

ZEBU CATTLE of INDIA and PAKISTAN

An FAO Study prepared by
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CONVERSION FACTORS

LENGTH	1 inch	= 2.540 cm.
	1 foot	= 0.3048 m.
	1 yard	= 0.9144 m.
	1 mile	= 1.609
	1 mile = 1,760 yards = 5,280 feet	
AREA	1 sq. in.	= 6.452 cm ²
	1 sq. ft.	= 0.0929 m ²
	1 sq. mile	= 2.59 km ²
	1 sq. mile	= 259 ha.
	1 acre	= 0.4047
	1 square mile = 640 acres	
VOLUME	1 cu. in.	= 16.39 cm ³
	1 cu. ft.	= 0.02832 m ³
	1 cu. in.	= 0.01639 liter
	1 gal. (U.S.)	= 3.785 liters
	1 gal. (Imp.)	= 4.546 liters
	1 gallon = 4 quarts	
MASS	1 pound	= 0.4536 kilograms
	1 short ton	= 0.9072 metric ton
	1 long ton	= 1.016 metric tons
TEMPERATURE	1 degree Fahrenheit	= 1.8 degrees centigrade

FIGURE 7. *Cattle of Group III.* Breeds classified in this Group are more ponderous in build and have pendulous dewlaps and sheaths. They often have lateral and curled horns, and usually red or some shade of red color, being occasionally spotted: the best dairy breeds among Zebus are found in this Group. A and B, Dangi bull and cow: the males are good workers but the cows produce little milk. C and D, Deoni bull and cow, resembling the Gir breed in many respects, but also carrying some Dangi blood. E and F, Gir bull and cow: they are famous for their massive size; cows are good milk producers, bullocks are powerful but slow at work.

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Introduction

Attention has been given by FAO to the cataloguing of genetic stocks since 1946. During the early days of the Organization a Standing Advisory Committee on Agriculture was established to assist in the planning of the Organization's program of work. One of the recommendations of that Committee, at its first meeting in Copenhagen in 1946, was that catalogues of important genetic stocks be established to facilitate the exchange of information and of breeding materials among plant and animal breeders. Obviously the approach to this problem in livestock must be different from that in the plant field. Much progress has been made in the establishment of catalogues of important genetic stocks, particularly of wheat and rice, and a substantial amount of information has already been published. With such material it is possible to describe many genetic traits in detail, and to enter the information on punch cards, thus making it possible to quickly locate stocks having any desired characteristic or characteristics.

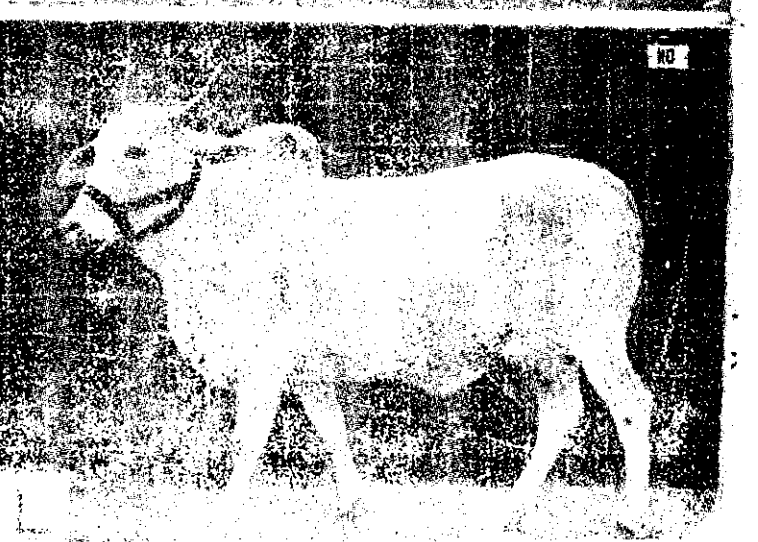
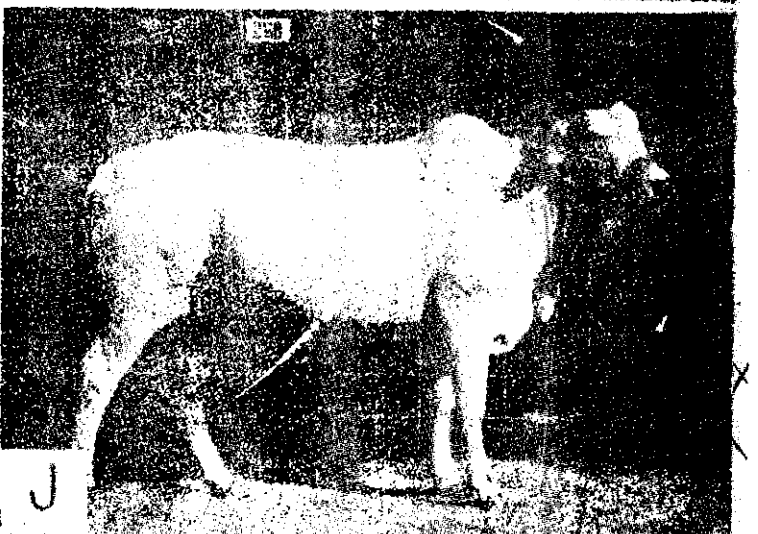
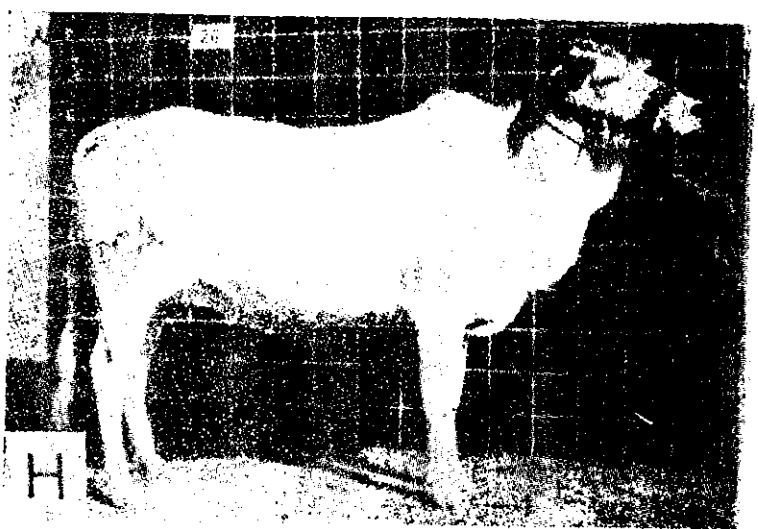
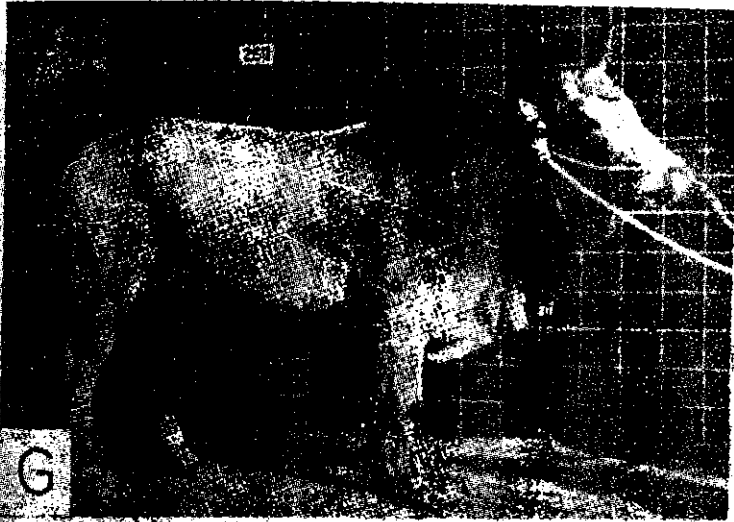
Specific knowledge of genetics in livestock is much more limited than in important crop plants, and the nature of the breeding material is also such that it is not possible to maintain stocks without heavy costs or to exchange them as freely as is possible with plant material. However, owing to the great importance of livestock production in human welfare, it was considered desirable to make a start in this field, even though the available information is very limited.

The initial effort at assembling information on livestock, the results of which are now published, has been concentrated on the cattle of India and Pakistan; firstly, because of the over-riding importance of cattle in relation to other types of livestock, taking world agriculture as a whole; secondly, because of the particular needs of tropical and sub-tropical areas for improved cattle production; and, thirdly, because of the special characteristics of many breeds in India and Pakistan, which make them suitable for use under tropical and sub-tropical conditions.



FIGURE 2. *Cattle of Group I.* The breeds classified in this Group are lyre-horned gray animals with wide foreheads, prominent orbital arches and a flat or dishd-in profile. They are deep bodied, powerful draft animals. A and B, a bull and a cow of Kankrej breed from Gujarat, Bombay, India. C and D, a bull and a cow of the Hissar breed: it is not a pure breed, Kankrej influence being very prominent, and will probably be extinct in the near future. E and F, a bull and a cow of Kenwari or Kenkatha breed, which are powerful draft animals.

FIGURE 3. *Other breeds of Group I.* G and H, a bull and a cow of the Kherigarh breed from Uttar Pradesh, used for light draft and trotting purposes. I and J, a bull and a cow of the Malvi breed: these are powerful draft animals, but the cows are poor milkers. K and L, a bull and a cow of the Tharparkar breed bred in the desert of Thar, good for both milk and draft.



Limitations of Available Information

While practical experience has resulted in a rough and ready selection of those species, breeds and strains which "do well" in a given environment, the time has long since come when this empirical knowledge needs to be critically examined and supplemented by scientific procedures. This has been the history of progress in every sphere of life; it has been the history of progress in the improvement of plant stocks; it will form the basis for wide development of animal stocks.

Lee and Phillips (1948) have systematically reviewed the ways in which climatic elements affect the functioning of animals and have also summarized the methods of studying reactions of animals to environmental stresses. The need for climatic studies in different climatic zones of the world is emphasized. Such studies should naturally have as their objective the hastening of the slow and very expensive evolutionary process which takes place under conditions of natural selection.

It has been recognized from the outset of this work that any compilation of information on the genetic and related physiological characteristics of the cattle of India and Pakistan, or of any other area, would be incomplete in many respects. The collection of such data on livestock is an expensive process, and in many cases even the more superficial data on productivity are almost entirely lacking. The material presented in this publication is, therefore, aimed at making generally available summaries of such information as could be obtained from all known sources with regard to the productivity of cattle of India and Pakistan in their native homes and in such other places as they have been used, either in pure form or for grading-up or cross-breeding, together with related information on the conditions under which each type or breed was developed and on physical characteristics.

Recognizing the many gaps that exist in such information as is available, it is hoped that the details given here will, nevertheless, be useful to livestock breeders in tropical and sub-tropical areas and to FAO's member countries whose territories are located in these zones. On the basis of existing information, this is the best obtainable indication of the characteristics and sources of breeding stock that might be used in their livestock breeding programs wherever it is thought wise to consider the use of Zebu

cattle of any of the important types and breeds originating in India or Pakistan, provided adequate animal health safeguards are observed in such introductions. It is also hoped that this publication will stimulate further studies aimed at filling the many gaps in existing information.

Anyone desiring to import animals of any of these breeds for breeding purposes should, of course, consult the veterinary authorities regarding the laws and rules governing such proposed importations, before initiating inquiries for breeding stock.

Importance of Adaptability to the Environment

There is ample evidence that adaptability to environment is one of the important factors to consider when deciding upon the type of stock to use in a livestock enterprise. This is true whether the environmental conditions are favorable or unfavorable. In a favorable environment, the profitable animal is one that is able to produce at a maximum level when ample feed of good quality is supplied and when other conditions of livestock production are optimum. In a less favorable environment, greater emphasis must be placed on ability to survive and less on immediate efficiency in transforming good quality feed into useable products. If environmental conditions are rigorous because of high temperature, scanty feed, feed of poor quality, severe winters, high elevation or other factors, then ability to survive and reproduce in the face of such obstacles must be given major consideration when selecting stock.

Man has frequently tried to transplant improved cattle, and particularly specialized dairy stock, to areas where the environment differs materially from that in their native home, or from the environment in other places where they have performed satisfactorily. The results have often been unsatisfactory, sometimes disastrous. This has been true particularly in the areas of lower altitude in the tropics, which are generally characterized by high temperatures, high rainfall, coarse roughage of low nutritional value, limited or no grain feeding and conditions favorable to parasitic infestation.

Improvement of environmental conditions should be an objective of every livestock producer, but in many areas limitations are laid down by nature, so that the producer can move within

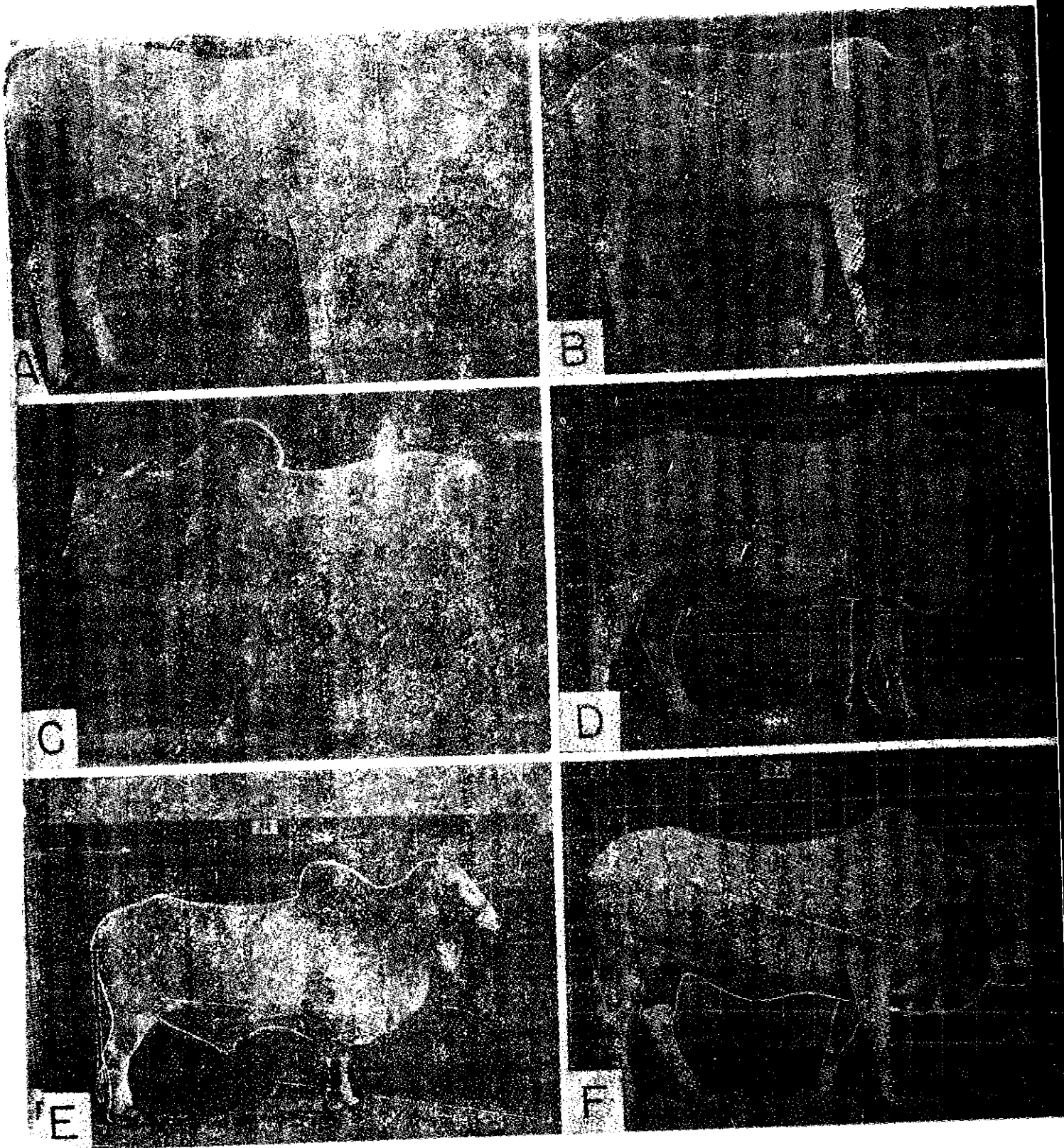


FIGURE 4. *Cattle of Group II.* The breeds classified in this Group are short-horned, white or light gray in color with long coffin-shaped skulls. The face is slightly convex in profile. A and B, Bachaur bull and cow, a draft breed from Bihar State. C and D, Bhagnari bull and cow, a draft breed from Baluchistan. E and F, Gaolao bull and cow, a light draft breed from Madhya Pradesh, bearing a close similarity to

economic limits only to a certain point in improving the supply and quality of feed and other environmental factors. In tropical and sub-tropical areas many of the conditions under which cattle must be produced are determined by nature, and if a producer's cattle are to perform profitably he must select and breed animals that are adapted to the environment.

The most productive types of livestock, as measured by yardsticks such as milk, butter fat and meat yields, have been developed in regions where ample feed is produced and where temperate climatic conditions prevail. Generally, these regions also happen to be those in which the economic status of the people is best and where considerable emphasis has been placed on research and its application. Livestock producers have actively tried to improve their animals and the conditions under which they are produced, through co-operative efforts and through programs sponsored by governments. In many of the less productive regions, the limitations laid down by nature have often prevented development by the livestock producer of animals highly specialized for meat, milk or wool production or work purposes. Generally, poorer economic conditions have also hindered the development of highly competent research and extension services to assist the livestock owner.

It is not surprising that livestock producers and agricultural leaders in less developed regions have, in many instances, obtained stock from more highly developed areas to use in improving the animals native to their own regions, or to replace them. The animal that has been developed to a highly specialized degree for beef, milk, or wool production or work purposes under favorable environmental conditions, stands in sharp contrast to many types native to underdeveloped areas, when only individual merit in the usual sense is considered.

But the contrast is often as marked in the apposite direction when the "improved" animal from a favorable environment must meet the tests of surviving and reproducing itself in the tropics, in semi-arid areas, or in other areas to which it is not adapted. To illustrate this point Bonsma (1952) cites an example of a South African ranch where over a 22-year period a total of 404 head of temperate zone purebred cattle was bought, but 279 or 69.1 percent died before being on the ranch for more than one year. Over this period the average calving percentage was 39 percent

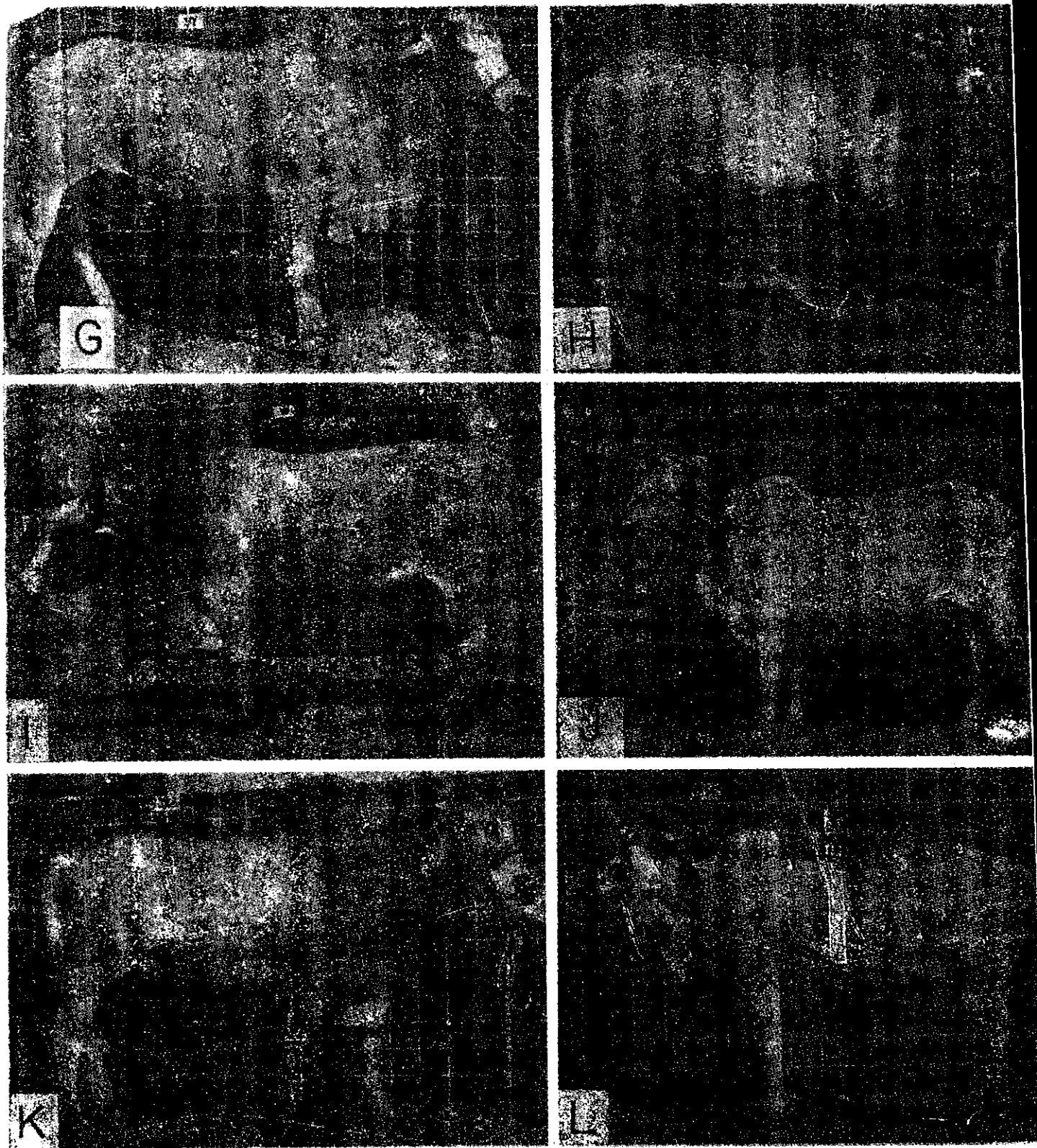
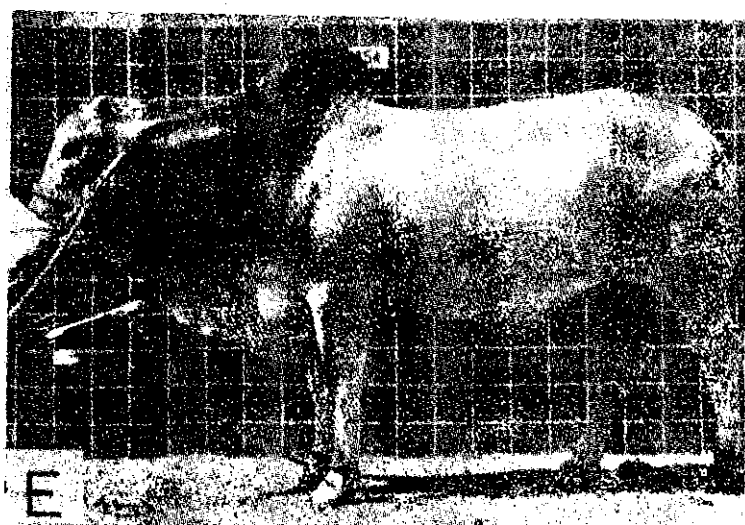
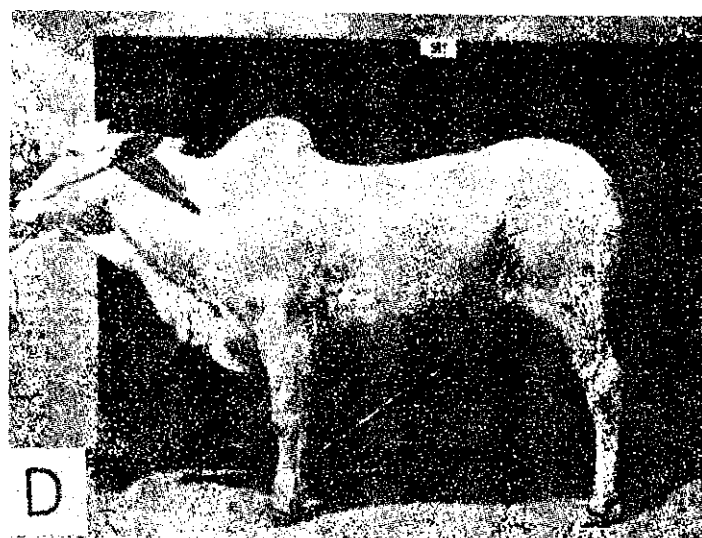
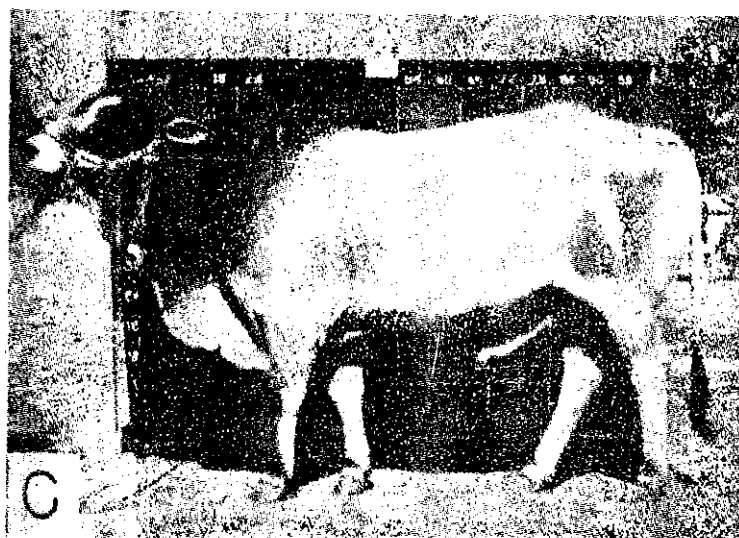
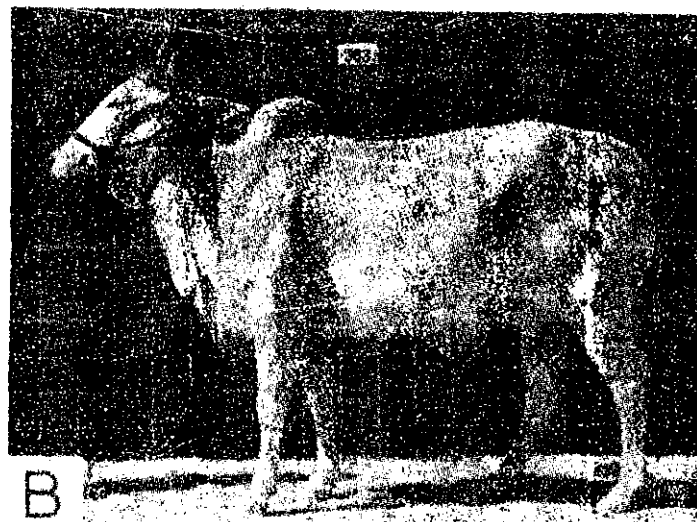
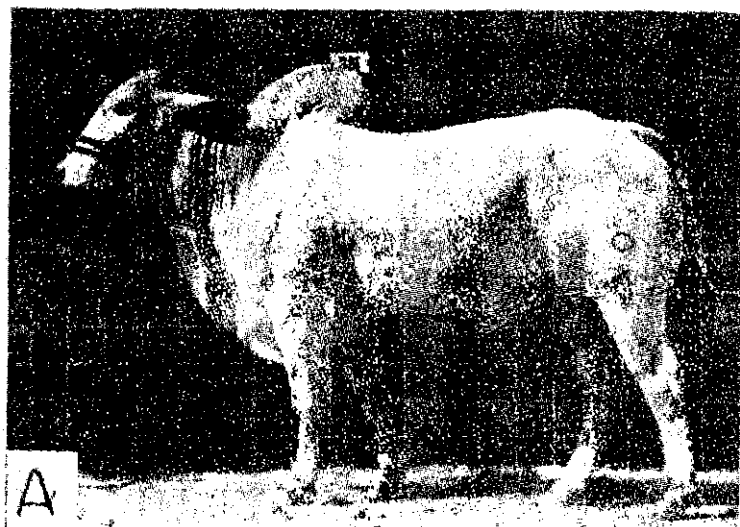


FIGURE 5. *Other breeds of Group II.* G and H, Haryana bull and cow: this is supposed to be one of the better dual-purpose (draft and milk) breeds. I and J, Krishna Valley bull and cow; good for slow, heavy draft: the breed is of recent origin. K and L, Mewati bull and cow: this breed is similar to Haryana with a trace of Gir blood.

FIGURE 6. *Other breeds of Group II.* A and B, Nagori bull and cow: this is a famous trotting breed in India. C and D, Ongole bull and cow, a powerful draft breed with fair milking capacity. E and F, Rath bull and cow, a breed similar to the Harijana.



and the calf mortality rate was 18 percent. This illustrates how national assets could be wasted through a wrong introduction.

Obviously, the lessons to be learned from previous efforts to introduce improved stock from the temperate zones into regions having less favorable environments should be considered in further attempts to improve livestock in the less developed areas. Those planning such work should also study the results of experimental breeding projects that have been carried out in various countries to develop types of animals adapted to special conditions. This is particularly important, since conditions that prevail on a large portion of the world's land area are not favorable to production of highly specialized beef or dairy cattle, large draft horses or other highly specialized types of livestock.

In many of these less favorable areas, production of livestock adapted to the local conditions is the only way in which the land may be utilized effectively. In others, particularly in the tropics and sub-tropics, there is need for milk and meat to supplement the human diet which is obtained largely from plant sources, and, animals from temperate regions often have not proved well adapted to conditions that prevail generally in these regions.

Much of the available information having a bearing on the breeding of livestock adapted to unfavorable environments has been summarized by Phillips (1949) in another FAO publication. It was not possible to collect and present all the pertinent facts, but sufficient examples were given to illustrate the dangers of introducing unadapted types, and to indicate the possibilities of improving livestock under unfavorable conditions, either by selecting within native types, introducing more productive types from other regions where similar conditions prevail, or developing new types adapted to specific sets of conditions. Hence, such details will not be repeated here. An example of the successful introduction of one type of cattle into a region other than its native home is shown in Figure 1.

Adaptability of Zebu Cattle to Tropical and Sub-tropical Conditions

In any discussion on the cattle of Southern Asia, cattle from the sub-continent of India and Pakistan naturally take the leading role, since this is the area in which the most productive types of

cattle, among those native to Southern Asia, have been evolved. Cattle in India and Pakistan belonging mainly to the species *Bos indicus* are also well-known as Zebus. In the Americas, these cattle have been known as Brahmans; however, this is a local term which cannot be applied to the *Bos indicus* species, but only to the particular type of Zebu which has been evolved in the southern United States by amalgamating several Indian breeds.

During the eighteenth and nineteenth centuries when new areas of the world were being colonized by Europeans, it was early noticed by the colonists that in regions having hot, arid or humid climates and short growing seasons of pastures or long intermittent spells of droughts, the cattle introduced from temperate zones could not easily withstand either the climatic stress or the rigors imposed by the fluctuations and nature of the feed supply. Together with the introduction of indented labor in some of these colonized areas from India in the nineteenth century, cattle from India also were introduced in the various European Colonial territories. The ability of Zebu cattle to thrive under vigorous conditions attracted the attention of the settlers, and attempts were made in various regions to breed these cattle pure or to use them for cross-breeding purposes.

In India itself (as constituted before the partition into India and Pakistan), owing to the great importance of cattle in the economy of the country, it was natural that much attention was paid to cattle breeding in past centuries. Organized effort to improve the cattle is, however, of more recent origin. Owing to the vastness of the country, difficulties in transportation, peculiar topography, soil and climatic conditions, breeds and types peculiar to various localities were evolved. Circumstances enumerated above also helped in the preservation of the purity of these evolved breeds and types.

At the same time, trade in cattle by itinerant cattle dealers, annual movement of cattle in search of grazing, and indiscriminate and uncontrolled breeding caused mixing of types, often to the detriment of the specific types. In spite of these unfavorable crosscurrents, and the lack of concrete breeding policies until recent times, India and Pakistan possess several diverse types of cattle, and many breeds with distinctive characteristics are recognizable within some of these types.

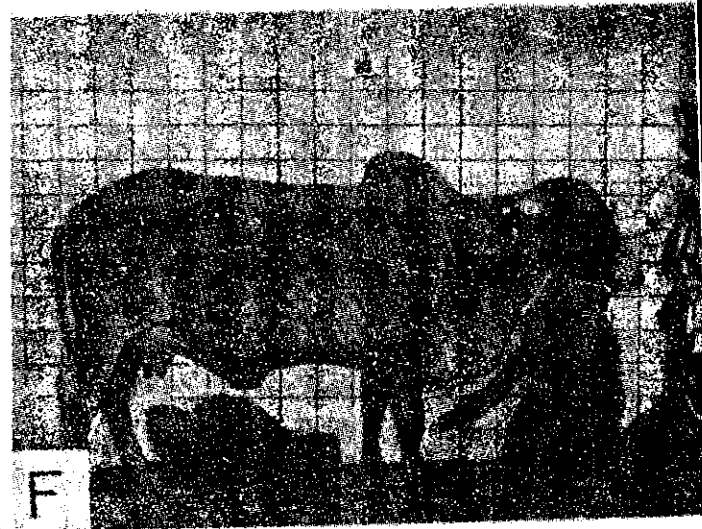
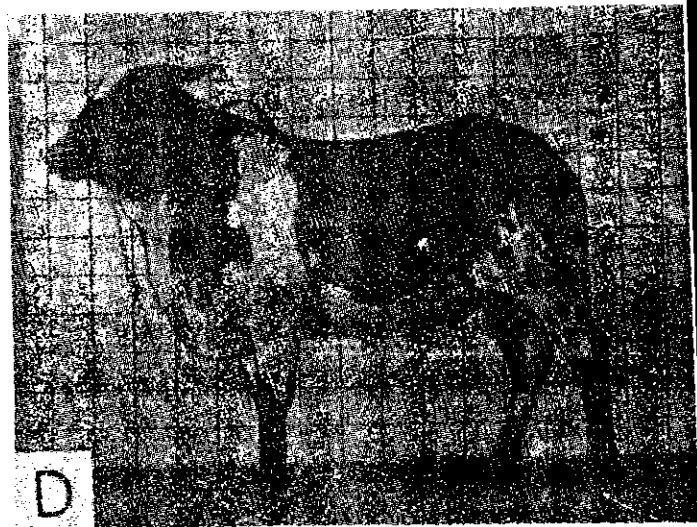
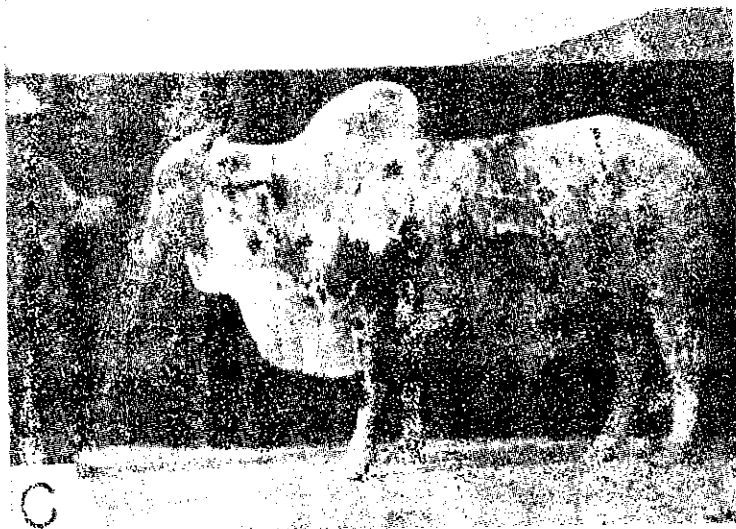
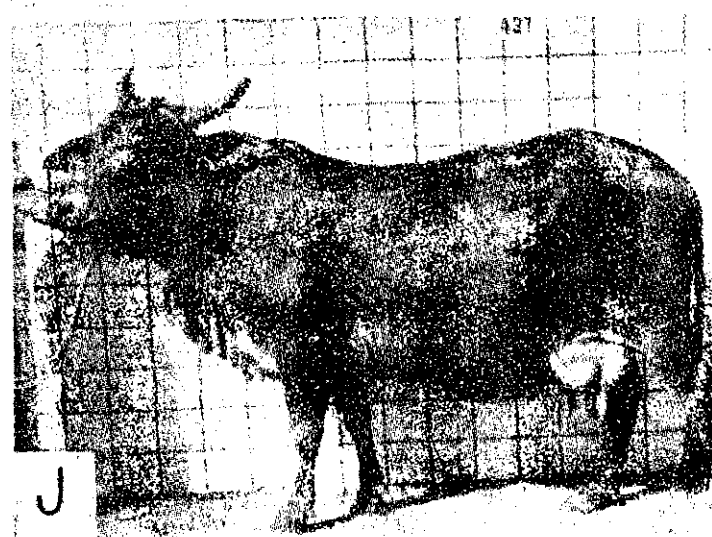
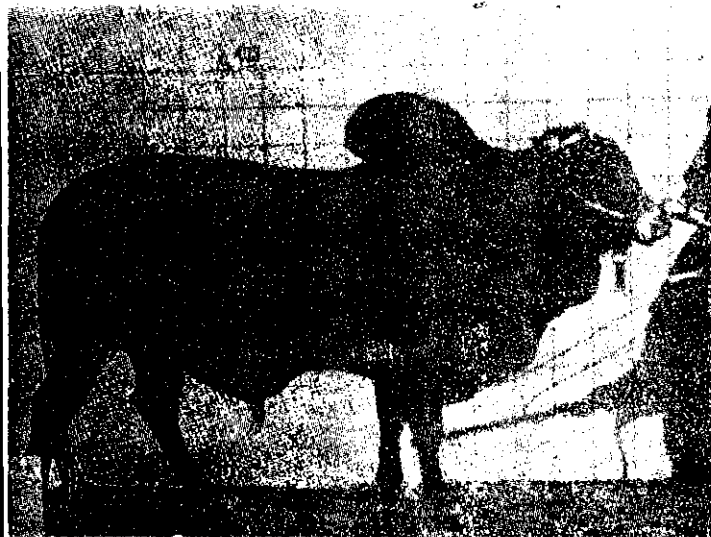
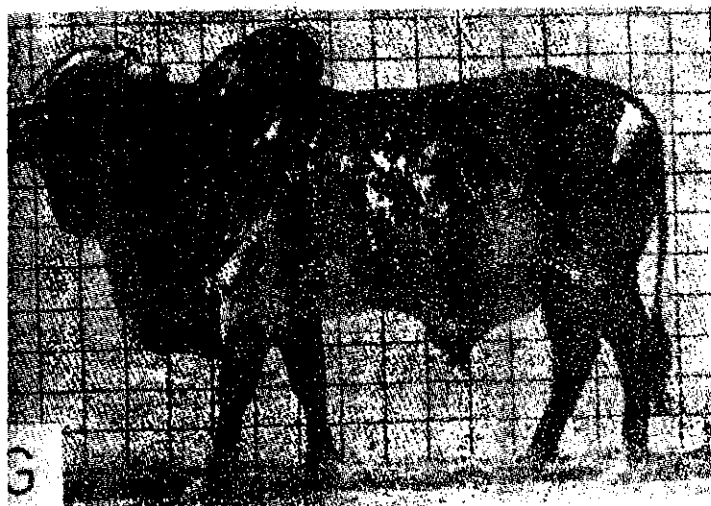


FIGURE 7. *Cattle of Group III.* Breeds classified in this Group are more ponderous in build and have pendulous dewlaps and sheaths. They often have lateral and curled horns, and usually red or some shade of red color, being occasionally spotted: the best dairy breeds among Zebus are found in this Group. A and B, Dangi bull and cow: the males are good workers but the cows produce little milk. C and D, Deoni bull and cow, resembling the Gir breed in many respects, but also carrying some Dangi blood. E and F, Gir bull and cow: they are famous for their massive size; cows are good milk producers, bullocks are powerful but slow at work.

FIGURE 8. *Other breeds of Group III.* G and H, Nimari bull and cow: this is a powerful draft breed evolved by crossing Gir and Khillari cattle. I and J, Red Sindhi bull and cow: the breed is famous for its milk production and reputed adaptability to various climatic conditions. K and L, Sahiwal bull and cow: this is an important milk breed in the Central Punjab; the bullocks are slow workers.



Classification of Zebu Cattle

Johnson (1951) has brought together some material from scattered sources into a popular article on the origin and domestication of *Bos indicus*. There is a substantial amount of agreement among these sources as to the origin of *Bos indicus* having been in the India-Pakistan-Burma-Malay area. Olver (1938) and Shirlaw (1940) have summarized some archaeological and historical evidence regarding the existence and introduction of various types of cattle now prevalent on the sub-continent of Indo-Pakistan.

No attempts were made, however, to classify these cattle into definite types or groups until Olver (1938) suggested a tentative classification on the basis of similarities in some obvious physical characteristics. Ware (1942), realising the importance of critical scientific studies necessary to classify the various types and breeds correctly, agrees in general to Olver's classification with minor modifications in details. Phillips (1944) crystallized the general scheme a step further by suggesting inclusion of appropriate breeds and types into those generally outlined groups, as defined by Olver and Ware. Das Gupta (1945) adopts the classification suggested by Olver (1938) and numbers the groups in a different order.

The following is an attempt to summarize these previous studies, so that readers may have an understanding of the broad classes into which the breeds described in this publication may be classified. Illustrations of the various types and breeds, as set forth by Phillips, are reproduced in Figures 2 to 12 to aid the reader further in visualizing the broad groups into which these Zebu breeds may be classified, and the differences and similarities to be found among the breeds in each group.

Group I

This group includes lyre-horned gray cattle with wide foreheads, prominent orbital arches, and thin faces, having flat or dished-in profiles. The Kankrej and Malvi are the most important breeds in this group. The Kenwariya and Kherigarh also fit into this group, but are so closely allied with the Malvi that they appear as varieties of Malvis rather than distinct breeds. The Tharparkar breed, which seems to have been influenced by the lyre-horned Kankrej, is classified by Ware (1942) and Phillips (1944) in this group. However, it should be mentioned that this breed seems to have been influenced, particularly in its northern habitat, by the short-horned breeds of Group II described below, and with perhaps equal justification it might be included in Group II since it appears to be intermediate to the two groups.

Group II

These are shorthorned white or light gray cattle with long coffin-shaped skulls, orbital arches which are not prominent, and with faces that are slightly convex in profile. The Bhagnari, Hariana and Ongole appear to be distinct and important types of this group. The Mewati, which may be included in this group, seem to have been evolved from a Hariana base, with traces of influence of the Gir from Group III, and the Kankrej or Malvi from Group I. The Nagori and Rath are more closely related to the Hariana breed in this group. The Gaolao, on the other hand, is closely related to the Ongole. The Krishna Valley breed, which is of much more recent origin and may be classified in this group, carries traces of Ongole blood together with some influence of the Mysore type of Group IV, and also the Gir of Group III, and possibly of the Kankrej of Group I. Phillips (1944) classifies Bachaur in this group: it seems to be related to the Hariana.

