Cultural Geography of the Jats of the Upper Doab, India.

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CULTURAL GEOGRAPHY OF THE JATS
OF THE UPPER DOAB, INDIA

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in
The Department of Geography
and Anthropology

by
Anath Bandhu Mukerji
B.A. Allahabad University, 1949
M.A. Allahabad University, 1951
June, 1960
ACKNOWLEDGEMENTS

Individual acknowledgement to many persons who have, directly or indirectly, helped the writer in India and in United States is not possible; although the writer sincerely desires to make it. The idea of a human geography of the Jats as proposed by the writer was strongly supported at the very beginning by Dr. G. R. Gayre, formerly Professor of Anthropo-Geography at the University of Saugor, M. P., India. In the preparation of the preliminary synopsis and initial thinking on the subject able guidance was constantly given by Dr. P. K. Sircar, Reader in Geography and African Studies, Delhi University. Professor N. K. Bose, Reader in Anthropo-Geography, Calcutta University, inspired and instructed the writer through his scholarly and enthusiastic discussions. Many photographs and unpublished data were supplied by the writer's brother, Mr. J. B. Mukerji, and father-in-law, Dr. A. N. Khanna. To the constant companions in the field, Messrs. R. N. Tikka, B. Singh, and S. Singh, this work is the fulfilment of a promise that their "love's labor will not be lost".

Additional concepts and methods of cultural geography were learned by the writer in the Department of Geography and Anthropology,
Louisiana State University. Each member of the staff led the writer on the path of his specialization to the core of geography as a science of landscape. The first draft was written under the guidance of Dr. F. B. Kniffen. Later, the burden of guidance fell on Dr. W. G. Haag whose encouraging and critical guidance helped the writer to give a better, final shape to the dissertation. Dr. R. C. West gave suggestions which effected a marked improvement in the maps and a substantial addition to the section on the vegetation of the Upper Doab. Dr. J. H. Vann and Dr. W. G. McIntire suggested lines of improvements which resulted in a more elaborate and scientific discussion of the geomorphology of the Upper Doab. The writer is greatly indebted to all the members of the staff and to Mr. Chan Lee for his informal and fruitful discussions.
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ABSTRACT

The central theme of this study is the description and interpretation of the cultural landscape of the Jat villages in the Upper Doab, India. The Jats are an ancient ethnic group engaged largely in agriculture in the Upper Doab. A study of their cultural origins and migrations indicated that the Jats developed cultural kinship with the Rajputs of Rajasthan during their stay in that area from the ninth through thirteenth centuries. Primarily through contacts with different culture groups during their migration the Jat material culture evolved through three stages of culture succession: 1. Nomadic way of life based on cattle herding and maraudery; 2. Semi-nomadic way of life based on temporary cultivation and cattle herding; 3. Sedentary agriculture with large nucleated settlements.

The present study is primarily concerned with the cultural landscape created in the third stage. The Jat cultural landscape is differentiated from that of the non-Jat villages on the basis of the following traits: the house, the settlement, the field, and the agricultural complex.

The Jat house consists of two separate buildings: the haveli (female residence) and the ghair (male residence and cattle yard).

The basic form of the Jat house consists of four sets of rooms which
completely enclose the courtyard. It was found that the form of the Jat house is ancient, and has evolved along with a change in the general way of living from nomadic cattle herding to sedentary agriculture.

The diagnostic trait of the Jat village settlement is its three-tier internal morphology formed by a core of havelis, a horse-shoe shaped road surrounding the core, and an outermost belt of the ghairs. The idea of this form was derived from that of the Rajput village settlement. Other diagnostic features of the Jat villages are the absence of temples, the existence of jathera for the worship of the clan ancestors, and the nearby presence of several abandoned sites (kheras) of the earlier settlements.

The Jat field pattern consists of fragmented holdings formed by widely scattered fields. The recently created fields are regular rectangular, while the ancient, evolved fields are irregular quadrilateral. The factors which contributed to the development of the field pattern were the use of heavy, iron plough, the incorporation of newly cleared and reclaimed irregular blocks of land; and the operation of the Hindu law of equitable inheritance of land.

Characteristic of the Jat agriculture are the intensive use of the land by large scale application of canal irrigation and chemical manures, and double cropping with a greater emphasis on sugar cane. The Jat agricultural economy is well balanced on sugar cane for cash...
income, wheat and maize for food, and millets for fodder. The horse as a prestige animal, water buffaloe for milk, and bullocks and camels for draught purposes form the livestock complex of the Jats.

From a study of their house, settlement, field, and agriculture it was found that the cultural landscape of the Jat village is markedly different from that of the non-Jat villages, and this difference is due to the differences between the cultures of the Jats and of the non-Jat people of the Upper Doab.
INTRODUCTION

The Jats, the cultural landscape of whose village settlements in the Upper Doab is the subject of the present study, have been considered as an ancient ethnic group distributed fairly widely in northwestern India (Map 1). The Jats are believed to be of Indo-Scythian origin and to have entered India at about the beginning of the Christian era. Among the people in the countryside the Jat is considered as an unique person because of his tall, athletic figure, long nose, and long head (Plates 1, 2, 3).

Originally, a tribe with a territory divided into its smaller, constituent, clan areas and each governed by clan chiefs, the Jats, today have no political organization, no chief, and no particular territory as their own. Thus, they do not, anymore, constitute a tribe. The consciousness of a common racial and cultural origin stemming from the Rajputs unites the Jats into a culture group. In this study, therefore, the Jats will be considered neither a caste nor a tribe but a distinct culture group.

PRESENT DISTRIBUTION OF THE JATS

The uniform distribution of the Jats over a continuous, compact area of the northwestern India is noteworthy (Map 3). This area covers
PLATE 1

Jat women. Note the dress of the girl on the left, a loose pajama; the saree of the old ladies in the centre; and the salwar of the lady on the right. Salwar is the Punjale folk-dress and has narrow ends.

PLATE 2

Jat men. Note the tall stature and sharp, long nose.
PLATE 3

Jat men; also showing the dhotee, kurta, and the Gandhi cap. Note the wooden-framed and jute-cord woven charpoy (khatia) on which two men are sitting. The high haveli buildings at the rear indicate wealthy farmers. In the foreground is the hookah in which tobacco is smoked.
central Punjab, Southeast Punjab, Southwest Punjab, Upper Doab, the northern parts of Malwa Plateau, and eastern and northeastern parts of Rajasthan (Map 1). The total Jat population in this area is about six million. The eastern limit of their present distribution is formed by the Ganga river in the Upper Doab and by the Chambal river in Rajasthan. On the west the middle and the lower Indus river and on the north the southern edge of the Tarai form the boundaries. In the south the Jats are not found beyond the central parts of the Malwa Plateau.

Several factors, cultural and natural, have operated in the past to fix the boundaries of the distribution of the Jats. Toward the east, the Ganga river forms the limit of the dry climatic region. From here up to the Indus river in the west there is a broad similarity in climate which is hot and dry in summer and cold and dry in winter. The climate changes abruptly east to the Ganga river, especially noteworthy being the increase in rainfall. The Jats, originally living in the dry steppe of Upper Sindh and Rajasthan, found the region up to the Ganga river similar to their former habitat. In recent times the Jats have migrated to the east of the Ganga river, but the number is negligible, and the area has expanded little. It appears that the Jats are well adapted to the dry region and have a great dislike for humid and cold areas. The Chambal river in Rajasthan and the Malwa Plateau in the south similarly limit the dry region in those
directions (Map 2). The Indus river in the west does not form a climatic boundary but a physiographic one. A short distance farther west, the plateau-hill complex of Baluchistan and the Sulaiman mountains (Map 2) formed an effective barrier to the movement of the Jats. Throughout their history, the Jats have been the dwellers of the plains and have avoided the hilly areas for their settlements. For the same reason they did not spread in sufficiently large numbers in the hilly Gujarat and the hill-plateau complex of the southwestern Rajasthan so as to leave their cultural impress on the landscape.

To the west of the Indus river the movement of the Jats was checked also by the strongly organized Baloch and Afghan tribes. Similarly, in the north the petty Rajput principalities of the foot-hills of the Himalaya resisted Jat movements. When the Jats settled permanently in the Upper Doab, they successfully grew sugar cane, cotton, and wheat. Beyond the Ganga river to the east, wheat and cotton could not be grown so well because of the humid climate. In Malwa and northeastern Rajasthan, east to the Chambal river the conditions favourable for the cultivation of cotton and wheat are not found. The Jats subsisting mainly on wheat, cotton, and sugar cane spread over an area suitable for their cultivation.

The present distribution of the Jats is the most extensive in their history (Map 3, 4). During the seventh century A.D. long before the Moslem invasions took place, the Jats spread equally on the
CHANGING DISTRIBUTION OF THE JATS

1 SEVENTH CENTURY
2 THIRTEENTH CENTURY
3 SEVENTEENTH CENTURY
4 TWENTIETH CENTURY

LIMITS OF DISTRIBUTION

Source: Historical Works mentioned in the text.

MAP 3
east and the west of the Indus river. Their distribution to the west of the Indus river contracted greatly during the thirteenth century A.D. almost wholly due to the Moslem invasion. Disjunct distribution resulted from the Jat occupation of the northern Malwa, southeastern Punjab, and the areas along the upper valley of the Jamuna river. At the time of the disintegration of the Mogul empire, the Jats expanded their possession and the distribution became continuous and more extensive (Map 3, 3). In the twentieth century the Jats have spread to the central Punjab and east of the Ganga river.

PREVIOUS INVESTIGATIONS

It may be categorically stated that our knowledge of the material culture of the Jats and of the cultural landscape of the Jat village settlements is almost nil. A few publications of the present writer (see bibliography) are the only ones on such topics. An extensive literature, however, exists on the social culture of the Jats. This material is of little direct concern to the understanding of the Jat material culture. Several books on the history of the Jats have been written, most of which are in Hindi, a few in Urdu; and only two in English by Burton and Qanungo (see bibliography). While the books in Hindi and Urdu were written mostly by Jats and based, primarily, on legends and folklores, as well as involving a great amount of subjective opinions, those in English were solidly based on reliable historical records and
documents. Thus, fortunately we have authoritative histories of the Jats in English and these are the basic references used in this present study.

OBJECTS OF THE PRESENT STUDY

Studies in the cultural geography of individual regions are quite common. The focus of the present study is the cultural geography of an ethnic group and thus it will be concerned with the cultural landscape created by the Jats. Since the Jats are almost wholly agriculturists, the subject is further narrowed down to a study of their village landscape. The objective of the present study is, thus, the description and interpretation of the cultural landscape of the Jat village settlements. This cultural landscape is formed of four culture complexes: the settlement, the house, the fields, and the agriculture. Diagnostic traits of the Jat culture which set them sharply apart from other people of the Upper Doab are the house-type, settlement-type, and field-pattern. Many details of agriculture help us further differentiate them from other people. This will lead to an attempt to determine the contribution of the Jat culture to the creation of the Jat cultural landscape.

APPROACH

The entire study is based on the concepts of culture history which includes the origin, dispersal, and the subsequent development
in the form and function of each culture trait and the trait-complexes. The application of this method stems from a conviction of the writer that no better method or guiding principle is available at present, for the study of the genesis and subsequent development of the culture complexes that form any cultural landscape. This culture historical approach is coupled for our purposes with the concept that cultural geography is essentially the study of the cultural landscape created by particular culture groups. Earlier reconnaissance studies of the villages of the Upper Doab made by the writer (see bibliography) had definitely shown that the cultural landscape of the Jat villages was markedly different from that of the villages of other agricultural people. The writer was then confronted with the problem of finding an explanation for such a difference. This led to the consideration of the genesis of the cultural landscape and involved the culture historical approach. Thus, the present work is a study of the cultural landscape based on the approach of culture history.

The question of time in culture history is of great importance. The limits of the time to which the writer had to go back, in order, to understand the genesis and subsequent development of the present cultural landscape were not determined by any a priori formulated principle. Such limits evolved at various stages of the study. At one stage, the time limit had to be thrown back, at others pushed forward. The study of the origin of the Jat house carried back to the times of
the early Aryans (circa 1,500-1,000 B.C.); an understanding of the internal morphology of the Jat village settlement necessitated tracing history to only Rajput times (circa 8th century A.D.).

Since the present study is of cultural geography based on the culture historical approach, it is imperative that it is or rather should be qualitative and not quantitative. Although statistical treatment is utilized where warranted in the present study, the problems have been treated largely from a qualitative viewpoint. Numerical data have been given at points of necessity to illuminate a particular problem and help in its interpretation rather than make it a basis for analysis. In the simple culture of the Jats based primarily on subsistence farming it is the over-all view of the way of life that is much more important than the statistically derived conclusions. Therefore, the method of qualitative description and interpretation has been used in the present study.

ORGANIZATION OF THE MATERIAL

The present study deals wholly with the Jats of the Upper Doab. The understanding of their cultural landscape involves a consideration of the sources of the culture traits and the modifications undergone by them during the course of dispersal. Chapter I therefore deals with the origin and migration of the Jats. These are the logical starting points for an understanding of the sources and adaptations of the culture
traits to changing cultural milieu. Greater emphasis is put on the cultural origin rather than on the racial; and on cultural kinship between the Jats and the Rajputs. The place of origin of the Jats in India has been postulated followed by a reconstruction of the stages, the routes, and the factors involved in these stages of migration.

The cultural landscape created by the Jats in the Upper Doab is the main theme of the present study. Although this region has been under continuous human occupancy since 1,000 B.C. or so, and the natural landscape had already undergone a vast change before the settlement of the Jats, the adaptation of their material traits to the natural environment will be better understood in the frame-work of the regional setting. Chapter II deals, therefore, with the physiography of the Upper Doab. This includes a detailed explanatory description of the geomorphology, climate, soil, vegetation, and the wild animals of the Upper Doab. An attempt is made to discuss the significance of each of these physiographic elements in terms of their relationship with the Jat cultural landscape.

The description and interpretation of the various elements of the Jat cultural landscape follow quite logically the study of the physical setting of the Upper Doab. Each element is studied in one chapter; Chapter III deals with the village settlement, Chapter IV with the houses, Chapter V with the field patterns, and Chapter VI with the agricultural economy. For each of these elements, studies are
arranged to include the origin, dispersal, and evolution of their forms and functions. Chapter VII presents a summary and conclusions of the findings of the entire study.

SOURCES OF MATERIAL

The present study is based, for the most part, on both extensive and intensive field work carried on mainly in the Upper Doab during 1951 and 1956. Additional reconnaissance work was carried on in northern Malwa and northern Rajasthan, in the winter of 1956 and the spring of 1957 respectively. While in the field notes were taken on the basis of conversation and personal observation of material and relevant non-material traits of the Jat culture. Photographs covering most of the topics studied were taken by the writer in the field. A large part of the present study is based almost wholly on material collected from field work.

Subsequent library researches helped the writer understand the problems confronted during the field investigations. Unpublished government documents were studied at the Tahsil Office, Gaziabad (Map 5); Collectorate Office, Meerut; Land Records Office, Allahabad; and the Central Secretariat Library, New Delhi. Unpublished village maps in the possession of Jat families were studied and reproduced. Some use has also been made of a few papers (see bibliography) published in India which included some of the materials gathered from field work and the results of subsequent research done by the writer.
CHAPTER I
ORIGIN AND MIGRATION OF THE JATS

The origins of the Jats like other older groups of historically and culturally important peoples of India are lost in antiquity. Many historians and ethnographers have written on the subject extensively, and many through their indiscriminate use of facts and fiction formulated unscientific theories. The volume of literature bearing on the subject is vast, but the problem is yet unsolved. The problem of the origin of the Jats is the most controversial one in the ethnology of India (Ibbetson, 1916, p. 102). The traditions of the tribe do not throw much light on their origin (Crooke, 1896, p. 27) which is enveloped in the mist of obscurity, yet to be dispelled by scientific research (Qanungo, 1925, p. 23). Again, it has been a common practice in Indian history to graft a fabricated genealogy on a true one, which makes it extremely difficult for one to study the true development of the individual dynastic histories.

ORIGIN

The leading contemporary authorities consider the Jats to be of native origin, having been derived from the Rajputs. Scholars
now think that the connection between the Jats and the Rajputs is more intimate than was formerly supposed and in physical types they are definitely Caucasian (Risley, 1901, p. 500). Even Nesfield who had asserted that Yadus (Epic period) were the ancestors of the Jats later on argued that if appearance goes for anything the Jats could not but be Caucasian (Nesfield, 1931, p. 60). Later ethnographic investigations show that the Caucasian Indo-Aryan type described in the Hindu epics, as a tall, fair-complexioned, long-headed race, with narrow prominent noses, broad shoulders, long arms, "thin waists like a lion," and "thin legs like a deer," is now confined mostly to the Punjab and Rajputana and represented by the Jats and the Rajputs (Havell, 1918, p. 32). On philological grounds also the Jats appear to be Caucasian Aryans.

"I have long ago convinced myself, from my journeys from Peshawar to Karachi that the Jat-folk is not more separated from the rest of the community than can be accounted for by various circumstances. The argument derived from language is strongly in favour of the pure Caucasian Aryan origin of the Jats. If they were Scythian conquerors where their Scythian language has gone to, and how come it that they now speak and have for centuries spoken a dialect of Hindi language. Physical type and language are considerations which cannot be set aside by mere verbal resemblances specially when the words on which reliance is placed come to us mingled beyond recognition by Greek or Chinese" (Elliott, 1879, p. 160).

It seems possible that the Jats, Rajputs and Gujars (professional cattle-herders), all belong to the same physical type. With
the Rajputs, Jats and Gujars are to be included in the same ethnic group (Haddon, 1929, p. 113). The evidence seems conclusive that the Jats must be placed in the same ethnic group with Rajputs and Gujars (Crooke, 1910, p. 43). In the Punjab there is the uniform tradition that the Jats come from the same stock as the Rajputs (Crooke, 1910, p. 43). That the Jats and Rajputs are branches of one great stock I have no doubt (Campbell, 1866, p. 85).

The differences observable today between the Rajput and Jat are due to the patterns of cultural evolution which each has undergone. We do not know it definitely but it seems probable that the process of differentiation might have started very early, even before the Caucasoids came into India. The differentiation might have been caused by their separate movements into India at different periods (Ibbetson, 1916, p. 101). The Rajputs are an earlier wave from the same stock as all the Jats in a later period (Campbell, 1866, p. 84). But it is generally agreed upon by the scholars that both belong to the Caucasoid race.

The popular traditions fixing the origin of the Jats in the Rajputs are at best partial truths. The native account is simple enough but it explains the origin of some clans of Jats, not all. It assumes that the Jats were already in existence when the new Jat clans began to emerge. When a Rajput married a Jat female, dined with a Jat, enforced the seclusion of women, or practiced the custom
of widow-marriage, he fell in the social scale and was afterwards considered a Jat.

The writer suggests that probably because of this social degradation, such Rajputs were thought similar to the Jat who handled the plough and was a subject of the ruler Rajput (Raj meaning king and put meaning son; i.e., son of a king). Hence, too, though the Rajput becomes a Jat, the clan name persists. Thus Punwar, Parihar, Bhatti, Rai, and Joya are clans common to both the Jats and the Rajputs. Further, the Jats always have as their last name, Singh, as do the Rajputs.

In regard to religious and social customs, Jats and Rajputs are very similar. The differences apparent among the former are the very grounds assigned for their lower social position. In the course of cultural evolution the Rajput has risen while the Jat remained stationary (Crooke, 1910, p. 29).

Considering all the opinions set forth by reliable ethnographers we think that the theory of Rajput origin of the Jats is probably the most valid so far as it is based on the data of social and physical anthropology available at present. As was pointed out earlier, the Jats are nearer to the Rajputs so far as physical type is concerned. Later ethnographers have found out that in many points of culture also there are similarities between the two. The close correspondence between these two sets of data and conclusions strengthen
further our suggestion that most probably the Jats are socially de-
graded Rajputs, with whom they are to be included among the
Caucasoid people.

It is impossible to assert that one of these theories is correct. 
Even the Rajput origin of the Jats is open to question. However, this
is certain that cultural affinities of the Jats have been with Rajputs
during the historical periods. The influence of this relationship is
reflected in the culture of the Jats, which is the most important point
in the present connection.

MIGRATION

The migration of the Jats was one of the significant events in
the medieval history of India, that is, about 800 and 1500 A.D. Many
important historical developments took place in northern and north-
western India, due, mainly to the migration of the Jats. In general
they moved radially from the steppes (bagar) bordering on Thar
desert (Map 4). However, the main directions of their movements
were east and northeast. There is no authentic history of Jat migra-
tion to the northwest (Qanungo, 1925, p. 23). Similarly, we have no
evidence at all of the first migration of the Jats from the plains of
Central Asia within the Indus (Balfour, 1873, p. 158). Our discuss-
ion of the migration of the Jats will thus have to be necessarily re-
stricted to that part which was effected in India. Fortunately, for
this, there are ample historical data in the form of written records.
It is intended here to study the migration of the Jats from a historical-geographical point of view. The historical accounts do not, of course, give minute details, but broad features of their migrations. Reasons for the movements can also be found.

The Jats in Malwa, southeastern Punjab and the Upper Doab are recent immigrants. This migration has taken place within the last one thousand years, the most important migrations within the last six hundred years. The Jats were not the original inhabitants of this region (Dutt, 1925, p. 102). There is no mention of them in the Upper Doab before the ninth century A.D. (Neville, 1911, p. 40). The persistent tradition of almost all the Jats is that they have come from the west in recent times, certainly not before the medieval period. The writer has found it also from his field interviews that the Jats believe themselves to be recent immigrants.

From the study of the nomenclature of their villages, it has been inferred that the Jats are recent immigrants into Upper Doab. Very few of the Jat villages are named after them. The Jats who came later had to add the suffix Jat or Jatauli to their village names to distinguish them from the villages of other peoples (Mukerji, 1957, p. 25). Two examples will clarify the point; Aurangabad Jatauli and Shidpur Jat were originally Moslem villages with their names Aurangabad and Shidpur to which Jatauli and Jat were added when Jats took possession of these villages.
The Jats deny having any association with the past cultures of their present habitat in Upper Doab. In this way they are entirely different from the non-Jat people. Their own customs were in practice until recently. They worshipped ancestor spirits instead of the Hindu Gods. They practiced karewa by which a woman from a lower caste could be married into their family. Even some of their festivals have been different from those of other Hindu peoples. Many of the material traits, as the three-tier village plan and the ghair (male house) also indicate their recent immigration into Upper Doab.

The Jats have been mentioned as professional dacoits and marauders in medieval periods (Elliot, 1901, p. 454). If they were already living in Upper Doab they would surely have been cultivators since in this region agriculture has been in continuous existence since the times of Mahabharata (circa 1500 to 2000 B.C.). This would have meant that there were two classes of Jats based on the mode of existence, the marauder Jat and the cultivator Jat. Then there would, in all probability, have been two social classes of the Jats. We, however, do not find any suggestion of such social classes among them.

The migration of the Jats has not been a continuous process. It has rather been a matter of slow increments which possibly has produced greater and more lasting results. The slow increments were provided by many minor migrations whose records are lost to us. The historical records enable us to reconstruct three major
migrations of the Jats. The three major movements took place during the following periods: (1) seventh to ninth century, A.D.; (2) eleventh to thirteenth century, A.D.; and (3) at the end of the seventeenth century.

First Stage

The Jats in the seventh century A.D. inhabited the country immediately east and west of lower Indus valley in Sindh and on the western frontiers of the bagar steppe. Between the Sulaiman ranges and Multan the whole area was continuously occupied by the Jats (Map 3). They were living there during the eighth century A.D. (Haig, 1928, p. 507). They were then the speakers of Jataki, the local dialect peculiar to southwestern Punjab and Multan; and even now in many districts of southeastern Punjab they speak Jataki. This also points to Multan as their habitat during earlier periods (Burton, 1898, pp. 137 and 138). The original habitat was upon the Indus about Multan during seventh and eighth centuries (Burton, 1898, p. 211).

The factors which induced the movement during this stage were more social-historical than physical. In this region of Multan the Jats practiced pastoral nomadism with sporadic farming. They appear first in Indian history as a nomadic group, alternately shepherd and temporary tiller of the ground (Burton, 1898, p. 141). In some years when rainfall was good they cultivated small patches of land dispersed over a wide area.
The two major invasions of Arabs into Sindh had created unsettled conditions in that area. About 662 A.D. the Arabs fought against the Jats (Majumdar, 1955, p. 126). These raids were directed principally against the Jats, who, compared to the Arabs with advanced techniques of warfare, were poorly equipped and were no match for them. In every engagement, the Jats were defeated and many of their villages were destroyed.

In 712 A.D. Muhammad-ibn-Kasim was sent by Caliph al Hajaj to punish the Jats. He killed and captured many of them. The whole of the lower Indus valley was shortly dominated by the Arabs (Majumdar, 1953, p. 182).

Besides these two Arab invasions, innumerable conflicts between the Jats and their neighbors, the Meds, created conditions of unrest. These induced the migrations of this period.

The first movement in large numbers was directed toward the southeast across the Sutlej river into the Bagar Steppe (Map 4). It is because of this migration that there is a tradition of the Jats having come originally from the west. The migration must have taken place after 712 A.D. in any case because Muhammad-ibn-Kasim who raided Multan and crossed Sutlej to invade Alor, the then capital of Sindh, did not encounter the Jats at the latter place. Alor was situated on the periphery of the Bagar Steppe. The Arabs continued to occupy the lower delta of the Indus until the end of the ninth century, affecting the lives of the Jats in Sindh (Davis, 1949, p. 23).
At that time the northwestern parts of Rajputana and the Bagar Steppe were sparsely populated. People fleeing other areas sought here periodic shelter. Down to seventh and eighth centuries A.D. this area was sought after as a refuge by defeated tribes (Kennedy, 1919, p. 493).

The route of migration, in all probability, was controlled mostly by the valley of the Indus (Map 4). The retreating Jats could not have taken the northern route because in that case they would have had to cross over several rivers of the Punjab. They did not, at that time, possess an advanced skill in navigation and in the use of boats. The main mode of migration was by horse. Defeated in successive wars the Jats were driven across the Sutlej river as desultory cavaliers (Balfour, 1873, p. 152).

A more northerly route would have involved a fight with the Arabs of Multan and a more southerly route would have been resisted by the Arabs of Mansurah. Further, the easiest crossing of the Indus lay at a point below the confluence of the Sutlej and Indus rivers, near the old site of Uch. Here the Indus is narrow. At other places, crossing the Indus must have been difficult for the Jats, a people adapted to movements on land.

Crossing the Indus, they entered into the Bagar Steppe. The Jats settled along the banks of the Hakra river which used to flow through this area during the eighth century. The settlements were
more numerous on its eastern bank as a defensive measure against raids from the west. The Jats continued to live in this area for four or five centuries.

Second Stage

The Jats in the thirteenth century A.D. had three nuclear areas of settlement (Map 3): southeastern Punjab often called Hariyana; northern parts of Malwa; and the Bagar Steppe. It is because of their occupation of the last-named area in this period that the Jat alone had the right of placing the mark of inauguration (tilak) on the forehead of every Rajput chief when he ascended the throne (Powlett, 1879, p. 193). At the time of Timur’s invasion in 1398 A.D. the Jats were settled around Delhi (Rose, 1924, p. 489).

The factors inducing the migrations in this stage were mainly geographical. The main cause was the drying up of the Hakra river (Map 4) which was the only source of water for the villages settled along its banks. The river channel dried up because the Sutlej whose waters once flowed in it changed its course. When the Sutlej shifted to the westward and abandoned the eastern arm of the Hakra (known as Ghaggar in eastern Punjab) the latter was left as a deserted channel (Oldham, 1893, p. 57).

The abandoned channel of the Hakra is now filled with sand and debris deposited primarily by wind. The process of filling has
been going on for centuries, as indicated by the old graves and trunks of trees found at depths of more than twenty feet below the surface (Oldham, 1893, p. 61). The date of desiccation can be approximately determined from Oldham's findings noted above. Since the Hindus burn their dead and since the interred bodies at the lowest occupation levels must be those of Mussalmans, the shift must have taken place since Mohammedan times, or say, within 800 years at most. The traditions current throughout the tract of the Bagar Steppe agree that until Mohammedan times, the Sutlej flowed in the Hakra channel and that until then, the country along its banks was fertile and populous (Oldham, 1893, p. 57). A legend narrated to Oldham suggests 1223 A.D. as the year when the Hakra dried up (Oldham, 1893, p. 64). This would be the time when the river became dry at its head. The process began in the stream's lower reaches in the early years of the eleventh century (Oldham, 1893, p. 63). Further evidences based on historical records are indicative of the same date. The country on the banks of the Hakra became waste through the river drying up, in the time of Rai Hamir Sodha, of Dhat who ruled in 1044 A.D. (Tod, 1880, p. 187). The decay of the abandoned channel continued for at least two centuries. Even in the thirteenth century A.D. according to Tabakat-i-Nasiri the whole area of the Bagar Steppe was under the grip of the drought because of the drying of the Hakra (Elliot, 1901, p. 364).
To summarize the details cited above, the Hakra which flowed through the original habitat of the Jats, began drying up in the early part of the eleventh century. It was dried up completely in the thirteenth century. This resulted in the exodus of the inhabitants who were mainly Jats (Oldham, 1893, p. 63).

The socio-economic and political factors were, however, not altogether insignificant. During the thirteenth century when the Hakra was drying up, the rule of Moslem rulers of Multan became strong (Maclagan, 1848, p. 559). The semi-nomadic Jats were forced away from the land because of the then prevailing drought and began attacking the caravans carrying food. The Multan rulers, soon put up an effective defense with posts situated on the western boundary of the Bagar Steppe. Probably, the normal increase of population and the resulting pressure from inadequate food supply also accelerated the migrations.

During the same period from the eleventh to the thirteenth centuries A.D. several raids were made by Moslem armies on the Jats. Mahmud Ghaznavi sent his seventeenth expedition about 1026 A.D. into India to chastise the Jats who had earlier looted his caravans. In the resulting battle the Jats were completely routed and had to migrate in large numbers (Raverty, 1892, p. 199 and Qanungo, 1925, p. 31). The fleeing Jats moved northward to the river valleys of Punjab, some by land along the Sutlej and some possibly by boats.
At this period the Jats must have become skillful boatmen since they fought with Mahmud Ghaznavi on the water (Row, 1803, p. 52 and Majumdar, 1957, p. 22). This war also resulted in their migrations to Sindh and to Sibi, west of the Indus (Burton, 1898, pp. 137 and 138).

A study of the present distribution of the Jats and the Rajputs also throws light on the pattern of migration of the former. Presently the Jats occupy middle and southeast Punjab, northern Malwa, Rajputana and Upper Doab. The Rajputs are found in the Salt Range, northern Punjab, Rohilkhand, Oudh, Central India, Central Doab, thence through Bundelkhand, Gwalior, Malwa, Mewar, Gujarat, Kathiawar and lower Sindh. Thus the Rajputs are found in a horseshoe shaped belt surrounding the central core of the Jats. This suggests that the Rajputs migrated toward the east first and the Jats followed them. This might explain why the Baghel and Bundel Rajputs extend east to the Jat states of Bharatpur and Dholpur.

The Jats moved radially from the Bagar Steppe, following the Rajputs, mainly to the northeast, east and southeast. The Rajputs in order to escape conversion to Islam and various Moslem atrocities moved to the periphery of the Mohammedan kingdom, and settled in the hills of the lower Himalaya and the plateaus of central India. In between remained the original concentrations of the Jats, many of them having been converted to Islam.
At this time the Jats moved eastward across the northern Rajputana to occupy the Upper Doab and certain areas around Delhi and also southeastward to northern Malwa (Campbell, 1866, p. 90). In 1398 A.D., Timur had to fight with the Jats near Sirsa (northwest to Delhi) when his army was attacked by the latter (Raverty, 1892, p. 288).

The route that lay across the northern Rajputana sandy low-lands (Map 4) presented little difficulty to tribal groups (Baden-Powell, 1899, p. 307). The branch which went over this route contained the bulk of the people. Coming from the west and not from Malwa, these Jats were treated as foreigners and social intercourse with them was less frequent (Baden-Powell, 1899, p. 305). Those who crossed the Jamuna River and settled in the Upper Doab called themselves Deswal (Deswal--of the original country) and those who remained west of the Jamuna River were called Pachchada (Pachch--from the west). These territorial divisions became in course of time, social.

Another route from bagar lay across the Thar and through Kuchaman pass in Aravalli into Malwa (Map 4). The main movements took place through the interlocking passes leading to the valleys trending in northeast and southwest directions, bounded by parallel ranges and opening into northern Malwa. The protected valley-routes facilitated the movements.
The plateau of Malwa (Map 4) has been a refuge of several tribes in various periods as it became for the Jats during the thirteenth and fourteenth centuries A.D. It is drained by the Chambal river, very fertile but difficult of access from without. It was admirably adapted for defense (Dalton, 1872, p. 150). Very soon the well protected and fertile plateau was filled up with the Jats who took to cultivation rapidly (Burton, 1898, p. 212).

The third route lay along the Sutlej toward Central Punjab. It was a comparatively easy route being free from topographical obstructions. The flat doabs (inter-fluvial upland) facilitated a rapid movement (Map 4).

**Third Stage**

There were three major movements during this stage, only one of them being of a very long range. They were significant in the emergence of the political power of the Jats.

At the time of the disintegration of the Mogul empire, about the later decades of the seventeenth century, the Jats, notable for their maraudery and robbery, organized themselves into an ordered and well-disciplined army. Sikhism converted the industrious Jat farmers of Malwa into a fighting tribe (Burton, 1898, p. 212). The migrations thus became semi-military in nature with a smaller range in distance.
The Jats living in Sindh had to become Muslims or to migrate to Rajputana. They chose the latter alternative. Similarly, they had to leave central Punjab and move to southeastern Punjab, for the same reason of escaping the Islamic conversion. Malwa received more than it could support which induced an outward movement. Migration and maraudery went on together, enabling them to amass a huge wealth. In 1658 A.D. the Jats plundered Dara Shikoh, a Moghul prince, and became the nobles of the land. They built forts of Bharatpur, Matras and Gohud at this time (Burton, 1898, p. 211). The kingdom of Bharatpur was established at this time (Qanungo, 1925, p. 47).

The second migration followed the death of Aurangzebe (1707 A.D.). In the reign of Suraj Mal (1723 A.D. - 1759 A.D.) his elder son Jawahir moved north to conquer southeast Punjab (Map 4) and his younger son Ratan Singh set out to conquer the Upper Doab region (Qanungo, 1925, p. 147). The conquest of these areas and the establishment of the rule of the Jat king of Bharatpur over them induced the Jats to migrate north in larger numbers.

The route (Map 4) lay mainly between the low spurs of Aravalli and the Jamuna river. At first the Jats moved mostly to southeast Punjab. Almost all the important Jat clans of Upper Doab point to Rohtak, in southeast Punjab, as their traditional home. The Malwa Jats worked their way up along the Chambal valley with Bharatpur at
its northern head. West of Bharatpur lay the hill ranges and to the east were the Jamuna and Chambal Rivers. It is, thus, highly probable, that as the Bharatpur Jats went north to occupy newly conquered lands in southeast Punjab and Upper Doab, so the Malwa Jats settled the lands in the Bharatpur itself.

Further Jat migration was naturally induced by the opportunity to exploit the unsettled conditions in the peripheral regions of the Mogul empire whose nucleus had contracted to extend only a little distance from Delhi. Relinquished areas were ripe for the pioneers to settle. The struggle for power between the strengthening Jats and the weakened ruler of Delhi invited the entry of other Jats. Such migrations associated with invasions have been quite common in human history (Nordenskiold, 1917, p. 116).

The third migration of this stage was also connected with invasion. In 1762 A.D. the Jats entered into an alliance with Wazir Jung of Oudh to help him expel the Rohillas from his dominions. After the successful battle the Jats occupied the land around Aligarh and more of them came north from Bharatpur (Srivastava, 1954, p. 249). From Agra and Aligarh the flood of the Jats moved along the Jamuna River to Upper Doab.

In conclusion it may be pointed out that the migration of the Jats started as early as the seventh century A.D. and continued in three stages until the end of the seventeenth century A.D. The
probable original area from which the dispersal toward the east took place was near Multan and in the Bagar Steppe. The main routes were across the sandy plain of northern Rajasthan, through the passes of Aravalli and along the valleys of Punjab, the Chambal and the Jamuna Rivers. The main causes of the migrations were sporadic raids by foreign armies, the dessication of the Hakra river, and resistance to Aurangzebe's policy of Islamic conversion.
CHAPTER II

PHYSICAL SETTING OF THE UPPER DOAB

In the geographical literature of Northern India the term *doab* connotes the land between any two rivers (*doab* is derived from *do*-two and *ab*-river) but the Doab always indicates the land between the Ganga and Jamuna rivers. The Doab is the wedge-shaped area of land that lies between the Ganga and Jamuna Rivers which meet at Allahabad (Map 2). The Upper Doab (Map 5) situated in the western parts of the State of Uttar Pradesh (May 1) consists of the districts of Sharanpur, Muzaffernager, Meerut, Bulandshahr, and Aligarh; and extends in a north-south trending belt. The districts divide the Upper Doab latitudinally (Map 5).

The Upper Doab extends from approximately 27° north latitude to 31° north latitude, and 77° east longitude to 79° east longitude; a distance of about two hundred miles north-south and of about sixty miles east-west. The shape of the region is roughly rectangular.

On its north the Upper Doab is bounded by the low Siwalik Hills which form a distinct physical barrier to the movement of people and culture in either direction. To the south, however, there is no such physical boundary; the district boundary of Aligarh delineates the
INDEX

1. UPPER GANGL CANAL
2. LOWER GANGL CANAL
3. EASTERN JAMUNA CANAL
4. DISTRICT BOUNDARY
5. RAILROAD

MAP 5
southern limit of the region. The Ganga and the Jamuna forming the eastern and the western boundaries of the region have never stood as cultural barriers. Throughout the four centuries of their settlements in the Upper Doab, the Jats have maintained uninterrupted cultural contacts with their people in Haryana and in Rohilkhand (Map 5).

The total area of the region is 9,173 square miles. The total population of the Jats in the Upper Doab is about half a million. The largest of the districts of the Upper Doab, Meerut, has an area of 2,323 square miles and a Jat population of about one fifth of a million. The Jats number about twenty per cent of the entire population of the Upper Doab. This large population of the Jats is commensurate with their cultural importance. The Upper Doab, thus, can be safely termed as the Jat culture area.

PHYSIOGRAPHIC FEATURES

Physiographically, the Upper Doab can be divided into three parts (Map 6): (1) the Recent Eastern Flood Plain of the Jamuna (Jamuna Khadar), (2) the Recent Western Flood Plain of the Ganga (Ganga Khadar), and (3) the Pleistocene Terrace (Bangar) flanked by the two flood plains on the east and the west. Thus, the two major physiographic features of the Upper Doab are the Recent flood plains and the Pleistocene Terrace.
The Jamuna Flood Plain

The Jamuna Flood Plain extends along the entire length of the western boundary of the Upper Doab. It is a low, sandy plain subject to annual flooding. It is more or less level and is lower than the adjoining Pleistocene Terrace. The height of the flood plain above the normal river stage ranges from two to eight feet, and its width varies from half a mile to three miles. During the period of the Summer Monsoons the flood plain is completely submerged by the flooded river with water reaching depths of fifteen feet in some places. During the dry, winter season; and the low river stage, large areas of sands and silts are exposed.

The eastern banks of the Jamuna Flood Plain are about fifteen feet high, and lower than the western banks of the Ganga Flood Plain (Fig. 1). At several places the Jamuna Flood Plain merges gradually with the Pleistocene Terrace, and there is no sharp break in slope that is characteristic of the Ganga Flood Plain (Fig. 1). Gully erosion on the banks has resulted in the formation of small, lateral spurs of the Pleistocene surface. Such a doab fringed with many branching spurs has been termed a fringed doab (Davis, 1899, p. 75).

The present channel of the Jamuna River is located at a distance of one to two miles from its eastern Pleistocene bank. The river has shifted its channel within its flood plain many times in the recent past (Wadia, 1953, p. 388). The flood plain must have extended
A REA OF MAP

UPPER DOAB

PHYSICAL SETTING

A_B PROFILE LOCATION

DISTRICT BOUNDARY

ISOHYET (MEAN ANNUAL)

FOREST (TARAI)

TERTIARY HILLS

PLEISTOCENE SAND RIDGE (BHUR)

PLEISTOCENE TERRACE ALLUVIUM (BANGAR)

RECENT FLOODPLAIN ALLUVIUM (KHADAR)

SOURCE: WADA, TOPO SHEETS, DISTRICT GAZETTEERS, AND FIELD NOTES.

MAP 6
IDEALIZED PROFILE A-B OF UPPER DOAB

FIG. 1
to a greater width in the east, which is clearly evidenced by the long line of villages now located at a distance from the present position of the channel. The small, abandoned channels of the shifting river on the flood plain are in different stages of decay and alluvial filling.

**The Ganga Flood Plain**

The Ganga Flood Plain is wider and far more continuous than that of the Jamuna (Map 6). The width of the Ganga Flood Plain varies from two miles in its northern part to about eight miles in the Meerut district and ten miles in the Aligarh district. In the Saharanpur district it has its greatest width of about twenty miles.

The Ganga River has shifted its channel more frequently and with greater violence than the Jamuna River. The fact that the Ganga River has shifted more toward the east is best evidenced by the changing location of the town of Garmuktesar (Map 5) whose distance from the Ganga River was formerly only half a mile but is now about two miles. The shifting of the Ganga River eastward is increasing the width of its western flood plain.

