall on a high water-table are perhaps associated with obliviating to a considerable degree the need for clustering in a compact central site.

(*ii*) *Floods*—Only the villages of high *Khadars* are secure from the annual flood, and, since such rises are limited and distributed unequally, the villages perched on these rises, are small and dispersed.

25. Ahmad, Enayat, op.cit., p.111.
26. Baillie, D. C. op.cit., p.223.
27. Baillie, D.C., op. cit., p. 103.

(*iii*) *Caste-hierarchy*—"Where the rural population is heterogeneous....., the depressed castes,.....live in a separate para or a group of homesteads on the outskirts of the village."[28] For example, in the village of Nandgaon (or for that matter any village of M.D.) the higher castes—Brahmins, Rajputs, Vaishyas and the Jats—live in one unit (though in separate wards not difficult to identify), but the untouchables live in a separate ward, some distance away (in some villages half a furlong or more) from the main settlement. Spate observes, "The aspect of the village varies not only with the general regional setting, with building materials and house-types, but with social factors. The generally greater emphasis on caste.....takes social fragmentation allied with spatial separation to the extreme, segregating the untouchables in outlying .... sub-villages, sometimes located several hundred yards from the main village of which they are service-components. This is indeed the climax of geographical differentiation; aparthied".[29]

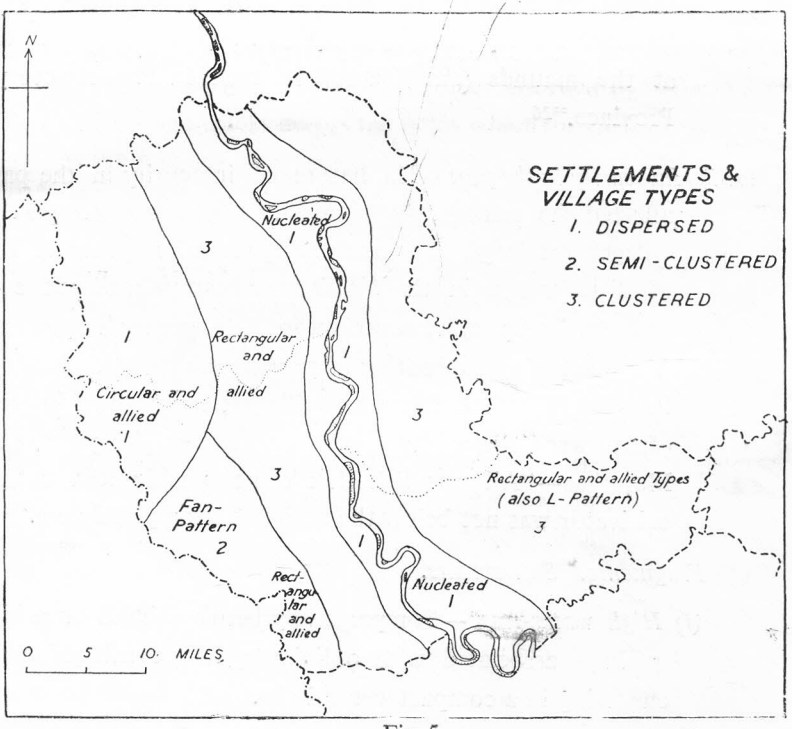


Fig. 5

(*iv*) *Security*—The EMD enjoyed comparative peace in the past over WMD. This feeling of security is probably associated with the growth of hamlets near the fields where the cultivators could perhaps pay better attention to their

28. Mukerjee, R.K.—*Man and His Habitation*, op. cit., p. 104.
29. Spate, op. cit., pp. 176-7.

crops. "Their simple huts can be seen up in a few weeks on any spot which is sufficiently above the rainfloods and their almost only object is to be as near as possible to the fields they cultivate."[30]

(3) *Distribution of the Settlement-types.*

Based on the above considerations the writer prepared Figure 5 showing the broad zones of the settlement types in M.D. The areas of dispersed settlements include the northern half of the western border and the Jumna—Khadar. In the former case the fact seems to be related to the insecurity in the past, the villages being on the tops of the maunds which are distributed unevenly ; while in the latter case the dispersed settlements are perhaps associated with the low watertable in the Khadar.

The areas of clustered settlements are the irrigated parts of M.D. These are also the areas of Domat (fertile alluvium).

One more type, an intermediary, has been recognised—the semi-clustered type. In this zone some villages (especially in the northern part) are on a raised ground perhaps being associated with *garki* (marshes); while others, to which the facilities for irrigation are available (especially in the southern part of the zone) and which do not suffer from the problem of *garki*, are not on the raised ground.

(4) *The village-patterns*[31].

(*i*) *Rectangular*—This is the most common type (Fig. 6, 5-10). One of the main reasons for the pattern is, probably, the shape of the cultivated fields. Secondly, the village compactness requires the houses to be close together, more so when there is no fortifying circular wall and the rectangle provides one of the convenient forms for the minimum cluster of dwellings.

(*ii*) *Chequerboard pattern*—This type emerges when the village lanes intersect at right angles (Fig. 6, 11 & 12). These village lanes are often the continuation of the cart tracks. Generally the village is made up of several wards inhabited by different castes.

(*iii*) *Square-village*—This type emerges on the crossings of the cart-tracks or roads (Fig. 6, 13 & 14). There may also be four-squares where the village is divided into four blocks (Fig. 6, 15).

(*iv*) *Hollow-rectangular*—A ruined site, a pond or a taboo is associated with the development of such village types (Fig. 6, 16 & 17).

30. Baden-Powell, B.H.—op. cit., p. 71.

31. This classification is based primarily on the shapes of the villages. This scheme is by no means a rigid one, but attempts have been made, as far as possible, to bring the nearest approximations into each type. Strictly geometrical shapes would be sought for in vain,—"There is in general very little that looks like a 'plan'.....," but further "within the seemingly chaotic agglomeration there is, as a rule, a strong internal differentiation,....." (See Spate, op. cit., p. 172).

(*v*) *Elongated village*—Natural or cultural forces in the site are such as have restricted the growth of the village in some direction and fostered its extension in the other (Fig. 6, 18-21).

(*vi*) *Street village*—The settlement is markedly elongated if the village happens to be a market centre and a metalled road or a railway line passes close by (Fig. 6, 22). "Such a pattern approaches what may be called stressendorf."[32]

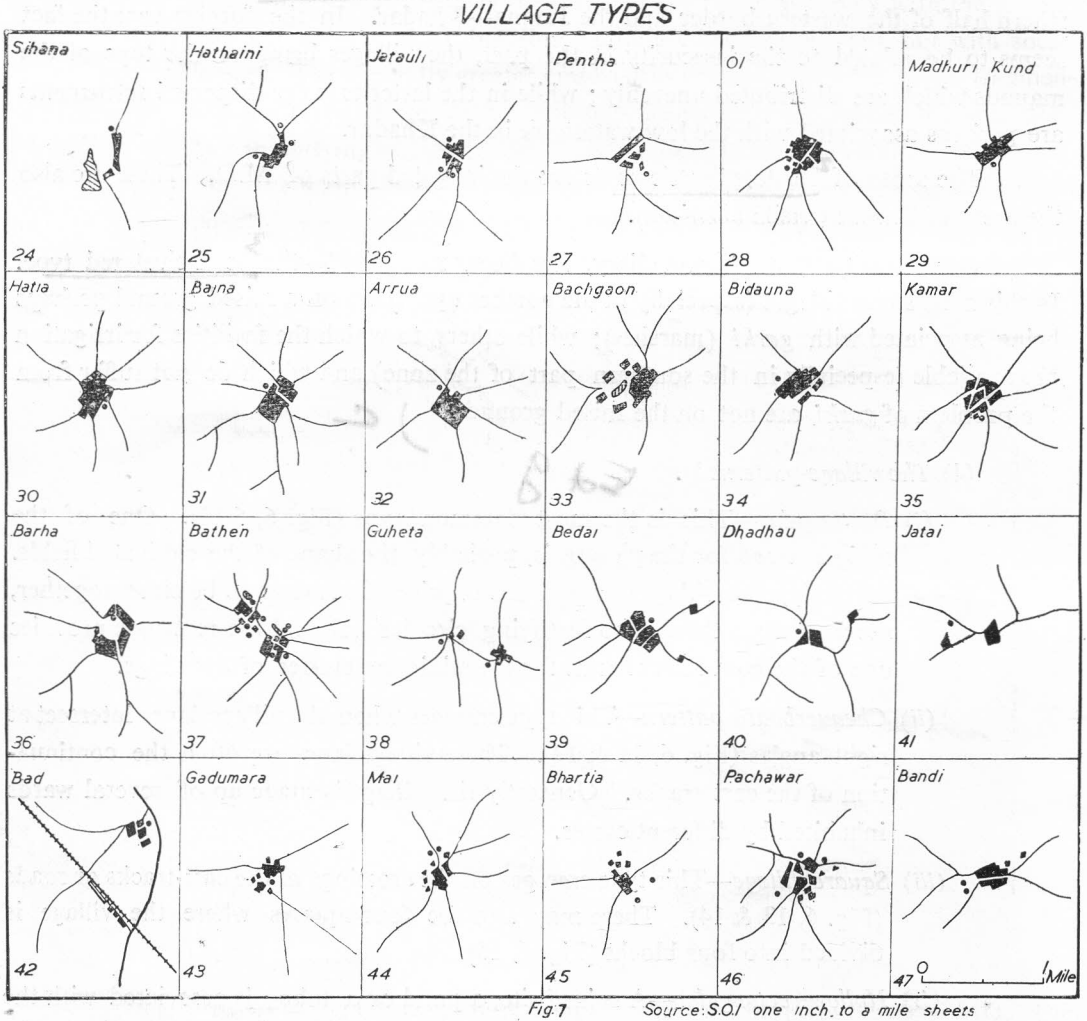


Fig. 7 Source: S.O.I one inch to a mile sheets

(*vii*) *Herringbone-pattern*—If there is a main lane in the village and the subsidiary lanes meet this one at right-angles, the pattern is described as "herringbone",[33] (Fig. 6, 23).

32. Ahmed, E.,—op. cit., p. 139.

33. See Youldon, O.G.—*The scarplands of Wiltshire, Gloucestershire,—Somerset Boarder—A Regional Study with particular reference to urban and rural settlements*, unpublished London, M.A Thesis, 1945.

(*viii*) *L-shaped*—Such villages occur when two forces act at right angles to one another, e.g., a road and a tank (Fig. 7, 24). Settlement may be converted from L to C or T according to the local conditions (Fig. 7, 25 & 26).

(*ix*) *Fan-pattern*—Such types occur when some focal point is situated at one end of the village. In Figure 7 (27) the focus is associated with the southeasterly slope of the mound on which the village is situated. This focus is accentuated further by the presence of the well at the base of a mound. The lanes of the village converge here on this well imparting to it a characteristic fan-pattern.

(*x*) *Circular village*—This form is a heritage of the unsettled days. This village is situated on raised ground and viewed from without gives an appearance of a fortified enclosure pierced by a few openings (Fig. 7, 28).

(*xi*) *Radial plan*—If the centre of the village exercises some dominant influence the village becomes radial (Fig. 7, 29-32). The influence may be a landlord's house, a temple or a shop.