Group III

Ware (1942) and Phillips (1944) mention that cattle in this group are more ponderous in build and have pendulous dewlaps and sheaths, prominent foreheads, and lateral and often curled horns. They are usually spotted either red and white, or various

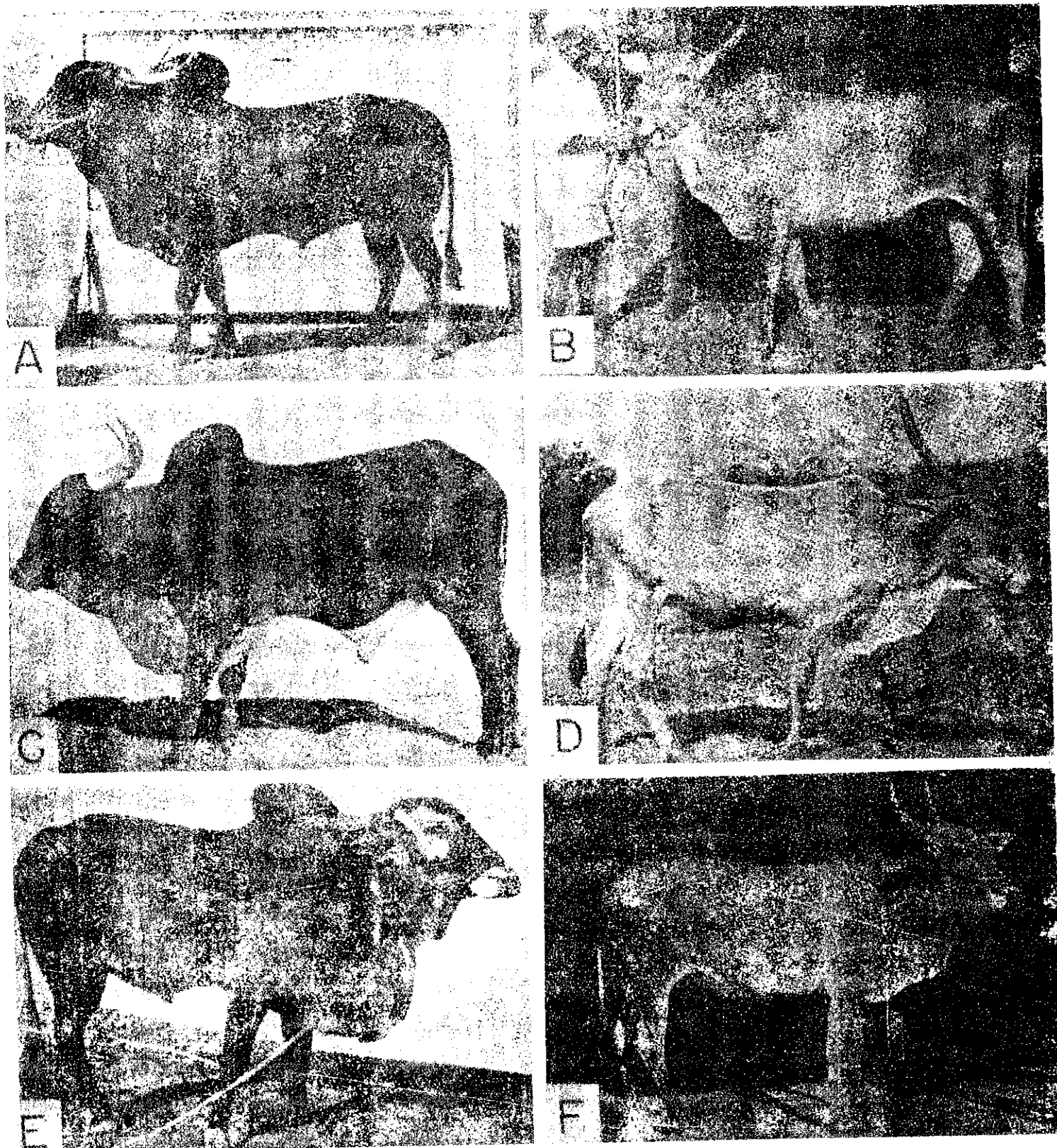
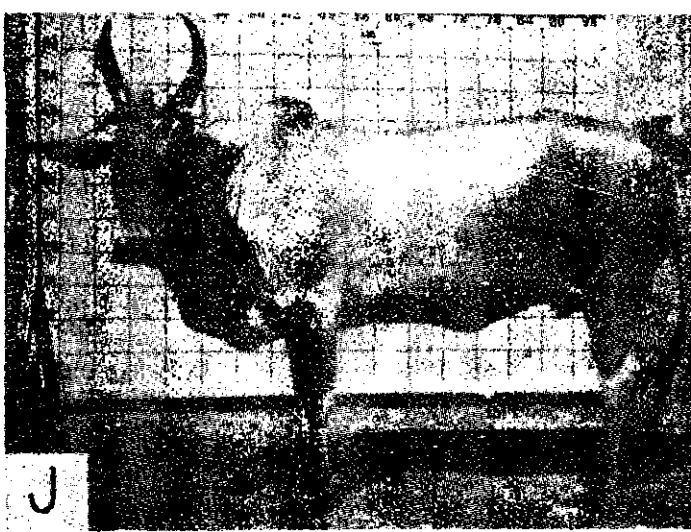


FIGURE 9. *Cattle of Group IV* Breeds classified in this Group are popularly termed "Mysore cattle." They are characterized by prominent foreheads and long, pointed horns rising close together, and are, with few exceptions, poor milkers. A and B, a bull and cow of the Hallikar breed, which appears to be the basic stock from which the other so-called breeds in this Group have been derived. C and D, a bull and a cow of Alambadi cattle, which differ so little from Hallikar that it is a question whether they are a separate breed. E and F, a bull and a cow of Amrit Mahal breed, developed in Mysore for use in quick transportation of military equipment: though not very large they are wiry and famous for their strong powers of endurance.

FIGURE 10. *Other breeds of Group IV.* G and H, a bull and a cow of Bargur breed which closely resembles the Amrit Mahal cattle: they are fiery, restive and difficult to train. I and J, a bull and a cow of Kangayam breed, very similar to the general Mysore type: though of moderate size, they are active and powerful and are highly prized as draft animals. K and L, a Khillari bull and cow: this breed of powerful draft animals is found in Southern Bombay State; though closely resembling the Mysore type of cattle there is evidence of infusion from the gray-white cattle of the North.



shades of red and white or solid red, dun or brown. The Gir is the most important basic breed which seems to have influenced most of the other breeds in this group. Olver, however, points out that breeds such as the Red Sindhi and Sahiwal also seem to carry some blood from the red and dun cattle of Afghanistan. The Afghan type of cattle have been classified in Group V by Ware (1942), and probably it is this type, together with the hill type of the Las Bela area of Baluchistan, which seems to be the basis on which the Red Sindhi breed has been built up, though both Sahiwal as well as Red Sindhi definitely appear to carry some trace of Gir blood. Other breeds such as the Deoni, Nimari and Dangi are probably of more recent origin, and have the appearance of being influenced by the Gir. As such, they are classified in this group.

Group IV

The cattle of this group are medium-sized, compact animals having powerful quarters and tight sheaths. The most striking characteristic of these cattle is the formation of the head and horns. The forehead is prominent and the horns emerge from the top of the poll fairly close together in an upward and backward direction and are very pointed. Cattle of this group, sometimes referred to as "Mysore type cattle", are pre-eminently suitable for fast work and endurance in the plow or on the road, but temperamentally they are highly strung and apt to be fierce. The coloring of these cattle is usually some shade of gray, varying from almost white to almost steel gray or black. Included in this group are the Amrit Mahal, Hallikar, Kangayam and Khillari breeds. The Alambadi and Bargur are minor strains.

Group V

The cattle included in this group are a heterogenous mixture of distinct strains. They are small black, red or dun cattle, often with large patches of white markings. The poll and hump may be covered with coarse hairs. They are active cattle, with small sheaths. They are either shorthorned or slightly lyre-horned. These small cattle are able to thrive where large animals could

not survive and are capable of rendering useful service as milch animals, as well as for miscellaneous work in the hilly regions and for light plowing. They are found all over India and Pakistan, and particularly in the Himalayas, in the hills of Baluchistan, in the rugged mountainous areas of northern Pakistan and in poor forest tracts all over the region. The more noteworthy breeds in this group are the Lohani and Rojhan (Mason, 1951) from Pakistan, the Ponwar from Uttar Pradesh (it may be interesting to note that Zebu cattle in Madagascar show a close similarity to the Ponwar), the Siri from the Himalayan foothills in the vicinity of Bhutan and Darjeeling, and Afghan breeds from the extreme north of Pakistan. In almost all the breeds of cattle in this group the position of the hump may be described as cervicothoracic but it is interesting to note that in Siri cattle the position of the hump is thoracic as in some African Zebus.

Group VI

The Dhanni breed of cattle from the northern portion of the Punjab in Pakistan is the only breed which is difficult to fit into any of the groups mentioned above and Phillips (1944) allocates this to Group VI. The animals of this group are medium-sized, compact and active. The dewlap and the sheath are tight. The coats are usually very shiny. Coloring in most animals consists of black or red spots on a white coat varying from almost white animals with evenly scattered spots over the whole body (similar to the Dalmatian dog) to animals that are predominantly black or reddish with typical spotting visible only on certain parts.

Method of Presentation

Information has been assembled on each of the breeds, mentioned under the classification of Zebu cattle, which is considered of sufficient importance to be of interest to breeders in countries other than India and Pakistan where Zebu cattle might be used in improvement programs. The information on each breed is presented under the following main headings and sub-headings:

Origin

Conditions in the Native Home of the Breed

Location, Topography and Soils

Climate

Vegetation

Management Practices

Physical Characteristics of the Breed

Functional Characteristics of the Breed

Performance in Other Areas

Sources of Breeding Stock and Information Regarding the Breed

Publications referred to in the discussion of each breed are listed at the end of the publication.

The material on the respective breeds is arranged in groups, following the classification described in the preceding section, to facilitate comparisons of breeds which have in common a number of important physical characteristics. It is recognized that, as further information becomes available, the classification may require revision. However, lacking any better basis for classification, this seems to be the method of presentation that will be most useful to readers. Within each group, the breeds are arranged alphabetically.

Group I

The breeds of the group described here are the Kankrej, Kenwariya or Kenkatha, Kherigarh, Malvi, and the Tharparkar or Thari.

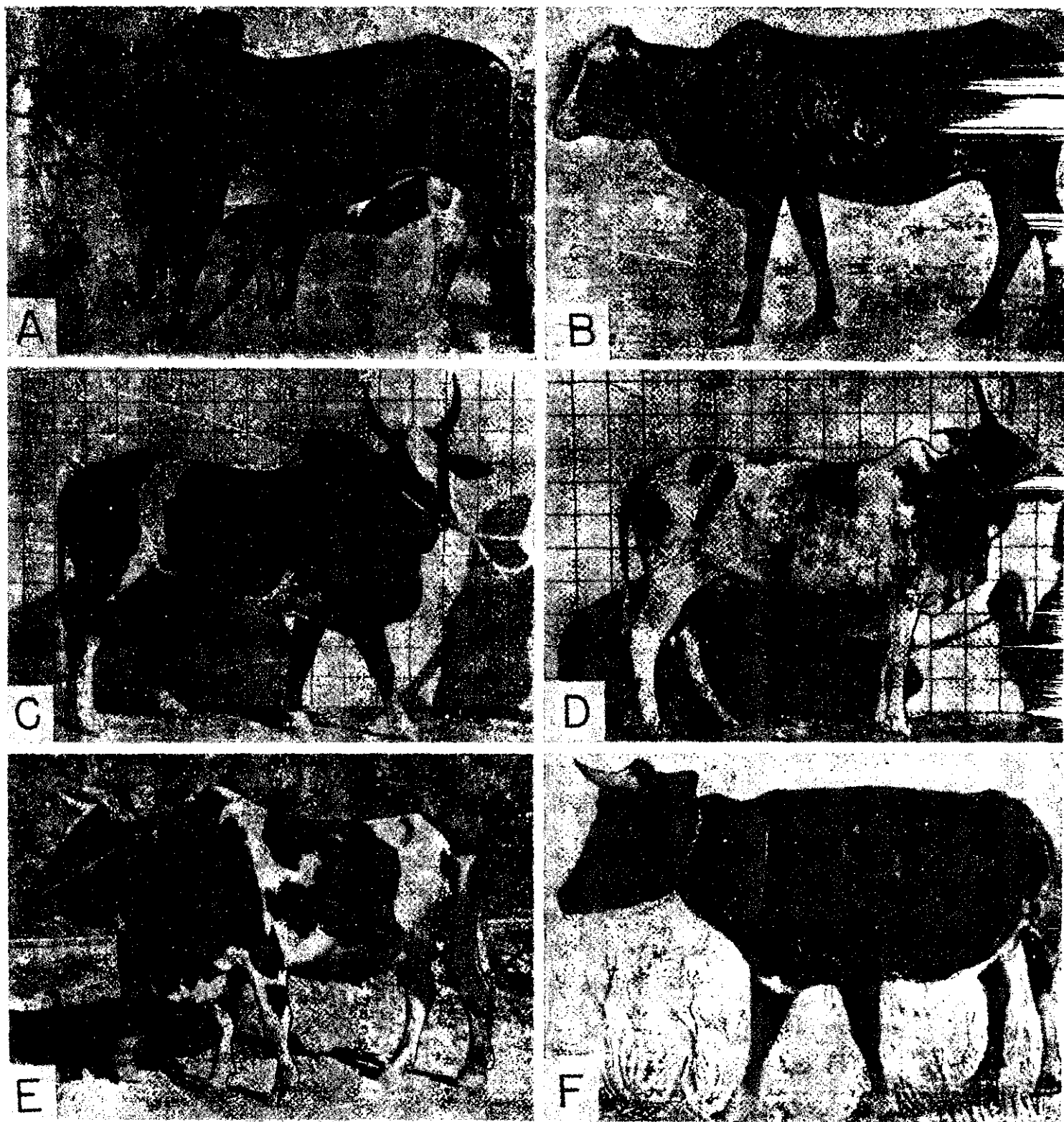


FIGURE 11. *Cattle of Group V.* The breeds included in this Group are a heterogeneous mixture of distinct strains. They are found all over the Indo-Pakistan area and particularly in the Himalayas, in the hills of Baluchistan and in the rugged mountainous areas of North Pakistan. A and B, Lohani bull and cow, found in Baluchistan and the adjoining portion of the North-West Frontier Province: the animals are small in size, but compact, and the cows are said to yield up to 10 lbs. of milk per day. C and D, Ponwar breed bull and cow, small cattle, bulls weighing up to 800 lbs: the cows give little milk. E and F, the Siri breed is said to come originally from Bhutan: the bullocks are good workers and the cows are said to produce a fair amount of milk.

The Hissar breed mentioned by Phillips (1944) as belonging to this group has been omitted because the Government Livestock Farm at Hissar, Punjab, India, where the breed was evolved has changed its policy. The present trend is to develop Hamana. It is anticipated that the Hissar breed will soon be extinct.

Group II

The breeds of the group described here are the Bachaur, Bhagnari, Gaolao, Haryana, Krishna Valley, Mewati, Nagori, Ongole, and Rath.

Group III

The breeds of the group described here are the Dangi, Deoni, Gir, Nimari, Red Sindhi and Sahiwal.

Group IV

The breeds of the group described here are the Amrit Mahal, Hallikar, Kangayam and Khillari. The Alambadi and Bargur mentioned by Phillips (1944) as belonging to this group have been omitted because they are of very minor importance and are not sufficiently distinct from Hallikar.

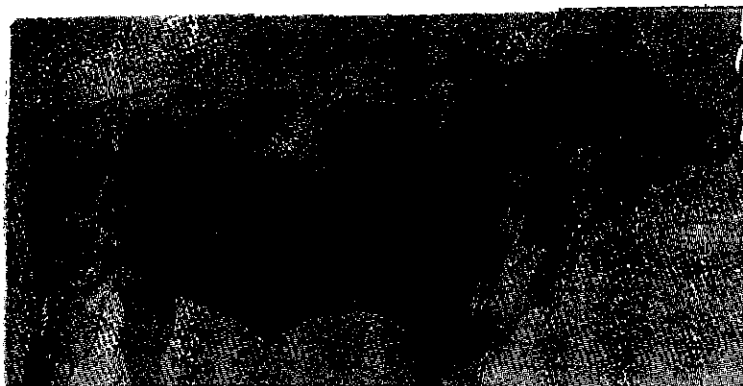
Group V

The breeds of the group described here are the Lohani, Ponwar, and Siri. Besides these there are several hill-type strains of cattle such as Afghani, Rojhan, Kumauni, etc., which belong to this group, but have been omitted, being of minor importance.

Group VI

This group is represented only by the Dhanni breed.

FIGURE 12. *Cattle of Group VI.* The Dhanni breed is the only one included in this Group. It does not seem to fit into any of the other Groups described, and therefore requires a separate classification. It is found in the Attock, Rawalpindi, and the hill areas of the Punjab, Pakistan. The spotting resembles that of a Dalmatian dog. The bullocks are valued as draft animals.



Group I

K A N K R E J

Origin

The Kankrej breed of cattle¹ takes its name from a territory of that name in North Gujarat of Bombay Province, India. The home of the breed is to the southeast of the Desert of Cutch in Western India, extending from the southwest corner of the Tharparkar District of Sind Province of Pakistan to Ahmedabad District in Bombay Province of India, and from Deesa in the east to Radhanpur in the west of the Banaskantha District of Bombay Province, particularly along the banks of the rivers Banas and Saraswati which flow from east to west and drain into the desert of Cutch.

In Radhanpur State, which is adjacent to the Kankrej tract, the breed is known as Wadhia. In Cutch State it is known as Wagad or Wagadia, taking its name from a community of herdsmen who breed these cattle. A similar variety known as Sanchoke is bred in Jodhpur of Rajputana, India. (Anonymous, 1926 (a)).

The pictures and carvings obtained from Mohenjodaro excavations in Sind, Pakistan, show that the cattle types existing in those days (about 3,000 B.C.) were very similar to Kankrej. The large Malvi breed of Rajputana resembles the Kankrej in some respects, though the size and shape of horns are different.

¹ See Figures 13 and 14.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area covered by this breed is roughly 700 square miles. The longitudinal position is between 71° and 74° E. and it is on either side of the Tropic of Cancer between 21° and 24° N. The Kankrej breeding tract is low-lying and dry. For the most part it is a treeless tract, and whatever trees are there are on the borders of the ponds and along the river banks. The two chief rivers, Banas and Saraswati, which flow through this tract are also seasonal and are partly dry during the summer months. In the southwestern part of the region the soils are sandy loam and heavy black, while on the eastern side they are mostly sandy with some sandy loam areas. In some districts the soil is clay loam of whitish gray color. When wet such soil is sticky and difficult to work and when dry it cakes and soon cracks over

FIGURE 13. Kankrej cows are fair milkers.



a large area. The sub-soil is yellowish white, of compact structure mixed with lime nodules and is impervious.

For the most part the country is a sandy, treeless plain with, in some places, rolling sand hills and between them valleys of black clay. To the north and northeast bordering on Sirohi lies an area covered with rocks and forest-clad hill ranges.

Climate

Climate varies greatly with the distance from the sea. Towards the sea it is more temperate with high humidity but with appreciable air movement. From November to February it is dry and cool, and spells of cold occur occasionally when the temperature goes down to 40°F. From March to June is the hot season when the temperature at times reaches as much as 120°F. Average rainfall ranges from 20 to 30 inches and is usually concentrated within the period from July to October. The climate during the rainy season is hot and humid, but nearer the sea fast air movement makes the weather pleasant.

Table 1. Climatological Data for the Kankrej Area

MEASURE OF CLIMATE	AVERAGE DATA BY MONTHS											
	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
(a)												
Mean maximum temp. °F . . .	82.4	89.4	98.2	105.5	110.2	104.8	95.5	91.9	94.4	97.6	91.7	85.6
Mean minimum temp. °F . . .	53.9	58.6	66.2	75.5	81.2	83.6	79.3	78.5	76.6	71.0	63.1	56.2
Rainfall, in inches	0.32	—	0.03	0.16	0.18	3.62	13.14	6.73	2.12	0.13	0.29	—
(b)												
Mean maximum temp. °F . . .	83.5	86.4	95.8	103.6	107.0	102.2	93.7	89.4	93.4	97.5	92.3	85.8
Mean minimum temp. °F . . .	51.4	54.3	63.1	71.3	77.4	80.5	78.1	75.9	74.1	66.9	57.9	52.3
Mean daily relative humidity, percent	48.0	42.0	40.0	43.0	57.0	68.0	80.0	84.0	77.0	53.0	42.0	46.0
Rainfall, in inches	0.11	0.16	0.08	0.03	0.43	2.18	9.0	8.62	3.54	0.41	0.10	0.04

(a) Supplied by the Director, Institute of Agriculture, Anand, Bombay from the data collected at Chharodi, Kankrej Cattle Farm, 1940-48.

(b) Average of 10 years for the Kankrej area supplied by the Indian Meteorological Department, Government of India, New Delhi.

The further climatological data from Deesa and Ahmedabad, represented in Table 2, will be of interest.

Table 2. Climatological Data from Deesa and Ahmedabad

MEASURES OF CLIMATE	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
D E E S A												
Barometric pressure reduced to 32°F	29.55	29.50	29.43	29.34	29.26	29.13	29.09	29.16	29.28	29.42	29.51	29.55
Mean wind velocity in miles per hour	3.32	3.38	3.32	3.60	5.26	6.54	5.93	4.76	3.17	2.55	2.83	3.10
Humidity %	37.0	33.0	31.0	31.0	44.0	57.0	73.0	78.0	70.0	51.0	38.0	39.0
Vapor pressure in inches of mercury	0.230	0.244	0.286	0.370	0.592	0.750	0.851	0.831	0.765	0.504	0.315	0.251
Mean monthly evaporation in inches	9.18	9.35	14.97	19.53	22.75	18.99	10.23	6.70	7.38	10.20	10.95	8.93
A H M E D A B A D												
Barometric pressure reduced to 32°F	29.86	29.82	29.75	29.66	29.59	29.45	29.42	29.49	29.60	29.72	29.81	29.86
Mean wind velocity in miles per hour	1.94	1.94	2.00	2.11	2.80	3.14	2.74	2.28	1.83	1.48	1.83	1.94
Humidity %	36.0	40.0	35.0	37.0	47.0	59.0	74.0	77.0	71.0	54.0	42.0	39.0
Vapor pressure in inches of mercury	0.280	0.308	0.340	0.449	0.657	0.786	0.871	0.843	0.787	0.560	0.367	0.300
Mean monthly evaporation in inches	9.30	7.84	12.09	14.40	16.22	12.15	6.63	5.05	5.79	8.31	9.09	8.80

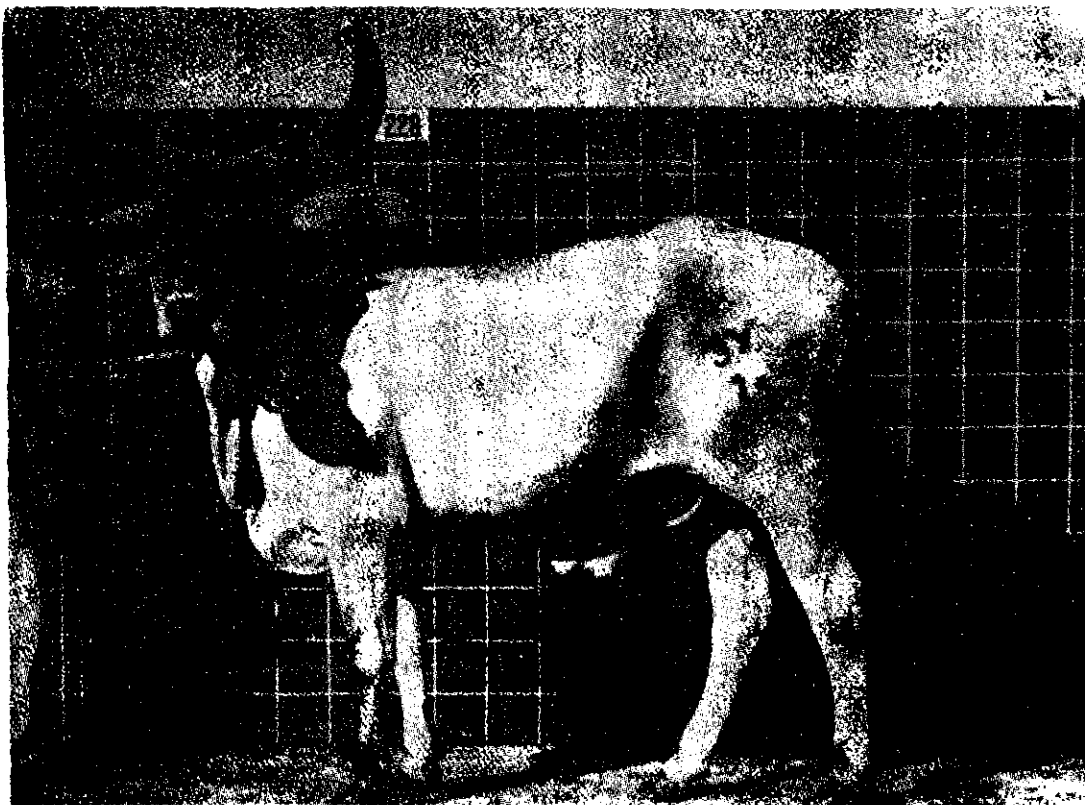
Indian Meteorological Department. Scientific notes Vol. VI. No. 61, pages 29 and 31.

Vegetation

Scrub forests and grazing areas are found in the north and northwest part of the tract. Common trees to be found are *Acacia catechu*, *Zizyphus jujuba* and *Boswellia thurifera* and *Ficus religiosa*. Prominent grasses found in the area are *Andropogon annulatus*, *Andropogon contortus*, *Ischaemum rugosum* and *Polytoca barbata*. Wherever pasture is available it is seasonal



FIGURE 14. The Kankrej breed is very highly prized in its native home for the production of fast, powerful draft bullocks. Above: a Kankrej bull. Below: a Kankrej bullock.



only. The growing season is from July to October. Pastures which are not grazed are usually harvested during the months of October and November, when the grasses are usually dry and coarse, and less nutritious than during the active growing season.

The low-lying area of the tract is flooded with 3 to 4 feet of water retained by embankments around the fields and is used for paddy cultivation when the water goes down. In some parts wheat is also cultivated when the water dries up completely. Usually in the black soils, rice, wheat, millets, sorghum or sugarcane are grown. In the light soils, pulses, oilseeds, sorghum and millets are extensively grown. Of the oilseeds, castor, rapeseed and sesamum are common. In the sandy areas palmyra palm is also cultivated. *Cyamopsis psoralioides* or *Cyamopsis tetragonoloba*, locally known as Guar, is a legume extensively cultivated and the seed is used as a cattle feed. Cotton seed and oil cakes are widely used as concentrates. No fodder crops as such are grown for cattle feeding and only the stovers and straws are used as stored roughages.

Management Practices

Kankrej cattle have a very important place in the agricultural economy of the whole of Gujarat and Saurashtra regions of Bombay Province. Bullocks of this breed are the chief motive power for all agricultural operations and for road transport in rural areas. But the majority of cultivators depend on professional breeders for the production of cattle.

In the past, the Kankrej breed has been developed mainly by professional breeders. Until recently these breeders were solely dependent on their cattle, but as more of the pasture lands were brought under cultivation the breeders had to settle down and pay attention to the cultivation of crops. Principal communities associated with the breeding of Kankrej cattle both in Gujarat and Kathiawar are the Rabaris, the Bharwads, the Maldharis, the Ahirs and the Charans.

The Rabaris and the Bharwads are the main cattle-breeding communities in Gujarat and it is estimated that practically 90 percent of the Kankrej cows in northern and central Gujarat belong to these communities. The villagers usually keep their cattle loose and seldom tied, each breeder making a paddock of thorns near his house in which the cattle are kept at night, from

which they are taken out for grazing in the day time. During the rainy season, when the village pastures offer some grazing, the cattle are kept in the village, but during dry months the cattle, particularly dry cows, young stock and breeding bulls, are taken miles away from home in search of fodder, going as far as south Rajputana in search of grazing. The Rabari and Bharwad breeders seldom store fodder for periods of scarcity.

Calves are not separated from cows until weaned by their dams. Breeders take great pains in selecting and caring for male calves to be retained for breeding. Other male calves are sold at ages varying from 6 to 12 months, being castrated and reared as bullocks for cultivators.

Physical Characteristics of the Breed

The Kankrej is one of the heaviest of the Indian breeds of cattle, and, being of all-India importance, is described by the Indian Council of Agricultural Research (Ware, 1938).

Table 3. Average Measurements of Kankrej Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight in pounds (at birth - 46.4)	388.0	538.0	929.0
Length from shoulder point to pinbones, in inches	42.9	48.7	55.0
Height at withers, in inches	42.5	47.2	51.5
Depth of chest, in inches	20.0	22.2	26.0
Width of hips, in inches	12.4	14.5	20.0
Heart girth, in inches	51.4	59.2	70.0

MEASURE	At one year	At two years	Mature bull	Mature bullock
<i>Males</i>				
Weight in pounds (at birth - 51.2)	396.0	551.0	1 357.0	1 222.0
Length from shoulder point to pinbones, in inches	44.9	46.9	62.7	63.2
Height at withers, in inches	44.7	48.1	62.2	59.2
Depth of chest, in inches	21.4	21.6	30.2	31.8
Width of hips, in inches	12.9	14.2	22.5	23.1
Heart girth, in inches	53.1	59.2	79.0	77.5

Data collected at Northcote Cattle Farm, Chharodi, Bombay State, India.

Color varies from silver gray to iron gray or steel black. Newly born calves have rusty red-colored polls, this color disappearing within 6 to 9 months. Forequarters, hump and hindquarters are darker than the barrel, especially in males. The switch of the tail is black in color. The forehead is broad and slightly dished in the center. The face is short, and the nose looks slightly upturned. The strong lyre-shaped horns are covered with skin to a higher point than in other breeds. The ears are very characteristic, being large, pendulous and open. The legs are particularly shapely and well-placed and the feet small, round and durable. They are active and strong. The hump in the males is well developed and not so firm as in some breeds. The dewlap is thin but pendulous and males have pendulous sheaths. Pigmentation of the skin is dark and the skin is slightly loose and of medium thickness. Hairs are soft and short.

Functional Characteristics of the Breed

Kankrej cattle are very highly prized as fast, powerful draft cattle. They are also fair producers of milk. The average milk production of Kankrej cows, based on records of performance at recognized farms in India during 1936-37 to 1939-40, is shown in Table 4 and of a herd at Chharodi in Table 5.

Table 4. Average Production of Kankrej Cattle at Recognized Farms in India

YEAR	No. of records averaged	Average lactation yield, pounds	Average lactation length, (days)	Average dry period, (days)
1936-37	54	3 232	305	184
1937-38	54	3 159	303	178
1938-39	38	3 161	315	144
1939-40	11	2 965	366	180

Memorandum - Ministry of Agriculture, Government of India. (Anonymous, 1950.)

**Table 5. Production of Kankrej Herd at Chharodi
(Bombay State, India)**

PRODUCTION	No. of animals	Quantities produced, lbs.	Fat %	Days in milk	Average calving interval days	Average no. of lactations during life
Average	33	2 868	4.56	279	499	8.5
Superior	17	4 392	4.69	336	499	7.5

Communication from the Director of the Institute of Agriculture, Anand, Bombay.

Frequency distribution of 348 Kankrej records of milk production from Anand and Chharodi Kankrej cattle farms during 1941-44 is as follows:

Below 1,500 lbs.	67
1,501 - 2,500 lbs.	85
2,501 - 3,500 lbs.	97
3,501 - 4,500 lbs.	62
4,501 - 5,500 lbs.	32
Above 5,500 lbs.	10

Performance records given in Tables 6 and 7 which follow refer to additional milk production performance of Kankrej cattle maintained at Chharodi and Anand respectively during the period 1941-1951. At Chharodi the cattle are maintained on semi-ranching conditions while the cattle at Anand are maintained under superior conditions of feeding and management.

**Table 6. Milk Production of Kankrej Herd at Chharodi,
Bombay State, for the Period 1941-1951**

CLASS OF COWS	No. of cows	No. of lactations	Average milk yield per lactation, pounds	No. of days in milk	No. of days dry	Average calving interval (days)
Selected cows .	40	121	4 443	371	153	524
Average cows .	45	91	2 665	307	191	498

Data supplied through the Indian Council of Agricultural Research.

**Table 7. Milk Production of Kankrej Herd at Anand,
Bombay State, for the Period 1941-1951**

CLASS OF COWS	No. of cows	No. of lactations	Average milk yield per lactation, pounds	No. of days in milk	No. of days dry	Average calving interval (days)
Selected cows .	22	57	4 893	362	117	479
Average cows .	13	49	3 067	252	144	396

Data supplied through the Indian Council of Agricultural Research.

The average age at first calving estimated from 294 calving records was 48.47 months, variation being from 33.1 months to 78.27 month—data supplied by Ministry of Agriculture, India. Though cows are bred throughout the year, there is a strong tendency for matings to take place from March to August. The average birth weight of males is 51.24 lbs., based on 255 records, and of females is 46.37 lbs., based on 287 records.

Average age at first service in males kept for breeding was calculated to be 34.4 months, over 50 records. Bulls are quick breeders and have an active breeding life of about 9 years, from 7 records. Male calves not required for breeding are castrated between 6-12 months of age, and are put to work when they are 3 to 4 years of age and weigh about 800 to 900 lbs.

Kankrej bullocks are noted as good draft animals, being very fast in cart work yet very powerful for hauling heavy loads and for field work. The gait of the Kankrej is peculiar to the breed, smooth in action with a very long and even stride. A pair of bullocks will haul about 1,400-2,000 lbs. in an iron-tired cart on a rough road, while on a good road they can haul up to 4,000 lbs. in carts with pneumatic-tired wheels. They can cover a distance of 25 miles in 10 hours, and shorter distances at the rate of about 3 miles per hour. They are used for all kinds of field work such as plowing, harrowing, threshing, transportation, drawing water from wells, etc. Usually they work from 8 to 10 hours a day.

As the breed is not used for meat purposes in India, information is not available on its meat qualities. However, the breed shows excellent potentialities for beef production and has been used for this purpose in Brazil and the Gulf Coast region of the United States of America.

A. regards resistance or otherwise to disease, it has been observed that they are resistant to Tick fever and also they show very little incidence of contagious abortion and tuberculosis, though no extensive studies are available to substantiate these observations regarding the latter two diseases. It has been noted that the bullocks are apt to suffer from cancer of the horn.

No specific genetic traits have been studied. It has been observed, however, that red color is recessive (Patel, 1945), and occasionally calves having red color are born.

Performance in Other Areas

Grading-up in India

In some parts of India the breed is used for grading-up local cattle, particularly in South Gujarat, Karnatak and Khandesh areas of Bombay State. It is also used in Ajmer-Merwara of Rajasthan, India. No records are available showing the results of grading-up work in other parts of India, but observations reveal that the grades are on the average better bullocks as well as better milkers than the local cattle. In all the areas mentioned above the cultivators are relatively prosperous and hard-working and are anxious to feed and care for better bullocks.

Brazil

Kankrej cattle, known in the Americas as Guzerat¹, were exported to Brazil as early as 1870. Fairly large consignments were exported in 1914. They are located mainly in the region of Central Brazil, especially in the States of Minas Gerais, São Paulo, Goiás, and Mato Grosso. There were some subsequent consignments but importation into Brazil was prohibited in 1921. They have been used for pure-breeding as well as for grading and cross-breeding, and have also entered into the formation of the Indubrasil breed of cattle which has been developed in Brazil.

Purebred Kankrej cattle are maintained at the Government's experimental livestock breeding station near Uberaba for improvement and study (Veiga, 1949). The station is located in

¹ See Figure 15.

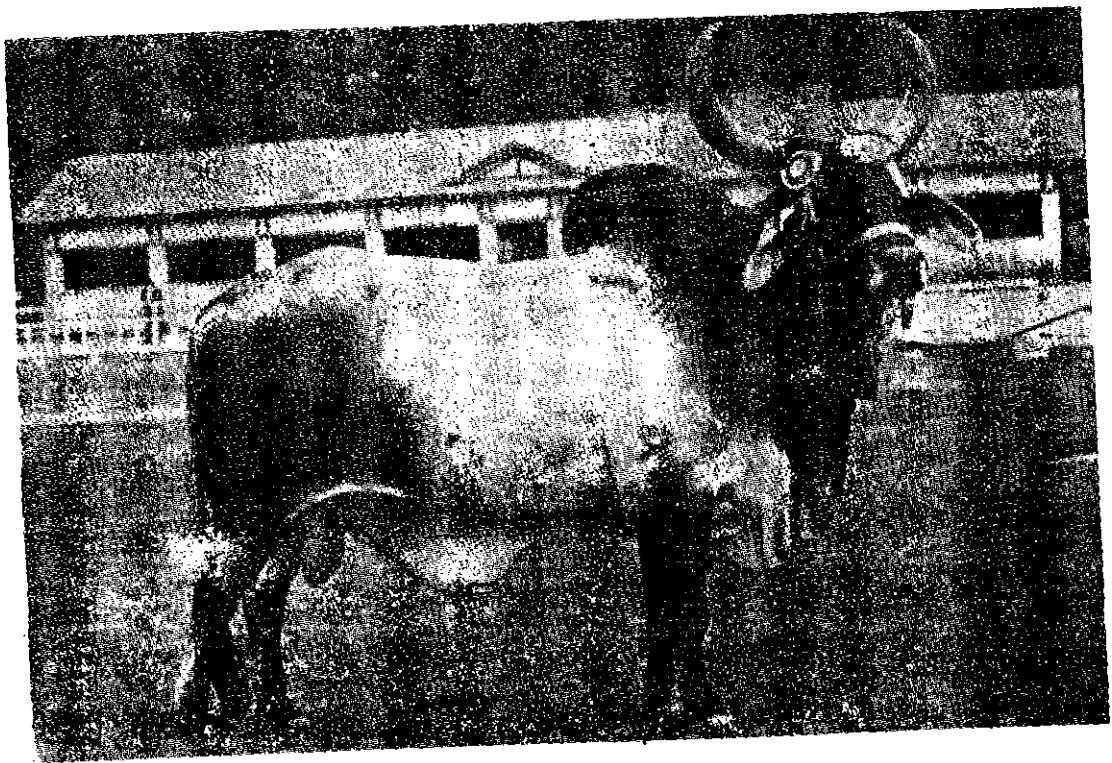


FIGURE 15. Kankrej cattle, which are known as "Guzerat" cattle in Brazil, have entered into the formation of the Indubrasil breed. Above: a Kankrej bull in Brazil. Below: a group of Kankrej steers in Brazil.



a zone of semi-humid tropical climate. The annual mean temperature is 72.0°F. It is 70°F. in the dry season and 73.5°F. during the rainy season. August is the driest month in the year with 55 percent of relative humidity. The annual mean precipitation of the region is 64.4 inches, January being the rainiest month with 12.8 inches of rain on the average.

The calving season usually begins by the middle of February and continues up to the beginning of November. Calves are usually left with the cows on pasture. Male calves are put on additional feed when they are six months old. This feed usually consists of ground millet, rice or wheat bran and cotton, the mixture having 14 percent protein. When the calves are about 8½ to 9 months old they are weaned and separated into sex groups. Bulls are allowed to breed when they are about 24 months of age, and heifers when they are 24-27 months old.

Weights of animals maintained at this station are given in Table 8.

Table 8. Average Weight of Kankrej Cattle in Pounds

A G E	Male	Female
	A	B
At birth	64.2 ± 2.7	61.7 ± 2.2
3 months	173.3 ± 4.6	155.5 ± 5.3
6 months	303.2 ± 9.9	239.9 ± 4.4
9 months	443.0 ± 15.4	384.3 ± 11.5
12 months	549.9 ± 21.5	473.0 ± 15.4
15 months	621.4 ± 35.1	532.5 ± 17.2
18 months	800.9 ± 43.4	699.9 ± 17.2
21 months	909.3 ± 39.2	678.9 ± 21.6
24 months	1006.1 ± 37.5	751.0 ± 17.6
Daily gain in weight since birth until 24 months	1.308	0.975

Numbers sampled are shown in brackets. From figures of the Government's experimental livestock breeding station near Uheraba.

In most of the Brazilian regions Kankrej are used for beef as well as for milk. They are mostly raised on grassland and are ready for slaughter at the age of 3½ years.

In an experiment undertaken at the "Laboratorio di Genetica Animal" in São Paulo (Villares, 1943) to find out the influence of the environmental temperature on body temperature,

it was observed that the Kankrej Cattle (average of 7 animals) registered average body temperatures of 101.0°F. and 102.0°F. when atmospheric temperatures were 70.5°F. and 87.0°F. This may be compared to the body temperature of European breeds of cattle (average of 89 animals representing 6 breeds) 101.2°F. and 103.5°F. when atmospheric temperatures were 69.5°F. and 87.0°F.

United States of America

Numerous strains of cattle from India are bred in the Gulf Coast region of the United States, where they are commonly referred to collectively as Brahman cattle (Black, 1938). Kankrej cattle (or Guzerat as they are generally known in the United States) have been popular since 1924. Gulf Coast breeders have used Brahmans to improve their grade and nondescript local cattle by crossing. Breeding investigations are being conducted by the U.S. Department of Agriculture at the Iberia Livestock Experiment Farm, Jeannerette, La., to develop a strain from Brahman-Angus that would breed true for good beef type showing high adaptability to the region. The Brahman cattle used in this work contained a high proportion of Kankrej blood.

The Gulf Coast area is subtropical and has a high rainfall. Mean monthly temperatures and average rainfall calculated from records at the farm are given in Table 9. The averages were calculated from figures over a 16-year period (1932-47) (Baker and Black, 1950).

Cattle on the Iberia Livestock Experiment Farm are managed according to good range practice. Native and improved pastures are used to the best advantage. Supplemental feeds, such as grass silage, hay, cottonseed meal, are given for 60 to 90 days in the feed lot and on pastures late in the winter and early in the spring. The cows are bred to calve when they are 3 years of age. Calves are weaned when 6 to 8 months of age. Information on average weight of females, some beef production data and also heat tolerance coefficients, according to the formula evolved at this station, are given in Tables 10, 11 and 12.