The Ganga River on its flood plain is a braiding stream, choked with towheads, and divided into numerous channels. The principal channel is identified with great difficulty during the normal river stage. The braiding is due to the excessive load composed of loose sand carried down by the Ganga River (Leighly, 1932, pp. 1-22; 1934, pp. 453-464; Russell, 1954, p. 13; and Rennell, 1781, p. 98).
During the high river stage the entire western flood plain is completely submerged under a vast, deep sheet of water. When the river returns to its normal stage the channels at the foot of the banks are abandoned and form long, finger-shaped lakes. The unequal deposition of sediments during the flood stage also creates surface inequalities, dams water in pockets, and forms small lakes (jheels).

The high, western banks of the Ganga Flood Plain are being continually eroded at a fast rate by an intricate system of gullies (khola). At places these gullies reach a depth of thirty feet from the surface of the Pleistocene Terrace. The break in the slope between the Ganga Flood Plain and the Pleistocene Terrace is abrupt and formed by the almost vertical bluffs (Fig. 1).

The Pleistocene Terrace

The most extensive, and from the viewpoint of human occupancy, the most important geomorphic feature of the Upper Doab is the Pleistocene Terrace (Map 6). This feature has always been termed as the interfluvial upland. It has been variously considered by geographers and geologists as a flat plain (Ahmad, 1952, p. 223; and Dubey, 1935, p. 9) of Pleistocene age (Wadia, 1953, p. 287; Spate, 1954, p. 34; and LaTouche, 1910, p. 199) or simply an elevated plateau (Dubey, 1935, p. 8). To the present writer, the feature appears to be a Pleistocene terrace built up by the floodplain deposits
of the Pleistocene rivers, the Ganga, the Jamuna, and their tributaries.
The Pleistocene Terrace is divided by the narrow flood plains of the
Katha, Kirsani, Hindan, Choiya, Kali, Karwan, Ganda, Sengar, and
Solani Rivers into several small, broad interfluvial uplands (Map 6).

The Pleistocene Terrace is bounded on the west by the Jamuna
Flood Plain. To the west of the Jamuna River extends the Indo-
Gangetic Divide on the axis of the Aravalli Ridge which extends up to
the Himalaya. This topographic conjunction between the Indo-Gangetic
Divide standing as the valley wall and the so-called interfluvial upland
deposited along it is highly significant in identifying the latter feature
as an alluvial, depositional terrace.

Horizontal stratification of the alluvial deposits and their
depths ranging from 3,000 feet (Wadia, et. al., 1935, p. 372) to 9500
feet (Oldham, 1917, p. 77) also suggest the interfluvial upland to be a
depositional alluvial terrace. The presence of lenticular gravelly sand
pockets (Wadia, 1953, p. 39) beneath the surface layer and that of clay
in its upper layers (Login, 1872, p. 195) indicate a grading of coarser
to finer materials from the lower to upper layers and further strengthen
our suggestion that this geomorphic feature represents the Pleistocene
Flood Plain of the Ganga River.

The Pleistocene Terrace is, further, characterized by the
generally reddish color of its sediments and the exposures of nodular
concretions of calcareous sediments (lime or kankar) (LaTouche, 1910,
Calcite nodules are formed by the slow accretion of particles of lime carbonate dissolved out of the slightly calcareous sediments by percolating water and redeposited in the form of nodules as the water evaporates (Wadia, 1953, p. 391 and LaTouche, 1910, p. 198). The reddish color of the sediments is due to their having been exposed to air, leached, and oxidized in the period preceding the Recent (Russell, 1957, p. 377; and Morgan and McIntire, 1959, p. 323).

The transformation of the Pleistocene flood plain of the Ganga into the Pleistocene Terrace was effected by the simple epeirogenic movement which uplifted the western part of the terrace and tilted it toward the east. The evidences of such a postulated uplift are the eastward slope of the Pleistocene Terrace along its entire north-south extension, and the incised streams flowing on this surface. Furthermore, it is only as a result of an uplift that the Pleistocene Terrace has been preserved from being eroded away by the Ganga and Jamuna rivers. Such an idea of the preservation of terrace by uplift has been proposed and substantiated by many geologists for different areas of the world (Russell, 1938, pp. 406-412; Fisk, 1938, p. 69; and Doering, 1935, pp. 651-658).

The possibility of an uplift seems considerable, in view of the fact, that the whole of the Indo-Gangetic Plain and particularly
its northern part adjacent to the Lower Himalaya has been subjected to a continuous isostatic activity. Geologists unanimously agree that there has been an uplift of the Indo-Gangetic Divide during the Pleistocene period (Wadia, 1953, pp. 56-57; Pascoe, 1919, pp. 138-155; and Pilgrim, 1919, pp. 81-99). Probably, along with this uplift of the Indo-Gangetic Divide, the Pleistocene Terrace of the Upper Doab was tilted downward to the east.

**Structure**

The structure of the Pleistocene Terrace, in particular, and of the Upper Doab, in general, is not well understood. The Pleistocene alluvial deposits of former Ganga and Jamuna Rivers completely cover the early surface to a depth of thousands of feet. Since no detailed work has been done, our knowledge of the subsurface geology of the region is extremely limited.

Suess (quoted in Wadia, 1953, p. 4) thought that the Gangetic Plain is a geosynclinal trough which has been filled by alluvium. Burrard (quoted in Wadia, 1953, p. 4) considered the Gangetic Plain to be a rift valley. Wadia argues that Burrard's theory is based on geodetic deductions alone, has little geological evidences to support it, and is not accepted by geologists (1953, p. 4). Wadia further suggests that the plain is a tectonic depression of only moderate depth and its conversion into flat plains is due to the simple process of alluviation (1953, p. 386).
Drainage Pattern

The entire Upper Doab is drained by the systems of the Ganga and Jamuna Rivers. All the major streams are tributaries to the Ganga except the Hindan (Map 6). Generally, all the streams flow on the Pleistocene Terrace in a north-south direction paralleling the Ganga and the Jamuna Rivers. These streams, together, form a sub-parallel drainage pattern (Map 6). Minor streams form a dendritic pattern.

There are few perennial streams flowing on the Pleistocene Terrace, a characteristic found elsewhere too (Morgan and McIntire, 1959, p. 324). Hindan and Solani (Map 6) are the only two perennial streams originating in the Siwalik Hills (Map 6). All other streams originate in the small depressions and marshes of the Pleistocene Terrace. These streams flow for a large part of the year, carry most water during the period of the Summer Monsoons, but are dry during the months of March to June.

The drainage texture of the Upper Doab is medium as is indicated by the small number of the short streams. The rather permeable material of the Pleistocene Terrace is conducive to the evolution of the medium drainage texture (Thornbury, 1957, p. 128). Again, the slight initial relief of the Pleistocene Terrace might have been another factor inhibiting the development of a large number of drainage lines.

In contrast to the medium drainage texture on the Pleistocene Terrace,
the bluffs of the Ganga are characterized by fine drainage texture being dissected by innumerable small streams. This is most probably due to the large available relief as well as the sudden increase in the gradient.

The channels of most of the streams of the Pleistocene Terrace are deep and bounded by the steep walls of the entrenched valleys (Fig. 1). The streams have mainly eroding channels, are single, and remain in the same position from one year to another. The streams are incised and meandering and exhibit striking deformities. Such distinctive, entrenched, meandering courses of the rivers on the Pleistocene Terraces have been observed elsewhere in India (Morgan and McIntire, 1959, p. 324).

The incised meandering of the Pleistocene Terrace streams developed as a result of the uplift undergone by the Pleistocene Terrace. The topographic effect of the incision is preserved by the older, more compact, resistant materials of the valley walls of the Pleistocene surface. The suspended load carried by the streams of the Pleistocene Terrace is rather small, due to the resistant material of the valley walls and, also, due to their short lengths originating within the Pleistocene Terrace itself. Due to the incision the streams never flood the adjacent terrace uplands. The small suspended load prevents the streams from developing either a braiding pattern or a large flood plain. Narrow flood plain is more characteristic of such streams.
Fixation of channels by resistant Pleistocene materials has resulted in their deformities. At every place, where the streams impinge, against the Pleistocene outcrops, they develop bends because the Pleistocene is more resistant than the Recent alluvium. The highly resistant clay-plug fillings of old cut off channels also inhibit meandering and fix the channels, a phenomenon observed and explained as such by other investigators (Russell, 1957, p. 382; 1954, p. 13; 1958, p. 8; and Vann, 1959, p. 349).

Such deformities are also, controlled by faults in the Mississippi Valley of the United States (Russell, 1952, p. 380) and this possibility cannot be ruled out in India until it is definitely known that no faults exist. The possibility of faulting appears considerable in view of the fact that the Upper Doab is included in the zone of crustal weakness and isostatic activity and is, thus, subjected to considerable tectonic strain (Wadia, 1953, p. 41). The alluvium of the Upper Doab conceals a zone of faulting (Randhawa, 1958, p. 22). Sudden bends and the long, straight reaches are undoubtedly controlled by fault patterns. Fault controls are also indicated by the almost right-angled confluence of the minor streams with the tributaries of the Ganga and the Jamuna Rivers. Because of its recurrence over wide areas and in the same east-west direction, the right angular confluence pattern conclusively demonstrates a fault control.
On the Pleistocene Terrace, Bhur is an unusual geomorphic feature that adds a variety to the rather monotonous natural landscape. Although of small size and limited in distribution Bhur is of great geographic interest both as a geomorphic feature and having significant cultural associations.

Early writers have described the form of Bhur in various ways. None of these descriptions, however, are complete. Wadia (1953, p. 393) describes it as an elevated piece of land but he confuses the readers by stating in the same book that Bhur is a sand dune (1953, p. 406). Spate (1954, p. 498) considers Bhur to be low, undulating sandy uplands. Bhur is also considered as a low, sandy ridge (Ahmad, 1952, p. 223); sand plateau of an irregular form (Dubey, 1935, p. 9); sand deposit (Login, 1872, p. 196); and sand dune (Coggin-Brown and Dey, 1955, p. 696).

In appearance, Bhur is a ridge with a flat top and gentle, lateral slopes toward the base (Fig. 2). The Bhur extends in a north-south direction paralleling the Ganga, the Jamuna and their Pleistocene Terrace tributaries (Map 6). It is the length rather than its width that is the characteristic feature of the Bhur. It extends in a single, sinuous line and nowhere exhibits a composite feature like a dune complex or dune chains. Its height varies from ten to thirty feet. The constancy of its width of about two hundred yards is at once striking.
IDEALIZED PROFILE OF BHUR SAND RIDGE

VERTICAL EXAGGERATION x: 6

AB Mukerji

FIG. 2
Flat-topped, gentle-sloped ridges may sum up the description of its form.

The origin of the Bhur has been explained as the result of aeolian deposition (Wadia, 1953, pp. 393, 403, and 406; Coggin-Brown and Dey, 1955, p. 696; and Login, 1872, p. 196). None of these writers, however, indicate the sources of the sand. Wadia's statements (1953, pp. 393 and 406) that the Bhur is found along the banks of the Ganga are true to a very limited extent. The main distribution of the Bhur is in the central part of the Pleistocene Terrace, located far away from the Ganga (Map 6).

Although the sandy flood plain of the Ganga River is a large source of sand, the possibility of the moisture-laden easterly winds transporting the sand against the high western bluffs of the Ganga River is almost nil. At the same time, we do not find any sand dunes at the foot of the western bluffs of the Ganga River. These facts validate Wadia's suggestions about the transportation and deposition of sand by the wind, in the form of dunes.

Toward the west, the Jamuna Flood Plain is equally farther removed from the Bhur and the eastern bluffs of the Jamuna River prevent transport of the sand by the westerly winds. The possibility of the Thar Desert (Maps 2 and 4), being the source of sand for the Bhur of the Upper Doab is nil. The winds blowing in the Upper Doab come from the northwest and not from the west which is the direction of the
Thar Desert. Moreover, there are no sand dunes nor sand ridges like Bhur in the intervening area between the Thar Desert and the Upper Doab. These facts suggest very definitely that there is no transportation of sand by the westerlies.

Recent investigations of the Bhur soil (Gerassimov, 1958, p. 195; and Singh and Chatterji, 1958, p. 191) show that the material of the Bhur soil is not pure sand deposited by wind as Wadia and others have considered it, but sandy loam that has undergone several stages and degrees of oxidation. Different horizons in the profile of the Bhur soil (Fig. 5) have colors ranging from yellow to red, which can easily be correlated with an ascending scale of the intensity of oxidation. It indicates, further, that the Bhur ridge was formed during the Pleistocene period, a fact also stated by Wadia (1953, p. 403). Had the Bhur been a feature formed of accumulated wind-blown sands, during the dry, hot months of the year (Wadia, 1953, p. 393); the soil derived from it and developed on it would have exhibited features entirely different from those described in the preceding lines.

Further evidences to invalidate the hypothesis of aeolian origin of the Bhur can also be adduced. As contrasted against the mobile sand dunes the Bhur ridges are stationary features. The local traditions, comparison of the oldest with the most recent topographic sheets, and toponymical analysis of the names of the villages eight to nine hundred years old, formed with the prefix Bhur indicate that it has long been an immobile feature.
The preceding discussion leads us to conclude that the Bhur is a ridge formed during the Pleistocene period. It was not formed by the sand deposited by the wind. With the data in hand, the writer proposes the hypothesis that the Bhur is a long, narrow ridge formed by the simple process of alluviation. At the time of deposition in the Pleistocene, the sediments, probably, consisted of a greater proportion of sand. The river might have been a braiding one, and the towheads and the channel bars connected with each other formed almost a continuous feature. This was the first stage of the formation of the sinuous Bhur ridge. Thus, Bhur is a braided channel deposit formed in Pleistocene channels on a higher flood plain.

Later, increased alluviation and the shifting of the channel raised the height of the terrace and preserved it. Wind might have piled up the sand picked from the adjoining flood plain, and thus, contributed to the building up of the terrace. Thus, the primary role in the formation of the Bhur was that of the river while wind played only an auxiliary role.

The presence of the Hindan, Kali, and Karwan Rivers along the entire length of the Bhur support the suggested alluvial origin. The form of the Bhur with a flat top and gentle lateral slopes also indicates a ridge made by river deposition. The morphological features of the Bhur soil are additional evidences to support the idea of alluvial origin.
Today the Bhur is broken at innumerable places by cart tracks, motor roads, canals, and the canal distributaries. At many places the lower ridges of the Bhur have been removed and the area brought under cultivation. Bhur soil, generally, is sandy loam with a low moisture-retention capacity. Heavy crops like sugar cane are not grown on the Bhur soil but light crops as millets, pulses, and vegetables are extensively grown on it. There are few Jat villages on or near the Bhur because sugar cane, the main crop of the Jat agriculture does not thrive on this soil.

Also, the water-table in the Bhur tract is very low and the digging and the operation of the deep wells is expensive. The sandy walls of the wells are highly unstable, readily collapsible, need constant repair, and thus add to the cost of maintenance. This explains why the Jats have always avoided the Bhur tract when they first settled in the Upper Doab in the sixteenth century before the modern era of canal irrigation.

CLIMATE

The weather and the climate of the Upper Doab embody most of the characteristics associated with Monsoon areas having interior locations: distinctive seasonal contrasts in temperature and rainfall, low annual rainfall with its high variability for its range, absence of snow or prolonged spells of cold, and a general aridity of the
atmosphere. Between the moist Rohilkhand (Map 5) on the east and the dry Hariyana (Map 5) on the west the Upper Doab displays transitional climatic characteristics. Subrahmanyam (1956, p. 310) places the Upper Doab in the dry, subhumid climate while Trewartha (1954, p. 383) considers it in the Monsoon and Upland Savannah Climatic Region (Cwg) characterized by the hottest month coming before the solstice and the summer rainy season.

**Temperature**

The mean annual temperature over the entire Upper Doab displays a striking similarity. Practically, no temporal variation in temperature has ever been recorded. Spatial differences are almost negligible. Saharanpur in the north (Map 5) has a mean annual temperature of 74° F. while Aligarh in the south (Map 5) has only 77° F. The similarity in the forms of the temperature curves (Fig. 3) of Saharanpur and Aligarh show very definitely a similarity in the temperature regimes of the two places and a spatial homogeneity in the distribution of temperature. The almost reliefless plain and the absence of any spatially variable climatic control operating in a season are highly conducive to the development of a homogeneity of temperature over the entire Upper Doab. Differences are purely local and explainable with reference to the localized factors.

Seasonal variation of temperature is pronounced (Fig. 3). The temperature regime is characterized by one maximum of about
MEAN MONTHLY RAINFALL AND TEMPERATURE

ABMukerji
90° F. occurring in June and one minimum of between 55° F. and
60° F. attained in late December or early January. Thus, the annual
range of temperature is between 30° F and 35° F. This considerable
annual range is due to the continental influences associated with the
interior location of the Upper Doab.

The summer of the Upper Doab is typically tropical while the
winter is like the summer of the temperate areas. It is this climatic
peculiarity that enables the Upper Doab farmers to grow both the
tropical crops such as rice, sugar cane, and cotton in summer and
the temperate crops like wheat, barley, and oats in winter.

A study of temperature curves (Fig. 3) reveals that the
changes from month to month are very little between April and
October. The sudden drop in the month of July coincides with the
period of maximum rainfall and is related to a large cloud cover, a
fact observed and explained as such by Simpson (1921, p. 163). The
temperature rises rather suddenly between March and April and drops
down between October and November (Fig. 3). These sudden changes
are due to the apparent movement of the sun between the Tropics of
Cancer and Capricorn. The movement to the Tropic of Cancer is re-
lated to the increase while that to the Tropic of Capricorn is coinci-
dent with the decrease (Kendrew, 1942, p. 119).

In the northern parts of the Upper Doab, specially in the belt
of area lying along the foot of the Siwalik Hills, the winter temperature
is lower than that of Aligarh. This difference is due to the cold air brought by katabatic winds (dhadhoo) blowing down the valleys of the Siwalik Hills. Snowfall in the Southern Himalayan Ranges also contribute to a lowering of the winter temperature of the northern parts of the Upper Doab.

While the mean annual temperatures show rather constant trends, the occurrence of enormous deviations from the mean are well known. In abnormal years, the summer temperatures have reached 115° F. while those of the winter have dropped down to 33° F. Frosts are not rare, but their severity is little destructive to the growth of the crop plants.

The annual daily range of temperature in the Upper Doab is small. During the winter, however, the diurnal range is large as the nights are considerably colder. During the summer, on the other hand, the continuous cloud cover prevents both the daytime solar radiation to reach the earth and the nocturnal radiation to go out, and thus, retards the diurnal change. In the absence of cloud cover and under the influence of day time hot winds (loo), the afternoon temperatures during the summer shoot up to 105° F. at most places.

Humidity

Paucity and unreliability of relative or absolute humidity data prevent their description and analysis in detail. From the little available data it appears that the relative humidity of the Upper Doab
follows a seasonal pattern of change similar to other climatic elements. As a general statement it may be said that humidity in the Upper Doab is uncomfortably high in the summer rainy season while winters are pleasant and dry.

The maximum relative humidity of about 80% is attained during July through September, thus, coinciding with the maximum rainfall. An abrupt drop is recorded in September when the Summer Monsoons begin to retreat. Relative humidity of about 60% remains stationary from December through January. From January, with the retreat of the Winter Monsoons and increase in temperature, the relative humidity decreases sharply, reaching a minimum of 30% in April. The minimum reached is not commensurate with a comparatively little decrease of rainfall; it is due to the large increase of temperature in April (Fig. 3).

A characteristic feature of the Upper Doab climate associated with high relative humidity is the occurrence of winter morning fogs. Clear, winter skies are conducive to uninterrupted back radiation which causes a large and rapid nocturnal cooling. This condition coupled with a considerable relative humidity activates the formation of the radiation fogs. These are ephemeral fogs and form in the morning. With the ascent of sun over the horizon and the consequent increase of temperature these fogs dissipate between nine and ten o'clock, a feature observed in other tropical areas (Watts, 1955, p. 36).
Monsoons, Air Masses, and Precipitation

The Upper Doab like the rest of India receives most of its rainfall during the Monsoons. The periods between the Monsoons receive only a little rain from local convectional activity and from a few cyclones. It is, therefore, logical to consider the Monsoons, the Air Masses connected with the Monsoons, and precipitation in combination.

The origin of the Monsoons since the time of Halley (1686) has been sought in the thermally-induced pressure gradients resulting from the unequal heating of the Indian Ocean and the Asiatic Mainland. This has been perpetuated as a simple, common place text-book explanation.

With the development of the study of air-mass climatology, the thermal origin of the Monsoons became gradually discredited. It is unanimously agreed upon, today, that the Monsoons are just segments of the general atmospheric circulation of the world and not just large scale convectional currents similar to land and sea breezes.

Flohn (quoted in Trewartha, 1954, pp. 98-99) considers the Indian Monsoons to be modifications of the planetary winds of the Tropics. The thermal low of northern India and the accompanying Monsoon is simply an unusually great northward displacement of the Northern Inter Tropical Convergence (NITC). Flohn further argues that the westerly current of the Monsoon is the expanded Equatorial Westerlies current embedded in the great mass of Tropical Easterlies or the Trades.
In a recent paper Flohn (1952, p. 271) completely rejects the classical interpretation of the Southwest Monsoon as a Southeast Trade crossing the equator and deflected by Coriolis forces. He, now, considers the Southwest Monsoon as originating from the Equatorial Westerlies, when the wet unstable equatorial air mass advances front-like into the dry, stable air mass of the Trades. This advance, Flohn thinks, is caused by the excessive heating of continents near the Solstices, which simultaneously increases the amplitude of seasonal shifting of the Inter Tropical Convergence. Therefore, the "monsoon rains" of India are caused by the seasonal shifting of the ITC region with its cyclonic disturbances travelling chiefly from east to west.

Crowe (1951, p. 68) advances another explanation for the "monsoon rains". He states that trade winds once thrust across the equator are subjected to thermal effects of land which undermine their internal stability. The consequent ascent causes rainfall.

Existing knowledge of the air masses of India is limited. The climate and weather of the Upper Doab result from the convergence and interpenetration of three air masses: Equatorial Maritime (EM); Mixed or Transitional (Tr); and Tropical Continental (Tc) (Malurkar, 1947, p. 148 and Roy, 1949, p. 290). Tropical Continental is specially prominent during the Pre-Monsoon period. This air mass originates in western Asia and has little humidity. It causes a large diurnal range of temperature during the later part of winter and in the

During the winter, the Upper Doab is subjected to cold-front weather. The modified polar air masses coming from southwestern Asia and moist, unstable tropical air mass coming from the east converge on a cold front and produce violent weather. The depressions form in the northwestern parts of India and travel eastward. Violent squalls, extreme turbulence, and thunderstorms characterize these northwesterly fronts (Garbell, 1947, p. 177 and Randhawa, 1958, pp. 34-35).

During the summer, the sharp convergence and cyclonic shear along the ITC form frequent frontal-wave disturbances which cause heavy rainfall in the Upper Doab (Rao, 1943, pp. 83-105). These eastern depressions originate mostly at the head of the Bay of Bengal and travel toward the northwest. In the Upper Doab their monthly frequency is three or four during June through September (Randhawa, 1958, p. 34).

Another notable climatic phenomenon associated with the air masses of the Upper Doab is the hot wind (loo) that blows during the summer afternoons. This hot wind owes its origin to a low formed in the northern parts of the Upper Doab (Malurkar, 1948, p. 48). A more detailed and acceptable explanation suggested by Roy (1949, p. 290) considers the origin of the hot wind in the air mass activity
during the summer. According to Roy, the Tropical Continental air mass after entering northern India gets progressively heated in the lower layers and is then caught up in the cyclonic circulation. This results in turbulent mixing, which together with the surface heating causes the air mass to develop nearly adiabatic lapse rate, with super-adiabatic lapse in the lowest half to one kilometre in afternoons, an ideal condition for instability.

The annual rainfall of the Upper Doab is under 40 inches. This amount is highly variable in amount, time, and space. Spatial variation is at once striking (Fig. 4), although the rainfall regime is similar in the northern and southern parts of the Upper Doab (Fig. 3).

The maximum rainfall occurs during the period of the Summer Monsoon from June through September. This, according to Flohn (1952, p. 271), coincides with the northernmost shifting of the ITC. In Saharanpur 81% of the annual rainfall occurs in the Summer Monsoon while in Aligarh the same period gets 80% of the annual rainfall. Over the entire Upper Doab, winter rainfall forms a small proportion of the total annual amount. The Post-Monsoon and Pre-Monsoon periods covering October through November and March through June respectively, receive the lowest rainfall of about one inch only. With the retreat of the NITC southward the normal trade-wind system is re-established which reduces the rainfall.
MEAN ANNUAL RAINFALL

Inches

North
Saharanpur
Muzaffernagar
Meerut
Bulandshahr
Aligarh
South

Inches

Miles

36
66
103
Miles

Meerut
Bulandshahr
Aligarh

Miles

36
66
137
Miles

Per cent

100

75
50
25

Per cent

100

FIG. 4
Rainfall in the Upper Doab varies considerably from the north to the south as well as from the east to the west. The mean annual isohyets therefore trend in a northwest-southeast direction (Map 6). From Saharanpur in the north the annual rainfall of 37 inches decreases continuously toward Aligarh in the south where it drops to an annual total of 25 inches (Fig. 4). This difference of about 12 inches of rainfall within a distance of only 140 miles, of an otherwise, reliefless plain subjected to almost similar general climatic controls is striking. Proximity to the Himalaya has been sought for a possible explanation. The air reaching the Himalaya is subjected to orographic uplifting which causes heavier rainfall near the mountains. Since the Himalaya is the main region of orographic uplifting, increasing distance from it results in decreasing rainfall (Simpson, 1921, p. 157).

Rainfall decreases from east to west also. The annual rainfall at Hapur in the east is 36 inches while at Bagpat in the west it is only 26 inches, a difference of 10 inches in a distance of about 40 miles. Simpson (1921, p.157) explains it as the result of the drying up of air coming from eastern India and corresponding decrease of rainfall toward the west.

The annual rainfall intensity \( \frac{\text{Annual Rainfall}}{\text{Annual Rainy Days}} \times 100 \) decreases along with the annual rainfall from north to south (Fig. 4).
The annual rainfall intensity at Saharanpur is 88 while at Aligarh it is only 75. Seasonal variations in the rainfall intensity at both the places are significant. At Saharanpur the rainfall intensity during the Summer Monsoon is 96 while during the Winter Monsoon it drops to 49. Values for the same period at Aligarh are 76 and 36 respectively. The highest rainfall intensity during the Summer Monsoon is caused by sudden cyclonic downpours associated with the ITC. Similarly, during the Winter Monsoon, a cold front causes a prolonged rainfall, and, thus, reduces the rainfall intensity.

The advantages of higher rainfall at Saharanpur are somewhat offset by the higher rainfall intensity. At Aligarh, on the other hand, rainfall is low but the rainfall intensity is also low. Thus, with similar temperatures, but different rainfall intensities, the efficiency of rainfall for agriculture is somewhat equalized at both places. Irrigation, therefore, becomes equally important in both the northern and southern parts of the Upper Doab.

The sudden increase in the rainfall from June onwards (Fig. 3) is due to the phenomenon well known as the "burst of the monsoon". Rahmatullah (1956, p. 176) explains it as the result of the appearance of the Equatorial Convergence Zone (ECZ) in northern India in the month of June when the Monsoons start raining suddenly.

In a recent paper Yin (1949, p. 400) relates the "burst of the monsoon" to the movement of the westerly jets. The burst of the
monsoon occurs as a mean low-latitude upper-air trough is displaced rapidly from one steady position near 90° E. to another relatively steady position near 80° E. The westward motion of the trough is caused by the displacement, in May, of a low-latitude westerly jet from a position south of the Himalaya to one north of it.

Rain never falls in the Summer Monsoon continuously for a long period. Short durational, heavy showers alternating with prolonged breaks in between are most characteristic. Crowe (1949, p. 47) relates such breaks in the continuity of rains with the pulsations in the advance and retreat of the trade winds in the north Indian Ocean. Rahmatullah (1952, p. 179) considers the vigorous fluctuation of the Equatorial Convergence Zone (ECZ) and the corresponding fluctuation in the field of the wind as the cause of the variation in the amount of rainfall during different periods within a season.

Another important feature of the rainfall of the Upper Doab is its temporal variability from year to year. This is the most important characteristic of the Indian rainfall (Williamson and Clark, 1931, p. 98). Annual rainfall variability in the Upper Doab is between 45% and 60% (Clark, 1932, p. 289). Variability changes in inverse proportion to the amount of rainfall (Clark, 1936, p. 30; and Williamson and Clark, 1931, p. 45). During the Summer Monsoon the variability of rainfall in the Upper Doab is only 25% to 30% while in October it is about 90% (Clark, 1932, p. 289). Similarly, variability of winter
rainfall is twice that of the summer rainfall (Williamson and Clark, 1931, p. 99). Variability has also been found to vary in an inverse proportion to rainfall intensity (Williamson and Clark, 1931, p. 45). Therefore, in Saharanpur variability is less than at Aligarh.

Discontinuous, variable rainfall of the Upper Doab is of great agricultural significance. So far as the important crops of Jat agriculture as wheat, maize, and sugar cane are concerned, rainfall is deficient and irrigation is indispensable. In the years of rainfall continuing up to October, the land becomes water-logged and there is no sowing of winter (rabi) crops. Variability in the month of October is, thus, of special significance. Similarly, early cessation of rainfall results in the postponement or restriction of sowings for the winter (rabi) crops. Irrigation, thus, becomes necessary in October.

Seasonal rainfall intensity and discontinuous rainfall create major problems for the farmers. Excessive rainfall concentrated within a few days fail to mature crops and damage them considerably. Failure of rain coinciding with the period of germination or of growth result in the failure of crops. On the other hand, a protracted rain during the Pre-Monsoon period destroys the crops standing ready for harvest.

SOILS

The soils of the Upper Doab are alluvial. They are of the greatest value agriculturally. These alluvial soils show minor
variations in density, color, texture, porosity, and moisture-content and in the composition of their clay-factor. In spite of minor differences in composition from district to district, in general they are light-colored loamy soils of a high degree of productivity. They have undergone little pedogenic evolution since their deposition by rivers so late as Pleistocene (Wadia, 1953, p. 508). They are still largely immature and have not developed any characteristic soil profile (Wadia, 1953, p. 508). In general, these statements appear to be true, but recent studies of the soils of the Upper Doab have added considerably to our existing knowledge and modified it.

A detailed discussion of the soil types of the Upper Doab cannot be attempted as no systematic soil-survey of the region has been done yet. For the purposes of land revenue the soils are classified on the basis of their distance from the site of habitation. The circular belt of soils adjoining the habitation is termed bara. Here the soils receive the most liberal supply of manure in the form of animal and human excreta. The color of the bara soil is dark, its humus and nitrogen contents are large, and the soil is highly productive. The belt farther removed from the habitation than the bara is termed manjha. The manjha soil is low in humus and nitrogen contents. This classification, although accepted by the government and used throughout the Upper Doab by the farmers is scientifically least satisfactory.
Recent studies made by the Russian geographer Gerassimov (1958, pp. 193-213) have suggested that the soils of the Upper Doab are to be classified as grey and brown soils (Gerassimov, 1958, p. 195). This suggestion has been supported by Randhawa (1958, p. 24). These soils have small quantities of clay, and consist generally of small sand and silt fractions. Calcareous in nature (Stewart, 1947, p. 8), they are alkaline in reaction, have various amounts of carbonates, and are of a low humus content. In the southern parts of the Upper Doab, especially in the Aligarh district we find zonal red-brown soils (Gerassimov, 1958, p. 202).

Topographically, the three broad soil types are, the Bangar, the khadar, and the dakar.

**Bangar Soils**

These occur on the Pleistocene Terrace. Generally, these are dark brown, argillaceous, loamy soils, with a small amount of sand and a large proportion of clay. Their lime content is high and at places they are diffused with nodular lime concretions (kankar). In general, however, most of the soluble salts and alkaline earth carbonates are leached out.

The idealized profile (Fig. 5) does not display any pan formation of lime concretions (kankar). Iron nodules are normally absent. The soil is neutral to mildly acidic in reaction. Humus is restricted
to A and B horizons only, larger in amount in the former than in the latter. Calcium and sodium are leached in the A horizon and are re-deposited in the B horizon.

**Khadar Soils**

These soils occur on the Recent flood plains of the Ganga, Jamuna, and their tributaries flowing on the Pleistocene Terrace. The khadar soils are annually renewed by flood deposits and hence remain rather immature. They are sandy in texture, mainly pale brown, micaceous, and show very little lime concretions (kankar). Deficiencies of phosphates, nitrogen, and humus limit their agricultural utilization. In the absence of a systematic study, a discussion of the profile of the Khadar soil is not possible.

**Dakar Soils**

Dakar soils are found in flat, basin-shaped depressions (dahar), and low-lying tracts which get inundated during the rains. Such soils have little natural vegetation. Artificial groves are also very few and tree growth is stunted due to the heavy soil texture and the presence of lime pan (kankar) in the subsoil which prevents a good root development. The dakar soils are, however, remarkably well suited for paddy cultivation. The word dakar has been derived from the dhankar soil of eastern Uttar Pradesh, dhankar being compounded of dhan---paddy and kar---produce.
The Dakar soils contain a small proportion of coarse-grained particles. The texture is that of loam to clay loam and the color varies from mottled brown to yellow grey. These soils are very tenacious and can be ploughed only when moist.

In the profile of the Dakar soil (Fig. 5) there is a sharp decrease of clay in the lime pan (kankar) and in the C horizon. Clay content in the eluviated A horizon is twenty-nine per cent and increases to thirty per cent in the illuviated B1 horizon. Illuviation is confined only up to the lime pan (kankar) in B2 horizon.

The distribution of silica and sesquioxides follows that of sand and clay in the profile. There is a slight accumulation of manganese oxide in the B1 horizon. Alkaline earths show a sudden accumulation in the lime pan (kankar) B2 horizon. The higher contents of magnesia in the upper horizons in comparison to lime points to the leaching processes in operation in the soil and a mature state of profile development. The soils are rich in potash. Nitrogen and organic matter contents decrease sharply in the subsoil.

Calcium is the dominant replaceable cation in the A horizon of the Dakar soil. The higher exchangeable sodium content in the layer of the lime pan (kankar) helps to decrease water infiltration in the soil profile. A surface layer with dominant calcium saturation and high percentage of magnesium and sodium in the subsoil layers helping to prevent water percolation are the dominant characteristics.
of the dakar soil making them ideally suited to paddy cultivation.

The hydromorphic dakar soils are situated on low-lying part of the local pedogenic complex. Therefore, the study of their origin should be made with reference to their genetic upland associates (Gupta, et. al., 1957, p. 10).

If the illuvial and hydrolytic action of water in the lowlands and the forces of the superaquivalent phase are superimposed on the characters of the normal profile of freely drained upland soil, one can visualize the genesis of the dakar soil. The resultant effect will be the formation of lime pan and deposition of other products of weathering with consequent diminution of profile depth. Translocation of clay is restricted and eluviation of all the chemical constituents is likewise diminished.

Streaks of grey and brown mottle the background color under alternate oxidation and reduction and have resulted in the formation of iron-manganese nodular concretions. The great accumulation of manganese in the $B_1$ horizon and the disappearance of phosphates from this horizon are the attributes of gley formation. The compact $B_1$ horizon may thus be identified with the gley horizon of the hydromorphic soils (Gupta, et. al., 1957, l. 11). The dakar soils can best be grouped under the tropical grey hydromorphic soils of the intrazonal order (Gupta, et. al., 1957, p. 11).
The extent of dakar soils, although patchy, is quite large in the Upper Doab. Much of it, at present, remains unutilized. The Jats grow a little paddy on these soils and also use it to make bricks. Should the Jats adopt paddy cultivation on a more elaborate scale for commerce and diet, the natural resource of dakar soil would be abundant.

Two more soil types, the bhur and the kallar deserve separate treatment on account of their considerable extent.

**Bhur Soils**

Bhur soils are found near and on the bhur sand ridges. Their color varies from brown to reddish-brown. In virgin bhur soils the contents of organic matter and nitrogen are small. In the cultivated bhur soils, however, the amount of organic matter is fairly high in the A horizon because of heavy manuring for the production of vegetables.

In all the horizons of the profile (Fig. 5) the proportion of fine sand is more than combined proportions of coarse sand, silt, and clay. There is a marked illuviation of clay in the B₂ horizon, as well as, in the C₁ horizon. Calcium content decreases with the depth of the profile while that of iron increases. The soils do not seem to be deficient in phosphates and potash. It is alkaline in the upper and neutral in the lower horizons.
Kellar Soils

These are salt-impregnated or alkaline soils and display saline and alkaline efflorescences. These soils have yet some mineral fragments in an undecomposed state. With weathering they liberate sodium, magnesium, and calcium salts and sulphurous acid. The alkali content of these soils is high, and there is a large excess of free salts (Wadia, 1953, p. 513).

Schokalsky (1932, pp. 149-151) regards the kellar soils as very saline solonets and solonshaks. The salts are transferred to the top layer of the soil from below by capillary action. Irrigation by canal water has facilitated this transference. The salts form a crust in the top soil thus making it impervious. Nothing grows on it. The soil is extremely poor in nitrogen and organic plant-food material.

VEGETATION

In the Indo-Gangetic Plain, in general, and in the Upper Doab, in particular, the original, natural vegetation is characterized by its sparseness, open savannah appearance, and limited number of species. Associations of species are found only in few areas. Some of the species are found in all the ecological habitats. Climatically, the region is suitable for the development of deciduous forests throughout. Man's intervention, however, has prevented the development of
the true climatic climax vegetation in the Upper Doab (Varma, 1936, p. 266).

**Past Vegetation**

The traditional historical evidences of the existence of the forests and cultural fires in widely distributed areas of India and in the Upper Doab are recurrent (Stebbing, 1921, p. 30). The Vedas and the later epics such as the Ramayana and the Mahabharata constantly refer to the existence of various kinds of forests in this area. The existence of a regular department of forests during the Epic period (1,000 to 600 B.C.) is also referred to in the Epics (Bose, 1942, p. 84).

Archaeological evidences based on the study of sculptures, and literary evidences based on the study of the Epics conclusively show, that until the seventh century A.D. a major part of the Upper Doab was covered with wet, tropical forests (Randhawa, 1952, p. 497). During this period a conscious attempt through legislation was made to protect the forests (Bose, 1942, p. 84).

The wet, tropical forests of the Upper Doab contained evergreen trees of Indo-Malayan affinities which flourish at present in Assam, Bengal, Burma, and the west coast of India (Randhawa, 1952, p. 497). Mention of four Indo-Malayan tropical trees: the leguminous, pinnate-leaved ashoka (Saraca indica Linn., Caesalpiniaceae); the large, madder tree with orange sized fruit and spreading branching,
the Kadamb (*An tho cephalus indicus* Rich., Rubiaceae); the rather tall, pale yellow, fragrant flower bearing champak (*Michelia champaka*, Linn., Magnoliaceae); and nagasura, St. John's wort (*Mesua ferrrea*, Linn., Guttiferae) with slender twigs and middle height; constantly recurs in the sculptures of the period 100 B.C. to 800 A.D. and suggests the existence of wet, tropical forests in the Upper Doab (Randhawa, 1952, p. 499).

The forests however changed to a great extent by felling and burning, persisted until recent historical periods. The nature of the forests also changed from the wet, tropical to dry, deciduous forests dominated by a very large, resinous tree *sal* (*Shorea robusta*, Dipterocarpaceae). The sal had actually displaced evergreen forests from the Upper Doab (Champion, 1939, p. 10). The *Sal* forests covered the area until the beginning of the British colonization (Misra and Puri, 1954, p. 27). The North Indian copper-plate grant inscriptions repeatedly mention the existence of forests and forest lands in each village (Gupta, 1933, p. 39). The original, natural vegetation of the Upper Doab before the movement of the Jats into the area was a dry, deciduous forest (Haig, 1958, p. 107) composed, predominantly, of *sal* (Calder, 1937, p. 71; and Spate, 1954, p. 63). Mogul emperors hunted tigers, wild water buffaloes, and wild elephants in the forests of this region until the sixteenth and seventeenth centuries A.D. (Spate, 1954, p. 79). Today the patches of the leguminous tree dhak
(Butea frondosa Roxb., Papilionaceae) in the vicinity of the villages are the vestigial remains of the old forests, which have been cut down and cultivated (Mukerji, 1940, p. 91).

Both cultural and natural factors have been resorted to for the explanation of the disappearance of the original vegetation and the development of the present savannah type of vegetation. Although detailed data on the problem is scattered through numerous memoirs, travel records, and revenue records, no systematic study has as yet been made.

As for the physical cause, increasing desiccation beginning around the eighth century A.D. and continuing up to the present time has been suggested by Randhawa (1952, p. 503) and by Login (1872, p. 186) as the cause of the disappearance of the forests. Randhawa (1952, p. 503) bases his arguments on the present coterminous distribution of the four Indo-Malayan trees mentioned earlier in the evergreen trees of India and adjacent countries to the east.

These evergreen forests receive an annual rainfall of over eighty inches. From the present natural distribution of these four trees Randhawa (1952, p. 500) infers that until about the seventh century A.D. the southern part of the Upper Doab had a rainfall of at least eighty inches or more. Today the rainfall of the southern part of the Upper Doab is less than twenty-five inches. Thus, increasing aridity is a definite conclusion (Randhawa, 1952, p. 501).
Randhawa's circuitous arguments are, however, most confusing. Whether it was the increasing aridity that caused the disappearance of the forest, or the disappearance of the forests as a result of their being burnt and felled by man, which in turn caused the aridity of the region, are problems that are not discussed by Randhawa. Aridity might have been the effect, rather than the cause of the disappearance of the original forest vegetation.