(*xii*) *Hollow-circular*—Allied to (*x*) and (*xi*) is a pattren where there is an 'unbuilt space' [34] on the centre of the village (Fig. 7, 33).

(*xiii*) *Polygonal village*—Since the village was never built according to any plan, irregularities in the outer form are common (Fig. 7, 34). This type is some what intermediate between the circular and the rectangular.

(*xiv*) *Oval village*—Compact villages situated on an oval rounded projection develop an oval form (Fig. 7, 35).

(*xv*) *Horse-shoe pattern*—A hill or a mound or a tank is likely to produce such a pattern (Fig. 7, 36).

(*xvi*) *Double nucleation*—The doppelt-dorfer (double-village) is a group of "two villages so near together that it must be admitted that one grew up by colonisation upon the other."[35] This could also happen if there is a railway station nearby. Examples in points are given in Figure 7 (37-42).

(*xvii*) *Irregular*—There are many villages in M.D. which do not show any pattern but are just a heap of houses huddled together forming an irregular village (Fig. 7, 43-47).

(5) *Distribution of the village types.*

Broadly speaking the clustered types are found to the west of the Jumna and fragmented to the east of the river. The rectangular village is the predominant type and

34. "Rynkdorf" of the German writers (See Ali, S. M.—*Population and Settlement in Ghaggar Plain*, Indian Geographical Journal, Vol. XVIII, 1942, p. 174).

35. Brunhes, J.—*Human Geography*, translated by T.C. Le Compte, 1920, p. 152.

along with its allied pattern is most common in the areas of clustered settlements (Fig. 5). Nucleated villages in the zone of dispersed settlements are also characterised by the rectangular and allied patterns. Individual forms within this broad group may occur anywhere according to local conditions. For example, the village with an elongated shape related to the site has a wide range of distribution. The chequerboard is a characteristic of larger villages and is not uncommon in the zone of clustered settlement. The hollow-square type is a pattern associated with some abnormal feature in the internal structure of the

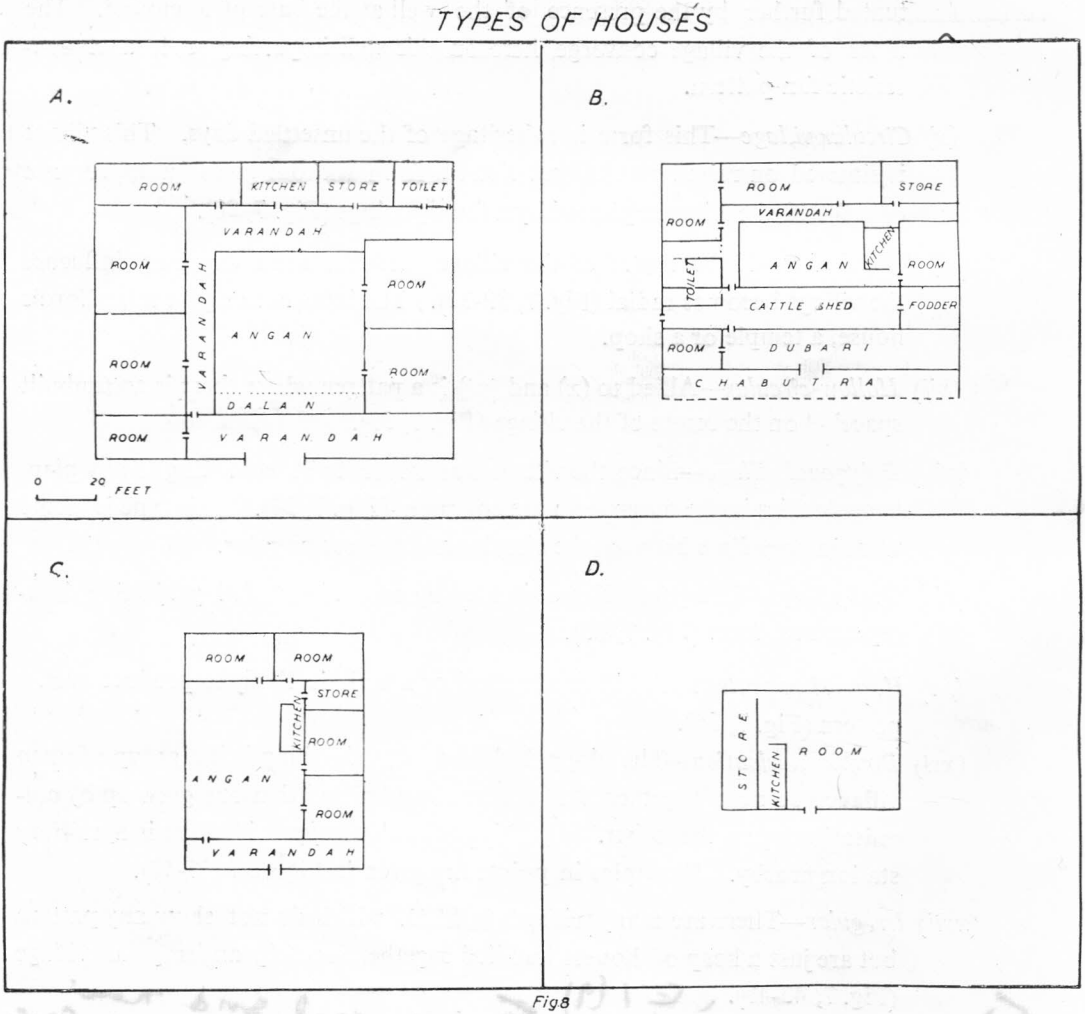


Fig8

village and its occurrence is not common. The square villages are not very common but the L-pattern is a common type in EMD. The circular villages, partly an outcome of the need for defence in the past, are found along the western border of M.D. Very frequently the radial plan is related to an earlier pattern of cart-tracks. The fan-pattern is a result of the peculiarities of site and, though independent of any regional characteristics, is found in the zone of semi-clustered settlements. These village-types have been shown in Figure 5.

(6) *Rural House types.*

"Environmental influence is well-seen in the flat-roofed blank-walled box standard in the.....Northern U.P.—so strongly reminiscent of S.W. Asia....." [36] As the rainfall decreased from east to west so does the slope of the roof of rural dwelling. The building material, a gift of the environment, indicates the regional characteristics while the size, height and the look of the house indicates the economic condition of the peasant. Nevertheless, in spite of these economic differentials, there are certain common features of these rural houses :—

(*i*) *Building material*—Perhaps throughout the Indo-Gangetic plains the building material of walls is the clayey mud derived from the village pond or depression. The lack of cheap timber, more precisely rafters for a wide span expresses itself in the universal narrowness of rooms in dwellings.

Usually the four categories of dwellings, based on the economic differences of the people, are found in M.D.,

(*a*) The dwellings of landlords (*banias*) or other moneyed people, are large, high, of masonry and may be two storied (Fig. 8, A);

(*b*) The second category consists of the upper middling house of a peasant. By its ground plan, size and structure, it is more common than the above (Fig. 8, B.)

(*c*) The third category is the average dwelling of a peasant. This is the most numberous and the most representative of M.D. (Fig. 7, C).

(*d*) Lastly, the dwellings of the poorest class especially the untouchables, which consists of a single room but and is usually thatched, is of universal occurrence in M.D. (Fig. 8, D).

(*ii*) *Lack of ventilation*—is a common feature. Windows are almost unknown and sky-lights (crude apertures in the upper portions of walls) are rare. This is associated partly with the ignorance of the people about even the rudiments of health and hygiene, and partly with fear of thieves—the most common type of crime being burglary and theft.

(*iii*) *Angan* (*Courtyard*)—Owing to the hot climate the *angan* is an essential item in the average dwelling of the area. In the hot season as well as on clear nights of the rainy season, women and children sleep here, as the ill-ventilated rooms or verandahs are too hot and stuffy. One of its corners is used as a kitchen during the summer. Purdah is observed to varying degrees among the different communities of M.D., and the open and relatively airy space that the courtyard provides is almost inevitable considering the hot and sultry weather of about two-thirds of the years. It is in the *angan* that women perform a lot of indoor work, *e.g.* grinding, husking and drying grains.

Apart from the distinctions resulting from economic conditions of different classes of people there are variations according to the locality, ethnic factors and the nature of occupations. Any variations from the usual mud walls is a question of expense; but the choice of roof depends greatly on locality. Thus in the vicinity of the flood plains of the

36. Spate, op. cit., p. 177.

rivers where thatching grass grows near at hand the thatch is most often adopted. At the same time it is everywhere sufficiently plentiful for each village to contain some houses thus roofed. Further, the social factors "are no less important than environments—Not only the site and lay out of the village, but the 'geography of the house' often reflects age old religious and magical traditions." [37] Houses of the Gujars are

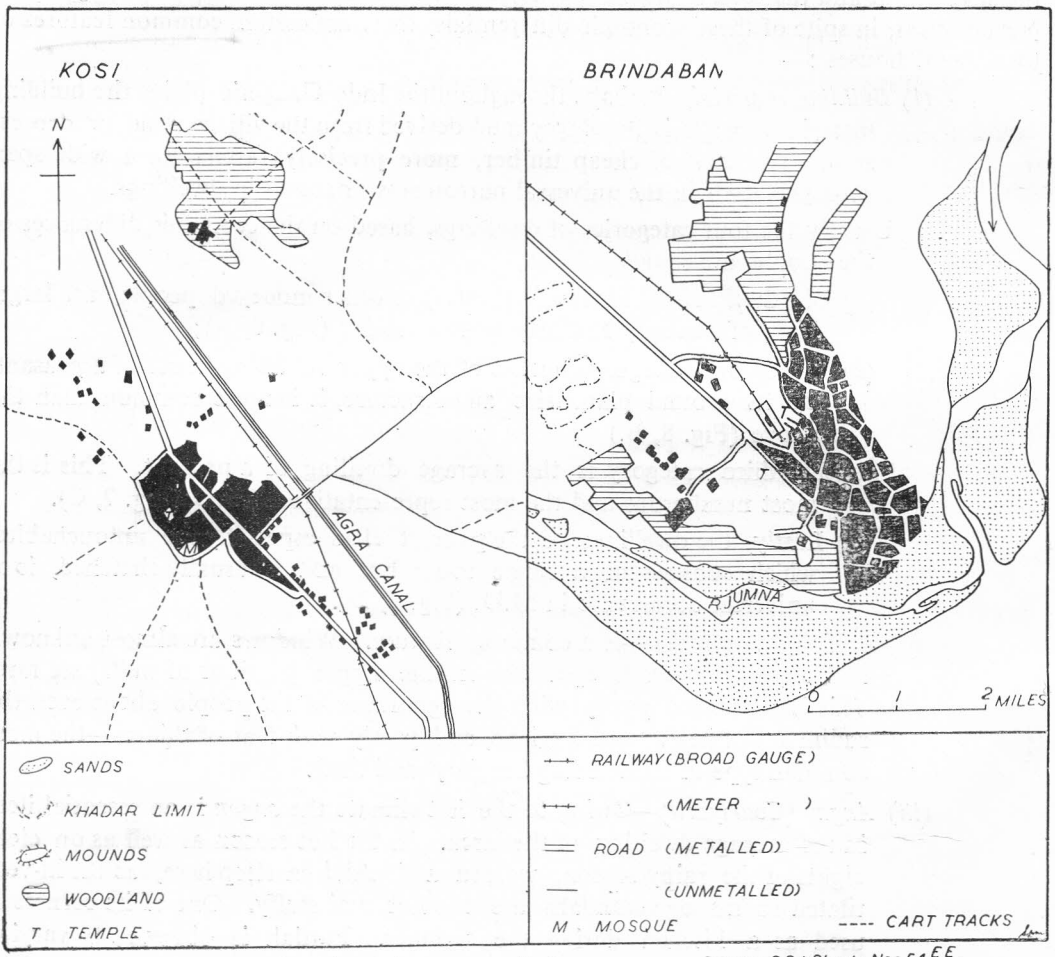


Fig 9 Source: S.O.I. Sheets, Nos. 54 E/5.10

usually smaller with fewer rooms as compared to those of the Jats. In the case of the former, *sarpat* (a local weed) gratings usually replace the wooden doors of the later. All the same, "The average house in this region is roomier, cleaner and more comfortable than in the rainier and poorer parts, viz. North and East U.P." [38]

Urban Settlements [39].