**Table 9. Monthly Average Temperatures and Rainfall
at Iberia Livestock Experimental Farm**

MONTH	Average temperature, °F.	Average rainfall, inches
January	54.3	4.9
February	56.6	3.9
March	61.6	5.0
April	68.7	3.9
May	75.0	5.3
June	80.2	6.5
July	81.5	8.0
August	82.0	6.4
September	77.9	5.3
October	68.4	2.5
November	59.4	4.3
December	53.9	4.8
Total rainfall		60.8

**Table 10. Average Weights, in Pounds, of Female Cattle
from Birth to Six Years of Age (1932-46)**

BREEDING OF CATTLE BRAH- MAN ANGUS	AT BIRTH			AT 6 MONTHS			AT ONE YEAR			AT FOUR YEARS		
	No.	Wt.	S.D.*	No.	Wt.	S.D.*	No.	Wt.	S.D.*	No.	Wt.	S.D.*
Half-breds, 1st genera- tion	36	66.2	8.84	56	349.5	42.94	50	560.6	79.68	47	766.4	93.86
Half-breds, 2nd gene- ration	21	61.6	10.32	21	375.2	51.60	14	520.4	88.28	9	732.2	102.08
Quarter-breds, average	96	62.2	10.13	96	375.1	46.10	90	580.5	71.13	84	753.3	80.59
Quarter-breds, 2nd generation	50	60.6	10.71	50	356.2	43.17	43	503.4	80.18	34	672.9	82.91
Three-eighths breds, average	48	63.5	10.61	48	377.9	43.41	43	493.8	82.60	35	683.0	80.23
Three-eighths, 2nd generation	15	63.1	13.20	15	374.3	44.53	14	478.2	73.19	9	685.9	74.54
	AT TWO YEARS			AT THREE YEARS			AT FIVE YEARS			AT SIX YEARS		
Half-breds, 1st gene- ration	29	895.9	101.44	22	1 011.7	118.88	20	1 032.5	96.81	18	1 047.8	85.03
Quarter-breds, average	56	878.7	76.92	34	895.1	83.93	30	968.7	102.50	25	979.0	125.40
Quarter-breds, 2nd generation	9	757.2	93.11									
Three-eighths breds, average	13	801.5	98.96	5	913.0	84.08	4	955.0	79.27	4	978.9	42.50

Source: Baker and Black, 1950. * S. D. - Standard Deviation

Table 11. Average Beef Production Data for Cross-Bred Steers of Brahman-Angus Breeding Fed to a Final Weight of 750 Pounds

ITEM	Half-bred 1st gen.	Half-bred 2nd gen.	Three- eighths - bred, 1st gen.	Quarter - bred back cross gen.
Steers, number	15.0	5.0	7.0	22.0
Birth weight, in pounds	71.0	65.0	59.0	62.0
Weaning weight, in pounds	454.0	453.0	435.0	444.0
Gain from birth to weaning, in pounds	383.0	388.0	376.0	382.0
Age when weaned, in days	232.0	227.0	252.0	237.5
Daily gain to weaning, in pounds . .	1.70	1.71	1.49	1.61
Final weight, in pounds	754.0	754.0	748.0	752.0
Cold carcass weight, in pounds . . .	414.0	415.0	384.0	411.0
Gain on feed, in pounds	290.0	300.0	313.0	308.0
Period on feed, in days	235.0	233.0	261.0	257.0
Daily gain on feed, in pounds . . .	1.27	1.29	1.20	1.20
Efficiency ¹	11.32	11.32	10.86	10.45
Carcass grade ²	19.0	18.8	17.1	17.8
Carcass yield ³ , percent	54.91	54.51	51.37	54.64
Age at slaughter, in days	467.5	459.2	513.0	494.1

Source: Baker and Black, 1950. ¹ Gain per 100 pounds' digestible nutrients consumed. ² Prime, 1 to 6; Choice, 8 to 12; Good, 14 to 18; Commercial, 20 to 24; Utility, 26 to 30; Cutter, 32 to 36. ³ Based on cold-carcass weights divided by final weights.

Table 12. Summary of Heat-tolerance Results for Females in Brahman-Angus Cross-Bred Lines

BREEDING GROUP	HEIFERS				MATURE COWS			
	YEARLINGS		2 YEARS OLD		DRY		LACTATING	
	Num- ber	Heat tolerance, coefficient	Num- ber	Heat tolerance coefficient	Num- ber	Heat tolerance coefficient	Num- ber	Heat tolerance coefficient
Half-breds	12	81.25	11	86.45	13	87.77	32	84.66
Quarter-breds	84	80.06	63	85.46	23	89.31	49	83.63
Three-eighths breds	47	80.98	32	86.34	10	88.85	15	84.80

Source: After Baker and Black, 1950. ¹ A low heat-tolerance coefficient signifies a high body temperature; a high coefficient, a low body temperature.

The Santa Gertrudis breed of beef cattle evolved in the

United States of America has Kankrej (Guzerat) blood in its make up (Rhoad, 1949).

Formosa

During Japanese occupation of the island, Kankrej cattle were imported during 1921 and subsequent years. As draft animals they are greatly appreciated by the Formosan sugarcane farmers.

Mauritius

Sugarcane estate owners imported Kankrej particularly for the production of draft animals, but no data have been published regarding the results.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are approximately 500,000 Kankrej cattle in Gujarat (Bombay State) in a total population of 1,300,000 cattle. The number is steadily increasing. The following may be contacted for further information regarding the breed and the availability of stock:

1. - Livestock Expert to the Government of Bombay, Poona, India;
2. - Director, Institute of Agriculture, Anand, Bombay, India;
3. - Animal Husbandry Commissioner to the Government of India, New Delhi, India;
4. - Secretary, Kankrej Cattle Breeding Society, Sanand, Ahmedabad District, India.

In Brazil, where some pure stock is maintained, the following agencies may be contacted for further information:

1. - Departamento de Producao Animal, Divisao de Zootecnia, Postal Box 215-B, São Paulo, Brazil;
2. - Sociedade Rural do Triangulo Mineiro, Postal Box 39, Uberaba - Minas Gerais, Brazil.



FIGURE 16. Kenwariya or Kenkatha cattle, bred beside the river Ken, resemble the Malvi breed. Left: a Kenwariya bull.



Right: a Kenwariya cow: they are poor milkers.



Left: a herd of Kenwariya cattle: they are small, sturdy and powerful draft animals.

KENWARIYA

Origin

The Kenwariya cattle¹, also known as Kenkatha, take their name from the River Ken, for they are bred along the banks of this small river in the hilly area of Bundelkhand. The River Ken originates in Vindhya Hills and flows through parts of Madhya Pradesh near Damoh, then enters the Banda district of Uttar Pradesh and joins the River Yamuna. Cattle of the Kenwariya type are also bred in the territories of Panna, Charkhari, Bijawar and Ajaigarh which are part of Vindhya Pradesh. As Malvi cattle are found extensively in Saugor and Damoh districts of Madhya Pradesh which is so near the Kenwariya tract, it seems reasonable to assume that Kenwariya cattle are related to Malvis in this area.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area where the breed is prevalent lies approximately between 78°5' and 81°6' east longitude and between the Tropic of Cancer and 26° north latitude. It is a rugged area transversed by the ranges of the Vindhya Hills, which never rise more than 2,000 feet above sea level. The Bundelkhand area lying southwest of the River Yamuna is non-alluvial in nature, the soils having been formed by the disintegration of the Central Indian hills, while sandstones, limestones and slates are extensively found.

Three types of soils are commonly found in the area. One type is reddish brown in color and very coarse-grained: it is shallow in depth and is poor in plant nutrients, and is usually found on high-lying areas where it produces very poor crops. The second type is brown in color, with greater depth, and is usually underlaid with a zone of calcium carbonate accumulation: it is suitable for cultivation provided manuring and irrigation facilities are available. The third type is dark brown to black in color and is the most fertile soil of the locality.

¹ See Figure 16.

Climate

During the summer, which extends from March to September, the maximum temperatures during the day are likely to exceed 115°F. during the months of May and June. Winters are comparatively mild. Air movement throughout the year is rapid. The average rainfall of the area is 35 to 40 inches. Most of the rainfall is concentrated during the months of July and August. The growing season of the grasses is thus short and they become coarse very quickly.

Vegetation

The whole of the area is known as a millet-growing area. *Andropogon sorghum* and *Pennisetum typhoideum* are extensively grown, also small millets such as *Panicum frumentaceum* and *Paspalum scrobiculatum* are on the poorer soils. Barley, wheat and oil seeds are grown as winter crops in the more fertile areas. A number of pulses such as *Cicer arietinum*, *Cajanus cajan*, *Ervum* (*Lens esculenta*), *Phaseolus mungo* and *P. aconitifolius* are also grown. Straws and husks from these crops are utilized as cattle feeds.

Management Practices

Only a few animals are maintained by each cultivator. Cows and young stock are maintained on grazing only which is scanty and generally consists of coarse grasses of low nutritive value. Bullocks are usually fed good quality straws.

Physical Characteristics of the Breed

The Kenwariya cattle are small, sturdy and fairly powerful, varying in color from gray on the barrel to dark gray on the rest of the body. The head is short and broad and the forehead is dished. Horns emerge from the outer angles of the poll in a markedly forward direction and terminate in sharp points. Ears are sharply pointed and do not droop. The body is short, deep and compact. The back is straight but the quarters are drooping. The limbs are short but powerful and the feet are hard. The hump is well-developed. The sheath is somewhat pendulous and ends with a black tip. The dewlap is moderately heavy. The tail

is of medium-length with a black switch reaching below the hocks. Some physical measurements of animals of this breed are summarized in Table 13.

Table 13. Average Measurements of Kenwariya Cattle

MEASURE	MALE			FEMALE			OX
	1 yr	2 yrs	Ma- ture	1 yr	2 yrs	Ma- ture	Ma- ture
Weight, in pounds	266	408	768	185	254	654	710
Length from shoulder point to pinbones, in inches	32	43	47	30	36	45	46
Height at withers, in inches	39	45	50	38	39	52	50
Depth of chest, in inches	10	11	18	8	10	16	17
Width of hips, in inches	11	18	20	11	12	17	18
Heart girth, in inches	50	56	70	43	46	66	68

Data collected by the Mechanized State Farm, Saidpur, District Jhansi, U.P.

Functional Characteristics of the Breed

Kenwariya animals are very popular for light draft on the road and for cultivation. They are observed to thrive on poor feed. On account of the hilly nature of the region and the poor grazing, only animals which can cover long distances and have strong feet can thrive under such rigorous conditions. Very little factual information is available at present on the functional characteristics of this breed.

Performance in Other Areas

The breed is restricted to the territory mentioned above.

Sources of Breeding Stock and Information Regarding the Breed

The Raja of Ajaigarh has contributed a great deal to the development of the breed in his territory. Further information regarding the breed may be had from the:

1. - Animal Husbandry Commissioner, Government of India, New Delhi, India;
2. - Animal Husbandry Commissioner to the Government of Uttar Pradesh, Lucknow, India.

KHERIGARH

Origin

Kherigarh cattle¹ are closely allied to the Malvi breed (Anonymous, 1908). The Kherigarh breed is mostly found in the Kheri district of Uttar Pradesh, India. Though the horn formation is typical of the lyre-horned Malvi type, the animals of the breed are much lighter in general appearance than the Malvis.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The Kheri district of Uttar Pradesh is located between 27°4' and 28°4' north latitude and between 80°2' and 81°2' east longitude. The district is bounded on the north by the River Mohan, separating it from Nepal, on the east by the Bahraich district and on the west by the district of Pilibhit. The district is studded with many lakes, while in the southwest area there are large shallow swamps.

Kheri is divided by the rivers which flow through the area into different tracts of varying conditions. The southwest region between the Rivers Sukheta and Gomti consists of fertile loam soils. The area between Gomti and Kathna is sandy and is called the Parehar tract; here the best Kherigarh cattle are bred. The most fertile part of the district is along the banks of the River Sarda in the northern region. The predominant soil consists of deep alluvium with occasional nodular limestone.

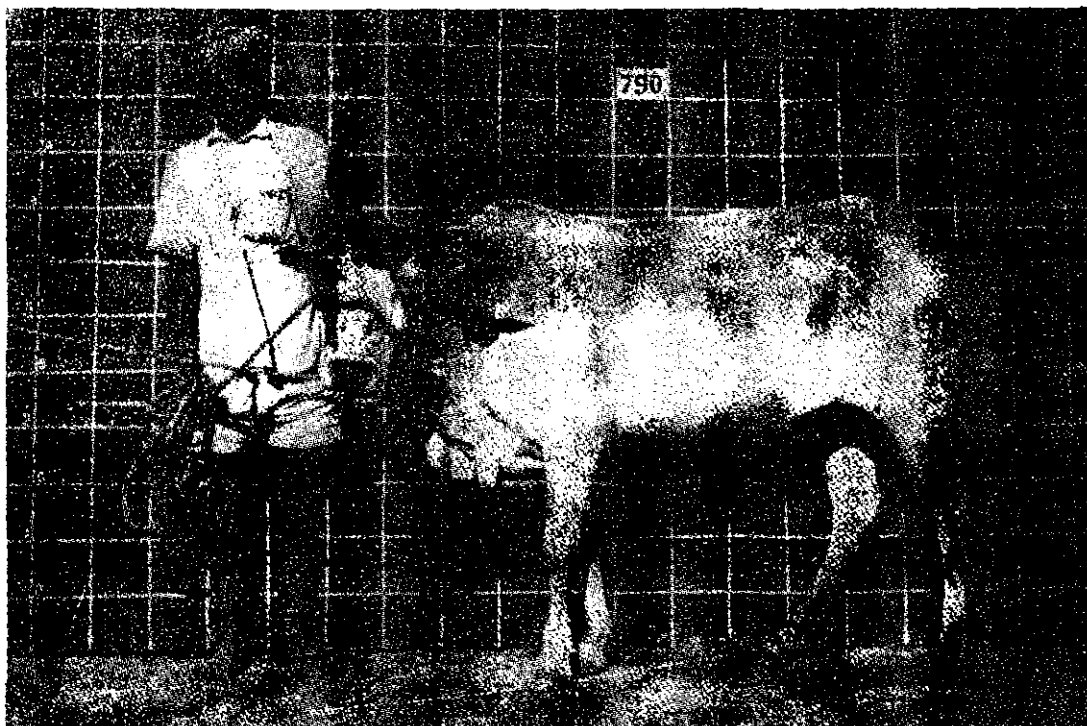
Climate

It is a submontane area having high humidity. During the summer months of May and June the maximum day temperature may go as high as 110° to 115°F. During the winter months the minimum temperatures rarely go below 35°F. The mean annual temperature is around 79°F. Annual rainfall ranges between 45 and 65 inches. In the northeast portion the rainfall is heavier.

¹ See Figure 17.



FIGURE 17. The Kherigarh breed is closely allied to the Malvi: it is found in Uttar Pradesh. The animals are active and good for light draft work, but the cows are poor milkers. Above: a Kherigarh bull. Below: a Kherigarh cow.



Vegetation

The district contains the luxurious vegetation typical of the damp submontane tract. Sugarcane is grown extensively and, among other field crops, rice, maize, wheat, barley, chickpeas, lentils and oilseeds such as mustard and rape are largely grown. On account of favorable rainfall and availability of water from lakes and rivers for irrigation, large portions of agricultural land yield two crops per year. The region has an abundance of coarse grasses and most of the cattle are maintained on grazing.

Management Practices

As the Kheri district supplies large numbers of draft bullocks to the Oudh and Gorakhpur areas of Uttar Pradesh, breeders take great care in rearing male calves. The animals are maintained primarily on grazing. During the hot season large herds are moved into the pasture areas of Nepal for grazing. The cows, being very poor milkers, are not given much attention.

Physical Characteristics of the Breed

Kherigarh cattle are generally white or gray in color. The face is small and narrow. Horns are thin and upstanding and measure 12 to 18 inches in length in bulls; cows usually have smaller horns. The ears are small and the eyes bright. The neck is short and looks powerful. The hump is well-developed in bulls. The dewlap is thin and pendulous and starts from right under the chin and continues right down to the brisket. The barrel is broad and deep. The sheath is short and moderately tight. Limbs are light. The tail is long, ending in a white switch.

Functional Characteristics of the Breed

The cattle of this breed are very active and thrive on grazing only. The bullocks are good for light draft and quick, light transport. The cows are poor milkers. The Government of Uttar Pradesh maintains a large herd of these cattle, but very little information has been obtained on their functional characteristics. It has been observed that the animals mature late and heifers first produce calves when they are about 5 years of

age. Bullocks of this breed are in great demand for light cultivation in the eastern districts of Uttar Pradesh. They are particularly prized by cultivators for their endurance.

It is estimated that they start work when they are about 4 years of age and weigh about 600 pounds. It is claimed that a pair of bullocks can haul about 1 ½ tons of load in a cart to a distance of 30 to 35 miles in a day traveling at times 3 to 4 miles per hour.

Performance in Other Areas

Bullocks of this breed are used in some of the Eastern districts of Uttar Pradesh, but no factual data are available on their performance in comparison with other breeds or types.

Sources of Breeding Stock and Information Regarding the Breed

There are large numbers of cattle in this region of the general conformation and type known as Kheri. Further information regarding the breed may be obtained from the:

1. - Animal Husbandry Commissioner to the Government of India, New Delhi, India;
2. - Animal Husbandry Commissioner to the Government of Uttar Pradesh, Lucknow, U.P., India.

MALVI

Origin

Olver (1938) classifies the Malvi¹ among the grayer, lyre-horned type represented by Kankrej cattle. He mentions that the large Malvi breed resembles the Kankrej in some respects though the horns are inclined more forward in the Malvis than in the Kankrej. He further states that it seems probable that there is a mixture of types in this breed but the face and horns

¹ See Figures 18 and 19.



FIGURE 18. A Malvi bullock. The breed produces massive, compact animals good for draft work.

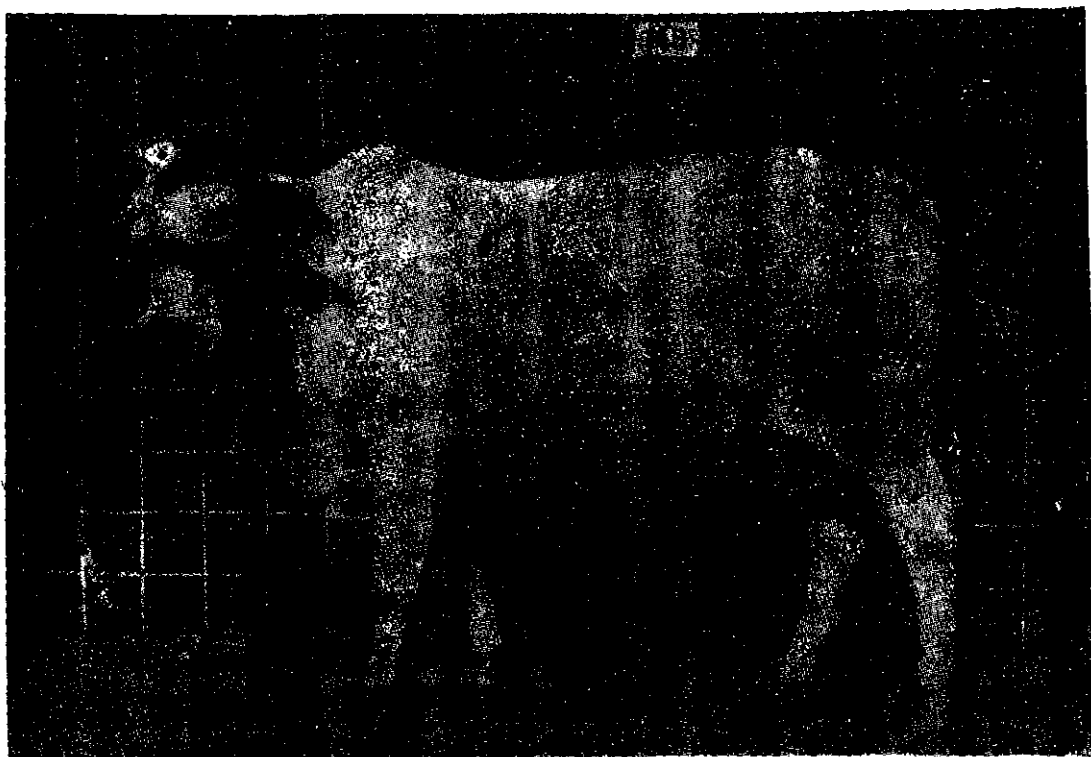
appear to be sufficiently similar to indicate some relationship to the Kankrej. Olver has also drawn attention to the resemblance between the Kankrej breed and the animal depicted on the seal which was recovered from the Mohenjo-daro site (estimated to be of 3,000 B.C.) but Ware (1942) thinks that the resemblance is even more striking between the animal on the seal and the lyre-horned Malvi breed.

Phillips (1944) classifies Malvis among the lyre-horned gray cattle with wide foreheads, prominent orbital arches, the face having a flat or dish-shaped profile. He also lists Kenwariya and Kherigarh in the group with the Malvis. Taking into consideration close similarity between these two latter breeds and Malvis and the geographical proximity of the habitat of these breeds it seems that possibly these latter two breeds are mere strains of the same stock represented by the Malvis.

The Malvi is primarily a draft breed which has developed into different strains which are heavy, light or medium in size, depending on soil conditions. For example, the Umatwara



FIGURE 19. The Malvi is a Central Indian breed with variation in type in different areas: the cows are poor milkers. Above: a Malvi bull.
Below: a Malvi cow.



strain bred in Rajgarh and Narsingharh areas is a slightly heavier type while the type towards Saugar is light. These cattle are mainly bred in the Malwa tract of Madhyabharat State. In the western parts adjoining Rajputana the type bred is larger in size. In parts of Madhya Pradesh where Malvis are bred, it is smaller in size. It is also bred in the northeastern section of Hyderabad state, where it is a popular breed for medium and light draft on the roads and for cultivation.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area where Malvis exist lies between 22°4' and 25°9' north latitude and 74°3' and 78°5' east longitude. It consists of two parts, the Malwa plateau proper, and the adjoining hilly tract of Vindhya hills to the east. The plateau has an average altitude of 1,600 feet above sea level, but the higher plateau land consists of vast rolling plains with flat-topped hills scattered over their surface. Some of these hills rise to about 3,000 feet above sea level. The area has a number of rivers such as Betwa, Chambal, Kalisind, Mahi, Parbati, Sipra, Tons, Ken and Dhasan. Most of these rivers take a very precipitous route and during the monsoon cause extensive erosion. The majority of these flow northwards and westwards and join either the Yamuna or the Ganges rivers in the north.

The major portion of the area is covered with fertile black cotton soil of the heavy loam type. Lighter soils with greater proportion of sand are also prevalent.

Climate

The Malwa plateau on the whole has a dry, moderate climate. During the summer, which extends from March to June, the day temperatures during the hottest parts of May go as high as 105°F., but being dry, are not oppressive. Nights are normally pleasant with plenty of cool breeze. Meteorological observations representing averages of 25 years taken at Nimach and Indore,

and typical of the area for the months of January, May, July and November are presented in Table 14.

Table 14. Meteorological Observations Representing Averages of 25 Years for the Months of January, May, and November for Nimach and Indore

	Height, feet	JANUARY		MAY		JULY		NOVEMBER	
		Mean temp. F.	Diurnal range	Mean temp. F.	Diurnal range	Mean temp. F.	Diurnal range	Mean temp. F.	Diurnal range
Nimach . . .	1 636	63.0	28.6	90.5	26.7	81.0	13.6	70.0	29.5
Indore . . .	1 820	64.4	29.4	89.4	26.8	78.0	12.3	68.9	29.1

Average climatological data for the Malwa Tract are summarized in Table 15.

Table 15. Climatological Data for Malwa

MEASURE OF CLIMATE	AVERAGE DATA BY MONTH											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	79.3	82.8	91.2	99.2	104.4	97.3	85.6	84.1	85.9	88.7	83.6	79.0
Mean minimum temp. °F . . .	49.8	54.6	61.9	71.3	79.0	77.5	74.1	73.2	72.1	65.2	45.2	49.5
Mean daily rela- tive humidity per cent at 0800 hours	57.0	52.0	35.0	27.0	34.0	66.0	88.0	88.0	84.0	61.0	57.0	61.0
Rainfall, in inches	0.24	0.15	0.34	0.22	0.57	5.93	8.89	7.77	7.09	1.3	0.29	0.20

Source: Indian Meteorological Department Government, of India, New Delhi.

Vegetation

The tract is highly cultivated; where no grain has been planted the land is covered with heavy fields of grass affording excellent grazing to cattle. Grazing is also available in areas which are

preserved as forest areas. During the rains the grasses grow fast but the growing period is limited to about 3 to 4 months. The principal cultivated crops are sorghum, maize, millets, *Cajanus cajan*, *Panicum frumentaceum*, *Paspalum scrobiculatum*, *Phaseolus mungo*, *Cicer arietinum*, wheat, lentils, barley and various oil seeds such as linseed, sesamum, mustard and groundnut. By-products from these are utilized as cattle feed.

Management Practices

As every village carries some area reserved for grazing, villagers take their cattle during the daytime to these areas and bring them back to the village folds in the evening. The animals are given supplementary feed such as straw or hay. Only bullocks are given concentrates. Wherever well irrigation is available fodder crops such as sorghum, maize or *Cicer arietinum* are grown for feeding only good animals.

Physical Characteristics for the Breed

Malvi cattle have short, deep and compact bodies. The back is straight but the hindquarters are drooping. The legs are powerful but short and the hooves are strong and black in color. The dewlap is well-developed and the sheath is moderately pendulous. The head is short and broad with dished forehead. The hair around the eye sockets and the eye membranes are black in color. The muzzle is broad, dark colored and slightly upturned. The horns, which emerge from the outer angles of the poll in an outward and upward direction, are strong and pointed. The ears are short and pointed and not drooping. The tail is of moderate length with a black switch reaching to about the fetlock. The color is gray, deepening in the mature male to a dark iron gray almost black on the neck, shoulders, hump and quarters. The cows and bullocks eventually become nearly pure white with age.

Functional Characteristics of the Breed

The breed is well-known for its draft qualities. It is observed to be good on the road for quick transportation. Also the

bullocks work well in the black cotton soil. They show great endurance and ability to carry heavy loads on rough roads. The cows in the village areas are observed to be poor milkers but selected cows on the farm show that they can produce 2,000 to 2,700 lbs. of milk per lactation. Average milk production of Malvi cows at the government farm at Hyderabad has been 2,311 lbs. of milk in 300 days with 175 dry days (Anonymous, 1950). The average age at calving has been observed to be 3 years and 3 months, with a calving interval of about 16 to 18 months.

Performance in Other Areas

The breed has not been exported to other areas, hence no specific information is available on this point. Besides its native home of Malwa the breed is found in the northwest area of Hyderabad State, in the areas around Sangor district of Madhya Pradesh extending up to the borders of Uttar Pradesh and also towards Bundelkhand area.

Sources of Breeding Stock and Information Regarding the Breed

The estimated population of Malvis is around 4,950,000 (Anonymous, 1946). For further information regarding the breed and its availability the following may be contacted:

1. Animal Husbandry Commissioner to the Government of India, New Delhi.
2. Director, Veterinary Services, Madhya Pradesh, Nagpur, India.
3. Director of Veterinary and Animal Husbandry Department, Madhya Bharat, Gwalior, Madhya Bharat, India.
4. Director, Veterinary Department, Hyderabad Government, Hyderabad, India.

THARPARKAR or THARI

Origin

The breed came into prominence during the first World War when some animals were taken to supply milk for the Near East army camps. Here their capacity for production under rigorous feeding and unfavorable environmental conditions at once became apparent. Since then many breeding herds have been assembled in India and Pakistan.

In India and abroad, these cattle are known as Tharparkar¹ since they come from the district of that name in the Province of Sind. The Tharparkar is, however, known differently in its own region. In its native tract and the areas neighboring on it, the breed is called Thari², after the desert of Thar; and it is also occasionally known as Cutchi, because the breed is also found on the borders of Cutch which adjoins Tharparkar to the south. Then again, in the past these cattle have been known as White or Gray Sindhi, since they are native to the Province of Sind and akin in size to the Red Sindhi: this name, however, is no longer used.

Conditions in the desert area have always been precarious and the cattle of the area have migrated to the surrounding richer areas, while, whenever there is a good year and grass is plentiful in the Thari area, cattle from the surrounding Sindhi, Kankrej and Nagori country have come in and thus influenced the Thari breed. The influence of the Kankrej blood, however, has been most predominant because of the breeders' preference for this type, and also, as one legend goes, the Thari breeders of Badin, a village in the south of Thari, lived for some generations in Radhanpur State and later migrated to Badin and brought with them fine Kankrej cattle from Radhanpur occasionally also known as Wadhiyar (Anonymous, 1926 (f)). Kankrej cattle are also stated to have been brought from Palanpur agency by the Thari nomads.

Though the Kankrej influence is predominant, the influence of other breeds is evident depending on the location of the herds. This is emphasized by Williamson (1947) who observed that the

¹ See Figure 20.

² See Figure 21.



FIGURE 20. Tharparkar cattle are found in the desert of Thar, Sind, Pakistan, and also in Kutch, Jodhpur and Jaisatmer, India. They are of medium size and compact, useful as draft animals and the cows are fair to good milkers. Above: a Tharparkar bull. Below: a Tharparkar cow.



Thari is not a homogeneous breed, but that it has the influence of the Kankrej, Red Sindhi, Gir and Nagori breeds. He points out that in the Thari area, towards the western side, the influence of the Red Sindhi is prominent. Towards the northern and north-eastern side the Nagori influence is naturally detected. In other parts Kankrej influence is predominant. A sprinkling of Gir influence is also evident. In spite of this heterogeneity that one finds, the Thari breeders appear to have successfully developed a medium type which is a fairly good milk producer under the poor feeding conditions of the desert area and has great power of endurance and resistance to famine and drought, and which has ability to cover long distances under desert conditions.

It is observed that the typical Thari cattle are found in the areas in the vicinity of Umarkot, Naukot, Dhoro Naro, Chhor, Mithi, Islamkot and Khari Ghulam Shah. They are also produced in the adjoining Indian States of Jodhpur, Jaisalmer and Cutch.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The district of Tharparkar in the southwest portion of Sind Province of Pakistan lies between $24^{\circ}13'$ and $26^{\circ}2'$ north latitude and $68^{\circ}40'$ and $71^{\circ}11'$ east longitude. However, it is the eastern portion of the district which constitutes the Thar desert and is the native home of the Thari breed. The Thar desert region is a vast sparsely populated area measuring about 8,000 square miles. It is bounded on the south by the treeless desert Rann of Cutch, on the west by the alluvial plains of Sind, on the east and northeast by the States of Jaisalmer and Jodhpur of Rajasthan, India, and on the north by the district Nawabshah and Hyderabad.

The whole area consists largely of sand dunes running parallel from southwest to northeast. These dunes or ridges are locally known as *bhits*. Fine sands from the deltaic regions and Rann of Cutch are blown over during the long, hot, windy season towards northeast forming long ridges or dunes in its course. The origin of a ridge usually is a bush or other obstruction which arrests the sand to windward and shelters it to leeward. Once formed, the ridge itself becomes the obstruction and grows as it began with a gentle slope on the side facing the wind and an

abrupt fall on the other. The ridges are naturally irregular and only roughly parallel so that they often enclose sheltered valleys, above which they rise to a height of 100 to 300 feet. These valleys are frequently moist enough to admit cultivation and, when not cultivated, yield crops of grass.

On the sand hills very little rain suffices to sustain a surprising amount of vegetation consisting of *Salvadora*, *Acacia*, types of mimosa and other brush trees. Grasses also spring up with very little rain.

Climate

The desert area is comparatively healthy, being dry and cool. The southern area has a relatively mild, equable climate, while in the north the summers and winters are likely to be a little more severe. Frost is unknown. Temperatures as high as 120° F. have been recorded. The normal rainfall of the area is about 8 inches, most of it falling from July to September. During the months from March to June strong winds blow from the southwest over the desert area. Particularly during May the winds are apt to be violent. Heat, coupled with sand-laden winds, makes life very miserable during this period. Meteorological observations for Hyderabad, Sind, which is just outside the desert area but has very similar climatic conditions, are given in Table 16.

**Table 16. Meteorological Data for Hyderabad, Sind,
Representing Averages for 10 Years**

MEASURE OF CLIMATE	AVERAGE DATA BY MONTHS											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	75.8	81.2	92.5	101.8	107.0	104.5	99.3	95.8	97.3	97.8	88.8	78.6
Mean minimum temp. °F . . .	50.6	54.4	63.8	71.9	78.2	82.0	81.4	79.2	76.4	70.2	58.8	52.0
Mean daily rela- tive humidity per cent at 0800 hours	63.0	72.0	79.0	87.0	88.0	86.0	88.0	90.0	89.0	83.0	68.0	64.0
Rainfall, in inches	0.46	0.44	0.29	0.15	0.06	0.72	3.20	1.50	0.52	0.02	0.08	0.2

Observations taken by the Meteorological Department at Hyderabad, Sind.

Vegetation

In the desert area the rainfall is low and irregular. However, during a good rainy season several nutritious species of grasses spring up profusely and are grazed by cattle. The depressions between the dunes that exist in the area act as catchment areas for rain and are cultivated with quick-growing and drought-resistant crops such as *Andropogon sorghum*, *Pennisetum typhoideum* and *Cyamopsis psoralioides*. The dunes and other areas are covered with brushwood, several types of mimosa and also permanent bushes. Flowers, leaves and pods of *Acacia arabica* are extensively used for cattle feeding. Even the pods and seeds are stored for seasons of scarcity.

Management Practices

The management and feeding of Thari cattle differs in desert regions and in big villages and areas near towns. In the desert they remain in the open most of the time, feeding in the scrub grazing areas, coming to the village once a day in the morning for watering and milking purposes. The villages in these areas comprise a few straw huts located near a well. In these areas there are also some rainwater ponds where cattle go during the daytime, rest for a couple of hours and again go out for grazing. On the whole, however, watering places are too few and far between to serve as regular sources of water. Wells are deep, between 100 and 200 feet.

Stall feeding is not practised in the desert area, so the cattle subsist almost entirely on natural grazing available in the scrub forest areas. Leaves and stems of permanent bushes and shrubs and also loppings of trees like acacia are utilized for feeding cattle. Though famines are frequent, no systematic attempts are made to preserve grasses. This naturally causes heavy mortality among livestock during the famine years. By-products of cultivated crops such as millet (*Pennisetum typhoideum*) and *Cyamopsis psoralioides* are utilized for feeding during dry periods.

In the big villages and near towns there are professional cattle breeders known as Maldars who keep large herds of Thari cattle ranging from 50 to 300 head of cattle. The cattle are sent to the nearby grazing areas during the daytime but are brought



FIGURE 21. In their native home, Tharparkar cattle are known as Thari. They are observed to have some Kankrej blood. Above: Tharparkar bullocks and a bullock cart. Below: A herd of Tharparkars seer in a desert grazing area.



back to the villages or towns in the evening and are kept enclosed in an open space surrounded by thorny bushes. Milking stock is retained in these villages but dry stock is usually sent farther away in the desert areas where more grazing may be available.

Some of the Maldars follow agricultural pursuits and grow crops such as cotton, millets (*Pennisetum typhoideum* and *Andropogon sorghum*), wheat, pulses and cluster beans (*Cyamopsis psoralioides*). The cattle are allowed to graze on the residues of the harvested fields. Other breeders purchase grazing rights after the crops are harvested. During dry weather, Maldars feed their stock on stovers, straws and other by-products of crops.

Milking animals are usually given some concentrates such as crushed cluster beans, oil cakes and broken rice. Calves remain in the villages from birth to about 4 months, after which they are allowed to go for grazing, but are grazed separately and not with adult stock.

Physical Characteristics of the Breed

Average animals of the Tharparkar breed are deep, strongly built, medium-sized, with straight limbs and good feet, and with an alert and springy carriage. As the animals are not handled frequently they are apt to be wild and vicious.

The usual color of the cattle is white or gray. In males, the gray color may deepen, particularly on the fore and hind quarters. All along the backbone there is a light gray stripe. The color of the cattle deepens during the winter months and also when the cows are pregnant. In the Thari tract, in addition to white and gray coat color, black and red or combinations thereof are usually encountered on account of the influence of Red Sindhi and Gir, though breeders do not approve of these colors and usually discriminate against them.

The head is of medium size, the forehead broad and flat or slightly convex above eyes: the front of the horns and face are practically on one plane. The skin between the eyes is often wrinkled, the wrinkles running perpendicularly. The eyes are full and bright. The eyelashes are black and there is a small ring of black on the eyelids.

Ears are somewhat long, broad and semi-pendulous and face forwards. Length in males averages 12.44 ± 0.17 inches, while in

females it is 11.90 ± 0.17 inches. Width in the males averages 6.77 ± 0.22 inches, while in the females it is 6.51 ± 0.09 inches, according to Wahid (1952). Average data on certain body measurements are summarized in Table 17.

Table 17. Average Measurements of Tharparkar Cattle

MEASURE	At one year	At two years	Mature	
<i>Females</i>				
Weight, in pounds.				
Length from shoulder point to pinbones, in inches	37.31± 0.46 (10)	43.7 ± 0.99 (10)	52.46± 0.33 (25)	
Height at withers, in inches . .	39.85± 0.42 (10)	42.90± 0.51 (10)	49.70± 0.40 (25)	
Depth of chest, in inches . . .	19.35± 0.34 (10)	21.9 ± 0.16 (10)	25.54± 0.38 (25)	
Width of hips, in inches. . . .	11.15± 0.23 (10)	13.95± 0.25 (10)	17.86± 0.22 (25)	
Heart girth, in inches	47.10± 0.67 (10)	53.30± 0.95 (10)	65.22± 0.53 (25)	
MEASURE	At one year	At two years	Mature bull	Mature ox
<i>Males</i>				
Weight, in pounds . .				
Length from shoulder point to pinbones, in inches	36.90± 0.78 (10)	47.50± 0.95 (10)	55.10± 0.49 (10)	56.64± 0.74 (10)
Height at withers, in inches	41.15± 0.38 (10)	46.90± 0.78 (10)	51.50± 0.39 (10)	53.45± 0.85 (10)
Depth of chest, in inches	19.29± 0.37 (10)	22.45± 0.41 (10)	23.85± 0.45 (10)	25.35± 0.45 (10)
Width of hips, in inches	11.25± 0.25 (10)	14.35± 0.23 (10)	19.95± 0.39 (10)	21.25± 0.33 (10)
Heart girth, in inches	47.10± 0.89 (10)	60.50± 0.35 (10)	72.70± 0.63 (10)	72.3 ± 0.80 (10)

Numbers sampled are shown in brackets.

Horns are set well apart curving gradually upwards and outwards in the same line as that of the poll with blunt points inclined inwards. A small portion of the skin with hairs extends over the base of the horns. In the males the horns are thicker, shorter and straighter than in the females.

The hump in the males is moderately well-developed, firm and placed in front of the withers. The dewlap is of medium size and the skin is fine and mellow. The sheath in the males is of moderate length, and is semi-pendulous. The navel flap in the females is prominent. The size is variable but on average

measures 6x2.5 inches. Shoulders are light and legs are comparatively short, but in good proportion to the body. The hooves are hard and black, of moderate size and have no tendency to turn out.

The color of the skin is black, except on the udder, under the belly, on the lower part of the dewlap and inside the ears where it is rich yellow. The hair is fine, short and straight, but in the male it is slightly curly on the forehead.

Functional Characteristics of the Breed

The Thari owner always sought for good milkers, as ghee or clarified butter is the main livestock product which gives him a dependable income, provided that the cows are good foragers and can withstand the rigorous conditions of life in the Tharparkar grazing district. He has also paid adequate attention to producing good quality, medium-sized, agile bullocks, thus trying to combine the qualities of milk production and draft ability in the breed. In the village areas the cows are milked only once in 24 hours and the calves are not weaned. Under these conditions it is estimated that they produce about 1,000 to 2,500 lbs. of milk in a lactation.

The government farm at Sakrand, Sind, has been systematically breeding Thari cattle for several years: another farm for Thari cattle has been opened recently at Mirpurkhas, Sind.

At the Sakrand farm weaning is not practiced, and under these conditions the average milk production of 174 samples has been $2,527 \pm 80.39$ lbs. in 298.7 ± 9.74 days. It is estimated that calves must have taken about 1,000 lbs. While a special group of 9 samples produced $6,232 \pm 121.5$ lbs. at the same farm an average of 50 samples was $4,596 \pm 61.9$ lbs.

Data in Table 18 summarize the milk production per lactation for different lactations studied at the Sakrand farm.

Table 18. Production of Thari Cows at Sakrand, Sind, Farm During Different Lactations

	1st	2nd	3rd	4th	5th	6th	7th
Yield in pounds (after calves were suckled)	3 382	3 392	3 642	3 581	3 647	3 228	3 562
Number of lactations	26	34	27	22	17	12	8

The average dry period for cows at the Sakrand farm from an analysis of 117 samples was 232.5 ± 15.2 days, while the average calving interval in 154 calving records was found to be 17.5 ± 0.61 months.

Complete lactation records during the whole of a lifetime were available for 38 cows only and it was observed that the average number of lactations during a lifetime worked out to 5.85 ± 0.25 , although for the entire breed it is estimated to be in the neighborhood of four. The average age at first calving is observed to be 47.24 ± 2.5 months.

Thari bulls, probably on account of poor nutritional levels in the home country, start service at the age of about $3\frac{1}{2}$ years, and it is estimated that the average breeding life of Thari bulls is 7 years, with a range of 5 to 9 years. They are observed to be quick breeders.

Thari bullocks are seldom put to work before they are $3\frac{1}{2}$ years old, when they are given light work and gradually accustomed to heavier tasks by the time they are 5 to 6 years of age. Then they do all types of field work, including working Persian wheels for drawing water, and they are considered to be particularly apt for carting. It is observed that these bullocks require careful handling as they are apt to be vicious. However, animals which are carefully and frequently handled become fairly docile.

The average weight pulled by a pair of Thari bullocks in desert areas is $\frac{1}{2}$ to $\frac{3}{4}$ ton in a cart with iron-rimmed wheels at the rate of about 2 to $2\frac{1}{2}$ miles per hour. The usual distance covered during a day is 18 to 20 miles. In cities and on hard evenly constructed roads a pair of bullocks can pull loads of $1\frac{1}{2}$ to $2\frac{1}{4}$ tons in a cart fitted with pneumatic tires. The daily distance covered varies from 20 to 25 miles in about 8 to 10 hours a day. Single bullocks are worked as pack animals and they usually carry a load of 350 to 500 lbs.

Thari cattle are said to be very hardy and resistant to several tropical diseases but definite data are lacking. Although animals of the breed are excellent foragers and can stand the rigors of climatic and environmental conditions, they have not been used primarily as a source of meat, and breeders have given little attention to meat qualities. No data are available on carcass qualities and characteristics of the meat.

Performance in Other Areas

India

Owing to their capacity for milk production as well as for work and their ability to thrive on scanty fodders, the Tharparkar cattle are now bred on a number of government farms in India. They are also used for grading-up local inferior cattle in certain areas where the farmers particularly like gray or white cattle. Thari cattle are also produced in the States of Jodhpur, Jaisalmer and Cutch in India.