Cultural activities of man have been far stronger and effective in the removal of the original vegetation cover. Three millennia of clearing for agriculture and of unregulated grazing (both often promoted by burning the forest) have stripped the forest from nearly all of the plains (Spate, 1954, p. 63). Activities of man including the felling of the trees and the burning of the forests have been recognized by other scholars (Misra, 1959, p. 3; Baden-Powell, 1896, p. 275; Varma, 1936, p. 266; and Chaturvedi, 1956, p. 455).

The forests were cut and burnt for both cultivation and grazing right from the Vedic Age (circa 1500 B.C.) (Gupta, 1933, p. 246; Chaturvedi, 1956, p. 455; and Wheeler, 1959, p. 126). Definite evidences of slash-burn agriculture are not available but the possibility of the practice cannot be ruled out. The forests were not only cut to clear lands for agriculture but also for wood to be used as fuel, building material, chariots, and a large number of sacrificial implements (Gupta, 1933, p. 246). While the forests were depleted for
economic uses, their preservation was not ignored. Religious in-
junctions preserved the forests during the Brahmamic and Buddhist
periods (Chaturvedi, 1956, p. 455). Dhak (Butea frondosa Roxb.)
and pipal (Ficus religiosa) were never cut down as both were and still
are regarded as sacred. Later, during the Mogul period the forest
suffered the worst than in any earlier period. Unlike the Hindus and
the Buddhists, the Moslems had little compunction about felling trees

The role of the Jats in removing the forest cover in the Upper
Doab has also been of some consequence. During the reign of Akbar
(1556-1605 A.D.) the Jats cleared the forests by felling the trees and
thus settled the cleared lands (Baden-Powell, 1896, p. 275). Such
clearing was most extensive in the central parts of the Upper Doab
where the Jats had settled permanently. The natural vegetation of
the edges of the Pleistocene Terrace and of the Recent flood plains
was relatively little modified by the Jats as their settlement here was
of very short duration.

Present Vegetation

The present vegetation of the Upper Doab is wholly different
from that of the past and displays an open, savannah appearance
(Mukerji, 1938, p. 99). The activities of man have disturbed the
soil: water: vegetation equilibria producing sharp environmental
gradients. As a result we get all stages of temporal and spatial community organization from the almost open ground and water to the relict forests (Misra, 1959, p. 3). The vegetation of the Upper Doab is composed of three broad types: the forest, the woodland, and the grass communities.

**Forest**

The true forest is found in the Saharanpur district on the Pleistocene Terrace (Map 6). This forest community is dominated by pure stands of **sal** (*Shorea robusta*). The sal grows specially well on the loam soils resting on a gravelly sand layer. The sal forests are low, moderately dense, and ordinarily closed. The sal tree has a great range of adaptability to different habitats. It's wood is very hard and is used widely for house building.

**Woodlands**

There are six woodland associations in the Upper Doab. Most of these are found both on the Pleistocene Terrace and the Recent flood plains.

1. Woodlands composed predominantly of the leguminous tamarinds (*Tamarindus indica* Linn., *Caesalpiniaceae*) are found on the riverine strips on both the Pleistocene Terrace and the Recent flood plains. The tamarind is native to tropical Africa but is now grown all over
India. The name tamarind (Imli in Hindi) has been derived from the Persian name tama-i-Hind which means Indian date. This is an indication of its recent introduction. The tamarind grows to a large size and great age. It has a canopy of billowing foliage. It reaches a height of about 50 feet. Its fruit is a pod with three to twelve seeds. The pods are green at first but when ripe they are buff and brittle. Apart from its natural occurrence in the riverine strips, it is found as a planted tree along the road and around villages. Tamarind groves in forests mark the site of deserted cultivation or an abandoned village (McCann, 1955, p. 65). The seeds are a rich source of pectin from which jams and pickles are made. Bark is used as tanning material.

2. Woodlands composed of tamarinds and mangoes (Mangifera indica Linn., Anacardiaceae) are found in both the Pleistocene Terrace and the Recent flood plains around the villages in small, compact groves. The mango is a large, spreading, evergreen tree with dark green leathery foliage; and small, yellow, odoruous flowers. The tree is grown
extensively all over India for its fruits. It is an ancient tree in India and very sacred to the Hindus. Its leaves are used as spoons for the pouring of libations, the wood is used in the funeral pyres, and marriage altar is decorated with its twigs and leaves. The flowers are dedicated to the Moon and Madan (the Indian equivalent of Cupid). The bark gives a gum used in medicine.

3. The woodlands having drought-resistant trees are found in the sandy flood plains (Spate, 1954, p. 63). The typical community is composed of two low leguminous trees: the thorny, gum exuding babul (Acacia arabica Willd., Mimosaceae) with stiff, leathery pods and pinnate leaves; and Prosopis spicigera, Mimosaceae, a low tree with slender, grey branches and edible pods with ten to fifteen seeds. Along with these two trees are found a fair mixture of thorny, dense, slender- branched shrubs Capparis decidua and Capparis aphylla (Capparidaceae) and a spinous tree Diospyros cordifolia (Ebenaceae) (Randhawa, 1958, p. 57). Several species of tamarisk with reduced scaly leaves are also found. The community is
sufficiently distinctive to have been named as rakh vegetation (Bor, 1953, p. 150). Since this community grows in an area with less than twenty inches of rainfall, in the Upper Doab, their distribution is determined by edaphic rather than climatic aridity. Hence, they are found mostly in the sandy flood plains.

The economic use of the community is quite considerable. The pods and branches are fed to goats and sheep. Unripe pod and bark are rich in tannin and are used in tanning. The bark of the babul exudes a gum which is used in place of Gum Arabic and its wood is an excellent fuel.

Continuous disturbance by the biotic factors, such as grazing, cutting of the trees, and intensive climatic droughts have forced some of the trees of the rakh vegetation to become xerophytic (Haig, 1958, p. 107). At places they are less luxuriant, floristically less complex, and have a simple structure with a low (20 to 30 feet maximum) single-tree storey. They are open and stunted (Spate, 1954, p. 69) with the trees widely scattered and thus, displaying a savannah appearance (Haig, 1958, p. 107).
4. Thorn scrub vegetation is found in the drier parts of the Upper Doab. This vegetation type has two sub-types: (1) thorn scrub found in climatically dry areas and (2) thorn scrub found in edaphically dry areas. 

(1) Thorn scrub predominates in the climatically dry areas of the Pleistocene Terrace. Mukerji (1938, p. 103) considers this to be the degraded stage of the original Monsoon deciduous forest, the change being effected by biotic factors. The thorn scrub vegetation reaches its maximum development in the ravines at the edges of the Pleistocene Terrace. According to Mukerji (1938, p. 112) it is in a stage of transition, and appears like savannah with trees interspersed in the thorn scrub woodlands.

Two small deciduous, leguminous trees; shisham (Dalbergia sissoo, Papilionaceae) with rachis zigzag leaves and thin, strap-shaped pods; and khair (Acacia catechu Willd., Mimosaceae) with brown bark, dark yellow flowers and dark brown pod; form a characteristic association on sandy escarpments overlooking the banks (Bor, 1953, p. 83). Other members of the thorn scrub community include Terminalia tomentosa (Combretaceae), a tall tree reaching a height of 80 to
100 feet, with small spicate leaves and a pod with a solitary seed; ber (*Zizyphus jujuba*, Rhamnaceae) a tall tree reaching up to 30 to 50 feet, with solitary straight thorns, and a fleshy fruit with a woody pod; and several species of *Euphorbia*.

The wood of the shisham is used for furniture and house construction. Its wood is very hard and is not eaten by white ants. Its wood is also used for carving. The wood of the khair is boiled and katha made from it. Katha is used as an ingredient in betel leaf for chewing. The ber branches are lopped for fodder and the leaves are fed to the tassar silkworm. Its thorny branches make good fences.

(2) Thorn scrub woods found on the edaphically dry bhur sand ridges on the Pleistocene Terrace are composed of xerophytic species. This vegetation includes leafless karils (*Capparis aphylla* Roth., *Capparidaceae*); kilu (*Salvadora oleoides* Dcne., *Salvadoraceae*) with tough leathery leaves and small flowers; babul (*Acacia arabica* Willd.); hingot (*Balanites aegyptica* Delile., *Simarubaceae*), a low 20 feet high tree with green flowers and large, woody fruit; pilkham (*Ficus cordifolia* Roxb., *Moraceae*), a
strangling fig; thorn bush (Zizyphus spp.) and several species of tamarisk with reduced scaly leaves. Karil, pilu, and babul form the rakh vegetation described earlier. Hingot (Balanites aegyptica Delile, Simarubaceae) thrives well in open country on still clay soil, and is found with other thorny scrubs and xerophytes (Bor, 1953, p. 247).

5. The elevated, well drained, and dry sites on the Pleistocene Terrace have a vegetation composed of the leguminous tree dhak (Butea frondosa, Roxb., Papilionaceae); the berry tree mahua (Madhuka longifolia Linn., Sapotaceae); and the berry tree nim (Azadirachata indica Linn., Meliaceae).

The dhak is a small, deciduous tree with crooked trunk and black branches. It is typical of the open grasslands and is often found in pure stands. It is particularly noted for its profusion of orange and vermilion flowers that cover the tree from January through March. Hence, it is also known as "The Flame of the Forest". The palge, green, young pod becomes pale yellow when ripe. A red, astringent gum is exuded by the bark.
The wood is used by the Jats to line up the wells. Leaves serve as dinner plates on big occasions. The bark produces a tanning material while the flowers are used in making a dye for cloth. The gum is used to cure diarrhea.

Dhak is one of the very few trees of the original vegetation that has survived the destructive effects of man's cultural activities. That is why, it is found, in more or less, pure stands. The explanation is to be found in its antiquity and its sacred nature. Its sacredness is associated with the moon. It is said to have sprung from the feather of a falcon imbued with soma, the beverage of the gods. Dhak leaves are used in the Hindu ceremonies connected with the blessings of calves to ensure their development as good milch animals. The dry twigs are fed to the sacred fire. The wood is sacrificial and is often mentioned in the Vedas (Blatter and Millard, 1954, p. 16). A Brahmin has to eat a dhak leaf at the initiation ceremony. In the trifoliate leaf of the dhak, the middle leaflet represents Vishnu (the preserver), the left leaflet Brahma (the creator), and the right Siva (the destroyer). Eating the dhak leaf is, thus, symbolic
of attaining the godly powers. Dhak, therefore, because of its immense cultural significance has been protected to the present day.

The mahua tree is noted for its delicious and nutritive flowers. It grows up to a height of 50 feet. It is a large, evergreen tree with a thick, spreading crown and lanceolate leaves that crowd at the ends of the branches. The bark is yellowish green, and the red wood is very hard. The fruits are fleshy, green berries and contain from one to four shiny, brown seeds.

The oil from the seeds is used to adulterate clarified butter (ghee), for cooking, for lighting, and for the manufacture of soap. An intoxicant liquor is distilled from the flowers. Low caste people cook the unripe fruit and eat as a vegetable.

The nim tree is a large, evergreen, growing up to a height of from 40 to 50 feet. The long leaves are alternate and pinnate. The flowers appear during March through May as tiny stars borne on long, drooping stems which spring from the axils of the leaves. The olive-sized fruit is yellow or purple.
The nim tree has many uses. The Margosa oil extracted from the seeds is effective in the treatment of leprosy and skin diseases. Leaves and fruits are both vermifugal and the latter are used as purgative. Bark and gum yield valuable indigenous medicines. It is a general belief in India that the mere presence of the nim tree keeps an area free from malaria. The Jat villages have nim trees, mostly wild and protected, scattered at various places, both in the habitation and in the cultivated fields. The Jats cook the tender green leaves with eggplant and eat it considering that this will give them immunity against skin diseases.

6. Characteristic associations of Butea monosperma and Tamarisk articulata Vahl. are found on saline lands on the Pleistocene Terrace. These two are considered as the most salt resistant trees in the entire region of the Upper Doab (Bor, 1953, p. 152; and Randhawa, 1957, p. 144). The Jats use its wood for making ploughs and Persian wheels.

7. Pure stands of the Indian wild date palm (Phoenix sylvestris Roxb.) are found in many wet depressions (dahar) on the Pleistocene Terrace. The saline soils
of these wet depressions can support no other crop except paddy which was not grown in the past to any large extent by the Jats or other culture groups who preceded the former. Today also, the acreage of paddy grown by the Jats is very little. This has resulted in the preservation of the pure stands of the Indian wild date. Furthermore, the little use of the wood also assures its survival. This is a graceful palm reaching a height of from 30 to 50 feet. The trunk is rough and the crown hemispherical. It has thick, pinnate leaves about ten feet long. The fruit is golden orange in color. Valuable fibre is obtained from the leaves and the leaf stalks. The wood gives a durable post or beam but used to a limited extent.

Grass Communities

Two grass communities occur in the Upper Doab. The first is found in moist sites on the Recent flood plains, and the second is found as meadow vegetation on the Pleistocene Terrace.

1. Tall, rank grasses are found on the moist sites of the Pleistocene Terrace. The community is formed by *sara* (*Themeda arundinacea* Rid), a six feet tall grass, with rigid, sharp-edged leaves; and *munja*
Saccharum munja Roxb.). These grasses form a thick, impenetrable, and continuous cover. They have deep, strong roots, and are ineradicable.

2. Meadow vegetation open to grazing is found in the waste lands and the level grounds between the cultivated fields. Thorny bushes are also prominent on such sites. Patches of Zizyphus nummularia are quite common (Randhawa, 1958, p. 57). Annual and perennial grasses give a strong, seasonal aspect to the communities. From July through October the moist meadow is a closed community of the grass Bothriochloa pertusa A. Camus.; Indigofera ennaephylla, a leguminous annual shrub with trailing stems and many branches, and a thin cylindrical pod; the grass Rungia repens Nees.; and the doob (Cynodon dactylon Pers.), a perennial grass with prostrate stem and widely creeping, forming matted tufts with short ascending branches (Misra, 1959, p. 4).

In the dry season the community on such meadows becomes open, but the total strength of the flora is not much depleted on account of the replacements by the winter annuals. Among the herbaceous xerophytic vegetation growing in the dry season are Leptaderia
*Spartium* with erect, cylindrical, almost leafless branches; the spiny *Alhagi camlorum*; the deep-rooted *Arnebia hispidissima*; and *Euphorbia thymifolia* with tough perennating root-stocks (Randhawa, 1958, p. 57).

The dry meadow is typical of the arid areas, not subjected to the retrogressive influence of more intense human factors. In general, they form a continuous cover but under severe grazing conditions the meadows assume a tufted character (Mukerji, 1938, p. 111). In the later stages of succession induced by overgrazing a seasonal grass *Aristida adscenscionis* Linn. becomes dominant.

**Summary and Conclusions**

The original climatic climax vegetation of the Upper Doab before the Christian era was of wet, tropical forests. Later, the dry, deciduous *sal* (*Shorea robusta*) displaced the early wet forests. Several centuries of cultural activities of man gradually destroyed the original forest from all except the small area in the Saharanpur district. One significant conclusion is the fact that the present vegetation of the Upper Doab has been produced largely by human activities.
The natural vegetation of the Upper Doab consists of three types: the forest, the woodlands, and the grass communities.

1. Forest, dominated by sal (*Shorea robusta*) is found on the Pleistocene Terrace in the Saharanpur district.

2. Woodlands are found on the following sites:
   a. Riverine strips on both the Pleistocene Terrace and the Recent flood plains dominated by the tamarind (*Tamarindus indica*).
   b. In both the Pleistocene Terrace and the Recent flood plains village groves composed of the tamarind and mangoes (*Mangifera indica*).
   c. Rakh vegetation, found on the sand flood plains formed of babul (*Acacia arabica*), *Prosopis spicigera*, *Capparis spp.*, and *Diospyros cordifolia*.
   d. Thorn scrubs are found on climatically dry and edaphically dry areas. Shisham (*Dalbergia sissoo*) and khair (*Acacia catechu*) form a characteristic association.

Ber (*Zizyphus jujuba*) and Terminalia tomentosa are other species found in the climatically dry areas of the Pleistocene Terrace. Thorn scrubs found on the edaphically dry bhur sand ridges on the Pleistocene Terrace are formed by xerophytic species, as karils
(Capparis aphylla), pilu (Salvadora oleoides) and hingot (Balanites aegyptica), pilkhan (Ficus cordiofolia), and several species of tamarisk.

e. Dhak (Butea frondosa), mahua (Madhuka longifolia), and nim (Azadirachata indica) form an association on elevated, well drained, dry sites on the Pleistocene Terrace.

f. Distinctive association of Butea monosperma and Tamarisk articulata are found on saline lands in the Pleistocene Terrace.

g. Pure stands of the Indian wild date palm (Phoenix sylvestris) are found in wet depressions on the Pleistocene Terrace.

3. Tall rank grasses, sara (Themeda arundinaceae) and munja (Saccharum munja) are found on the moist sites on the Recent flood plains. A meadow vegetation formed of Zizyphus mummularia, Bothriochloa pertusa, Indigofera ennaephylla, Rungia repens and doob (Cynodon dactylon) is found between the cultivated lands of the Pleistocene Terrace.
WILD ANIMALS

With the gradual disappearance of the native vegetation from the Upper Doab, its wild animals also have become either extinct or reduced in numbers. This process of extinction of the wild animals like the removal of the native vegetation has been operating since the Vedic Age (circa 1,500 to 1,000 B.C.). No detailed work exists on the historical animal ecology of the Upper Doab, although, historical documents are replete with references to wild animals in relation to vegetation and cultural activities.

Wild Animals of the Past

Lions, tigers, bears, buffaloes, apes, and elephants were the seven wild animals (aranyak) mentioned repeatedly in the epics written in the Upper Doab (Bose, 1942, p. 66). Lions (Felis leo) and tigers (Felis tigris) were the principal carnivores. Tigers abounded in the humid forests of the north while lions inhabited the southern drier parts of the Aligarh district. Ravines of the Jamuna Flood Plain were inhabited by large herds of lions. The depredations of lions and tigers in killing the smaller animals and human beings needed a communally organized defense (Bose, 1942, p. 65). Clan organized hunting of wild animals with the help of dogs was widely practiced (ibid., 1942, p. 67).

The wild animals, however, persisted as long as the vegetation that sheltered them endured the axe of man. In the absence of a
subsistence economy based wholly on hunting, wild animals were assured of a large measure of preservation. They were killed either for ceremonial purposes or when they became definitely destructive. They were protected by the ethical principle of non-violence to living things (*ahimsa*). Animals and birds were also regarded as conveyances (*bhanas*) for gods and goddesses. (owl for Lakshmi, the Goddess of Wealth; the peacock for Kartik, the God of Warfare; the lion for Durga, the Goddess of Power; the swan for Saraswati, the Goddess of Knowledge; etc.) and hence killed very rarely.

In the recent historical periods hunting was widely practiced by the rulers and the local lords. Historical documents describe a large number of both carnivorous and herbivorous animals found in the forests of the Upper Doab in the sixteenth and seventeenth centuries A.D. Elephants, wild buffaloes, and rhinoceroses are specially emphasized (Mukerji, 1938, p. 123). The extinction of the animals by hunting was selective. The Mogul period hunting concentrated on tigers, lions, and larger animals. Babar hunted tigers, rhinoceroses, wild elephant, and wild buffalo (Mukerji, 1938, p. 135) while his grandson Akbar hunted tigers and lions along the Jamuna Flood Plain (Mukerji, 1938, p. 136). Wild elephants inhabited the swamps of the flood plains (Mukerji, 1938, p. 136), and wild pigs were numerous and used to attack the men on the fields (Mukerji, 1938, p. 126).
The disappearance of the wild animals is closely linked with the removal of vegetation. The cultural activities of the medieval colonists of the Upper Doab completed the triangle of animals-vegetation-man relationship. Among themselves these three raise an interesting but little understood problem of the changing ecological balance.

The lack of large open spaces among shrubs and thickets which gradually superseded the aboriginal forest, made it difficult for the large predaceous animals to pursue their prey. Hence, they gradually dispersed or declined rapidly in numbers (Mukerji, 1938, p. 126). Animals were also destroyed by men for their safety (Mukerji, 1938, p. 126). With the gradual reclamation or drying up of the swamps and marshes, the larger semi-aquatic animals like the rhinoceros, the wild buffalo, and the pig became extinct. Later, the tigers, lions, and the elephant followed the path of extinction. Deer, antelope, and black bucks still abound in the remnant vegetation.

**Wild Animals of the Present**

The larger wild animals of the present times inhabit mostly the ravines along the flood plains of the Ganga, the Jamuna, and of some of the smaller streams. Both carnivores and herbivores are found in this habitat. The tiger, striped hyaena (*Hyaena striata*), leopard (*Felis pardus*), jackal (*Canis aureus*), and the large wolf (*Canis pallipes*) form the carnivorous community.
The herbivorous community is formed by the Nilgai (*Portax pictus*), the black buck (*Antelope bezoartica*), the hare (*Lepus ruficaudatus*), and the wild pig (*Sus serofus*). The Nilgai is found near the streams in the dry season. The Indian gazelle (*Gazella bennetti*) commonly called the ravine deer, inhabits the barren ravines along the Jamuna River. Rooting and digging animals like moles and porcupines are common in the flood plains. The animals are hunted for meat and for hides. The quail of the procupines is used as a pen.

Bird communities are large and varied in the flood plain areas. The small common crane (*Grus cinerea*), stork (*Ciconia alba*), large egret (*Heredias alba*), and jabiru (*Mycteria australis*) are found widely distributed. Among the birds of prey the vulture (*Neophron percnopterus*) is the most prominent.

On the high bluffs the Indian cliff swallow (*Lagenoplastes fluvicola*) and rose-winged paroquest (*Palaeornis torquates*) make their nests. Peacocks inhabit the deep, barren ravines. The *saras* crane (*Grus antigone*) lives along the banks and on the sand bars. In the swamps we find spoonbills (*Platalea leucordia*) and black geese (*Sarcidornis melanotus*) (Hornaday, 1904, p. 75). Black patridges inhabit the areas near the rivers while quail is found in the scrubs near the water bodies. The shooting of the birds is forbidden by religious injunctions. But sometimes they are shot for meat.
The rivers abound in all kinds of fishes. Two kinds of turtles, *Batagur thurgii* and *Trionyx gangeticus* are abundant. Fresh-water porpoise (*Platanista gangetica*) is found at various places.

On the upland bangar wild animal life is limited both in number and variety. Millennia of cultivation has wiped away the vegetation that sheltered the wild animal life. A few open areas have wolves (*Canis lupus*), wild hog (*Sus scrofa*), and black bear (*Ursus labitus*). The wild elephant (*Elephas indicus*) inhabits the moist forests of the Saharanpur district. In other swampy areas swamp deer or *bara singha* (*Cervus duvaucelli*) is abundant. Savannah type of environment near the edges of the bangar is inhabited by the sambhar deer (*Cervus aristotelis*).

Fields are infested with field mice (*Arvicolah* spp.) which are very destructive to the harvest. The jungle cat (*Felis chaus*) and tree cat (*Paradoxurus musanga*) are quite common. Black bucks maraud the wheat and barley fields which are protected by drum sounds made by the farmer sitting on a watch post in the fields.

Insects are infinite in number but of negative significance. Collembolans, termites, dragon-flies, locusts, beetles, spiders and hymnopterans are found in all the parts of the Upper Doab.
CHAPTER III

JAT VILLAGE SETTLEMENTS IN THE UPPER DOAB

The Jats like most of the other agricultural groups of Upper Doab live in compact, nucleated villages (Figs. 7 and 8). The feature that distinguishes their villages from those of others is the three-tier plan on which they are built. This plan has been introduced only by the Jats in Upper Doab, for other groups have not acquired this trait. It is the thesis of the writer that the Jats themselves acquired this trait either from Malwa or from Rajputana by their contact with the Rajputs. Thus the three-tier Jat village settlement plan in Upper Doab is a created form rather than an evolved one.

PAST MORPHOLOGY

The early eighteenth century Jat village was generally surrounded by a mud wall, and a ditch, as a protection against thieves. The settlement was often entered by gates made of bricks. The gates contained side-rooms where the older people sat and gossiped. The main streets of the village ran through one gate to another and with numerous alleys formed an intricate pattern. All the houses were joined to each other by common walls, leaving very little of the open, unbuilt space. This was the morphology of the village in the past (Mukerji, 1940, p. 70).
PLATE 4

The ghairs in the foreground and the havelis in the background. Compact Settlement is evident.

PLATE 5

Compact Settlement. In the foreground are the gul, the sugar cane fields, and the embankment road.
PRESENT MORPHOLOGY

In the present period the walls and ditches have disappeared, the gates and their rooms are found rarely and the aspect has become more open. The external form of the villages is polygonal, the irregularities being due to the incorporation of built-up areas during the several periods of its growth.

Internally, a Jat village consists of a three-tier plan (Fig. 7). There is, first, a central compact block of female dwellings (haveli). In this area, the houses have their walls against each other, forming a continuous built-up area. The doors of the houses open on to the minor alleys which are extremely tortuous and which very often end as blind alleys closed by the back walls of the houses. The shape of the central built-up block is half-elliptical like a horseshoe.

The second element of the three-tier plan is the wide road that runs around the central block. This road has both the entrances on the same side.

Outside the road is the second area of male dwellings (ghair). It skirts the road in a belt and does not form a block. The doors of the houses open on to the main road and their back walls face the cultivated fields.

The three-tier plan of the Jat settlement is also shown by its generalized profile. The highest terrace in the centre has the smallest
horizontal width (Fig. 6 and Plates 4 and 5). It consists of the tops of the female dwellings of important and rich families. These dwellings are generally of three stories. The height is about forty-five feet. Enclosing this center is found the second, intermediate terrace of maximum horizontal width. This consists of the tops of the female dwellings of the average peasants. The dwellings are about thirty feet high and of two stories. The third terrace on the periphery of the settlement consists of the tops of low male dwellings (ghair) whose height is about fifteen feet. These dwellings are invariably of one story. Between the second and third terraces the profile shows a deep valley-like gap that is the street.

LANDSCAPE EXPRESSIONS OF SOCIAL FEATURES

Family Blocks

The houses belonging to the members of the same parental family are grouped in blocks (bakhal), similar to the kumi of Japan (Hall, 1931, p. 99). These blocks constitute an unitary division (tholla) of the village and are under the administrative control of some important person of the division. Many of these divisions constitute a larger unit (pana), under the administrative control of the village headman (lambardar).
Caste Neighbourhoods

The houses belonging to different castes are found, grouped in different areas of the settlement. Thus there is a distinct caste-wise specialization of built-up area in the settlement. The dwellings of the untouchables (shudras) are found in the most unhealthy area, generally near some waste-drain or mosquito breeding pool. This area is generally the farthest removed from the nuclear area. The nuclear area contains the havelis of the Jats. In the outer residential belts are found the ghairs of the Jats and the houses of the low castes. Each neighbourhood is constituted of the houses belonging to one caste only.

Reclit Features

Certain relict features are observable in the Jat villages. These consist mainly of walls and fortifications built in medieval times. In some villages the walls are found intact as in Jalalabad in Muzaffernagar district. Such walled villages are generally found on the contact-point sites where the flood-plain (khadar) and inter-fluvial upland (bangar) meet each other. The walls are built both of mud bricks and thin kiln-baked mud bricks (lakhaoria).

Features of Worship

The Jat villages contain few places of worship. Few of the villages have temples. Out of a random sample consisting of one
The broken brick room is the jathera and the small mound of earth with a tree on it is the bhumia.

A modern school building in a Jat Settlement.
hundred and seventy-seven villages in Ghaziabad sub-division (tahsil), only thirty-one were found to contain temples. In Jat villages, however, are normally several shrines connected with ancestor worship of the different clan-ancestors. Among such places of worship is the place of the Jathera cult. Jathera is a form of ancestor worship in which the bridegroom at the time of his marriage pays his respects to the ancestral spirit believed to reside in a shrine. This consists, generally, of a mound of earth or a brick-built room (Plate 6). Each clan has its own jathera, so, there may be several such shrines in a village, inhabited by several clans.

In contrast to the clan jathera is the village bhumia. This also is a mound of earth (Plate 6) built on a spot near the proposed settlement at the time of its founding. On this mound (bhumia) the man who died first was burnt. Eventually a brick-built shrine was constructed on this mound. The dead man was thus deified as the bhumia (earthgod).

Each Jat village has its own cremation site (murdaghat) which is invariably situated in a field on the side of the village pointing toward the Ganga River. In general, the cremation site is fixed in a fallow and uncultivable field (banjar, kallar, usar, reh, and parti qadim). But if such a field is not available in the desired direction, the site is fixed in a cultivated field. There are often several cremation sites, each for a different caste of the lower caste
strata. The site belonging to and used by one low caste cannot be used by another low caste. The Jats, however, permit the use of their cremation site by the lower caste.

**Water Features**

In the cultural landscape of the Jat villages the water bodies, created artificially, are very important elements. The ponds (jhor) and wells (kuan and chah) are ubiquitous.

Every Jat village has one or more ponds, situated at the periphery of the built-up site (Plates 6 and 30). These ponds were created by the digging of earth for the construction of houses. Some ponds are as old as the village itself. The ponds belong to the village council (panchayat) and are used for various purposes by the entire village community. Low-caste people bathe and wash their clothes in them and clean their domestic utensils too. The cattle are washed in these ponds. The water is not used for human drinking. Water nuts (singhara) and lotus flowers are also grown in these ponds.

Each Jat settlement contains a large number of wells, most of them lined with bricks or cement (pucca kuan). The population size of the village has a rough correlation with the number of wells, while their distribution within the built-up area is related directly to the caste-differentiation. There are wells for Muslims, for Jats and other higher castes, and for the untouchables. Even the wells for the untouchables are further divided for their use by its different
constituent castes. A well reserved for use by the leather-working caste (chamar) cannot be used by the janitor caste (bhangi) who stand at the lowest rung of the ladder of the caste hierarchy.

The brick-walled wells are large, with their diameter ranging from six to ten feet. Water is lifted in metal pitchers by a rope that runs on a pulley.

**Commercial Core**

The permanent commercial core is nonexistent in the Jat settlement. The few shops dispersed in various sectors of the settlement cater only to the needs of these localities. Temporary shops are crudely constructed on the sites of periodic markets (painth). The site of the periodic market is fixed at the periphery of the settlement on some barren field, near the canal or near the pond. The shops are arranged in a square, leaving plenty of space within for the large crowd of buyers. (For a detailed description and analysis of a bi-weekly market, see Mukerji, A. B., 1957. Bi-Weekly Market of Modinagar. Indian Geographer, Vol. 2, No. 2, pp. 271-293, Delhi).

**Internal Road System**

The road system within the settlement is very intricate and without any formal plan. The major street (Fig. 7) runs in a horseshoe form around the nuclear core; from this several narrow and tortuous and sometimes blind alleys penetrate inwards. More often
COMPARATIVE MORPHOLOGY OF UPPER DOAB RURAL SETTLEMENTS

KHANDARPUR (JAT)  
BAKHARBA (JAT)  
GAONRI (JAT)  
FATEHPUR (TYAGI)  
KALCHINA (MOSLEM)  

MALE HOUSE (GHAIR)  
FEMALE HOUSE (HAVELI)  
LOW CASTE HOUSE  
POND  
WELL  
CART ROAD  
MAIN ROAD  
CANAL  
TRAIL  
MOSQUE  
ABANDONED SITES  
NAT SETTLEMENT

FIG. 7

SOURCE: VILLAGE MAPS
than not, a way through the maze of streets is found with great difficulty. The main street is generally paved with bricks. (Photos 23, 39, 844) while some of the alleys leading to the female houses of rich peasants are also paved with bricks (kharenja). The paving of such alleys is financed by the rich peasants. Other alleys are unpaved. During the rains these become impassable, both to pedestrians and vehicles (Plates 3 and 40). The breadth of the main street is about ten feet, just sufficiently wide to allow the easy movement of the bullock cart.

SITE AND SIZE OF JAT SETTLEMENTS

The Jat settlements are found built on artificially raised sites. When a village is founded, the first thing done is to dig out tanks to hold rain water for cattle and for washing; the village is built on the spoil bank; and in the course of time as old houses fall down and new ones are built, the village is raised higher above the surrounding plain (Ibbetson, 1882, p. 120). Such artificially raised sites are common in many rural settlements (Aurosseau, 1920, p. 229). Natural topographical control of the sites is rare. The site is merely the centre of an almost featureless tract of cultivated fields (Dubey, 1935, p. 159). Near the settlement is always a pond, which acts as a reservoir for the heavy and sudden downpours of rain in the absence of proper drainage, and thus saves the settlement from flooding.
**Contact-Point Settlements**

A long line of Jat settlements stretches along the high banks of the Ganga and Jamuna Rivers (Fig. 1). These are both the contact-point and dry-point settlements. The contact is between the flood-plain (khadar) and the Pleistocene Terrace (bangar). They are dry-point sites too, as they are not flooded in the years of normal flood. The banks are quite high throughout the entire settled area, ranging from twenty to thirty feet above the adjoining flood-plain.

The settlements here are set in broken lands (Fig. 8). The gullies extend mainly in an east-west direction, eroding back through the high banks. They protect the settlements from deluges of rain water from the interior, since they carry it rapidly into the major streams. In the past, the gullies gave protection against marauders, while these marginal settlements in turn formed a long line of defense for the central bangar settlements.

The sites of these contact-point settlements are permanent. The banks are both high and stable. Stability is due to the calcareous nodular formations (kankar) which form the different layers of the vertical wall. Since the main channel of the Ganga has shifted to the east, there is now little undercutting or caving of the high bank. The settlements on these sites are more than three hundred years old.
1 CONTACT-POINT SITES (LINEAR PATTERN)
2 BANGAR SITES (KNITTED-KNOTTED PATTERN)
3 RAVINE SITES (IRRREGULAR PATTERN)
/ CART TRACK  SETTLEMENT
/ CANAL  POND
/ KHADAR  SAND BARS
/ UNMETALLED ROAD  DISSECTED SLOPE

FIG. 8
Central Pleistocene Terrace Settlements

The sites of the settlements in the central parts of the Pleistocene Terrace (bangar) indicate a complex relationship between the canals, roads, tanks, wells, cart tracks, and sometimes also the small streams (Fig. 8). Here are the largest and the most prosperous settlements and the maximum concentration of Jat villages. One of the most characteristic elements of the landscape of this region is the elaborate pattern of irrigation canals. Almost all the Jat villages are found situated near the canals, their distributaries, or their minor channels (Fig. 8 and Plate 5). The poorest sites may be too high for ordinary canal levels. Such sites extend in line within an area dissected by ravines, where it is difficult to sink wells.

The central bangar sites are nodal, each village being a focus of several roads (Fig. 8), ranging from cart tracks to good motor roads. The older settlements like Khanjarpur (Meerut district) were situated around a well, dug by the cooperative effort of the community. The subsurface rocks are soft, and the water table is quite high everywhere. The soil being compact, the walls of the wells are stable. Consequently, maintenance is not an expensive affair and the longevity is great. Most are as old as the settlements themselves.

Site Shifting of Jat Settlements

One of the most interesting phenomena in the culture history
of the Jat settlements is the shifting of their sites. A large number
have changed their sites several times during their life. An example
may be cited.

The settlement of Daulatpur Urf Farrukhabad Kayastha
Gaonri (Fig. 7) was established by the Baloochees on a site removed
from the road (Fig. 7). Later they left it and the village was destruc
ted, becoming reduced to a mound (khera). Next, the gypsy people
(banjaras) founded the settlement near the site abandoned by the
Baloochees (Fig. 7). This was also deserted and another mound
formed in course of destruction (Fig. 7). The Kayastha caste people
followed the gypsies, and founded the village on its present site, near
the canal (Fig. 7). The Jats came later and ousted the Kayastha
people. The shifting of the settlement sites has resulted in the exis
tence of the two raised mounds of abandoned sites.

Such mounds are common features in most of the Jat villages.
Some villages contain several mounds, indicating previous abandon
ment and the shifts of the sites. The village of Bamnauli (Meerut
district) has as many as four mounds.

Size

The Jat settlements are characterized by their enormous
areal and demographic size. The length, for example, of Lumb
(Meerut district) is about five miles. The maximum and minimum
distances between two settlements are about four and two miles respectively. The distribution of the settlements is, in general, quite uniform, with few areas of concentration or empty space. Hence, the villages are, in general, of large areal extent, as, for example, Adha (1,460 acres), Ahar (3,825 acres), Malakpur (3,686 acres).

Large population of these villages is very characteristic (Mukerji, 1940, pp. 69 and 70). Daha (5,126), Tikri (7,773), Nirpura (6,205), and Doghat (6,119) are typical examples.

FUNCTIONS OF THE JAT SETTLEMENTS

The Jat settlement, like its universal counterpart, is mainly a place of residence. Thus, its function is residential. A few shops scattered here and there in the settlement cater only to the local needs, their number depending on the material prosperity and the total population of the settlement. Periodic markets (painth) are held in many Jat settlements serving smaller settlements around them. These markets are held in different settlements on different days of the week, so that, the cultivators and the artisans get an opportunity to buy and sell their products on several days of the week, in one settlement or another. In these markets the harvests are sold by the farmers and bought by the agents of the moneylenders (mahajan).

The settlements situated at the center of the smallest revenue sub-division (parganah) are the seats of its headquarters. Lawar,
Sardhana, Loni, and Hastinapur are such settlements in Meerut district serving the needs of administration. Many villages, during the Mogul period, had administrative functions as headquarters for the revenue sub-divisions (tappa and mahal). Even after the dissolution of the old administrative system, these settlements continue to enjoy the same importance due to historical inertia. Lawar (Meerut district), once the headquarter of a sub-division (tappa) of forty-five villages is an example.

Most of the Jat villages have schools giving free education to their children. The student body is fairly large. Being rich and constantly striving for material progress, the Jats encourage education greatly. Education is becoming an important function of these villages.

HISTORICAL DEVELOPMENT

Three-Tier Structure

The compact nucleated village is indigenous in this area, as has been pointed out earlier. The characteristic morphological feature is, however, the horseshoe pattern of the road and the three-tier structure. This unique pattern is not native to this area and is not found in the settlements belonging to other castes, tribes, and groups of people. The Rajput, Muslim, and Tyagi villages have
altogether a different morphology (Fig. 7). This suggests that the three-tier structure most probably was brought by the Jats from their early habitats.

The Jats of Upper Doab have in general come from Malwa Plateau and the Bharatpur area. In these areas, too, the conditions during different periods before the establishment of Bharatpur State were most unsettled. The peaceful regime of Bharatpur kings was frequently disturbed by raids on the frontiers and minor rebellions within.

The forested area was large. Only in very few patches were the forests cleared and settlements established. Wild animals were a constant dread. Tales of Akbar hunting tigers in Malwa are still very popular in that countryside.

During those days in Malwa, when the Jats had first established their settlements, the influence of Rajputs was very strong. The necessity of a union to fight against their common enemy, the Muslims, was very well realized by the Jats and Rajputs.

Thus the need for defensive measures against the frontier raids, Muslim attacks and wild animals was acutely felt. This need had a great influence on the plan of the village. The geometrical plan of the Rajput village was thus an adaptation to the purpose of
defense. The most common Rajput village plan has a nucleus of the fortified buildings of feudal lord, surrounded by a road and an outer belt of the houses of his subjects.

Besides the needs for defense, social customs also necessitated two houses for almost every Rajput family, one for the males and the other for the females. This trait was borrowed by the Jats who also built two houses. Thus the nucleus, in later periods, contained the female houses and the outer belt the male ones. Only the nature of the buildings and their functions have changed, the plan remaining the same. Instead of a fortified group of buildings, there is, in a Jat settlement a nucleus of female houses (havelis) and in the outer belt the houses of males and cattle (ghair).

Thus we find that the three-tier plan is a Rajput trait introduced by the Jats in Upper Doab. Probably it was brought by them from the Malwa region. In that region it is still the most widespread trait in the settlements of both Rajputs and Jats. The route by which the Jats migrated north to southeast Punjab and Upper Doab via Bharatpur has a close correspondence with the distribution of this three-tier morphology.

Nucleated Settlement

Although the three-tier plan was a Jat introduction, the nucleated settlement was already in existence in Upper Doab. The
settlements in ancient times were not continuous; large areas of forests were interspersed between the large nucleated settlements. The need for protection against wild animals and forest robber bands or dacoits (dasyus) necessitated a strong, nucleated settlement.

The daily activities were organized on a community basis. The ploughing, sowing, irrigating, and harvesting of the fields involved the participation of the whole community to which the lands belonged (Baden-Powell, 1896, p. 204). The clearing of the forests was too big a task for an individual, so that too was a community activity. The source of water for domestic purposes and for irrigation was centralized in a few common wells in the settlements.

All these physical and cultural conditions were conducive to a nucleated form of the settlements. It would not be unreasonable thus to suggest that the nucleated settlement in this area is of great antiquity. It appears definitely to be a local development.

The first land settled by the Jats was on the high banks, near the edge where the flood plain and the Pleistocene Terrace meet. The upland edge was the most suitable site for the first settlements. The Jats coming along the Ganga and Jamuna formed small nuclei near the rivers. The water was easily available and abundant here. The high banks are never subject to the normal floods of the rivers. The open and thin vegetation of babul (Acacia arabica Willd.) growing on the sandy soil near the edge of the upland must have been cleared very easily.
The Jats did not venture in the initial stages to move to the central parts of the Upland but remained on its edge. Until then, the area was partly forested. The basic units of revenue (parganahs) were cultivated spaces in the forest clearings occupied generally by a single clan (Smith, 1919, p. 400). There were villages in the central upland owned and cultivated by the Muslims. Several important Muslim states, like Baghpat and Sardhana (Meerut district) and Jahangirabad (Bulandshahr district), preserved and protected by the active help of the Delhi emperor resisted the movement and settlement of the Jats in the central upland.