(1) *Preliminary considerations.*

Out of 14 places recognised as towns by the census of 1951, the writer has

37. Spate, op. cit., p. 177.
38. Ahmad, E. op. cit., p. 167.
39. For a brief general discussion on 'Towns in India,' see Spate, op. cit., pp. 181-4.
For a detailed general discussion on 'Towns in U.P.' see Ahmad, op. cit., pp. 176-338.

mapped out 11 (Figs. 9 to 13). Except for the city of Mathura (that to doubtfully),[40] other towns appear to be merely overgrown villages. This kind of origin is perhaps well illustrated by the several villages which have been included in the list of towns at successive censuses.[41] In the case of large *mauzas*, if the central site is adhered to and hamlets do not grow, the village continues to expand in extent and population and becomes a convenient centre for itinerent *beoparis* (traders). "This leads to further growth and it is brought under the Village Sanitation Act. The deciding line begins to be passed where, when owing to the increase of traders and manufacturers not dependent on village lands, the cost for the payment of village watchmen, charged on the land revenue, and therefore proportionate to the area of the village lands, becomes insufficient to provide for watch-and-ward. It then becomes necessary to apply the special Act which allows the imposition of a house-tax for payment of watchmen in trading towns and..... bazars."[42] As such the tax is never levied from a merely agricultural population, "its existence is evidence that the place is more or less urban in character."[43]

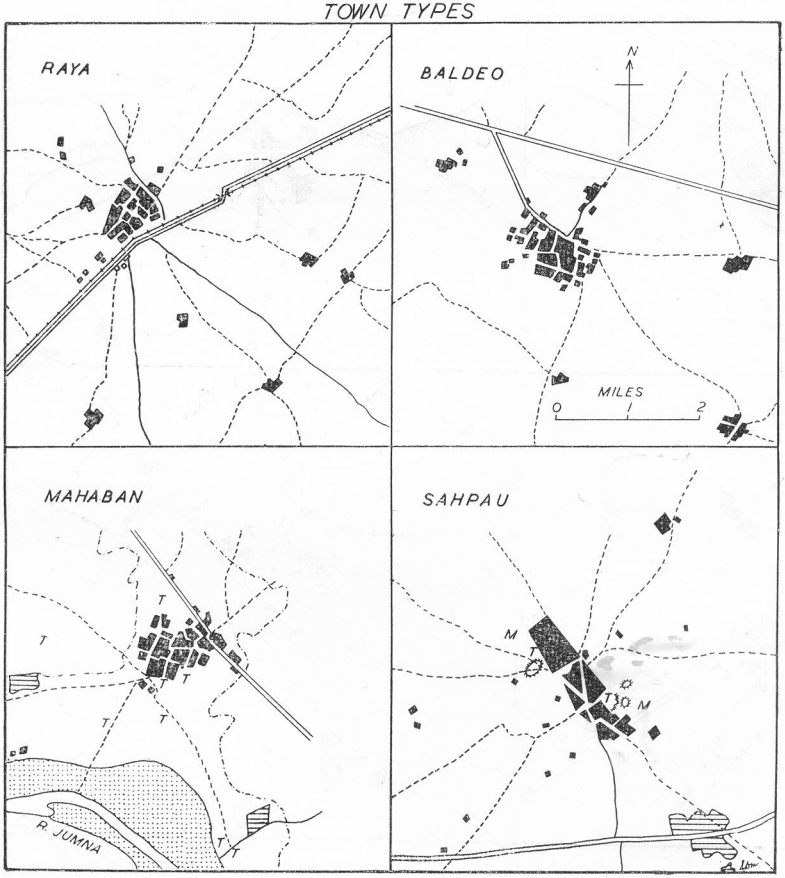


Fig.10 Source: S.O.I. Sheets, Nos. 54 $\frac{E.E.E.I.}{H\ 15\ 11\ 3}$

Out of the 14 towns, 9 are supposed to have a religious origin. We do not-know the exact nature of the origin of a large number of towns in this category, but their predominantly religious character, their association with various deities and the existence of a number of temples and shrines do not leave much doubt as to their religious

40. For there is a mythological saying that this town is as old as 5,000 years and was founded first by the younger brother of Lord Rama (an incarnation of God in the Hindu religion); but this argument has no place in authentic history.
41. Censuses of India, U.P., 1941 and 1951 Reports.
42. Baille, D.C.,—Census of India, 1891, Vol. XVI, N. W. Provinces and Oudh, Pt. I, 1894, p. 93.
43. Blunt, E.A.H.,—Ibid, 1911, Vol. XV, United Provinces, Pt. I, Report 1912, p. 23.

nature.[44] The birth of the town of Mathura is rather legendry (and perhaps shrouded in mystery) while some probably came into existence during Budhist period of Indian history. Obviously, the towns with a religious origin have never remained mere centres of worship. Traders and artisans have flocked to these centres because of some scope for commerce and industry offered by the presence of a large number of worshippers and the periodic visits of numerous pilgrims.

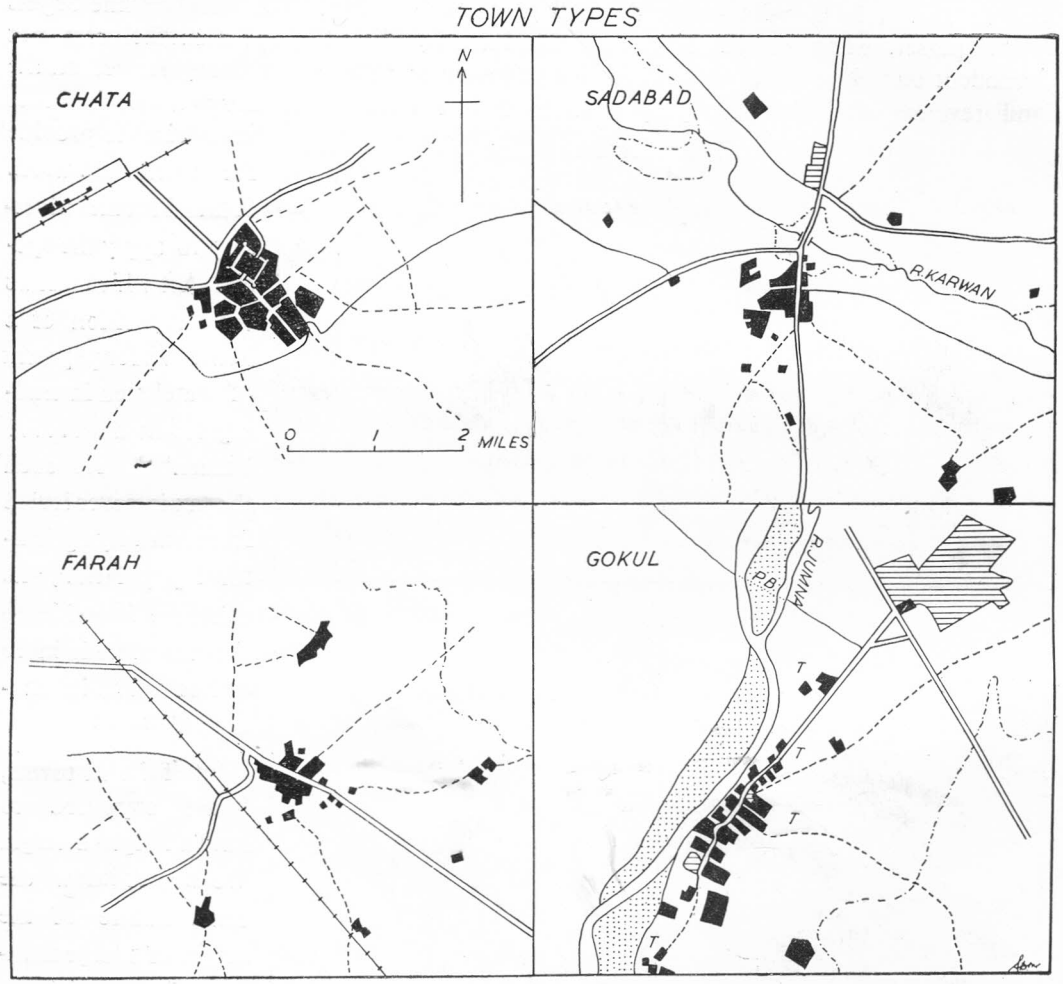


Fig II Source: S.O.I. Sheets, Nos. 54 E/E/E 103/5/11

The other five towns seem to have overgrown from *Mandis* (market places) since the development of communications of commerce. These economic factors have, perhaps, contributed largely to the development of towns notably since the advent of the British rule. These factors probably have provided facilities for the addition of non-agricultural population in a number of villages along the railways (or roads) thus raising them to the status of towns (See Kosi, Raya, Sadabad, in Figs. 9, 10, 11).

44. See Growse, F. S.—*Mathura, A District Memoire*, Allahabad, 1880, (Chapter XII—The etymology of local names in Northern India, as exemplified in the district of Mathura, p. 294).

(2) *The distribution of towns.*

Fig. 14 shows a greater concentration of towns in WMD. This fact could perhaps be explained in terms of these arguments:—(*i*) Relative frequency of old routes between Delhi and Agra (See 'Long Walke' of Fig. 2); (*ii*) The favourable location of this part of M.D. in respect of certain communities, such as the Jats, Meos, Gujars and Rajputs who immigrated from the west; (*iii*) Early development of roads, railways and canals in WMD; (*iv*) Rural economy perhaps counts much on surplus agricultural produce and needs maximum market towns as collecting and exporting centres, *e.g.*, Sonkh for oilseeds and Kosi for cotton.