Three of the most important Thari herds are established at Karnal in the Punjab State and at Patna and at Kanke, Ranchi, in the State of Bihar.

Fine performances of the Tharparkar cattle during the first World War in Mesopotamia encouraged the Government of India to experiment on these animals. A herd of Tharparkar cattle was established at Karnal in the Punjab in 1923. Karnal is situated in an area which has mostly sandy loam soil. Summer temperatures are fairly high, reaching 116° F., but summers are usually dry. Annual rainfall is about 25 to 30 inches. The area is noted for its abundance of grasses. At the Karnal farm in the pasture area, *Cynodon dactylon* is predominant and relished by the cattle. Besides pasture, fodder crops such as cowpeas, Egyptian clover, sorghum and maize are also grown. Calves are weaned at birth.

Average milk production, based on 568 lactations from the year 1923 to 1934, at the Karnal farm is shown in Table 19 (Dastur and Kothavalla, 1946).

**Table 19. Average Milk Production of Tharparkar Cows
at Government Cattle Farm, Karnal (1923-1934)**

MEASURE OF PRODUCTION	Purchased cows	Farm-bred cows
Average milk production, in pounds	2 294	3 791
Average days in milk	242	311
Average dry days	147	95

Cows at this farm were milked 4 times a day during recent years and under these conditions the average milk production

has been 4,349 lbs. in 286 days, average percentage of fat being 4.2. Individuals have yielded as much as 9,655 lbs. in 305 days. The average calving interval has been 14½ months, and average age at first calving during recent years, 2 years 8 months and 10 days. Though no particular season has been observed for mating it has been noticed that the maximum number of services have taken place during the months of February and March. Average birth weights of male calves have been 54 lbs. while those of females have been 52 lbs. Males, on average for 20 bulls, start service at the age of 2 years 9 months and 18 days, with an average breeding life of 10 years. They are noted for their quick service.

Bullocks are put to work on the Karnal farm when they are about 3 years old and have attained the weight of about 850 pounds. They are agile and swift, and willing workers. A pair of bullocks will haul a load of 4,000 lbs. in a cart with pneumatic tires. They are able to cover a distance of about 25 miles in a day of 8 hours. Without any load they can take a cart at the rate of 4 to 5 miles per hour. The measurements summarized in Table 20 were recorded at the Karnal farm.

Table 20. Average Measurements of Thari Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	347 (9)	548 (9)	815 (9)
Length from shoulder point to pin bones, in inches	43 (9)	50 (9)	57 (9)
Height at withers, in inches	41 (9)	46.5 (9)	48 (9)
Depth of chest, in inches	18 (9)	22 (9)	24.5 (9)
Width of hips, in inches	13 (9)	17 (9)	20 (9)
Heart girth, in inches	48 (9)	59 (9)	69 (9)

MEASURE	At one year	At two years	Mature bull	Mature bullock
<i>Males</i>				
Weight, in pounds	344 (9)	540 (9)	1260 (9)	956 (6)
Length from shoulder point to pin bones, in inches	42.5 (9)	50 (9)	63 (9)	56.5 (6)
Height at withers, in inches	41 (9)	47.5 (9)	54.5 (9)	52 (6)
Depth of chest, in inches	19 (9)	22 (9)	27.5 (9)	26 (6)
Width of hips, in inches	12 (9)	15.5 (9)	20 (9)	19 (6)
Heart girth, in inches	49 (9)	57.5 (9)	77 (9)	70 (6)

Numbers sampled are shown in brackets.

In addition to Karnal, herds of Tharparkar cattle are also maintained in government farms at Patna and Ranchi in Bihar. Both of these places are located in paddy-growing areas with average rainfall ranging from 45 to 55 inches. The highest average maximum temperature during May and June may exceed 105° F. at Patna. Ranchi is at an elevation of over 3,000 feet.

The data in Table 21 are a summary of the production of Tharparkar cattle bred on the Government farms in India from a Report of the Ministry of Agriculture, India, 1950.

Table 21. Average Performance of Tharparkar Cows

NAME OF FARM	No. of records	Lactation yield - lbs	Days in milk	Days dry
Government Cattle Farm, Patna . .	37	3 080	244	157
Government Farm, Kanke, Ranchi .	21	4 282	277	186
Indian Agricultural Research Institute, Karnal	46	4 869	280	155

The average performance records as reported from recognized farms in India during 1936/37 to 1939/40, are summarized in Table 22.

Table 22. Average Records of Performance of Farm-Bred Cows at Recognized Farms in India during 1936-37 to 1939-40

YEAR	No. of records	Lactation yield, pounds	Days in milk	Days dry
1936-37	89	4 056	281	118
1937-38	109	4 056	267	162
1938-39	90	4 721	270	150
1939-40	100	4 323	268	154

Studies conducted at the Indian Veterinary Research Institute (Bhattacharya *et al.*, 1950; 1952) from 699 Tharparkar cows with 2,425 calvings showed that the average gestation period for female births was 286.89 days while the average gestation period in case of male births was 288.97 days.

It was observed that sex ratio in calves born was 99.83 males for 100 females. The incidence of twinning was 0.46 per 100 calvings.

Sources of Breeding Stock and Information Regarding the Breed

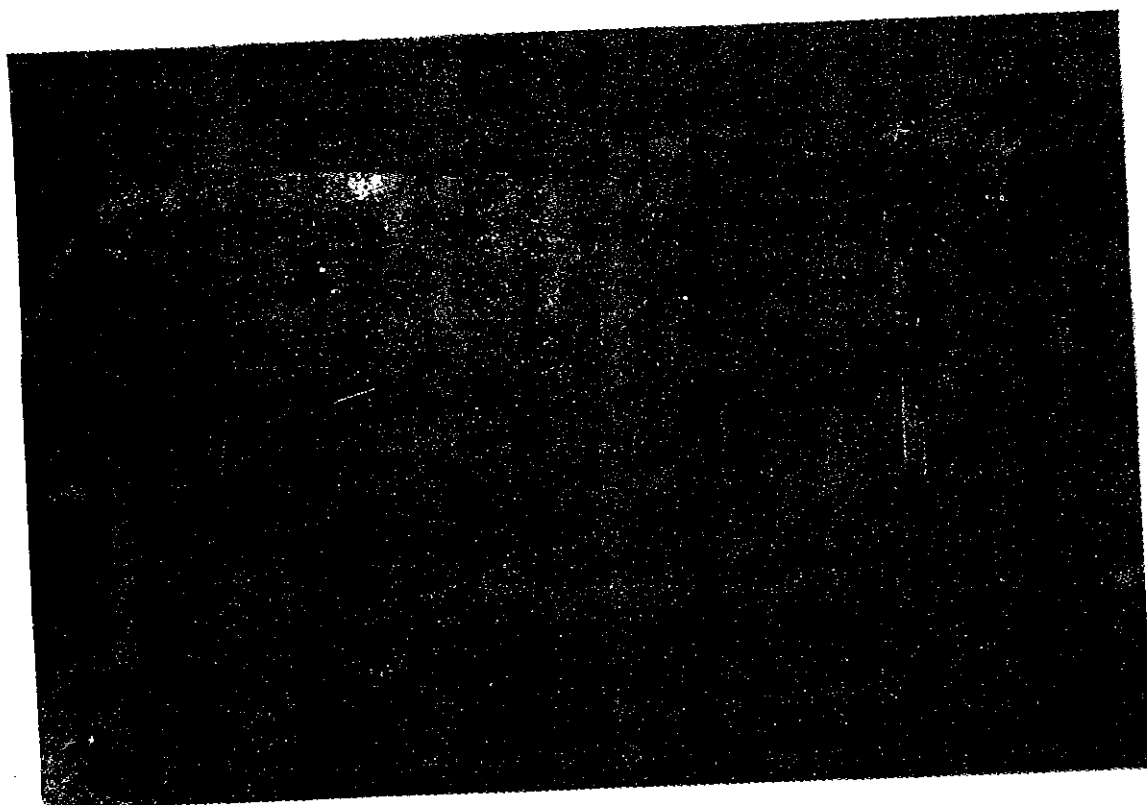
It is estimated that the number of Thari cattle in Pakistan is approximately 652,000 (Livestock Wealth of Pakistan, 1949). The most important places where Thari cattle are found are Dhoro Naro, Mithi, Chhor, Islamkot, Mirpurkhas, Khari Ghulam Shah and Naukot; also in the cattle markets of Badin and Mithichachro. In India the breed may be available in parts of Jaisalmer and Jodhpur States. For further information, the following authorities may be contacted:

1. Animal Husbandry Commissioner, Government of Pakistan, Karachi, Pakistan;
2. Livestock Officer, Sind, Mirpurkhas, Sind, Pakistan;
3. Animal Husbandry Commissioner, Government of India, New Delhi, India.



FIGURE 22. The Bachaur breed, found in Bihar, closely resembles the Hariana. The cows give very little milk. Above: a Bachaur bull. Below: a Bachaur cow.

By courtesy of Mr. S. R. Sen.



Group II

BACHAUR

Origin

Phillips (1944) observes that though the Bachaur¹ has not been classified by other authors it appears to belong to the group of shorthorned white or light-gray cattle. The breed has very close similarity to the Haryana breed. Some think it may be a deteriorated strain of the Haryana. The breed is well-known for its draft qualities and ability to thrive under poorer conditions of feeding.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The breed is found in the Bachaur and Koilpur subdivisions of the Sitamarhi district of Bihar State, India. This area is situated in the north central part of Bihar, lying approximately between 26° and 26°6' north latitude and 85° and 85°6' east longitude, and consists of a low-lying alluvial plain transversed at intervals by ridges of high ground. Beds of nodular limestone are occasionally found in the tract. There are two important rivers in the tract, Lakhandai and Bagmati, the latter originating in Nepal. On account of the generally flat nature of the country, the rivers are subject to floods during the rainy season causing heavy inundations in the area. The major portion of the area is fertile

¹ See Figures 22 and 23.



FIGURE 23. A Bachaur bullock. The breed is well-known for its draft qualities.

By courtesy of Mr. S. K. Sen.

and is intensely cultivated. Large-sized patches of grassland interspersed with alkaline soils are occasionally seen.

Climate

Dry westerly winds are experienced during the months of April to June. Though absolute maximum temperature during summer rarely exceeds 112 to 115°F. the mean maximum ranges from 100° to 105°F. during the months of April to June. Even during the coldest month, which is January, the mean maximum temperature is about 70°F. while the mean minimum is about 48°F. The average rainfall of the area is about 50 to 55 inches, the heaviest rainfall being in the months of July and August. Humidity is on an average 67 percent in March, 66 in April, 76 in May and varies from 84 to 90 percent during other months. Cyclonic storms of great intensity occur during the months of August and September.

Vegetation

No special fodder crops are grown in the area for the cattle except *Lathyrus sativus* in the paddy fields and mustard which is sown thickly as a winter crop and then gradually thinned and used as green fodder. Of the various crops grown, paddy, barley, wheat, chickpeas, mustard, lentils and sugarcane are most important. By-products from these crops such as straws and husks are extensively used as cattle feeds. In the grassland areas, various kinds of grasses prevail which can stand waterlogging conditions of the soil. *Cynodon dactylin*, *Dichanthium annulatum* (*Andropogon annulatus*), *Cenchrus ciliaris*, *Eleusine indica* and *Heteropogon contortus* are commonly found in the area. Grazing is available only from 3 to 5 months in a year.

Management Practices

The Koir and Ahir communities are important cultivators as well as cattle breeders in the area. Individual members of these communities own large herds of cattle which are grazed in the nearby grassland areas, but the majority of the cultivators own only a few animals. Cows having bull calves are not milked at all and the calf is allowed to take all the milk. Young calves are taken for grazing in the areas adjacent to the villages along with older cattle and are observed to thrive well. Breeders pay particular attention to raising bullocks and also are careful in selecting good bulls for breeding purposes.

Physical Characteristics of the Breed

The animals of the breed are compact with straight backs, well-rounded barrels, short necks and muscular shoulders. The forehead is broad and flat or slightly convex. The eyes are large and prominent. The horns are medium-sized and stumpy. Ears are medium-sized and drooping. The hump is compact, firm and medium-sized. The sheath and navel flap are light and close to the body. The dewlap is medium-sized and not so heavy. The feet are fine, well-shaped and strong. The height of a bull behind the hump is 58 to 62 inches and the heartgirth measurements range from 68 to 72 inches. The tail is short and thick and usually does not go far beyond the hocks. The most common color is gray or graying white.



FIGURE 24. Bhagnaris are chiefly used for draft. The cows usually give a fair amount of milk. Above: a Bhagnari bull. Right: a Bhagnari cow.



The Bhagnari breed is also known as Nari, Kachhi and Dajal. Left: an 18 months' old Bhagnari bull. Below: a Bhagnari bullock.



Functional Characteristics of the Breed

The breed is well-known in the area for its medium draft abilities. In the days of the East India Company during the early part of the nineteenth century, large numbers of bullocks of the breed were always in demand for transport purposes. Bullocks of this breed are medium-paced and a pair can carry loads in a cart up to $\frac{2}{3}$ of a ton. The cows are not good milk producers but average quality animals produce 2 to 4 lbs. of milk a day after feeding their calves.

Performance in Other Areas

The breed is used in the adjacent areas of its native home mainly for draft purposes. It is supposed to be doing well as the demand for bullocks is steadily increasing, but no specific records of performance are available.

Sources of Breeding Stock and Information Regarding the Breed

Large numbers of bullocks are usually available in the cattle fair held at Sitamarhi, Bihar, during the months of March and April.

Further enquiries regarding the breed may be made to the

1. Director of Animal Husbandry, Patna, Bihar, India.
2. Animal Husbandry Commissioner, Government of India, New Delhi, India.

BHAGNARI

Origin

The Bhagnari breed of cattle¹ belongs to that general group of cattle described (Phillips, 1944) as having short horns, a long coffin-shaped skull, orbital arches not prominent, a face that is slightly convex in profile, and white or light gray in color. These cattle may have entered Pakistan through the Bolan pass with the Rig Vedic Aryans and spread into the area now comprising

¹ See Figure 24.

part of Kalat State of Baluchistan (Olver, 1938). They are also known by other names, such as Nari, Kachhi and Dajal, though Bhagnari is the officially recognized name. The Bhagnari cattle are well-known in that part of Pakistan for their heavy draft qualities.

There are two types of Bhagnari cattle: a small type bred in the lower valley of the River Nari around Jacobabad and a large type bred in Upper Nari Valley, in the territory north of Jacobabad and extending up to Sibi. The Dajal strain found in the Dera Ghazikhan district of the Punjab, has resulted from the importation of bulls from Kalat State (Diack, 1893-1897). The first bulls were taken to that area about 100 years or more ago.

Conditions in the Native Home of the Breed

Location, Topography and Soils

Kachhi is a division of the Kalat State of Baluchistan where the Bhagnari cattle are principally bred (Minchin, 1907). This area lies between 27°53' and 29°35' N. and 67°11' and 67°28' E. It consists of a flat triangular plain 5,310 square miles in area with its base in the upper Sind Frontier District of Sind and is enclosed by the Marri and Bugti hills on the east and by the Kirthar and Central Brahui hill ranges of the Jhalawan country on the west. On the northeast side of its apex lies the district of Sibi. The principal rivers are the Nari, The Bolan, the Sukleji and the Mula. On entering Kachhi all these rivers are dissipated into a large number of channels spreading over the great alluvial stretches of which the area is composed. These rivers are subject to floods and the flood waters are utilized for irrigation purposes by means of erecting dams in the river beds. These dams all along the-river line are a peculiar feature of the area. Floods usually occur during the months of July and August and also in spring.

The geological structure of the country is uniform, mostly consisting of a level bed of clay burnt by the sun and probably of great depth. The general aspect of the country is desolate and bare, especially those areas which are beyond the reach of river and channel floods. There are patches of desert which have practically no vegetable life. Locally, these areas are known as "pator patto", the largest of which is in the central portion of

the district which is traversed by the Sind-Pishin railway. The village Bhag, from which the breed takes its name is located about 12 miles to the north of the railway station, Belpat, on the Jacobabad-Quetta line.

The soil is extremely productive wherever it can be irrigated. The best soil in the tract is light loam with a moderate amount of sand. Another type of soil prevalent in some parts is light clay on the surface with a subsoil having a quantity of sand. This type is supposed to retain moisture and is largely utilized by cultivators for production of sorghum.

Climate

Climatological data for Jacobabad, which is the nearest station where meteorological observations are made, are summarized in Table 23.

Table 23. Climatological Data for Jacobabad

MEASURE OF CLIMATE	AVERAGE DATA BY MONTHS											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	72.7	78.5	91.5	100.4	111.6	113.9	108.0	103.7	102.3	99.0	87.6	76.1
Mean minimum temp. °F . . .	43.8	49.1	59.9	70.2	79.0	84.9	85.0	82.2	77.0	64.7	52.8	44.9
Highest max. temp. °F . .	103.0	112.0	119.0	126.0	127.0	126.0	117.0	113.0	112.0	112.0	103.0	89.0
Lowest minimum temp. °F . . .	25.0	29.0	37.0	48.0	61.0	70.0	71.0	68.0	60.0	47.0	36.0	31.0
Mean daily relative humidity per cent at 0800 hours	71.0	62.0	58.0	49.0	50.0	66.0	70.0	81.0	77.0	60.0	63.0	69.0
Mean daily relative humidity per cent at 1700 hours	28.0	32.0	27.0	23.0	23.0	27.0	39.0	41.0	37.0	28.0	27.0	32.0

Information from the Meteorological Department, Government of Pakistan.

Kachhi is one of the hottest areas of Pakistan. Scorching winds blow in the summer. Winter lasts from the middle of November to the middle of March, when the morning and evening

air is cool and crisp but during the middle of the day it is hot in the sun. Frost may be expected during November and may cause damage to the crops. Though the area gets summer as well as winter rains the amount of rainfall is very scanty. In average years it may be 8 to 10 inches, and most of it falls during the months of July and August. These are very hot months of the year. Plowing and other field operations are usually carried on after sunset or before 10 o'clock in the morning.

Vegetation

There are no regular pastures or grazing lands in the tract but the land subject to flood irrigation provides abundant grazing after the spring and summer floods and rains. The principal grazing grounds are to be found near Jhal, Chattar, Kotra, Khari, Kunara and Shoran. The pasturage is common to the tribesmen in whose area it lies. The supply of forage is also supplemented by the collection of grasses from the hills. There are about a dozen varieties of good grasses prevailing in the area. *Panicum antidotale* during famine years supplies grain to the poorer population of human beings as well as fodder to the animals. Since this area gets very little rainfall, most of its cultivation is dependent on flood irrigation from rivers. In normal years, three crops are raised and harvested. The first or principal crop is sown in July and August and reaped in autumn. It consists of sorghum, millets and pulses such as *Phaseolus radiatus* and *P. mungo*. All the by-products from these crops, such as stover and straw, are utilized for cattle feeding. The second or spring crop consists of wheat, barley, mustard and rape. The third crop, sown during late spring, depends on the floods in the rivers. Cultivators usually raise fodder sorghum or *Setaria italica* for fodder purposes. Watermelons are also grown during this season.

Management Practices

On account of precarious rainfall conditions and scarcity of regular irrigation facilities, people have come to depend on livestock more than cultivation. The Magassis, Domkis and Rinds are some of the important livestock breeding tribes though none

of them breed animals in large numbers. They are primarily farmers and each one keeps only 3 or 4 head of cattle. On account of the large demand for Bhagnari bulls for draft, as well as for breeding purposes in other areas, the farmers pay great attention to the rearing of males. Actually, a farmer feels that his year is lost if a female calf is born.

Excessive heat and scarcity of drinking water are two great limitations to increasing the livestock production in the area. Farmers usually shift to Sind areas during famine years.

Physical Characteristics of the Breed

The average Bhagnari animal has a long but compact deep body, with a short, powerful neck. The predominant color is white or gray deepening to almost black, particularly on the neck, shoulders and hump of the mature males. In cows, the color becomes slightly deeper during winter or in advanced stages of pregnancy. Bulls of a gray color usually change to white after castration. Gray cattle also show a white stripe along the backbone.

The forehead is usually flat and wide or slightly convex. The convexity is more pronounced in the bulls. Horns are stumpy, well set apart and generally curve outwards and upwards and inwards. They are thick at the base and taper towards blunt points.

Ears are medium-sized, broad, semi-pendulous and facing forwards. The average length in males is 11.75 inches and in females 10.4 inches, while the average width in males is 6.2 inches and in females 5.7 inches. Eyes are bright, full and placid, with black eyelashes. The hump in males is moderately developed and firmly fleshed. The dewlap is of medium thickness, small and never pendulous. In the male the sheath is moderate in length and semi-pendulous. In females the navel flap generally hangs, average size being 6 to 8 inches x 2 to 3 inches. The skin is of medium thickness and slightly loose. The pigmentation is dark. Hindquarters are powerful but sloping. Hooves are black, medium-sized and rounded. They are hard and well-shaped with digits close together. The tail is short, with a black switch.

The average measurements of Bhagnari cattle are summarized in Table 24.

Table 24. Average Measurements of Bhagnari Cattle

Table 24. Average Measurements

MEASURE	At one year	At two years	Mature	
Females				
Length from shoulder point to pinbones, in inches	35.67 \pm 0.47 (12)	43.31 \pm 0.43 (12)	52.8 \pm 0.40 (40)	
Height at withers, in inches	38.5 \pm 0.50 (12)	44.2 \pm 0.38 (12)	51.0 \pm 0.25 (40)	
Depth of chest, in inches	16.8 \pm 0.29 (12)	22.25 \pm 0.40 (12)	25.85 \pm 0.20 (40)	
Width of hips, in inches	9.58 \pm 0.48 (12)	13.04 \pm 0.19 (12)	17.40 \pm 0.17 (40)	
Heart girth, in inches	43.33 \pm 0.40 (12)	51.93 \pm 0.60 (12)	66.60 \pm 0.92 (40)	
MEASURE	At one year	At two years	Mature bull	Mature bullock
Males				
Length from shoulder point to pinbones, in inches	38.25 \pm 0.5 (12)	44.8 \pm 0.77 (12)	61.43 \pm 0.37 (69)	61.94 \pm 1.08 (16)
Height at withers, in inches	42.16 \pm 0.27 (12)	46.8 \pm 0.50 (12)	57.34 \pm 0.23 (69)	59.12 \pm 0.76 (16)
Depth of chest, in inches	19.5 \pm 0.30 (12)	21.8 \pm 0.40 (12)	29.72 \pm 0.61 (9)	31.25 \pm 0.42 (16)
Width of hips, in inches	10.58 \pm 0.20 (12)	12.87 \pm 0.10 (12)	18.94 \pm 0.55 (9)	19.82 \pm 0.38 (16)
Heart girth, in inches	48.0 \pm 0.26 (12)	53.5 \pm 0.44 (12)	74.70 \pm 0.71 (69)	76.80 \pm 0.94 (16)

Numbers sampled are shown in brackets.

Functional Characteristics of the Breed

Bhagnari cattle are primarily used for draft purposes. Little or no attention has been paid to developing the milk producing qualities of the breed. It is, however, observed that under average conditions, cows, after having nursed the calf, yield fair quantities of milk. At the Sibi cattle show the record production per day was as much as 44 lbs. There is a considerable variation in their milk production per lactation, ranging from 1,000 lbs. to 5,000 lbs.

At the government cattle farm for Bhagnari cattle at Dadu, Sind, some records have been obtained. As the calves are not

weaned, milk production figures are only for the actual production after the calves are fed. It is estimated that on an average a calf takes about 1,000 lbs. of milk till weaning. Average production of all tested cows was 1,857 lbs. per lactation, the number sampled being 132. Average production of a special group of 22 cows producing 2,500 to 3,000 lbs. was 2,700 lbs. per lactation, while a small selected sample of 3 cows produced an average of 3,700 lbs. In a study of 128 lactations it was observed that the average lactation period was of a duration of 262 days, while an average of 111 records showed that the dry period was 158 days. An analysis of 131 records showed that the average calving interval was about 397 days.

From records of 28 cows at the Dadu farm it was observed that the average age at calving for the first time was 42.18 months. The minimum and maximum age at first calving observed in this sample was 29 and 50 months, respectively. Average birth weight of female calves was 45.5 lbs., the number of records being 33.

Bhagnari bulls usually start service at the age of about 2 years and 6 months to 3 years. Active breeding life of an average bull from a sample of 17 bulls showed that it was about 8 years (7.96 ± 0.88 years). As a rule Bhagnari bulls are quick breeders.

Bhagnari bullocks are put to work when they are about 3 years of age, although they are not castrated until they are about 4 years old. They are given light work in the beginning but are accustomed to hard work when they have 6 or 8 teeth. As a rule Bhagnari bullocks are very docile, even-tempered and steady workers. It has been observed that these bullocks are particularly useful for heavy draft purposes and in irrigated areas for deep plowing. They are comparatively slow, but this is believed to be amply compensated for by their ability to work for longer hours and pull heavier loads under high temperature conditions.

In the village areas where the roads are dirt tracks only, a pair of bullocks will carry about 1 to $1\frac{1}{4}$ ton of load in an iron-tired cart at the rate of about 2 to $2\frac{1}{2}$ miles per hour. On smooth, hard roads, in pneumatic-tired carts they are observed to carry as much as 2 tons of load at the rate of 3 to $3\frac{1}{2}$ miles per hour. The daily distance covered in a cart varies from 20 to 25 miles.

The bullocks are observed to keep good physical condition while performing continuous work for very long hours. During intensive field operations they work 10 to 12 hours per day,

otherwise they work for 8 to 10 hours a day. In the towns and cities where they work mostly in carts hauling heavy loads they work practically throughout the year. In the field work, depending upon the area, they work 6 to 9 months in a year.

The breed had never been primarily utilized for production of meat but judging from the conformation, heavy liveweight, and tendency to fatten even under poor feeding conditions, it is conjectured that the breed would be quite suitable for beef production.

Bhagnari cattle are said to be hardy and fairly resistant to a number of tropical diseases, but no experimental studies are available to substantiate the statement.

Performance in Other Areas

The Punjab

The Bhagnari breed has been imported to the Dera Ghazi Khan district of the Punjab and utilized for grading-up the local cattle for the last 100 years. The breed, in this new environment, is known as Dajal.

The climatic and agricultural conditions of the Dajal tract are very similar to those in the Bhagnari tract and the breed has been observed to do very well in the Dajal tract for a very long time.

The Government of Pakistan has recently established a Bhagnari cattle breeding farm at Quadirabad, in the Dajal area, to supply superior stock. It is hoped to utilize the draft quality of the breed for some of the neighboring districts of the Punjab.

Sind

In Sind, Bhagnari cattle are in great demand in the irrigated areas on the right bank of the river Indus. In north Sind they are used for most heavy field operations and are very much liked by the cultivators. The Government of Sind has established a Bhagnari cattle farm at Dadu. In the villages of the districts of Jacobabad, Larkana and Sukkur, Bhagnari bulls are used to improve the indigenous cattle.

Sources of Breeding Stock and Information Regarding the Breed

Accurate census figures for Bhagnari cattle in Kalat State are not available. It is, however, estimated that the total number is about 400,000, while the estimates for the Dajal tract are over a million (Anonymous, 1949).

Breeding stock is usually available from the villages of the Kachhi subdivision of Kalat State in Baluchistan. The following villages are specially noted for excellent stock: Mithri, Bhag, Chhelgarhi, Hajishahr and other small villages North of Jacobabad.

There is an annual cattle fair at Sibi in Baluchistan during the month of February where large numbers of Bhagnari cattle are sold. The Deputy Director of Animal Husbandry, Quetta, Baluchistan, may be contacted for help and advice.

Animals of the Dajal strain of Bhagnari are available at the cattle fairs held at Dajal, Dera Ghazi Khan, Multan and Jhang.

Further enquiries regarding the breed may be made to the

1. Deputy Director, Animal Husbandry Department, Quetta, Baluchistan.
2. Animal Husbandry Commissioner to the Government of Pakistan, Karachi, Pakistan.

GAOLAO

Origin

Olver (1938) and Phillips (1944) classify the Gaolao cattle¹ in the group which are shorthorned, white or light-gray in color, with a long coffin-shaped skull, orbital arches not prominent and with a face slightly convex in profile. Olver also observes that the native home of the breed is located along the route taken by the Rig Vedic Aryans from the Northern passes through Central India to the South. There is a close similarity between the Ongole and the Gaolao except the latter are much lighter, with greater agility.

Parmerker observed in 1952 that in the 18th century the

¹ See Figure 25.

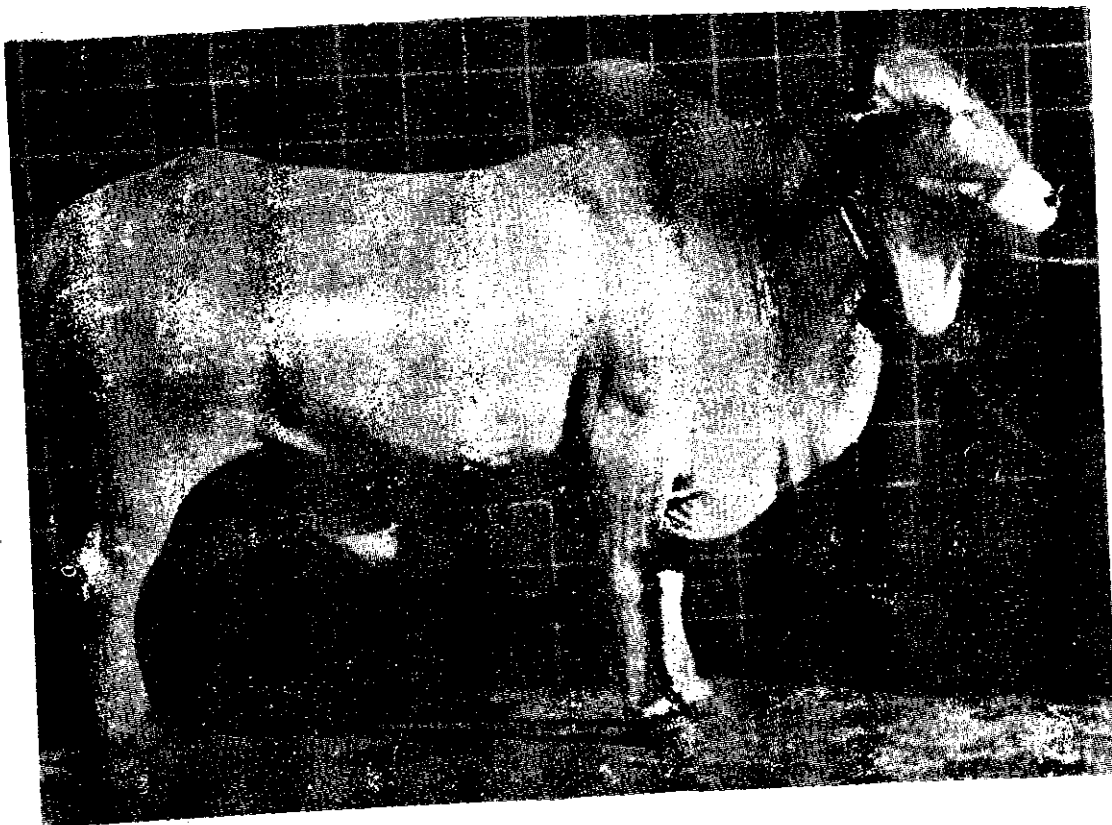
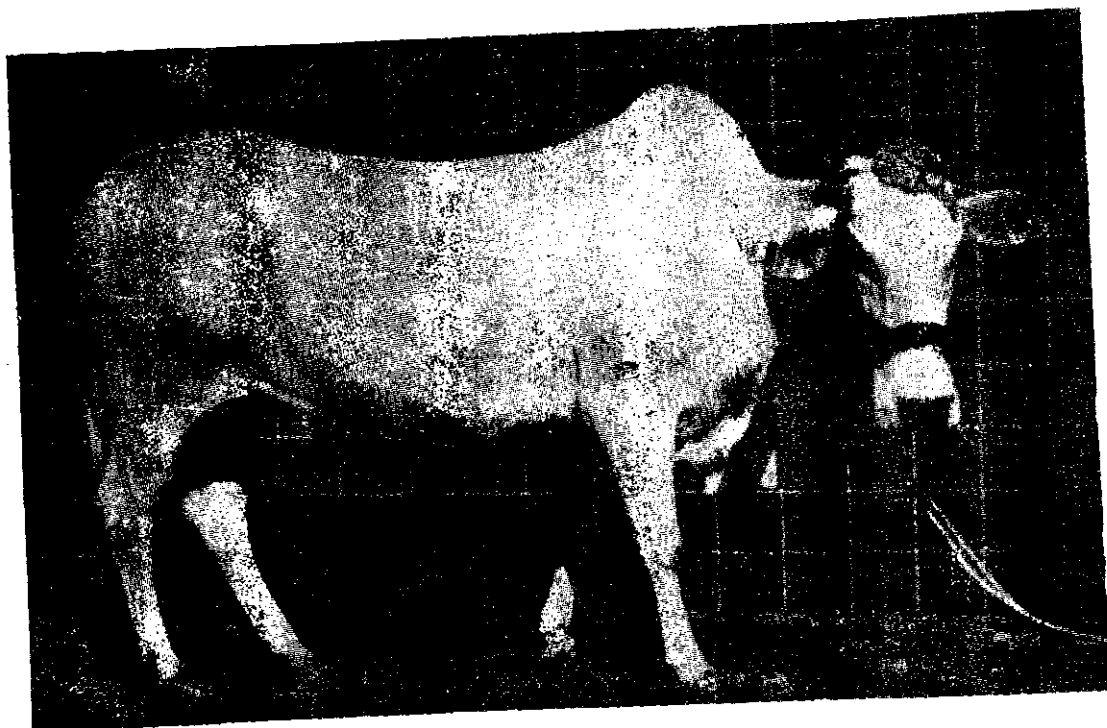


FIGURE 25. Gaolao cattle, found in Madyha Pradesh, closely resemble the Ongole breed. The bullocks are noted for their quick movement, but the cows have only a moderate milking capacity. Above: a Gaolao bull. Below: a Gaolao cow.



Marathas developed this breed into a fast-trotting type suitable for quick army transport in the hilly areas of Gondwana, Madhya Pradesh. It was used mainly for military purposes by the Maratha army when invading the local Gond Kingdom. Old historical records show that the breed had fair milk-producing capacity, but during the last two centuries selection has been directed mainly towards developing a capacity for quick draft. The breed is found principally in the districts of Wardha, Nagpur and Chindwara.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area where most of the Gaolao cattle are bred is hilly and consists of a long strip of land extending from northwest to southeast, the principal rivers being the Wardha and the Wainganga. There are numerous streams, the more important being the Bor, the Kannan, the Dham and the Asoda. All of these have rapid flow eastwards and are observed to cause much erosion. An outlying spur of the Satpura range runs down through the area. Most of the Arvi subdivision, which is supposed to be the center of the best specimens of the breed, is hilly. The southern portion is an undulating plain intersected by streams and broken here and there by isolated hills. The average altitude of the area is about 2,000 feet above sea level.

Nearly the whole area consists of a thin covering of black or brown soil over a sheet of trap rock. This soil varies in depth from 10 feet to a few inches, the average thickness being about 2 feet. The best black soil is found principally in the level ground along the left bank of the Wardha River. In the hilly country of the north, shallow brown soil is found mixed with sand.

Climate

The summer becomes oppressive, particularly during the months from April to July. Winters are very mild. Climatological data for the area are summarized in Table 25, on the next page.

Table 25. Climatological Data for Gaolao Area

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	79.0	82.5	90.8	98.1	102.0	93.6	83.9	81.8	84.8	86.9	82.1	78.2
Mean minimum temp. °F . . .	50.4	54.1	61.3	70.1	76.5	75.2	71.9	70.8	69.4	62.5	54.5	48.4
Humidity per cent at 0800 hrs. I.S.T. . .	70.0	64.0	52.0	41.0	44.0	69.0	83.0	84.0	79.0	65.0	66.0	71.0
Rainfall, in inches . . .	0.93	0.95	0.71	0.41	0.77	6.84	10.58	10.3	7.07	1.76	1.06	0.45

Information from Indian Meteorological Department, New Delhi, India.

Vegetation

The Forest Department has preserved large areas of land at strategic places in the tract for the conservation of soil. These are mainly grasslands for grazing, and harvesting of grass for hay-making is allowed. Grazing is usually available from the middle of July to the end of October. Grasses mature quickly and become coarse and woody. These are harvested and preserved as hay for dry weather.

The following species of grasses are commonly found: *Cynadon dactylon*, *Andropogon annulatus*, *Isiclema* (*Anthistiria*) *wightii*, *Isiclema laxum* (*Anthistiria laxa*), *Andropogon contortus* and *Apluda ruria*. The soil is suitable for growing crops such as sorghum, paddy, cotton, *Cajanus cajan*, *Cicer arietinum*, linseed and groundnut. Sorghum is grown extensively and the seed is used for human consumption while the stover is utilized for cattle. Lentils are also grown.

Management Practices

In general, cultivators do not keep more than six or eight animals but big landlords usually keep much larger numbers. An average big landlord in Arvi subdivision may carry as many as 100 head of cattle in his herd. He usually depends on the grazing that may be available in the nearby grasslands. For dry weather feeding, sufficient quantities of hay and sorghum stover are preserved. Cows and young stock are usually undernourished, but bullocks and young male calves ready for sale are usually

well-fed. Concentrates such as cottonseed, linseed or groundnut cake and rice bran are given.

A great deal of attention is paid to the training of young bullocks, particularly for speed: bullocks hitched to light carts are trained for racing, small wooden prods with sharp iron tips being occasionally used to goad the bullocks to run fast.

Physical Characteristics of the Breed

Gaolao animals are of medium height, of rather light build and tend to be narrow and long. The head is markedly long and narrow with a straight profile usually tapering towards the muzzle and somewhat broader at the base of the horns. The forehead is usually flat, though it appears to recede at the top, giving a slightly convex appearance. The eyes are almond-shaped and placed slightly at angles. The ears are of medium size and are carried high. The horns are short and stumpy, blunt at the points and commonly slope slightly backwards.

The neck is short, with a moderately well-developed hump, which is usually loose and thus hangs on one side. The hind quarters are slightly drooping. Limbs are straight and muscular. Hooves are of medium size, hard and durable, and suited to hard road and hillside work. The dewlap is voluminous but the sheath is only moderately developed. The skin is thin but loose. The tail is comparatively short, reaching only a little below the hocks. Females are usually white and males gray over the neck, hump and quarters. Average data on certain body measurements are summarized in Table 26.

Table 26. Average Measurements of Gaolao Cattle

MEASURE	Mature male	Mature female	Mature ox
Weight, in pounds	950	750	900
Length from shoulder point to pin bones, in inches	47	41	43
Height at withers, in inches	57	49	50
Heart girth, in inches	72	67	60

Data from the Government Cattle Breeding Farm, Garhi, Madhya Pradesh, India.

Functional Characteristics of the Breed

As mentioned earlier, the breed has been developed for fast transportation purposes in hilly country. Within the last 20 years, however, more attention has been devoted to milking qualities, although, on account of poor feeding conditions, heifers calve late, at the age of four years or more. Though there is no regular breeding season, it is said that the majority of the animals breed from February to May and again in the months of October and November. Males start serving when they are about 2½ years old and the active breeding life is about 7 to 8 years. They are observed to be quick breeders. With regard to milk production, it has been observed that the average production of special groups of cows has been 1,800 pounds of milk in 250 days. The average calving interval has been 13 months. Superior animals have produced 2,660 pounds of milk in 381 days, with a calving interval of about 15 months, and an average percentage of fat of 5.5.

Male calves are castrated and trained for light work when they are about 2½ years old and weigh about 600 lbs. Gaolao bullocks, if properly trained, are active and willing workers. With an average load of a half ton in an iron-tired cart, a pair of bullocks can travel 20 to 25 miles a day within 7 to 8 hours actual travel. They are used for all kinds of agricultural work such as plowing, sowing, intercultural operations, threshing, lifting water from wells for irrigation, hauling agricultural produce to the markets, etc. It is estimated that they work for 270 days in a year at the rate of 8 to 10 hours per day.

Performance in Other Areas

It is only recently that the breed has been utilized for grading local scrub cattle in the districts of Yeotmal and Amraoti and Raigarh tract of Balaghat district in Madhya Pradesh, and no data are available on the results.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are about 440,000 head of Gaolao cattle in Madhya Pradesh (Anonymous, 1946). For further information regarding the breed, the following may be contacted:

1. Director of Civil Veterinary Services, Madhya Pradesh, Nagpur, India.

2. Secretary, Go Seva Sangh, Wardha, Madhya Pradesh, India.
3. Animal Husbandry Commissioner to the Government of India, New Delhi, India.

HARIANA

Origin

The Haryana breed¹ belongs to the group of cattle which are shorthorned, white or light gray colored with a long coffin-shaped skull, orbital arches which are not prominent and with the face slightly convex in profile (Phillips, 1944). This type presumably entered through the northern passes with the Rig Vedic Aryans (Olver, 1938). There is close similarity in types amongst the cattle represented by the Bhagnari breed on the one hand and the Gaolao and the Ongole on the other hand. Ware (1942) supports Olver's view that this group entered India with Aryan invaders and further mentions that according to Smith (1923) this invasion occurred between 2,200 and 1,500 B. C. All the breeds represented in this group are located along the route taken by the invaders from the northern passes through Central India to the south, stretching from Kalat in Pakistan to a point on the southeast, a few miles north of Madras, India.

Haryana cattle take their name from the tract known as Haryana situated in the East Punjab, India, and lying between 28°30' and 30° north latitude and 75°45' and 76°30' east longitude, chiefly in the eastern half of Hissar district and also comprising part of Rohtak and Gurgaon districts, and the States of Jind and Patiala. The name of Haryana is most probably derived from "*Hari*" (green) and is reminiscent of a time when this was a rich and fertile tract. Archaeological remains show that the country watered by the Sarswati was once the scene of a flourishing Hindu civilization (Anonymous, 1908). Olver (1936) observes that in Haryana cattle of the Delhi-Rohtak-Gurgaon tract is an example

¹ See Figures 26 and 27.