The settlement of the Jats in the villages of central upland was possible during the period following Aurangzebe's death. The authority of the Delhi government contracted to a radius of about fifty miles around Delhi. This was the time when Jats in large numbers came from their border villages and captured the central villages with looting, arson, and murder.

The second impetus to Jat settlement was given by an unique policy of the British government. It granted villages with proprietary rights to the Jats who had rendered services to British families during the mutiny of 1857. Many Jat estates were originally established on these grants. Pali (Bulandshahr district), Mendu (Aligarh district), and Mohiuddenpur (Meerut district) are settlements which came into existence this way.
Thus it is that originally the settlements of the Jats were spread on the two edges of the bangar and formed a linear pattern of distribution. These are some of the oldest Jat settlements. Innumerable Jat villages in the central upland have alliances with the border villages by marriages. More often than not, the Jats of the central bangar villages still own lands and houses in the border villages. One or two members of the parent family remain in the border villages and cultivate the fields.

The Jats in the recent past used two methods to acquire the villages belonging to other communities; one reflects their martial character and the other reveals their shrewd business acumen.

Whenever and wherever the Jats found that the peasants and landlords (zamindars) were weak, they virtually captured the settlements and village lands by arson, loot, and murder. Bakharba (Meerut district) was originally a very large settlement belonging to Tyagees. The Jats captured it by violence in 1880. Now there is not a single Tyagee family in this village. Literally hundreds of villages now belonging to Jats and situated in the central upland were captured from other groups in this way.

The second method was the purchase of the entire village by the Jats from the Muslims owners. Partabpur and Mehrauli (Meerut district) are two examples. These villages were once owned by Muslims who grew sugar cane and produced unrefined sugar (gur).
The Jats from Karnal (Punjab) visited these villages to exchange their cereals for the gur of the Muslims. On discovering the profitable nature of the sugar cane crop, they began to manipulate to purchase the villages. Ultimately they succeeded and now there is not a single Muslim family in these two villages.

Besides these two main methods there were a few others by which the Jats acquired and settled their villages. The case study of Hathras (Aligarh district) is a typical example. The ruling Jat house of Hathras traces its origin to one Makan who came from Rajputana in the late sixteenth century A.D., and settled near Mursan (in Hathras sub-division). He was himself a Taneja Jat and married a woman of Mursan. Partly with the aid of her clansmen and partly by his own efforts, the country then being but imperfectly developed, he and his descendants acquired a considerable estate. In the course of time the parent village threw out hamlets (dakhili mauzas), all occupied by the descendants of a common ancestor. These clusters of settlements came to be known as talupas. The dakhili mauzas became large nucleated settlements and in their own turn threw out more dakhili mauzas.

FACTORS OF SITING AND NUCLEATION

The Jats specialize in the cultivation of sugar cane, which is a heavy crop requiring heavy loamy soil. The Jamuna flood plain
(khadar) was not therefore suitable for the initial occupation of the Jat. The largest number of Jat villages are now found in the central upland (bangar) (Mukerji, 1954, p. 19). Other geographers have noted the attractiveness of the terraces for human settlements in the upper valleys of the rivers (Brunhes, 1952, p. 67). The upland consists of large extent of continuous flat and easily workable land which facilitates the construction of canals, their distributaries and minor channels, and the cultivation of sugar cane on an extensive scale.

Generally, the villages are situated near the canals. The villages being older than the canals, the latter were constructed so as to pass near the former. Such villages benefit very largely from the irrigation facilities and thus are productive and wealthy. However, in the lands situated at a level lower than the canals, inundation results in a widespread deposit of salt efflorescence (reh). This decreases the productivity of the lands and eventually the wealth of the villages.

It is noteworthy that the type of site used by the Jats in the Malwa region is found again in the contact-point sites of Upper Doab (Fig. 8). In the Malwa region, the site was a rocky outcrop or broken land surrounded by a meandering river and its ravines, perfect for defense. High sites also gave protection against floods. Nearness to the river as the only source of water was also essential as the hard, metamorphic rock could not be easily broken for the digging of a well.
The building of the settlement on a new site was necessitated primarily by the needs of defense. There was a period of general disorder when the Jats were beginning to settle in these settlements. That the defense requirements were particularly significant is amply supported by the fact that kheras are not so widely found in Malwa. There the settlements were always situated in inaccessible places and therefore needed no shifting. In Upper Doab, due to the proximity of Delhi, the capital of the Mogul empire, the impact of political disintegration was felt most keenly.

The settlements were built on new sites also because the Jats considered it inauspicious to build on a ruined Muslim settlement. It was also considered inauspicious to build on the ruins of any settlement belonging to any other community excepting the Jats themselves.

During the later periods, shifting of the settlements from one site to another was also induced by the new irrigation channels and distributaries. The shifting was not related to irrigation itself but to the facilities offered by the channel for drinking and washing water for cattle. It is also used by women for washing clothes.

Thus, settlement sites were shifted for causes, natural or cultural.

The nucleated settlement as has already been described is of great antiquity in this region. The earlier conditions still prevail. The Jat settlements almost always consist of one single, compact
site (Brockman, 1901, p. 80).

It is necessary to emphasize, that the factors of physical geography, like the supply of water, and the productivity of soils did not cause the nucleated settlements of the Jats. These were merely conducive to such a formation and did sustain the form once it was established. Tribal mode of occupation of land and its division, communal ownership, and a survival from an early nomadic life were more potent factors of the creation of the nucleated form.

Before the Jats came in Upper Doab, they were already occupying nucleated settlements in Malwa and western Rajputana. Living together in a nucleated settlement was a characteristic trait of their nomadic culture. In Upper Doab, the villages they occupied subsequently were already nucleated, so they found a similarity with their own trait. There were thus, conditions which helped the trait to live on, unchanged. Moreover, due to the inertia of this trait, the new villages they built were also nucleated. However, the number of such villages created by the Jats is extremely small.

Thus the nucleated villages of the Jats were neither created nor developed as such by them. They, in general, just moved into the nucleated villages. Hence, it is important to explain why the Jats did not create a form other than the already existing nucleated one and not the factors which created it. In other words, we must know the
factors which helped the survival of the nucleated form of the Jat village and the contribution of the Jat culture toward this phenomenon.

For the pioneer Jat settlers, probably, nothing was more necessary than a proper and strong arrangement for protection, of their crops, their properties and their cattle. Crops required protection against smaller animals like the pig and deer, their own persons against the larger animals like the tiger. In the more open country there was the constant danger of freebooters. Protection against all these threats induced the Jats to live together, and this was conducive to a survival of the nucleated form of settlement.

A set of common objectives and activities could best be worked out by a "living together". The factors of necessity of cooperation for irrigation, defense against insecurity, agrarian regime and agricultural economy were also operative here. They are universally valid in many lands and in different periods (Huq, 1930, p. 54).

Agrarian regime has played an important role in keeping the settlement in its nucleated form. What Richtofen said about the Chinese villages is true of the Jat villages as well. "They are groups of families, united by a common descent, or at least having rites in common, who cleave to one another because of the necessity for cooperating in the cultivation of the same crops" (Richtofen, 1882, p. 680).
Intensive farming and the communal routine of agriculture dependant formerly on wells and now on canals, have favored the nucleated Jat settlement (Mukerji, 1940, p. 69). Jat panchayats (socio-political groups) were based until recently on cultivation carried out as a communal activity (Jayaswal, 1939, p. 128). These panchayats always favored one compact site for all the houses of the village. The collective management of pastures and distributions of water supply has succeeded an earlier regime of collective ownership and periodic redistribution of holdings, village groves, and meadows (Mukerji, 1940, p. 61). It has similarly been noted that the compact settlement may be held to imply the existence, at least at the origin, of some form of communal cultivation (Demangeon, 1925, p. 199).

The distribution of holdings and the regulation and distribution of water, which equally call for consolidation are contributory factors of the nucleated settlements of the Jats in Upper Doab (Mukerji, 1940, p. 63).

We do find even now a considerable extent of mutual cooperation in agricultural activities. Wells, tanks, cremation sites, and pastures belong, generally, to the village council. Agricultural implements are very often exchanged and borrowed, between the people of the same village.

There is a definite relationship between the field pattern and the nucleated form of the Jat settlement. The holding of a peasant
here consists of several fields scattered all over the village (Map 7). Now, since the fields are scattered over the entire village, it becomes all the more imperative for the peasants to live together in a central spot. The scattered field pattern equalizes the opportunities for all and its successful utilization is closely related to the centralizing effect of the nucleated settlements (Mukerji, 1940, p. 63). The same author emphasizes that the scattered field pattern cannot work without the centripetal force of the nucleated settlement (Mukerji, 1940, p. 63). From all the scattered fields, the farmer in a nuclear core is at a minimum distance. The transport of plough, cattle, and carts to and from the scattered fields has further fostered the nucleated settlements.

Nucleation also reflects the nature of colonization of the Upper Doab settlements by the Jats. The colonization was organized by well-knit clan communities and not by individual families. The appropriated villages and the settlements were the property of a particular clan and managed under the bhaiyachara system of tenure. That such a tenure resulting from the clan colonization fostered nucleated settlements has been noted by several authors (Crooke, 1894, p. 103; Mukerji, 1940, pp. 5-6; and Baden-Powell, 1896, p. 275).

Among the Jats there are strong superstitions about the sites of the dwellings which prevent the disintegration of the nucleated form. A new site for a dwelling located away from the site of the settlement
is avoided as far as possible because of the fear that it may prove inauspicious. A house can be built only after the sanction of the priest as regards the site has been obtained. A Jat, it is considered by the rural folk, cannot build his house beyond the boundary of the settlement site indicated by the existence of a shrine of the village god (bhumi). This is an important factor contributing to the preservation of the nucleated form. Moreover, the site of the ancestral house being sacred cannot be abandoned. Furthermore, the extension of a settlement on the south or west is also forbidden, the two directions being considered of ill omen. South is associated with death (Yama) and west with darkness (Nishada).

It is a common practice with geographers to resort to physical geographical explanations for cultural features as the nucleated form of settlement. The present student found such explanations invalid in most cases of the Jat settlements. We have no evidence whatsoever that the factors like the uniformity of relief emphasized by several authors (Demangeon, 1925, p. 199; Blache, 1950, p. 316; and Mukerji, 1940, p. 75), uniformity of soil fertility (Demangeon, 1925, p. 205), and availability of underground water caused the nucleation of the Jat settlements. It was not the availability of ground water but the cooperative effort, both the physical labor and money required to dig the well and maintain it by annual repairs that fostered such a nucleation.
It is interesting to note, further, that even in areas where canals have been constructed and the wells are no longer so important, the nucleated form still persists. This is largely due to the inertia inherent in such a form maintained by the Jats as they seem to have a preference for it (Mukerji, 1940, p. 71).

Evidences are very conclusive, therefore, to validate the thesis that the nucleated Jat settlement is the resulting expression of historical events and cultural heritage.

LIFE CYCLE OF A JAT SETTLEMENT

The study of different periods of growth, senility, and decay in the history of a Jat settlement has given rise to the concept of the life cycle of the settlement. Two settlements were studied by the writer: Gadana (Meerut district), a settlement founded in 1857 A.D., and Bakharba (Meerut district), founded in 1746 A.D. Enquiries concerning the changes undergone by the settlements were quite definite in showing three periods of what may be termed formative, resultant pattern, and recent changes. The cultural landscape of the settlements during the three periods also underwent a change. The following statistical data support the notion of three stages in the life cycle of the settlement.
## TABLE 1

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of plots purchased</th>
<th>Percentage to the total plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1857 to 1908 A.D.</td>
<td>1,538</td>
<td>82</td>
</tr>
<tr>
<td>1908 to 1942</td>
<td>291</td>
<td>15</td>
</tr>
<tr>
<td>1942 to 1957</td>
<td>35</td>
<td>3</td>
</tr>
</tbody>
</table>

## TABLE 2

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of fire-baked brick houses</th>
<th>Percentage to the total brick houses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1857 to 1908 A.C.</td>
<td>37</td>
<td>15</td>
</tr>
<tr>
<td>1908 to 1942</td>
<td>85</td>
<td>34</td>
</tr>
<tr>
<td>1942 to 1957</td>
<td>126</td>
<td>51</td>
</tr>
</tbody>
</table>

## TABLE 3

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of persons emigrated out to other professions</th>
<th>Percentage to total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1857 to 1908 A.D.</td>
<td>8</td>
<td>1.1</td>
</tr>
<tr>
<td>1908 to 1942</td>
<td>25</td>
<td>3.5</td>
</tr>
<tr>
<td>1942 to 1957</td>
<td>67</td>
<td>9.5</td>
</tr>
</tbody>
</table>

(These data for Gadana were supplied by the Kanungo of Jalalabad pargana of Meerut district)
Formative

The village was purchased by the Jats from the Banias (trading caste). During this period the Jats were expanding the cultivated area of the village by purchasing lands from other villages (Table 1). The purchase was effected not only through clear proposals but also by force, arson, and even murder. Manipulations were practiced. The patwari (village accountant) was bribed to change names of the owners in the revenue registers. Much litigation was carried on. In short, this was the period of unstable conditions.

Cultivation was not of a high standard. The main task was to extend the territorial limits of the village. Land near the village was deemed worthy of incorporation. Large plots were purchased at one time by individual families.

The building activity was at an accelerated rate. Large mud-brick houses were being erected. The streets, however, remained unpaved. In the nucleus building activity went on without interruption and also without plan. Immigration was rapid and there was clearing of woodlands to extend the cultivated area.

Resultant Patterns

This period was characterized by the consolidation of possessions. Few plots were purchased during this period (Table 2) probably because of the lack of financial resources.
The landscape had altered. More large brick houses were built (Table 2). Brick paving of streets was extended. Digging of canals, distributaries, and other minor irrigation channels was completed. By and large the standard of cultivation was advanced. The Jats became especially attached to the land and their cattle whose number increased enormously. There was a slow, steady, natural growth of population. Though the contact with towns had begun, the characteristic self-sufficient economy persisted.

Recent Changes

This is, in general, the period of stagnation. The first material expression of such a state of conditions is the extreme subdivision, fragmentation, and scattering of the fields constituting the holdings. The rapid breakdown of the joint-family system results in the fragmentation of the original large blocks and the scattering of the fields.

Economic life is changing fast. Plots are being sold to the villagers of other villages. The houses are becoming urbanized (Table 3) with city utensils and furniture. Even the exterior form of the house is becoming urbanized, with large windows and iron railings. Most of the new houses are built of fire-baked bricks.

Social life is being disturbed by drinking, prostitution, and the cinema. Many go to urban areas (Table 3) for jobs, and acquire
the urban evils more than the urban good. More of the landlords are now entering into business and professions. Some build their houses in towns. Contact with towns is regular and hence the typical life of the village is undergoing a gradual transformation.
CHAPTER IV

JAT HOUSES

The traditional Jat house is a distinctive element in the rural landscape of Upper Doab. Like their settlements, the houses of the Jats do not display a distributional variety. The influence of cultural traditions is thus uniformly spread over the whole area of Upper Doab, affecting and resulting in the same type of house. The object of this chapter is to describe and interpret the form, function, and structure of the Jat house, and to trace its evolution and dispersal.

The form, function, and structure are related not only to the physical milieu but more so to the culture of the people. The use of mud bricks as the basic building material reflects the local geographic environment, but the form of the house is the result of its cultural antecedents and the present agricultural economy. The traditional Jat house has resisted changes to a very great extent, so that they can be studied in their original form, function, and structure.

BUILDING MATERIALS

The building material of the Jat houses is always mud. This is dug out from ponds during the summer when the cracked surface of the dry bottom makes it easy to work. Besides, the mud is dug out in
summer as the houses are to be built in this season before the rains start. The use of mud for bricks is very old in this region. Stone is rarely used. Wood is used for the roof and doors. Mud is used for making the bricks, and for the plastering of the walls, the roof, and the floor.

The mud dug from the ponds is mixed with water to form a thick paste (gara). This is put in rough, big wooden moulds to form large bricks (dhaiya) measuring, eighteen inches by eight inches. The process is easy and economical. The bricks are dried in the sun. More substantial houses are built of fire-baked mud bricks which are far more durable and regular in form but are smaller than sun-dried bricks. The sun-dried bricks are mortared by the mud itself which is very tenacious; lime and sand are also used for mortaring, lime being available locally in the form of calcareous nodules. The modern rich Jat house uses the Portland cement for mortar.

Besides mud, wheat stalks (bhoosa), and yellow soil (pilia) are extensively used. Wheat straw, with mud is used for plastering of the outer surface of the walls while dung and pilia are used to plaster the interior surface.

The use of wood for the construction of the house is very limited. The climate, notably the very warm and very dry summers, followed by a rainy season cleaves the wood until it is destroyed. The white
ants and other insects whose swarming is favored by the climate de-
teriorates the wood rapidly and its preservation becomes very diffi-
cult (Dubey, 1935, p. 164). Again, during the process of colonization
and extension of cultivation, the woodlands were being cut down con-
tinuously and today the source for wood is all but gone in this region.
Of the several woods, that of the Nim tree (*Azadirachata indica*) is
used most. This wood resembles mahogany, is mottled, hard, and
heavy. When derived from old trees, it is so bitter that no insects
will attack it. Mango wood (*Mangifera indica*) is soft and durable, and
is admirably suited to planking. Jamun (*Eugenia jambolana* Lam.)
and Sheesham (*Dalbergia sissoo* Roxb.) wood are also used extensively.
The poorer houses use a considerable quantity of dhak wood (*Butea
frondosa*) which grows locally, everywhere. The use of wood import-
ed from other areas of the country is extremely limited.

CONSTRUCTION OF THE HOUSE

The construction of the house is a community activity. Many
families cooperate in this work in a system of joint labor. The con-
struction of the roof, wall, and the floor is quite elaborate but the
time taken is not very long. After the harvest in March and April, "peasants are comparatively free. The house has to be built before the
rains start in the middle of June."
Foundation

The walls are built on foundations that are some four to six feet deep below the surface of the ground. In the foundation is a large amount of lime nodules (kankar) and broken bricks from the ruins of the houses are mixed with new bricks. This is considered to make the foundation strong. The width of the foundation is about five feet. When the foundation is filled up to the surface, the construction of the walls begins.

Walls

The walls, as they rise, gradually become slightly thinner. The thickness (asar) of the walls on an average is three feet, in some cases as much as five feet. The walls are constructed, as usual, by the systematic placing over of the bricks, one above the other. The bricks are cemented with mud. Then, the outer surface of the wall is plastered (lisai) with a paste of clay and crushed wheat stalks. This plaster is quite thick and sticks for about five to ten years. On the inner surface, the plastering (lipai) is done with a paste of cow or buffalo dung and yellow soil. All the walls are erected simultaneously, so that they are completed at the same time. The walls are built up to a height (bheet) of about fifteen feet in the first story.
Roof

After the walls are constructed, the flat roof is added immediately. First, the frame of long beams (karis) of wood is placed supported on the two long walls. The long beams are of sheesham wood and very strong. Small rectangular wooden pieces (barange) are placed on the beams covering the empty spaces between them completely. Thus the beams (kari) and the rectangular pieces (barange) form a cross-pattern. On this initial surface of the roof is placed a layer of dried grass (poola), cut and dried in bunches. The long bunches are opened and spread over the kari-barange framework. The layer of grass is uniformly spread about one foot in thickness. A layer of mud is added to that of the grass. This layer of six inches of thickness, covers the grass layer thoroughly and compresses it somewhat. The two together are compacted into a strong surface by light pounding with a small wooden mallet, generally performed by women. The last layer is that of dry, powdered earth, spread over the entire mud surface. Another light pounding completes the roof. The roof is then divided into small portions, each over one room, by mud dikes. In the roof over the room where grain is kept, a small hole (dhumala) is opened for light.

Floor

Construction of the floor is much simpler. Low spots between
the four walls are filled with mud; and by pounding a flat, level floor
is constructed.

TYPES OF BUILDINGS

On the basis of form and functions, there are three separate
buildings erected by the Jats. These are called ghair, haveli, and
garhi. The first two buildings constitute the house of an average Jat
peasant while the garhi is a large fortified house including within one
building both the haveli and the ghair.

Ghair

The ghair is a one story building (Plates 8, 9, 10, 11, and
Fig. 9). It has a simple rectangular plan. On one side of the long
wall, are three or four bedrooms for the males. There is a verandah
whose roof is an extension of that of the rooms adjacent to it. Other
rooms generally do not have verandahs. The rooms have no windows
and have only one door for each one of them.

The other side of the ghair contains the cattle stalls, which is
an open, rectangular room, very often thatched with a sloping roof.
The thatch is made of wheat stalks and local grass. A room for green
fodder faces the stall from the opposite side of the ghair.

The walls are perpendicular and the roof is flat (Plate 16).
The characteristic flat roof has been noted by several earlier writers
(Sion, 1929, p. 312; Dubey, 1935, p. 163; Bose, personal
PLATE 8

Ghair of an average Jat farmer. Note the milk buffalo, the open courtyard, and the fodder cutter in the verandah.

PLATE 9

Ghair of a rich Jat farmer, with a car, tractor, and the brick-built rooms.
PLATE 10

View of a ghair. Note the wooden-wheeled gadee, trees for the shade for cattle and men, and the bitora being built-up.

PLATE 11

Ghair of a poor Jat farmer. Note the high earthen wall and the cattle stalled under the shade.
PLANS OF JAT HOUSE AND GHAI R

H A V E L I  F I R S T  F L O O R

1. BED ROOM
2. DUBARI
3. MILCH BUFFALO STALL
4. DINING ROOM
5. KITCHEN
6. HAND PUMP
7. STAIRCASE
8. CHAJJA
9. WATER TANK
10. BARJA
11. MANGERS
12. DRAFT CATTLE STALL

H A V E L I  S E C O N D  F L O O R

A. FUEL
B. JUNK
C. GRAIN
D. SGR
E. FIELD
F. GREEN
G. DAIRY
H. DRY MAIZE
I. IMPLEMENTS
J. IMPLEMENTS
K. IMPLEMENTS
L. IMPLEMENTS
M. IMPLEMENTS
N. IMPLEMENTS

G H A I R

A. WELL
B. CHOWK
C. BED ROOM
D. STORE ROOMS
E. FIELD
F. DRY MAIZE

FIG. 9
communication). There is a low, mud wall surrounding the entire courtyard. One large gate is cut in one of the side walls, farthest removed from the stall. A long platform of mud, containing built-in mangers is erected by the side of the stall where the cattle stand under the shade of the neem trees (Azadirachta indica). Near the stall, is a suction pump worked by hand, to supply water to the cattle.

Haveli

The plan of the haveli (Fig. 9) is also roughly square or rectangular. The rooms form four blocks flanking the four sides of an enclosed courtyard. The courtyard is the basic element around which the buildings are erected. It has been noted as such by several earlier writers (Sion, 1929, p. 312; Dubey, 1935, p. 164; Bose, personal communication; and Sankalia, personal communication). The roofs are continuous.

The entrance to the courtyard (Fig. 9) is through a room known as dubari with two doors not in line. In a line with the dubari are four more rooms. On the side opposite the dubari are three large rooms. On the two other sides are three rooms each. This completes the first story plan.

The second story plan (Fig. 9) contains few rooms. In front of the rooms are rectangular roofs known as chajja. These are extensions of the roof under which are long open verandahs called tibari.
Chajjas are flanked by low walls. On the side in which there are no rooms there is one long tibari and one raised platform called barja which has a window looking toward the fields.

Only a few windows open toward the road. The doors and windows open toward the courtyard (sehan). The number of doors and windows is extremely limited, at the same time, the doors are narrow and low. Specially the entrance door is always lower and narrower than the doors placed in the interior (Dubey, 1935, p. 164).

The third story (Plates 12 and 13) of the haveli contains one single room in one corner. The rest of the roof is bounded by high walls. This room contains large windows on all the four sides. The bounding high walls also contain many windows.

Garhi

Garhi is the completely isolated and fortified house, connected with the settlement by a cart track. In form the garhi is rectangular. Within, it is divided into two large blocks containing the ghair and the haveli. It also contains small houses for the agricultural laborers. The garhi is bounded by very high brick walls and is entered by a high-vaulted door. While the garhi is limited in distribution, it is a symbol of prestige, comparable to the castles of the local lords built in the medieval ages, and displays many Rajput features.
PLATE 12

A modern haveli. Note the Portland cement plastering, iron railings in the windows, barja on the right, and the third-story-room on the left corner.

PLATE 13

An old haveli, with a fortress appearance. Note the solitary room on the top story.
FUNCTIONS OF BUILDINGS

**Ghair**

The functions of haveli and ghair and their different portions are both fixed and elaborate. The main functions of the ghair are directly related to the agricultural economy. The ghair can be thought of as a farmstead for within it are provisions for man, beast, and implements. In the ghair are draft cattle, the fodder cutter, the cane crusher, the bullock carts, and other agricultural implements. The large area of the courtyard of the ghair is necessitated by its several functions, mentioned above, and including the small water tank in the centre near the hand pump. During the two seasons of sowing and harvesting the ghair is the place of busy activities. Corn heaps are made in its courtyard and winnowing and threshing carried on.

The two bedrooms infrequently used by the males are occasionally occupied by guests.

The verandah is necessary for proper ventilation and to keep the sun rays from direct contact with the walls of the room. During rains it provides shelter where the idle peasants sit and gossip. An arch-form gate adds prestige to the ghair. The wide gate allows an easy passage for the large carts and tractors to enter the courtyard. Sometimes the gate is closed with strong wooden door panes.
Haveli

While the main function of ghair is agricultural, that of the haveli is domestic and residential.

We enter the courtyard (Plate 15) through the dubari which prevented, in older times of insecurity, the enemy to enter the courtyard directly through the offset doors, and now prevents any foreigner from doing so. The objective of excluding the women from the sight of non-family males is thus fulfilled. The two small, windowless rooms on either side of the dubari serve to store dung cakes and maize cobs used as fuel and cattle feed, respectively.

Since the kitchen, dining room and granary are used for feeding the family, they have common doors opening into each other. This arrangement facilitates the bringing of cereals and other food materials into the kitchen. The three rooms open into the verandah (tibari) which again provides ventilation and a shield during the hot summer and protection from rains.

In the granary is a large boxlike mud or wood chamber (kuthala) provided with a lockable door. The kuthala protects the grain against fire and theft.

Across the courtyard are the four rooms containing dairy implements, milch buffaloes, and green fodder. Here the women prepare ghee (clarified butter), makkhan (butter), and dahi (curd), using many metallic pitchers and long wooden churners. Though
the four rooms form an organic unit, they do not open into each other. The object is apparently to keep the dairy room clean. All these rooms excepting the room for green fodder open into the tibari.

Opposite the dubari are three rooms, the central one for the old females, who keep a constant and direct watch over the entrance into the courtyard. At the corners are rooms for gur (unrefined sugar) and for residence.

The courtyard (sehan or chowk) has several functions, on different occasions. It is here that the children play, the old women gossip, the young girls sing in chorus and the women from the kitchen get a breath of fresh air. It is here that the marriage altar (mandap) is erected (Plate 14). When a member of the family dies, his body rests in the courtyard for a period of mourning before the funeral procession sets off.

The second floor of the haveli is mainly residential in function. The several rooms belong to the several sons of the family. The young girls, wives of the sons, and their children occupy these rooms. The chajja is primarily meant for ventilation (Fig. 9). The barja permits a draught of air to enter the house, while the adjoining raised platform enables the women to view the landscape in seclusion (purdah) (Fig. 9). The solitary room on the third floor, formerly used by males to keep watch over the household and the fields, is nowadays used very rarely.
PLATE 14

Marriage rites being performed in the courtyard.

PLATE 15

Courtyard of the haveli. Note the well in the foreground and the verandah on the right.
The factors of agrarian economy, climate, and building materials affecting the Jat house have been discussed already. Social factors and historical conditions have also been significant in the present Jat house. The rectangular form offers more convenient floor space for an easy and more satisfying division according to the needs of the joint family system.

ASPECT OF THE BUILDINGS

Defense has necessitated a compact form, especially for the havelis. For defense also, the main doors of the houses open on blind alleys. The havelis have high walls. The number of doors and windows is kept to a minimum. Young girls, wives, and children reside in the second story.

The architecture is very simple and sculpturing is almost totally absent. The walls are bare of any ornamental and artistic decorations. These indicate the absence of artistic consciousness among the Jats. The main emphasis is laid on the functional aspect of the house.

The orientation of the house is guided by superstitions. The house must never have a southern or western aspect since the southern direction is dominated by the God of death (Yama Raj) and the west is dominated by the darkness (Nisha). Therefore, a house with a north-facing door is always built in front of one with a south-facing door to counteract the evil effects of the south-facing door. Generally,
the havelis face toward the east, i.e., toward the Ganga river. The east is regarded auspicious because of sun-rise (Suryodaya) and the north is the direction of the Himalaya (i.e., devalaya or the abode of Gods). The geographical interpretation of this superstition given by Dubey is as follows: The hot winds (loog) come in this area from the west while the moisture laden cool winds (purabaiya) come mainly from the north and east. The morning sun is never as red as that of the afternoon, hence a house must be turned toward the east or the north (Dubey, 1935, p. 162).

It is always unlucky to build a house broader in front than at the back. Such a house is called sher-dahan (lion mouthed) or baghdahan (tiger mouthed). A house to be lucky should always be cow mouthed, i.e., it should be broader at the back than in the front. Houses to be lucky should also have an even number of sides, preferably four, six, or twelve.

EVOLUTION OF THE JAT HOUSE

A discussion of the problem of the evolution of the Jat house is necessarily based more on speculation than on historical data. The main reason for such a limitation is the complete lack of archaeological evidences. No work on the house types of earlier periods has yet been done for this area and there is no book on the domestic architecture either of India in general or of Upper Doab in particular.
The earliest houses were all built of mud and sun-dried mud bricks (Sankalia, personal communication). The average age of such houses, rainfall remaining fairly constant, was probably fifty to eighty years. Wind and rain, sooner or later, eroded the house away which thus disappeared without leaving any trace on the surface. It is therefore, very difficult to reconstruct the plan and the details of the house as it existed in the past.

The student proposes the thesis that the Jat house has come as a diffused trait from southwest Asia. The similarities between the southwest Asian mud house and the Jat house are at once striking and may not be entirely fortuitous. The similarity in the basic form, the inner courtyard surrounded by rooms on its four sides, the rectangular plan of the house and the courtyard and the flat roof is very persistent. The few cases of deviations are just accidental anomalies and do not in any way weaken our suggestion of the Jat house having its antecedent in the southwest Asian mud house.

In Upper Doab itself, the archaeological remains go to prove that the roofs were made of thatch and did not have the inner courtyard, the walls were made of clay bricks, but baked in fire, using wood as fuel. The house consisted of several huts with gable roofs, laid outwards from a single, longitudinal beam of log wood. The vulnerability of the house, to fire because of wooden building materials is amply demonstrated in the classical stories of Mahabharata, which
PLATE 16

Flat, terraced roof of the compactly built houses.

PLATE 17

Courtyard of a poor Jat haveli.
describes the mass destruction of villages by fire ignited by the enemies. We have, however, no archaeological evidences of the existence of a flat-roofed, mud brick house in Upper Doab. It seems therefore highly probably that the present Jat house is not a native of this area since it has no local antecedents.

Though the mud house of the Jats is an ancient type, it may not be as old as the times of Mohen-jodaro (2,500 B.C.) when bricks were baked in fire using wood as fuel. A long time must have passed before the land of western India was denuded of its thick vegetation. Probably at this time the southwest Asian house appeared in the western parts of India. The bricks could not be baked in fire, largely because the forests were gone and the need of thatch in poor, rural houses was not felt so compelling as the rainfall had decreased. The trait became strongly rooted very soon and preserved itself through a continuous chain of modifications.

Aryan Antecedents of the Jat House

While the flat roof and the use of mud appear to be traits brought by unknown people from the regions of southwest Asia, the inner courtyard in the haveli and the ghair itself seem to be of Aryan origin. In the beginning the Aryans were pastoralists and the social structure consisted of clans. The clan basis of living made it conducive for a group of families to build their huts around a central square or round land (Fig. 10). The cattle were kept under close
POSTULATED EVOLUTION OF JAT HOUSE

ARYAN CLAN HOUSE

ARYAN FAMILY HOUSE

INNER COURT

PRESENT JAT HOUSE

H A V E L I

G H A I R

A INDIVIDUAL FAMILY HUT
B CATTLE YARD
1 MALE ROOM
2 RECEPTION ROOM
3 INTERIOR COURT
4 OUTER COURT
5 WORSHIP ROOM
6 CATTLE STALL
7 FUEL
8 KITCHEN
9 FODDER
10 BED ROOM
11 DINING ROOM
12 GRANARY
13 HEADMAN'S HUT

FIG. 10
watch in this enclosure for protection from wild animals and cattle thieves. All the cattle of all the families were kept in this enclosure. The ancient Aryan hamlet was thus a pastoral camp.

Such a simple form of settlement might have been facilitated by the extremely small population of ancient clans and also by the need of a strong cooperative unity. There was no need, thus, of each house having a courtyard for the cattle. The little agrarian and the pastoral activities were carried on in the central square.

A curious relic of this arrangement is the hamlets of the Nats (Fig. 7) found all over the Upper Doab, and always near the Jat settlements. The Nat hamlet is almost exact replica of the Aryan hamlet described above. It has a large, rectangular courtyard surrounded on four sides by rectangular huts, all of one single room, and made of thatched roofs and mud walls. There is only one entrance to the central courtyard, all the huts being built with common walls. Thus, the huts and the hamlet are linked through the central courtyard. The Nat economy is purely pastoral; they keep the cattle, the fodder, the butter churner, and all other utensils in the courtyard.

In course of time when the clan became large, the individual families broke away and built houses retaining the original pattern and incorporating the enclosure in the courtyard. Thus the house became the replica of the clan hamlets. This means that the courtyard
and the individual house built around this basic element was a later addition. It might be of an age when the Aryans had developed independent family system and an economy based on both pastoralism and a little agriculture which gave them more stability and a tendency toward sedentary living. All over the world the common courtyard is associated with primitive pastoral tribes where the individual family is of little significance and all activities are communal, guided and controlled by one single leader. Once the activities became complex based on pastoral-agricultural economy, the common courtyard disappeared, the individual courtyard in each house became the center of family life, as it remains today after centuries of changes. It is obvious therefore that the individual courtyard originated with the individual family house.

The elements of the ancient Aryan house form are clearly recognizable in the modern Jat house. The modifications undergone by such a house are also very marked. The room for men (1) and the outer courtyard (4) of the Aryan house (Fig. 10) are now separated from the building. These two elements form a separate building, wholly unconnected with the residential building and is known as ghair. The pastoral origin of the word ghair is definite because ghair is derived from ghera which means enclosure for cattle.

It is possible that so long as Aryans remained pastoralists, the care of cattle was under the charge of the females and to make
this arrangement work effectively, the best solution was to stall them in the same building where the people lived. It is interesting to note that the kitchen room and the cattle shed were built in contiguity which must have facilitated the two tasks of tending the cattle and attending the preparation of meal. When the Aryans gave up their pastoralism and took up agriculture wholly, the charge of the cattle changed hands from females to males.

The larger space required for agricultural implements, draught cattle and laborers probably necessitated a separate building. Here now, the men stay for most of the time, going to and coming from the fields. The cheap barren lands at the outskirts of the settlement also have been conducive for the building of the ghair, away from the main residential building (haveli) within the settlement core. Proximity to fields might have been another consideration. In later periods, the idea of sexual division of the house strengthened further to preserve the original two building dwelling unit.

With the transference of the functions of men's residence and cattle shed to the ghair, the outer courtyard and the men's hall of the early Aryan house disappeared. So that today's Jat haveli has only one courtyard and no men's hall. The worship room (5) (Fig. 10) also disappeared, the few agricultural rituals are performed on the fields themselves.
The reception room for relatives and intimate guests still remains and is known as dubari (a room with two doors). The male relatives come here to stay and to talk to the females. The inner courtyard, meant mainly for the females still remains the basic element of the house plan.

It has been suggested in an earlier paragraph that the economic function of keeping the cattle, harvest and agricultural implements might have been the raison d'etre of the courtyard. It is no doubt the favorite meeting place of the females, here they gather to gossip, spin, weave, or make baskets. But from times immemorial the courtyard of the haveli has remained a place of supreme ritualistic significance.

It is the place where right from the Aryan times havan (fire sacrifice) has been conducted. The havan connected with birth, marriage and death has been conducted here. The havan pit is dug here. On its birth, a child is shown here to the villagers for their blessings. The courtyard is indispensable for marriage because marriage cannot be performed in a place which has a roof. The most important rite in Jat marriage is the witnessing of the couple by the sun, the moon, the planets, and the stars when the groom takes the hands of his bride in his own. This makes the courtyard indispensable where all these heavenly bodies can look upon the pair directly. On their death, the persons are laid down here to be mourned by the
village. Although its pastoral function is now performed by the ghair, its importance as a meeting place for the family as a whole in daily activities and at the three crisis periods remains supreme. For this reason alone, it will continue to maintain its indispensability.

Rajput Antecedents of the Jat House

We have in an earlier chapter postulated the hypothesis that the Jats of Upper Doab came from Malwa and Rajputana through Bharatpur. In those areas also we find the same house type as that of the Jats except that instead of mud as the building material stone is used to greater extent. It is obvious therefore that many elements of the Jat house have been derived from the Rajput house. The sexual division of the Rajput dwelling unit into two separate buildings survived in the Jat house.

Secondary elements like the barja, dubari, the large entrance door of the haveli, and the solitary room on the third floor are all Rajput elements. The barja is not found in the havelis of any other group except the Jats. We, however, find it in the Rajput havelis of Bharatpur and Malwa. There also the function of the barja was the same; the females enjoyed the breeze without being seen from outside. Also, from the barja the females could see the Rajput soldiers returning back from the battlefields.

Dubari, like barja, again is not found in the havelis of groups
other than those of the Jats. It, as an adaptation to the needs of defense, is found widely in Rajputana. Its main function, as explained earlier, was to check the direct intrusion of the enemies in the house. The Jats found it necessary to retain this element primarily because the conditions at the time of their settlement in Upper Doab were very insecure.

The large door of the haveli is interesting because here only can we observe the artistic taste of the Jat expressed in the solid construction of the doors and the exquisite carving of the wooden panels. The door is an element of prestige; it is therefore made very imposing, and stronger by adding steel plates and nails studding the interior sides of the panels.

The third story solitary room was used in the Rajput havelis of Malwa, for keeping a watch over the countryside and the settlement. It, thus, served the purpose of a watch tower. Its retention in the Jat house was necessitated by the unsettled conditions of Upper Doab at the time when the Jats were settling here. It served the same function which it served in Malwa.

The two doors, the front door and the back door, of the Jat house are characteristic features. The back door may be in existence simply as a matter of persistence of an architectural trait. The Jats, however, give at least three reasons for its existence. In older times the individual houses were attacked very often, when the females
slipped out from the back door and took shelter in the fortress of the local landlord. During the Mogul times, the females observed purdah and went to fetch water from the wells through the back door avoiding the front door where the males sat and gossipped. Again, it is through this door that milk cattle came in for the females to milk them. All these three conditions are now almost non-existent, but the cultural habit persists and most of the Jat houses still build a back door more often than not in a secret position.

The rural house, like many other rural cultural traits, is very conservative, so the Jat houses have changed but little. They tend locally to retain the same general characteristics over long periods of time and they have a structure and form, handed down from one generation to another (Scofield, 1936, p. 230). The influences of urban contacts of recent periods are, however, clearly visible.

Two houses (Plate 19) standing side by side displaying such differences can be best explained as the creations of urban and rural influences. The sun breakers, the large windows with iron railings (Plate 18), windows with glass panes, and Portland cement plastering of the walls and roofs are becoming very popular. The wooden beams of the roof are being replaced by iron and steel frames. The basic plan, however, has resisted all changes.
PLATE 18

The entrance door flanked by iron-railing windows. Note the heavy wooden doors.

PLATE 19

Contrast cement house with those of mud.
CHAPTER V
JAT FIELD PATTERN

The object of this chapter is to describe and interpret the pattern, function, and evolution of the Jat fields. Among the diagnostic traits of the Jat culture, their field pattern is very important. Pattern, function, and evolution are connected with each other in an organic unity. Cultural factors have been far more dominant than geographical ones in the evolution of the Jat field pattern. The field pattern in this work means the areal arrangement of different kinds of fields, the inter-relationship of the fields among themselves, and also with the central settlement unit. The individual fields (khet) together comprise the holding (zameen) of a farmer.

DIKES

Form

The unique feature of the rural landscape of Upper Doab, as of much of the Indo-Gangetic Plains is the total absence of any kind of fence, stonewall, or hedge to delimit the extent of individual fields and holdings. Instead, low mud-built dikes (daul) about eight inches high, and two feet wide, separate one field from the other (Plate 25). These dikes are the only material expressions of the
idea of the areal extent of each field. They are also the lines which separate one village from the other, for the purposes of revenue and administration.