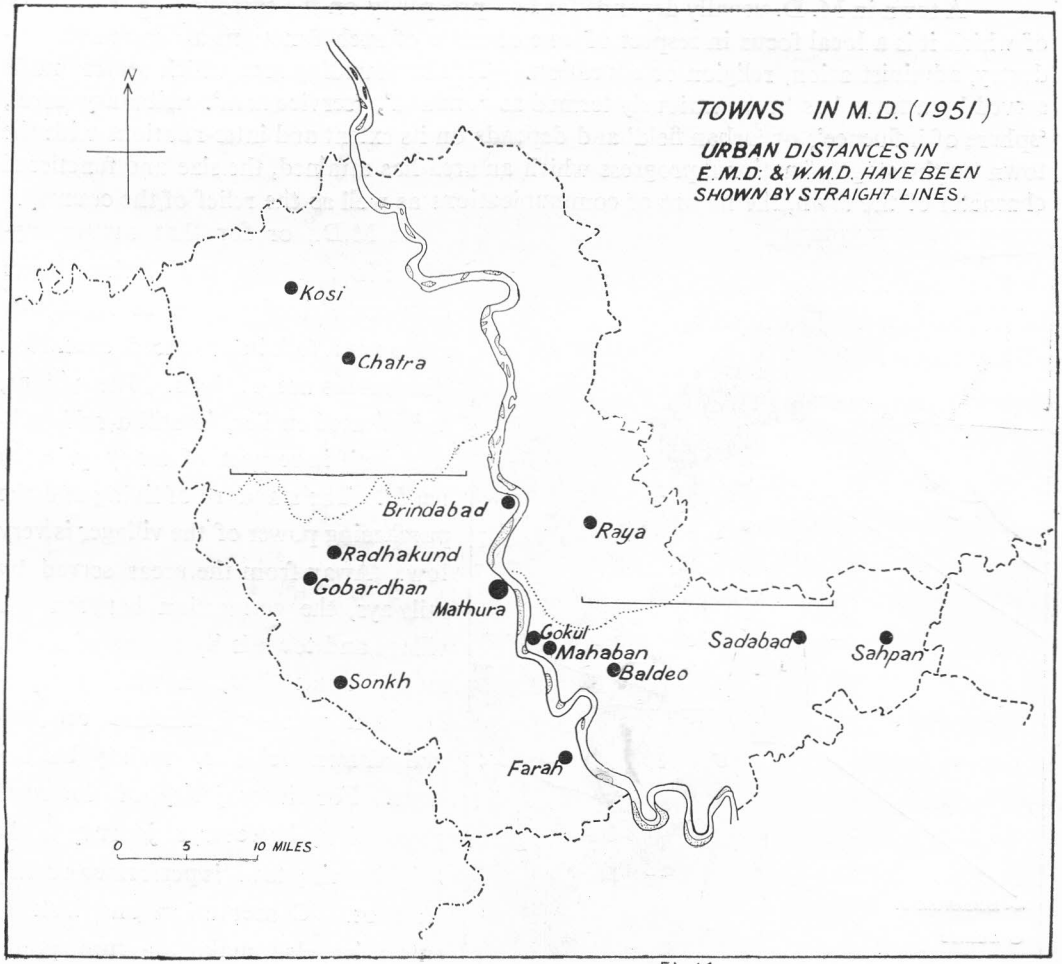


Fig. 14

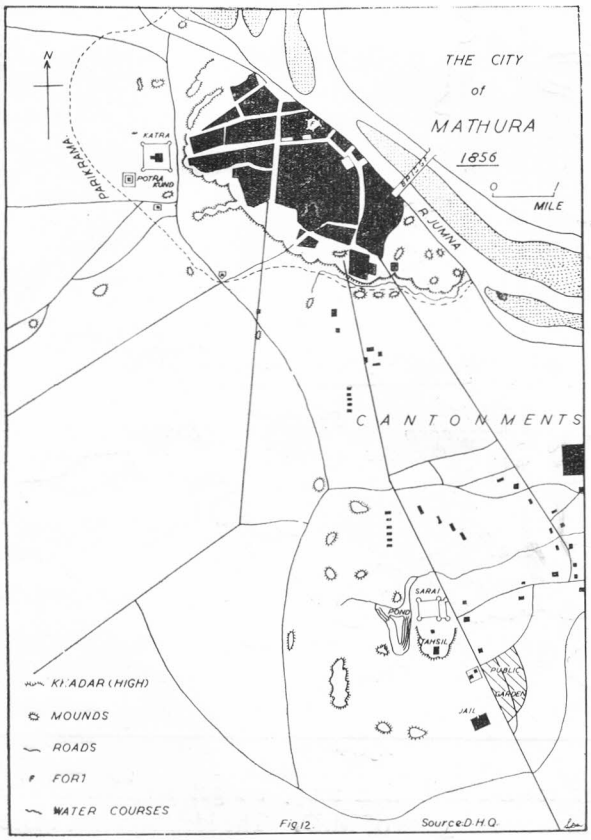
From this brief analysis of the town-distribution map, we get an idea of the frequency of towns in the eastern and western parts of M.D. The idea becomes more useful when the urban distances are represented in both parts.[45]. Though these average

45. See Winid, W.—*The Scope of Urban Geography*, *International Geog., Congress*, Warsaw, 1934, Vol. 3, Sec. 3, pp. 171—218.

distances do not show the actual condition, as towns are not distributed with geometric evenness; nevertheless, they present a result (not directly brought out by the town-distribution map) which affords an approximate idea of the frequency of towns, their average radii of influence or the extent of the 'rural sea' in which they occur as 'islands'. Being related both to the area and to the number of towns the inter-urban distances form a sort of economic index. They are related, in varying degrees, to the physical conditions, historical antecedents, present prosperity and the density of population of the eastern and western tracts.

(3) *Size and functions of the towns*:[46]

A town in M. D. usually depends for its prosperity on the surrounding rural area of which it is a local focus in respect of one or more of such functions as commerce, industry, administration, religion or education. This surrounding area which serves and is served by a town has been variously termed as 'umland', 'service area'. 'tributary area', 'sphere of influence', or 'urban field' and depends on its extent and inter-relations with the town on the stage of national progress which an area has attained, the size and functional character of the town, the nature of communications as well as the relief of the country.



In M.D., or for that matter anywhere in northern India, the villager does not visit the town as frequently as do rural folk in advanced countries. The causes are obvious. The village, as indicated earlier, is still a self-sufficient unit in respect of many primary needs. The standard of living and the purchasing power of the villager is very low. Away from the areas served by railways, the connection between the village and town is by means of roads, mostly unmetalled, on which the predominant means of transport are animal drawn vehicles, mainly bullock carts. For the majority of the rural population, however, a journey to the neighbouring town is performed usually on foot. Conservatism and lack of enterprise also make the rural population relatively indifferent to the towns.

Yet even in M.D. the town "does not function in vacuum; it utilises in more or less degree the district around it.[47] Commerce and administration are the functions

46. For the purposes of this paper only a general treatment is perhaps enough.
47. Dickenson, Robert E.—*City, Region and Regionalism*, London, 1947, p. 40.

of towns that are most important in establishing a link between themselves and the countryside. The commercial connection between the town and the tributary area is the strongest. The town acts as the collecting, marketing and exporting centre of the agricultural or industrial products. It imports from other towns, districts or states the commodities and goods not produced locally and distributes these along with the goods produced in the town itself to the countryside. Usually not directly, except within a small radius but through smaller towns, permanent village shops or by means of the weekly or bi-weekly village markets.

It may also act as a centre of through traffic (*e. g.* Farah, Mathura, Kosi in WMD and Raya in EMD) which may not have much to do with the local tributary area. The process of collecting goods from rural areas is a complex one. The produce may either

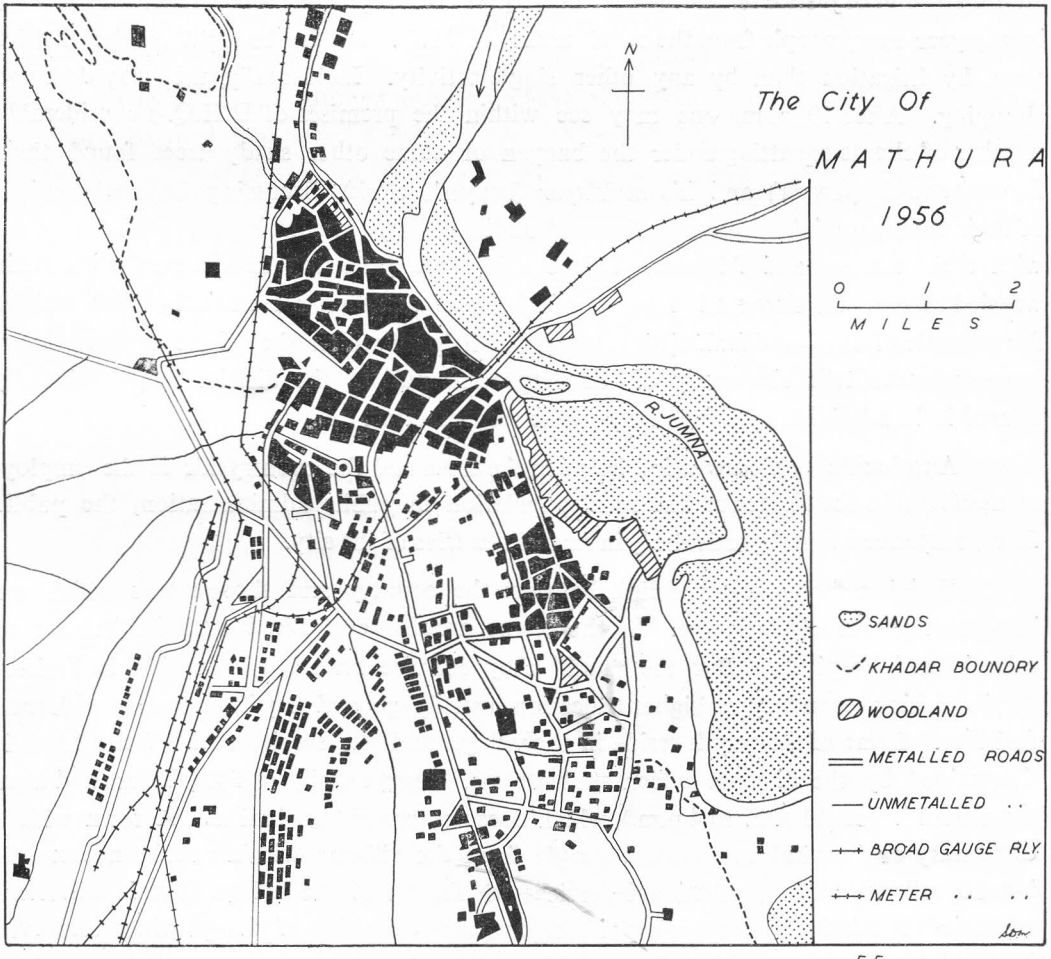


Fig. 13. Source: S.O.I. Sheets, Nos. 54 $\frac{E.E}{10.11}$

be carried by the cultivator to the local *mandi* (*i.e.*, wholesale market usually applied to a grain market which may be in a town or a larger village) or by the itinerant dealer. From there the commodities may be sent to the trade centre of the district or bigger towns or cities enjoying a higher commercial status. "Broadly speaking, wholesale

markets.....draw their supplies from within a radius of 10 to 20 miles."[48] The process of distributing goods from the city to the town or village takes a more or less similar course in the reverse order. Thus the hierarchy of towns ranging from the smallest country town to the largest city acts as a continuous chain in the process of collecting and distributing goods.