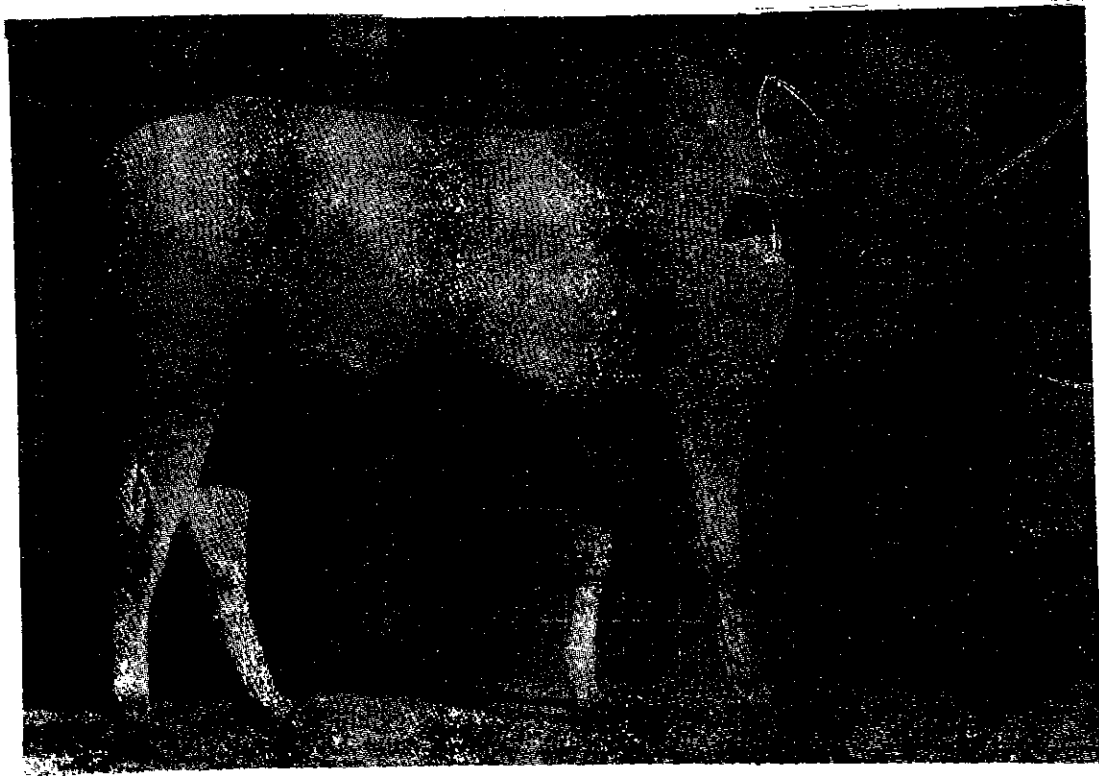


FIGURE 26. Harianas are found extensively in the northern part of India, particularly in the Punjab and Western Uttar Pradesh. The bullocks are powerful work animals.

of an original draft breed in which development of milking qualities has received some attention, during the days of the Moghul Emperors when large quantities of milk were no doubt required in this area.

Besides the Haryana tract the breed is produced in more or less pure form in the territories represented by the States of Jind, Nabha, Patiala, Jaipur, Jodhpur, Loharu, Alwar, Bharatpur and the western districts of Uttar Pradesh such as Meerut, Bulandshahr and Aligarh.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The Haryana tract, as mentioned above, forms a part of the East Punjab State in India. It is an irregular oval in shape, with its long axis lying northwest and southeast. On the northwest it is bounded by the Ghaggar Valley; on the west, southwest and south by the Bagar and Dhundauti or sandy tracts which

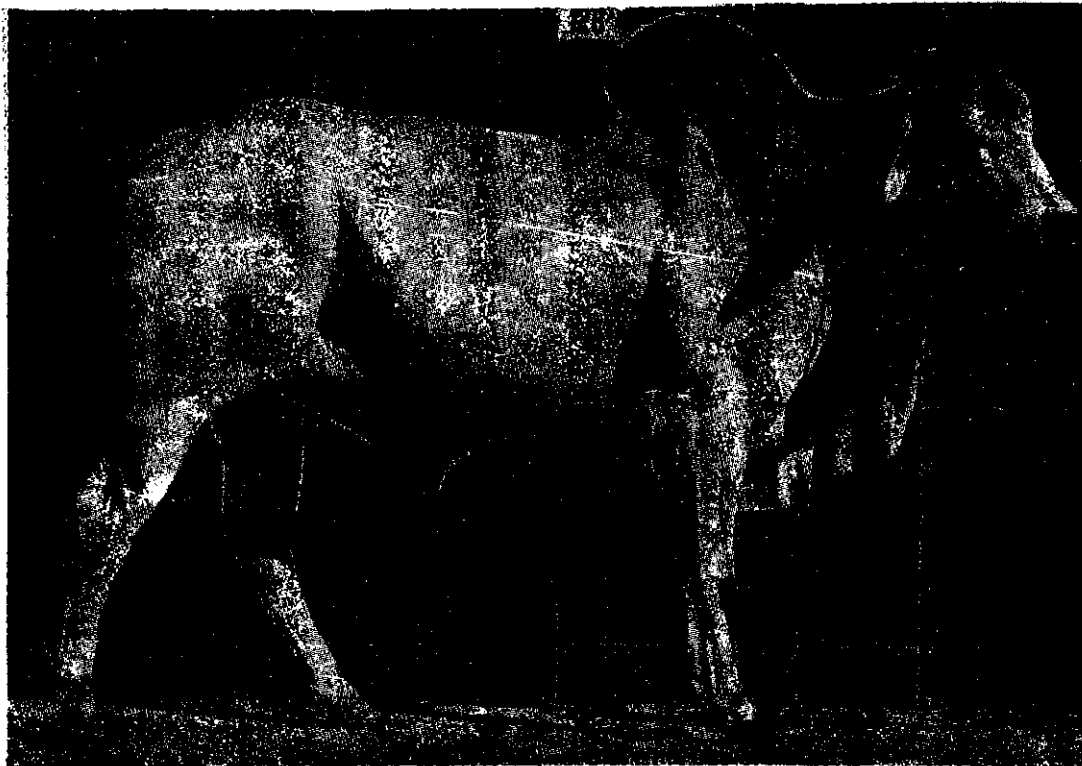
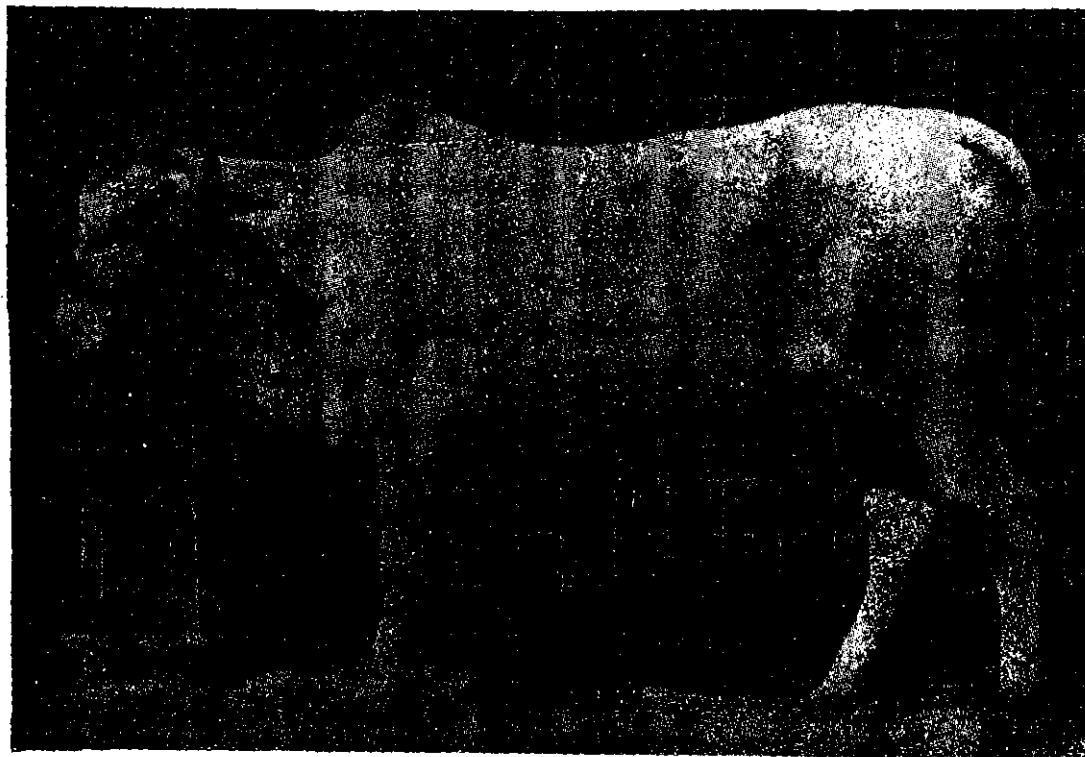


FIGURE 27. The Hariana is supposed to be one of the best dual-purpose breeds in India. Milk production of the cows is estimated average about 3,000 pounds per lactation. Above: a Hariana bull. Below: a Hariana cow.



are a continuation of the Rajasthan desert comprising particularly parts of Bikaner; on the east it is bounded by the Yamuna River. The average altitude of the area is about 700 feet above sea level.

The leading feature of the tract is its firm clay soil. In the Rohtak district the soil is mostly light colored alluvial loam; in Hissar, soft loam with reddish tinge interspersed with sand and clay. In some parts of the area, sand hills are present and in the low-lying parts the clay is hard. Calcareous limestone is also found in some parts of the area. All soils give excellent crop returns with sufficient rains but, unless irrigated, fail entirely in times of drought, though sandy soils as are prevalent in this area can yield good crops even with less rain. Saline efflorescence is not uncommon where the drainage lines have been obstructed. The average water level is quite deep, ranging from 60 to 100 feet, except in areas where there are canals where the water table may be 30 or 40 feet deep.

Climate

The Haryana tract has a relatively dry climate. Average annual rainfall for this area is about 18 inches. Rains usually occur during the months of July, August and September. During the summer months, day temperatures may go as high as 115°F., and sandstorms are common. Average wind velocity from May to August may vary from 2.2 to 4.2 miles per hour. Average climatological data are summarized in Table 27.

Table 27. Climatological Data for the Haryana Tract

MEASURE OF CLIMATE	AVERAGE DATA BY MONTHS											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	70.8	76.2	87.8	97.8	105.3	105.6	99.6	96.3	96.7	94.6	84.3	74.2
Mean minimum temp. °F . . .	41.4	47.2	56.8	66.7	76.0	82.2	81.2	79.0	74.5	63.2	49.8	43.2
Humidity per cent at 0800 hrs. I.S.T. . .	72.0	68.0	54.0	44.0	39.0	51.0	70.0	73.0	68.0	57.0	57.0	72.0
Rainfall, in inches	0.50	0.54	0.64	0.26	0.54	1.26	4.28	4.87	2.81	0.61	0.06	0.39

Information from the Indian Meteorological Department, Government of India,
New Delhi, India.

Vegetation

Various field crops such as *Pennisetum typhoideum*, *Sorghum vulgare* and *Eleusine coracana* are grown. Lentils and chickpeas are also grown. Barley, wheat and oilseed crops such as sesamum, rapeseed, mustard are also commonly sown. By-products from these crops are utilized for cattle feeding. In canal-irrigated areas in the tract fodder crops such as maize, Egyptian clover and sunflowers are occasionally grown, especially for cattle.

The tract has the following species of grasses which are extensively used for grazing as well as for haymaking; *Cynodon dactylon*, *Cyperus tuberosus*, *Eleusine aegyptiaca*, *Cenchrus echinatus*, *Pennisetum cenchroides*, *Panicum colonum* and *Andropogon annulatus*. A stunted kind of *Zizyphus*, *Zizyphus nummularia*, is extensively found in the area. Its leaves are greatly valued for cattle feeding.

Management Practices

The majority of breeders of Haryana cattle own less than twenty acres of cultivable land and they generally keep from 6 to 10 head of cattle each. The cattle are grazed on community pastures; usually there are considerably more cattle on these pastures than there should be in relation to their optimum carrying capacity. When rains are adequate, animals have enough to graze for 8 to 10 weeks.

Haryana cows are mainly kept for producing bullocks for sale, the milk yield being a secondary consideration. Usually only half of the milk is drawn from a cow during the first 2 or 3 months and the remainder is left to the calf to suck, especially if it is a male calf. Calves are generally reared on milk alone for the first month or six weeks, after which some grain and green fodder is allowed to the calf. Good milking cows are given stall feeding besides grazing.

During winter and summer months when there is no grazing cattle are fed chopped dry *Sorghum* or millet stover; straw from pulses along with leaves of *Zizyphus nummularia* is also fed. In early summer, ground chickpea and oats along with wheat straw is fed. Heavy yielders and working bullocks are also given concentrated feeds such as cottonseed, oilcakes, chickpeas, mungo

beans and cluster beans. Migration of cattle generally takes place when there is general famine on account of scanty rains.

Physical Characteristics of the Breed

Animals of the Haryana breed are well-proportioned and compact in build. The head is carried high, giving a graceful appearance. The face is long and narrow with a flat or slightly convex forehead. There is a well-marked bony prominence at the center of the poll which is said to be characteristic of the breed. The muzzle is wide and black in color. Eyes are large and bright. Ears are relatively small and slightly pendulous. They are approximately 12 to 13 inches long. Horns are fine and short, ranging from 4 to 9 inches in length, being thinner in females than in males, and while more or less horizontal when short, may curve upwards and inwards as they grow. Banana horns, loose at the base, are occasionally seen but not favored by the breeders.

The neck is moderately long, thin and fine; it is thick in bulls and gives the appearance of being short on account of a big and well-developed hump, and is wide and strong in bullocks. The dewlap is small, thin and free from flesh folds but is fairly large in bulls. Approximate length of the dewlap is indicated by measurements on bullocks, from a sample of 40 bullocks which ranged from 52 to 75 inches with an average of 62 inches; the width ranged from 7 to 14½ inches with an average of 10 inches while the thickness of the dewlap ranged from 0.3 to 0.5 inches.

The hump in the males is large but ~~decreases~~ in size considerably after castration. It is of medium size in females. Limbs are moderately long and lean. Feet are small and the hooves are well-shaped, hard and black in color. The back is long and straight with good depth and breadth in males but slightly sloping forward in cows. The sheath is short and tight and the navel flap is very close to the body.

Hindquarters are slightly higher in females than forequarters. Loins are broad and level. Hips are broad and smoothly covered. The rump is broad but slightly sloping. The tail is rather short, thin and tapering, and carries a black switch reaching just below the hocks. The udder in the females is relatively capacious and extends well forward and behind. The teats are medium-sized, the fore teats being longer than the hind teats. The skin is fine,

thin and tight around the body. It ranges in thickness from 0.3 to 0.6 inches. It is of black color and is covered with a white or gray coat. In the case of bulls the color over the front quarters and hindquarters is slightly dark or dark gray. Any color other than white or gray is considered a disqualification for entry into the Haryana breed registry. Similarly, a white switch is also a disqualification.

Average data on certain body measurements are summarized in Table 28.

Table 28. Average Measurements of Haryana Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	200.0	465.0	785.0
Length from shoulder point to pin bones, in inches	35.5	41.6	53.8
Height at withers, in inches.	38.0	43.2	52.2
Depth of chest, in inches	12.8	14.8	23.3
Width of hips, in inches	10.5	13.4	17.4
Heart girth in inches	43.0	56.0	67.1

MEASURE	At one year	At two years	Mature bull	Mature ox
<i>Males</i>				
Weight, in pounds	192.0	710.0	810-1 100	1 175
Length from shoulder point to pin bones, in inches	34.6	49.7	60.3	58.6
Height at withers, in inches	37.6	48.4	56.3	56.4
Depth of chest, in inches.	11.5	20.6	26.7	26.8
Width of hips, in inches	10.0	13.2	20.0	18.6
Heart girth in inches.	39.0	62.0	76.0	69.2

Data collected from Government Livestock Farm, Hissar, The Punjab, India.

Functional Characteristics of the Breed

The Haryana breed is one of the most important dual purpose breeds of cattle in Northern India. The bullocks are powerful work animals, particularly for fast plowing and road transport. Cows are capable of producing a fair amount of milk and on account of this quality they are exported in large numbers from

their native area to the large towns of North and East India, notably, Cawnpore, Allahabad, Banares, Patna and Calcutta.

The Haryana breed of cattle cannot claim to be termed as early maturing. The average age at first calving is observed to be about 54 months, while the range lies between 33 to 72 months. Bhattacharya *et al.* (1950) observe from a study of 647 animals and 1,892 calvings that the average gestation period is 287 days. It is slightly shorter for female calves than for male calves. The incidence of twinning was observed to be 0.09 percent.

Average age of Haryana bulls when they are first ready to serve is about 3½ years; they are observed to be quick at service, and the active breeding life of a bull is estimated to be about 10 years. It is observed from a study (Aggarwala, 1952) of 10 bulls and 115 cows that the reaction time to consummate service for the bulls varied from 5 seconds to 1 hour, 52 minutes and 30 seconds, while the average time taken was 21 minutes and 35 seconds. The reaction time is taken as the interval between bringing the bull to a cow and the actual time of ejaculation.

Young males which are not to be retained for breeding are castrated at the age of about 3 years and gradually trained for working in plows and carts. Haryana bullocks are observed to be even-tempered, active and willing workers. On dirt tracks the bullocks work without shoes but when they work in carts on hard roads they are usually shod. On an average, a pair of bullocks can pull a load of about a ton in an iron-tired cart on a hard road at the rate of 2 miles per hour. They are supposed to cover a distance of 20 miles in a working day. In the Haryana tract itself a pair of bullocks can do all field operations including transportation of produce on a holding of approximately 14 acres.

Haryana cows are in great demand in the large towns in Uttar Pradesh, Bihar and Bengal, India. Data obtained in rural areas of the tract indicate that the cows average approximately 3,000 pounds of milk in a lactation period. Smith (1930) and Kothavalla and Kartha (1939) present data showing range in production per lactation from 1,562 to 6,742 pounds of milk. Dastur and Kothavalla (1946) have summarized the data based on 424 lactations of the Haryana cattle maintained at the Government Cattle Farm, Karnal, the Punjab, for a period of 12 years: the

average milk yield of purchased Harianas was 2,379 pounds in 255 days with 150 days dry, while the average yield of farmbred Harianas was 3,634 pounds in 304 days with 106 days dry, the highest yield observed being 7,412 pounds in 344 days.

From the Memorandum of the Ministry of Agriculture (1950) it is observed that from 427 individual records of Harianas from recognized farms the average milk yield from farmbred Harianas was 3,275 pounds in 301 days with 123 days dry, while from 97 individual records of purchased Harianas the average milk yield was 3,053 pounds in 296 days with 157 days dry.

Records from the Government Livestock Farm, Hissar, East Punjab show that the average production of all tested cows was 1,332 pounds of milk in a lactation period of 166 days, while the average production of superior cows was 2,938 pounds of milk testing 4.0 to 4.8 percent butterfat in 324 days. The average calving interval was observed to be about 19 months. From the same farm production records of various lactations for 3 years, 1948 to 1951, are summarized in Table 29.

Table 29. Milk Production Records in Various Lactations

ORDER OF LACTATION	Number of records	Pounds of milk	Days in milk
1st lactation	17	1 375	273
2nd	92	1 785	263
3rd	84	1 887	273
4th	48	1 738	320
5th	26	1 913	285
6th	13	2 117	263

Observations at the Government Livestock Farm, Hissar, East Punjab, 1948-1951.

Singh and Tandon (1942) and Singh and Bhattacharya (1949) have studied the occurrence and mode of inheritance of syndactylism or uncloven hoof in the Hariana breed of cattle. Flexed fetlocks have also been observed in Hariana cattle. Both of these characters are recessive and detract from the value of the animals as draft cattle.

Lall (1948) has studied the dentition in Hariana cattle. He

observes that the first pair of permanent incisors come up in about 50 percent of the animals at about 2 years, while at 2½ years all of them will have this pair. By the third year the second pair of incisors is up, and in the fourth year the third pair of incisors is up. The permanent dentition is complete between 4½ to 5 years. In the Haryana cattle examined in Bengal, dentition is slightly later. It seems that, compared to temperate zone cattle, the Harianas complete their dentition later.

Average body temperature, pulse rate and rate of respiration in Haryana cattle studied at the Indian Veterinary Research Institute, Izatnagar, India, are given in Table 30.

Table 30. Average Body Temperature, Pulse Rate and Rate of Respiration in Haryana Cattle

A G E	No. of animals considered	Body temperature	Pulse rate	Rate of respiration
3 months	12	101.93	76.1	19.4
6 months	12	101.77	73.0	18.0
1 year	12	101.77	71.5	19.3
1½ years	12	101.36	63.6	18.1
2 years	12	101.18	58.3	17.7
3 years and above	12	101.01	57.5	17.2

Performance in Other Areas

Kaura (1950) reports that combination of draft and milk qualities in this breed along with its hardy constitution and ability to thrive in a variety of climates has led to its wide use in other States of India, particularly in Uttar Pradesh and Bengal, for pure breeding as well as for grading-up local inferior cattle.

In Uttar Pradesh, purebred herd are being maintained at the Government Farms at Madhurikund, Mathura, Aligarh, Jhansi and Babugarh. The average milk production of Haryana cows, based on 140 individual records at the Government Cattle Farm, Jhansi, was 2,970 pounds in 334 days with 110 days dry (Anonymous, 1950). Similarly milk production based on 132 records at the Government Cattle Farm, Madhurikund, was 2,815 pounds in 284 days with 118 days dry. In Uttar Pradesh, the Haryana

breed is used to grade-up the local cattle in the dry western districts where the average rainfall is 25 to 30 inches and the summer is very hot and dry, and also in the central, slightly humid districts where the average rainfall is from 35 to 45 inches but the summers are equally hot and dry.

Haryana cattle have been extensively used in grading-up local cattle in Bengal. No information is available regarding their behavior under the climatic and environmental conditions prevalent in Bengal. Large numbers of Haryana cows are maintained in Calcutta by the milk sellers. A herd of Haryana cattle is maintained at the Livestock Research Station at Haringhata, near Calcutta. The average yield of 156 cows at this farm in 1950 was 2,880 pounds with a calving interval of 417 days.

Sources of Breeding Stock and Information Regarding the Breed

Haryana cattle are regularly sold in large numbers through accredited cattle dealers in the Haryana tract. Cattle breeding societies working under the guidance of the Indian Council of Agricultural Research, New Delhi, promote the various activities for the breed such as registration, testing, sale, etc.

It is estimated that there are approximately 1,191,000 Haryana cattle in its native home.

Further information regarding the breed may be had from:

1. The Animal Husbandry Commissioner, Government of India, New Delhi, India;
2. The Director, Veterinary Services, Punjab, Simla, India.

KRISHNA VALLEY

Origin

The Krishna Valley breed of cattle¹ is used exclusively in the black cotton soil of the watershed of the River Krishna and other

¹ See Figure 28.

adjacent rivers such as Ghatprabha and Malprabha in the southern portions of Bombay State and Krishna Valley tract of Hyderabad State (Anonymous, 1926-c).

The breed is of recent origin: it is claimed that during the last two decades of the nineteenth century some of the Rajas of the Southern Mahratta country which lies in the watershed of these rivers tried to evolve a powerful bullock for agricultural purposes in the sticky black cotton soil. It is claimed that Gir cattle from Kathiawar, Ongole cattle from Madras, possibly Kankrej from Gujarat, and local cattle having Mysore-type blood in them were used to evolve the Krishna Valley breed. Maharaja Sangli, at one time a well-known breeder of Krishna Valley cattle, contributed substantially in making judicious use of all these strains to produce the desired type of animal which eventually became known as Krishna Valley. As animals of this general type were used for breeding on a wide scale even before the characteristics were fixed to any extent, there is wide variation in the characteristic of the breed. Massiveness in size was the chief dominating factor which attracted the attention of the cultivators.

The breed is found in the districts of Satara, Belgaum, Dharwar and parts of Bijapur of Bombay State and also in the native States of Miraj, Sangli, Kolhapur and Jamkhindi which are now part of Bombay State also. They are also bred in the southwestern part of Hyderabad State. The longitudinal position of the area is approximately between 15°8' and 17°8' N. and 74° and 78°E. The shape of the area resembles a long boot with its toe towards the east.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The whole area is on a plateau east of the Sahyadri range of hills, also known as the Western Ghats. The average altitude of the area ranges from 1,800 to 2,500 feet above sea level. The whole area is broken by low ranges of hills mostly covered with brushwood, and the valleys are shallow: as mentioned elsewhere the principal rivers are Krishna, Ghatprabha and Malprabha while

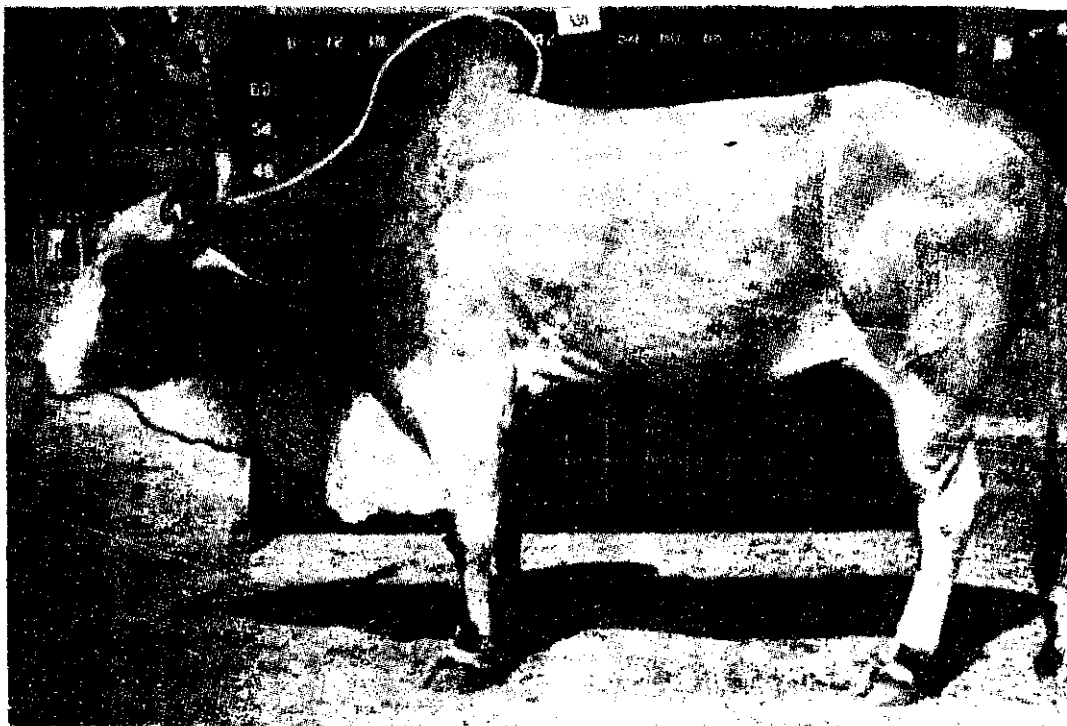


FIGURE 28. The Krishna Valley is a recent breed, and the type is not well fixed. The bullocks are massive, powerful animals useful for slow draft and heavy plowing. The cows are fair milkers. Above: a Krishna Valley bull. Below: a Krishna Valley cow.



there are several smaller streams with only a seasonal flow so that during hot months they usually dry up. The soils belong to three main classes: red, in the hills; black, which is generally found near the river banks, and most widely distributed in the Krishna Valley; and a third of light gray color and full of gravel. The black soil is particularly fertile. One of its varieties of black soil being friable but, when impregnated with moisture, forming a tough clay almost impervious to water, so making a valuable lining for tanks. The gray soil is not so tenacious and unless it receives abundance of irrigation it is not very productive: it also requires far more dressings of manure compared with black soil.

Climate

Rainfall and other pertinent meteorological observations are given in Table 31.

Table 31. Climatological Data for the Krishna Valley Tract

MEASURE OF CLIMATE	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	33.5	88.3	93.7	96.0	93.1	81.4	76.1	76.3	79.3	83.3	82.5	81.8
Mean minimum temp. °F . . .	57.8	59.4	63.7	67.1	68.2	68.2	67.2	66.4	65.5	65.3	61.5	58.4
Relative humidity at 0800 hours, I.S.T.	60.0	51.0	46.0	58.0	70.0	86.0	93.0	93.0	90.0	79.0	65.0	60.0
Rainfall, in inches	0.13	0.05	0.27	1.60	2.46	8.14	16.15	9.67	4.88	4.67	1.74	0.37

Information from Indian Meteorological Department, Government of India, New Delhi. Average for ten years.

The climate is generally mild and dry. In the months of April and May there is considerable heat during the day but the nights are pleasant and cool, and even during the summer months there are occasional showers of rain with thunder, causing a considerable decrease in temperature. The cold and dry season

lasts from the middle of October to the middle of February, while the dry summer season is from February to June: from June to the middle of October is usually the rainy season or wet period. Rainfall decreases as one moves from the western portion of the region to the east: it ranges between 50 inches in the west to approximately 30 inches on the eastern side.

Vegetation

The dry crops of the tract are *Andropogon sorghum*; this is usually mixed with *Cajanus indicus*. *Pennisetum typhoideum*, groundnut, *Zea mays*, *Paspalum scrobiculatum*, *Eleusine coracana*, *Cicer arietinum*, *Dolichos lablab*, and *Phaseolus mungo* are some of the other crops. By-products from all of these crops are utilized for cattle feed. Cotton is extensively grown in the area. Irrigated crops of the area are sugarcane, tobacco, betel vines and various garden crops. Shevri (*Sesbania aegyptiaca*) is grown extensively along the banks of rivers; the plant remains green throughout the summer and the loppings are used for feeding cattle.

In pastures on the banks of the rivers the following grasses are available: spear grass, *Aristida depressa*; *Dicanthium caricosum* (*Andropogon caricosus*), *Andropogon contortus* and several other varieties which are highly relished by the cattle. Grasses grow quite tall, to a height of 4 feet, and are usually cut for haymaking two or three times during a season, beginning in July and ending in February.

Management Practices

Grazing lands in the area are extremely limited. Along the river banks areas which are likely to be flooded and eroded are being preserved with the cultivation of *Acacia* trees and grasses. Cattle are usually allowed to graze only after the grasses have been harvested for haymaking.

Due to the non-availability of grazing facilities and most of the agricultural land being under intensive cultivation, only useful animals are maintained by the villagers. All animals are stall-fed throughout the years, green feed of both summer as well as winter-grown sorghum, maize, beans, grasses and hemp being available for about ten months of the year. The usual practice of the

cultivators in the area is to sow broadcast sorghum very thickly and then, when the crop is 3 or 4 feet high, to start thinning it gradually so that adequate green fodder is available every day.

During the dry period when no green feed is available the animals are fed sorghum stover, hay, straw from pulse crops such as *Cajanus indicus* or *Cicer arietinum*. Bullocks are usually fed along with roughages four pounds of concentrates consisting chiefly of *Dolichos biflorus*, crushed chickpea (*Cicer arietinum*), *Cajanus indicus*, or cotton seed. Milking cows are also given about two pounds of concentrates but other stock rarely get anything. It is the usual practice to feed the concentrates before or after milking but never at the time of milking.

Calves are not weaned but the male calves are allowed two teats while female calves are allowed only one teat till the cows go dry. Male calves usually get special care. When they are about 2½ years they are gradually broken to work. Between 3 and 4 years of age they are castrated and sold as working bullocks.

As the animals are stall-fed, the breeder is able to control the breeding of his cows. In many villages of the tract, bulls are kept specifically for this purpose, a fee being charged for the use of the bull.

Physical Characteristics of the Breed

As the breed is an admixture of at least three distinct types, Gir from Kathiawar, Ongole from Madras State and local beasts with blood of the Mysore basic type (Olver, 1938), it shows a variety of characteristics which in its short history of formation have not become well fixed. However, certain characteristics were emphasized by the original breeders and had a greater chance of perpetuation.

The animal is large, having a massive frame with deep broad chest, but is loosely built, measuring 15 to 16 hands on the top of the hump and weighing 1,500 to 1,600 lbs. However, the tendency in the past few years has been to breed a slightly lighter but compact and more agile animal.

The color most sought after is gray-white with a darker shade on the forequarters and hindquarters in the males. Adult females look more white. Brown and white, black and white and mottled colors are often met with. The forehead has a distinct

bulge surmounted by small curved horns which usually emerge in an outward direction from the outer angles of the poll and curve slightly upwards and inwards but which vary a great deal in size and shape. The neck is short and thick and the dewlap is well-developed and pendulous. The sheath is also slightly pendulous. The ears are small and pointed and breeders prefer them not to droop too much.

The body is short but the barrel is large and well-developed. Legs are short and thick and look powerful. Hooves are said to be soft.

Average data on certain body measurements are summarized in Table 32.

Table 32. Average Measurements of Krishna Valley Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	314.0 (3)	548.0 (3)	713.0 (31)
Length from shoulder point to pin bones, in inches	38.0 (3)	48.0 (3)	52.0 (31)
Height at withers, in inches	40.3 (3)	46.0 (3)	48.0 (31)
Depth of chest, in inches	22.3 (3)	26.0 (3)	29.0 (31)
Width of hips, in inches	10.0 (3)	14.0 (3)	16.0 (31)
Heart girth, in inches	48.0 (3)	59.0 (3)	66.0 (31)

MEASURE	At one year	At two years	Mature bull	Mature bullock
<i>Males</i>				
Weight, in pounds	349.0 (7)	606.0 (5)	1132.0 (6)	1210.0 (9)
Length from shoulder point to pin bones, in inches	41.0 (7)	48.6 (5)	59.2 (6)	60.4 (9)
Height at withers, in inches	42.0 (7)	50.2 (5)	56.0 (6)	57.0 (9)
Depth of chest, in inches	24.5 (7)	29.4 (5)	34.0 (6)	36.0 (9)
Width of hips, in inches	10.5 (7)	15.2 (5)	18.5 (6)	18.5 (9)
Heart girth, in inches	50.0 (7)	60.4 (5)	75.7 (6)	77.1 (9)

Numbers sampled are shown in brackets.

Functional Characteristics of the Breed

The Krishna Valley is a heavy draft breed suitable for cultivation purposes in the black cotton soil area which becomes extremely difficult to work during the rainy season, and for



FIGURE 29. A pair of Krishna Valley bullocks. Breeders from Brazil and the United States imported animals of this breed on account of their size and weight, but the cattle did not retain their identity.

hauling heavy loads¹. On account of contributions from Gir and Ongole it has also potentialities of milk production. However, the milk-producing capacity is extremely variable in the breed and no efforts on the part of the breeders were directed towards improving this characteristic.

Average data of 84 cows from the Government Cattle Breeding Farm at Hyderabad show an average yield of 2,147 pounds of milk in 271 days with a dry period of 193 days. Also records from recognized farms show an average of 2,731 pounds of milk in 314 days with a dry period of 164 days.

Average age at first calving is about 4 years. Males, which are usually well-fed, start serving when they are about 2½ years old. It is observed that the bulls are a bit slow as breeders.

Bull calves which are to be used for draft purposes are broken for work when they are about 2½ years old. Krishna Valley bullocks are observed to be even-tempered, and willing workers. They are not so quick in their action. In heavy soils they can perform field work with patience and without showing

¹ See Figure 29.

signs of fatigue. They get tired soon, however, if put to work in rough and stony areas. Under these conditions they usually develop hoof troubles.

A mature pair of bullocks will haul a two-ton load on metalled roads over short distances, but over long distances they usually haul about one ton at a pace of about $2\frac{1}{2}$ miles per hour for 8 to 10 hours a day.

Performance in Other Areas

On account of the apparent softness of the hooves and the heavy weight of the animals they are not generally appreciated by the cultivators in areas other than the native home of the breed. However, their large size and heavy weight attracted the attention of breeders from Brazil and the United States of America (Parr, 1926), but, though animals of the breed were exported to these countries, they did not retain their identity.

Sources of Breeding Stock and Information Regarding the Breed

According to an estimate (Anonymous, 1946) the total number of Krishna Valley cattle is 650,000. The breed is reared by cultivators who own only a few animals each and there is always a scarcity of animals for sale. Young bulls are available for sale at animal fairs held at the following places in Bombay State: Chinchli, Jamkhindi, Ichalkaranji and Athni.

The following persons may be contacted for further information on the breed:

1. Livestock Expert to the Government of Bombay, Poona, Bombay, India.
2. Director of Veterinary and Animal Husbandry Department, Hyderabad State, Hyderabad, India.
3. Animal Husbandry Commissioner to the Government of India, New Delhi, India.

MEWATI

Origin

Mewati cattle¹ are found in the tract known as Mewat, but the breed is sometimes spoken of as Kosi, on account of the fact that large numbers of cattle of this breed are sold from the market at Kosi, a small town in the district of Mathura. Mewati cattle are similar in type to Haryana (Phillips, 1944), but show definite evidence of an admixture of Gir blood (Olver, 1938; Ware, 1942). Native habitats of Rath and Nagori cattle being adjacent to Mewat, these two breeds may also have contributed to the formation of the Mewati.

Conditions in the Native Home of the Breed

Location, Topography and Soils

Mewat is an ill-defined tract lying south of Delhi including the whole of Alwar and part of Bharatpur and a small part of Mathura district of Uttar Pradesh: it also includes a part of the Gurgaon district of the Punjab. Most of the area is flat, rocky and sandy, and is intersected by the lower ranges of the Aravalli hills. The soils may be divided into three classes: a stiffish clay which, though somewhat difficult to work, yields the heaviest crops; loamy soil, easier to work but requiring heavy manuring—about 60 percent of the cultivated area falls into this class of soil; a third type is sandy and is found at the foot of hills and along the banks of streams, being only suitable for lighter crops.

The water supply is mostly from ponds, and supplies are largely dependent on local rainfall, for there are few wells; sweet water is found at great depths, that from shallow depths being brackish.

Climate

The climate is dry throughout the year except in the months of July, August and September when it is hot and humid. Summer temperatures during May and June go as high as 115°F., and in

¹ See Figure 30.

FIGURE 30. The Mewati breed, also known as Kosi, resembles the Haryana, with some mixture of Gir blood. Right: a Mewati bull. Below: a Mewati bullock.



Mewati cattle are powerful and docile, and are useful for heavy plowing: the cows, seen below, are fair milkers.



this season sandstorms occur frequently which, though unpleasant, usually bring about a decrease in temperature. The average annual rainfall of the area is about 22 to 25 inches, four-fifths of which is received in July, August and September.

Vegetation

Though small areas are preserved as pasture areas, cattle have to depend mostly on the by-products of cereal farming. Sorghum, millets, *Cajanus cajan*, *Phaseolus radiatus*, *P. mungo*, wheat, barley and chickpeas are extensively grown. Of the oil-seeds, rapeseed and sesamum are largely raised. Of the grasses, *Pennisetum cenchroides*, *Andropogon pertusus* and *Cynodon dactylon* are most popular and commonly found.

Management Practices

As the bullocks of this breed are in greater demand by cultivators, breeders pay more attention to the rearing of bull calves. The cattle get very little grazing; only for a limited period of about 2 months, in August and September, are they taken out for grazing; otherwise they are stall-fed. In the winter months, they get chaffed sorghum or millets and during the summer, hay and various straws of wheat, barley, *Phaseolus mungo*, *P. radiatus*, etc. Concentrates such as oilcakes and crushed grains are given to working bullocks only.

Physical Characteristics of the Breed

Mewati cattle (Baldrey, 1909) are usually white in color with neck, shoulders and quarters of a darker shade: occasionally, individual beasts have Gir coloration. The face is long and narrow with the forehead slightly bulging. Horns emerge from the outer angles of the poll and are inclined to turn backwards at the points. Eyes are prominent and surrounded by a very dark rim. The muzzle is wide and square and the upper lip thick and overhanging, giving the upper part of the nose a contracted appearance. The muzzle is pitch black in color. The ears are pendulous but not so long.

The neck and the whole frame is strong but the limbs are light. The legs are relatively long and the frame of the body gives an impression of being loosely built. The chest is deep but the ribs

are flat. The head and neck show an upright carriage. The dewlap, though hanging, is not very loose. The sheath also is loose but not pendulous. The legs are fine and round with strong, somewhat large hooves, well - rounded in shape. The tail is long, the tuft nearly reaching the heels. Cows usually have well-developed udders. Average data on certain body measurements are summarized in Table 33.

Table 33. Average Measurements of Mewati Cattle

MEASUREMENT	Mature cow	Mature bull	Mature bullock
Height at withers, in inches	48	61	54
Length from shoulder to pin bones, in inches	48	69	57
Heart girth, in inches	60	74	66

Source: Singh and Singh (1936).

Functional Characteristics of the Breed

Mewati cattle are, in general, sturdy, powerful and docile, and are useful for heavy plowing, carting and drawing water from deep wells. Bull calves are castrated when they are about 3 years of age and broken for light work. They are supposed to take a full load of the work when they are about 4½ years of age. A pair of bullocks can haul about 1,200 to 1,500 pounds of load in an iron-rimmed cart at an average speed of 3 miles per hour, a distance of 15 to 20 miles per day. In field work, they are worked for 8 to 10 hours per day.

The cows are supposed to be fair milkers. It is estimated that they produce on an average about 10 pounds of milk per day after feeding the calf, but definite data are lacking. Heifers are bred to calve when they are about 4 years old. Calves are not artificially weaned. Male calves usually receive a greater share of the milk than the female calves.

Performance in Other Areas

Only bullocks of this breed are exported, largely to parts of Uttar Pradesh. They are very much appreciated for their steady work in the fields and are credited with economical feeding.

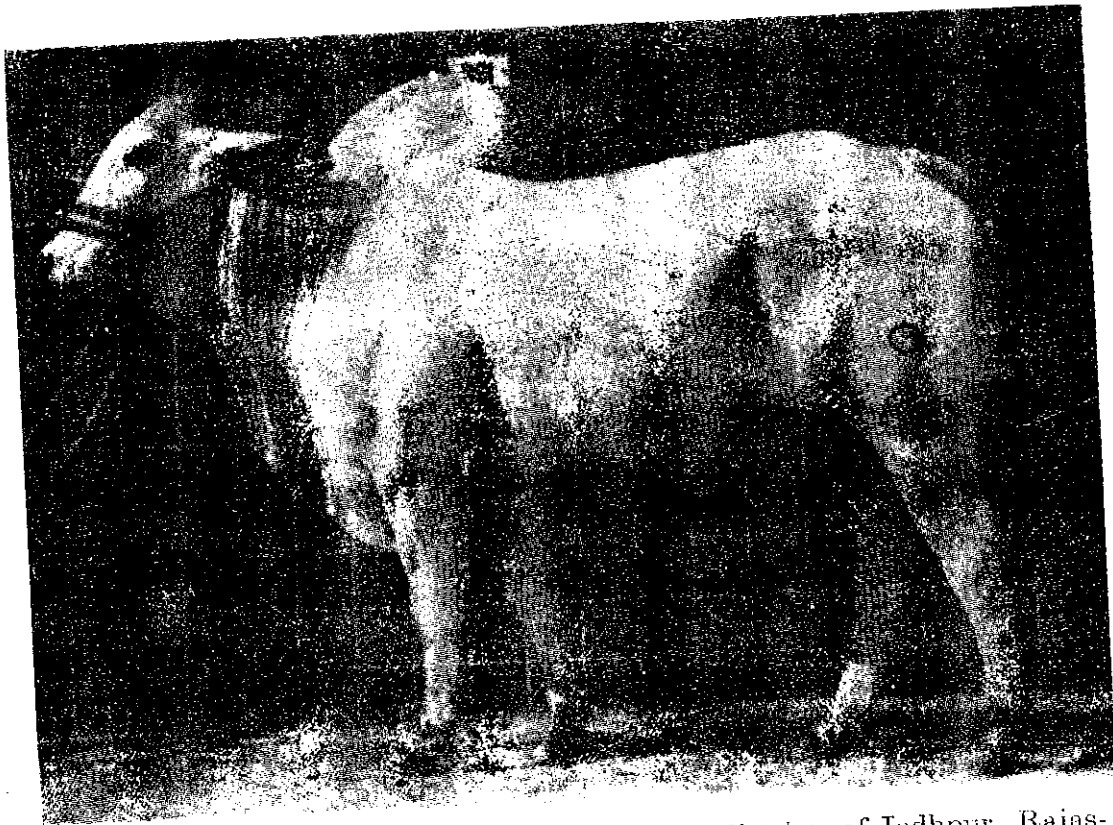


FIGURE 31. In the Barmar and Balotra districts of Jodhpur, Rajasthan, the milking qualities of the Nagori breed are fairly well-developed. Above: a Nagori bull. Below: a Nagori cow.



Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are approximately 400,000 Mewati cattle in the area (Anonymous, 1946). For further information regarding the breed, the Animal Husbandry Commissioner to the Government of India, New Delhi, India, may be contacted.

NAGORI

Origin

Nagori cattle ¹ are prevalent in the former Jodhpur State, now a part of the State of Rajasthan in India.

Ware (1942) and Phillips (1944) classify Nagori in the group of cattle with short-horned wither or light gray cattle with a long coffin-shaped skull, orbital arches not prominent, and face slightly convex in profile. Olver (1938), however, suggests that

¹ See Figures 31 and 32.

FIGURE 32. A Nagori bullock. Nagoris are some of the most famous trotting draft cattle in India, and are valued for fast road work.



probably the blood of gray lyre-horned cattle might have entered into the composition of Nagori cattle. Taking into consideration the proximity of the native homes of the Hariana in the north and northeast and Kankrej in the south and southwest, it seems reasonable to suppose that Nagori cattle may have evolved from these two groups. Frequency of famines in the native home has necessitated extensive movements of the cattle to other regions in search of fodder, and this has no doubt led to frequent intermixture.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The tract of the country called Nagore lies to the north and northeast of Jodhpur, but Nagori cattle are also bred in the districts of Barmer and Balotra which are to the south and southwest. The longitudinal position of the area lies approximately between 71° and 74° east, while the latitudinal position is between $25^{\circ}5'$ and $27^{\circ}5'$ north. Most of the area covered by the tract is sandy plain with an average altitude of 700 feet, except towards the west, nearing the ranges of the Aravalli hills, where the soils in the foothills are sandy loam. In the area towards Balotra and Barmer the soil is sandy and the water is scarce and brackish, except along the banks of the River Luni.

Climate

The climate is dry, even in the monsoon period, and characterized by extreme variations of temperature during the cold season. During the hot months the heat is apt to be intense during the day but nights are pleasant. Scorching winds blow with great violence during the months of April, May and June, and during this period sandstorms frequently occur. The climate is often pleasant towards the end of July and in August and September. October and part of November is again apt to be hot. Winter extends from November to March. Meteorological observations for the area are summarized in Table 34.

Table 34. Climatological Data for the Nagore Tract

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	76.3	80.6	90.5	99.4	105.4	103.6	96.9	91.8	94.2	95.5	87.6	79.0
Mean minimum temp °F . . .	48.6	52.6	61.5	70.8	79.4	82.3	80.2	77.0	74.8	64.4	55.4	50.5
Humidity per cent at 0800 hrs. I.S.T. . . .	50.0	50.0	39.0	35.0	45.0	66.0	73.0	82.0	76.0	54.0	45.0	53.0
Rainfall, in inches	0.15	0.24	0.11	0.13	0.41	1.42	3.97	4.84	2.40	0.32	0.11	0.11

Information from the Indian Meteorological Department, Government of India, New Delhi, India.

Vegetation

Large pasture areas are preserved through State control. Whenever there are sufficient rains, ample grazing is available for the cattle for 3 to 4 months from August to October or November. Depending on irrigation facilities available, such as from wells, ponds or rivers, fodder crops such as lucerne and cluster beans (*Cyamopsis psoralioides*) are grown. Maize, sorghum and millets are grown as monsoon crops. By-products from these crops are extensively utilized as fodders for cattle. Pulses, such as *Cajanus cajan* and *Phaseolus mungo* are also grown. During winter months crops such as wheat, barley, *Cicer arietinum* are grown. Oilseeds, particularly sesamum and rapeseed, are grown.

Management Practices

As income from cattle forms the major share of the agricultural income, every cultivator keeps a number of cattle. Cultivators in the Barmer and Balotra areas devote more attention to the rearing of females as they derive some income from the sale of ghee (clarified butter) from their cows, while cultivators of Nagore pay more attention to the rearing of bullocks (Baldrey, 1909). On the other hand, a large number of young male calves is bought by the Nagore cultivators from the Balotra and Barmer areas for rearing.

Besides the cultivators, there is also a professional class of

breeders who depend entirely on cattle raising. These are known as Banjaras. Their cattle solely depend on the grazing and these people drive their cattle up to Sindh, Gujarat, and Malwa in search of grazing. Buying and selling of cattle is also one of their main activities.

Cultivators' animals are usually stall-fed. It is only during the daytime that the cattle are taken to the nearby pasture grounds. Grazing is available only for 3 to 4 months.

A calf at birth is allowed all the milk of the cow but if it is a heifer calf the allowance is reduced to half within a month and it may be weaned at about 4 months. Male calves are allowed to be nursed longer. It is usual amongst the cultivators to get the males castrated when they are about 6 months old. This practice naturally results in retaining only the best bulls. Bulls are selected by the villagers in the proportion of one bull to about 80 cows.

Cows in the Balotra and Barmer areas are well-fed. In Nagore the breeders usually procure good milking cows from Balotra and also 1 to 2 year old male calves.

Physical Characteristics of the Breed

Generally the Nagori cattle are fine, big, upstanding, active and docile, with white and gray color. They have long, deep and powerful frames, with straight backs and well-developed quarters. There is throughout the Nagori breed a tendency to legginess and lightness of bone, though the feet are strong. It is supposed that this characteristic has given the breed its agility and ease of movement.

The face is long and narrow but the forehead is flat and not so prominent. The eyelids are rather heavy and overhanging and the eyes are small, clear and bright. The ears are large and pendulous. The horns are moderate in size and emerge from the outer angles of the poll in an outward direction and are carried upwards with a gentle curve to turn in at the points. The neck is short and fine, and looks powerful. The dewlap is small and fine. The hump in the bulls is well-developed but not so firm and thus in many cases hangs over. The shoulders and forearms look muscular and powerful. The legs are straight with hooves compact, strong and small. The tail is of moderate length reaching

just below the hocks and terminating in a tuft of black hair. The sheath is small. The skin is fine and slightly loose. The cows usually have well-developed udders with large teats.

Average data on certain body measurements are summarized in Table 35.

Table 35. Average Measurements of Nagori Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	230	450	700
Length from shoulder point to pin bones, in inches	36	42	50
Height at withers, in inches	36	48	55
Depth of chest, in inches	9	14	20
Width of hips, in inches	12	18	24
Heart girth, in inches	34	35	72

MEASURE	At one year	At two years	Mature bull	Mature ox
<i>Males</i>				
Weight, in pounds	250	480	800	700
Length from shoulder point to pin bones, in inches	40	45	57	55
Height at withers, in inches	36	48	60	57
Depth of chest, in inches	10	15	24	22
Width of hips, in inches	10	20	27	24
Heart girth, in inches	35	50	80	75

Data collected at Nagur Cattle Breeding Farm, Rajasthan, India.

Functional Characteristics of the Breed

The Nagori breed is one of the most famous trotting draft breeds of India and is generally appreciated for fast road work. As such, more attention has been paid by the breeders towards producing an agile yet powerful animal with a great deal of endurance. However, it may be mentioned that breeders, particularly in the Barmer and Balotra areas, have not neglected the milking qualities of the animal.

From records maintained at the Nagur Cattle Farm, Rajas-

than, it is observed that the heifers calve for the first time when they are about 40 months old. In rural areas, however, they seldom appear to calve earlier than 48 months. Males start breeding at the age of 3 years and the active breeding life is about 8 to 10 years. It is noted that though there is no marked breeding season in the Nagori, most animals are bred during the rainy season and in the winter months. The average weight at birth of female calves is 22 pounds while the males weigh 25 pounds.

The average milk production of cows kept at the Nagur Cattle Farm is 1,800 pounds in 225 days. This is actual production in addition to calf-suckling. The average calving interval is 460 days. In the rural areas of Barmer and Balotra the cows yield about 15 to 18 pounds of milk after feeding calves, but those in the Nagore area do not produce as much milk: about 12 to 15 pounds per day.

Nagori cattle are famous as trotters, being used all over Rajputana in light iron-wheeled carts for quick transportation. They are also worked for all agricultural purposes, such as plowing, cultivation, drawing water from wells and transportation of field produce to markets.

The Nagori breeder usually castrates his male calves when they are about 6 to 8 months of age, this early castration being supposed to allow the animals to develop agility and quickness in movement. It is normal practice to castrate animals during the months of April and May when the weather is dry. They are broken for light work when they are about 3 years old and weigh about 600 pounds, and are able to haul about 800 pounds of load in a light two-wheeled iron-rimmed cart on a sandy track and cover a distance of 36 miles in 8 hours actual travel or within a total period of 11 hours with 3 hours' rest. For short distances up to 20 miles, they can travel at the rate of 6 miles per hour.

Performance in Other Areas

Bullocks of this breed are exported to other areas such as Sindh, Punjab, Gujarat and Malwa, where they are utilized for light and quick transportation.

Sources of Breeding Stock and Information Regarding the Breed

A big cattle fair is held annually at Balotra during April or May when large numbers of Nagori cattle change hands. Nagori cattle are also taken to the cattle market at Pushkar near Ajmer in Rajputana. It is estimated that the total number of Nagori cattle may be 376,000 (Anonymous, 1946). For further information regarding the breed, the Animal Husbandry Commissioner to the Government of India, New Delhi, India, may be contacted.

ONGOLE

Origin

The Ongole breed¹, like other breeds of cattle in India, takes its name from the geographical area in which it is produced. It is also called the Nellore breed for the reason that formerly Ongole Taluk, a division of a district, was included in the Nellore district, but now it is included in the Guntur district (Littlewood, 1936). The area is part of the Madras State of India.

Olver (1938), Ware (1942) and Phillips (1944) include this breed of cattle among the gray-white cattle of the North, having white or gray color, stumpy horns and a long coffin-shaped skull. It has a great similarity with the Gaolao breed of Madhya Pradesh and also has a resemblance to the Bhagnari type of cattle in the north of India. This similarity is not surprising in view of the fact that these breeds lie along the path taken by the Rig Vedic Aryans in their march from the north to the south of India.

It is claimed that the finest specimens of the breed are found in the area between the Gundalakama and Alluru rivers in the Ongole and Kandukur taluks, and also in the villages of Karumanchi, Nidamanur, Pondur, Jayavaram, Tungtoor and Karvadi and along the banks of River Musi. They are also famous from the taluks of Vinukonda and Narasaraopet (Littlewood, 1933).

¹ See Figures 33 and 34.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area of this breed extends over parts of the districts of Kistna, Guntur and Nellore and now parts of Vizagapatam also, the longitudinal position approximately being between $79^{\circ}4'$ and $80^{\circ}2'$ east and the latitudinal between 15° and $16^{\circ}1'$ north. On the east of the tract lies the Bay of Bengal, on the west the area spreads to the Nallamalai range of Eastern Ghats, a series of hills. On the northern side it is bounded by the River Krishna which joins the Bay of Bengal in its eastward direction. In the south it is surrounded by the southern boundaries of Nellore district.

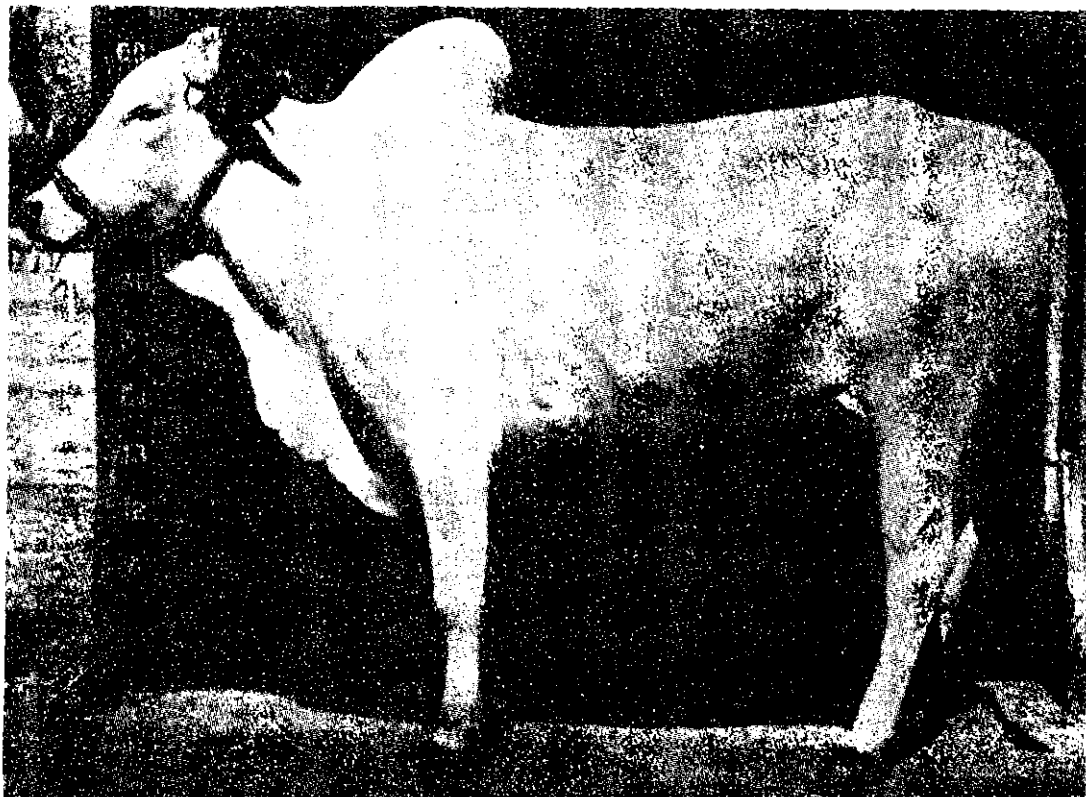
The Ongole tract is mostly flat but the hilly ranges begin as one moves west. There are a number of perennial streams and rivers running through the tract. Most of these run from west to east. The most important river, the Krishna, flows across the northern borders of the tract, while the Manneru, the

FIGURE 33. An Ongole bullock. Animals of the breed have been exported to Brazil, Ceylon, Fiji, Indochina, Indonesia and the United States, where there is some Ongole blood in the Santa Gertrudis breed.





FIGURE 34. Ongole cattle, found in the Guntur district of Madras, are also called Nellore. They are used for heavy draft work: milk yield varies from a few hundred pounds to more than 5,000 pounds per lactation.
Above: an Ongole bull. Below: an Ongole cow.



Paleru and the Musi rivers run across the center and the south of the tract. The banks of these rivers form excellent grazing areas; also, on account of the danger of floods, the adjoining areas are allowed to remain as grasslands. Gundlakama and Alluru rivers in the Kandukur subdivision of the Guntur district are specially well-known for their grazing areas as some of the finest specimens of Ongole cattle are produced in this section.

Soils towards the seacoast are alluvial and of very good quality. As one goes further from the sea this soil is mostly black cotton soil containing plenty of lime. As one reaches the eastern ranges of hills, the soil becomes poorer and is full of gravel, while the soil on the slopes of the hills is mostly red.

Climate

The climate of the tract is dry and mild and is not subject to sudden changes. Sea breezes make the area near the coast generally cooler than the inland area. March to June are usually hot months: winter months, on the other hand, are very mild. The tract receives rains from the southwest monsoon from May to September, as well as the northeast monsoon from October to December, and so there is usually an exceptionally long pasture season. Average rainfall for the tract is from 30 to 35 inches.

Climatological data are summarized in Table 36.

Table 36. Climatological Data for the Ongole Tract

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F	86.5	90.9	95.0	99.9	104.8	99.5	94.2	93.4	92.7	91.0	87.5	86.1
Mean minimum temp. °F	64.2	68.6	73.1	77.7	81.1	80.7	78.3	77.9	76.7	74.4	70.1	64.3
Relative humidity at 0800 hrs. I.S.T.	86.0	85.0	84.0	83.0	72.0	72.0	78.0	77.0	81.0	83.0	82.0	83.0
Rainfall, in inches	0.48	0.21	0.88	0.55	2.56	4.81	5.59	5.33	5.28	5.84	3.89	0.23

Source: Indian Meteorological Department, Government of India - average for ten years.

Vegetation

In the drier zones of the tract, where soil is mostly alluvial or black cotton type, there are some permanent pastures but there are also what are known as temporary pastures. On these fallow lands, which need regeneration, goats are folded prior to the monsoon. In the monsoon, excellent pasture springs up naturally and very rapidly; care is taken, however, to see that *Acacia* tree plants which also spring up naturally are well preserved. Temporary pastures are left down for 7 to 8 years, until the *Acacias* are sufficiently grown.

Grasses consist mainly of *Iseilema* (*Anthistiria*) *wightii*, *Andropogon monticolus* (*Chrysopogon montanus*). *A. caricosus* as well as leguminous plants, such as *Indigofera linifolia* and *Phaseolus trilobus*. The first-named grass is the most important and highly relished by the cattle. In the wetter areas in the south, where mostly paddy is grown, cultivated crops such as vetches and lentils and straw from paddy are fed. In drier areas straws from sorghum, *Panicum miliaceum* and also the vetches and pulses are fed. Extensive forest grazing areas in the western side towards the eastern hilly ranges offer many varieties of grasses. In the drier zones, oilseeds, notably groundnut, are grown, also cotton oilcakes and cottonseed are extensively used for cattle feeding.

Management Practices

In the alluvial tract there are no large breeders and the majority of cultivators own from 8 to 12 head of cattle. It is only in the shallower black soils, such as are seen in and around the Kandukur and Addanki subdivisions that one finds breeders owning up to 50 head of cattle. The system of feeding observed by the breeders of the different parts naturally depends upon the extent of pasturage available. In the low-lying parts in the south where paddy is principally grown, a certain portion of the dry land is often kept as pasturage for cattle. Most of the cattle, however, leave the villages during July to October and are sent to the western areas towards hilly ranges where extensive wastelands and jungle tracts exist. The breeders often club together and send their cattle in large numbers under professional graziers

known as Lambadies. If the northeast monsoon is favorable, the cattle have good feeding till January.

It has been mentioned that cows in this tract come in heat in two periods, February to March and August to October. This is attributed to good grazing in field or forests just previous to the above periods.

The bull calf usually receives much better attention and feeding than the heifer calf, being usually allowed all or a major part of the milk from its dam. After weaning, bull calves are given good fodder and some concentrates while the heifers get whatever they can pick from the fields or whatever fodder is left over after feeding work-cattle. Heifers mature late because of poor feeding.

Bull calves which are not to be retained for breeding are usually broken for work when they are 20 to 24 months old. Most of the bull calves are sold to cattle dealers at this age who take them to the western and northern districts where these bull calves are reared. In their new homes they are usually stall-fed and all care and attention is bestowed on them. The result is that they attain very good size. It is claimed that bull calves brought in at this age from the breeding tract and reared in these western districts grow into stronger bullocks and on an average have a working life of 8 to 10 years, but bullocks brought at later ages do not have the same efficiency and working life.

Physical Characteristics of the Breed

The Ongoles are large-sized animals with loosely knit frames, large dewlaps which are fleshy and hang in folds extending to the navel flap, and slightly pendulous sheaths. They have long bodies and short necks; limbs are long and muscular. The forehead is broad between the eyes and slightly prominent. Eyes are elliptical in shape with black eyelashes and a ring of black skin about $\frac{1}{4}$ to $\frac{1}{2}$ inch wide around the eyes. Ears are moderately long, measuring on an average from 9 to 12 inches, and slightly drooping. Horns are short and stumpy, growing outwards and backwards, thick at the base and firm without cracks. In some animals the horns are loose; this is probably due to the horn core not growing well.

The hump in the males is well-developed and erect and filled

up on both sides and not concave. The skin is of medium thickness, mellow and elastic and often shows black mottled markings. The popular color is white. The male has dark gray markings on the head, neck and hump and sometimes black points on the knees and on the pasterns of both the fore and hind legs. A red or red and white animal of typical conformation is occasionally seen.

According to the herdbook standards established for the Ongole breed of cattle (Ware, 1938), the following are points of disqualification:

- (a) red color and red patches on the body;
- (b) white switch;
- (c) white eyelashes;
- (d) flesh colored muzzle;
- (e) light colored hooves;
- (f) dark gray markings on the hindquarters;
- (g) dark mottle appearance on the body.

Average data on certain body measurements are summarized in Table 37.

Table 37. Average Measurements of Ongole Cattle

MEASURE	At birth	At one year	At two years	Mature
Females				
Weight, in pounds	60	498	616	900-1000
Length from shoulder point to pin bones, in inches	27	46	46	52.5
Height at withers, in inches	30	46	47	52.0
Depth of chest, in inches	—	23	23	—
Width of hips, in inches	—	16	16	19.0
Heart girth, in inches	27	57	58	68.0
Males				
Weight, in pounds	66.7	481	770 0	1200-1350
Length from shoulder point to pin bones, in inches	30.5	46	53.0	62.7
Height at withers, in inches	31	47	52.0	58.5
Depth of chest, in inches	—	23	28.0	—
Width of hips, in inches	—	16	18 5	21.5
Heart girth, in inches	28	56	66 0	82.5

Functional Characteristics of the Breed

Ongole cattle are efficiently used in their native home for both work and milk production. They are usually docile and the bullocks are very powerful, suitable for heavy plowing or cart work but are not considered to be suitable for fast work or trotting purposes, though of late a small, compact, hardy type is being developed and is used towards the northern parts of the Ongole tract; for the more western black cotton soil areas heavier animals are still in demand.

The cows are fair milkers giving an average yield not far short of the average of more developed milk breeds of Indian cattle. It is maintained that yields in well-kept herds average about 3,500 pounds per lactation. One estimate puts the average milk yield of the breed at 2,500 pounds with a daily average of 9 pounds. For the Madras milk trade Ongole cows are in great demand. Average milk production records are summarized in Table 38.

Table 38. Milk Production of Ongole Cows

YEAR	Average lactation yields, pounds	Average lactation length, days	Average dry period, days
1936-37	2 938	316	141
1937-38	3 161	303	129
1938-39	2 689	306	128
1939-40	3 338	329	265

Average percentage of fat in milk is 5.05 percent. Average calving interval is calculated at 16 months, while it is estimated that the average number of lactations during a lifetime is 6 to 7. Cows, if properly fed and managed, are regular breeders, most services taking place during two periods of the year, February to March and August to September. Average age at first calving on well-maintained farms is 3 to 3 $\frac{1}{4}$ years, while under village conditions it is estimated at 4 to 4 $\frac{1}{2}$ years.

From studies conducted at the Indian Institute of Veterinary Research it is observed that the average gestation period for male calves was 289.7 days, while for female calves it was 287.4 days. Sex ratio of calves born was 94.5 males to 100 females. The inci-

dence of twinning was 0.45 per 100 births. Average weight of calves at birth is 60 pounds for females and 66 pounds for males. Calves as heavy as 84 pounds were produced on government farms. Calves are either white, white with reddish brown patches or reddish brown color at birth. They generally change to pure white when they are 6 months old.

Males specially reserved for breeding purposes are usually allowed to serve when they are 2 or 2½ years old. On account of the usual village practice of allowing bull calves to run with the herd they start serving earlier. Ongole bulls are rather slow in serving. Their average breeding life is 8 to 10 years.

Male calves which are not to be retained for breeding are castrated when they are 2½ to 3 years old. At this period they usually weigh about 800 pounds. Bullocks used for transportation purposes walk at the rate of 2 to 3 miles per hour and can cover about 24 miles in a day. The bullocks are used for one purpose or another almost throughout the year.

The physiological capacity of Indian breeds of cattle to tolerate the high temperature and in some regions high humidity is well-known, though studies actually conducted to test these qualities are few. The data in Table 39 were collected on a three-quarter-bred Holstein-Ongole heifer at Trinidad in the British West Indies (Duckworth and Rattray, 1948).

Table 39. Hematology of the Three-Quarter-Bred Holstein-Ongole Calf During the First Year of Life

AGE (months)	Erythrocytes (millions per cu. mm.)	Coefficient of variation (%)	Leucocytes (thous. per cu. mm.)	Coefficient of variation (%)	Hemoglobin (gm. per 100 ml.)	Coefficient of variation (%)	Packed-cell volume (%)	Coefficient of variation (%)
0-1	8.4	15.5	10.4	23.1	10.3	14.6	29.5	16.3
1-2	9.0	8.9	10.3	33.0	10.0	8.0	29.5	8.2
2-3	9.0	22.2	12.2	22.9	10.2	10.8	30.9	
3-4	9.0	21.1	13.9	26.6	10.4	11.5	30.3	12.5
4-5	8.0	17.5	13.7	24.1	9.7	10.3	28.2	8.9
5-6	7.9	13.9	14.5	25.5	9.7	10.3	27.8	9.0
6-7	8.0	17.5	13.5	21.5	9.6	11.5	27.9	12.2
7-8	7.7	16.9	13.8	17.4	9.1	12.1	27.1	11.4
8-9	7.4	18.9	14.0	19.3	9.0	11.1	26.7	12.0
9-10	7.7	16.9	14.8	21.6	9.3	6.5	27.5	10.9
10-11	7.1	14.1	13.5	21.5	8.9	6.7	26.8	8.2
11-12	7.3	17.8	14.7	20.4	9.3	7.5	27.6	10.9

The following figures are for the hemoglobin content of blood from Ongole cattle in the Phillipines (Manresa *et al.*, 1940).

<i>Description</i>	<i>Hemoglobin (gm. per 100 ml.)</i>
Young cattle	8.7
Adult cattle	9.9
Adult cattle	9.8
Adult cattle	11.9

Performance in Other Areas

Brazil

Ongole cattle are known in the Americas as Nellore¹. The State of Rio imported the first consignment of Ongoles in 1895, but the really large consignment of 800 animals was brought to Uberaba in Minas Gerais in 1906 from India. From these two states it spread to other states in Brazil. Ongoles are very popular in Brazil as they give good weight for age and on an average gain 1.98 pounds per day up to the age of 2 years when they will give an average live weight of 782.5 pounds, while under careful management and liberal feeding, 2 year old Ongole steers weighed 1,185 pounds at the experimental breeding center of Sertazinho.

Purebred Ongole cattle are maintained at the government's experimental livestock breeding station near Uberaba for improvement and study. The station is located in a zone of semi-humid tropical climate. The annual mean temperature is 72.0°F. It is 70.0°F. in the dry season and 73.5°F. during the rainy season. August is the driest month in the year with 55 percent humidity. The annual mean precipitation of the region is 64.4 inches, January being the most rainy month with 12.8 inches of rain on the average.

The calving season usually begins by the middle of February and continues up to the beginning of November. Calves are usually left with the cows on pasture. When 6 months old, bull calves are put on additional feed which usually consists of ground millet, rice or wheatbran and cottonseed, the mixture having 14 percent protein. At about 8½ to 9 months old they are

¹ See Figures 35 and 36.



FIGURE 35. Ongoles, known as Nellores in Brazil, are popular and primarily used for beef production, being fattened on good pastures. Above: an Ongole bull in Brazil. Below: an Ongole cow in Brazil.

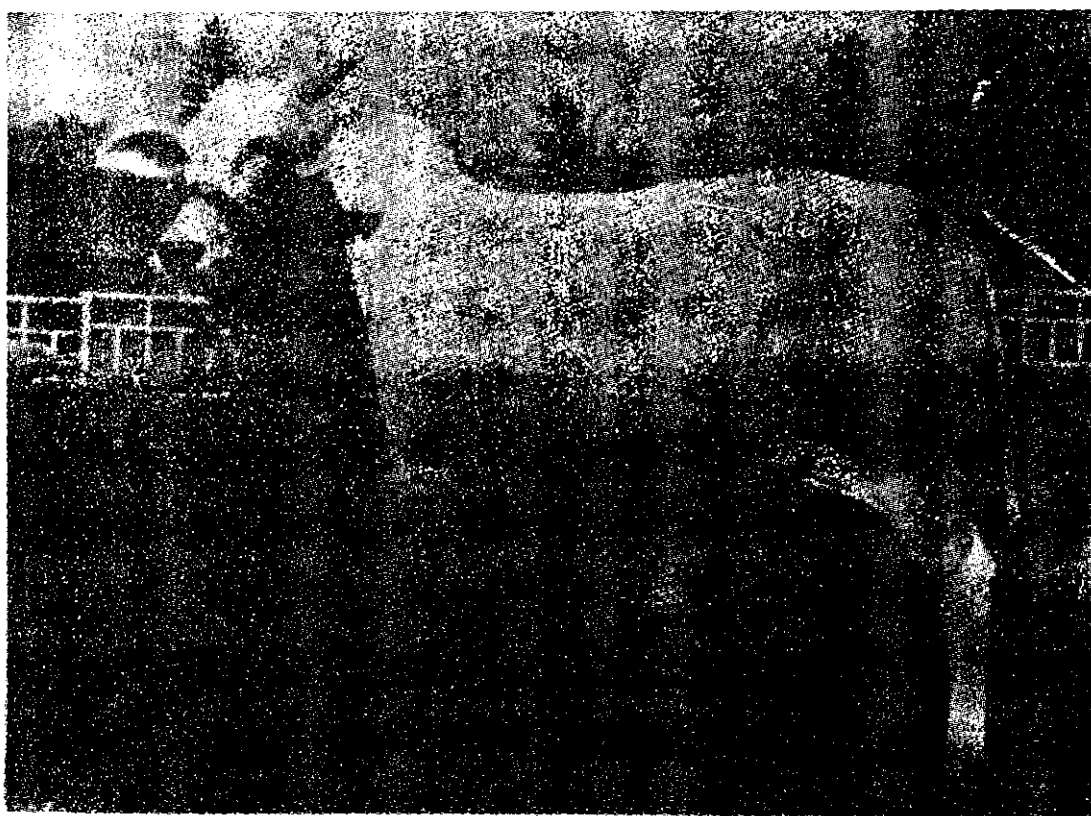




FIGURE 36. A group of Ongole heifers in Brazil.

weaned and separated into sex groups. Bulls are allowed to breed when about 24 months old and heifers when 24 to 27 months old. Weights of animals at this station are give in Table 40.

Table 40. Weights of Ongole Cattle, in Pounds

A G E	Male	Female
At birth	65.7 \pm 1.3 (21)	54.7 \pm 1.5 (30)
3 months	163.2 \pm 3.3 (52)	145.7 \pm 3.7 (57)
6 months	284.4 \pm 4.4 (54)	260.6 \pm 6.4 (54)
9 months	409.0 \pm 9.2 (44)	381.5 \pm 8.1 (54)
12 months	511.6 \pm 11.2 (32)	431.7 \pm 3.3 (54)
15 months	606.4 \pm 11.1 (24)	491.9 \pm 11.7 (46)
18 months	730.9 \pm 20.9 (18)	561.2 \pm 12.8 (32)
21 months	863.5 \pm 34.6 (8)	646.9 \pm 14.8 (33)
24 months	962.3 \pm 49.2 (7)	689.0 \pm 13.0 (36)
Daily gain in weight since birth until 24 months	1.52	0.926

From figures of the Government's experimental livestock breeding station near Uberab, Brazil. Figures in brackets refer to the number of animals recorded.

Ceylon

Ongoles have been imported into Ceylon from time to time in the past, particularly in the northern dry zone of the island. They are liked by cultivators for heavy field work in dry lands, it has been observed that they thrive better in this part of Ceylon than in the wetter southern area. The higher output and cash value of the crops of this zone, combined with more adequate sources of nutritious fodder, enable them to be reared and maintained on a satisfactory plane of nutrition. The milking capacity of this breed has not been exploited to any extent.

Fiji

Ongoles were imported into Fiji long ago by the sugarcane estates for draft purposes. They are now mixed up with local cattle. Animals with more typical Ongole features are still prized by the estate owners for heavy cultivation and transportation work. Small cultivators use the cows for household milk production.

Indochina

In Indochina, Ongoles were imported along with some other Indian breeds primarily for improving the work stock.

There are three types of soils in this region. Red soils are prominent in the hilly regions; these areas are well-drained and supplied with plenty of water from streams. Gray soils in the plains and valleys are fertile but dependent on rain; during the rainy season they produce an abundance of cattle feed, but during the dry season scarcity of water makes it very precarious for cattle. The low deltaic regions are swampy where rice plantations are prevalent, and these are regions where Ongoles have been tried. Nearer the sea, however, the climate is milder; as one goes into the interior it is hot as well as humid, the long dry season and the long rainy season making the rearing of cattle difficult.

Various cultivated fodders such as sorghum, maize, Guinea grass, Elephant grass and wild sugarcane are available in the region.

The measurements summarized in Table 41 are reported for typical Ongole cattle in the region:

Table 41. Measurements of Typical Ongole Cattle in Indochina

MEASUREMENTS	Bull, 4 years	Bullcalf, 2 years	Ox, 9 years	Cow, 5 years
Height behind the hump, in inches	54.0	51.6	55.9	48.8
Heart girth, in inches	81.5	78.7	92.6	80.7
Length from shoulder point to pin bones, in inches	63.4	58.3	65.0	57.9
Width of hips, in inches	19.3	16.95	20.5	18.9
Length of ears, in inches	8.75	8.75	9.87	8.75

Indonesia

Indian cattle of South-Indian origin have been imported to the islands of Java, Sumatra, Borneo and North Celebes since 1906. These have been used mainly for breeding purposes, the primary aim being to improve the draft and beef production of the region. In the year 1914, 42 males, 496 females and 70 calves were introduced on Sumba island to establish a pure-bred stud center of the Ongole breed¹. It was envisaged that breeding animals from this center would be used on other islands for improvement work. Sumba produced over 1,200 bulls prior to World War II for other breeding areas in Indonesia. They are used for pure breeding as well as grading-up native cattle. At present it is estimated that there are over 22,000 animals of this breed in Sumba and the number is increasing.

In Java, on natural grass plains, bulls at 5 years of age weigh 1,100 to 1,430 pounds, while individuals maintained and stall-fed weigh 1,320 to 1,760 pounds. They are primarily used for draft purposes. An authority gives his estimate of the draft ability of Ongoles in Java as follows: "If the draft accomplishment of native Javanese cattle is placed at 100, then the cross-bred bullock is equivalent to 128, while the pure-bred Ongole is equivalent to 172".

¹ See Figures 37 and 38.



FIGURE 37. A group of Ongole cattle on Sumba Island, Indonesia.
There are more than 22,000 Ongole animals on the island.

Sumba, where the breed is maintained pure in large numbers, has the high temperature of the tropics, but humidity is low compared with other islands. The southern part of the island is mountainous, but the northwest and eastern part is plain. Mean rainfall of the area is 71.4 inches. December to May is the season of heavy rainfall while June to November is fairly dry. In the dry season there is a shortage of both grass as well as water, and cattle in large numbers are, therefore, exported. The breed is developed for draft and beef purposes. Animals are kept on ranges and never get supplementary feed.

As draft animals they are especially prized, for the bullocks are even-tempered and willing workers. The hooves of the animals are strong enough for all field work, but when working on metalled roads the hooves are covered with rubber patches.

Bullocks are broken for work when they are 18 to 24 months old and weigh about 550 to 650 pounds. In Surabaya where the scavenging service employs Ongoles it is observed that they move at the rate of 3.1 miles per hour and work for 6 to 7 hours daily, carrying a load of about 2,800 pounds.

Age at first calving for the females is approximately 2 years and 6 months. They are ready for service when they are 18

to 24 months old. It seems that they are sexually mature earlier than in India.

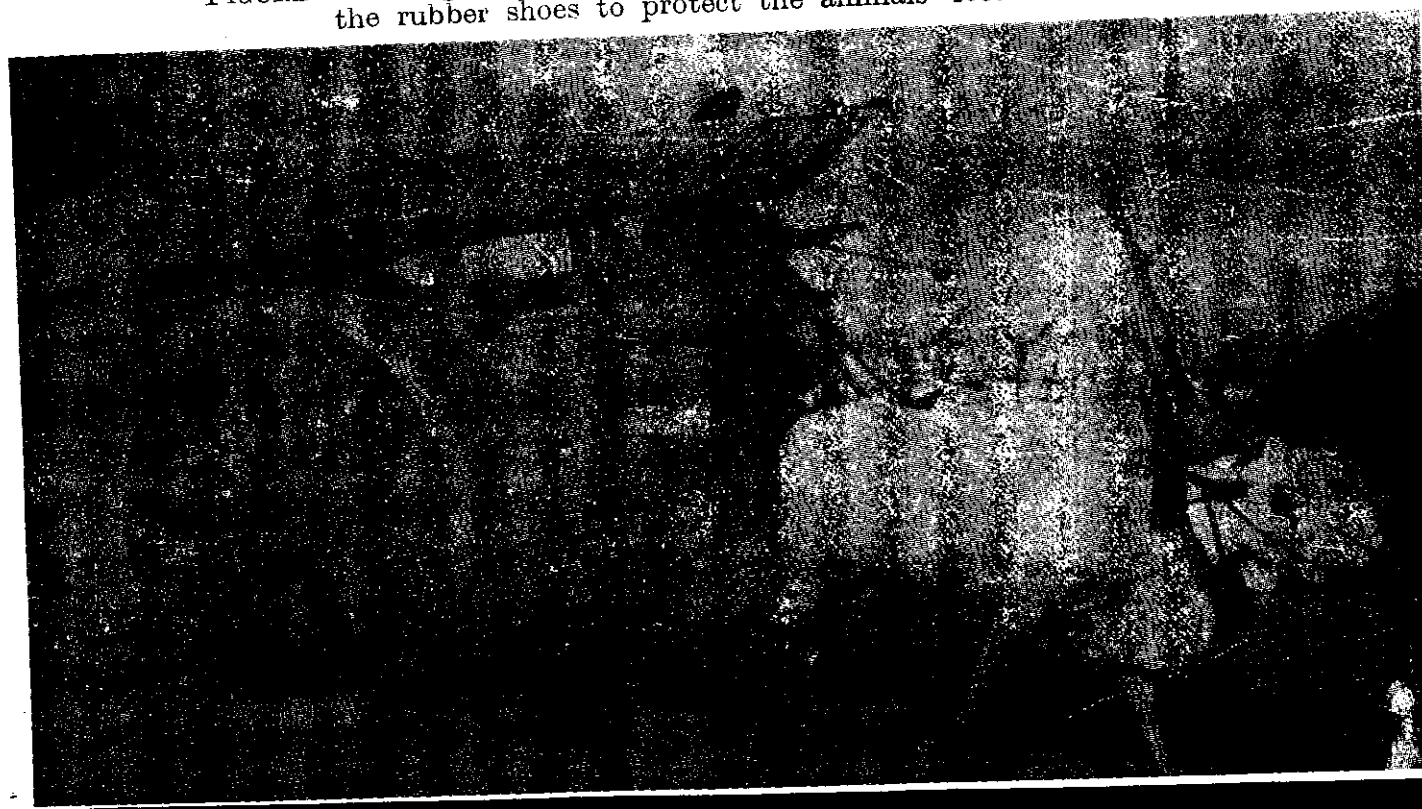
Weights and measurements of some typical animals are given in Table 42.

Table 42. Weights and Measurements of Typical Ongole Animals in Sumba

MEASURE	Mature male	Mature female	Mature ox
Weight, in pounds	1 164.0	838.0	995.0
Length from shoulder point to pin bones, in inches	63.4	53.5	
Height at withers, in inches	54.3	52.5	
Heart girth, in inches	78.2	65.7	
Width of hips, in inches	19.7	17.8	

It is observed that Ongoles when mature fatten easily on grassland. They are slaughtered from 4 to 6 years of age when they weigh approximately 1,100 pounds. Dressing percentage is approximately 50 percent.

FIGURE 38. Ongole bullocks in a cart, Surabaya, Indonesia. Note the rubber shoes to protect the animals' feet.



Malaya

Indian cattle constitute the majority in Malaya particularly in the western side of the peninsula south of Kedah. The early Indian settlers who were mostly from Madras State naturally took with them cattle of Ongole, Halliker and Kangayam types. As the cattle are used for all three purposes of milk, meat and draft, Ongoles acquired popularity.

Feed conditions, however, are not very favorable. Herbage becomes fibrous quickly as the inter-monsoon dry season advances and the animals kept on these pastures begin to lose condition, and though exact figures are not available it is observed that the present-day locally bred Ongoles are inferior to their parent stock (Marsh and Dawson, 1947, 1948).

United States of America

In 1906 a valuable importation was made by A. P. Borden, executor of the Pierce Estate, at Pierce, Wharton County, Texas. This shipment was mostly of Nellore (Ongole) breeding. Animals of this breed are popular in the United States where they are mostly found in the Gulf Coast region (Black, 1938).

Their physical characteristics are described as follows: they have smaller ears, finer bone and lighter color than Kankrej. Color varies from steel gray to almost white. Rhoad, while giving the genesis of the Santa Gertrudis breed writes: "The first exploratory cross on the King Ranch with the Brahman was made in 1910. The sire used was a half-bred Brahman-Shorthorn bull presented as a gift by the Tom O' Connor Ranch of Texas. This bull became known as the O' Connor bull and was destined to play an important part in the development of the Santa Gertrudis breed. He was a large, almost black bull and showed considerable Nellore (Ongole) breeding". Monkey, the famous foundation sire of the Santa Gertrudis breed, had traces of Ongole blood both in his sire as well as dam (Rhoad, 1940).

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are 1,502,000 cattle of this breed in India. In view of the vitality of these animals it is surmised that the numbers are increasing. For further information regarding the breed and its availability, the following may be contacted:

1. The Director of Animal Husbandry, Madras State, Madras, India.
2. Animal Husbandry Commissioner to the Government of India, New Delhi, India.

In Brazil, where some pure stock is maintained, these agencies may be approached for further information:

1. Departamento da Producao Animal, Divisao de Zootecnia, Postal Box 215-B, São Paulo, Brazil.
2. Sociedade Rural do Triangulo Mineiro, Postal Box 39, Uberaba - Minas Gerais, Brazil.

In Indonesia, where Ongoles are bred in large numbers, information will be supplied, on request, by the head of the Animal Industry Services, Department of Agriculture and Fisheries, Djakarta, Indonesia.