The low dikes are, in appearance, the same everywhere (Mukerji, 1926, p. 30). They usually run straight; at places they are curved. The rectangular form of the fields allows the dikes to be built as straight lines. The rectangular pattern of dikes is specially noticeable in those parts of the village where a large block originally held by one single joint-family was divided into small fields, as a result of the disintegration of the joint-family and the operation of the Hindu law of inheritance. Where new lands are added by slow accretion as a result of clearing of woodland and the reclamation of cultivable waste land, the dike pattern becomes irregular. There are then many curved dikes as the boundaries of irregularly shaped fields.

There are two kinds of dikes, those on which the people and cattle move between the fields and the settlements and those which form the walls of the water channels (nali). The water channels also separate one field from the other and hence have the function of delimitation. The most striking characteristic of the dikes is their enormous total length. In the adjoining map (Map 7) the length of the dikes totals nearly one hundred and ninety miles; the area of the village lands is about two hundred and fifty acres, so that the length
of the dike per acre comes to about 0.7 miles, an impressive figure. The continued subdivision of holdings has further increased the number and length of the dikes.

The reason for using mud for the construction of the dikes is obvious. Stone is not available anywhere in Upper Doab and wood is scarce. No building material is as widely distributed and so easily procurable as mud. The Jats therefore had to adopt mud dikes in place of stone walls which they used in Malwa, before they moved into Upper Doab. The result of the use of mud dikes is the rather open appearance of the rural landscape.

The absence of stonewalls, hedges, or any kind of fence is associated with the general nature of agriculture. While the region has some dairy production, cattle-rearing is extremely limited, and fencing cattle from the fields is unnecessary. According to an understanding among all the farmers, the fields are closed to cattle except those which have yielded the rabi (winter) crops. After the rabi fields have been cleared of their harvests, they are thrown open to cattle to feed on the stubble. Rarely do the cattle of one farmer enter the fields of another since they are always carefully tended. The understanding effected and enforced by the Panchayat (Village Council) thus makes it unnecessary to enclose the field by high walls. On rare occasions the cattle enter the fields and destroy the standing crops, and then violent quarrels are precipitated.
Trespassing on the fields of others, even by the cattle, is always regarded as a crime. In such circumstances, the use of fence is unnecessary.

Origin

The origin of the dikes presently in use in Upper Doab is not known. It is known, with certain definitiveness, that the early Aryan pastoral-farmer used to fence his cultivated fields (Maity, 1957, p. 73). In ancient times, among such Aryans, there were rigidly followed laws of fencing and for the punishment for cattle straying (Maity, 1957, p. 73). When a field was situated on the borders of a village, or contiguous to a pasture ground, or adjacent to a road, fencing was a legally enforced practice and the herdsman was not responsible for the destruction of grain in that field if it was not protected by a fence (Maity, 1957, p. 74).

It appears, that so long as the Aryans were cattle herders and their economy based on pastoral-farming, fencing was practiced. Later periods saw the development of pure farming with lesser and lesser emphasis on pastoralism. Probably, at this point in their history, the Aryan people, after having settled down in the river valleys of the Punjab, Upper Doab and Malwa, gave up the practice of fencing, thus creating the open field pattern.

The concept of individual fields worked by individual farmers, but owned communally, is as ancient as the Vedic period
(Circa, 1,500 B.C.). The fields then were measured with a staff of reed and bare strips or balks (khilya) were left between the fields. Probably, these balks, at a later period, were built with reduced sizes and eventually became low, narrow mud dikes. This is, merely, a suggestion, for we do not have the necessary historical records, or any relict features on the present day cultural landscape to reconstruct, in a definite manner, the place and the mode of the origin of low, narrow mud dikes.

Function

As explained earlier, the dikes are the dividing lines between two fields, hence what is seen on a village map are the lines criss-crossing each other showing the dikes (Map 7). Since the dikes delimit the extent of individual fields, any change in the area of the fields consequent upon new acquisitions or reductions is reflected in the movement of the dikes back and forth and in changed forms. The frequency of change in the position of dikes, thus, reflects an unstable socio-economic rural condition. Despite this the dikes are comparatively stable in their positions.

The dikes are the ancient roads in their most primitive form. For countless generations they have been the only roads linking the fields and the settlements. They also join one settlement to another by joining themselves to the dikes-system of
another village. Once all the fields are taken up by cultivation, the building of wide roads becomes a near impossibility. In that event the dikes are indispensable as they occupy little land. Moreover, where the roads would have to take so many turns and would have to be aligned at innumerable points, the dikes provide the movement with a minimum of distance, from the settlement to the fields.

The dikes check soil erosion where the land is sloping. In every village, local depressions (dahar) along with adjacent raised fields are quite common. In such places the dikes are the effective means of preventing wash. The tendency of intense sheet erosion induced by a rapid runoff is checked by the dikes.

Finally, the dikes regulate the flow of irrigation water and retain it within the field for which it is meant. The regulation of water flow in a crop economy depending wholly on canal irrigation is all important. At one time only a few fields receive water from the canals, and then for several days they are cut off from the source of supply. Here, the dikes prevent runoff of water.

The socio-economic significance of the dikes is very great. In times of disputes over land ownership, the existing dikes are removed and new ones are built, resulting in the loss of land for one farmer and gain for the other. The illegal shifting of the dikes also results in revenue loss to the government because the intervening strip involved in the dispute remains a sort of no-man's land until
the decision of the revenue authorities comes into effect. Within the
village community factions are created supporting or disputing the
shifting of the dikes. Frequent riots are the outcome of such social
breakdowns. The farmers thus regard the dikes as something very
sacred and always worth fighting for their protection.

FORM AND EVOLUTION OF THE FIELDS

The forms of the fields do not display great varieties. The
two basic forms are the regular rectangular and irregular quadri-
lateral or polygonal (Map 7). These forms are found in different
parts of the village and are associated with different stages and pro-
cesses of the expansion of the cultivated lands.

The rectangular forms are associated with created patterns
as opposed to evolved patterns. The processes of creation and evo-
lution are definitely the components of the Jat culture complex and
have been little influenced by external environment.

The process of colonization and settlement by the Jats con-
sisted of the acquisition of large blocks of lands either by purchase
or by violence. Clearance of forests and woods and their subsequent
settlement was also quite common. Nothing was commoner in north-
ern India during thirteenth and fourteenth centuries and in subse-
quent periods than to hear the Jat clan groups claiming occupancy
rights on the ground that they cleared the forests and woods
(butamar or butashigafi). This process resulted in the extension of cultivated area. It involved the whole community which consisted originally of one single clan and several of its constituent families.

After the acquisition, the involved families divided the newly acquired block among them (Map 8). The village as a whole, with all its lands belonged to the community. This is the Bhaiyachara system of land tenure, most characteristic of the Jat culture. The cultivable land of the village was divided on this basis. The division of the block was done in a way that the resulting fields were rectangular (Map 8).

The farmers were imbued with the ancient notion that the field should be of such a size that one plow team could plough the field in one day. The area therefore remained constant but the form had to vary according to the length of the furrows. In the earlier periods the light wooden plough was used which was quite conducive to a long furrow. Sufficient length for the furrows was allowed so that there would be no wastage of time in turning the plow too infrequently. In most of the fields (Map 8), the length of the furrow is about sixty to eighty yards. In earlier periods, thus, the polygonal or quadrilateral fields were uncommon and long, rectangular fields were associated with the light, wooden plows.

The power drawing the plow, supplied by the pair of bullocks remained the same. However, the light, wooden plow was
YARDS 500

Souruo. R stsn u s H op R o eo rtfs.

RSissonu Ka nun go's Off/co. Modinagar

KHANJARPUR

LATIFPUR TIWRA

SEVENTEENTH CENTURY
LAND DIVISION

- SEVENTEENTH CENTURY
- FAMILY BLOCKS (MAHAL)
- PROBABLE SITE OF HABITATION
- WELL
- MAIN ROAD
- CART ROAD

Source: Revenue Map and Records.
Revenue Kanungo's Office, Madinagar

MAP 8
replaced at a later period by heavy, iron plow. This was associated with the sugar cane cultivation for which a deeper tilth was necessary. The heavy plow could not be pulled through a long furrow, hence the length of the field had to be reduced, so that the bullocks could pause and take breath more frequently. This produced the square fields.

The fields ploughed by the tractors are mostly, long and rectangular, rather than squares. The longer furrows here are required to minimize the number of turnings. Some rectangular fields have also been created in recent years by the integration of several contiguous square fields, so that tractor ploughing may be practiced.

The square fields evolved both from the waste lands brought under cultivation and from the rectangular fields. The waste land (banjar) was found, and even now is found in large irregular, polygonal blocks (Map 7). There has never been any rigid rule of division of such blocks and the result was an unsystematic development of irregular fields.

The introduction of canals for irrigation was also very conducive for the formation of square fields. The water irrigating the fields flows between the furrows and in order that they be thoroughly irrigated, they should not be long. It should also be noted that the time during which a field receives water is limited, having been fixed by the irrigation authorities.
Another explanation found out in the field work for the subsequent subdivisions of an originally rectangular field into a square one is the element of the small irrigation channels (*nalīs*). When the original rectangular field is subdivided, it is always easy to do so by constructing the irrigation channel so as to divide its breadth-wise. In this case the small channel can irrigate the square fields on its two sides very well and a long channel parallel to the length of the rectangular field becomes unnecessary. Thus, the breadthwise subdivision of the rectangular field results in square ones.

It appears thus, that the rectangular fields are of greater antiquity than the square ones. In most of the cases, square fields evolved from the originally created rectangular fields.

**FORMS AND EVOLUTION OF THE HOLDINGS**

As explained earlier, several fields constitute a holding of a farmer. The holdings generally have fields scattered all over the village lands (Map 6). A few cases, however, of the compact holdings are found, in which all the fields belonging to a farmer are situated in one contiguous block (Map 7). Fragmented structure of the holdings is common throughout India and is widespread in many oriental countries. Many factors responsible for their creation and existence are common throughout south, southeast, and east Asiatic countries. The Jat holdings display many similar features.
Fragmented holding results from the subdivision of the original block owned and held communally, or by the clan. Subdivision is widespread. The intensity of subdivision can be understood very well by an example: the 762 fields of the village Yaqutpur Mavi (Meerut district) are divided among 135 farmers of the village. This means that on an average about six fields are in the possession of one farmer. However, the number of fields belonging to one farmer varies greatly from the average. Some farmers have as many as twelve fields while others have only one.

The intensity of subdivision may further be understood by considering the following example: a farmer had twenty acres of land in five blocks of four acres each. He had five sons. After his death, according to the law of inheritance, each son claimed a part in each of the five blocks. Each block was, thus, subdivided into five smaller fields, each measuring four-fifths of an acre. Thus, from a holding of twenty acres, twenty-five fields were created, all scattered in different blocks. The extreme extent to which dispersal can be carried on is shown on the map (Map 7). Fields are separated by a distance as great as two thousand yards and their distances from the settlement are as much as twelve hundred yards. Fragmentation is characteristic.

An important result of subdivision is the very small size of the individual fields and holdings. In the village Jahangirpur (Meerut
district) 135 farmers own about 250 acres of land, so that the average holding per farmer comes to only 1.1 acres. The average, however, gives a false picture of the economic situation; for the holdings vary in area from forty acres to less than one acre. The variability in the size of fields follows accordingly, being 0.3 acre at the lowest end and 1.3 acre at the highest end of the scale. With an increase in the size of the holdings there is an increase in the size of the individual fields. Subdivision is more popular and has greater incidence among the poorer farmers who have smaller holdings than among the rich farmers. The richer farmers consolidate their lands and try to make cultivation more economic. Moreover, the rich farmers have tractors to farm with, which further necessitates large-sized fields.

EVOLUTION OF THE FIELD PATTERN

It has already been explained that the earlier stages of colonization of Upper Doab were carried out by small bodies of Jats. They occupied the most fertile clearings in the forests and the woodlands. These large groups were subsequently split into smaller ones which further divided the territory among them. The traces of this early form of colonization may be observed at the present time in the subdivision of the territory represented by such local terms as pargana, tappa, mahal, patti, tholla, pana, and
ilaqa. Many of these terms date back to Akbar's time and the Jats simply borrowed them from the Mogul system of revenue administration.

The pargana boundaries very often coincide with natural features. In the past, the pargana was more often than not a fairly well defined local region. This was generally held by one clan. Gradually, from one center in the pargana, cultivation extended, followed by the disintegration of the original nucleus and creation of the newer settlements as dakhili mauza. Boundaries were slowly demarcated, and separate estates were formed.

The typical Jat village is a clan village. Thus the entire village land belongs to all the families constituting the clan. Every family therefore gets a share in each block of land. Again, since the clan is composed of joint-families, each member of the individual family gets a share in each field scattered in several blocks. The clan village is essentially a Jat characteristic. Thus, the systems of the clan village and joint-family result in a subdivided and fragmented holding.

The wasteland of the village was always held and even now is held as the common property of the whole village community. In the Jat villages as they now exist, there are only faint survivals of the three primitive Marks, as they appear in the Teutonic form of the institution. We can perhaps recognize in the habitation site the
original settlement where the right of selecting positions for houses is carefully restricted; in the cultivated area the Arable Mark; and the Common Mark in the unculturable tracts where the village cattle can graze (Crooke, 1897, p. 282).

With reference to the settlement proper we find that the fields belonging to one farmer are distributed in a fairly standard pattern. A typical holding consists of one field in the highly manured belt of land (bara) surrounding the settlement proper, one field in the middle zone (manjha) which is less highly manured, and the third in the outer most belt (jungal) growing sugar cane with the help of canal irrigation.

A fact which has been discovered by the writer from a study of the schedule of crop-rotation is that the Jat villages have invariably what is so common in the western countries, the three-field system (Mukerji, 1957, p. 145). This three-field system consists of a three-year rotation of wheat, sugar cane, and fallow, distributed in three different fields.

The smaller fields are situated in the land adjoining the settlement proper. They get more manure in the form of human and animal excrement. Being nearest to the houses, these fields are best cared for. Since every farmer wants to have a share in this land, the incidence of subdivision becomes greater and the fields grow smaller in size. Also, the land situated nearest to the settlement
proper is of highest value (Neville, 1903, p. 33).

Near the settlement, the fields are irrigated by wells. The people of low caste who cannot get costly canal water from a distance have to rely on wells. The irrigating capacity of wells is small thus effecting a reduction in the size of the fields.

On these small fields, people of low caste grow vegetables by intensive methods of cultivation, using the hoe which necessitates a smaller size of the field. The revenue dues of land depend on the area of the land. A small field thus produces more by intensive cultivation and gives a higher income to the farmer.

The larger fields are situated in the parts of the village irrigated by canals. Such fields are found in the outermost belt of land (jungal). Here, sugar cane is grown on a large scale with the use of mechanical implements and tractors. Large, heavy plows are also used here. The heavy irrigation necessary for sugar cane growing is easily supplied by the nearby canals.

Large fields are also situated in banjar and usar lands whose productivity is very low. The intensity of subdivision on these lands is low, hence the fields are kept larger. Such lands can be brought under successful cultivation only by a large investment.

Another characteristic feature in the Jat field pattern is the comparatively small area of bara lands. The bara land almost disappears in the rich general farming of the Jats in the north
(Neville, 1903, p. 37). The uncultivated land adjoining the settlement is kept reserved for the houses to be built in the future. Moreover, except for the few fields growing vegetables, the Jats do not grow sugar cane on the fields of the bara lands.

Of the various causes of fragmentation and subdivision, none is so important as the operation of the law of inheritance. Under this law, every son, after the death of his father, gets a share in the total property. Every son gets a share in every field situated in different blocks. Thus a field is subdivided and the holding is fragmented.

The practice of crop rotation which the Jats follow so rigidly can succeed when each family has several kinds of lands suiting various seasonal conditions. This also results in subdivision and fragmentation of the holdings. The holding becomes more productive when its constituent fields are scattered in different soil blocks (Mukerji, 1926, p. 31).

Fragmentation was also necessitated by the necessity of having two harvests. Only then each farmer could have fields for cultivation at both harvests (Hailey, 1919, p. 533). The Jats grow both the winter (rabi) and summer (kharif) crops. It is generally not possible in the event of a lesser amount of rainfall to grow winter crops on a field from which summer crop has been harvested. For this a field near the canals is required for continuous and large amount of irrigation.
The uncertainties of rainfall both in time and amount have also encouraged fragmentation. Fragmentation serves as an insurance against the risks of agriculture in the Indian climate (Mukerji, 1926, p. 33). When a farmer has several fields in several tracts growing different crops, in case of a failure of one crop he will be assured of the success of the other. The different crops have different adaptations to the variable elements of climate and hence one of them survives the seasonal variations of such elements.
CHAPTER VI
ECONOMY OF THE JATS

The economy of the Jats in the Upper Doab is wholly based on sedentary agriculture. That they are one of the most skilful agricultural people in northwestern parts of India has been emphasized already. Jats associate themselves with cultivation more than with any other occupation. It is largely because of this that ethnographers like Ibbetson and Crooke suggested that Jats are large-scale cultivators and in this type of farmers they have no parallel in the whole state (Dubey, 1935, p. 33).

The object of this chapter is to describe and interpret the agriculture of the Jats in the Upper Doab. The details are organized systematically in two parts, production and distribution. In production, land-use, agronomic practices, cropping pattern, individual crops, land-tenure, and agricultural calendar have been studied in detail. Roads, vehicles, and trade come later as elements in the distribution complex.

PATTERNS OF LAND USE

The Upper Doab is one of the most intensely cultivated regions in India. This is well reflected in the Jat villages. In the
four villages which were intensively surveyed by the writer, it was found that out of 3,815 acres of total land area, 2,787 acres, i.e., about 73% of the total land is under cultivation. The four villages, Latifpur Tiwra (pop. 1,377), Asifpur Ujheda (pop. 1,897), Jalalabad (pop. 4,137), and Amrala (pop. 1,106) are located in Meerut district. The writer has conducted field-work in other villages spread over the region of the Upper Doab and found that the general picture of agricultural economy and of land-use in the Jat villages remains much the same. Thus, the four villages discussed here are fairly typical of the Jat villages in the Upper Doab.

The following table indicates the use of land for different purposes.

**TABLE 4**

(Area in acres)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Tiwra</th>
<th>Ujheda</th>
<th>Jalalabad</th>
<th>Amrala</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Area</td>
<td>512</td>
<td>731</td>
<td>1,573</td>
<td>999</td>
</tr>
<tr>
<td>Total Cultivated Area</td>
<td>418</td>
<td>573</td>
<td>1,095</td>
<td>701</td>
</tr>
<tr>
<td>Barren Cultivable (Usar)</td>
<td>23</td>
<td>Nil</td>
<td>Nil</td>
<td>94</td>
</tr>
<tr>
<td>Barren Uncultivable (Banjar)</td>
<td>Nil</td>
<td>Nil</td>
<td>47</td>
<td>147</td>
</tr>
<tr>
<td>Settlement (Basti)</td>
<td>26</td>
<td>78</td>
<td>164</td>
<td>32</td>
</tr>
<tr>
<td>Cremation Plot (Murdaghat)</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Water-bodies (Pani)</td>
<td>13</td>
<td>25</td>
<td>45</td>
<td>12</td>
</tr>
</tbody>
</table>
### TABLE 4 (continued)

(Area in acres)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Tiwra</th>
<th>Ujheda</th>
<th>Jalalabad</th>
<th>Amralla</th>
</tr>
</thead>
<tbody>
<tr>
<td>New land (Nautor)</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Current Fallow (Parti-i-jadid)</td>
<td>11</td>
<td>50</td>
<td>144</td>
<td>9</td>
</tr>
<tr>
<td>Permanent Fallow (Parti-i-qadim)</td>
<td>Nil</td>
<td>Nil</td>
<td>4</td>
<td>Nil</td>
</tr>
<tr>
<td>Irrigated by Canal flow (Nahar-tor)</td>
<td>351</td>
<td>551</td>
<td>462</td>
<td>458</td>
</tr>
<tr>
<td>Irrigated by Canal lift (Nahar-dal)</td>
<td>Nil</td>
<td>Nil</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Irrigated by Well (Kuan Sinchit)</td>
<td>27</td>
<td>21</td>
<td>7</td>
<td>150</td>
</tr>
<tr>
<td>Total double-cropped (Dofasli Kul)</td>
<td>214</td>
<td>309</td>
<td>571</td>
<td>389</td>
</tr>
<tr>
<td>Irrigated double-cropped (Dofasli Abi)</td>
<td>149</td>
<td>247</td>
<td>393</td>
<td>227</td>
</tr>
<tr>
<td>Unirrigated double-cropped (Dofasli Khaki)</td>
<td>65</td>
<td>62</td>
<td>178</td>
<td>162</td>
</tr>
</tbody>
</table>

(Taken from the Patwari Records of 1955)

The intensive use of the land is well indicated in Table 4 by the small area of current fallow (parti jadid) (Map 9). Permanent fallow (parti qadim), a widespread feature in the villages cultivated by agricultural people other than the Jats is absent in those belonging
KHANJARPUR

SOURCE: FIELO NOTES

LATIFPUR TIWRA VILLAGE
LAND USE

SUGAR CANE
WHEAT
MILLETS AND FODDER
DOUBLE CROPPED (IRRIGATED IN WINTER)
BARREN
FALLOW
CANAL
WELL
HOUSES
MAIN ROAD
CART ROAD
FIELD BOUNDARY

SOURCE: FIELD NOTES

MAP 9
to the latter. On an average, only three to ten per cent of the cultivated area is left fallow. The Jats have reclaimed most of the permanent fallow and brought it under cultivation. Current fallow is limited because sugar cane, the major crop of the Jat villages, remains on the field for about nine months and thus leaves little time for the field to lie unplowed.

Barren cultivable (usar) has also been brought under cultivation or is in the process of being reclaimed. Formerly, this land lacked plant food which is now being supplied by the Jats in the form of chemical fertilizers. The barren uncultivable (banjar) is of a small area. Such lands are found generally, in large blocks (Map 9). At the time of founding the village, houses were built on this type of land and gradually all this land was built up. Originally, barren uncultivable was productive land but due to wasteful agronomic practices in the past, it became depleted of its plant food and was gradually abandoned. Thus, barren uncultivable land is a culturally created feature. In many villages, the author was told that such land could again be brought under productivity, but at a capital investment which would make the attempt prohibitively costly.

The cremation field is located north of the habitations, toward the direction of the Ganga River (Map 9). In all the Jat villages this rule of location of the cremation field is maintained. In the Jat villages and in no other, the lower caste people can and do use the
Jat cremation site. Thus in Jat villages land is saved by having only one cremation field, instead of separate ones for each of the different castes.

Large or small ponds (jhor) (Map 9) constitute the water bodies, which cover a small area. The ponds were dug originally to provide mud for building the houses. Filled by rain, these ponds supply water to cattle. As this is an important function, their reclamation for cultivation probably will never be attempted. Everywhere such ponds are located contiguous to the habitation site and are within easy reach of unherded cattle.

On the basis of mode of irrigation land is classified in the Jat villages into three groups, (1) canal lift irrigation (nahardal), (2) canal flow irrigation (nahar-tor), and (3) well irrigation (kuan sinchit). Of these the land irrigated by lifting water from the canal comprises the smallest area, since only a few fields are situated above the level of the canals and their distributaries. The labor required in lifting water also prohibits the extension of such type of land.

The land irrigated by wells is small in area. Water in large amounts cannot be procured with as little labor and as cheaply from the wells as from the canals. Only the land situated around a well is irrigated by its water. At other places, when the water in the canal is reduced, the Jat farmer resorts to well irrigation as
a supplemental and protective rather than productive measure. In villages belonging to people other than Jats, there is a wide belt surrounding the habitation, where the land is irrigated by wells and vegetables are grown with methods of intensive cultivation. Jats grow a little of their fodder near the habitation by well irrigation but no vegetables. Hence, in the Jat villages the area of the land irrigated by well is limited and not usually located around the habitation.

The area irrigated by gravity flow from the canals is the largest, since nearly everywhere the fields lie lower than the distributaries and irrigation channels (guls). The flat land of the villages is highly conducive to the practice of gravity flow irrigation. Mostly, the sugar cane fields are irrigated by this method. The fields irrigated by canal flow irrigation are found all over the village. Similarly, most of the double-cropped fields are also irrigated in the same way.

The double-cropped area comprises almost half the total cultivated area (Map 9). This again is an indication of the intense use of the land. About seventy percent of the double-cropped area is irrigated. The rainfall in winter is so low that crops cannot be grown without irrigation. Hence irrigation and double-cropping go together.
There is little possibility for further extension of cultivation in the Jat villages because the uncultivable land including the habitations, orchards, water bodies, barren uncultivable, and the cremation field will, probably, never be brought under cultivation. In the future, total production will be increased by higher yields per acre and not by any extension in cultivated area (Nath, 1953, pp. 4-18; and Karan, 1957, p. 63).

AGRICULTURAL IMPLEMENTS AND PRACTICES

IMPLEMENTS

The Plough

Jat agriculture is plough agriculture. Their knowledge and use of it is old. In Rajasthan and Malwa through which the Jats passed on their way to the Upper Doab, the plough is widely used as the main cultivating implement. The Jats had used it even when in Rajasthan and Malwa.

The plough used by the Jats is the same as that used by other agricultural people in the Upper Doab. This plough (Plate 21) is in form like an ard or Egyptian plough with an iron share. The plough is an ancient agricultural implement. Its invention, like that of agriculture, is pre-historic (Tylor, 1889, p. 74). The earliest known example of a plough is on a Sumerian seal of 3,500 B.C. found in the Royal Cemetary at Ur (Bishop, 1936, p. 266; Singer,
PLATE 20

Cultivator hoe and the Meston moldboard plough.

Plate 21

The ancient wooden plough. Note the wooden-wheeled gadee.
1966, vol. 2, p. 83). The seal shows a fully developed form which justifies postulating a long previous period of evolution. Perhaps, this process of evolution must go back at least as far as the fifth millennium B.C. or even before.

The exact place of origin of the plough is not known with certainty. Tylor, (1889, p. 78) suggested that probably it was evolved in the valley of the Nile. Later scholars believe that the place of its origin is in Mesopotamia (Curwen, 1953, p. 74) or somewhere in the lands between Egypt and Persia (Singer, 1956, p. 83).

The plough probably was developed from the digging stick and hoe (Curwen, 1953, p. 72). According to Bishop (1936, pp. 261-281) the digging stick developed into the foot plough quite early. More effective tillage resulted from the application of the principle of traction. By this method, while one individual pushed the implement, one or more others pulled it with cords. Afterwards cattle and other animals were substituted for human power and thus the true traction-plough evolved.

Tylor (1889, pp. 77 and 78) suggests that the essential feature of ploughing is that it makes a continuous furrow and the primitive plough was an enlarged and transformed hoe to make that furrow. Later, the yoke was invented for the pair of oxen to draw the plough (Tylor, 1889, p. 82).

A metal share was not used in Mesopotamia in early times (Bishop, 1936, p. 268). Iron shares came in use around 1,200 B.C.
in Palestine (Wainwright, 1936, p. 19). Sometimes in the latter half of the second millennium B.C. a seeder was attached to the plough (Bishop, 1936, p. 267). The seeder consisted of an upright tube open at both ends, through which an attendant dropped the seed as the ploughing went on.

It is not definitely known whether the Indus Civilization of 3,000 B.C. (circa) had the ox-drawn plough or not. This area had active commercial contact with Babylonia at a time when it had already long used the plough. The early use of the plough therefore in the Indus Valley Civilization is at least possible. There are more conclusive evidences supporting the belief that Aryans had the plough when they migrated into India (Peake and Fleure, 1933, p. 138; Rapson, 1922, p. 99; and Bishop, 1936, pp. 261-281). The Indian and Iranian names for the plough are based on the word krish which indicates that it was common to both groups before they separated (Peake and Fleure, 1933, p. 138; and Rapson, 1922, p. 99).

The Indus people probably did not have the plough (Kosambi, 1956, p. 64). We know that the Indus Valley Civilization existed until about the invasion of the Aryans (ca. 1,500 B.C.) and prior to that event there was no other movement of the Aryans into India. This strengthens our suggestion that the Aryans introduced the plough into India (Peake and Fleure, 1933, p. 138; Rapson, 1922, p. 99; and Bishop, 1936, p. 267). Possibly the early Aryans brought into
India a fully-developed plough and the later Aryans added the metal share (Agrawala, 1953, pp. 195 and 196). Ritualistic significance of the plough to the Vedic Aryans also supports the view of its Aryan introduction. The Vedic poets sang that God himself taught the use of the plough to Manu, the first man on earth and gave one to him as his gift. In the rite for ploughing the Aryans made sacrifice to Sita, which was the furrow personified (Rapson, 1922, p. 237 and Tylor, 1889, p. 77). Linguistic evidence is supplied by the fact that the Hindi name hal for plough is derived from halya of the Vedic Aryans.

Once introduced into Punjab, the plough spread rapidly over northern India before the middle of the first millennium B.C. (Bishop, ibid., p. 277). The plough used in this period consisted of four parts, the long wooden pole (isha), the central bent portion called potra, the tie of the yoke, and the ploughshare (kusi or phala). The ploughshares were of iron, six inches long, and three inches wide. The bullocks were attached to the yoke (yuga) by a rope (yotra or yoktra). This plough was used for shallow cultivation. It was well suited to cultivation in the drier parts of northwestern India where ploughing aimed at pulverizing light soils and not at turning over the sod (Curwen, 1953, p. 79).

Today the Jats use two types of ploughs, the wooden plough (hal) and iron plough (meston). The wooden plough (Plate 21, Fig. 11) is made wholly of wood except the iron bar with pointed end which
Modified after Lewis

1. Sower (Nali)  
2. Holes (Katha)  
3. Leather thongs (Harli)  
4. Wooden yoke (Jooa)  
5. Wooden beam (Halas)  
6. Triangular iron frame (Kat)  
7. Iron bar (Kus or Kharwa)  
8. Handle (Hateli)  
9. Triangular wooden piece (Pahri)

FIG. II
fixes the share to the handle and the triangular iron frame (kat). The iron bar with pointed end projects out behind the heel of the plough and can be forced forward as it wears down. When the fields are ploughed deeply (lagu) the yoke is harnessed higher up the wooden beam while in shallow ploughing (askulsiya) the yoke is fastened lower down the beam near the share.

The Meston plough was introduced in 1897-98 (Howard, 1909, p. 79). It has same parts as those of the wooden plough except that the whole share is made of iron (Plate 20). Its form is also similar to that of the wooden plough. The basic difference between the two kinds of ploughs is that the wooden one merely scratches the soil making shallow furrows and very low ridges while the Meston plough contain a mold board and inverts the soil. The latter type is used particularly for deep ploughing of the sugar cane fields.

**Leveling Implements**

For leveling the field by breaking clods a large, wooden roller (patela, lakar, or dhelaphor) is used (Plate 22). This weighs from five to six hundred pounds. It is attached to the yoke by traces termed guriya.

**The Hoe**

Weeding is done with the hoe. The use of this ancient implement is widespread throughout the country. In early times this was
PLATE 22

Clod breaker, attached by iron chains to the hump of the camel and pressed by the man.

PLATE 23

Hoe in the right hand and the sickle in the left.
the main implement used in breaking the soil (Singer, 1956, p. 98). The invention of the hoe preceded that of the plough which had evolved from the former instrument. Probably, it was first used in Mesopotamia (Curwen, 1953, p. 64). Its use in India goes back to the age of the Indus Valley Civilization in which it was the main cultivating implement, the hoe was used increasingly for uprooting weeds (stanbhagna) and loosening the soil for the encouragement of the growth of seedlings (Agrawala, 1953, p. 199 and Maity, 1957, p. 76).

The present-day hoe has not undergone any change in form. It consists of an iron blade, fixed at an acute angle to its handle. The wooden handle (Fig. 11 and Plate 23) passes through the hole in the top of the iron blade and is fitted automatically by its width equalling that of the hole. The blade is trapezoid in form with a tapering, thin edge at the bottom which is convex outwards.

Jat farmers of comparatively better financial standing use a recently introduced implement called a cultivator (Plate 20). Actually, it consists of a number of hoes arranged in two sets fixed to two iron rods. These are joined to a handle and a yoke. The entire implement is made of iron. It is used for weeding as well as for breaking the soil and is drawn by bullocks.
The Sickle

The sickle is used everywhere by the Jats for reaping. Like the hoe and the plough, its use in India is both ancient and widespread. Its origin may be traced to the ancient Near East (Singer, 1956, p. 95). The earliest specimen from Fayum in Egypt has a straight handle and a straight head. From 3,000 B.C. onwards the wooden mounts of flint teeth became curved (Curwen, 1953, p. 108) With the general use of iron, modifications were introduced and the balanced sickle was evolved. In the balanced sickle the blade is bent back at the handle-end and then curved forward in a long sweep which enables the grain to be cut with less strain on the wrist. It is not definitely known whether the people of the Indus Valley Civilization had the sickle or not. The sickle was, however, used by the early Aryans (Kosambi, 1956, p. 83).

The two types of sickles used by the Jats are the ordinary sickle (hasuli) and the toothed sickle (daranti). The ordinary sickle (Fig. 11) has an iron blade and a wooden handle, the long end of the blade goes all the length of the handle and projects out from there. This fixing prevents the blade from falling out. The inner concave edge is sharp. The toothed sickle (Fig. 11) has the same parts and the same form as the ordinary one but its inner edge instead of being plane has a continuous series of teeth which ends at that point where the backward curve of the blade begins. The ordinary sickle is used
to reap grains while the toothed sickle is used to cut the sugar cane stalks.

**Winnowing Implements**

For winnowing the Jats use winnowing scoop (*supa*) (Plate 34). It is made of thin pieces of stalks of pulse plants. It is an ancient implement.

**Motor Tractors**

Apart from these folk implements the Jats have recently begun using motor tractors. Their use became widespread immediately after the Second World War when the Jats had accumulated a large capital by selling sugar cane to the mills at a high price. The tractors are used on the field only, their use in carting the sugar cane to the mills is very limited. Even on the fields, mechanical harvesting with the help of a tractor is unknown. Primarily, the tractor is used for ploughing the fields and breaking the clods.

**TECHNIQUES**

Cultivation consists in general of the following operations, ploughing, manuring, sowing, weeding, irrigating, reaping, threshing, and loading.

**Ploughing**

Ploughing is done mostly by the wooden plough drawn by a
pair of bullocks. The farmer keeps the plough in a straight line by controlling its handle. Ploughing is aimed to produce ultimately a ridge and furrow pattern. Ploughing begins just before the monsoon breaks. Hot weather (May-June) ploughing enables the soil to retain a large part of the moisture of rainfall. The number of ploughings given to fields varies according to the crop to be grown on them. In every case, however, more than one ploughing is given to most of the fields. The light plough makes only superficial scratches and the furrows are deepened only by repeated ploughings (Hunter, 1886, p. 483). This is also the reason why ploughing is done in one continuous furrow and no cross-ploughing is practiced. Repeated ploughings pulverize the soil and help retention of soil moisture. The fields for sugar cane are ploughed from twelve to fifteen times (Watt, 1893, p. 170). The observations of the author give slightly different number. The Jats at the present time give about six to ten ploughings, possibly because heavier ploughs of iron are being used more frequently. The wheat fields are given about eight ploughings (Duthie, and Fuller, 1882, pt. 1, p. 3) but as many as fourteen are also known (Howard, 1909, p. 37). Soon after the beginning of the monsoons the fields become moist and more easily cultivable, the farmer works day and night in ploughing the fields.
Leveling

After the field has been ploughed its surface is rendered level by running over it the clod breaker (patela). By this the field becoming level loses its ridge and furrow surface. The field is then ready for sowing.

Sowing

The seed is sown either broadcast (patera), or dropped through a drill (nali or sel or bans) fastened to the handle of the plough. While the plough makes the furrows and the ridges the seeds fall into the former. The next ploughing on the ridges breaks them and the furrows having the seeds become the ridges. Finally, the clod breaker is moved over the field to make the soil compact and fix the seeds securely. This also enables the soil to retain moisture by preventing its evaporation from below. As soon as the seedlings appear in rows, the space between them is ploughed and the ridge and the furrow surface reappears on the field.

Weeding

Sowing is followed by weeding which begins after a fortnight, and is continued at intervals whenever the necessity arises. Weeding is done by large groups of women. They scratch the surface of the fields with the hoe, when the weeds are either uprooted or severed from their roots and soon wither. The weeds are gathered in
heaps at intervals at the edges of the fields and left to rot. The weeding of the tall grasses is done first by flooding the fields and then uprooting them individually. Often, the weeds are ploughed back into the soil to manure it. Throughout July and August the fields are flooded with just the right amount of water for a fixed period every day. This flooding itself helps to deter the growth of the weeds. A scarcity of water very often leads to an excessive growth of weeds. The number of weedings like that of ploughings varies according to the crops. Sugar cane and wheat fields are weeded more than others.

**Irrigation**

The region of Upper Doab is a semi-arid area with an annual rainfall of thirty inches and a marked rainfall variability. Irrigation developed early to protect the crops against the vagaries of rainfall. Today Jat agriculture in Upper Doab is irrigation agriculture. Irrigation more than any other factor enabled the agricultural prosperity of Upper Doab in general and of Jats in particular to reach the present-day high standards. Irrigation in Jat villages is based primarily on canals and only secondarily on wells.

The history of canal irrigation in the Orient is very old. It has been suggested that canal irrigation may have started at about the middle of the fourth millenium B. C. in the river valleys of Mesopotamia when a growing population necessitated a reliable supply of water for an assured agricultural production (Farbes, 1955,
The building of a weir or a dam across a river is a primitive practice. From such a reservoir water is distributed to the fields in the canals. This was the beginning of canal irrigation. Fundamentally, this principle has remained unchanged up to the present day.

Irrigation, however, did not develop as an adaptation to the climate which was becoming dessicated. The older belief that irrigation agriculture was developed during a period of dessication does not appear to be tenable any longer (Adams, 1955, p. 7). Between three and four thousand B.C. when lifting devices were uncommon, canals that were deep enough to divert the streams at low-water levels had to be dug for long distances in order to irrigate during planting (Adams, 1955, p. 10). Again, around 2,400 B.C., 1,800 B.C., 1,200 B.C., 800 B.C., and 600 B.C., there were great revivals of canal construction in Mesopotamia (Forbes, 1955, pp. 17-22). Canal irrigation as a form of perennial irrigation was developed because of the necessity of water during summer when the water in the river is low (Forbes, 1955, p. 17). Such a system obviously needed the accumulation of water in the river at a certain place by damming.

The beginnings of canal irrigation in India are vague and little understood. Very little is known about the irrigation practices in the Indus Valley Civilization (Forbes, 1955, Vol. 2, p. 11), but the
possibility of the existence of irrigation there has been suggested (Basham, 1956, p. 18). No traces of ancient canals have been found in the excavations of the sites of Indus Valley Civilization (Forbes, 1955, p. 11).

Repeated references of the irrigation practices are found in the Vedas (ca. 1,000 B.C.) when canals were built (Basham, 1956, p. 42; and Forbes, 1955, p. 12). During the third century B.C. many rivers were dammed, artificial lakes or reservoirs were formed, and canals were taken out from them (Forbes, 1955, p. 12). This system first in use in Rajasthan and Central India gradually spread all over India (Forbes, 1955, p. 12). For this spread Buddhism played an important role since to Ashoka, the Buddhist emperor, the supply of water to agricultural fields was one of the supreme virtues. From this time onwards canal irrigation became widespread. The remains of dams and canals built during the Gupta Period (300-500 A.D.) and later during the reign of Avantivarman (855-883 A.D.) are conclusive evidences of the existence of a canal irrigation system (Maity, 1957, p. 87). Later, Firoz Shah in the middle of the fourteenth century A.D. built many canals, one of which, the Eastern Jamuna Canal is still in use.

Modern developments in canal irrigation in the Upper Doab began with the British enterprise. In the latter half of the nineteenth century, three large canals, Upper Ganga, Lower Ganga, and Eastern Jamuna were built (Map 5). Numerous distributaries (rajbhaya)
and irrigation channels (gul) were taken out from these main canals.

The adoption of canal irrigation in whole by the Jats occurred only after they had permanently settled in the Upper Doab. In Malwa, where the Jats had lived for centuries before migrating to Upper Doab, irrigation was from artificial and natural reservoirs. And, although canals were known in Malwa as they are at present, they were few in number. Digging canals in the rugged terrain of ancient, hard rocks in Malwa is far more difficult than in the soft alluvium of Gangetic plain of the Upper Doab.

When the canals were first brought into operation, the Jats were extremely reluctant to use irrigation. In several villages the older Jats reported to the author that the British officers had to induce them to use canal irrigation by giving them money. The Jats thought that they would have to pay high irrigation taxes for use of canals of uncertain dependability for the supply of water. The government was anxious to make the canals a success because large capital had been invested in their construction and the cost of maintenance was high. Reluctance to use canal irrigation was also due to the fact that the Jats used it rarely in their former habitat. In the latter part of the nineteenth century when sugar cane replaced cotton over a wide area, canal irrigation became extensive. The Jats gradually began practicing more and more canal irrigation, and today among all other agricultural people, they pay the highest irrigation taxes; since the volume of water used by them is also the largest.
The main features associated with canal irrigation and found in the landscape are the canals (nahar), distributaries (rajbhaya) (Plate 24), large irrigation channels (gul) (Plate 25), and small irrigation channels (nali). Gul and nali are banked by mud walls the former having higher walls and carrying a large volume of water than the latter. The gul feeds the nali and is constructed by the village council (Panchayat) while the latter is constructed by the individual farmer or a group of farmers who have a mutual understanding among themselves for the time and quantity of water to be taken by them for irrigating their fields. Mostly, however, nali remains the property of an individual farmer. The guls and nalis are built along the dauuls of the various fields. The canals are built by the government department of irrigation.