The other principal urban function which connects the town with the countryside is administration. There is an unusal concentration of administrative functions at the D.H.Q. (District Headquarters) at the cost of T.H.Qs. (Tahsil Headquarters), which deal only with petty cases. The rural population seeking administration of justice have to go to D.H.Q. from all parts of the district. Probably, in any year more people from the rural areas of M.D. will be brought to the district town by litigation than by any other single activity. Incidentally, they may do some shopping. After 10 a.m. one may see within the premises of D.H.Q. a considerable number of clients squatting under the banyan or some other shady trees found their favourite *vakil* (lawyer) and his *mukhtyar* (lawyer's clerk) discussing the crucial points of their case, bargaining about the fees and additional tips or chatting on similar matters with their witness and friends. This considerable gathering of villagers with their wearied faces, dust-covered legs, small bundles containing essentials—often rations for a couple of day—and *lathis* (sticks) with the help of which they have trudged fairly long distances tells eloquently of the important pull of the district town (primarily related to its administrative function) on the rural interior.

Another basis of connection between the town and the countryside is the employment offered in the former to the rural population in public administration, the public force, cantonments and particularly in small industries of the city.

Religion forms another link between the country and those towns which are important centres of pilgrimage. In the towns are also centralised such institutions as schools and hospitals. But the "pull" they exercise on the countryside is limited. Pupils seeking secondary or higher education usually go and stay in the towns with such facilities. Some of the pupils reside in the villages and the service area of the town is determined by the distance which students can cover, usually on foot, before and after the school hours (10 a.m. to 4 p.m.), which does not exceed 2 to 4 miles. A town with a dispensary or hospital may attract people from the villages within a radius not exceeding 10 miles. "The recreational services which attract the village folk in advanced countries are relatively scarce except in large towns and cities of the province and even in the latter case they fail to attract the rural folk who lack both the money and the quick transport necessary to encourage such visits."[49]

48. Report on Fairs—*Markets and Produce Exchanges in India*, Marketing Series No. 45, New Delhi, 1943, p. 37.

49. Ahmad, E.—op. cit., pp. 231-2.

(4) *The morphology of the towns.*

(*i*) *Preliminary remarks*—From the viewpoint of morphology we are concerned, perhaps, mainly with the ground plan of a town rather than it s function or history although the latter do appreciably affect its ground plan and aspect. The groundplan consists of sheets and built-up ground while the aspect expresses itself through buildings. Buildings, however, form much less a permanent feature than the ground plan. In the following brief analysis, therefore, greater emphasis will be laid on the study and interpretation of the ground plan of the towns of M. D.

The town plans of the area (Figs. 9-13) appear to have been influenced by several factors which may broadly be classed as natural and cultural or man made. Among the natural factors the river Jumna appears to have played an important role. The cultural features consist of two sets of factors, *viz.*, historical-forts, old market places, town walls, mosques and temples or old routes; and existing features of the site and environs *viz.*, market places, roads, railway stations and administrative offices, etc. Deliberate planning both in the past and present is an important factor but information in our case as to planning in the past is almost non-existent; and during mordern times planned reconstruction of the towns (in their older parts) has generally been of a fragmentary and haphazard character.

(*ii*) *Town plans*—In all the town plans (Figs. 9-13) we find one thing common—the street pattern is generally irregular. One of the main reasons for this is the chequered historical antecedents of the towns. Owing to the fear of invasion from some neighbouring states or invader, such towns were built near or around the local fort (Fig. 12). Houses were built huddled together in a very compact manner and with the increase of population "the streets became narrower and more irregular, not only because of the overcrowding, but also because they offered thereby greater resistance to attacks."[50] In many cases the towns were fortified with a wall, resulting in a greater compactness and irregular street pattern because of the desire of all the inhabitants to be within the fortification, When attacked, however, by an enemy such precautions proved insufficient and the town was usually devastated with a consequent total or partial dispersion of the original population. The new settlers, however, rebuilt on the ruins of the same town owing to its advantages of site and the available building materials. This new town was usually built according to the taste or the whims of the invader and probably differed in lay-out at least in parts, from its pre-existing form. In course of time this

50. Linton, J.A.—*Town Planning in India*, 1929, p. 15.

new town met a similar fate as the predecessor and was built again with a re-orientation of the cultural and economic interests of the town and probably fragmentary remains of the original plan survived. "This is a tale common to the majority of the towns of the non-Himalayan portion of the province."[51] As a result of the total or partial destruction and reconstruction of the towns and a sucessive assimilation of different cultures in the past, a lack of common interests among the various communities occupying different wards and general absence of planning, the street pattern of the towns of M.D. is generally irregular. Thus, the "Historical vicissitudes or raised land in the site, the unequal pull of various roads according to the commercial connection of the town with the surrounding areas, the position of the railway station and the administrative section, and the location of the market places as factors which appear to have contributed in varying degrees for the form of such towns."[52]

So far we have seen that the distribution of population, siting and types of rural settlements, village patterns or house types are to a great extent related to the natural and cultural features of M.D.; we have also noticed that the towns of the area originated owing to diverse causes and that their distribution is related not only to the natural and existing cultural aspects but also to the historical antecedents of the area. Further, the predominance of a single function, except in the case of some country towns where agriculture may dominate other occupations is uncommon in the province. While the small factory or cottage industries occupy some important place in the city of Mathura, commerce appears to be the most evenly distributed and important function in the majority of towns of all sizes. The administrative function is concentrated usually at the D.H.Q. with the result that T.H.Qs. have been dwarfed (*e. g.* Mat is not a town). While the city of Mathura may show some impact (though rather too superficial) of the West, the smaller ones are still considerably rural and predominantly native in aspect. The town plans seem to be related in the varying degrees to the natural and cultural 'dominants' in their sites.

ACKNOWLEDGMENT

The writer is thankful to Dr. R. O. Buchanan, Professor and Head of the Department of Geography, London School of Economics (University of London) for his helpful suggestions and criticism.

51. Ahmad, E. op. cit., p .325.
52. Ahmad, E. op. cit., p. 335.

SNOW SURVEYS IN WEST PAKISTAN

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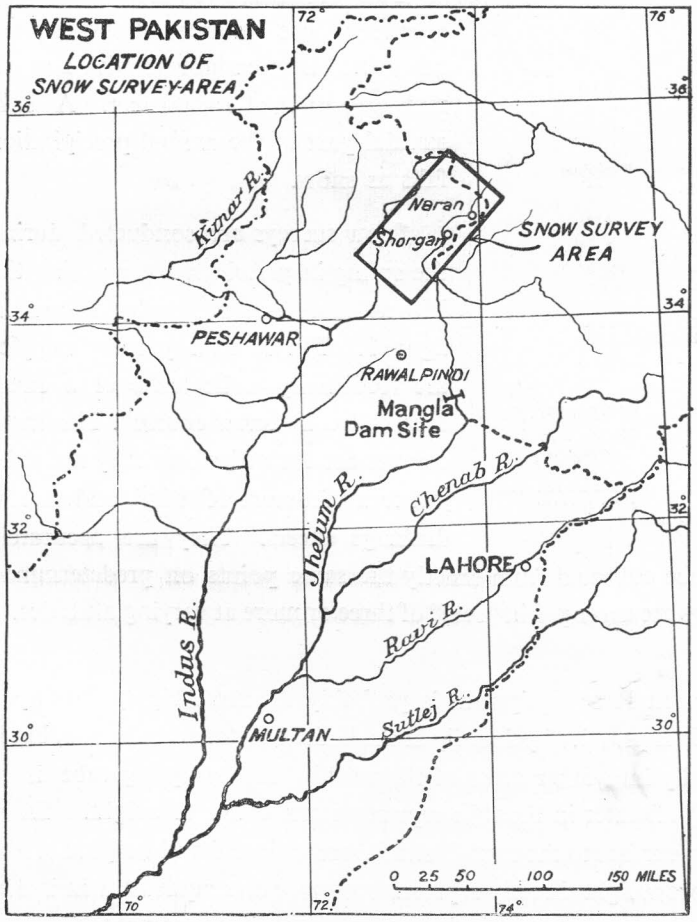
THE Ultimate development of water resources in an area requires that all factors of the hydrologic cycle be investigated and evaluated. The Indus Waters Treaty of 1960 envisages the construction of two large dams on the Indus River System. These dams, which are a big step towards the full utilization of the waters of the Indus Basin, will provide storage to assure irrigation and power supplies at all times of the year. The water which will enter these reservoirs comes from two sources: the melting of snow and ice and monsoon rainfall. Melt supplies are most important the firsthalf of each year, and rainfall assumes most importance from the beginning of July. Therefore the irrigation water supply necessary for maturing the rabi crop and for planting the kharif crop is derived from melt water.



It is important to determine the comparative magnitude of this melt runoff. The Jhelum River upstream of the proposed Mangla Dam (See figure 1), in which catchment snow studies have begun, is a good example. Its melt runoff derives primarily from snow fields as opposed to the huge ice fields which feed the Upper Indus River. The snow field in the Jhelum catchment represents at any one time during the spring, a reservoir of about five million acre feet. This is the equivalent of the Mangla first stage storage capacity. To manage intelligently the Mangla reservoir, it is obviously desirable to have a knowledge of snow conditions prior to the melt season. By using techniques developed in other snowy regions it may be possible to predict subsequent runoff by knowing the winter and spring snow conditions.

It is not possible to conduct snow investigations over the entire Mangla catchment for geographical and practical reasons. Therefore, in 1961 the Water and Power Development Authority (WAPDA) initiated snow surveys in the catchment area of the Kunhar River which is an important tributary of the river Jhelum. (See figure 2).

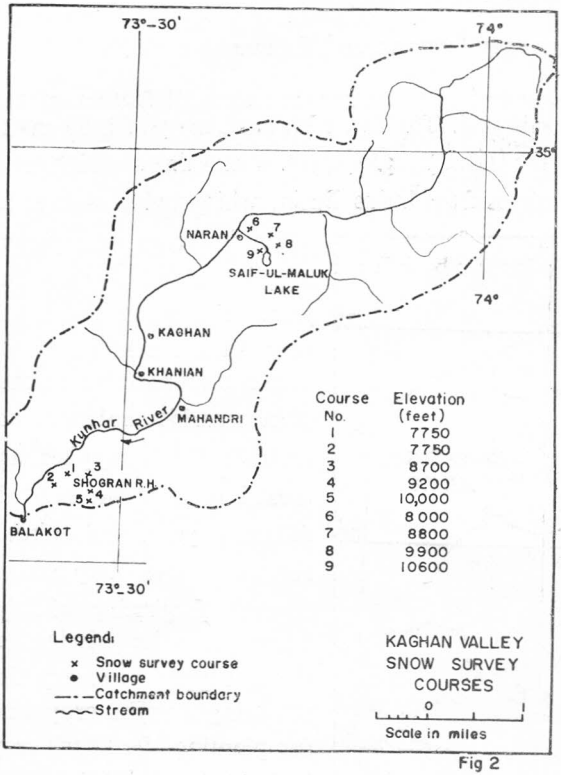


Fig 2

This catchment, which is readily accessible, has an area of 900 square miles and is mountainous with a maximum elevation of 15,500 feet. A substantial part of the annual precipitation falls as snow.

Snow surveys are conducted during the spring in preselected areas using the Mount Rose snow sampler shown in figure 3. Ten to twenty snow samples are ordinarily collected over a small area called a "snow course". The snow courses are located where they are subject to a minimum of wind and lateral drainage effects. They are accurately marked so that samples may be collected from exactly the same points on predetermined dates each year. The courses are arranged in "sets" of three or more at varying altitudes.