RATH

Origin

Rath cattle¹ belong to the white, narrow-faced, stumpy-horned group of cattle represented by the Haryana cattle. As a distinct type, they are bred in a very small area in Alwar of Rajasthan State. Particularly the area between Bansur and Narnaul and between Mundawar and Narnaul is noted for pure specimens of the breed (Baldrey, 1909). They are also bred in adjacent areas but, owing to the proximity of other similar breeds such as Haryana, Mewati and Nagore, they are likely to be mixed with these in strain. Rath cattle are reputed to be economical to maintain. As medium-sized draft cattle, they are considered very

¹ See Figures 39 and 40.



FIGURE 39. Rath cattle are powerful animals of medium size similar to the Haryana but somewhat smaller in size. Above: a Rath bull. Below: a Rath cow.



suitable for work in the plow or on the road. The cows are fairly good milkers (Olver, 1938; Phillips, 1944).

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area where Rath cattle are bred lies in the north and west of Alwar and other adjacent territories in Rajasthan. The general surface of the area is flat and sandy but there are irregular chains and groups of low hills which, as a rule, are entirely barren and covered with rocks and stones. The soil is a deep sandy loam and with relatively little rain it yields good crops. The water supply is mostly from tanks, and dependent on the local rainfall: water in the shallow wells is brackish and only very deep wells provide sweet water.

Climate

The climate of the area is dry but very hot during summer, particularly when scorching winds blow. During the winter months, cold winds are sometimes apt to be unpleasant, though the average winter, which extends from November to February, is dry and healthy. The rainfall of the area is very moderate. Meteorological observations for the area are summarized in Table 43.

Table 43. Climatological Data for Rath Area

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	76.3	80.6	90.5	99.4	105.4	103.6	96.9	91.8	94.2	95.5	87.6	79.0
Mean minimum temp. °F . . .	48.6	52.6	61.5	70.8	79.4	82.3	80.2	77.0	74.8	64.4	55.4	50.5
Humidity per cent at 0800 hrs. I.S.T. . .	50.0	50.0	39.0	35.0	45.0	66.0	73.0	82.0	76.0	54.0	45.0	53.0
Rainfall, in inches . . .	0.15	0.24	0.11	0.13	0.41	1.42	3.97	4.84	2.40	0.32	0.11	0.11

Information from the Indian Meteorological Department, Government of India, New Delhi, India.

Vegetation

There are only limited areas for pasture. Important species of grasses that are found there are *Cynodon dactylon*, *Pennisetum cenchroides*, *Cenchrus echinatus*, *Andropogon annulatus* and *Heteropogon contortus*. These are available for grazing from August to October, later they are harvested and preserved as hay.

As there is a scarcity of water in the area and also as the rainfall is not heavy, most of the dry farming crops are grown. Sorghum and *Pennisetum typhoideum* are extensively grown as summer weather crops, also *Cajanus cajan* and other lentils. Stovers and straws from these crops are utilized as fodder. Sorghum and cluster beans are grown as fodder crops also and fed green to cattle. Wherever water is available for irrigation, turnips and other root crops are grown for feeding cattle. Wheat, barley, *Phaseolus radiatus*, *P. mungo*, peas, mustard and rapeseed are grown and by-products from these crops utilized for cattle.

Management Practices

As pasture areas are so limited, most of the cultivators keep only a few animals of the breed, the number depending upon the amount of land available for cultivation. The water supply is also another limiting factor in breeding large numbers of animals. The cultivator, however, is very painstaking and besides the limited grazing and by-products from his farm-grown crops, he collects leaves from shrubs and trees such as *Zizyphus nummularia* and various types of *Acacia* and these are fed to the cattle mixed with chaff millet and sorghum stover or straws from wheat and barley.

Every village in the area has communal bulls in approximately the proportion of 1 bull to 100 cows. These bulls are selected by the villagers and paid for by philanthropic wealthy people. The bulls are fed by the community.

Physical Characteristics of the Breed

Rath cattle are medium-sized but powerful, with white or gray coloring. In the bull, the coloring of the neck and shoulder is generally darker than the rest of the body. The face is straight,



FIGURE 40. A pair of Rath bullocks: the animals of this breed are adapted to moderately heavy draft work.

narrow and medium-sized. The forehead is flat and does not show any protuberance in full-grown animals. Young animals under 3 years occasionally show this protuberance but it straightens up as the animal reaches maturity. The nasal bones are somewhat wide and coarse. The muzzle is wide and black. The eyes are wide open and clearly defined by the dark eyelids. Horns are small and emerge laterally in a somewhat forward direction from a moderately broad poll and curve inwards at the tips. The ears are short and pendulous, the inner surface facing forwards.

The neck is fairly long. The hump is moderately developed, placed well in front of the withers. The dewlap is light and the sheath is very small. The body is of moderate length with deep chest and well-sprung ribs. Quarters are well-developed and also the legs. The tail is short with black switch and set rather high giving the quarters a somewhat drooping effect. The feet are

small and compact. Average measurements of Rath cattle are given in Table 44.

Table 44. Average Measurements of Rath Cattle

MEASUREMENTS	Cow	Bullock
Height at withers, in inches	40-51	56-61
Length from shoulder point to pin bones, in inches	48-59	56-65
Heart girth, in inches	57-64	72-81

Data reported by Baldrey (1909).

Functional Characteristics of the Breed

As the area in which Rath cattle are bred is dry and with very limited grazing, the number of animals in the area is restricted but, at the same time, this has kept the breed pure as no outside animals come into the region for grazing purposes. It is observed that they are economical to maintain and are regarded as a poor man's breed. The bullocks are very good workers in the plow or on the road for transport purposes. The dirt tracks in this area being of heavy sand, powerful and active bullocks are essential and Rath beasts are well suited for this work. They are observed to work steadily for 10 hours a day in fields and can travel about 20 miles a day carrying a load of half a ton in heavy sand. They are credited with long life.

An average cow that gets part grazing and part supplemental roughages, such as stovers and straws with little or no concentrates, is observed to produce 12 to 16 pounds of milk a day after feeding its calf, but accurate data are lacking. The average lactation period is of a short duration of approximately 200 days.

Bull calves are castrated when they are about 2½ to 3 years old.

Performance in Other Areas

Some families from the area migrated to Berar in Madyha Pradesh with their cattle in the early years of this century. The

cattle were maintained pure and they have increased in number. Under conditions of black cotton soil the cattle have done well.

Sources of Breeding Stock and Information Regarding the Breed

Rath cattle are usually sold in large numbers in the markets of Rewari and Pushkar. For further information, the Animal Husbandry Commissioner to the Government of India, New Delhi, India, may be approached.

Group III

DANGI

Origin

Dangis¹ have taken their name from a tract of the country in Bombay State known as Dangs. It is a hilly tract with heavy rainfall and very poor agricultural economy. The breed has become well-known on account of its hardy nature and ability to work hard under heavy rainfall conditions. Phillips (1944) observes that the Dangi breed, which is similar to Deoni, appears to fit into the group of cattle represented by the Gir, Red Sindhi and Sahiwal.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The home of Dangi cattle is a small area comprising part of Ahmadnagar, Nasik, Bansa, Dharampur, Jowahar and the Dangs of Bombay State in India (Ware, 1942). The principal geographical feature is the existence of the chain of hills known as the Western Ghats. These hills run north to south, with spurs on the eastern side. Though the average altitude is about 2,000 feet above sea level the highest elevation rises to 4,500 feet above sea level. The approximate latitudinal position of the tract is between 20° and 22° north while the longitudinal position is between 73° and 74° east. The whole area is hilly, broken by deep

¹ See Figures 41 and 42.



FIGURE 41. A Dangi bull. Dangi cattle, found in the hilly tract of Dangs in Bombay State, are valued on account of their hardy nature and ability to work under heavy rainfall conditions.

ravines. Towards the center and west there are dense forests while to the east there are large clearings. In the valleys and depressions good black soil exists, while on the slopes and uplands the soil is red or black with boulders. Important rivers in the area are the Mula, Ghod and Godavari.

Climate

The climate is, on the whole, pleasant. The cold season, which lasts from November to February, is dry and invigorating. Hot dry winds from the northeast then set in, lasting from March to the middle of May, when the temperature may go up to 106°F. during the daytime. Then the rains set in. Average rainfall in

the area may be about 100 inches. The major part of the precipitation is during the period from May to September. Average climatological data are given in Table 45.

Table 45. Average Climatological Data for Dangs

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average maximum temp. °F	84.3	88.4	94.8	99.7	101.3	92.0	85.6	84.9	86.2	89.0	85.7	83.4
Average minimum temp. °F	52.8	55.5	62.5	89.5	71.9	71.9	70.5	68.9	67.9	65.5	58.1	52.7
Humidity per cent at 0800 hrs I.S.T.	55.0	47.0	41.0	41.0	50.0	73.0	79.0	79.0	78.0	61.0	55.0	56.0

Information from the Indian Meteorological Department, New Delhi, India.

FIGURE 42. A Dangi cow. These cattle are used for medium-slow draft: the cows are poor milkers.



Vegetation

Forest areas offer facilities for grazing. The following species of grasses are more commonly found: *Ischaemum aristatum* and *I. rugosum*, *Iseilema* (*Anthistiria*) *wightii*, *Andropogon pumilus*, *Dichanthium annulatum* (*Andropogon annulatus*), and *D. caricosum*, *Heteropogon contortus*, and *Themeda* (*Anthistiria*) *triandra*. They are available for grazing from July to September. During the months of October and November they are in semi-green condition, later they become dry and coarse and are harvested for use as hay. Among crops grown in the area are paddy and *Eleusine coracana*. By-products from the cultivated crops mentioned are utilized for feeding cattle. *Pennisetum typhoideum*, *Phaseolus radiatus*, sorghum and *Dolichos biflorus* are also grown and stovers and straws from these are used for cattle feeding.

Management Practices

Dangi breeders are semi-nomadic; they wander from place to place for a period of 9 months from January to September. During the remaining 3 months they stay at home. Dangi cattle depend largely on whatever grazing they can pick up during their wanderings. During the months of April and May, when most of the grasses in the forest areas are withered or consumed, the cattle are maintained on the loppings from the trees. The herds are driven 50 to 70 miles away from home in search of grazing. Cows and other stock, except breeding bulls, are not given any concentrates. These cattle are extensively used for plowing, harrowing and other field operations and also for carting timber from the forest areas.

Physical Characteristics of the Breed

The Dangis are of broken red and white or black and white color. The animals are medium in size, with deep bodies and generally of ponderous build. The height behind the hump ranges from about 45 to 50 inches while the heart girth measures from about 58 to 60 inches, on the average.

The head is usually small with a slightly protruding forehead. The muzzle is large. The horns, though of variable size, are generally short and thick. The ears are small.

The animals have powerful hind and forequarters with a short back well-coupled, and the legs are short and stout. The hooves are exceptionally hardy, being black and flint-like. The dewlap is slightly pendulous. The sheath, though loose, is not excessively pendulous. The hump is medium-sized and firm. The skin is of medium thickness and the coat is shiny. It is observed to exude an oily secretion which protects it from heavy rain.

Functional Characteristics of the Breed

The Dangis are primarily medium-slow draft animals. They are well-known for their excellent working qualities in heavy rain and in rice fields and also on the hilly tracks. They are hardy animals and subsist mostly on grazing alone. As draft animals they carry heavy timber at the rate of 2 to 3 miles per hour depending upon the type of terrain and can cover a distance of 20 to 24 miles per day. It has been observed that they work an average of 210 days a year.

The cows are poor milkers but during the last few years attempts have been made to develop their milking qualities. A sample of 8 cows produced an average of 1,180 pounds of milk in 258 days besides feeding their calves. Average percentage of fat in the milk was 4.3. The average annual yield from cows at the cattle breeding farm at Tegur, Bombay State, was 427 pounds after feeding calves (Anonymous, 1950).

Performance in Other Areas

The animals are more or less restricted to their native areas, having been used very little elsewhere in India or Pakistan.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are over 550,000 animals of this breed in the native area (Anonymous, 1946). Further information regarding the breed may be had from:

1. Livestock Expert to the Government of Bombay, Poona, Bombay State, India;
2. Animal Husbandry Commissioner to the Government of India, New Delhi, India.



FIGURE 43. Deoni cattle, known as Dongari in its native State of Hyderabad, were developed from a mixture of Gir, Dangi and local beasts. The bullocks are used for heavy cultivation and the cows are reported to be the best milking animals in that region. Above: a Deoni bull. Below: a Deoni cow.



DEONI

Origin

The Deoni breed of cattle¹ also sometimes known as Dongari (which means "of the hills"), has been evolved within the last 200 years. It is claimed that it has been developed from a strain descended from the admixture of Gir, Dangi and local cattle. A contribution from the Gir type of cattle is quite evident in the formation of the head and ears, and also of the horns to a certain extent. They also show a great similarity in general conformation and ruggedness to the Dangi cattle of Bombay State, an area which is not far from the Deoni cattle breeding area.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The breed is prevalent in the northwestern and western portions of Hyderabad State and, more particularly, in the Bidar district. The approximate area covered by the breed lies between 17°30' and 18°55' north and 76°30' and 77°55' east. Low laterite ranges of hills cross the region.

The whole area is hilly with an average altitude of 1,600 to 2,350 feet above sea level. There are shallow valleys and plateaus where the soil varies from clay loam to black cotton soil. Black cotton soil is generally encountered in basins, valleys and hollows, while red soil is found higher up. The black soil is derived from schistose and gneissose rock (trap) and the red soil from laterite, both being very fertile. On the top of the hills and plateaus, though the soil is good for cultivation, it is full of gravel, which naturally means that work animals must have strong hooves. All the soil is not brought under cultivation but vast areas are judiciously kept as grazing areas and scrub forests.

The most important river in the tract is the Manjra which

¹ See Figure 43.

flows eastwards. There are 8 or 10 other streams which flow only part of the year. However, none of these streams or rivers are utilized for irrigation purposes. The waters of the lateritic region are chalybeate and said to possess tonic properties. The whole of the area is well-drained.

Climate

The district of Bidar and the surrounding area is noted for its healthy climate. The high plateau area of the southern side has particularly mild summers and the winters are also mild. However, this area gets less rainfall than the western and northern areas. The average rainfall of the area is between 28 and 30 inches. The rainy season extends from June to October. Climatological data for the area are summarized in Table 46.

Table 46. Climatological Data for the District of Bidar

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F	84.7	88.6	95.9	101.3	103.5	94.2	86.0	84.8	86.2	89.7	86.1	83.5
Mean minimum temp. °F	56.7	59.6	68.9	73.7	75.8	73.0	70.9	69.6	69.2	66.9	60.3	55.8
Mean daily relative humidity per cent at 0800 hours	50.0	43.0	35.0	34.0	47.0	75.0	84.0	86.0	81.0	61.0	57.0	56.0
Rainfall, in inches	0.29	0.17	0.20	0.24	0.72	5.44	6.74	4.79	6.69	1.79	0.95	0.27

Supplied by the Secretary, Indian Council of Agricultural Research, Ministry of Agriculture, Government of India, New Delhi. Average of 10 years collected by the Indian Meteorological Department, Government of India, New Delhi.

Vegetation

As there are very few irrigation facilities, except from the wells and a few tanks, most of the crops are dependent on monsoon rains. Sorghum and millets are extensively grown for grains and stover is utilized for cattle. Cotton and oilseeds are also largely grown. Cottonseed and oilcakes are used as cattle feed. Large varieties of grasses are produced in the forest and pasture areas.

Management Practices

As is the general practice in India, the calves are not weaned, but particular attention is paid in allowing liberal amounts of milk to bull calves. Most of the animals are given individual attention, as each farmer usually has only one or two cows, a pair or two of bullocks and some young stock, although some of the larger breeders may have as many as 50 animals. From July to February there is usually plenty of grazing in the nearby hilly forest areas. It is only during the daytime that the animals are taken to the pastures, while in the evenings and during the night the bullocks, bull calves and milking cows are generally given hay or sorghum stover, with some concentrates such as groundnut oilcake, cottonseed, chickpea (*Cicer arictinum*), millets, etc. The cultivator is partial to his bullocks, which are usually found to be well-fed.

Physical Characteristics of the Breed

The Deoni is a medium-sized animal which resembles the Gir in physical structure to a large extent. The body color is usually spotted black and white. The face is also similarly patchy and spotted with black and white. The forehead is convex and bulging, though breeders have not paid the same scrupulous attention to this trait as the breeders of Gir cattle, and though the ears are long and open forward they lack the leaflike structure and also the notch at the tip of the ear that is typical of the Gir. The horns in typical animals take a characteristic outward and backward curve similar to that generally to be seen in Gir cattle.

The skin is loose and of medium thickness. The dewlap is heavy and the sheath is usually pendulous. The hair is soft and short. The cows have a fairly well-developed udder. The body is massive and upstanding with considerable depth. The hooves are well-made and shapely and of a black color. The bony structure gives appearance of strength. Heifer calves weigh about 40 pounds at birth, and bull calves about 45 pounds. Some important physical measurements are given in Table 47.

Table 47. Average Measurements of Deoni Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	220	380	650
Length from shoulder point to pin bones, in inches	31	45	56
Height at withers, in inches	35	46	52
Depth of chest, in inches	20	28	33
Width of hips, in inches	10	16	17
Heart girth, in inches	40	57	64

MEASURE	At one year	At two years	Mature bull	Mature bullock
<i>Males</i>				
Weight, in pounds	226	400	1 456	1 150
Length from shoulder point to pin bones, in inches	34	42	66	62
Height at withers, in inches	37	45	59	60
Depth of chest, in inches	21	24	38	36
Width of hips, in inches	10	12	21	20
Heart girth, in inches	40	50	81	74

Data collected at Deoni Cattle Farm, Hyderabad State.

Functional Characteristics of the Breed

The Deoni has been especially evolved from a mixture of Dangi, Gir and local cattle to suit the local conditions of cultivation and transportation. The area is hilly with extensive sprinkling of pebbles and rocks, and well-constructed roads are few. Most of the transportation and communication is carried on through unbeaten tracks, while the cultivated lands consist largely of heavy black cotton soil. These conditions demand a fairly heavy type of animal which has strong feet and endurance capacity. The Deoni has been meeting the needs of the cultivators for slow, heavy draft, but the cultivator has also paid attention to the milking qualities of the cows, though the primary concern has been the obtaining of adequate draft power for his agricultural and marketing operations.

The Hyderabad State Government maintains a Deoni cattle breeding farm for improvement in milk as well as draft qualities of the breed. Average milk production of all tested cows for the

Year 1948/49 has been 1,666.5 pounds in an average lactation period of 306 days. The average dry period has been 141 days. Animals from the Government farm which are classed as superior have produced 2,403 pounds in 300 days, all milked only twice a day.

The average calving interval is estimated at 447 days, though very little information is available regarding regularity of breeding. The majority of the animals are said to come in heat during the months of February and March. Age of heifers at first calving is approximately 3 years and 10 months.

Deoni bulls are put to service when they are about 3 years old, and it has been observed that they are somewhat slow breeders. Male calves are castrated very late and the bullocks are put to work when they are about 4 years old. Deoni bullocks are willing and active workers but slow in movement. Taking into consideration the nature of the land, a pair of bullocks will carry approximately 1,200 pounds of load in an iron-tired cart and travel a distance of about 21 miles in 10 hours. They are usually worked for 252 days in a year at the rate of 8 to 10 hours a day.

Performance in Other Areas

The breed has not spread beyond its native home.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are approximately 650,000 Deoni cattle in the tract (Anonymous, 1946). The Hyderabad State Government is sponsoring schemes for the development of this breed, and in view of the greater demand for cattle of this type the number is increasing.

The following are some of the important places and markets in the district of Bidar, Hyderabad State, India: Dongarpatti, Udgir Taluka - Rainapur Market - Hundergulli Market.

For further information regarding the breed, these authorities may be contacted:

1. Animal Husbandry Commissioner to the Government of India, New Delhi, India.
2. Director of Veterinary and Animal Husbandry Department, Hyderabad, Hyderabad State, India.



Figure 14. A Gir herd in the grazing area of Kathiawar, India. Gir cattle are found in their purest form in the forest of that name in Southern Kathiawar: the leaf-like ears notched near the tip, and the prominent, broad and convex forehead are characteristic.

GIR

Origin

The native home of the Gir breed of cattle¹ is in the Gir hills and forests in the south of the Kathiawar peninsula on the west coast of India. In the adjacent States of Junagarh, Bhavnagar, and in Amreli Prant of Baroda State, they are bred extensively. Cattle having Gir blood are, however, met with over a wide area including north Kathiawar up to Cutch, western Rajputana, the northern part of Bombay State and as far south as the western portion of Hyderabad State. Most of the States in Kathiawar maintain pure herds of Gir cattle.

Definite contributions of Gir blood are in evidence in the following breeds of cattle: Mewati, Red Sindhi, Deoni and Nimari.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The area covered by the breed is south of the Tropic of Cancer between 20°5' and 22°6' north: the longitudinal position is approximately between 70° and 72° east. The area covered by the Gir hills and forests is approximately 1,500 square miles but the breed spreads besides this area into Junagarh State to the east and Amreli Prant of Baroda and Bhavnagar to the west which would cover about 6,000 to 7,000 square miles.

The surface of the area is for the most part undulating, the altitude of the region varying from 429 to 1,925 feet above sea level. The Gir range of hills is low, the highest peak being 3,666 feet above sea level. Some of the low-lying valleys between Gir ranges are liable to floods. The ranges run west to east and are nearly parallel with the southern seacoast of Kathiawar. Though the area abounds in streams, ponds and wells, the only river of importance originating in the highest part of the Gir forest is Shatrangi, which drains into the Arabian Sea. In the Junagarh State area the rivers Bhadar and Sāraswati are important; they drain towards the western seacoast of Kathiawar.

¹ See Figures 44 and 45.



FIGURE 45. Gir bullocks are large and powerful, but slow and lethargic. Selected cows average nearly 4,000 pounds of milk in a lactation.
Above: a Gir bull. Below: a Gir cow.



All the Gir hills being volcanic in origin, consist of trap and basalt. There is much variety in the texture, quality and depth of soil habited by the breed. The soil is generally black with scattered tracts of the lighter kind of soil. The soils of the Gir forests and adjacent areas are either light-colored or red. Black soil is supposed to be very fertile but the lighter colored and red soils respond well to the irrigation.

Climate

The climate of Kathiawar in general may be said to be temperate and pleasant, and the rainfall is moderate. The months of January, February and March are marked by heavy dews and thick fogs. The summer season begins in March and lasts till the end of June when the rain falls. The southern section is slightly hotter than the northern one. Monsoon begins in June and ends in October. Rainfall in the northern and central areas varies from 20 to 25 inches, while in the west, as in Junagarh, and in the south, the annual rainfall averages about 40 to 45 inches.

Average maximum and minimum temperatures of areas near the Gir forest are given below:

	<i>Max.</i>	<i>Min.</i>
Hot season.	98°F.	84°F.
Rainy season.	88°F.	77°F.
Winter	88°F.	60°F.

Even during the hot season, when occasional day temperatures may go as high as 105°F., the nights are pleasant and cool with plenty of breeze.

Table 48. Climatological Data: Average of Ten Years for the Gir Area

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F. . . .	75.8	79.4	89.0	97.7	102.5	97.9	89.2	85.5	87.6	91.7	85.4	78.2
Mean minimum temp. °F. . . .	47.5	50.6	60.4	71.2	78.8	79.0	75.8	73.8	71.2	63.7	54.2	48.6
Mean daily humidity, percent	54.0	49.0	45.0	38.0	43.0	63.0	76.0	78.0	73.0	55.0	53.0	57.0
Rainfall, in inches	0.11	0.14	0.10	0.16	1.14	3.30	7.25	6.92	3.86	0.66	0.06	0.08

Supplied by the Indian Meteorological Department, Government of India, New Delhi.

Table 49. Climatological Data from Rajkot in Kathiawar

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Barometric pressure reduced to 32 °F	29.58	29.55	29.48	29.40	29.32	29.18	29.15	29.22	29.33	29.45	29.53	29.58
Mean wind velocity in miles per hour	2.44	2.88	3.63	4.88	6.63	6.81	6.94	6.06	4.19	2.56	2.25	2.12
Vapor pressure, in inches of mercury	0.276	0.333	0.443	0.539	0.695	0.794	0.851	0.820	0.774	0.621	0.389	0.287
Mean monthly evaporation, in inches	8.22	6.92	11.11	14.40	20.29	16.62	10.08	8.25	11.70	7.78	8.82	8.09

Indian Meteorological Department, Scientific Notes, Vol. VI, No. 61, page 31.

Vegetation

The Gir forest, though thickly wooded, is more extensively used for pasture purposes than as a source of timber. The principal trees found in the forest are Teak (*Tectona grandis*), black wood (*Dalbergia latifolia*), Babul (*Acacia arabica*), Jambul (*Eugenia sambolana*), dhak (*Butea frondosa*), Indian padauk (*Acacia catechu*). In areas other than the Gir forest there are not any important trees. Mangoes and Mahua (*Bassia latifolia*) are commonly found besides palms and *Casuarina* in coastal regions. The following grasses are prominent varieties in the forest area: *Cynodon dactylon*, *Dichantium* (*Andropogon*) *annulatum*, *Iseilema* (*Anthistiria*) *wightii*, *Iseilema* (*Anthistiria*) *laxum*, *Ischaemum rugosum*, *Apluda varia*, *Themeda* (*Anthistiria*) *triandra*, *Heteropogon contortus*, *Chrysopogon montanus*, *Ischaemum pilosum*, *Cenchrus biflorus*, *Polytoca barbata*.

The grass-growing season in the Gir forest and other pasture areas of Kathiawar is between July and December. In the higher regions of the Gir hills pasturage is also available up to March or April and herds of cattle are usually taken there. Depending upon the quality and depth of soil and the availability of irrigation facilities, varieties of crops are grown in the area. The following are important from the point of view of the cattle industry as the by-products from these crops are utilized in cattle feeding: sorghum, millets, wheat, rice, pulses such as

Phaseolus mungo, *Phaseolus radiatus*, *Cajanus indicus*, *Cicer arietinum*, *Pisum sativum*, sugarcane; and of the garden crops, carrots are used for cattle feeding in some parts of the area. *Cyamopsis psoralioides* and *Vigna catjang* are also utilized to a certain extent as fodder crops.

Professional breeders maintain their cattle mostly on pastures. There is very little storage of grasses. Cultivators, on the other hand, make use of pastures to a limited extent as well as stovers, dried grass, etc. They also feed concentrates such as wheat bran, gram husk, pulse seeds, cottonseed, oilcakes, etc., to their milking animals and working bullocks.

Management Practices

Besides cultivators who own only a few animals, Gir cattle are largely bred in Kathiawar by professional breeders known as Rabaris, Bharwads, Maldharis, Ahirs and Charans. These lead a nomadic life, moving their cattle from place to place in search of grazing. Good pasture is usually available from July to December; thereafter the pastures are scanty. From January onwards the animals are moved to the hillsides in the Gir forest where good pasture is available for the next 2 or 3 months. Grazing is permitted in most of the forest reserves and fees are realized by levying certain rates per head of cattle grazed.

Calves are allowed to suck for 8 to 12 months and milking cows are usually retained in the village areas, but dry cows and weaned young stock are taken to the distant pastures. Bullocks and milking cows are fed concentrates such as wheat bran, crushed pulses, grain husk, oilcakes and cottonseed, and fodders such as stovers of sorghum and millets, dried grass or straws. Only the milking cows, bullocks and young calves are provided with shelter; other animals are not housed or sheltered. Herds maintained by many Rajas and chiefs in Kathiawar are partly stall-fed and partly maintained on pastures.

Breeders take good care of the bull calves, which are sold to the cultivators to be trained as bullocks when they are about 18 to 24 months old. To make the best use of cow dung and urine there is a prevailing practice in Kathiawar to keep the animals herded in a field for 3 or 4 nights for which the owners of cattle



FIGURE 46. In Bombay city, India, Gir cows are famous for their large milking capacity. Above: a Gir bull in Bombay. Below: a Gir cow in Bombay.

By courtesy of Dr. S. S. Khot.



receive some remuneration and at the same time some feed for their cattle.

Physical Characteristics of the Breed

In purebred Girs, the entire red color is sometimes encountered although it is usually mottled and varies from yellowish red to almost black. The popular color is white with dark red or chocolate brown patches distributed all over the body. A well-defined patch of either dark or light color, generally found on one or both sides of the body, is typical of the breed: it may be noted, however, that this peculiar Gir coloring seems to be recessive.

Table 50. Average Measurements of Gir Cattle

MEASURE	Mature male			Mature female		
	Max.	Min.	Average	Max.	Min.	Average
Weight, in pounds			1 200.0			850.0
Length from shoulder point to pinbones, in inches . .	66	51	60.1	64	48	55.0
Height at withers, in inches .	56	48	53.5	57	45	50.4
Depth of chest, in inches . .			23.7			22.1
Width of hips, in inches . . .	24	12	17.8	21	12	17.0
Heart girth, in inches	80	60	71.8	74	58	66.0
Birth weight, in pounds . . .			56.0			53.0

Date supplied by Ware, 1938 and the Indian Journal of Dairy Science 1950. 3 (2): 46-51.

The most noticeable characteristic of the Gir is a very prominent and broad forehead, which forms a heavy, bony shield covering part of the head. This broad bony forehead overhangs the eyes to such an extent that they appear to be partially closed, thus giving these animals a sleepy appearance. The ears are markedly long and pendulous, opening to the front and resembling a curled up leaf, the points turning inward in such a way that particularly in young animals the tips almost meet under the jaw. There is a characteristic notch near the tips. Greatest

width of ears varies from 5.5 to 9 inches while the length varies from 10 to 17 inches. Horns are peculiarly curved. Starting at the base of the crown they take a downward and backward curve and again incline a little upwards and forwards taking a spiral inward sweep, finally ending in a fine taper.

The dewlap is only moderately developed while the sheath in males is usually large and pendulous. The skin is loose, pliable and of fine quality and the hair is short and glossy. Hooves are of medium size and black in color. They are supposed to be medium hard, and bullocks are usually shod when continuously working on hard roads.

Functional Characteristics of the Breed

Gir cows are fairly good milkers, though in their native home the variability in milk production is very large; in Bombay city and its suburban areas the breed is prized for this characteristic¹. Gir bullocks are extensively used as draft animals. They are heavy, powerful animals but are medium-paced in movement.

The average milk production of Gir cows, based on records of performance at recognized farms in India during 1936/37 to 1939/40, is shown in Table 51.

Table 51. Average Production of Gir Cattle at Recognized Farms in India

Y E A R	No. of records averaged	Average lactation yield, in pounds	Average lactation length, in days	Average dry period, in days
1936-37	5	2 753	295	197
1937-38	22	3 850	378	120
1938-39	33	3 763	347	138
1939-40	46	3 475	324	123

Information from memorandum, Ministry of Agriculture, Government of India.

At the Kandivilli Cattle Breeding Farm, near Bombay, average milk production records were taken, as shown in Table 52.

¹ See Figure 46.

**Table 52. Average Production of Gir Cattle at Kandivilli
Cattle Breeding Farm, Near Bombay**

GROUP OF ANIMALS	Milk yield, pounds	Days in milk	Days dry	Fat percentage
1) Average production	3 500	300	150	Morning: 4.6 Evening: 5.4
2) Superior production	4 500	310	130	Morning: 4.6 Evening: 5.2

The figures in table 53 are quoted from milk production records of Gir cows maintained at the Indian Dairy Research Institute, Bangalore. They comprise completed lactations during the year 1949/50 (Laxminarayan, 1950).

**Table 53. Average Production of Gir Cattle at the Indian
Dairy Research Institute, Bangalore**

LACTATIONS	Milk yield, pounds	Days in milk	Days dry
37	3 211	290	154

Data collected (730 samples) show that the average percentage of fat in milk from Gir cows is 4.54, while average solids-not-fat percentage is 9.15 (Dastur and Kothavalla, 1946).

The average age of heifers at their first calving is variable: it is estimated at 51 months. Later calvings are more regular, with intervals of 14 to 16 months. Although cows calve throughout the year there is a strong tendency, particularly observed in Kathiawar, that they calve more often in the months of January, February and May. Average birth weight of calves estimated from records at the Indian Dairy Research Institute at Bangalore is 56 pounds for males and 53 pounds for females.

Gir bulls are put to service at an average age of 40 months and it is considered that Gir males are, to some extent, shy

breeders. Bull calves are not weaned from their mothers until they are 8 to 10 months old and are usually allowed a fair share of the milk. The average breeding life of bulls is usually 7 years.

The bullocks, if well-developed, are heavy, powerful animals. They are even-tempered and are supposed to be good for long-distance heavy transportation. In an iron-tired bullock cart they can haul about 1,200 pounds of weight for 20 miles in about 7 to 8 hours. They are extensively used in their native home for all agricultural operations such as plowing, harrowing, pulling water from wells, and transportation. On an average they work for 10 hours a day.

Gir cattle are reputed to be the best beef cattle of India though they are not used for this purpose in India. They were exported to Brazil during the latter part of the 19th century and developed there as one of the important beef breeds. The Gir has played a prominent role in the evolution of Indubrasil cattle of Brazil.

Performance in Other Areas

Grading-up in India

Intentionally or unintentionally, Gir cattle have been used extensively for grading local cattle over a wide area of Western India from Cutch in the north to as far south as the Hyderabad State. Owing to the annual movement of Gir cattle in search of grazing, or in the course of transportation of goods on pack cattle, they have contributed their blood to the various breeds of cattle existing between western Rajputana and the eastern borders of Uttar Pradesh.

Existence of Gir blood is clearly visible in Mewati, Deoni and Nimari breeds of cattle. It is also to be seen in some Red Sindhi cows. Gir has also contributed to the formation of the Krishna Valley breed.

Pure herds of Gir cattle are maintained at Rajkot, Bhawnagar, Jamnagar, Junagarh, Bombay, Ahmednagar, Ahmedabad, Ajmer and Bangalore. Purebred bulls from these herds are used to grade-up the local cattle from the surrounding areas.

Brazil

Gir cattle, known as Gyr in Brazil¹, were imported into São Paulo for the first time in 1890. Subsequent consignments came in until 1920. After that the importations were stopped. They are bred extensively in Central Brazil in the States of Minas Gerais, São Paulo and Goiás Mato Grosso. Gir cattle have been used for pure breeding as well as for grading and crossbreeding. The Indubrasil breed of cattle originated from crosses made between Gir and Kankrej (Anonymous, 1947).

The climate prevalent in the area where Girs are extensively bred is tropical. The annual average temperature is 72.5°F. with variations of 5.4°F. to 12.6°F. The precipitation varies between 45 and 70 inches. From April to September is usually a dry period with rainfall as low as 2 inches. During October and until April the pastures provide excellent feed for the cattle; the majority of the pastures are natural, but in advanced Brazilian regions there are also cultivated pastures.

The following species of grasses are prominent: *Panicum maximum*, *Hyparrhenia* (*Andropogon*) *rufa* and *Melinis minutiflora*. Wherever purebred cattle are reared under superior management, supplementary rations are fed to the cattle during periods of scarcity. The following feeds are usually used: corn, rice bran, wheat bran, cottonseed meal. Chopped sugarcane is also used. Gir cattle, though primarily used for beef production, are also used for milk production.

The color of the Gir, as accepted in Brazil, is red, white, red and white with spots, or yellow. It is the conformation of the Girs which is prized most by the breeders, though, for beef production, the animals are on the smaller side. In appearance they are strikingly impressive.

In Brazil, Gir cattle are utilized to produce beef on grassland feeding alone. It is observed that the females usually calve for the first time when they are about 39 months old and that they mature sexually earlier in Brazil than in India, although exact data are lacking. There is no fixed breeding season and the animals are ready for mating in any season. Bulls are ready

¹ See Figure 47.



FIGURE 47. Girs, exported to Brazil, are greatly valued for their beef production. This breed was used in the formation of the Indubrasil breed in that country. Above: a Gir bull in Brazil. Below: a Gir cow in Brazil.



for service at the age of 2 years, having an active breeding life of 8 to 10 years.

In experiments carried out at the Experimental Breeding Center of Sertaozinho, it was noted that the dressed meat percentage from Girs amounted to 62.1 percent. At the same center it was observed that 2-year-old bullocks from Gir crosses weighed 1,195.3 pounds.

It is noted (Anonymous, 1949 (b)) that from two lots of 5 Gir-cross cattle each, the average weights at slaughter were 842.5 and 833.7 pounds while the cold carcass weights were 495.2 and 496.1 pounds. It is noted from a study in Brazil (Veiga, 1945) that Gir cattle have a hereditary recessive sub-lethal factor of flexed limbs.

Though no exact studies are available, the foraging capacity and resistance to tick-borne diseases amongst Gir are favorably regarded by breeders.

Purebred Gir cattle are maintained at the Government Experimental Livestock Breeding Station near Uberaba for improvement and research. The station is located in a zone of tropical climate of semi-humid type having around 2,330 hours of direct sunlight in 12 months. The mean temperature is 70°F. during the dry season and 74°F. during the rainy season. Of these two seasons, August is the driest month in the year with 55 percent of relative humidity; January being the most rainy month with 12.8 inches of rain. Annual rainfall in the region is 64.4 inches; the region has on average 125 days of rain during the year.

The breeding season is planned to begin on 1 May and continues until the end of January; consequently, the calving season starts in the middle of February and continues through to the first half of November. Cows are allowed to calve in previously chosen pasture grounds and the calves are nursed by their mothers. When the calves are about 8½ to 9 months old, they are weaned and separated into sex groups, at which time bull calves are put on an additional feeding schedule which is a mixture of ground feeds having millets, rice or wheat bran and cottonseed meal with approximately 14 percent protein.

Bulls are allowed to breed when they are 24 months old. Similarly, heifers are allowed to be bred when they are 24 to 27

months old. Weights of animals maintained at this station are given in Table 54 (Veiga, 1949).

Table 54. Weights of Gir Cattle at the Government Experimental Livestock Breeding Center, Uberaba, in Pounds

A G E	Male (pounds)	Female (pounds)
At birth	54.2 + 1.98 (27)	52.5 + 1.3 (31)
3 months	141.3 + 6.4 (32)	134.7 + 3.7 (46)
6 months	250.0 + 12.3 (36)	233.0 + 6.4 (45)
9 months	351.9 + 13.2 (28)	321.7 + 7.7 (43)
12 months	421.8 + 16.3 (19)	382.1 + 9.0 (39)
15 months	514.0 + 31.5 (8)	435.5 + 13.4 (36)
18 months	606.4 + 34.4 (7)	484.9 + 10.6 (33)
21 months	712.9 + 26.5 (7)	553.2 + 9.3 (29)
24 months	794.7 + 34.8 (5)	601.9 + 11.2 (28)
Daily gain in weight from birth until 24 months old . . .	1.027	0.763

Figures in brackets refer to the number of animals recorded.

In an experiment conducted at the Animal Genetics Laboratory in São Paulo to find out the influence of the environmental temperature on body temperature, it was observed that Gir cattle (average of 6 animals) registered average body temperatures of 101.0°F. and 102.0°F. when the atmospheric temperatures were 70.5°F. and 87.0°F. This may be compared to the body temperatures of European breeds of cattle (average of 89 animals representing 6 breeds) 101.0°F. and 103.5°F. when atmospheric temperatures were 69.5°F. and 87.0°F. (Villares, 1943).

United States of America

Numerous strains of cattle from India, including Gir, are bred in the Gulf Coast region of the United States, where they are commonly referred to collectively as Brahman cattle. Though Gir blood has not been maintained in a pure form, its influence can be seen in many herds of so-called Brahman cattle in Texas, Louisiana and Florida.

Australia

Zebus, or animals with Indian breeding, were introduced into Australia from the U.S.A. In the 1933 importation there was

a bull of Gir breeding. These animals were taken for a cross-breeding project to evolve strains which could stand tropical conditions and produce economically under those conditions.

Sources of Breeding Stock and Information Regarding the Breed

Though the largest concentration of Gir cattle is seen in Kathiawar, a number of important breeding herds are found in Bombay State. A breed registry of Gir cattle has been started under the guidance of the Indian Council of Agricultural Research, New Delhi, India.

The following may be contacted for further information regarding the breed and the availability of stock:

1. Livestock Expert to the Government of Bombay, Poona, India.
2. Animal Husbandry Commissioner to the Government of India, New Delhi, India.

In Brazil, where pure stock is maintained, the following agencies may be contacted for further information.

1. Departamento da Producao Animal, Postal Box 215-B, São Paulo.
2. Sociedade Rural do Triangulo Mineiro, Postal Box 39, Uberaba, Minas Gerais.

NIMARI

Origin

Nimari cattle¹ show an admixture of Gir and Khillari (Tapi Valley strain) breeds. The breed has taken the coloration from the Gir as well as its massiveness of frame and the convexity of the forehead. It has acquired the hardiness, agility and temper of the Khillari with the formation of feet and occasional carrotty color of the muzzle and hooves. Starting from Barwani and

¹ See Figure 48.

Khargone districts of Madhyabarar, the breed spreads into Khandwa, and parts of Harda of Madhya Pradesh. It is also bred in adjacent parts of Bombay State. In the Satpura ranges of Madhya Pradesh there is a strain of cattle known as Khamla, which is much smaller in size but very akin to the Nimari: in addition, the Khamgaon strain found in Berar may be an offshoot of the Nimari. This breed of cattle is much prized for draft work, though few animals show evidence of fair milking qualities.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The approximate area covered by this breed lies between 70° to 76° east longitude and 21° to 23° north latitude. The tract known as Nimar is made up of parts of territory from Madhya Pradesh as well as Madhya Bharat States. It is comprised of the whole Narbada Valley from the Ganjal River on the east to the Hiranpal on the west, in both of which places the Vindhya and Satpura ranges of hills run down to the river. The Narbada River forms the northern boundary, while the Tapi River is to the south. The whole surface is hilly and undulating. Throughout the area the geological formation is the trap rock of enormous thickness. Near the Narbada River, sandstones, limestones and other strata appear in places. The ridges and hills are under forest.

The soil of the area is formed from disintegrated trap rock and is partly alluvial. Along the flat banks of streams it is a rich, black clay from 4 to 10 feet deep and extremely stiff. In ordinary years it produces two crops. Next to this in excellence is the ordinary black soil of the Narbada Valley which will produce wheat or other spring crops without irrigation. The upper Tapi Valley also contains a considerable area of this kind of soil. On the summits of the plateau and high-lying level ground, is found a shallow brown soil resting on gravel and suited for rain-fed crops, which do not require large quantities of water.