Water is taken to fields by cutting a gap in the low wall of the nali and making a low dike across it (Plate 25). Water then flows by gravity into the fields and moves through the furrows. In these furrows water is allowed to stand to a depth of six to eight inches, so that the ridges between the furrows are fully saturated with water. The flow of water is unaided by the farmer. Such a gravity flow irrigation is termed nahar tor. When the field has been irrigated for the required period (depending upon the water requirements of the crop and the amount of water already available in the soil) the cut in the nali is closed by the mud of the dike that was built across it. The water then flows into the nali to another field.
PLATE 24

Rajbhaya in the centre with the embankment road on the left.

PLATE 25

Gul in the centre; a small dike in the channel for diverting water into the fields. Note the earthen dikes of the fields on the left.
Apart from gravity flow irrigation, lift irrigation is also practiced in some villages where the fields are situated at a level higher than the guls. No nalis can be constructed in this situation and water is lifted directly from the gul into the field. This practice is known as nahar dal. Water is lifted by a large, shallow basket made of palm leaves, or a flattish leather bucket, having two long sets of ropes attached to its opposite sides. Two men standing on the two sides of the leather bucket (boka) dip it into water and swing it over to the field (Plate 26). It is obviously more laborious than the flow irrigation and is of limited use, generally for small fields.

The use of well irrigation in the Jat villages is of a limited extent. During the summer when the volume of water in the main river is reduced, all the canals are also affected, receiving less water from the river. It is then that the Jats have to use well irrigation to give the first watering (palewa) to the fields growing sugar cane. Well irrigation is, however, protective rather than productive. It protects mainly the winter crop. Every Jat village contains at least a few wells for the periods of emergency.

The history of wells like that of canals is ancient. The first wells with walls of circular bricks were built in the cities of the Indus Valley Civilization (Forbes, 1955, Vol. 1, p.178). Such wells were dug by hand. Hand-dug wells were built later in Egypt and Mesopotamia around 2,500 B.C. Whether these wells were used
for irrigation or for domestic consumption is not definitely known. Wells of Harappa and Mohenjo-daro were found only in private houses and market squares. Wells artificially made were contrasted with springs during the Vedic Age and were used in irrigation (Majumdar, 1951, p. 399). In later Hindu periods the digging of wells was considered to be a high virtue. Wells gained a ritualistic significance and were regarded as deities. The Moslem rulers were instrumental in spreading wells over a large area for irrigation.

In the Upper Doab the wells dug are of two types. The spring well consists, in essentials, of a hole carried down to the first impervious layer of clay (mota) which presumably overlies a layer of water-bearing sand. The layer of clay is then pierced by a smaller hole, and if the sand-bed below contains water in a sufficient quantity, there is an immediate rush of water into the well until it rises approximately above the clay layer (Moreland, 1909, p. 37). The clay layer (mota) acts as a beam to support the well which is termed sota kuan. These wells are found in the Pleistocene Terrace and water is lifted by a Persian wheel (rahat) the weight of which necessitates the brick-lining of the walls to prevent them from collapsing. Masonry wells (pucca kuan) of thin bricks (lakhoriya) are widespread in the Jat villages of Upper Doab. These wells last several hundred years.
The second type of well is the percolation well (*choya kuan*), found generally in the Recent Flood Plains. These have a diameter of six to eight feet. This well depends for its supply of water upon percolation through the sides and the base. They are easy to construct through the soft alluvium of sand and gravel but they irrigate a smaller area than the spring well. Generally, these percolation wells are not lined with bricks but with wooden plank-work or with frame-work of stalks of pulse plants. Such unlined wells (*kuccha kuan*) are cheaply constructed. They can be built near the field, whereas long channels are required to bring water from spring, masonry wells situated only at particular sites where the clay layer in lenticular beds is found (Williamson, 1925, pp. 141-153). Furthermore, the unlined wells can be sunk in a few hours in case of immediate need and the monetary risk involved is very little. The percolation well is operated by a *shadouf* (*dhenkli*).

The two devices used in lifting water from the well are the Persian wheel (*rahat*) and *shadouf* (*dhenkli*). The Persian wheel (Plate 27) consists of a large vertical wheel which raises the water in tin buckets attached to an iron belt which is an endless chain. Formerly, earthen buckets were used but during the British regimes tin buckets came into widespread use. A second vertical wheel is fixed to the same axis as that of the first with cogs. The third large, horizontal cogged wheel, turned by a pair of bullocks or a camel, puts the
PLATE 26

Irrigation by swing-basket (boka).

PLATE 27

Persian wheel worked by a camel. Note the cog-wheel and chain of buckets.
former two wheels in motion and the buckets come up full with water and empty themselves as they become inverted. Thus, it provides a continuous supply of water. A Persian wheel can irrigate about twenty five acres of land when worked by two bullocks for thirteen hours a day for one whole month. The two bullocks are changed after every four hours when another pair is brought in. The camels are more productive, since they walk fast and can cover a greater number of revolutions in a shorter time.

The Persian wheel is not native to India. It was preceded by the invention of the toothed wheel, probably by Archimedes around 212 B.C. (Singer, 1956, Vol. 2, p. 676). Sometimes in the late third century B.C. Ma Kun of Sogdiana (northeast Iran) invented it (Laufer, 1933, p. 247). How it spread to India is not known and is a problem open for investigation. Early references to its use are ample. In Buddha's time (circa 7th century B.C.) water was drawn by means of the lever and by wheel and axle-arghatta (Bose, 1942, p. 101). The arghatta is evidenced in the Pallava copper grant plate of the second century B.C., and its figure appears again in a wall painting of Nasik cave dating back to the second century B.C. (Bose, 1942, p. 208). Thus, the idea that the Persian wheel was introduced by the Arabs is thoroughly invalidated. Noria (Persian wheel) was invented and diffused to India much before the Arabs (De Planhol, 1959, p. 64). Katyana in second century B.C. mentions arghatta
PLATE 28

Dhenkli. Note the simple, wooden structure and the ease of operation.

PLATE 29

Manure pit full with manure being dug into by a hoe and placed in a basket. Note the dark color of the highly decomposed material.
from which the modern vernacular name *rahat* is derived (Agrawala, 1953, p. 69). It is probable that it was first introduced in the western Punjab by Metrodorus of Constantine around second century B.C. (McCrindle, 1901, p. 185). At about the same time the Persian wheel (*saqiya* in Egyptian) was common in Egypt (Clarke, 1944, p. 13). The Persian wheel of the Punjab has the same construction as that of Egypt (Mukerji, 1907, p. 142). This may be evidence of a common centre of origin.

From western Punjab it diffused to Sind where it has a different name, *charkhi*; and where it is very old in use (Chablani, 1951, p. 25). The first definite evidence of its use in western India is found in Bana's *Harsha-Charita* written during sixth century A.D. (Laufer, 1933, p. 244 and Majumdar, 1954, p. 586). About around the eighth century A.D. King Lalitaditya constructed a series of Persian wheels (Maity, 1957, p. 87) and around tenth century A.D. their use became common in western India (Majumdar, 1955, p. 400). In Moslem periods its use was extended still farther even into Upper Doab, as recorded by Peter Mundy (1936, p. 228) and John Fryer (1915, Vol. 2, pp. 94 and 171, and 1915, Vol. 3, p. 156).

The second device *shadouf* (*dhenkli*) (Plate 29) is used in unlined wells of Recent Flood Plains area. It is of Egyptian origin (Clarke, ibid, p. 9). The *shadouf* consists of a long beam oscillating at the apex of a forked upright pole on the see-saw principle. The
receptacle for water is attached by a rope or a long pole to one end of the beam, the other end of which is weighted to secure a counterpoise and so ease the task of drawing water. It is operated by human labor, supplies a small amount of water and is discontinuous in the supply.

The widespread use of shadouf in the Gangetic plain suggests its antiquity there. When and by whom it was introduced into India is not known. The Sanskrit word tulam definitely points to its Pre-Arabic widespread existence.

Factors affecting the use of irrigation

Of the physical factors influencing the extent of irrigation the amount of rainfall is the most important. In general, a low rainfall induces an increase in irrigation and vice versa. Irrigation, however, is not of supplemental or protective character only, in the Upper Doab; for sugar cane in summer and wheat in winter cannot grow without it on the meagre moisture supplied by the rains.

The water requirements of summer (kahrif) and winter (rabi) crops are different, and hence their relationship to amount of rainfall and amount of irrigation required for their successful maturity are also different. The summer crops depend on the rains during June, July, and August while the winter crops depend on that falling during October to January.
The summer crops require a larger amount of moisture since the extreme heat causing a great deal of evaporation makes the rain water rather inadequate and irrigation becomes necessary. Winter crops are more resistant to climatic rigours and rainfall variations. The affinity between rainfall, irrigation, and successful harvest of summer crops is more intimate than that in the case of winter crops. And, although, a high rainfall in summer corresponds to a little irrigation, in years of low rainfall irrigation fails to prevent a reduction of the cropped area.

The drought years, however, affect a larger shrinkage in the winter crop area than in the summer crop area, though two-thirds of the former and only one-third of the latter are normally irrigated. In general, the winter crop acreage is greater than that of summer crop acreage but in all the drought years when the deficiency in the annual rainfall is more than thirty per cent there is a reversal, though both crop acreages suffer shrinkages. The extreme shrinkages of the winter crop area in the years of severe drought are the result of the failure of rains in the post-Monsoon period of September and October.

In a year of deficient rainfall, when the Post-Monsoon period receives little rainfall, the seeds cannot germinate without a preliminary irrigation (palewa) in November, when they are sown.
When the rainfall is not great artificial irrigation becomes very successful and the winter area does not show shrinkages as large as that of the summer. Canals really protect the winter crops (Map 9). In drought years the winter crops cannot be fully supplied with water from canals and large areas are left uncultivated.

The economic factor influencing the use of irrigation is also of some importance. A poor farmer does not use canal irrigation for wheat, but a richer farmer of the same village (the factor of rainfall thus becomes inoperative) uses it not only for wheat but even for poorer and coarser crops like pea and gram. The need of a large amount of fodder is acutely felt. In the same field if fodder (metha) and gram are grown in two different parts during winter, it is the fodder that will be irrigated and not gram. To the Jat fodder is more important than the gram. But if fodder and wheat are grown in the same field, irrigation is used for both. To the Jat both fodder and wheat are of equal importance.

Of the individual crops influencing the use of irrigation, sugar cane is the most important (Map 9). This is the crop, on which more than on any other, the agricultural economy of the Jats is based. Everywhere it is grown by irrigation from canals. In the five districts of Upper Doab and in all the villages surveyed by the author the acreage of irrigated sugar cane is more than ninety five
per cent of the total cultivated sugar cane. Extension of sugar cane
cultivation and irrigation go together.

Manures

Jat agriculture is notable for its large use of manures, both
organic and chemical. Commercial fertilizers are used only in the
sugar cane fields. Whenever manure is available it is copiously
applied to the more valuable crops. Caste prejudices standing in
the way of utilizing the night soil do not operate in the Jat villages.

The most widely used varieties of manure consist of or-
ganic matter, cow and buffalo dung being the most usual. Manure
is prepared in the compost pit which is dug in a corner of the field
(Plate 29). In this pit cattle dung, night soil (human excreta collect-
ed by the municipality of towns), domestic refuse, cattle urine,
ashes of the burnt leaves and plants, and rotten vegetation are
collected and undergo decomposition.

Manuring season covers the months of May and June when
the compost pits are familiar features in the fields. Manuring is
done along with watering (palewa) of the ratoon (paidee). Otherwise
it is ploughed in the soil when sugar cane is grown by setts. Soon
after the crops have been harvested and carried to the stacks, the
carts bring loads of manure from the compost pit. The manure is
placed in heaps at regular intervals all along the fields. Immedi-
ately, before any seed is sown it is carefully spread over the whole
surface and then ploughed in.

Considerable amount of manure in the form of excreta is added by the cattle directly on the fields while feeding on the stubble after the harvest. Similarly, the people of the village defecate in their fields and add more manure. Throughout the country human excreta added to the soil by the villagers themselves is considered a perennial source of manure.

Green manuring is widely practiced by the Jats. San hemp, a green plant having a dense foliage and a large amount of vegetative matter is grown for this purpose. Before the plant matures, it is ploughed in the soil thus adding the valuable manure. Gwar is also ploughed in.

Recently, chemical fertilizers like potassium nitrate and ammonium phosphate have been introduced. These are used only in the sugar cane fields. These fertilizers are added to the irrigation water when it moves through the furrows of the field.

Reaping

Crops are reaped by either an ordinary or toothed sickle. Reaping is done mostly by the Jat women. Sugar cane is cut near the surface leaving a ratoon (paidee). The stalk is held near its head by the left hand and a blow is applied by the right hand holding the toothed sickle. The leaves are cut off from the cane by the ordinary
sickle. In reaping the grain plants, the ears are held in the left hand and a blow by the right hand holding the ordinary sickle is applied, near the lowest end of the stalk. The stalks are cut at the surface in order to get the whole of their vegetative matter which is fed to the cattle.

**Threshing**

The plants after being cut are tied in sheaves and placed in stacks *(poola)* in the farmhouse *(ghair)*. The technique of threshing is simple. The stalks with ears and sheaves are spread on the threshing ground. A pair of bullocks keeps circling over the spread stalks treading it continuously. This treading *(paira)* dislodges the grains from the ears and crushes the stalks and leaves to form straw.

The mixture of grain and chaff is put into the winnowing scoop, lifted up and allowed to fall. The chaff is blown away by the wind leaving the grain in a heap.

**Storing**

After winnowing is completed grain is carried in baskets and stored in small earth-built chambers *(kuthala)* built along one of the walls of the innermost room of the *havelli*. These chambers are cubical in shape and built on a raised earthen platform.

Dried fodder and stalks of threshed grain are stored in conical structures *(boonga)*. These conical structures *(Plate 30)* are
PLATE 30

Bitora, showing the opening from which dung cakes are taken out. Closed structures are boonga for straw.
made of different layers of stalks and dried fodder. Circular belts of grass and stalks are tied together by ropes made of sugar cane leaves. One belt partly covers the other. When fodder is needed the lowest belt is broken and fodder taken out.

Dried dung cakes (upley) to be used as a fuel is stored in dome-like conical structures (bitora) (Plates 20 and 30). The dung cakes are arranged in a pyramid, the circular layers becoming smaller toward the apex. The bitoras are destroyed and rebuilt every year, but remain throughout the year. They are built on barren lands near the pond, the source of water and clay which are mixed with cattle dung, dry stalk pieces, and sugar cane leaves to make the cakes. The cakes are dried in the sun. After the pyramidal arrangement, the dung cakes are plastered with dung mixed with mud and straw. On an average about twenty five hundred pounds of cakes are preserved in one bitora. To take out dung cakes, a small opening is opened in the middle of the structure (Plate 30) and they are taken out without disturbing the regular systematic arrangement.

**Double Cropping**

Double cropping is an important feature of the agriculture of the Upper Doab in general, and of Jat agriculture in particular. It consists of growing summer (kharif) and winter (rabi) crops on the same field. About fifty per cent of the total cultivated area in the sample villages is double cropped (Map 9).
The practice of double cropping is ancient in India (Maity, 1957, p. 79). The Greeks found it a great source of wonder that India produced two crops a year (Basham, 1956, p. 194). The Jats adopted the practice after settling in the Upper Doab. Before coming to the Upper Doab, living in Malwa the Jats did not practice double cropping because the autumn and winter rainfalls there are not sufficient to permit cultivation of winter crops. Surrounded as it is on all sides by the spurs and salients of the Aravallis and Vindhyas, Malwa is a rain-shadow region. Also, canal irrigation was totally absent there in the past. Hence, double cropping was not practiced there and it is practiced very rarely even now. There is, thus, no doubt that the Jats adopted the practice of double cropping in the Upper Doab.

The Jats, however, modified the method to some extent. In villages belonging to agricultural people other than Jats, double cropped fields lie very near the habitation and double cropping is done by well irrigation. The Jats extended double cropping to all the good land of the village instead of restricting it to the highly farmed area surrounding the habitation (Map 9). This is chiefly because of sugar cane. Good land with high productivity and located near the irrigation channels are invariably the double cropped fields. Increase in double cropped area is everywhere ascribed to the development of canal irrigation.
Increase of population has also encouraged a widespread increase of double cropped area (Mukerji, 1933, pp. 139-142). The pressure of population on land was already quite great when the Jats arrived in the Upper Doab. In such a circumstance agricultural extension was practically limited in the direction of double cropping.

Growing of cash crops like sugar cane and cotton also gave an impetus to the increase in the double cropped area. Subsistence economy in early periods was based on only pulses and wheat and millets. Exchange economy based on sugar cane and cotton effected a sudden increase in the double cropped area.

Apart from these cultural factors, purely physical factors of climate and soil also influence the extent of double cropping. Climate of the Upper Doab is temperate in winter and sub-tropical in summer, hence both temperate and sub-tropical crops are cultivated (Dubey, 1935, p. 29). It has been shown that the annual fluctuations in the double cropped area are mainly due to variations in the amount and time of rainfall (Mukerji, 1933, pp. 139-142).

The texture and the fertility of the soil also determine the efficiency of moisture, success of artificial irrigation, the quantity of plant-food available, and thus, the extent of double cropping. Stiff clay (dakar) soil become water-logged immediately after the rains and no winter crop can be grown on it. Clay (karail) and clayey loam (rausli and matiar) retain moisture long after the rains have ceased
and are thus grown with winter crops with little or no irrigation. Sandy soils (bhur) of Muzaffernagar and Saharanpur respond well to irrigation and produce a fair quantity of winter crops. The most extensive double cropping is developed on the loamy soils irrigated by canals.

**Mixed Cropping**

The practice of mixed cropping is widespread in Upper Doab. The Jats grow mixed crops such as millets and pulses; wheat and barley (gojai); wheat and gram (gauchani); wheat, gram, and pea (bejharo) (Map 9).

There are three patterns of mixed cropping, (a) the seeds are sown together. Crops ripening at the same time such as wheat and gram are thus, sown together; (b) the seeds of two crops ripening at different times are sown in alternate rows, so that both can be harvested easily. Fodder (metha) and wheat are grown in this way; and (c) seeds are sown in two entirely separate parts of the same field. Pea and fodder (metha) are grown in this way. Millets are grown on the borders of the field of maize. The following table shows the main crops and the subsidiary crops grown with them:

<table>
<thead>
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<th>TABLE 5</th>
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<tbody>
<tr>
<td><strong>Main Crops</strong></td>
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<td>Wheat</td>
</tr>
<tr>
<td>Gram</td>
</tr>
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TABLE 5 (continued)

<table>
<thead>
<tr>
<th>Main Crops</th>
<th>Subsidiary Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Pulses, san hemp, and gram</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>Gram, pulses, beans, san hemp, and fodder</td>
</tr>
<tr>
<td>Millet</td>
<td>Pulses</td>
</tr>
<tr>
<td>Maize</td>
<td>Pulses</td>
</tr>
</tbody>
</table>

The advantages accruing out of the practice of mixed cropping are well known to the Jats. Mixed cropping is generally considered to be the insurance obtained against an entire failure of the harvest in the years of low rainfall. Under such conditions one or the other of the mixed crops is most likely to mature. The deep, tap root of gram is supposed to reach the lower layers of the sub-soil and to extract moisture therefrom.

Another advantage is concerned with the supply of nitrogen. It is probable that denitrification is common during the monsoon phase, and that the amount of available nitrogen is small at the time when the winter crops are sown. Wheat is therefore, grown with gram which is able to make use of atmospheric nitrogen and so relieve the pressure on the combined nitrogen.

Mixed cropping also, economizes tillage in small holdings. It is another way of saving time and space (Curwen, 1953, p. 295). It assures a quantity of yield sufficient for the maintenance of the family.
Such practical advantages understood rationally might not have been the origin of the practice of mixed cropping. Mixture of crops other than legumes are also grown, such as wheat and oats, and wheat with barley (gojai). These mixed patterns do not increase the nitrogen content of the soil.

In the early periods, a farmer probably wanted to get from the same field food for both his family and cattle, thus effecting a saving in his labor and the land resources. Thus wheat (for humans) and barley or oats (for cattle) began to be grown as mixed crops, sown in separate rows and reaped row-wise.

Another probable explanation is suggested here. In the earliest stages oats was a weed, tolerated in the wheat and barley fields. This has persisted up to the present day even though it was domesticated subsequently.

**Rotation of Crops**

Rotation of crops in Indian agriculture is an ancient practice. It has been mentioned in the Rig Veda and the Taitiriya Samhita (Majumdar, 1938, p. 10). Its origin in place and time is lost in antiquity. Permanent agriculture means that the fields may produce more than one crop in the course of a year. This necessitates the conservation of fertility of the soil. Leguminous crops were grown to fix nitrogen in the soil and restore its lost fertility.
An interesting cultural explanation has been put forward by Kosambi (1956, p. 130). The ban on beef-eating encouraged the later Aryans farmers to grow protein crops like peas, grams, pulses, and beans. Rice was their staple crop which gives a balanced meal only with meat, fish, or legumes. Rotation was thus, a consequence of the vegetarian diet and economy.

The value of crop rotation in checking the exhaustion of the fertility of the soil is well-known to the Jats. The pattern prevalent over a large area of western Gangetic plain has been adopted by the Jats and modified to suit the growing of sugar cane specially. Legumes, pulses, and fodder crops are the main factors influencing the pattern of crop rotation in Jat villages.

In general, the field is used alternatively for winter (rabi) and summer (kharif) crops, and a part of it is allowed to remain fallow every year. During the summer season, almost all the land is utilized in growing sugar cane and maize. In the winter season, a substantial portion of the land is always left fallow since in this season there is no cash-crop to be grown. The practice of fallowing ensures a larger yield of sugar cane in the subsequent season.

During the winter season these fallow fields are thoroughly ploughed and a better tillage is achieved, which is required for a heavy crop like sugar cane. Many Jats consider a regular practice of crop rotation as an absolute necessity for the cultivation of sugar cane.
Starting with an irrigated field and with wheat as the first winter crop, the summer crop will be maize, followed by gram with millets in the winter. Cotton comes in the second summer followed by a fallow in the third winter. After that the field will be taken up for sugar cane which grows for a major part of the year. It is usually followed by one of the millets.

In general, the land must lie fallow for at least one harvest and then the land is ploughed in, usually by two ploughings. If ratooning is not to be done the sugar cane fields after being watered (palewa) are sown with wheat. In July millets, maize, and pulses are sown to be harvested in September and October. After this, the millet fields are sown with gram and maize fields with either wheat alone or wheat in combination with gram (gauchani). After these crops have been harvested in March, the field is left fallow up to July.

The influence of soils on crop rotation is great and there are many variations from the standard pattern of crop rotation because of the varying efficiencies of the soil. The clay (dakar) soil of Saharanpur and Muzaffarnagar districts are suitable for rice and from the same fields two crops of rice (aghani and kuari) are taken.

In the Jamuna Flood Plain (kadar) wheat is the major crop and so, there is no necessity of a winter fallow as for sugar cane. A large amount of fodder crops are grown in these fields. In the Ganga Flood Plain (kadar) the rainfall is greater than that in the Jamuna
Flod Plain and the soil a bit more moist and therefore, *aghani* rice is grown successfully. This kind of rice is not so popular in the central areas containing heavy loam (*matiar*).

An ordinary schedule of crop rotation covering a period of three years is given below:

**TABLE 6**

**Field A**

<table>
<thead>
<tr>
<th>Summer or Kharif (July to September)</th>
<th>Winter or Rabi (October to April)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year Fodder crop (<em>Gwar</em>)</td>
<td>Pea or gram or sugar cane</td>
</tr>
<tr>
<td>2nd year Sugar cane</td>
<td>Pea or fodder (<em>Metha</em>)</td>
</tr>
<tr>
<td>3rd year Fallow</td>
<td>Wheat</td>
</tr>
</tbody>
</table>

**Field B**

<table>
<thead>
<tr>
<th>Summer or Kharif (July to September)</th>
<th>Winter or Rabi (October to April)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year Sugar cane</td>
<td>Pea or fodder (<em>Metha</em>)</td>
</tr>
<tr>
<td>2nd year Fallow</td>
<td>Wheat</td>
</tr>
<tr>
<td>3rd year Fodder crop (<em>Gwar</em>)</td>
<td>Fallow</td>
</tr>
</tbody>
</table>

**Field C**

| 1st year Millet (*Jwar*)             | Gram                              |
| 2nd year Maize                       | Wheat                             |
| 3rd year Fodder (*Gwar*)             | Fallow                            |
| 4th year Sugar cane                  | Sugar cane                        |
It is clear from the schedules given above that every field in the course of three years must bear three crops, namely, wheat, fodder, and sugar cane. Sugar cane is always grown on a field which has lain fallow during the previous season. Leguminous crops are grown in all the three schedules, so that adequate amount of nitrogen is added back to the soil. The millet fields are rarely cultivated with sugar cane as the millets exhaust the soil very much and sugar cane in its own turn is an exhaustive crop.

CROPS

Jat agriculture consists almost wholly of Old World plants. Only one New World plant, maize, is grown by the Jats. The leading crop complex of the Jat agriculture is the native trilogy---sugar cane for cash earning, wheat as the main cereal, and millets as fodder. These three together occupy almost sixty per cent of the cultivated area. Though vegetables are grown in the Jat villages, the Jats do not grow them but gardening castes (Arain, Mali, Saini, Jatia, and Jatav) perform this task. Fruits are not grown. That the Jats do not grow vegetables and fruits is a widely known fact verified on the field by both the writer and an anthropologist (Lewis, 1956, p. 281).

Many of the crops although of Old World origin have been recently adopted by the Jats. The older Jats informed the author that millets for fodder were introduced in the beginning of this century. San hemp, cow pea, and Indian millet were introduced in 1907 A.D. by
the Jats who came from Punjab to settle in the Upper Doab (Supp. Note. Meerut Gazetteer, 1935, p. 17). Pusa wheat, a variety evolved in the Pusa Agricultural Research Institute, Bihar, was introduced in 1915, and immediately became popular with the Jats (Supp. Note. Muzafarnagar Gazetteer, 1935, p. 3). Coimbatore varieties of sugar cane were introduced around the 1920's and grown widely by the Jats.

**Cropping Pattern**

Crop-wise analysis (Table 15) leads us to the generalization that sugar cane is the most important crop in Jat villages, while fodder and wheat balance each other fairly well. Maize is everywhere more important than cotton which was once very popular. Characteristic of the Jats is the balance between food, non-food, and fodder crops.

The comparative study of areas of different crops in the four villages studied intensively is tabulated below.

**TABLE 7**

(Area in acres)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Tiwra</th>
<th>Ujheda</th>
<th>Jalalabad</th>
<th>Amrala</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar cane</td>
<td>172</td>
<td>219</td>
<td>374</td>
<td>239</td>
</tr>
<tr>
<td>Wheat</td>
<td>115</td>
<td>174</td>
<td>314</td>
<td>198</td>
</tr>
<tr>
<td>Fodder crops</td>
<td>113</td>
<td>125</td>
<td>194</td>
<td>173</td>
</tr>
</tbody>
</table>
It is evident from the table given above that sugar cane acreage is the largest among all other crop acreages. Wheat is the most important food crop. The growing of these two crops has resulted in the creation of a fine balance between subsistence and exchange economies, an unique feature of Jat agriculture. Cotton was once of considerable acreage in these villages but its place has been taken up by sugar cane in recent years. Maize is grown for both food and fodder.

The various other crops like millets, san hemp, and pulses are also grown but as subsidiary crops in mixed cropping, and their acreages are less than any one of sugar cane, wheat, fodder, and maize. Production of wheat is in general greater than consumption and from many Jat villages it is exported in considerable quantities.

The areas under various crops and hence the total areas of summer and winter crops change in time, adjusting themselves to the factors of irrigation, population density, and soil fertility. The development of canal irrigation has added thousands of acres to the winter
crop area with the result that whereas before 1860 there was preponderance of summer over the winter crop area, now the conditions have reversed completely.

The changes in the cropping pattern necessitated by the growing pressure of population on land brought in a new trend and there was some change from subsistence food grain farming to commercial cash crop farming. Only by growing the more exhausting but more paying crops could the growing population be maintained at a high material standard. Millets and pulses suffered a reduction in acreage while wheat gained it. Now, it is grown for cash also and maize is consumed to a large extent as a cereal. The commercialization of crops is the most interesting feature of Jat agriculture in recent times.

In the Jamuna Flood Plain the summer crop area is larger than the winter crop area. Here, lower rainfall and sandy soil limit the moisture supply to plants, so, both wheat and sugar cane have smaller but equal acreages. Fodder crops are grown over a large area, thus, making the summer crop larger than that of winter crop. The table given below gives the cropping pattern of a Jat farmer, representative of a Jat village in Jamuna Flood Plain (Village Lohari, Meerut District).
### TABLE 8

(Area in acres)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area</th>
<th>Crops</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar cane</td>
<td>2</td>
<td>Wheat</td>
<td>1 1/2</td>
</tr>
<tr>
<td>Maize</td>
<td>1</td>
<td>Gram</td>
<td>1/4</td>
</tr>
<tr>
<td>Millet (Fodder)</td>
<td>1/2</td>
<td>Fodder (Metha)</td>
<td>1/2</td>
</tr>
<tr>
<td>Cotton</td>
<td>1/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3 3/4</td>
<td>Total</td>
<td>2 1/4</td>
</tr>
</tbody>
</table>

(Collected personally)

The Table 8 indicates that though the proportion of sugar cane in summer crop area is less than that of wheat in rabi, the proportion of sugar cane to total cropped area is greater than that of wheat. This is, primarily, due to the economic pull exerted by the big gur markets (gur mandees) at Bagpat which is only fifteen miles away from the village. The importance of sugar cane area in the whole picture of the Jat agriculture is thus evident. Here, again we find the balance between one cash crop (sugar cane) and one food crop (wheat) while maize is largely grown as fodder.

Almost the same cropping pattern prevails in the Jat villages of the Pleistocene Terrace (bangar). The Table 9 given below gives the crop areas of a Jat farmer of a Jat village in that area (Village Bakharba, Meerut District).
TABLE 9

(Areas in acres)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area</th>
<th>Percentage to total Kharif</th>
<th>Percentage to T. C. A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar cane</td>
<td>31 1/4</td>
<td>41</td>
<td>25</td>
</tr>
<tr>
<td>Millet</td>
<td>15</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Bean</td>
<td>10</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>San hemp</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Cotton</td>
<td>2 1/2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Maize</td>
<td>2 1/2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Rice</td>
<td>5</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Pulses</td>
<td>3 3/4</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>75</td>
<td>100</td>
<td>60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area</th>
<th>Percentage to total Rabi</th>
<th>Percentage to total T. C. A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>25</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Mustard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>10</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Pea</td>
<td>15</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

(T. C. A. -- Total Cropped Area. Data collected personally)
In the Pleistocene Terrace village, there is a wider variety of crops than in the flood plain village. Sugar cane retains its supremacy as a cash and wheat as a food crop. Beans become important primarily because the Jats of this tract derive their protein mostly from bean curry. Legumes including gram, pea, and pulses cover more area than wheat itself, their extent is evidence of scientific farming of the Jats as legumes add the nitrogen back to soil taken up by heavier crops like sugar cane and wheat. Summer crop area is here greater than that of winter crop area primarily because there are many summer crops like beans and rice, not grown in flood plain areas.

The crops grown by the Jats may be arranged under three broad groups: food crops, fodder crops, and green manure crops.

FOOD AND FOOD CROPS

The food crops of the Jats can be better understood by an initial knowledge of their diet. Hence, a description and interpretation of the Jat diet is given here.

Jat Diet

Most Jats are vegetarians since they are Arya Samajists (a Hindu reformist faith) and theoretically not expected to eat meat. But urban influences and habits acquired from army profession have changed a few Jats to non-vegetarian diet. Jat soldiers returning from the two World Wars tried to introduce meat diets. But religious
injunctions prevented its adoption except to a very little extent.

Abstinence from meat diet is one of the practices by which the Jats have tried to raise their social status in the caste hierarchy, since, the higher "clean" castes are theoretically expected to be vegetarians.

Wheat and maize are the staple cereal foods. Pulses and beans are consumed in large quantities while green vegetables are regarded as merely delicacies. Mangoes are eaten during the summer. Milk and milk products, and gur (unrefined sugar) are consumed in large amount in every meal.

Wheat is consumed in summer and maize in winter. This seasonal difference in the main cereal of the diet is due to the fact that wheat is grown in winter and harvested in summer while maize is grown in summer and harvested in winter. The bulk of wheat and maize are consumed as atta which is whole wheat or maize grains ground to flour. The atta is passed through a coarse sieve to remove the fibre rich bran which is fed to the cattle. The wheat or maize flour is made into unleavened bread (rotee), and fried rotee (paratha) and puree.

The method of making rotee consists of mixing flour with requisite quantity of water and kneading the mixture until the dough is obtained. The dough is allowed to stand for some time, about half to one hour, and then given a second kneading, after which a small portion of the dough is rounded off between the palms of the
hand and rolled on a circular wooden board with a wooden roller into a flat, circular, and thin (about 1/16 inch or 1/12 inch thick) rotee. This is then placed on a shallow pan on an open fire. One side of the rotee gets baked in about two minutes when it is turned over and baked on the other side. After both sides are baked the rotee is placed on fire direct and manipulated by a pair of tongs when it separates in two layers by becoming inflated. It is then ready for eating.

The preparation of paratha consists in preparing the dough with a little oil or clarified butter (ghee) mixed with the flour and rolling the dough as in the making of the rotee. A thin layer of oil or ghee is smeared on one side and the rotee is folded, another thin layer is smeared and a second fold given. This twice folded rotee is rolled again and baked on a flat open pan. When both the sides are baked a little ghee is added and rotee is fixed to a certain extent. It is then called paratha and is ready for eating.

A third and important preparation is called puree. Small, flat pieces of rotee, three to four inches in diameter are deep fried in ghee over open fire. The preparation is then known as puree. The puree is the food of the rich. In the poor families puree is made on big occasions and served to the guests.

Rice in terms of daily diet and hence as a source of carbohydrate is of little significance. This trait of indifference to the consumption of rice is shared by the Jats with other culture groups of
the Upper Doab. This Jat trait is also indicative of their cultural kinship with the people of the dry steppe area of Rajasthan where rice is almost never used as a daily meal. In both areas, however, among the Jats and among the people of Rajasthan rice is a prestige cereal and is served as a boiled dish to the guests. Rice is boiled in an amount of water that leaves no liquid starch which is thus absorbed by boiled rice itself. This, again is a trait which indicates the cultural relationship of the Jats with the people of western India. In eastern India, in Bengal and Bihar, a larger amount of water than is necessary to fully boil the rice is added, and thus, liquid starch is produced in larger quantities than can be absorbed by boiled rice. This liquid starch is thrown out before the rice meal is ready for eating. The rational explanation of the Jat practice of retaining the liquid starch, and allowing it to be absorbed by the boiled rice may be found in the little consumption of water which had small resource in the dry, steppe region of India. It may also be a conscious effort to increase the starch content of the rice meal.

Rotee, paratha, puree, and boiled rice (chawal or bhat) are eaten with vegetable curries (taridar subjee), soup made of the split cotyledons of the decorticated seeds of the pulses and the beans (dal), boiled vegetables (ubli subjee), fried vegetables (bhujia), and fried vegetable earlier boiled (sookhi subjee). All the vegetable dishes are highly spiced. Boiled vegetable is mixed with curd to form a salad.
(raita). Pickles (achar) and chutney of vegetables, and raw fruits like tamarind, mango, cauliflower, carrot, and garlic are taken to make the rotee-subjee combination more palatable and tasty.

Breakfast generally consists of milk, curd, unrefined sugar (gur), and one of the following: pancake (missi rotee) made of gram flour fried in oil, a mush (pakora) made of gram flour and vegetables, carrot pudding (gajar ka halwa), pudding of cream of wheat (suji ka halwa), or a porridge of half-broken fried, and boiled wheat in milk (dalia) mixed with sugar. Often in the afternoons, the Jats eat popped maize smeared with clarified butter (ghee) and salt; and roasted semi-ripe maize smeared with salt and mustard oil.

The large consumption of milk of the water buffaloe and milk products in the Jat diet is noteworthy. This, again, seems to point to the cultural kinship of the Jats with the nomadic and semi-nomadic pastoral people of the dry steppe region of western India, among whom milk is one of the most important elements of the diet. The puzzling problem is, however, this; that the Jats claim themselves to be of Aryan origin for whom the milk of cow was the usual liquid food, and yet they almost never drink cow's milk or use it in the preparation of milk foods. The origin of the trait of the consumption of water buffaloe's milk among the Jats is not known. It is definitely known, however, that water buffaloe's milk is used over a wide area in the central parts of India by primitive, non-Aryan, non-Hindu
forest dwelling tribes. It is, thus, strange that the Jats claiming an Aryan descent adopted a supposedly pre-Aryan trait and have been practising it to this day. When asked to explain this practice the Jats told the writer that the obvious reason for the use of the water buffaloe's milk was that it contains more fat as compared to the cow's milk. Scientific nutritional studies have definitely shown that the fat content of the water buffaloe's milk is more than twice that of the cow's milk (Patwardhan, 1952, p. 12). Culture historical explanation of this trait may be found in the culture contact between the Jats and the primitive water buffalo loving tribes of the Malwa Plateau, where the former people lived a long time during the early stages of their movement to the Upper Doab.

Milk is used in various ways. It is drunk with gur (unrefined sugar), both cold and warm but never without being boiled once. This, probably, is done to purify it by bringing it in contact with fire, and also to kill the microbial germs. Milk products made from it include ghee, buttermilk (chach), curd (dahee), khoa, rabadi, malai, channa, and kheer.

Ghee is butter fat from which water is removed by heating. The making of ghee consists in bringing the fresh milk to boil and allow it to remain at that temperature for five minutes or longer. It is then allowed to cool slowly and when warm to the touch inoculated with preformed curd. The lactic fermentation which proceeds may
cause a firm curd to be formed between eight to thirty-six hours depending upon the environmental temperature. This is how curd is prepared and this is the first stage in the preparation of ghee. An equal quantity of water is added to the curd and the mixture is churned in earthen or metallic vessels by a wooden churner. In twenty to thirty minutes butter (makhan) separates which is then removed, and pressed to remove excess buttermilk. The preparation of the butter (makhan) is the second stage in the preparation of ghee. The butter is placed in a pan on the open fire and heated, the fat melts; and when sufficiently heated the water boils and evaporates. The heating is continued on low fire till all the water has been driven off. The water-free product is then known as ghee.

Buttermilk (chach) is the by-product of butter preparation. Chach is extremely palatable and the Jats consume it in large quantity. Chach contains most other nutrients of milk except its fat. It is taken by the Jats as a beverage, either sweetened or salted. Chach is also a cheap substitute for curd.

The preparation of curd (dahee) has already been described. It is a delicious food equally nutritious as milk.

Among other milk products malai is the cream which rises to the top on slow heating of milk; it is skimmed off and sold as such or consumed at home by the Jats. Rabadi is whole milk boiled down to a thick consistency and sweetened. Khoa is whole milk concentrated in
open pans till a granular solid still containing some water is obtained. Channa is made by curdling milk either by lime juice, alum, or decomposed curd. The curdled mass is freed from whey, pressed, and is made into sweets. Channa, khoa, malai, and rabadi are prepared on big occasions.

Cooking and frying is done with clarified butter (ghee) and vegetable oils (taila), main varieties being of groundnut and mustard. Lard is never used because the religious injunction against its consumption.

The only fruit consumed by the Jats in the ripe form and without any preparation is the mango. This fruit is eaten only during the latter part of the summer and throughout the rainy season when it is harvested.

Cultural interpretation of the Jat diet is interesting. The Jat diet consists, primarily, of baked, boiled, and fried foods. Baked and boiled foods (kachcha khana) are regarded impure while fried foods (pucca khana), milk products, and fruits are considered as pure. This notion of the purity and the impurity of foods is prevalent among all the castes and culture groups professing Hindu faith and is derived from the earliest Vedic Aryans. Preparation of food by boiling is not suited to arid environments with a marked lack of water. Probably, both boiling and baking were borrowed by the Vedic Aryans from the no-Aryan tribes (nishadas—dark-skinned tribes) and, hence,
boiled and baked foods were regarded impure. Therefore, today, the Jats following the ancient practice do not eat baked or boiled foods on religious occasions or on days of fasting.

The little use of green vegetables and the absence of meat in the Jat diet have cultural explanations. The Jats do not grow green vegetables because cultural relationships with the Rajputs prohibit them to do so. Their origin in the arid, steppe region of western India also explains the indifference of the Jats to the consumption of green vegetables. It is most probable that the Jats adopted green vegetables after permanently settling in the plains as agriculturists. The abstinence of meat stems from the well known Hindu religious principle.

The place of maize in the Jat diet is also an interesting problem. Maize is a recently introduced crop and is generally regarded 'a poor man's diet', and yet the Jats consume it in large amount during the winter. Maize diet is never served to the guests nor is it eaten on religious occasions. One of the reasons of its consumption during the winter is simply its availability in that season. The economic reason may be found in the fact that wheat is a costly crop and any surplus can be sold as a cash crop and hence it is not stored for the winter.