Snow Survey Techniques

Sampling with the Mount Rose equipment is probably the most highly developed method of snow surveying. It is practiced primarily in the United States and Canada, but is also being introduced gradually into other areas of the world. The sampling tube is of such a diameter that one inch of water in the tube represents one ounce of weight. Snow cores, extending from the snow surface to the earth beneath, are collected and weighed on the portable scale. The snow core weight directly represents snow water equivalent in inches of water. From the depth and snow water equivalent, snow densities are computed.

A second method, in limited use, is to observe the depth of snow, by means of a graduated gauge or rod usually read from an aeroplane. If the snow density can be correctly estimated, the water equivalent of the snow at the spot can be approximated.

The first method always produces results of highest accuracy. The determined depth and water equivalent of the snow-pack is an average for each particular small area as actually observed on the snow course.

Regarding the second method, it is doubtful that, at present, installation and reading of aerial snow markers in the mountains of West Pakistan would produce the type or dependability of information required to assist in future operations of large reservoirs and power plants.

Fig. 3

Forecasting Methods

The end product of snow survey data collection and analysis is a forecast of the volumetric water supply at a given streamflow station. The forecast may be for a period that is days, weeks or months in advance but it is usually in terms of months. This is accomplished by developing a relationship between snow water equivalent and stream runoff.

The snow surveys, in general, do not yield a direct measure of the volume of snow lying on the mountains. Rather, they are an index which relates measurements made at a specific location, over a period of time, to subsequent streamflow in the melt period. It is not possible to begin forecasting streamflow until at least five years of data both of snow surveys and streamflows have been collected. A reasonable degree of accuracy (ten to fifteen per cent.) cannot be expected before at least ten years of good data are available.

Climatic and geographical conditions in some areas of the world make it impossible to derive a usable accurate relationship of snow water equivalent and stream runoff. Dr. Church, who was often called the "father of snow surveys", visited the subcontinent in 1947 in an effort to help in establishing a suvrey programme. His activities were confined to the eastern Himalayan region. There, he found that due to the low-latitude and the east-west orientation of the mountain barrier, temperatures were unusually high at altitudes where

winter snow packs ordinarily accumulate elsewhere in the world. This meant that snow courses had to be established at higher altitudes which increased the difficulties of surveys. The monsoon runoff proved to be so great that it dampened out the snow-melt water influence on stream flows. These factors combined to make snow surveys in the eastern Himalayas an academic matter with little present practical use. The Central Water and Power Commission of India, which organization inherited the survey programme at the time of partition, abandoned snow surveys about nine years ago.

None of the factors, which limit the applicability of snow surveys in the eastern Himalayas, appear to be significant in the Kunhar catchment.

The value of snow survey data frequently can be increased through use of a forecasting parameter embracing the status of watershed soil moisture. There are several known methods of gauging watershed soil moisture. One is by installation at snow courses of special units, which indicate soil moisture by resistance to passage of electric current. Another is to determine base flow of rivers during the December-February low flow period. A third method is to record the low flow of deep-seated springs.

Stream flow is being measured by the Surface Water Circle of WAPDA at Naran, Khanian and Garhi Habibullah. Use of the river base flow as a qualifying parameter will be checked when enough data are available for forecasting. Since there is no assurance that these factors will correlate, it is planned in the interim to make direct soil moisture measurements at the time of each survey. To accomplish this, Coleman fiberglass electrodes have been buried at one foot intervals up to four foot depths at each course. Their electrical leads rise through a stand-pipe to a terminal board where a soil moisture meter is connected by the survey party at the time of each survey. The per cent of soil moisture is indicated by the measured resistance to flow of electrical current through the units. No plan has been made to measure the flow of springs for correlation purpose.

1961 Programme

Considerable preparations were made prior to the 1961 survey programme. Food, medicine and bedding were stored at Kaghan, Naran and Shogran during the fall of 1960. A training session was held at Murree, in January 1961, during which several Pakistani engineers were taught the techniques of snow surveying, how to move over snow on skis and snow shoes, and how to adapt themselves to working under cold weather conditions. From the group participating in the training session, parties of two or three men were formed for the various surveys. This size party is in keeping with general practice.

The surveys were conducted at intervals of one month, the first being at the end of February and the last at the end of April. The first survey was conducted under previously unknown conditions because no reliable information could be gathered concerning snow, road, and weather conditions in the valley. The party observed during the surveys, that

many residents of Naran had not abandoned their homes even though the valley was snow-bound beyond Khanian. There was no apparent occupation by the residents during this period, except survival.

At Kaghan and Naran it was possible to employ first-class mountain porters who shared the burden of carrying equipment. The use of porters eased the logistic problem considerably since on the first survey it was necessary to walk and ski over sixty miles in the snow. Five days elapsed from the time the party left the vehicles until their return from a given set of snow courses.

The snow line, during the first survey, lay at about the 4,500 foot elevation on the north and east slopes, and about 1,000 feet higher on the south and west slopes. The snow measured six foot deep at the 10,000 foot elevation, about five feet deep at the 9,000 foot elevation, and about four feet deep at the 8,000 foot elevation. The snow was surprisingly dense with the minimum density measured being about 31 per cent.

On the second survey, the snow between the 8,000 and 9,000 foot elevations had diminished by one to two feet, while at the 10,000 foot elevation there was an equal or greater depth.

On the third survey the snow line had moved up to about 9,000 feet on the north and east slopes and to about 10,000 feet on the south and west slopes. At this time there was still six feet of snow at the 10,000 foot elevation. There was about five feet of snow among forest trees at the 9,000 foot elevation. The density was between 45 and 50 per cent.

The days were warm during the surveys but at night the temperature dropped to just below the freezing point. The snow crusted over so that it was possible to move on foot until about 11 a.m. at which time it became necessary to travel by skis or snow shoes. There was very little wind and very little evidence of wind action on the snow. There were a great number of small slides where tributary channels enter the Kunhar River. Also several large snow slides between Kaghan and Naran blocked the main road and at some points nearly blocked the river. On the high line path to lake Saif-ul-Maluk, Course 9, there were slides about half a mile before the lake outlet. It was possible, to pass below the slides on the approach to Saif-ul-Maluk Lake by going up the outlet channel. Above Shogran, serious slide areas were encountered beyond Sari Kabai, course 4. The sari Kabai slides were avoided by going over the top of Paya Peak.

Future Programme

It is important, especially in the early years of any snow survey network, to establish the approximate periods of increase and decrease of the accumulated water equivalent at the snow courses. This objective was not entirely accomplished in 1961 and revision of the schedule for future surveys is necessary.

From figure 4 it appears that the maximum water equivalent accumulated on the highest courses in May, whereas on the lowest courses, it occurred before the first survey. The apparent discrepancy between the maximum accumulations on courses 4 and 8 is probably explained by the fact that the latter part of the second survey was conducted during a snow storm. The Shogran courses were not resurveyed; therefore, if the storm was area wide, which is highly probable, the maximum accumulation on the 9,200 foot course probably took place the first week in April rather than as shown in May.

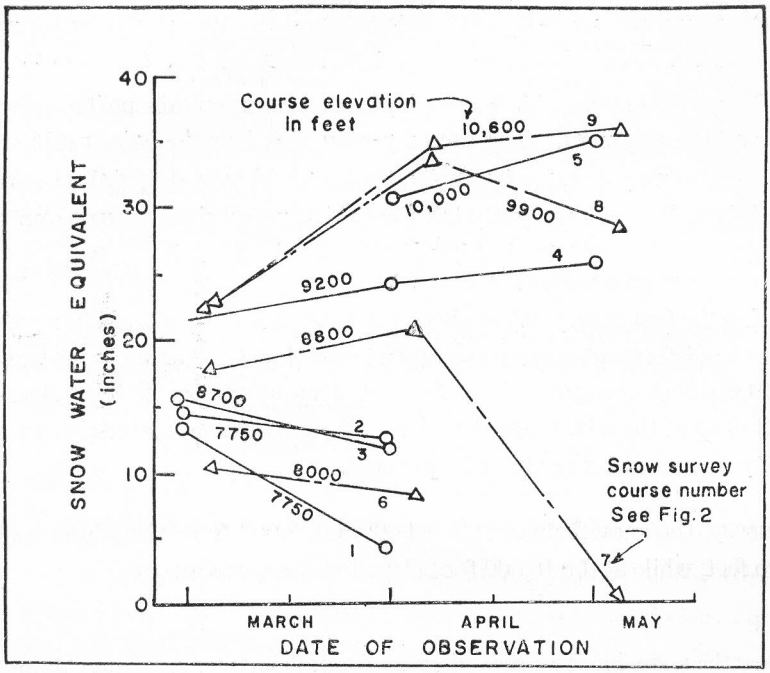


Fig. 4 SNOW SURVEY WATER EQUIVALENTS

A total of eight surveys per course will be made at two week intervals between 1st February and 15 May to ensure that the approximate date of maximum water equivalent accumulation is determined in 1962. The February surveys are proposed primarily for checking accumulation on the lower courses, while the 15 May survey is to check the accumulation on the highest courses. The number of surveys will be reduced after the dates of occurence of maximum water equivalent are determined. Eventually only three or four surveys per year should be required to achieve satisfactory forecasting.

Conclusions

The accelerated programme of water resources development in West Pakistan requires that all phases of the hydrologic cycle be analyzed both quantitatively and qualitatively. One of the most important aspects of the cycle, which indicates the potential future runoff, is the measure of the water equivalent of the winter snow pack. A small change from the normal of water depth stored in this huge natural reservoir may significantly alter the runoff pattern during the entire melt season. For this reason snow surveys were initiated by WAPDA in 1961 in the Kunhar River catchment. Although volumetric forecasts cannot

be made with one year of data, certain preliminary conclusions can be drawn as to the probable dates of maximum snow water equivalent accumulations in the Kunhar. It should be recognized, however, that the date of maximum accumulation can vary somewhat from year to year. River hydrographs and snow measurements combine to indicate that the snowpack at intermediate elevations (8,000 to 9,000 feet) may often reach its annual maximum accumulation of water before March 1st, and thereafter become depleted by rising melt rates. At elevations above 9,000 feet the peak seasonal accumulation seems unlikely to occur prior to March 15. On the other hand the snow courses below 8,000 feet may often show their maximum water accumulation early in February. Following the greater number of surveys in 1962, the pattern of snow accumulation should be better established.

The results obtained in 1961 indicate that snow surveys in the Kunhar Valley are both practical and desirable.

Figures, 1, 2 and 4 were taken from, "West Pakistan 1961 Snow Surveys and 1962 Program" a report by Harza Engineering Company International and the Water and Soils Investigations Division (WASID), WAPDA.

NEWS AND NOTES

SALINITY CONTROL AND RECLAMATION IN CHAJ DOAB

The land between River "Chenab" and "Jhelum" in the canal irrigated plains of Northern Indus plain is known as Chaj Doab. It has area of 2,823,500 acres. Its a flat plain with an average gradient of one foot per mile from north to south. The study of the landscape shows that there are 5 landforms in the doab which occupy area as follows:

	Thousand Acres
Scalloped interflowes ..	962.0
Meander flood plain ..	1214.5
Active flood plain ..	298.5
Channel ..	252.5
Bed rock ..	7.5
Water ..	

The follwoing is the predominent land use in the Doab.

	Thousand Acres
Perennially canal irrigated ..	1448.5
Seasonally Canal irrigated ..	239.5
Dry cropped ..	278.5
Seasonally canal irrigated inconsiderable well irrigation ..	135.8
Well irrigated ..	44.0
Seasonally flooded ..	178.5
Scrubland ..	100 5
Unimproved grazing land ..	45.0
Reserve Fores ..	12.5
Other wood land ..	.5
Swamp and Marsh ..	16.0
Settlements ..	5.0
Unused land ..	223 0
Water ..	97.5

Before the introduction of canal irrigation cultivation in Chaj Doab depended on wells, inundation cuts from the river, rainfall and river floods.

In the pre-irrigation time the groundwater regime in the Chaj Doab was essentially in equilibrium groundwater inflow under natural conditions balancing the outflow. With the introduction of canal irrigation in 1903 when the lower Jhelum canal was opened, the canal seepage disturbed the hydrologic balance, which resulted in a steady rise in the water table. In 1917 when the Upper Jhelum canal was opened the seepage increased still further and augmented the rise of water table. During the last 55 years water table has risen at places by as much as 70 feet resulting in an increase in ground water storages of 21.6 million acre feet (M. A.F.) With the rise in water table the components of groundwater discharge have gradually increased in rivers Jhelum and Chenab which during pre-irrigation times were influent have now become effluent and with the shallow depth to ground water, evapotranspiration losses have assumed major proportions. The groundwater has again almost reached a new state of equilibrium close to ground surface, in which the annual increase in groundwater storage has been reduced to 0.1 M. A. F. or one seventh of the initial rate.

Studies have indicated that the components of natural groundwater inflow and outflow in the Doab have not changed materially and the annual seepage from the canals has remained fairly constant, so that for any level of storage it is possibe to determine the un-recovered losses from the historic records of storage increasement.

The Chaj Doab is extensively affected by waterlogging and salinity. In 49 per cent. of the area, water table is within 5 feet of the ground surface and only 7 per cent is severely damaged.

Apart from these menaces, the surface drainage in the area is inadequate and the recurring flooding during the rainy season not only cause wide damage to agricultural lands, crops, and public property but lead to further spread of waterlogging.

At present irrigation supplies in the area are spread so thinly that adequate crop yields cannot be

obtained. The present duty is 464 acres per cusec of authorized outlet discharge and the intensity of the irrigation is about 90 per cent. In practice the outlet discharge is only 84 per cent of the authorize so that the effective duty is 550 acres per cusec only.

All the above factors have combined to limit the agricultural potential of the area and continued deterioration of land is resulting in a decline in productivity every year whereas the demands are increasing with the growth of population. It is estimated that the lands in the Chaj Doab produce 44,000 tons less food annually (valued at Rs. 17·6 million) than before the waterlogging and salinity started. Moreover the decline in food production annually at present is about 1,000 tons.

In view of the situation presented above, West Pakistan Water and Power Development Authority entered into an agreement with a firm of consulting engineers, M/s Tiptons and Kalmbach Inc. Denver U. S. A., in Dec. 1959. The consultants have prepared a Feasibility report on salinity control (Denvor Clorodo, Dec., 1960), Reclamation Project No. 2 Chaj Doab, West Pakistan. This project aims at:—

1. Lowering the water table to remove waterlogging.
2. Removing salts from the soils by leaching.
3. Removing flood hazards by proper surface drainage.
4. Supplying additional water to fulfill the consumptive use requirement of crops.

To achieve the desired objectives, the project has been concieved as a tubewell drainage-cum-irrigations project supplemented with surface drains. The tubewells will serve dual purpose. Pumping from the groundwater reservior will lower the water table and major portions of the tubewell supply mixed with canal waters will be utilized for leaching the salts and supplying the optimum crop requirements.

With the start of pumping the tubewells, the watertable will start declining as water will be withdrawn from groundwater storage. Initially the rate of the regional watertable decline is expected to be 7 ft. during the first 5 years and 6 ft. during the next five years period. Thereafter the lowering of the watertable with further slow down as less and less water is withdrawn from storage and a greater component of evapotranspiration losses is intercepted. It is estimated that mining of groundwater can be continued for a period greater than the expected life of 50 years for the tubewell without excessively depleting the groundwater storage for increasing the pumping lift beyond economical limits.

In determining the tubewell pumpage, requirements for irrigation and drainage have been kept in mind. Apart from meeting optimum water supply for the presently irrigated lands, the tubewell pumpage and canal supply will bring under perennial irrigation an additional area of 455,000 acres raise the intensity of irrigation to 105 per cent.

The annual consumptive use of the crops in the project area has been worked out at 302 million acre feet (MAF) of water and the leaching requirements as 0.76 M. A. F. so that after allowing conveyance losses of 15 per cent. the total water delivered to the water courses comes to 4.44 M. A. F. out of this, 12.67 M. A. F. is available from canal supply and 1.77 M. A. F. has to be pumped from tubewells. An additional 0.2 M. A. F. is required for drainage so that the total annual pumpage will be 1.97 M. A.F. This pumpage will be achieved by installing 3,311 tubewells. For the surface drainage the project provides mainly for the remodelling and reconditioning of the existing drains and structures and the construction of about 450 miles of new drains along with the enlargement of a pumping station to increase its capacity from 12 to 70 acres.

Studies made by the WAPDA's consultants indicate that after the construction of the project the elimination of waterlogging and salinity and the availability of irrigation water supplies for optimum crop requirements will result in considerable improvement in yields per acre. It is estimated that the total crop production will increase by more than 1 million tons per year.

'THE ROLE OF SCIENCE IN THE DEVELOPMENT OF NATURAL RESOURCES'

CENTO Scientific Symposium.

A symposium on "the role of science in the development of natural resources" was organized by the Atomic Energy Commission under the auspices of Scientific Counsel of the Central Treaty Organization at the Assembly Hall, Lahore, from 8th to 13th January, 1962. It was attended by the delegates from U. S. A., Turkey, Iran, U. K. Pakistan and the staff and the students of the Panjab University, Lahore.

The opening ceremony was held on the 8th January, under the presidentship of Dr. I. H. Usmani Chairman Pakistan Atomic Energy Commission. The inaugral address was made by Mr. Akhter Husain, H. Pk., Minister of Education and Scientific Research, Government of Pakistan.

On the following days the symposium split up into the following sessions to which the papers were contributed :—

1. Fuel and Power.
2. Hydrology and water Conservation.
3. Atomic Energy.
4. Plant Products.
5. Forestry.
6. Agriculture and Soil.
7. Public Health.
8. Animal Husbandary.

The concluding session was presided over by Dr. I. H. Usmani. The Chairmen of all the sessions and the leaders of the national delegation also made a number of recommendation in the concluding session.

CAMBRIDGE EXPEDITION TO NAGAR KARAKORAM 1961

The expedition which was organized by John Staley with the approval of the Cambridge Expedition Committee of Senior members of the university and with the support and backing of the Mount Everest Foundation and Royal Geographical Society, has been successfully concluded. The expedition left Cambridge by land rovers in the middle of June 1961 and arrived there about the beginning of October.

It was intended to travel upto Minapin village by land rover, but due to floods and road damage, most of the journey in Gilgit Agency and Nagar State was done on foot, the equipment and supplies were carried by donkeies, mules and porters.

One of the main objective of the expedition was to explore and study the Minapin glacier. The expedition studied the nature, rate of flow and ablation of the glacier, and surveyed the Minapin valley with particular reference to glacial land forms. The snout's position was fixed by detailed mapping. The study of the structure of plant communities, especially the flora associated with the glaciers and its moraines, was also done.

The Scientific staff of the expedition consisted of

1. John Staley. Leader.
2. Philip Llord. Botanist.
3. David MacBryde. Surveyer.
4. Bill Graham. Assistant Glaciologist.
5. Elizabeth Pott. Physiographer.
6. Paul Gamble. Glaciologist.
7. Sheila Mega. Botanist.
8. Peter Somerville. Cine-photographes and Mechanic.
9. Anis A. Abbasi. Liaison Officer.

The expedition had the academic support of :—

1. Professor K. Mason M. C, M. A. (Professor Emeritus of Geography, University of Oxford).
5. Professor J. A. Steers, M.A. (Prof. of Geography, University of Cambridge)
3. Mr. E. J. H. Corner, M.A. F.R.S., F.L.S., School of Botany, University of Cambridge.
4. Dr. R. W. Hey, M.A., Ph.D. (Swick Museum of Geology, University of Cambridge).
5. Dr. J. W. Glen, M.A., Ph.D. Chairman, Research Committee, British Glaciological-Society.

Preliminary report has been prepared. Detailed accounts of the findings of expedition are in preparation.

STATISTICAL SUPPLEMENT

Population of Pakistan, 1961

The second decennial census of Pakistan was taken throughout the country from 12th to 31st January, 1961, and the results were published in Nov., 1961. Districtvise figures of population are given in table I. Some salient features of 1961 population are as follows :

The population of Pakistan excluding Jammu and Kashmir, Gilgit, Baluchistan, Junagadh, Manavadar and Pakistan enclaves in India on 1st Feb., 1961 was 9,38,31,982 persons including 1,11,369 non-Pakistanis. The total population of East Pakistan excluding non-Pakistani nationals on the same date was 5,08,40,235 persons.

The 1951 population for Pakistan after adjusting non-Pakistanies and the population of Gowadar (which became part of Pakistan in 1958) was 7,56,72,496 persons 4,00,84,342 males and 3,55,88,154 females. The 1961 population of Pakistan had increased 23·85 per cent of total population 23·0 per cent males, 24·8 per cent females. Whereas West Pakistan has shown an increase 27·1 per cent of total population 26·5 per cent of males and 27·8 per cent of females. In East Pakistan the increase was 21·1 per cent of total population 20·1 per cent males and 22·5 per cent females.

The increase in population between 1951-61 was very unexpected and significantly larger than the estimates made previously.

Locaity	Area in Sq. miles	Total Population[1]			Persons per Sq. miles
		Both Sexes	Males	Females	
Pakistan[2]	3,65,529	9,37,20,613	4,93,03,645	4,44,11,968	256
East Pakistan	55,126	5,08,40,235	2,63,48,843	2,44,91,392	922
West Pakistan	3,10,403	4,28,80,378	2,29,59,802	1,99,02,576	138

TABLE No. 1

EAST PAKISTAN

Locaity	Area in Sq. miles	Total Population[1]			Persons per Sq. miles
		Both Sexes	Males	Females	
The figures below each division relate to districts.					
Rajshahi Division.	13,347	1,18,50,089	61,25,732	5,57,24,357	888
Dinajpur	2,609	17,09,917	9,02,389	8,07,528	655
Rangpur	3,704	37,96,043	19,70,253	18,25,790	1,025
Bogra	1,502	15,74,105	8,05,939	7,68,166	1,048
Rajshahi	3,654	28,10,964	14,39,459	13,71,505	769
Pabna	1,877	19,59,060	10,07,692	9,51,368	1,044
Khulna Division	12,810	1,00,66,900	52,19,770	48,47,130	786
Kushtia	1,371	11,66,262	6,07,198	5,59,064	851
Jessore	2,547	21,90,151	11,40,202	10,49,949	860
Khulna	4,652	24,48,720	12,84,086	11,64,634	526
Barisal	4,240	42,61,767	21,88,284	20,73,483	1,005
Dacca Division	11,937	1,52,93,596	79,48,297	73,45,299	1,281
Mymensing	6,361	70,18,906	36,43,633	33,75,273	1,103
Dacca	2,882	50,95,745	26,78,962	24,16,783	1,768
Faridpur	2,694	31,78,945	16,25,702	15,53,243	1,180
Chittagong Division	17,032	1,36,29,650	70,55,044	65,74,606	800
Sylhet	4,785	34,89,589	18,08,446	16,81,143	729
Comilla	2,594	43,88,906	22,45,879	21,43,027	1,693
Noakhali	1,855	23,83,145	12,07,964	11,75,181	1,285
Chittagong	2,705	29,82,931	15,80,537	14,02,394	1,103
Chittagong Hill Tracts ..	5,093	3,85,079	2,12,218	1,72,861	76

1. Excluding Non-Pakistanis.
2. Excluding Jammu and Kashmir, Gilgit and Baltistan, Junagardh, Manavadar and Pakistan enclaves in India.