No scientific nutritional study of the Jat has yet been made. Certain generalizations, however, can be made. The Jat diet
indicates a preponderance of cereals but deficiency in protective food-stuffs. The chief source of calories and of starch (carbohydrates) is wheat in summer and maize in winter. Bulk of the proteins are supplied by pulses, beans, milk, milk products, vegetables, and wheat. Some protein is also supplied by cereals. The consumption of large quantities of these foods in daily diets can be better understood as a practice to make up for the deficiency of protein resulting from an abstinence of meat, fish, egg, and animal fat. Low consumption of vegetables and fruits is responsible for deficiency of mineral components of the diet. Certain amount of phosphorus is provided by the cereals while calcium and magnesium are derived from milk. A little vitamin C is provided by the small consumption of fruits and green leafy vegetables. Vitamin A, B, D, are provided by milk and fresh butter (Mukerji, 1954, p. 17). On the whole, the Jat diet is nutritious and wholesome. It is nutritionally balanced and very healthy.

Food Crops

The food crops grown by the Jats can be better studied under four groups as follows:

Starches

1. Wheat

Wheat is the staple food of the Jats. Among the winter crops it stands first, both in the acreage and the total cash
earnings. Of the total cultivated area in a Jat village, about one-third is given to growing wheat. In its contribution to the Jat economy, wheat comes second to the sugar cane earnings.

The wheat grown by the Jats is the common, bread wheat (*Triticum vulgare Vill*). Some of the common varieties in the class of soft, white wheat grown by the Jats are safed, gajar, mendha, rutta, munia, mihira, muria, and monda sambharia. Barha and kathia are hard white varieties while lal and surkh are soft red.

Wheat was introduced into India by the Aryans. It may have been first domesticated in an area which extended from Afghanistan-Indian border to the Mesopotamian Valley (Vavilov, 1951, p. 31; Sauer, 1952, p. 80; De Candolle, 1959, p. 358; and Dyson, 1953, p. 10). This view is supported both by botanical and archaeological considerations. The Sanskrit name of wheat is gendhum, which is derived from gandum, a Persian word. The Aryans came to India from an area which was in ancient times a part of Persia and where they cultivated wheat. After settling in India they developed Sanskrit and adapted the Persian word gandum modifying it to gendhum, from which evidently the words gehum and gom of Hindostani have been derived. Linguistic evidence thus suggest very strongly the possibility of the Aryan introduction of wheat into India.
The Upper Doab is ideally suited for growing wheat, climatically and edaphically. It is a temperate area with thirty inches of annual rainfall. Wheat is grown by the Jats on all kinds of soils and lands, the fertile loam (*rausli, dumat, doras, and siwai*) however, is the most popular.

The crop is entirely a winter one. It is sown in the last week of October or beginning of November and cut in March or April. The best lands are always selected for wheat. It is generally sown in land which has lain fallow during the preceding summer (*kharif*) season. In highly manured lands near the village habitation it is grown on the lands that earlier bore the maize crop.

The fields are ploughed as many as fourteen times (Howard, 1909, p. 37); however, only eight ploughings are common (Duthie and Fuller, part 1, 1882, p. 3). The clods are broken by a flat beam (*patela*) attached to the yoke by a rope and drawn by a pair of bullocks. A man stands on the beam and the clods are more easily broken by the added weight. Cowdung is added to the soil to manure it. *Crotalaria juncea* is used as a cover crop and ploughed in the soil. All the wheat fields are carefully manured.

There are two common methods of sowing wheat prevalent among the Jats. A man simply follows the plough and drops
the seed into the furrow. The seeds are covered by the earth thrown up by the next furrow. The second method is dropping the seeds down a bamboo pipe fastened to the plough handle. When the ground is damp, the seed is sown broadcast and ploughed in and it is not buried more than one inch below the surface. The amount of seed used per acre varies from one hundred to one hundred forty pounds. After the sowing the field is levelled with the clod crusher. This practice saves irrigation by enabling the water to spread more quickly over the surface. It also helps moisture to come up from sub-soil and ensure good and even germination (Howard, 1909, p. 38).

All wheat fields are irrigated artificially. When the monsoons retreat early and September becomes dry, wheat fields are irrigated before sowing. This preliminary watering (palewa) is given to assure a successful germination and to carry the crop through the seedling stage. The first watering is given in November to the young crop, a second in January and a third in March.

Wheat is grown both alone and mixed with other crops. Wheat and barley (the mixture known as gojai) are grown together, harvested and threshed together, and ground together into flour. Another combination is wheat and gram (gochani). Wheat is sometimes grown after a summer crop in the same
year on the same field. More commonly it is grown after a winter crop in the preceding year, with a fallow period of eight to nine months. This is done to make the most profitable use of the manure left over by sugar cane, which has usually been treated liberally.

Harvesting begins about the middle of March and extends well into May. The plants are cut by hand with a sickle. Large bundles are made, so that they may be readily counted and are usually stacked roughly for threshing. The grain is threshed on the threshing floor. It is trodden by the feet of cattle yoked and fastened to a post in the center of the threshing floor of beaten earth. They are driven round and round the stake about which the wheat is heaped. In a short time the brittle straw is broken up into short pieces and the grain is freed from the chaff. The grain is separated from the chaff by being thrown into the air by a pitchfork. The winds carry the dry chaff (bhoosa) away while the grain falls back on the threshing floor. Then winnowing is finally used to clean the grain (Plate 32). The yield per acre of wheat grain is about twelve hundred pounds.

Stalks and straw are fed to the cattle. The threshed stalks are mixed with clay to make a wall plaster. The grain is ground into flour in a hand-grinder (rotary querns) by the Jat women (Plate 31). The flour (atta) is made daily in the morning
PLATE 31

Rotary quern worked by hand, consisting of two rough-surfaced, circular stone pieces. The hole in the middle of the upper piece feeds the grain into the quern. Wheat is being dried in the sun on the left.

PLATE 32

Winnowing scoop (soop).
before the farmers go out to their fields. For some unknown reasons the Jats never consume flour ground in a flour mill operated by Diesel oil machines. Flour is made into thin, round cakes (rotee) similar to the Mexican tortilla, and are baked on earthen ovens. This is the main element in their diet.

2. Maize

The primary center of domestication of maize (Zea mays Linn) is the South American and the Central American area (Vavilov, 1951, p. 39; De Candolle, 1959, p. 397; and Mangelsdorf, 1951, pp. 263-289). There is still much controversy today about the place of origin of maize. Scholars generally agree, however, that maize is a New World crop.

In India, maize is a recent crop, being introduced only after contact with the Portuguese, shortly after 1,500 A.D. Such an idea is based on several facts: (1) There is no reference to maize in the works of the travellers who visited India before the discovery of America; (2) Maize has no Sanskrit names. The Hindostani word for it is bhutta which is derived from the word bhukta (to eat); (3) Maize is in no way associated with any of the domestic or religious rites of the Hindus; (4) There are no archaeological remains of the seed or the stalk and no pictorial representations on ancient monuments. These support very strongly our notion that maize is a recent crop in India.
The time and place of introduction of maize into India is, however, an open controversy. The kinds of maize in India and the routes of entry present a vast research problem which has as yet scarcely been touched (Edgar Anderson, personal communication of February 5, 1959). Laufer in an early publication suggested that maize was introduced into India, probably by the Portuguese in the sixteenth century, but there was no documentary evidence to support it (Laufer, 1907, pp. 224 and 241). Today most botanists and anthropologists believe that maize is a Portuguese introduction into India, (Merrill, 1954, p. 373; Wright, 1949, pp. 61-81; and Ho, 1955, pp. 191-201). The suggestion of Stonor and Anderson (1949, pp. 355-404) that maize is pre-Columbian in Asia and in India has been discredited by Mangelsdorf and Oliver (1951, pp. 263-291). In a personal communication, Mangelsdorf repeats that maize was introduced into India by the Portuguese (letter dated March 3, 1959). The English botanists had stated quite early the same ideas (Duthie and Fuller, 1882, part 1, p. 21; Watt, 1893, p. 334; and Blatter and McCann, 1935, p. 2). The exact place where maize was introduced into India was Goa, a Portuguese possession on its western coast (Watt, 1893, p. 334; Merrill, 1954, p. 373; and Mangelsdorf, personal communication, ibid).
At first, maize was grown in gardens only as a delicacy until the eighteenth century, after which it spread rapidly over all of India (Watt, ibid, p. 334). It is reasonably certain therefore that maize came into the Upper Doab sometime in the eighteenth century and where by the early part of the nineteenth century its cultivation became widespread (Watt, 1893, p. 335).

Maize (Zea mays Linn) belongs to the genus *zea* of which no wild species are known today. It is a tall, annual grass growing to heights of from three to fifteen feet (Plate 33). The jointed stem is solid and contains a large amount of sugar when young. The cob is produced below the tassel on the stalk and is protected by the leaves (Plate 34). The mature grains are produced in rows on the cob. In Upper Doab two varieties, yellow (*pili makka*) and white (*dhauli makka*) are grown.

Maize is an important summer crop, sown between the fifteenth of June and the fifteenth of July and reaped in September. It is grown on loamy, clayey soil situated around the habitation and is given large amount of human and animal excreta. The fields are ploughed from three to six times and the seeds are dropped into the furrow behind the plough. The crop is weeded frequently. Earth is carefully banked up around the roots, so that each plant appears to be standing on a little mound of its own.
PLATE 33
Maize plant of Upper Doab.

PLATE 34
Maize cob of Upper Doab.
Two to four tons of cattle dung and ashes are applied to one acre of land. It is always grown alone because of its habit of quick growth. Compared to the white variety, the yellow one requires less irrigation and ripens early. On the whole, however, maize requires a large amount of irrigation. The yield per acre is about 800 pounds of grain.

The cobs are pulled while green and eaten as a vegetable and also by roasting it. Stalks are then used as cattle fodder. When intended to be used for popping and flour, the grains are ripened either on the plant or by spreading the matured cobs on the roof. The grains are dislodged either by women with their fingers or by the treading of cattle. The dry stalks are fed to the cattle and used in thatching, while the dried cobs are burnt as fuel in the earthen ovens.

3. Rice

Rice is grown to a small extent by the Jats, and consequently its contribution to their economy is limited. It does not play the same important role in their rituals as it does in those of orthodox Hindus. Rice is not the staple food of the Jats; they make porridge with milk and rice to be served to the special guests. Its use is quite limited.

Rice is an ancient crop in India. Most scholars agree that cultivated rice (Oryza sativa Linn) was first domesticated in
the general area of southeast Asia including eastern India
(Watt, 1892, Vol. 5, p. 498; Sauer, 1952, p. 27; Roschevicz, 1931, p. 1; Vavilov, 1951, p. 29; De Candolle, 1959, p. 387; Chatterji, 1951, p. 21; and Ramiah and Ghose, 1951, p. 9). Botanical, archeological and philological considerations have led these scholars to this conclusion.

As regards forms and diversities of varieties, the richest area of their development is specially India and Indo-China (Chatterji, 1951, p. 18). The same author has noted (ibid, pp. 18 and 19) that the two wild species _O. sativa_ Linn. var. _fatua_ Prain and _O. officinalis_ Wall ex Watt, which contributed to the evolution of the cultivated rice are found distributed most widely in southeast Asia.

In the Sanskrit language rice was known as _dhanya_, _vrihi_, and _shali_, all referable to roots which denote life, existence, or subsistence. The word _vrihi_ which definitely means rice occurs in Atharvaveda, generally agreed to belong to a period around 1,000 B.C. (Chatterji, 1951, p. 20). Impressions of rice on terra-cotta found in East Punjab conclusively proves the existence of rice in Northern India about 2000 years ago (Chatterji, 1951, p. 20). The earliest archaeological evidence for the presence of rice in the Upper Doab is around 800 B.C. (Wheeler, p. 130). The Arabs adapted the Tamil word
arishi and called rice as arruz or uruzz (Majumdar, 1938, p. 212 and Chatterji, 1951, p. 21). European names oryza (Greek), reis (German), rizo or riza (Italian), riz (French) and rice (English), are evidently derived from the two words arruza and arroz.

The genus *Oryza* is composed of twenty-three species. Twenty-one of these are wild and two cultivated, *O. sativa* and *O. glabberina* (Chatterji, 1948, p. 185). It is a large annual grass growing to a height of from two to four feet. It produces a panicle, an inflorescence composed of a number of fine branches, each terminating in a single grain surrounded by a husk. The grains are readily detached together with this brown husk.

Apart from the absence of any cultural necessity for the growing of rice by the Jats, the minimal environmental conditions are also discouraging. Rice is a plant of the hot, moist regions. Upper Doab is hot but not moist. The limiting factor is the supply of water which is used almost exclusively for sugar cane. Rainfall is wholly insufficient for the growing of rice. Within the Upper Doab rice is grown in stiff, clay soil found in depressions (dahar).

The Jats grow the white-grained early maturing varieties of rice. In Saharanpur the large-sized safed muzi
variety is grown very widely by the Jats. This has a thin, yellow-husked grain and is considered a high class rice. In Muzaffernagar the small-sized variety Jarhan is grown in its eastern parts.

Rice is always sown alone. All rice in the Upper Doab is transplanted. The fields are given from four to six ploughings (Duthie and Fuller, part 1, 1882, p. 17) and then flooded. It is sown in June in heavily manured nurseries. The seedlings are taken up when about a foot high and planted out in regular lines at a distance of six inches, from two six seedlings being planted together. After the rains have ceased, two or three waterings are given. The crop is harvested in November.

The yield per acre of unhusked rice is about 1300 pounds while that of husked grain is about 1000 pounds. The crop is cut with sickles just as wheat or barley. The ears are separated from the straws and then threshed by treading of the cattle. Later, the grain is pound in a wooden mortar (okhli) with a wooden pestle (mansari), and finally winnowed. The straw and rice hulls are fed to the cattle.

Sugar

The only source of sugar for the Jats is the one manufactured from sugar cane.
Sugar Cane

Sugar cane is the most important crop in Jat economy, both in acreage and in cash earnings. The material prosperity of the Jats has been almost wholly based on the production of sugar cane, to the extent that Jat economy can be considered as a monocrop economy. Its cultivation has shown an enormous increase during the past century. As early as 1860 A.D. sugar cane covered nearly twenty-five percent of the cultivated area of the Jat villages. In 1955 A.D. the proportion had jumped up to about forty per cent, while in some Jat villages it rose as high as fifty percent.

Sugar cane belongs to the family Graminae and genus Saccharum. There are three species of cultivated canes; 1. Noble or Tropical cane (Saccharum officinarum Linn) which is not known in the wild state and has large stalks. The cane is soft, sweet, and juicy. 2. North Indian cane (S. barberi) which has been grown for centuries in northern India. It is thinner and poorer in sugar content than the noble cane. 3. Chinese cane or Pansahi cane of India (S. sinensis). It is hardy and slender with a high fibre content and low sugar content. There are two wild species; 1. S. robustum from New Guinea and tallest of all the known canes. 2. S. spontaneum which is distributed widely in India, tropical Africa, Egypt, Turkey, China, and Southeast Asia. It is high in fibre and low in sugar content.
Sugar cane is a vigorous, rapid growing perennial grass, reaching a height of eight to twelve feet or more under cultivation, and a diameter of about two inches. The propagation is by vegetative method (asexual propagation) from cuttings termed seeds or setts. Each seed contains one or more buds and each bud produces primary, secondary and tertiary stalks. The stalk is more or less cylindrical. The buttress roots support the plant and the tap roots secure nutrients. The leaves are alternately attached to the nodes, thus forming two ranks on opposite sides of the stalk.

The inflorescence is a silky panicle often termed arrow or tassel which is about a foot in length. The largest and most complex tassels are found in the oldest cultivated species, S. officinarum, their tassels exceeding two feet in length. Each tassel bears many small spikelets arranged in pairs on the branches. The number of spikelets range from hundreds in the S. spontaneum to thousands in S. officinarum. Each spikelet contains a bi-sexual flower with three anthers and a single ovary.

S. officinarum is an old species in India and Southeast Asia. Nowhere in southeast Asia has it ever been found in the wild state. As is common to other ancient crops, the problem of the origin of sugar cane still remains controversial. Most scholars, however, agree that it originated in the general area of southeast Asia (De Candolle, ibid, p. 154; Brandes, 1958, p. 1; Vavilov, ibid, p. 30).
Of these scholars, Brandes gives some specific details. He thinks that *S. officinarum* has been derived from *S. robustum* which is native to New Guinea. He further suggests that this evolution occurred sometime between 8,000 B.C. to 15,000 B.C. From New Guinea sugar cane migrated to a satellite centre of diversity somewhere in southwestern Orissa, in India at about 6,000 B.C. He continues that this route of migration lay across Celebes, Borneo, Malaya, and Burma (Ibid, p. 1). Similar ideas have been put forward by Noel Deerr (1949, p. 14). Both Brandes and Noel Deerr believe that sugar cane was carried by migrating peoples.

These ideas have been successfully refuted by Indian botanists. Cytogenetical studies supported by morphological evidences indicate that the thin, hardy cane of northern India (*S. barberi*) originated from the natural hybridization of *S. officinarum* and *S. spontaneum*, in the regions of Bihar, Bengal, and Orissa (Parthasarathy, 1951, p. 64). This has been supported by the discovery of natural hybrids of *S. officinarum* and *S. spontaneum* in a wild state in Orissa (Mukerji, 1949, pp. 47-58). It appears thus that *S. officinarum* is indigenous in this area (Parthasarathy, 1948, p. 608). In a recent paper (Mukerji, 1957, pp. 55-61) it has been very conclusively shown both on botanical and cultural evidences that *S. officinarum* originated in the area of the common frontiers of India, Burma, and China. Other scholars have
also inclined to such a view (Sauer, ibid, p. 26; Vavilov, ibid, p. 26; and De Candolle, ibid, p. 154).

Linguistic evidences also strengthen the view of Indian origin of sugar cane. The Sanskrit name for it was ikshu, ikshura or ikshava. All the words for sugar cane in modern Indian languages are derived from the Sanskrit name. European language names are derived from Sarkara or gura (cane sugar). On the basis of linguistic evidences alone, India is the area of origin of sugar cane (De Candolle, ibid, p. 159; and Watt, 1893, Vol. 6, pt. 2, p. 31). It has been under cultivation in this area for about 3000 years (Watt, ibid, p. 31).

Originally the Jats used to grow the merthi variety of sugar cane in Upper Doab. Other varieties of some importance were dhaur, bodi, kanara, and dhaur-kinara (Banerji, 1950, p. 37). These varieties were gradually replaced by those of Coimbatore introduced into Upper Doab in 1925.

Propagation is done by two methods, by planting a cutting from the stalk with a bud, and by leaving the root and the lower part of the stalk in the ground (ratoon, paidee in Hindi). The yield from the cutting method is about 40,000 pounds per acre while that from the ratoon is about 28,000 pounds per acre. The ratoon takes about eight months and cutting about nine months to attain maturity. The quantity of juice and sugar content are greater in the cutting cane than in the ratoon.
The preparation of the field essentially consists of from twelve to fifteen ploughings (Watt, ibid, p. 170), breaking the clods, and making the ridges and furrows. The cuttings are buried at an interval of one foot on the ridge. The sowing takes place in March. Soon after, the fields are given irrigation by filling the furrows with water. Water is introduced and withdrawn alternatively after a day's interval. Irrigation continues until June, after which it is gradually withdrawn.

During April, May, and June, fertilizers and manures are also applied along with irrigation. The fertilizers are first mixed with the soil by ploughing and then watering is done.

Harvesting is done in November. The cane is cut near the ground by a toothed sickle (daranti), followed by the cutting of the leaves and finally the cane is loaded in a bullock cart and sent to the sugar mill or the ghair.

Before the erection of sugar mills, all sugar cane was crushed for juice and unrefined sugar (gur) in an indigenous way. Today much of the produce goes directly to the sugar mill. However, every Jat has his sugar press in his ghair and its use has by no means become extinct.

The use and the art of manufacture of sugar in India is very ancient. Sugar and its varied uses are referred to innumerable times in Mahabharata (1,000 B.C.), Ramayana (1,500 B.C.), travels of
Nearchus and Megasthenes (400 B.C.), Charaka Samhita (78 A.D.), and Vishnu Purana (800 A.D.). The Sanskrit name for unrefined sugar was guda from which its names in other languages have been derived. Names in European languages (like Sucre, Zucchero, and rohrzucker) and in Modern Indian languages (gur, gula, sakkar, khand, and bheli) have been derived from various Sanskrit names. The persistency with which certain Sanskrit names appear and re-appear in the various languages of India, argues for the knowledge in sugar having proceeded from a common center in this area (Watt, ibid, p. 29).

Gura is an old classic name for central Bengal. Many old towns in Bengal have names like Magura. These indicate that probably sugar making was started in Bengal (Watt, ibid, p. 29). It is here that the method of purifying gur into white sugar was introduced from China, thus giving the product the name Chini (Watt, ibid, p. 29).

After the cane is cut, it is crushed in a wooden mill (kolhu) or an iron roller mill (charkhi). The wooden mill is constructed by the local carpenter. The cane is cut into short pieces (gareriyam) and put into the wooden mill (Plate 36) or iron mill (Plate 35), operated either by a camel or a bullock. The juice is collected into a pit dug into the ground, from where it is taken out and boiled in large cauldrons (karhais) and earthen ovens (Plate 35). The oven is open on one side from which bagasse is put in to be burnt as fuel.
PLATE 35

Sugar cane juice being boiled in iron pans, on high-walled earthen ovens. The rectangular, wooden pan holds the boiled juice for solidification. Note the iron roller-mill worked by a camel.

PLATE 36

Wooden crusher mill worked by a bullock. Bagasse in the right corner will be used in the oven.
The juice is allowed to simmer slowly and the scum rises to the surface. The scum is skimmed off by pushing a small board along the surface, the scum adheres to this and is scraped off with a potsherd. Sometimes milk or sodium carbonate is added which helps the coagulation of albuminous matter. The juice is boiled slowly until it becomes quite thick and finally consistent enough to make large cakes (dhaiyas), each weighing about ten pounds.

The process of boiling and concentration varies according as its result is to be gur, shakar, or rab. Gur is a mixture of sugar crystals and uncrystallized syrup, boiled until of a sufficient consistency to be made up into cakes (dhaiyas).

Shakar is formed when the boiling is a little more prolonged, and the mixture of crystals and syrup is violently stirred while cooling, when its color becomes lighter and it crumbles into small pieces.

In the making of rab the boiling is not so prolonged and the result is syrup containing masses of crystallized sugar imbedded in it. The preparation of sugar from rab consists in draining the uncrystallized molasses away from the sugar crystals. The rab is poured into coarse cotton bags and subjected to pressure in which about half of the molasses are drained off. The semi-pure product is placed in wicker crates and the molasses is allowed to filter down slowly. The flowery whitish sugar resulting from this process is known as khand.
Apart from juice used in gur-making, leaves are used as fodder and for making ropes. Bagasse is burnt as fuel.

Oil

The oil consumed by the Jats is extracted from the following two oil seeds.

1. India colza

This oil seed plant originated in temperate Europe (De Candolle, 1959, p. 38) or in the Near-Eastern center (Vavilov, 1951, p. 34). The origin of the Hindostani name sarson (Brassica campestris Linn) is not known. This is not a Sanskrit word and it seems therefore certain that it is of recent introduction in India, much later to the Aryan invasion (De Candolle, 1959, p. 37).

B. campestris is an annual plant. It has yellow flowers and yellow seeds. It is always grown with wheat and barley, in rows paralleling those of the major crops. It is sown in October and harvested in April, immediately after the harvesting of wheat and barley. The yield per acre of the seeds is 160 pounds.

The Jats use the leaves as a vegetable and make many dishes of it. It is also cut green and used as cattle fodder. The oil extracted from the seeds is used in cooking and lighting.
2. **Linseed**

Flax or linseed (*Linum usitatissimum* Linn.) originated in the central Asiatic center (Vavilov, 1951, p. 31). Although there is a Sanskrit name *alasi* for linseed, it appears to be under cultivation since the Aryan times. De Candolle suggests that the crop originated in the general area between the south of Persia and Crimea, and was introduced by the eastern Aryans into India (1959, pp. 122 and 130). In India it has been grown primarily for its seeds from which oil is extracted.

Linseed is an annual herb and produces rich, brown colored seeds. It is grown alone on heavy, black, and clayey soil. Occasionally, it is grown in a line around the border of a wheat or barley field or in parallel lines across a field of gram. It is rarely irrigated. The plants are cut down when the seeds are ripe and the seeds are separated from the capsules by beating with wooden sticks. The average yield per acre is 700 pounds of seeds.

The seed yields one-fourth of its weight of oil which is extracted by pressure in a wooden seed-crusher (*oil-mill*), This work is done by one belonging to a caste whose traditional occupation is to extract oil from the seeds (*teli*). Linseed is used for frying and lighting the earthen lamp.
Proteins

The Jats are almost entirely vegetarians. They derive their proteins from the following legumes:

1. **Field Pea**

   The field pea (*Pisum arvense* Linn.) is a variety of garden pea (*Pisum sativum* Linn.). It has no Sanskrit name (the Hindostani name is *matar*) which indicates its recent cultivation in India. Italy is most likely its original home (De Candolle, 1959, p. 328; Vavilov, 1951, p. 35; and Duthie and Fuller, part 2, 1883, p. 18). The Aryans introduced it into India in their later migrations there (Duthie and Fuller, part 2, p. 18).

   It is a winter (*rabi*) crop, sown in the middle of September and harvested in March. The Jats grow it as a second crop after the preceding summer (*kharif*) crop of rice. It is rarely irrigated and manure is never used. It is grown on heavy loam and is sown broadcast. The average yield per acre of the beans is 900 pounds.

   The chaff is used as cattle and horse fodder. The ripened grains are used as a pulse and ground to flour.

2. **Cow Pea**

   In the Upper Doab the species of cow pea grown by the Jats is *Vigna catiang* Linn. It appears to be an ancient crop as
evidenced by its wide geographic distribution throughout India as well as by the several vernacular words denoting its seeds (Hindostani - Lobhia, and Bengali - Barboti).

Vavilov postulates northwestern India and Abyssinia as its centers of origin and domestication (1951, pp. 27 and 38).

It is grown both as a food and a fodder crop. The Jats are fond of making cow pea curries. Its leaves and stems are used as fodder for the cattle. The ripened grain is split and eaten as a pulse (dal) while the green pod is used as a vegetable.

Cow pea is a summer crop (kharif). It is sown in the month of July, at the commencement of the rains. It is always sown with cotton and millet in the same field. It ripens in October and November.

Apart from its food and fodder values, its nitrogen fixing function in the soil is of importance. After it is harvested, generally wheat is grown on its field to take the advantage of added soil fertility.

3. **Pigeon Pea**

This is another leguminous crop, with its origin in the Indian center (Vavilov, 1951, p. 26). Its Sanskrit name was arhuku from which the modern Hindostani word arhar has
been derived. Pigeon pea (*Cajanus indicus*) is the only species of the genus *Cajanus* (De Candolle, 1959, p. 334).

It is generally grown with cotton, pearl millet, and Indian millet. It is highly susceptible to frost. It is sown at the beginning of the rains and takes full nine months to mature to be harvested in March or April. Thus, it occupies the ground for a longer period than any other crop except sugar cane. It does not require manuring and grows very well on a light, moist soil which allows its roots to penetrate downwards easily. When sown with millets, it is broadcast but with cotton it is sown in lines about fifteen feet apart. It is rarely irrigated.

Harvesting and threshing follow the pattern of those of other grain plants. The leaves are used as fodder for the cattle, the stalks for roofing, basket-making, and for making the tubular wicker work for lining the earthen wells in order to prevent the earth from falling in, and the beans are used as human food. The Jats grow it principally for fodder (the yield per acre of grain used as human food is 600 pounds while that of straw used as fodder is 1300 pounds) and eat it only occasionally.

4. **Chick Pea**

This legume (Bengal gram or *Chana* in Hindostani)
originated in the Indian center with a secondary center in the Near-Eastern region (Vavilov, 1951, pp. 26 and 35).

Chick pea (Cicer arietinum Linn.) and fourteen other species comprise the genus Cicer. All of these species are of western Asiatic origin, excepting one which is native to Abyssinia. The cultivated species comes from the tract lying between Greece and the Himalayas (De Candolle, 1959, p. 323). It was introduced into India in ancient times as evidenced by its Sanskrit name chennuka from which all the other names in Indian languages are derived. The western Aryans carried it into India (De Candolle, 1959, p. 325).

It is a winter crop (rabi), sown in September and harvested in April. It prefers the heavy clayey loam on which its yield is the highest. However, it grows on all types of soils from the lightest loam to the heaviest clay. It is grown with either wheat (the mixture being known as gochani) or barley. It is sown by being drilled behind the plough. If grown alone, it is never irrigated. It is harvested and threshed like wheat. The yield per acre of the grain is about 700 pounds.

The Jats use it primarily as cattle and horse feed. The straw (bhusa) mixed with ripened grain is considered the most nutritious food for both the cattle and the horse. For human consumption, its flour is mixed with that of wheat and made
into tortillas. Such a practice is considered as an indication of poverty and the Jats rarely resort to it.

5. **Green Gram**

Green gram (*Phaseolus mungo* Linn.) has a wide distribution in India, growing under the humid conditions of Bengal as well as dry conditions of Punjab. This is wild in India. There is no Sanskrit name but the number of varieties in India is considerable. There are several names for this crop in modern Indian languages (*moong, munga, munger*). De Candolle (1959, p. 346) considers its origin and domestication in India. Vavilov (1951, p. 27) postulates Bengal-Assam region as its place of origin. It is under cultivation in India for about two thousand years (De Candolle, 1959, p. 346).

It is a summer crop (*kharif*). It is sown with cotton on the same field, at the commencement of the rains and is harvested in October. It stands drought very well and does not require irrigation. The yields of grain and fodder are 400 pounds and 1200 pounds per acre respectively.

The ripened grain is split and used as a pulse (*dal*). The leaves and stalks are used as fodder. Compared to *Phaseolus radiatus* Linn. (*Urad or mash*), the consumption of green gram by the Jats is less frequent.
The common vernacular name of this legume is urad or mash. It is a variety of Phaseolus mungo Linn. It originated in India (De Candolle, 1959, p. 346 and Brukhill, 1953, p. 37) in the Bengal-Assam area (Vavilov, 1951, p. 27). It is an ancient crop in India as evidenced by its Sanskrit name mash (Majumdar, 1938, p. 28). The seed of mash is the reputed origin of the weight known as masha, twelve of which comprise a tola and nine hundred and sixty make a seer (one half of a pound). The great antiquity of this weight system is another proof of its ancient cultivation.

Urad is grown on slightly heavier clayey soils or brown alluvial soils. It is a dry crop and grows well in Upper Doab where the average rainfall is less than thirty five inches. Generally, it is sown with either cotton or Andropogon sorghum (jowar). When grown with cotton it is sown in furrows. Some Jats grow it alone, sowing it broadcast. It is sown in May, June, and July, and is harvested in October and November. It takes from three to five months to ripen. It leaves the soil rich in plant nutrients and is followed by wheat on its fields. The average yield of the grain is about 400 pounds per acre.

Urad is a multi-purpose crop. The grain is used for food, the husks of the pod are fed to the cattle, and the stalks
are used as fuel and for making baskets. The use of the grain as a pulse is very ancient. The Buddhist monks popularized its use throughout India as a substitute for meat, the consumption of which was forbidden by Buddhism. The Jats who have always been strict vegetarians consider its protein comparable to animal protein. This is the pulse which the Jats cultivate and consume the most (Duthie and Fuller, ibid, p. 39).

7. **Aconite-leaved kidney bean**

This legume (**Phaseolus acontifolius** Jacq.) originated in the Indian center (Vavilov, 1951, p. 27). Although of Indian origin, its cultivation here is recent as indicated by the absence of Sanskrit names (De Candolle, 1959, p. 345). The Hindostani name is mouth while among the Punjabis it is named moth.

It is grown as the sole crop on the most inferior land although it prefers light, sandy soils. The fields have to be given three to four ploughings and the seeds are sown broadcast. It is rarely irrigated and the yield per acre is about 700 pounds.

The Jats grow it both as a pulse for human consumption and as cattle fodder. The beans are used for curry, it being regarded as a source of protein. The stalks and leaves are fed to the cattle.
FODDER CROPS

The Jat agriculture is characterized specially by the large number of fodder crops. They include both the cereals and legumes.

1. **Gwar**

This legume (*Cyamopsis psoraloides DC.*) originated in the Indian center (Vavilov, 1951, p. 27). The ancient Sanskrit name *gwar* indicates its antiquity in India.

The Jats grow it primarily as a cattle fodder. The pod, plucked green, is occasionally eaten as a vegetable. The ripened grain, the leaves, and the stalks are all mixed together and given to the cattle. When grown as a vegetable for human consumption, it is invariably done so on highly manured lands surrounding the habitation. As a cattle fodder, it is grown with pearl millet on light, sandy soil. It is sown at the beginning of the rains and is harvested in October. The average yield per acre of grain is about 800 pounds.

2. **Barley**

Barley is of great antiquity as a cultivated cereal. It was first domesticated in the region between the Black Sea, India and Abyssinia (De Candolle, 1959, p. 370). A secondary center in the Mediterranean area has been postulated
(Vavilov, 1951, p. 35). The Sanskrit name yava is mentioned in the Rigveda and in the later Vedas dating to around 1,000 B.C. (Majumdar, 1938, p. 33).

Barley belongs to the genus *Hordeum* and the Jats grow only *Hordeum Vulgare* Linn. In Upper Doab only the six-rowed variety (*H. hexastichon* Linn.) is grown. Barley is an annual plant and seldom reaches more than three feet in height. The inflorescence is a dense head with three sessile spikelets alternating at each joint of the straight axis.

It is a winter (*rabi*) crop, sown in October and reaped in March or April. It is grown on light, sandy soil with little or no manuring. The fields are prepared by four ploughings given them. Very little irrigation is applied. The seed is sown by dropping the seed behind the plough direct from the hand or down a bamboo tube fastened to the plough stilt. It is grown with wheat (the mixture of grains is known as gojai) and with gram (the mixture is known as bejhar). Harvesting, threshing, and winnowing are done the same way as that of wheat. The yield per acre is about 1300 pounds.

The Jats rarely eat the grain mixed with wheat or gram. It is mixed with chopped stalks and leaves and fed to the cattle. The straw mixed with mud is used as a plastering material for the walls of the houses.
3. **Pearl or Cat-tail Millet**

This millet (*Pennisetum typhoideum* Linn) probably originated in either Africa (Godbole, 1927, p. 248) or in India (Vavilov, 1951, p. 26 and Godbole, 1927, p. 248). Seven of the forty species comprising the genus *Pennisetum* are found in western India of which only *P. typhoideum* Linn. is cultivated (Godbole, 1927, p. 248). The Sanskrit name, if any, is not known, nor is the etymological derivation of its Hindostani names, bajra or bajri.

It is a tall plant, growing from six to fifteen feet in height, with three to eight compact cylindrical spikes that bear white grains. It is a summer (*kharif*) crop. It is rarely grown alone; generally it is planted with kidney beans (*moth* or *Phaseolus acontifolius* Linn.) on poor, light soil on the land situated away from the habitation. It requires about fifteen inches of rainfall. Sporadic downpour of rains with plenty of sunshine between the showers is an ideal condition for its growth. It is never manured, and but rarely irrigated. The land is ploughed once or twice only and the seed is sown broadcast in early July. It is harvested in early October. The yield per acre of grain is about 500 pounds while that of fodder is about 2400 pounds.
Thus, it has an enormous yield of forage. The Jats never eat the flour of its grain, but, along with the stalks, feed it to the cattle and horses.

4. Oats

The oat plant (Avena sativa Linn.) was first cultivated in the northern parts of Italy and Greece (De Candolle, 1959, p. 373). A great number of endemic varieties of the common oats are found growing as weeds in cultivated fields of the Near Eastern center, especially in Transcaucasia (Vavilov, 1951, p. 33). There is no Sanskrit name for oats and the Hindostani name Jai is derived from Jau (barley). It is a recent crop in Upper Doab (Duthie and Fuller, part 1, 1882, p. 13). There it is grown probably due to the influence of the stud depots at Hapur (Meerut district) and Saharanpur, and also due to the horse breeding practiced by the Jats (Duthie and Fuller, part 1, 1882, p. 13).

Oats vary in height from two to five feet. The leaves are abundant and bluish green in color. The grain is surrounded by a hull formed by the inner scales. It is grown on the highly irrigated fields around the habitation. It is sown broadcast in November and harvested in March. With a copious supply of irrigation a large amount of nutritious green fodder for the winter is produced. It is cut thrice for fodder and then it bears
a crop of grain. The Jats do not eat it but feed it to the cattle and the horses. The average yield of the grain per acre is about 1500 pounds.

5. Indian Millet (Juar in Hindi)

The main area of its domestication is the mountainous region of western and central China (Vavilov, 1951, p. 21). Two secondary centers of origin in Abyssinia and in Bengal and Assam have also been postulated (Vavilov, 1951, p. 26). De Candolle (1959, p. 382) believes it to be of African origin.

The Indian Millet (Sorghum, Andropogon Sorghum or Sorghum Vulgare Per.) is a tall coarse annual, growing to a height from three to fifteen feet and resembling maize in habit. The inflorescence is a dense head or panicle, forming a spike of seeds and the grains are rounder and smaller than those of the true cereals (Hill, 1952, p. 325).

It is a summer (kharif) crop, sown at the commencement of the rains and harvested in November. It is grown with the beans (Phaseolus mungo, Phaseolus radiatus, and Vigna catiang) preferably on clayey soils. The seed is sown broadcast and irrigation and manuring are applied very rarely. Harvesting, threshing and winnowing are done in the usual way. The yield per acre of the grain is 800 pounds and of dry fodder about
5,000 pounds. The yield per acre of green fodder is about 25,000 pounds (Duthie and Fuller, part 1, 1882, p. 28).

The dry stalks and leaves are chopped together and fed to the cattle. The Jats grow it solely for fodder.

FIBRE CROP

Cotton

Cotton (Gossypium arboreum) is an ancient plant in India. Most scholars agree that the original diploid cotton was first domesticated in the Indus Valley around 2,500 B.C. (Sauer, 1952, p. 82; De Candolle, 1959, p. 403; Vavilov, 1951, p. 28; and Hutchinson et al, 1947, p. 70). Genetic, archaeological, and philological considerations support very strongly the Indus Valley origin of the Old World cotton. The most ancient cotton fabrics known are the fragments recovered during the excavations at Mohenjo-daro in Sind at levels which are dated approximately 2,500 B.C. (Dulati and Turner, 1928). The various names of cotton in the languages of the Old World are derived from the Sanskrit words for the processes of opening, spinning, or opening implements as taman, kartanam, pinjanam, aekna, and karpasa, which are weightier evidence of its Indian origin (Gulati, 1956, p. 259). The Hindostani word kapasa for cotton is derived from its Sanskrit name karpasa. The Babylonian and Greek names for cotton, sindhu and sindon, respectively point to its Indian
origin (Majumdar, 1938, p. 70). The Arabic name for cotton, qutn, is derived from the Sanskrit word kartna meaning spinning. These considerations lead us to believe that cotton of the Old World was domesticated in India.

From the Indus valley, cotton and its culture spread up the great river valleys of Punjab (Hutchinson et al., 1947, p. 86). In East Bengal and Assam there developed the center of variability comprising race bengalense which is grown in Upper Doab (Hutchinson et al., 1947, pp. 86 and 87). In its origin this was a variety of G. arboreum and was a perennial cotton. In the Upper Doab, however, the plant has been forced to assume the annual habit on account of frosts and freezes of winter. It grows up to a height of ten or twelve feet. It has robust, woody stems with dark, red branches ascending at an acute angle. The leaves are narrowly and deeply lobed and the corolla is dark red, drying nearly black. The seeds are green and number three to eight in each cell. The fibrous hairs composing the lint, floss, or staple occur on the seeds. The staple length of the Upper Doab cotton is from three-eighths of an inch to five-eighths of an inch, and capable of spinning from 6's to 8's reelings.

Cotton is a summer crop in Jat agriculture, sown between the fifteenth of May and the fifteenth of June and harvested in the middle of October. It requires rich soil and is therefore grown near the habitation which receive a copious supply of human and animal
excreta. It is rarely manured otherwise. The fields are ploughed from four to six times and on the first fall of the rains, the seed is sown broadcast. Irrigation is rarely applied. Cotton is sown generally with *Phaseolus* crops, in lines, the latter giving the former, a protection from cold winds and frosts (Duthie and Fuller, 1882, part 1, 1. 76). The yield per acre is 150 pounds of fibre.

Cotton is picked off by hand, and is generally done by the Jat women. The seeds are separated by hand, by the children and women. Spinning is done with the spinning wheel by each Jat woman at her leisure, and the thread given to the village weaver (*Julaha*). The stalks are cut off and used in making baskets and mattings to line the walls of the earthen wells. The stalks are also burnt as fuels in domestic ovens.

The *contribution of cotton to the economy of the Jat is very little, who grow it to fulfil the domestic needs only. A century ago, cotton was grown to a greater extent. The establishment of sugar mills shifted the emphasis from cotton to sugar cane and today the economy of the Jats is largely based on the latter crop.*

**GREEN MANURE CROP**

*Sunn, sun, sanai or san hemp* (*Crotalaria juncea* Linn.) is an ancient Asiatic plant. It originated in the Indian center (Vavilov, 1951, p. 28). It is the earliest fiber to be mentioned in Sanskrit writings (Hill, 1952, p. 32).
The plant is a shrubby annual legume from six to twelve feet in height with bright yellow flowers. It is a summer (kharif) crop, sown at the commencement of the rains and harvested at the end of September. It prefers light, sandy soil. Generally, it is grown with cotton or millets as a border of their fields. The field is ploughed only twice and the seed is sown broadcast. No irrigation is practiced nor any weeding is done. The cultivation of this crop is rather careless. The yield per acre is 640 pounds.