WEST PAKISTAN

Locality	Area in Sq. Miles	Total Population			Persons per Sq. Mile
		Both Sexes	Males	Females	
West Pakistan	3,10,403	4,28,80,378	2,29,59,802	1,99,20,576	138
Peshawar Division	28,153	63,72,467	33,16,377	30,56,090	226
Hazara	6,292	13,84,552	7,00,815	6,83,737	220
Mardan	1,211	8,13,840	4,22,066	3,91,774	672
Peshawar	1,646	12,13,468	6,51,558	5,61,910	737
Kohat	3,473	6,27,795	3,21,769	3,06,026	181
Malakand Agency	12,344	15,36,766	8,01,689	7,35,077	124
Mohmand „	887	2,94,215	1,54,400	1,39,815	332
Khyber „	995	3,01,319	1,63,580	1,37,739	303
Kurram „	1,305	2,00,512	1,00,500	1,00,012	154
D. I. Khan Division	11,130	12,05,719	6,38,870	5,66,849	108
D. I. Khan	4,723	3,82,746	2,05,239	1,77,507	81
Bannu	2,034	4,28,061	2,24,421	2,03,640	210
N. Waziristan Agency	1,817	1,59,470	79,000	80,470	88
South „ „	2,556	2,35,442	1,30,210	1,05,232	92
Rawalpindi Division	11,206	39,79,139	20,58,491	19,20,643	355
Campbellpur	4,148	7,66,813	3,89,574	3,77,239	185
Rawalpindi	2,022	11,37,085	5,90,686	5,46,399	562
Jhelum	2,772	7,49,229	3,79,948	3,69,281	270
Gujrat	2,264	13,26,012	6,98,283	6,27,729	586
Sargodha Division	17,095	59,76,939	31,91,144	27,85,795	350
Mianwali	5,403	7,46,733	3,93,375	3,53,358	138
Sargodha	4,775	14,67,621	7,83,988	6,83,633	307
Lyallpur	3,516	26,83,838	14,36,345	12,47,493	763
Jhang	3,401	10,78,747	5,77,436	5,01,311	317
Lahore Division	8,907	64,48,575	34,65,757	29,82,818	724
Lahore	2,216	24,79,687	13,55,492	11,24,195	1,119
Gujranwala	2,312	12,91,886	6,92,596	5,99,290	559
Sheikhupura	2,312	10,80,619	5,76,587	5,04,032	467
Sialkot	2,067	15,96,383	8,41,082	7,55,301	772
Multan Division	24,826	66,02,924	35,37,760	30,65,164	266
D. G. Khan	9,359	7,76,620	4,17,574	3,59,046	83
Muzaffargarh	5,613	9,89,878	5,30,512	4,59,366	176
Multan	5,630	27,02,354	14,52,036	12,50,318	480
Montgomery	4,224	21,34,072	11,37,638	9,96,434	505
Bahawalpur Division	17,508	25,74,066	13,90,029	11,84,037	147
Bahawalpur	9,587	7,35,524	3,98,997	3,36,527	77
Bahawalnagar	3,428	8,22,827	4,39,369	3,83,458	240
Rahimyarkhan	4,493	10,15,715	5,51,663	4,64,052	226
Hyderabad Division	36,821	32,90,956	18,03,011	14,87,945	89
Hyderabad	4,969	12,85,711	7,10,798	5,74,913	259
Dadu	7,342	4,85,122	2,65,896	2,19,226	66
Thatta	6,933	3,61,733	1,93,111	1,68,622	52
Sanghar	4,142	4,30,090	2,36,856	1,93,234	104
Tharparkar	13,435	7,28,300	3,96,350	3,31,950	54
Khairpur Division	20,293	31,33,712	17,08,607	14,25,105	154
Khairpur	6,018	4,72,137	2,58,800	2,13,337	78
Jacobabad	2,982	5,28,709	2,91,157	2,37 552	177
Nawabshah	2,896	6,91,539	3,77,511	3,14,028	239
Sukkar	5,531	8,36,867	4,56,408	3,80,459	151
Larkana	2,866	6,04,460	3,24,731	2,79,729	211
Quetta Division	53,115	6,30,118	3,52,819	2,77,299	12
Sibi	10,446	1,23,049	67,570	55,479	12
Loralai	7,364	1,10,720	60,968	49,752	15
Zhob	10,475	87,686	48,369	39,317	8
Quetta Pishin	5,314	2,67,400	1,53,391	1,14,009	50
Chaghi	19,516	41,263	22,521	18,742	2
Kalat Division	72,944	5,30,893	2,86,832	2,44,061	7
Kalat	30,931	3,41,420	1,86,706	1,54,714	11
Kharan	18,553	42,483	22,530	19,953	2
Mekran	23460	1,46,990	77,596	69,394	6
Karachi Division	8,405	21,34,870	12,10,105	9,24,765	254
Karachi	1,357	20,44,044	11,61,990	8,82,054	1,506
Lasbela	7,048	90,826	48,115	42,711	13

BOOK REVIEWS

GEOGRAPHY OF WORLD AFFAIRS : by J. P. Cole 11 x 18 cms 347 A penguin special 1960.

Geopolitics made a great noise at the end of the 19th Century and in the early 20th Century. The British Halford Mackinder and German Haushofer developed their own ideas and interpretations of world geography and land masses. Whether the prognostications of Mackinder have been tested or proved or not, is beside the point but since then it can safely be said that remarkable development of systematic thinking has taken place in political geography. Books like "Elements of Political Geography", "War Potentials of Nations", "World Political Patterns", "Political Geography and the World Map" have brought fresh insight into political geography and the close relationship between it and political science has been brought into focus.

2. Political Geography, as it is, has sharply limited sphere of operation. Although political geographers are not concerned at all with the structure of Government etc., they realise that the implications of a system of Government or political ideology have considerable geographical importance. The developments in the communist world cannot be properly perceived without consideration of the implications of their philosophy of Marxism, as modified by the communist leaders. Some authors find political geography a field of study, which has not been defined and naturally their books lack a formal methodological contribution. Some just degenerate into regional texts, having the country-to-country approach, as if incapable of affording afresh evaluation of modern political geographical problems.

3. "Geography of World Affairs" is not one such book. Although it is claimed by the Publishers that the main purpose of the book is to help the reader who is not a specialist in geography to find his way about the world and to provide him with facts about the location, population, size and activities of the more important countries in it, yet it studies the interactions between the two basic elements of a state, *i.e.*, territory and man.

4. Starting from "Projections and Maps", the book speeds through "The Process of Europeanization", "Area and Population", "Urban Revolution" and ends up with the broad field of power politics of the Soviet Union, the United States of America and the United Kingdom. In its traverse, the book does not ignore the description and analysis of politically organized areas.

5. The author has a refreshing approach to "Regional Division of the World". With the help of five maps, he comes to the conclusion that for the purposes of the

book, the world can be divided into twelve regions. Bartholomew's regional projection has been convincingly used by the author, to show, first, the main divisions of—

1. An outer zone of large land masses and oceans separated, except in the Arctic Ocean area, from (3) the Communist block, by
2. An inner zone of peninsula, islands and seas.

The 'Outer Zone' is divided into—

(*a*) Anglo-America;
(*b*) Latin-America;
(*c*) Africa except the Northeast and Northwest; and
(*d*) Australasia.

The 'Inner Zone' is divided into—

(*a*) Non-communist Europe and Northwest Africa;
(*b*) South-West Asia and Northeast Asia;
(*c*) South Asia;
(*d*) South-East Asia; and
(*e*) Japan, Korea and Formosa;

The 'Communist Block is divided into—

(*a*) The U.S.S.R. and the Mongolian People's Republic;
(*b*) East Europe; and
(*c*) Communist China.

6. Oblique zenithal equidistant projection has been used to show the location of each of the sub-divisions. With this technique, the author has tried to prove forcefully that a crisis in any country immediately affects neighbouring countries in the same region, arouses interest in adjoining areas but more slowly attracts attention in regions that do not adjoin it, *e. g.*, the Israeli invasion of Egypt of October, 1956, and the uprising in Hungary brought the most immediate and violent reaction from the adjoining areas.

7. Mankind has been confronted with the most grave and terrible problem of triangular struggle for power among the United States of America, the United Kingdom and the Union of the Soviet Socialist Republic. 'Part three' is purely devoted to the important features of the U.S.A. and the U.S.S.R., while some aspects of the U.K. as a world power have not been ignored. As Raul Haya de La Torre, a Peruvian politician, remarked, "Britain, a second class power? Could the country that can teach the whole world lessons in political freedom ever be a second class power?"

8. Appendices in books are usually overlooked by some of the readers. In this book, Appendix I draws one's attention; and it is surprising that "The position of

Russia in relation to Europe" has been relegated to an appendix. It should have a chapter to itself. It is an intelligent analysis, based on the thinking of men like Toynbee, Russel and Spengler. The author leaves the question open and a reader is left no wiser, and is more or less inclined to talk "of the Western Countries, *including* Russia."

9. On the whole, the book provides intelligent reading and to borrow the words of Hartshorne, it is a book on "political geography."

FAZAL-UR-RAHMAN KHAN

DIRECTORY OF PAKISTAN GEOGRAPHERS Compiled By M. M. Memon and M. Rehman, pp. 36-Pakistan Institute of Geographers, Karachi-5, 1961.

The Directory of Pakistan Geographers is a new attempt to list the names and interests of the Geographers of Pakistan. It was compiled on the basis of questionnaires sent to the geographers in the country irrespective of their vocation. In all 208 persons are included.

There are three sections, A, B and C in the directory; Section A includes the list of Geographers in alphabetical order with date of birth, academic qualifications, year of obtaining the degrees present position and permanent address, Section B shows subject area and specialities, Section C is the index showing the locations of geographers in the universities and the affiliated colleges.

The directory gives the names of both professional and non-professional geographers who hold academic degrees in geography.

The directory brings out the wide range for interest of Pakistan geographers. The tabulation in the index B shows that on the whole there are more specialists in the field of economic geography, geomorphology, Pakistan, and physical geography.

It is a good, informative and useful publication.

A. A. A.