The Jats grow it as a green manure and plough it in the soil. This increases the nitrogen content of the soil. The tops of the plants are cut off and given to cattle.

AGRICULTURAL CALENDAR

The Jat farmer engages himself in the agricultural activities for almost the entire year. There is only one month, Asarh (15th June to 15th July), when he is comparatively free. The monthly schedule based on Hindu Calendar runs on the following general pattern:

1. **Asarh** (15th June to 15th July)

2. **Sawan** (16th July to 15th August)
   - Ploughing for winter crops begins. Sowing of summer (kharif) crops continues.
3. **Bhadon** (17th August to 17th September)

Ploughing for winter crops continues. Harrowing, weeding, and hoeing of summer crops are done. Sugar cane plants are tied together (*bandhai*) with its leaves to form bunches, so that proper aeration in the field is maintained and lodging is prevented.

Supplementary activities include making of ropes (*rassee batai*) of *san hemp*, by women.

4. **Kuar** (18th September to 18th October)

The ploughing of the same fields for winter (*rabi*) crops is continued. Fodder crops are harvested. Cotton is picked. Maize, millets, and other summer crops are harvested. Pulses are harvested along with early growing rice.

5. **Kartik** (18th October to 16th November)

Picking of cotton is continued. Winter (*rabi*) crops are sown. *Munji* rice (maturing in five months) is harvested. Millets and Pulses are harvested. Harvesting of sugar cane begins. Sugar cane is crushed and *rab* and *gur* made.

6. **Aghan** (17th November to 15th December)

First watering (*kor*) of wheat and other valuable winter crops. Harvesting and crushing of sugar cane continues.
7. **Pus** (16th December to 14th January)

Fallow fields are ploughed. Harvesting and crushing of sugar cane and making of gur and rab continues. Ploughing of the ratoon sugar canes is continued. Second watering of the winter crops is given.

8. **Magh** (15th January to 12th February)

Watering of the fallow lands (palewa) is done. Harvesting of sugar cane continues. Watering of the ratoon cane fields. Ploughing of the fields from which sugar cane has been harvested. Watering of the winter crops continues.

9. **Phalgun** (13th February to 14th March)

Sowing of sugar cane begins and watering of the fallow land continues.

10. **Chait** (15th March to 13th April)

Mustard is harvested. Sowing of sugar cane ends. Watering of the fallow land continues. Harvesting of wheat and other winter crops continues.

11. **Baisakh** (14th April to 14th May)

Harvesting of winter crops continues. Fodder crops and crops for green manure are sown. Wheat and barley are threshed.

12. **Jaith** (15th May to 15th June)

Hoeing (khudai) and weeding (narai) of sugar cane fields.
Watering of sugar cane fields (bharai). Threshing, winnowing, husking, of wheat and other winter crops. Cotton is sown. Pulse is harvested. The winter produce is graded and transported.

The harvesting and sowing operations are mostly simultaneous. This is the reason why farmers do not get leisure for a longer period.

Sugar cane occupies the field for almost one year and its cultivation and final disposal involves many operations and much labor. Agricultural labor is distributed equally throughout the year and there are no periods of maximum and minimum efforts.

PARTICIPATION OF WOMEN IN AGRICULTURE

The Jat woman participates in several of the agricultural activities, both on the field and at home. Among the people of higher social status, the Jats are alone in using the labor of their women. This at once distinguishes the Jats and their women from other higher castes and agricultural people, of the same status.

The Jat woman participates in sowing the seed grains as her husband ploughs; weeding; irrigating by distributing the water from one plot to another; and harvesting with sickle. All these activities of the Jat women are old (Crooke, 1896, p. 230). In the ghair she does the work of winnowing, making dung cakes for fuel, operating the chaff-cutting machine, and feeding the cattle. At home, she milks
the buffalo and prepares butter with a churner. In a rotary quern she grinds the grain as a matter of daily routine for the Jat eats rotee made of fresh flour.

The Jat woman is sturdy and hardworking. She is regarded by her family as an economic asset. "A Jatni (Jat woman) for me, all the rest are a mere waste of money" runs the popular Jat saying. The Jat woman, however, never works on the fields of other farmers as hired laborer. The Jat woman working on their own fields do not affect their social position in the village since the Jats are considered as having the highest positions, both socially and economically, in their village.

This element of the Jat agriculture is definitely their own. In Upper Doab, there is no other known group from the upper strata of society whose women move and work in the fields. The Rajput, Tyagee, and Brahmin women observe strict veiling (purdah). In southeastern Punjab, Malwa, Rajasthan, and in eastern Sindh, the Jat woman participates in agricultural activities without any kind of restraint. The origin can be explained in two ways.

The Jats have lived for centuries with the Rajputs in Rajasthan. All through the Medieval and early part of the Mogul period the Rajput woman took part in the battles as a soldier and as a general, on equal terms and status with her husband. The Jat
woman living with the Rajput people followed the same practice. There was no veiling then and no taboo against the movement of the Rajput woman outside her house. During the latter part of the Mogul period, veiling became an universal practice with the Rajputs. They had by then, become the kings and chiefs of principalities under the protection of the Mogul kings and emperors of Delhi. The Jats remained free-booters, shepherds, cattle-raisers, and soldiers, or just as subject people of the Rajputs. They retained the practice of their women's participation in their outdoor activities and when they became agriculturalists the agricultural fields substituted for the earlier battlefields.

Another possible explanation also is based on the change of type of economy. The early Jats were nomadic. In such an organization the participation of woman in outdoor work was common and necessary. The rearing of the cattle and feeding them were especially the work of women as well as milking, making butter, and clarifying butter (ghee). It is possible that with a change in economy from nomadic pastoralism to sedentary agriculture, the work of the women has simply been transferred from the former to the latter.

**LAND TENURE**

In common with many other agricultural people of Upper Doab, the Jats have two types of land tenure, Bhumidari and Seerdari. The
difference can best be understood by considering the history of land tenure system in the Upper Doab.

From the Medieval period onwards a large part of the land in this area belonged to the local landlords (zameendars). He owned the land in the villages and the farmers who were his subjects tilled it, took a portion of the produce for themselves, and gave the rest to the landlord. During the Mogul period, changes in payment were effected in that, instead of a portion of field produce only, money could also be given. In the British system, payment in cash completely substituted payment in kind. During all these three periods the landlord remained an intermediatory between the tillers of the soil and the central authority.

After 1947, when India became an independent nation, landlordism was abolished. The farmer who was until now paying the rent for their land to the landlord, became its owner by paying a sum which is ten times that he was paying as his rent (lagan). The rent was paid to the government. The land he owns now can be sold, transferred, left as uncultivated, be built upon, or disposed of any way the farmer likes. This tenure is known as Bhumidari. The erstwhile landlord also retains the land tilled earlier by his slaves under the Bhumidari system. Both types of Bhumidars have now to pay half the revenue tax (malguzari) which they were paying to the government before 1947.
The tenant farmers after 1947 became the owners of the land for which they were paying revenue tax (lagen) to the landlord. This tenure is known as Seerdari in which the land can be used for cultivation only. The rent is now paid to the government.

The characteristic land tenure system of the Jat villages has been termed bhaiyachara. This is a Jat principle and is not practiced by any other group (Baden-Powell, 1896, p. 216). In this all the landlords formerly owning lands of one village were members of one patrilineage, all tracing descent from a common ancestor. This happened as a result of clan ownership of Jat villages which were considered as clan estates for revenue purposes. The holder of the land had a right in the village common proportional to his private holdings. Both the landlord and his farmers were Jats.

LIVESTOCK

In common with other agricultural people of India, the Jats keep a large number of livestock. Their importance as agricultural work animals is primary. Bullocks and camels are used in most of the agricultural work. Cows are kept to a very limited number while milch buffalos supply all the milk required by a family. Horses are used very rarely but are kept to enhance social prestige.

Cattle belong to the genus Bos which has two primary species, Bos indicus found in Asia and Africa including the zebus or humped
cattle, and *Bos taurus*, found in Europe and having no hump. The zebus of India have evolved from *Bos namadicus* (Sauer, 1952, p. 93). The domestic *Bos* have been found in the earliest stratigraphic levels dating 5,000 B.C. in Sialk I, Iran (Dyson, 1953, p. 662). The zebu appears first at Rana Ghundai I in north Baluchistan (Sauer, 1952, p. 94). At later dates *Bos* is found at Harappa in the Indus valley (Prashad, 1936, no. 51). *Bos* had a domesticated status in the parts of Iran near Sialk I and it appears that the presence of *Bos* in Indus Valley is merely a geographical extension of the pattern of Sialk I around 5,000 B.C. (Dyson, 1953, p. 663). It is therefore more than probable as Marshall suggests (1931, p. 658) that *B. indicus* originated outside India. It has been identified at Harappa (Prashad, 1936, p. 34) and Mohenjo-daro (Marshall, 1931, pp. 28, 29, and 654).

There is definite evidence that the same type of zebu, which is found throughout India today, was in use in the Indus Valley Civilization (Ware, 1941, p. 3). The long and large horned humped varieties are found in all the strata of Mohenjo-daro site, and have also been identified on the Indus seals. Although the long horn zebu was there from the very beginning, the short horn zebu was introduced into India by the Vedic Aryans between 2,000 and 1,500 B.C. (Oliver, 1938, no. 17; Epstein, 1933, p. 24; Ware, 1941, p. 3; and Shirlaw, 1940, p. 28).

Of the four varieties of cattle kept by the Jats, *Hissar*, *Hariana*, *Nagori* and *Amrit Mahal*, the most popular and numerous
are those belonging to Hariana. This has short horns, white color, long coffin-shaped skull, orbital arches which are not prominent, and with the face slightly convex in profile.

All the breeds represented in the Hariana variety are located along the route taken by the ancient pastoral Aryan invaders into India (Joshi and Phillips, 1953, p. 87). At present, the cattle of this variety are bred in the districts of Rohtak, Hissar, Karnal, and Gurgaon (East Punjab State), all located along the Aryan invasion route. The Jats buy their cattle from the villages of these districts, the Ganga bathing fair at Garhmukteshwar (in Meerut district) and Bateshar fair in Agra.

The Hariana cattle are fed chopped dry sorghum, millet stalks and straw of pulse plants, during dry winter and Pre-monsoon summer months when there is little grass on the meadows and there is no grazing. In early summer, a mixture of ground chick pea, oats, and wheat straw is fed. During the monsoon period when they have to work hard, the cattle are fed such concentrated feeds as cotton seed, oilcakes, mungo beans, and cluster beans.

The Hariana breed is principally useful for draft purposes. For fast ploughing and road transport, they are the best. The bullocks travel about twenty miles in a day. On an average, a pair of Hariana bullocks can pull a load about a ton in an iron-tired cart on a
hard road at the rate of about two miles per hour which is better than the record of and other multipurpose draft cattle of northern India (Joshi and Phillips, 1953, p. 94).

**Hissar** variety was developed in the vicinity of the city of Hissar in Southeast Punjab at the Government Cattle Farm in 1809. It is a hybrid born of *Kankrej* bull and *Hariana* cow (Phillips, 1944, p. 277) which is good for plowing.

**Nagori** is bred in the northeastern part of Jodhpur district (Rajasthan State). It is famous as a trotting draft cattle and for fast road work. It has a light body and long thin legs.

**Amrit Mahal** variety was bred in the fifteenth century in Mysore. It was used for warfare. It has long horns and a great capacity of endurance.

All the cattle are used in plowing, breaking the clods, irrigating, threshing, and are hitched to the bullock carts. Bullocks are used in all these operations. These uses of such animals are very ancient (Maity, 1957, p. 93).

**The Buffalo**

This is the premier milk producing animal kept by the Jats. It is never used in any agricultural or domestic work and is kept wholly to produce milk. Only the she-buffalo is therefore kept.

The buffalo or water buffalo (*Bubalus bubalis* Linn.) is the
direct descendant of the Arni buffalo (*Bubalus arnee*) which is still to be found in Assam (Koppers and Junglelut, 1942-45, p. 661). It was, however, domesticated first in the Indus Valley Civilization when the climate here was more humid (Prashad, 1936, p. 34). Water buffalo, as the very name suggests, is semi-aquatic in its natural habitat but is found in domestication all over India. The best breeds are found in northern India although the climate there is hot, dry, and rigorous. Uniformity of type and outstanding qualities as a milk animal point to centuries of sound breeding (Kothavala, 1935, p. 51).

The breeds kept by the Jats are Murrah and Mehsana, the latter being little kept. Murrah is native to the Indus Valley region, mostly to the southwestern part of the Punjab and western parts of Sind (Kothavala, 1935, p. 51). Further development of the breed took place in the southeastern parts of Punjab and Delhi State (Phillips, 1945, p. 71).

The Murrah buffalo derives its names from its chief characteristic which is the tightly curled horn (*murrah*). It has no hump. It has a massive, heavy bodied appearance, and legs shorter than other zebu cattle. It is jet black in color and weighs about 1,600 pounds.

It produces about 4,500 pounds of milk in a lactation period of ten months. The fat percentage in milk is about eight. It thrives
much better than the Indian cow on coarse grass and fodder. The clarified butter (ghee) has a better flavor and taste and high nutritive value. The larger amount of milk and the greater fat percentage induces the Jats to keep milk buffaloes rather than cows. Many primitive tribes, besides the Jats, keep buffalo for the same reasons (Koppers and Jungblut, ibid, p. 647).

The Camel

The camel belongs to the genus Camelus comprising two species, the dromedary (Camelus dromedarius) having one hump and the bactrian having two humps. The Indian camel kept by the Jats belongs to the dromedary species.

Both species descended from an ancestral form of the Siwalik Hills (Pumpell, 1908, p. 384). It was domesticated in the Near East for packing (Dyson, 1953, p. 667). Sauer is more specific and postulates Arabia as the place of its domestication (1952, p. 94). It was used for riding in the late second millenium and was already domesticated, as evidenced by the representations in sculptures of the Persians and Assyrians (Pumpell, 1908, p. 384). Fossil remains of one humped camel have been found in Harappa (Prashad, 1936, pp. 9 and 58).

The Jats hitch the camel to Sikrim (Plate 42). Their more important agricultural use is the operation of Persian wheel, the main
irrigation machine of the Jats. The camel is rarely used for riding by the Jats except in the area comprised of the sandy flood plains of Ganga and Jamuna rivers. It is never used for any other work on the field as ploughing or clod breaking. Unlike the zebu cattle it has no symbolic, ritual significance in the Jat culture.

The Horse

The domesticated horses belong to the genus Equus and are generally classed into two groups, the oriental (Equus parvus), and the occidental (Equus robustus). The wild, ancestral form was the same for both these groups.

Equids have been identified from Harappa (Prashad, 1936, pp. 8 and 28; Sauer, 1952, p. 95) and Mohenjo-daro (Marshall, 1931, pp. 654 and 666). These equids however, belonged to the onager or ass group and not to the true horse (Lundholm, 1949, pp. 1-287; and Basham, 1956, p. 18). There is now an unanimous agreement on the point that there is no evidence for the true horse in the Near East before 2,000 B.C. (Hilzheimer, 1935, pp. 133-139). From the excavations of Harappa we get clear evidence of the presence of the true horse introduced there by the Aryans (Basham, 1956, p. 27).

To the early Aryans (1,500 B.C. circa), the horse was the animal of prestige, the high sacrifice, and the flesh of solemn festivals (Sauer, 1952, p. 96; Kosambi, 1958, pp. 83 and 115; and Peake
PLATE 37

Dagra, road connecting the settlements and the highway. Note the linear ridge and furrow pattern made by the cart wheels.

PLATE 38

Unsurfaced alley of a settlement. During the rains it becomes impassable.
and Fleure, 1933, p. 138). The horse first gained its military importance in India with the historical Aryan groups but hitched to the fast Aryan chariot, not ridden (Kosambi 1958, p. 77; Basham, 1956, pp. 35 and 36; Maity, 1957, p. 96). It was not until a few centuries later that the horse was also ridden by all military people in India (Kosambi, 1958, p. 77). At such a period consideration of speed became more important in the breeding of the horse than the hauling capacity.

The horse was used in early periods of Indian history chiefly by the warrior classes (Basham, 1956, p. 195). The Jats deriving the horse-trait from the Rajput warrior class modified its used later on. Today the Jat uses the horse only for riding and for no other work. It is an animal of prestige.

The Jats were, in their early history, marauders and nomads. The horse carried them to distant places for loot and also to conquer small principalities. The swiftness with which the settlement zone of the early Jats expanded areally must be ascribed partly to their possession and use of the horse. Thus the horse not only played a significant role in the primitive economy of the Jats but also in their dispersal over a large area. Probably because of this and also as a result of the continuation of the cultural traditions of the ancient Aryans, the Jats maintained the horse as an element of social prestige.
TRANSPORT

The means of transport for the Jats are the same as for all the other agricultural people of Upper Doab. The Jats do not have any vehicle peculiar to them. Some of the carriages like bullock-carts are of great antiquity. The Jats have not contributed any special feature to the culture of transport, nor have they any special type of road. Everywhere there is a uniform repetition of the same elements.

Roads

There are four types of roads connecting villages to the main roads and to other villages. These are used for the movement of men, animals, and large or small carriages.

Large village roads connecting villages to the main road belong to the first type. Each Jat village is connected to the main road by at least one such road which functions as a feeder road. The village roads (Plates 41 and 42) are eight to twelve feet in width, have surfaces of broken nodules of calcareous material (kankar), but are not drained by gutters. These roads are of great importance, for they only connect the villages with the main road and thus to the outer world.

The second type of roads are those which connect one village to another, and are primarily used by bullock-carts. These cart-tracks (dagra) (Plate 37) have surfaces of loose gravels and sand and are difficult to pass on during the monsoon period. Characteristic of
PLATE 39

Brick-floored kharanja, road within the settlement.
these roads is the pattern of linear, ridges and grooves, made by the wheels of the bullock-carts. Several such roads radiate from one nodular village. The importance of these roads is both social and economic. They help the villagers to carry on social intercourse between two or more villages. Economic exchange between the villages themselves is also carried on over these roads, uninterrupted by the traffic of the main highway. Purely residential villages are connected by these roads to the market villages and specialized markets where wheat and gur are disposed of.

The third type of road, connecting the villages is that which runs on the embankments of minor irrigation channels (gul), distributaries (rajbhayas), and canals (nahar) (Plate 24). Those running on the embankments of distributaries and the canals are fifteen to twenty feed wide and are used by large carriages including the motor trucks. Those running along the minor irrigation channels are used by pedestrians and cattle. Except for a period during the monsoon these roads are constantly used and a very large proportion of the movement of sugar cane takes place on them.

The fourth type of road is universally found everywhere in all these villages on the narrow dikes separating the fields (Plate 25). Pedestrians and cattle move on it comfortably. Historically, these are the most ancient roads. These dike roads connect the field to the
village habitation as well as one field to another. Considering the extreme scattering of fields constituting one holding, over the entire village area, these dike roads (daul) are of great utility.

**Vehicles**

The vehicles used by the Jats are varied but none characteristic of them. These vehicles can be arranged for the purpose of our study into three groups, the grouping being based on form and function.

In the first group are the rath and the tonga used for the conveyance of persons. These are small carriages but very popular.

The rath is of great antiquity as mentioned in the war of Mahabharata (c. 1,000 B.C.). The chariots were drawn by oxen, mules, or horses and names of various parts of chariots occur very frequently in the Rig Vedic hymns (Majumdar, 1951, p. 399).

The rath is a small chariot with a small dome roof supported on four wooden posts standing on the four corners of the main body. It has a protruding hood. The vehicle has two wheels with radial spokes and the whole is made of wood. In ancient times the axle was made of wood while in modern rath iron-axles are being used. The rath carries only four persons including the driver. It has a good speed of six to eight miles per hour, considering the mud road of the villages.

Tonga is also like a chariot but it has no roof (Plate 40). Depending upon its size, it is drawn by either one or two bullocks. It is
PLATE 40

Tonga, an open carriage with no roof, seats four comfortably. Note the light, wooden structure and double-spoked wheels.
an open structure, the body being made of wood, and the axle is of iron. The floor of the body is made of neem and mango wood planks, and is surrounded by wood walls standing two feet high. The body is wider in the front than in the rear. The tonga is used for the conveyance of persons and has a speed same as that of the rath. Carrying capacity is limited to four persons in the smaller and six in the larger tonga.

The second group consists of bullock-carts and is used for the transport of grains, agricultural products, like gur, and sugar cane.

Bullock-carts have been in use from the times of Indus Valley Civilization in which they were the chief means of conveyance (Majumdar, 1951, p. 177). Throughout the Rig Veda we find carts being used as a means of bringing harvest from the field (Majumdar, 1938, p. 134). The early Aryan bullock-cart had heavy wooden wheels (Kosambi, 1956, pp. 82 and 83) and looked very much similar to the cart that Jats use at present (Plate 41).

Modifications have resulted in the use of iron and axle, iron wheels, and rubber tires. In the carts with iron axle and iron wheels, there has been practically no change in the formal appearance. The cart with rubber tires has a different appearance.

The cart that has wooden wheels is termed gadee (Plates 10 and 21). Gadees with iron wheels are also common (Plate 41).
PLATE 41

Gadée with iron wheel carrying sugar cane to the mill.

PLATE 42

Sikrim with arched thatch. Note the large capacity but a clumsy appearance.
The gadee is wholly made of wood except the iron axle. It is a long cart, the longer half is at the rear of the wheels and the shorter half is at the front. There are two large spoked wooden wheels of a diameter of about four feet. The whole structure is made of logs and planks nailed together. The floor has a matting of stalks of pulse plants. The gadee is drawn by two bullocks.

The cart with rubber tires is termed dunlop (Plate 44). It is a recent introduction, becoming popular during the First World War when a large quantity of rubber tires were sold at a very cheap rate by the Army disposal depots in Meerut, Aligarh, Saharanpur. These dunlop carts are easy of traction, fast in speed, and give much relief to the bullocks. It has a more or less square shape. It is made of metallic frame-work with a large piece of tin as the floor. Side-walls are also of metal (Plate 44). The dunlop cart is generally used to transport gur and dairy products.

The third group of carriage has a wagon termed sikrim. It is a high, closed wagon and is always drawn by camels (Plates 42 and 43). In appearance, it looks like a large closed box. It is made either of wooden planks or of tin plates. The box is fixed on four wheels, the pair of small wheels in the rear. As is evident from the photographs (Plates 42 and 43) the capacity of the sikrim is large and it can withstand the wear and tear of a rough and long journey. Its
PLATE 43

Sikrim with a gabled thatch.

PLATE 44

Dunlp gadee with rubber tires.
durability is longer than that of the gadee. The Sikrim is used mainly to transport grains and household goods. Sometimes the passengers ride on the top of the sikrim, protected from the sun by the gabled thatch roof (Plate 42) or the arch-roof (Plate 43). The cumbersome build of the sikrim reduces its speed considerably, so that the average remains as low as seven to nine miles per hour.

TRADE

The structure of trade among the Jats is no different from that of any other agricultural people of Upper Doab. Each Jat village has a few shops where kerosine, spices, and grains are sold. These small shops are maintained by the people belonging to the traders' caste (vaisya). The Jats do not keep a shop of any kind.

Most trading is done at the bi-weekly markets (painth). These markets are of purely local importance and serve an area within a radius from eight to ten miles. The markets are held in a marketplace in a village which is situated centrally with reference to the villages from where the markets receive their commodities and to which they are redistributed. Centralization is a feature of evolution and has little geographical relationship. Tradition and social intercourse between the villages determine the village market's location and situation. Market places have been in existence since Buddhist times (Majumdar, 1951, p. 180).
These periodic markets are held on certain fixed days of the week. The days are fixed both according to social traditions and with reference to important episodes in the lives of deities and saints. Every day of the week has a market being held in one or the other village. This enables the sellers and the buyers to attend many different villages almost all the days of the week. Thus, buying and selling are carried on simultaneously, through the entire week.

The volume of trade varies with the locality depending upon its products and the material prosperity of the people. The Jats sell wheat and gur in these markets and since these are sold in December, January, March, and April, they do not attend as sellers during the rest of the year but as buyers of their daily necessities. The periodic markets have no religious significance and do not provide entertainments. The participants concern themselves only with business.

On the days set for holding the periodic markets, villagers from the surrounding rural area come with their products to sell and their money to buy necessities. A few traders from the nearby towns bring urban products. The gathering starts at about eleven in the day and ends about six in the evening. Exchanges are conducted through the medium of currency. No dealings in barter are known in these periodic markets. The prices of the commodities are settled by bargain between the buyer and the seller and haggling is common. This
practice is of ancient origin, well-known in Vedic Age (Majumdar, 1951, p. 396 and Majumdar, 1936, p. 177) and in later Buddhist periods (Majumdar, 1936, p. 180; and Rapson, 1922, p. 216).

No shop is permanent in the periodic market which is ephemeral. Except on the market-days the site of the market remains empty. The shops consist merely of a collection of baskets (tokrees) placed either on ground or on wooden platforms. Luxury goods are displayed on pieces of cloth. Within the market, strong areal specialization is to be observed, as one part contains only shoe-sellers, another only vegetable sellers, and the third only the cloth sellers. The shops are arranged on two sides of a village road or on the four sides of a rectangular piece of land.

Apart from the periodic markets, the Jats sell gur and wheat to large permanent markets in big cities like Meerut, Muzaffernagar, Bagpat, and Hapur. Such trade is carried on independantly without the help of a middle-man (baniya), and is done only once or twice in a year, just after the harvest.
CHAPTER VII
SUMMARY AND CONCLUSIONS

The Jats have been recognized as an ancient, ethnic, and agricultural group. Physically they are different from the agricultural people of the Upper Doab but culturally this difference is still more pronounced. This explains the distinctive cultural landscape of the Jat villages.

The Jats have light, brown skin; dark, brown hair; and dark brown eyes. The hair of the Jats is straight. The most characteristic physical features are straight nasal profile, tall stature, and long thin legs. The average height of the Jats is about five feet eight inches. With a cephalic index of seventy-five, the Jats are predominately dolicocephalic. Some Jats are mesorrhynchic but most are leptarrhynic. We have suggested on the basis of anthropometric measurements of the Jats and their comparison with those of Rajputs that they are physically related to each other. Both are classified as Caucasoid.

The origin of the Jats remains an unsolved problem, although published literature on the subject is vast. The theories which could be considered somewhat scientific were suggested by
Tod and Risley. The former postulated, on some historical grounds, an Indo-Scythic origin, while the latter basing his theory on anthropometric data suggested a Vedic Aryan origin. Probably, most Jat clans are of Rajput origin. Similarities between the Rajputs and the Jats of both physical and cultural traits strengthen the theory of the Rajput origin of the Jats. This cultural kinship is basic to the understanding of the sources of Jat cultural traits and the present Jat cultural landscapes.

The problems of when, where, how, and what traits were acquired by the Jats to build up their culture led to a detailed discussion of the migration of the Jats from the Multan nucleus to Upper Doab. The Jats began to move from the Multan nucleus toward the east, southeast, and northeast, at about the seventh century A.D. This movement continued until the ninth century. The factors which induced this movement were cultural; nomadic way of life, Arab invasions directed principally against the Jats, and the inter-tribal conflicts between the Jats and the Meds. During this stage the Jats moved on the route lying along the valley of the Indus and reached the Bagar Steppe.

The second stage of the movement began about the eleventh century and continued to the thirteenth. During this stage the Jats moved out radially from the Bagar Steppe to the northeast, east, and southeast. A considerable number moved across the
northern Rajputana and reached Upper Doab. A second branch, following another route across the Thar desert and through the Kuchaman Pass in the Aravalli ranges, moved into Malwa. Still another route along the Sutlej carried some into central Punjab. The factors which initiated and maintained the movements of the Jats during this stage were partly natural and partly cultural. The drying up of the Hakra River as a result of the shifting of the eastern arm of the Sutlej was the natural cause of the movement. Moslem raids on the Jat villages and the forced conversion of the Jats to Islam were other causes of the movement.

The movement through Rajputana was very slow, providing ample time for the Jats to acquire, adapt, and assimilate many of the Rajput culture traits. The Jat culture in Rajputana evolved along with that of the Rajputs resulting in the cultural kinship between the two groups.

An interesting problem encountered during the discussion of this stage of the movement was the correspondence between the natural phenomenon of the diversion and decay of the river channels and the cultural phenomenon of the Jat movements. The details of the problem are not known and are open to further investigation.

The third stage began around the seventeenth century when the Jats, in order to escape Islamic conversion and to carry
on maraudery and highway robbery, began to move from Central Punjab and Malwa to Southeast Punjab and Upper Doab. The establishment of the Jat principalities of Patiala, Nabha, Jind, Kapurthala, Alwar, Dholpur, and Bharatpur further induced the Jats to move into those areas in large numbers. The treaty with the Nawab of Oudh in 1752 enabled the Jats to settle in large numbers near Aligarh from where they spread northward to occupy the core areas of the Upper Doab. The major routes of movements during this stage lay along the valleys of Chambal and its tributaries.

Through these three stages the Jats moved into Upper Doab and settled permanently. It is on the Pleistocene Terrace bounded by the Ganga and Jamuna Rivers on the east and west respectively that the early Jats founded their permanent settlements. Their earlier occupation of the low flood plains of the Ganga and Jamuna was short lived. Jat villages in these tracts were abandoned as soon as the Mogul control of the core areas of the upland became weak and the Jats moved inwards to capture the villages till then occupied by other agricultural people. By the end of the seventeenth century the Jats had established themselves over the entire Upper Doab.
Physiographically, Upper Doab is the Pleistocene Terrace flanked by the flood plains of the Ganga, Jamuna, and their tributaries. These form a sub-parallel drainage pattern dividing the Pleistocene Terrace into smaller inter-fluvial uplands. North-south trending sand ridges add variety to the otherwise featureless physiography of Upper Doab.

Soils of Upper Doab are characterized by a lack of variety of types. They are immature and lack any characteristic profile. The only known classification of Upper Doab soils is based on the distance of fields from the settlement, the nearest being considered most fertile.

The climate of Upper Doab is continental. Summer temperatures are as high as 90° F, while those of winter drop down to 60° F. Mean annual temperature is about 75° F, while the annual range of temperature is about 30° F. Frosts are rare. Rainfall, the most significant climatic element for agriculture, is almost wholly monsoonal and is characterized by a high degree of variability, in time, amount, and space. Rainfall decreases from north to south and from east to west. Average annual rainfall for Upper Doab as a whole is about thirty inches, of which about twenty-five inches fall during June through September and the remainder in the period of the retreating monsoons, from October to January.
The Upper Doab has been under cultivation from about 1000 B.C. Today, the original vegetation is all but gone. Here and there, open woodlands are found, probably, the secondary growth resulting from the burning of the forests.

The cultural significance of the Upper Doab lies in the fact that it served as the stage on which the Jats created their distinctive cultural landscape. Once settled in this region, Jats changed their culture rapidly by adopting many Rajput traits which they had acquired earlier and by adapting many traits of the local non-Jat people. Soon they created a new and distinctive landscape. Agriculture became the central theme of Jat culture in the Upper Doab, replacing completely the older way of life, a semi-nomadic pastoralism and associated maraudery. It is in the upper Doab that the Jats attained their cultural climax.

The cultural landscape of the Jat village consists of the settlement, houses, field and crop patterns. These are the elements which give material expression to Jat culture. Through these elements, again, we attain an understanding of the contribution of the Jat culture and the interplay of its traits with those of the culture of the Upper Doab in particular and of Rajput in general.

The Jat settlement is rural. It is nucleated in form. The feature that distinguishes a Jat settlement from that of the
other culture groups of Upper Doab is its three-tier plan. The Jat settlement consists of a core of havelis surrounded by a horse-shoe shaped road, on the outer edge of which are the ghairs and the houses of people of low castes. This three-tier plan was created by the Rajputs in Rajputana during the medieval period, and was acquired by the Jats during their stay in Rajputana. Subsequently, the Jats modified it and introduced it into the Upper Doab.

A diagnostic trait of the Jat settlement is the almost total absence of temples. Instead, a few mounds of earth, or empty brick-built rooms serve for the worship of ancestors and of the village gods. This trait is purely tribal in origin, and brought into the Upper Doab by Jats themselves.

Still another characteristic feature is the enormous areal and population size of the Jat settlements. Further, these are characterized by many high and large earthen mounds which are the abandoned sites of former settlements. The Jats, having captured a settlement, always built their houses on a new site nearby.

The Jat settlement was from the beginning nucleated. Cultural, and not physical factors, have preserved this form up to the present. Especially important in preserving the nucleated settlement have been the tendency to live together, a survival from the early nomadic way of life; the need for defense against the
Moslems, robbers, and wild animals; clan ownership of land; communally organized agricultural activities; and various superstitions which forbid the building of a house outside the settlement.

A concept of the life-cycle of a Jat settlement is formulated here. This may have applications to the study of villages of other culture groups as well. Life-cycle reconstructed from the history of two Jat villages reveals three ages: formative, resultant patterns, and recent changes. These ages are delimited on the basis of three criteria: the number of fields purchased by the Jats from other people; the number of fire-baked brick houses; and the number of Jats migrating out from the village in search of jobs. Formative is characterized by the largest number of fields purchased from other people; least number of fire-baked brick houses and least number of emigration. Increase in the land ownership is the keynote of this age. Resultant patterns are revealed by consolidation of possessions, a large number of fire-baked brick houses and an increasing rate of emigration. The recent changes strike a note of stagnation. Family blocks of land are broken into small and scattered fields. Houses become urban in appearance. The number of fire-baked brick houses and the emigration to urban centers is the largest. In this stage, peasant culture becomes influenced by the urban culture. Most of the Jat settlements at present are in the third stage.
The Jats of Upper Doab live in houses built of sun-dried and fire-baked mud bricks. Mud is dug from the ponds located near the settlement. Wood is used for the roof and the doors. The houses have rectangular rooms and flat roofs.

The most diagnostic trait of the Jat as regards the house are the two physically separate buildings; the ghair and the haveli. Ghair is built on the periphery of the settlement and has a rectangular plan and one story. It has a large courtyard surrounded by mud walls. Functionally, the ghair is the farmhouse. Here, the agricultural implements are kept, cattle are stalled, threshing floor is made, and fodder is stored.

The haveli is built in the core of the settlement. It is residential in function meant primarily for the females and the children. The haveli is rectangular in form. It has a central courtyard enclosed completely by four sets of rooms. The haveli has three stories of which the lower contains rooms for kitchen, stores, dairy, guests, and milch cattle. The second story has bedrooms. The third story has only one room.

Dubari, barja, and the back door are characteristics of the haveli. These three traits are Rajput in origin. Flat roofs and mud bricks suggest the antecedents of the Jat house in that of the alluvial areas of southwest Asia. Garhi is a building located away from the
settlement and containing both haveli and ghair in one physical unit. It is undoubtedly of Rajput origin.

The ghair and the central courtyard are of Aryan origin. The early Aryans were pastoralist-farmers. The clan house then consisted of several huts for individual families constituting a clan. These huts were made of thatch and wood; and enclosed the courtyard where cattle were stalled and where nearly all the clan activities were conducted. When the clan broke up, individual families built houses of wood and mud. Such houses had two courtyards, an inner for the rituals, and an outer for the cattle. Still later when pastoralism-farming was replaced by sedentary farming the outer courtyard with its set of rooms was separated from the residential part. Thus haveli and ghair were created.

Today the courtyard of the haveli serves as the place where rites connected with birth, marriage, and death are performed and where all the social activities of the females are carried on. Its significance is both religious and secular.

Agricultural land in a Jat village is divided into small fields separated by low mud dikes. Fields constituting an individual holding are scattered all over the village. Fragmentation and scattering are characteristic. An average holding of a Jat farmer consists of about six fields separated by distances of as much as two thousand yards. The fields are one to one and a half acres in size.
Two forms of the fields have been recognized; the evolved, regular rectangular; and the created, irregular quadrilateral.

The field pattern of the Jat villages resulted from certain culture processes operating in the Jat culture history. Among these, the more important have been the Bhaiyachara system of land ownership, the division of land into family blocks, and the law of equitable inheritance of property. Crops and their adaptation to climatic variations, types of ploughs, and irrigation system have been factors of secondary importance.

In the beginning, under the Bhaiyachara system the land belonged to the clan and agricultural activities were organized by the community. Later, the land was divided into family blocks. Finally, the joint family disintegrated and the family blocks were split up into smaller fields. The ownership of the land changed hands from the clan to the individual farmer. According to the law of equitable inheritance every son got a share in every field constituting a family block. Thus, the holding became fragmented into small and scattered fields.

Quadrilateral fields evolved with the use of heavy, iron-share plough, which shortened the length of the furrows. Such fields also evolved from the irregular blocks of waste lands, woods, and pastures later brought under cultivation. Irrigation channels also divided the rectangular fields into quadrilateral ones.
Jats are primarily and almost wholly agricultural people. Jat economy is based wholly on field agriculture. A large part of the contents of their culture comprises the various agricultural traits. It is through agriculture that Jats work out their relationship with and exploit the resources of the land. Basic to the understanding of this relationship is the knowledge of their tools, techniques, and associated value systems.

Generally, and in many of the details Jat agriculture resembles the agriculture of the other residents of the Upper Doab. The use of the plough, the draft cattle, canal irrigation, bullock-carts, and the cultivation of sugar cane are common to both. There is not a single crop which the Jats grow that is not grown by other agricultural people of Upper Doab. Several crops, however, like tobacco, potato, vegetables, and fruits are extensively grown in the Upper Doab by agricultural people other than the Jats whereas these crops are absent among Jats. The crop-complex characteristic of the Jats comprises wheat for domestic consumption, sugar cane for earning cash income, and maize and millets for fodder. This enables the Jats to maintain a balance between subsistence and exchange economies and thus create a well-integrated economy.

Features in the land use characteristic of the Jat villages are the extremely limited area of permanent fallow, small area of
current fallow, and a little area of barren, uncultivable land.

Much land is saved by having only one cremation field for all the caste groups. At least half of the cultivated area bears two crops a year, the winter crop being wholly irrigated. All these features are indicative of the intense use of the land. The prospects of any extension in the cultivated area are sharply limited, an increase in the total agricultural production will be effected by an increase in the yield per acre.

Cultivation techniques and the associated implements, are, in general, the same for Upper Doab and Jat agricultures. Cultivation consists, primarily of plowing, sowing, manuring, irrigating, weeding, reaping, threshing, and storing. Techniques and associated implements which distinguish Jat agriculture from that of the Upper Doab are its very large use of canal irrigation, organic manure, chemical fertilizers for sugar cane, the Meston plough, the combination-hoe cultivator, and the motor-tractor ploughs. Double cropping, crop rotation, and mixed cropping are common to both the Jat and Upper Doab agricultures. The Jats have, however, modified the pattern of double cropping in that they have extended this practice to all the lands of the village, irrespective of their proximity to the settlements.

The agricultural calendar of the Jats shows that they do not have periods of maximum and minimum efforts, the agricultural
works being distributed nearly equally throughout the year. Perhaps the most distinctive trait of the Jat agriculture is the participation of Jat women in agricultural operation, at home, in the farm house, and on the fields. The probable manner of evolution of this trait was from the participation of the Rajput women along with their husbands in the battles. Subsequently, the Rajput women followed the change in the way of life when agricultural fields replaced the battle-fields.

Two systems of land tenure; _bumidari_ and _seerdari_ are prevalent among the Jats. All the fields cultivated by a Jat is owned by him. Before 1947, the characteristic land tenure of the Jats was the Bhaiyachara system in which the entire village belonged to the clan inhabiting it.

The Jats keep a large number of livestock. Bullocks and camels are used for draft, buffalos for milk and horse for riding. The absence of the cow is the noteworthy; the Jats do not drink its milk.

Adequate road mileage connects the Jat villages which are easily accessible to the urban areas by the highways. The roads joining the Jat villages are narrow and surfaced with calcareous nodules. They serve very well the bullock-carts and human movements.

_Rath_ and _tonga_ are used for the conveyance of persons.
Gadee and sikrim transport sugar cane, gur, and other merchandise.

Most of the trading done by the Jats is carried on at bi-weekly markets. These are small ephemeral markets held on certain fixed days of the week, in one or the other village. Jats sell their gur and wheat in such markets. The contribution of the Jats to trading practices and to trade in general is almost nil.

Consideration of the elements of natural cultural landscape of the Jat villages enabled us to reconstruct the different stages through which the Jat culture evolved. The first stage was of primitive, semi-nomadic pastoralism; the second, temporary cultivation combined with maraudery and highway robbery; and the third was of sedentary farming, true agriculture with plough and cattle. Thus, the first stage was primitive, the second exploratory, and the third exploitative.

The three stages were evolved in three different habitats in which the Jats lived. The first stage coincided with the Bagar Steppe, the second with Rajputana, and the third with the valleys of Chambal and the Upper Doab. The changes in culture of the Jats thus, have a close correspondence to the changes in their habitats. The three stages evolved through an acquisition of culture traits by the Jats from the cultures of the different habitats where they lived during
their movements. Cultural succession within the Jat culture thus, is to be explained by culture processes. Physical factors, however, have not been insignificant, but only secondary. They have been conducive to the growth and preservation of the acquired culture traits. True agriculture by plough and cattle, canal irrigation, and cultivation of sugar cane, wheat, and maize have been aided by higher rainfall, heavy loamy soil, and level topography of Upper Doab as compared to Bagar and Rajputana.

The Jats have acquired some traits from the Rajput culture and the cultures of the people living in the Upper Doab. Subsequent modification of these acquired traits, and their integration with the traits of their own culture have enabled the Jats to create and preserve a distinctive cultural landscape in their village settlements.
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Date of Examination:
1 April 1960