Climate

The climate is dry and healthy. During summer months, though the heat is severe during the day, the nights are cool and pleasant. Light rainfall and cool winds from the west make the

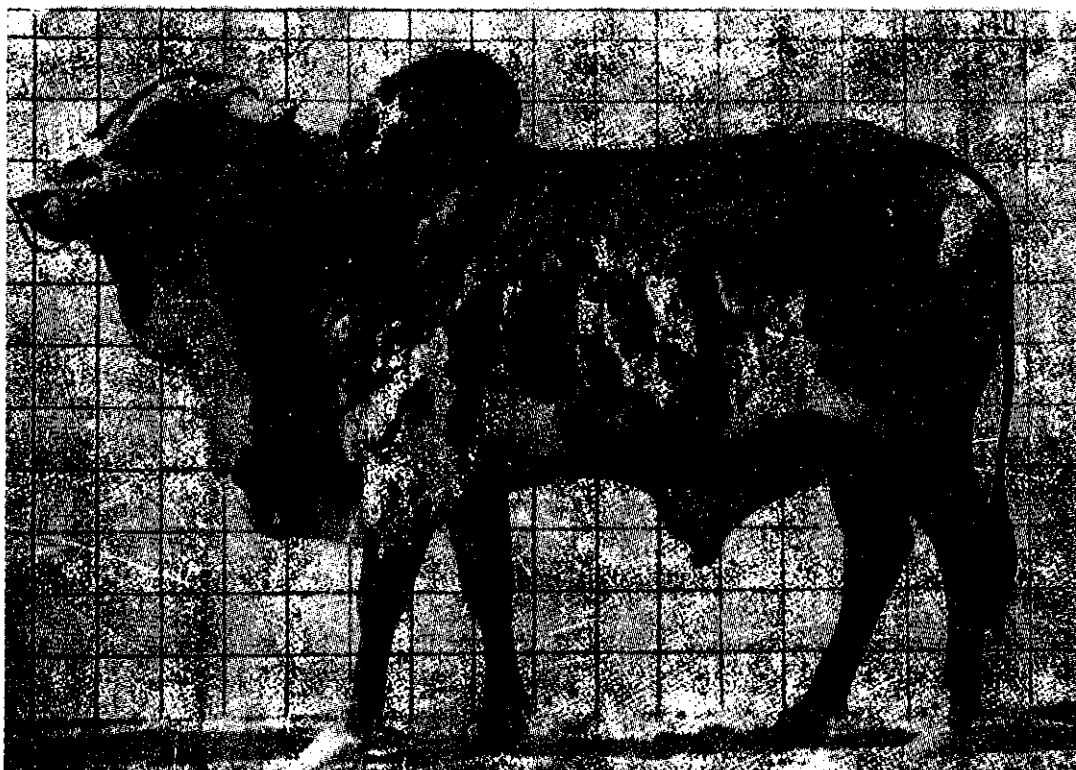


FIGURE 48. Nimari cattle, a cross between Gir and Khillari cattle, are variable in type. They are much prized as active work cattle but few cows show evidence of fair milking qualities. Above: a Nimari bull. Below: a Nimari cow.



monsoon season pleasant. The winter is very mild. Average climatological data for the area are summarized in Table 55.

Table 55. Climatological Data for the Nimar Tract

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	79.3	82.8	91.2	99.2	104.4	97.3	85.6	84.1	85.9	88.7	83.6	79.0
Mean minimum temp. °F . . .	49.8	54.6	61.9	71.3	79.0	77.5	74.1	73.2	72.1	65.2	45.2	49.5
Barometric pressure reduced to 32 °F	28.95	28.90	28.84	28.75	28.68	28.57	28.55	28.61	28.70	28.85	28.92	28.96
Mean wind velocity in miles per hour . . .	1.45	1.94	2.36	3.63	4.67	4.73	4.24	3.94	2.91	1.45	1.27	1.21
Humidity, per cent	49.0	36.0	27.0	27.0	38.0	63.0	78.0	82.0	78.0	57.0	49.0	48.0
Vapor pressure in inches of mercury294	.271	.277	.335	.508	.730	.797	.771	.748	.521	.365	.312
Mean monthly rainfall in inches	0.32	0.12	0.14	0.10	0.42	5.42	8.61	6.49	5.97	1.23	0.53	0.28
Mean monthly evaporation in inches	5.36	8.40	12.15	15.60	23.72	11.97	6.17	4.40	6.24	6.91	6.24	5.64

Information from the Indian Meteorological Department, and evaporation data calculated by Raman and Satkapan (1948).

Management Practices

Every cultivator maintains a few animals. Soil conditions in Nimar demand the use of heavier implements which necessitates the use of powerful bullocks. The Nimari cultivator is observed to be very hardworking and a careful husbandman.

During the monsoon times almost all the cattle are maintained on grazing, though bullocks which have plenty of field work are stall-fed. They are fed on harvested grasses, together with concentrates such as cottonseed, crushed chickpeas and oilcakes of sesamum or groundnut. In winter all the cattle are stall-fed. It is usual practice to grow vetches such as *Lathyrus sativus* for cattle feeding. Green chaffed sorghum is also extensively fed especially to lactating cows, young stock and working bullocks. During summer months cattle are fed with loppings from trees

such as *Acacia arabica*, *Hardwickia binata* and *Ficus benghalensis*. Male calves receive special care both in feeding and management. The surplus male calves are sold when they are about 2 years of age.

Physical Characteristics of the Breed

The animals are well-proportioned and compact in appearance. In general they are red in color with large splashes of white on various parts of the body. In the Khamgaon strain the color is occasionally black or light red and white. In the Khamla strain it is red with a violet tinge and white or yellow and white.

Average data on certain body measurements are summarized in Table 56.

Table 56. Average Measurements of Nimari Cattle

MEASURE	At one year	At two years	Mature
Females			
Weight, in pounds	320	460	672
Length from shoulder point to pin bones, in inches	32	43	48
Height at withers, in inches	34	44	52
Width of hips, in inches	10	12	22
Heart girth, in inches	45	48	63
MEASURE	At one year	At two years	Mature
Males			
Weight, in pounds	380	530	860
Length from shoulder point to pin bones, in inches	38	46	57
Height at withers, in inches	40	48	61
Width of hips, in inches	8	10	24
Heart girth, in inches	45	52	68

Average data supplied by the Nimar Cattle Breeding Farm, Madhya Bharat.

The head is moderately long with a somewhat bulging forehead, it is carried alertly and gives the animals a graceful

appearance. The horns usually emerge in a backward direction from the outer angles of the poll, somewhat in the same manner as in Gir cattle, turning upwards and outwards and finally backwards at the points. Occasionally, the horns are also like the Khillaris in size and shape, with copper color and pointed. The ears are moderately long and wide and are not pendulous. The muzzle in many animals is either copper-colored or amber-colored.

The body is long, with a straight back and moderately arched ribs with the quarters usually drooping to some extent. There is a tendency to prominent hips common to the Gir. The dewlap and sheath are moderately developed, though the sheath is apt to be pendulous. The hump in bulls is well-developed and apt to be hanging at times. The limbs are straight and clean and the tail is long and thin with a black switch reaching to the ground. Hooves of the animals are strong and can stand rough wear on stony ground. The skin is fine and slightly loose. The cows usually have well-developed udders.

Functional Characteristics of the Breed

The breed is popular on account of its working capacity in rough areas. Bull calves are usually castrated and put to light work when they are about 3 to 3½ years of age. They are apt to be vicious, but if properly trained are willing and active workers. A pair of bullocks will haul an average load of ¾ to 1 ton in a bullock cart on a hard road a distance of 20 to 25 miles in a day. With lighter loads they cover the distance at the rate of about 3 to 3½ miles per hour. In field work they usually work for 8 to 10 hours a day. The average working life of bullocks is estimated to be 6 to 8 years.

Heifers usually calve at the age of 4 to 4½ years. Only a few cows, which are observed to have sufficient milking capacity after adequately feeding their calves, are milked. It has been observed at the Cattle Breeding Farm at Tagur, Bombay State, that the average annual yield of Nimaris has been 609 pounds after feeding their calves. On the Jalgaon Cattle Farm in Khandesh, Bombay State, the annual yield has been 901 pounds after the calves were fed. On the Gangapuri Cattle Farm, also in Bombay

State, the annual yield on one time milking after feeding calves has been 665 pounds. Under average rural conditions the calving interval is about 18 months.

Performance in Other Areas

The breed has been exported to parts of Bombay State and parts of Berar, Madhya Pradesh, within the last few years. Particularly in Bombay State attempts are being made to develop the milking qualities of the breed. It is used in the above areas for grading the local, inferior cattle, as well as for pure breeding.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are over 300,000 Nimari cattle and the number is increasing. The following may be contacted for further information:

1. Animal Husbandry Commissioner to the Government of India, New Delhi, India;
2. Director, Veterinary Services, Madhya Bharat Gwalior, Madhya Bharat, India;
3. Director, Veterinary Service, Madhya Pradesh, Nagpur, Madhya Pradesh, India.

RED SINDHI

Origin

The Sindhi or Red Sindhi breed of cattle¹ are mostly found in the district of Karachi and Hyderabad and in that region north of these districts known as Kohistan. The Las Bela strain, perhaps the most prominent strain, is found in the State of that name in Baluchistan. Olver (1938) mentions that the hill type of cattle of the Las Bela area of Baluchistan appear to have been the basis on which this breed has been built up.

The breed is similar in many respects to the Sahiwal breed of the Punjab and also at one time might have been closely

¹ See Figure 49.

related to the red type of cattle of Afghanistan and the Indian border. Extensive movement of cattle of Sind for grazing in the past has led also to admixture of blood from breeds such as the Gir.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The longitudinal position of Sind is 65° to 70° east, situated just above the Tropic of Cancer with latitude 24° to 30° north. The region to which the Sindhi is native is hilly in the north and in the west while in the south it has a low altitude and until recently was subject to floods: westwards the region rises to an altitude of 3,000 to 4,000 feet. The Kohistan area is a succession of broad valleys lying between ranges of hills running north and south. The cultivation in this area is dependent on spring from the somewhat bare hills, which are mostly composed of limestone. Portions of valleys which are not cultivated are covered with grasses and brushes. The soil varies from loam through sandy loam to sandy (Aitkon, 1907).

Climate

Annual rainfall ranges from 10 to 12 inches and a large proportion of this precipitation is during the months from July to October: winter rains are rare. Diurnal temperature variation in most parts of the area is not large. Mean temperature during winter months is between 64° and 69°F . During the months of May to July the mean temperature ranges between 88° and 92°F , while during the rest of the year it ranges between 70° and 80°F . Absolute maximum temperature may rise to 115° to 120°F . during June. Absolute minimum temperature may reach 35° to 40° during December and January. Winds generally blow from the south-west in the months of April to September with a speed of 12 to 13 miles per hour. Winds in other months tend to come from the north, and blow at a speed of 5 to 10 miles per hour. Climatological data for Karachi and Hyderabad (Sind), giving average figures by months, are shown in Tables 57 and 58; evaporation data calculated by Raman and Satakopan (1948) from other meteorological factors are also included in the tables.

Table 57. Average Climatological Data for Karachi (Drigh Road)

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	76.6	80.3	88.6	94.4	95.1	94.4	90.8	88.0	89.7	94.7	89.8	81.1
Mean minimum temp. °F . . .	49.9	53.0	61.9	71.0	77.5	81.9	80.9	78.6	76.3	68.1	59.9	53.7
Humidity per cent at 0800 hours	49.0	63.0	63.0	64.0	69.0	71.0	77.0	78.0	75.0	58.0	53.0	55.0
Rainfall, in inches	0.40	0.52	0.29	0.17	0.09	0.67	3.64	1.33	0.47	0.01	0.07	0.19
Barometric pressure reduced to 32 °F	30.06	30.00	29.91	29.80	29.69	29.53	29.39	29.57	29.72	29.87	29.99	30.06
Mean wind velocity in miles per hour	3.78	4.15	5.00	5.92	7.14	7.63	7.63	7.20	6.16	4.03	3.23	3.54
Humidity per cent	55.0	59.0	65.0	77.0	82.0	81.0	82.0	84.0	81.0	68.0	60.0	53.0
Mean monthly evaporation in inches	7.56	7.28	8.84	10.11	7.35	8.49	7.91	6.11	6.33	8.59	7.98	8.22
Mean monthly rainfall in inches	0.52	0.39	0.33	0.17	0.07	0.86	2.94	1.67	0.42	0.01	0.04	0.14

Information from the Pakistan Meteorological Department and Indian Meteorological Department, Scientific notes Vol. VI No. 61 (p. 27).

Table 58. Average Climatological Data for Hyderabad, Sind

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	75.8	81.2	92.5	101.8	107.0	104.5	99.3	95.8	97.3	97.8	88.8	78.6
Mean minimum temp. °F . . .	50.6	54.5	63.8	71.9	78.2	82.0	81.4	79.2	76.4	70.2	58.8	52.6
Humidity per cent at 0800 hours	61.0	62.0	58.0	57.0	62.0	68.0	73.0	76.0	75.0	64.0	58.0	60.0
Rainfall, in inches	0.17	0.24	0.20	0.07	0.19	0.39	2.98	2.03	0.63	0.03	0.06	0.10
Barometric pressure reduced to 32 °F	29.97	29.91	29.80	29.68	29.55	29.40	29.36	29.44	29.59	29.76	29.90	29.98
Mean wind velocity in miles per hour	2.99	2.86	3.44	4.48	5.97	7.33	7.20	6.88	5.58	3.44	2.53	2.92
Humidity per cent	52.0	52.0	45.0	43.0	50.0	58.0	64.0	68.0	65.0	55.0	51.0	51.0
Mean monthly evaporation in inches	5.89	5.77	11.07	15.36	21.42	20.22	17.14	13.27	11.85	10.63	7.71	6.39

Supplied by the Indian Meteorological Department, New Delhi.

Vegetation

Depending on the soil and availability of irrigation, the chief crops grown in the area are paddy, sorghum, pulses, clover, wheat, linseed and cotton. Straws and stovers from these form the bulk of the roughages fed to cattle. No regularly seeded pastures are available in the area but lands which are not too good for cultivation or are under forest are under grass cover. Forests which consist mostly of *Acacia*, *Zizyphus* and other trees utilized for fuel purposes are to be found along the banks of the rivers or streams.

On account of scant rainfall and concentration of that limited rainfall within 3 months, the growing period of grasses is short and they are available scantily only from August to October. The most commonly found grasses are *Eleusine flagellifera*, *Cynodon dactylon* and *Paspalum sanguinale*. There are other varieties which become coarse and woody quickly. Surplus grasses are harvested but they are not so palatable or nutritious.

Management Practices

The majority of cattle breeders known as "Maldars" are nomadic and take cattle for grazing from place to place. In the Kohistan area the cattle subsist on natural grazing only. The grazing consists of brushwood, natural grasses and shrubs. Thus the cattle are exposed to weather throughout the year without much shelter (Anonymous, 1926 (b)). In the villages, cultivators maintain their cattle on pastures as well as by-products of farm crops. More recently big landlords who take great interest in cattle breeding have grown special crops such as Egyptian clover, oats, maize, lucerne, sorghum and guar (cluster beans).

In and around Karachi and Hyderabad numbers of cattle owners have settled on account of a demand for milk and milk cows. Roughage being scarce, breeders have depended largely on concentrates, particularly for their milking animals. Concentrates fed are oilcakes, crushed grain or other pulses, pulse husks, wheat bran and crushed beans. These are usually soaked in water for several hours before feeding. The animals are milked twice a day and the concentrates are fed at milking time. Calves are not



FIGURE 49. Red Sindhi cattle, found in southwest Sind, Pakistan, also exist in India and show adaptability to a variety of climates. The bullocks, though small, make useful draft animals. This is one of the better milking breeds among Zebus. Above: a Red Sindhi bull. Below: a Red Sindhi cow.



weaned from their mothers at an early age, but the cows are very docile in nature and can easily be trained to be milked without calves being present.

Physical Characteristics of the Breed

Sindhis, as a rule, are small in size. Their comparative smallness is appreciated a great deal in areas where large animals are not needed and where feed conditions preclude the use of large animals, and they are reputed to have a capacity to adapt themselves to varying conditions of soil and climate.

This breed has a deep, compact frame, with round drooping quarters. The color is red, the shades varying from dark red to dun yellow. Though specks of white are seen on the dewlap and occasionally on the forehead, no large white patches are seen. In bulls, the color is likely to be dark at the shoulders and thighs.

The head is well-proportioned with an occasional bulge in the forehead, coming apparently from the admixture of the breed with the Gir breed of cattle. Horns are thick at the base and emerge laterally and curve upwards. Ears are moderately sized and drooping. The length of the ears is around $10\frac{1}{2}$ inches, while the width is about 6 inches.

The hair is soft and short, and the coat shines in bright sunlight. The skin is slightly loose and of medium thickness, while pigmentation is usually dark. The sheath is inclined to be pendulous. Hooves are compact but foot trouble is likely to develop in rocky areas. The udder, though capacious, has a tendency to be pendulous. The hump is of medium size, though well-developed in bulls (Ware, 1938).

The average weight of calves at birth is about 40 to 45 pounds for females and 42 to 48 pounds for males. Females weigh at 12 months of age 330 to 340 pounds, at 24 months 515 to 525 pounds and at 36 months 640 to 650 pounds. Mature cows weigh around 650 to 700 pounds, while bulls weigh 950 to 1,000 pounds. Average data on certain body measurements are summarized in Table 59.

Table 59. Average Measurements of Red Sindhi Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Length from shoulder point to pinbones, in inches	38.25 ± 0.55 (12)	41.75 ± 0.51 (12)	50.74 ± 0.41 (51)
Height at withers, in inches . .	38.04 ± 0.34 (12)	41.74 ± 0.39 (12)	47.53 ± 0.27 (51)
Depth of chest, in inches . . .	18.75 ± 0.37 (12)	24.00 ± 0.95 (12)	24.61 ± 0.21 (51)
Width of hips, in inches	11.33 ± 0.15 (12)	13.16 ± 0.51 (12)	16.57 ± 0.21 (51)
Heart girth, in inches	46.25 ± 0.71 (12)	52.75 ± 0.74 (12)	62.35 ± 0.36 (51)

MEASURE	At one year	At two years	Mature bull	Mature bullock
<i>Males</i>				
Length from shoulder point to pinbones, in inches	39.12 ± 0.43 (25)	45.00 ± 0.36 (15)	55.00 ± 0.07 (16)	56.84 ± 0.72 (19)
Height at withers, in inches	41.72 ± 0.35 (25)	45.83 ± 0.24 (15)	51.50 ± 0.48 (16)	54.13 ± 0.57 (19)
Depth of chest, in inches	20.64 ± 0.19 (25)	22.80 ± 0.34 (15)	26.67 ± 0.31 (16)	28.92 ± 0.46 (19)
Width of hips, in inches	11.86 ± 0.19 (25)	13.80 ± 0.10 (15)	17.12 ± 0.32 (16)	18.81 ± 0.42 (19)
Heart girth, in inches	48.60 ± 0.55 (25)	54.86 ± 0.63 (15)	69.12 ± 0.75 (16)	69.21 ± 0.53 (19)

Numbers sampled are shown in brackets.

Functional Characteristics of the Breed

The breed is primarily used for milk production, though in its native area the bullocks are used for all agricultural operations like plowing, carting, threshing, drawing water from wells, etc.

Records from the Government Cattle Farm at Malir, Karachi, show that the average milk production per lactation (305 samples) of all cows was $3,442.9 \pm 81.3$ in 274 days. The production is exclusive of the milk taken by the calf as weaning is not practiced on this farm. A special group of cows producing 4,000 to 5,500 pounds averaged 4,591 pounds, the number of lactations sampled being 41, while an average of 35 superior lactations was 6,778 pounds.

The average milk production of the entire group at the Malir farm during different lactations is shown in Table 60.

Table 60. Average Milk Production at the Malir Farm

ITEM COMPARED	LACTATIONS					
	1st	2nd	3rd	4th	5th	6th
Yields, in pounds	3 981	4 303	4 159	3 873	4 136	3 910
Days in milk	308	284	265	258	258	268

From the study of 222 lactation records at Malir Farm it was found that the average dry period was 160 days. The average calving interval was observed to be about 14.7 months and the average age at first calving, 41 months. It is estimated that the average number of lactations during a lifetime may be around 5.

From a study of 858 calves born at Malir Farm, it was observed that 53.4 percent were bulls and 46.6 percent were heifers. From breeding and calving records it was noted that there is a tendency for calvings to be concentrated in the period between August and December. In the case of the bull calves, they usually start breeding when they are 3 to 3½ years old, but well-nourished calves start service earlier, at about 2½ years. The bulls are apt to be slow in serving. The average breeding life observed was 6 to 7 years.

Bullocks used for draft are castrated when they are 3 to 4 years of age. Though comparatively small in size — usually a pair of bullocks weighs 1,500 to 1,800 pounds — the bullocks make very useful draft animals either on roads or fields. Being medium-paced and steady workers, they are suitable for field operations. On a rough dirt track they may pull 1,500 to 2,000 pounds of load on a two-wheeled iron-tired cart having a steel axle for 7 to 8 hours a day at the average rate of approximately 2 to 2½ miles per hour. As a pack animal a Red Sindhi bullock will carry 300 to 500 pounds of load.

As the breed has not been used for meat purposes, no studies are available to show its tendencies in this respect. The breed is observed to have to a moderate degree the resistance to tick fever and foot-and-mouth disease so characteristic of the Indian Zebus. They are moderately susceptible to rinderpest, but as regards other diseases, very little information is available.

Performance in Other Areas

India and East Pakistan

Herds of the breed have been exported to different parts of India and Pakistan such as East United Provinces (Allahabad), Travancore (Anna Malai hills), Assam (Shillong), East Bengal (Dacca), Madras (Hosur), Mysore (Bangalore) and Central Provinces (Jubbulpore) both for pure breeding and grading-up of local nondescript cattle. These places present a variety of climates from the equable, temperate climate of Bangalore and the high-temperature, humid climate in Travancore, with a rainfall of over 100 inches. The breed is also acclimatised to places like Shillong, situated in a hilly area about 6,000 feet elevation with annual rainfall of over 50 inches, and where, during the winter months, the temperature is apt to go below freezing point. On the other hand, temperature conditions during summer months, with hot, dry winds, are apt to be trying at Allahabad in East United Provinces (now known as Uttar Pradesh). The day temperature during hot weather may go as high as 116° F. to 118° F.

The average milk production of Red Sindhi cows, based on records of performance at recognized farms in India during 1936/37 to 1939/40 is shown in Table 61 (Anonymous, 1941). Distinction is made between animals bred and reared on these farms under favorable conditions of feeding and management, and animals which were purchased from the open market but fed and managed under approved farm conditions. When the records were obtained, yields as high as 12,000 pounds in a lactation of a little over 300 days had been recorded.

Table 61. Average Data on Milk Production of Red Sindhi Cows

YEAR	BRED ON FARMS				PURCHASED FROM MARKET			
	No. of records averaged	Av. lactation yield, pounds	Av. lactation length, days	Days dry	No. of records averaged	Av. lactation yield, pounds	Av. lactation length, days	Days dry
1936-37	85	3 604	296	130	15	3 531	314	140
1937-38	62	3 934	325	123	77	3 854	279	250
1938-39	80	3 971	325	130	70	3 448	283	135
1939-40	106	3 660	312	137	80	3 448	279	192

Average composition of milk from Red Sindhi cows as reported from a large number of samples in India is as follows:

Percentage total solids	13.44 ± 1.204
Percentage fat	4.925 ± 0.97
Percentage solids-not-fat	8.497 ± 0.532

An interesting study of crossing the Red Sindhi with the Jersey is being conducted at the Agricultural Institute at Allahabad, Uttar Pradesh, India. Results of this work are given in Table 62.

Table 62. Record of Performance of Animals from Cross-Breeding Red Sindhi With Jersey Cattle

BREED	Number of lactations averaged	Average lactation yield - pounds
Pure Red Sindhi	225	3 084.5
Jersey-Sindhi	129	4 551.6
1/4 Jersey - 3/4 Sindhi	148	3 916.9
1/8 Jersey - 7/8 Sindhi	27	3 754.7
1/16 Jersey - 15/16 Sindhi	6	3 891.3

Information up to December 1949 of Animals resulting from cross-breeding Red Sindhi and Jersey and back-crossing with Red Sindhi at Allahabad Agricultural Institute. (1950, A Brief Review of the Progress).

Ceylon

Red Sindhis are kept at Polonnaruwa Farm in Ceylon, which has slightly undulating topography. The soil is sandy loam and fertile. The annual rainfall is 50 to 75 inches, being heaviest during July to October. There is very little diurnal or seasonal variation in temperature which averages 77°F. with humidity of 66 percent by day and 83 percent by night. Under conditions of grazing and supplemental roughages but with only a limited quantity of concentrates, the actual yield after the calves where allowed to suckle approximated 7.0 pounds per day. Though the management has not been too satisfactory, it was noticed the cows where shy breeders and the calving interval has been 15 to 20 months.

Tanganyika Territory

In Tanganyika Territory, where Red Sindhis are used for grading native cattle and where poor conditions of management, shortage of good grazing and water and the disease menace is present, the mean yields of 11 selected Sindhi-native cows ranged from 2,457 to 3,835 pounds in lactation periods of 282 to 305 days. Butterfat percentage ranged from 4.0 to 5.7 while solids-not-fat percentage ranged from 8.9 to 9.7. The yields were recorded after the calves were suckled.

Philippines

In the College of Agriculture, University of the Philippines, the average daily milk production of all cows on the basis of 300 days was 4.6 liters and the average lactation was 345 days.

Rigor and Palicte (1949) observed from a study of records of Red Sindhi cattle maintained at the Alabang Stock Farm that milk production of imported Red Sindhi cows and their daughters born at the farm compared favorably with that of the breed in its native homeland. Some of the other items studied are summarized in Table 63.

Table 63. Comparison of Certain Characteristics in Red Sindhi Cattle in the Philippines and Pakistan

ITEM STUDIED	PHILIPPINES			PAKISTAN		
	Aver.	Min.	Max.	Aver.	Min.	Max.
Gestation period, in days . . .	280.0	252.0	299	285.9	257.0	328
Age at first calving, in days . .	1 109	921.0	1 418	1 227 0	720.0	1 650
Interval between calving, in days						
a) Imported	443.09	286.0	872			
b) Bred at the farm	447.58	307.0	628	441.10	300.0	620
Number of calves born, per 100 breeding cows	83.28	65.15	100	85.16	60.28	100

Observations made at Alabang Stock Farm on Red Sindhis and compared with similar observations made in Pakistan. .

United States of America

In an attempt to breed dairy cattle better adapted to the severe climatic conditions that prevail in the Gulf Coast area

of the United States of America during the summer months. experimental cross-breeding work with Red Sindhis was initiated at Beltsville, Maryland, in the year 1946. Two males and two females were imported from the Red Sindhi herd at the Agricultural Institute at Allahabad. Matings of the Red Sindhi bulls with Jersey, Brown Swiss and Holstein cows were planned. Crossbreds are raised in the same way as the other dairy animals at Beltsville. All crosses are being studied from the standpoint of production, growth rate and heat tolerance. Production records are made in 3 milkings daily. Records of the first ten Sindhi x Jersey crossbreds are summarized in Table 64 (Forhman, *et al.*, 1951), and growth rate as measured by body weight in Table 65.

Table 64. Actual Production Records of the First 10 Sindhi x Jersey Crossbreds to Complete a Lactation at Beltsville, Maryland, U.S.A.

HERD No.	PRODUCTION			Age at calving		Days milked
	Milk	Butterfat		Yr.	Mo.	Number
	Pounds	Percent	Pounds			
SX-1	10 757	5.99	645	2	1	365
SX-2	8 521	6.33	539	2	1	365
SX-3	10 300	6.06	624	2	2	365
SX-6	9 405	5.42	510	2	2	365
SX-7	4 767	5.75	274	1	11	305
SX-8	8 710	6.41	559	2	0	365
SX-9	9 186	6.77	622	2	1	365
SX-10	9 354	5.42	534	2	1	365
SX-11	9 902	5.52	547	2	1	365
SX-12	5 567	5.43	302	2	1	305

Table 65. Relative Growth of Red Sindhi x Jersey Females and Their Jersey Dams, as Indicated by Body Weight at Beltsville, Maryland, U.S.A.

AGE	Dam - daughter pairs	AVERAGE WEIGHT Sindhi x Jersey		Relation of daughters to dams
		Jersey dams	daughters	
	Number	Pounds	Pounds	Per cent
Birth	26	58	65	112
6 months	22	281	315	112
12 months	21	518	562	107
18 months	19	655	682	104
24 months	17	824	857	104
36 months	9	914	947	104

To study comparative heat tolerance of the Jerseys and the various combinations of Sindhi and Jersey, determination of individual responses to a fixed hot atmosphere in relation to age, stage of lactation and season are being made. This is being done in climatic chambers by 6-hour exposures to 105°F. and 34 mm. Hg. vapor pressure (wet bulb 92°F.). The results from the exposure to a hot atmosphere indicate that less change in body temperature takes place in the crossbreds than in the Jerseys, both as heifers and as lactating cows. Results are summarized in Table 66.

Table 66. Comparative Heat Tolerance of Jerseys and Sindhi × Jersey Crosses

COMPARISON	Normal body temperature (°F.)	Mean body temperature during exposure (°F.)	Normal respiration rate	Mean respiration rate during exposure	Normal pulse rate
<i>Jersey :</i>					
6 months old	101.9	103.44	27	148	90
12 months old	101.6	103.30	22	147	78
18 months old	102.2	103.05	21	149	72
<i>Sindhi × Jersey :</i>					
6 months old	102.0	102.17	23	124	88
12 months old	101.7	102.30	20	122	76
18 months old	101.5	102.00	20	120	72
Cows by Stages of Lactation					
<i>Jersey :</i>					
3 months in lact. . .	101.6	104.14	36	137	67
6 months in lact. . .	101.5	103.50	35	136	67
Dry	101.2	102.99	32	138	64
<i>Sindhi × Jersey :</i>					
3 months in lact. . .	101.5	102.30	28	134	68
6 months in lact. . .	101.3	—	28	—	68
Dry	101.2	102.08	24	126	68

In addition to the experimental work at Beltsville, similar work along the lines is being carried out at experiment stations in Louisiana, Texas and Georgia.

Studies of animal blood have taken a prominent part in

physiological research related to heat tolerance. Rusoff, Fr Scott (1951) report on some of the blood constituents s, packed blood cells volume (hematocrit), hemoglobin, plas and plasma inorganic P for 16 Jersey dams and their Sindhi-Jersey daughters. The information is summari Table 67.

Table 67. The Mean Hematocrit, Hemoglobin, Plasma CA and Inorganic of Jersey Dams and Red Sindhi-Jersey Daughters Determined Monthly Year Period

	No. OF SAMPLES		MEAN AND S.E.*		RANGE	
	Sindhi Jersey daughters	Jersey dams	Sindhi Jersey daughters	Jersey dams	Sindhi Jersey daughters	
Hematocrit (%) .	304 (a)	304 (a)	35.23 ± 0.28	29.95 ± 0.24	17.0 — 58.0	21.9
Hemoglobin (g %) .	384	384	10.23 ± 0.06	9.03 ± 0.05	8.50 — 15.60	7.0
Calcium (mg. % plasma)	384	384	9.63 ± 0.07	9.60 ± 0.06	8.62 — 13.96	8.7
Phosphorus (mg. % plasma)	384	384	7.53 ± 0.08	5.38 ± 0.04	3.75 — 14.29	3.2

(a) Determinations made on 19 months only. * S.E. - Standard Error.

Animals of the breed were also exported to Malaya French Indo-China, Burma and Formosa, but records of mance or behavior in those areas are not available.

Sources of Breeding Stock and Information Regarding th

The estimated population of the breed is 253,000 (Anoi 1946). Breeding stock without any production records had from open markets in and around Thanobulakha pursakro, Tatta, Kotri, Karachi and Hyderabad, Sind, P (Anonymous, 1949 (a)).

Further information regarding the breed, enquiry be made to the Animal Husbandry Commissioner, Min Agriculture, Karachi, Pakistan.

Small herds of well-bred animals are maintained in India also, and information about them may be had from:

1. Registrar, Central Herd Books, Indian Council of Agricultural Research, New Delhi, India.
2. Secretary, Indian Council of Agricultural Research, New Delhi, India.

SAHIWAL

Origin

Olver (1938) observed that the Sahiwal breed¹ is closely allied to the cattle of Afghanistan, that they are pale red or dun mixed with white and are among the best milking breeds of India (Pakistan). He further mentions that large numbers of people from Rajputana and Kathiawar with their cattle at one time came into the area of the Sahiwals and it is evident that some Gir blood, introduced in all probability at that time, still exists in this breed. Sahiwal cattle are also known as Montgomery cattle, as they are largely bred in the district of Montgomery, The Punjab, Pakistan.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The home of this breed is the dry central and southern area of the Punjab (Pakistan) in the neighborhood of the River Ravi and the area known as Nili Bar. A large part of the area lies in the district of Montgomery. The approximate location of the area is between latitude 29°5' and 31°2' north and between longitude and 74°8' east.

Montgomery district is in the shape of a rough parallelogram. Its southeastern side rests on the Sutlej River, while the Ravi River flows through the district parallel to Sutlej and not far from its northwest border. Except along the river banks and portions watered by the canals where silt has accumulated, the area

¹ See Figure 50.

is sandy. Sandy loam and loam soils are predominant. The whole area is undulating plain. A very large proportion of the agricultural land is now under canal irrigation.

Climate

The average rainfall of the area is about 10 to 12 inches with an average number of 23 rainy days from April to October and 8 rainy days during the rest of the year. The heat of the summer is severe. From May to the middle of October, and especially in June and July, the heat during the day is intense; the maximum temperature goes as high as 118°F. Heavy dust storms are likely to occur during the months of May to July. Winters are mild and pleasant.

Climatological data for the area are summarized in Table 68.

Table. 68. Climatological Data for Montgomery District

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F . . .	68.1	72.5	83.8	95.7	105.4	107.8	102.9	100.1	99.3	95.0	83.4	72.0
Mean minimum temp. °F. . . .	41.7	46.4	56.0	66.6	76.9	83.3	83.7	81.7	75.9	63.5	51.6	43.1
Humidity, per cent at 0800 hours I.S.T. . .	78.0	81.0	71.0	59.0	53.0	59.0	72.0	77.0	73.0	66.0	69.0	78.0
Rainfall, in inches	0.46	0.50	0.42	0.34	0.36	0.98	2.42	2.80	1.27	0.08	0.05	0.26

Information from Indian Meteorological Department, New Delhi, India.

Vegetation

Only limited grazing areas are available. Along the banks of rivers and streams some natural grasses provide pasturage for a few weeks after rains, prevalent varieties being *Cynodon dactylon*, *Eleusine aegyptiaca*, *Pennisetum cenchroides*, *Panicum colonum* and *Andropogon annulatus*. The main crops grown in the area are wheat, barley, cotton, chickpeas, lentils and rapeseed. By-products from these are largely fed to the cattle. Besides these the following crops are grown for fodder purposes and utilized for cattle feeding either as green crops or as hay: *Andropogon sorghum*, *Cyamopsis psoralioides*, *Trifolium alexandrinum*, turnips, oats and lucerne.

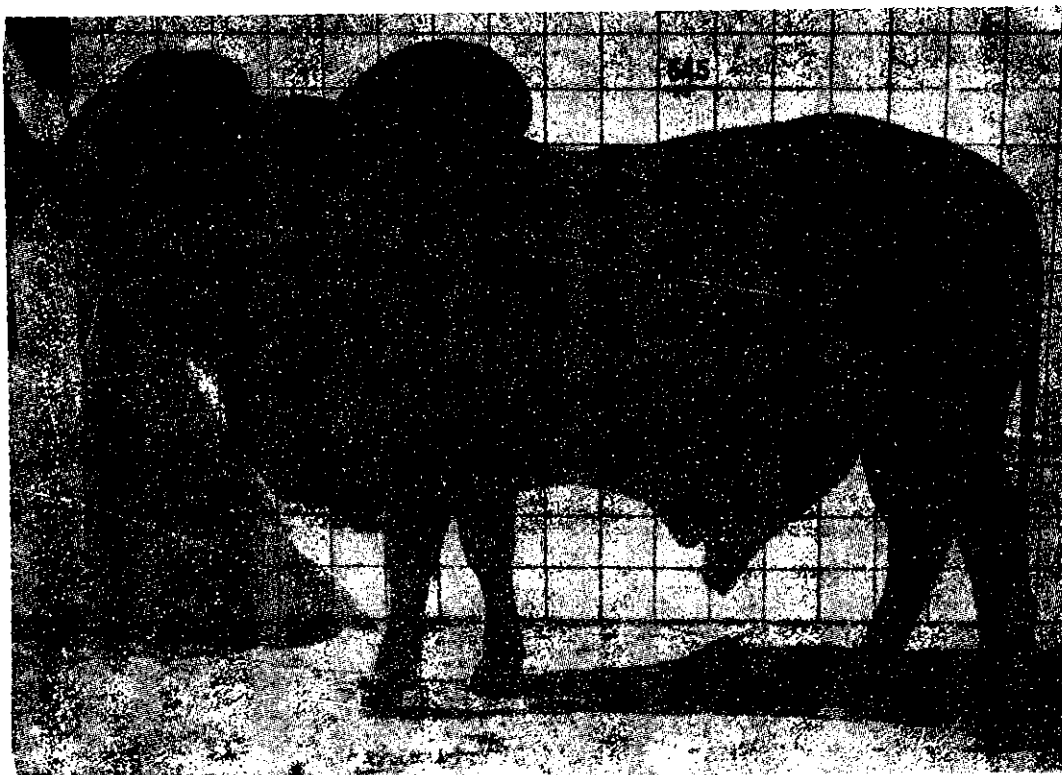
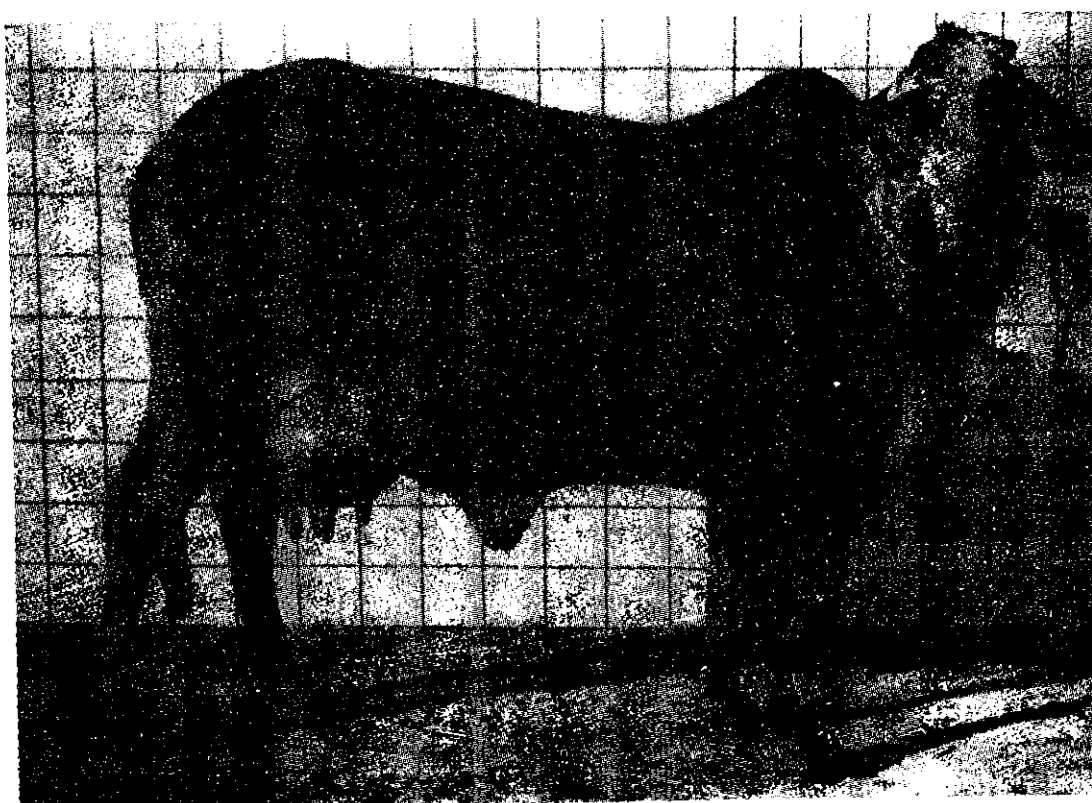


FIGURE 50. The Sahawal is the best dairy breed in Pakistan; selected cows producing 12,000 pounds of milk in a lactation; improved herds exist also in India. The bullocks are lethargic but useful for slow work.
Above: a Sahiwal bull. Below: a Sahiwal cow.



Management Practices

Prior to the availability of canal irrigation in this area, cattle breeding was the main source of agricultural income. A community of breeders, known as "Junglies", owned large herds of cattle and successfully maintained them on the available pastures. Since the establishment of canals large areas of land which were under pasture were brought into arable farming and the number of cattle owned by the average breeder was reduced.

At present an average cultivator maintains 2 or 3 cows. Grazing is available along the banks of rivers and streams but fodder crops, including legumes, are cultivated for feeding animals. There is also a class of landholders who own large areas of land and these maintain a large number of Sahiwal cattle. Some of the finest specimens of this breed are found on these privately-owned farms.

Sahiwal calves are not weaned at birth, but when 8 to 10 months old. The breeders maintain their animals on cultivated fodders and by-products of cereal crops and pulses. Wheat straw is carefully preserved and fed throughout the year. Crushed chickpeas, cottonseed, wheatbran and rapeseed oilcakes are fed as concentrates to the cattle. As Sahiwal cows are in demand outside their breeding area for urban milk supply, people pay a great deal of attention to the selection of bulls to sire their cows.

Physical Characteristics of the Breed

The Sahiwal is a heavy breed with symmetrical body and loose skin. The animals are usually long, deep, rather fleshy, short of leg, and comparatively lethargic and heavily built. They are commonly of a reddish dun color, but many are pale red, while dark brown and almost black colorings, splashed with white, are occasionally seen. White patches on the body are sometimes observed but whole white or gray color is rare.

The forehead is medium-sized in the females, but broad and massive in the males. Eyes are mild and placid. Ears are medium-sized with black hair on the fringe. The average length of the ear ranges from 10 to 12 inches, while the width is from 4 to 5 inches. Horns are short, thick and usually not more than 4

inches in length. Horns that are loose at the base are common among females.

The neck is short and lean, while the dewlap is large and heavy. The hump in the males is massive and frequently falls to one side. The abdomen is deep and large and the back is straight. The navel flap is loose and hanging, and the sheath in the males is also pendulous. Hip bones are high and wide apart. The loin is broad and strong. The rump is long and nearly level. The tail is long and fine with a black switch reaching almost to the ground. Hocks are wide apart with no tendency to straightness. The udder is generally large, pliable, firmly suspended from the body and not fleshy, although pendulous udders are not uncommon. Hooves are soft and wear out quickly on hard roads. Pigmentation of skin is frequently light. Average data on certain body measurements are summarized in Table 69.

Table 69. Measurements of Sahiwal Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	400.0	850.0	900.0
Length from shoulder point to pin bones, in inches	44.0	49.5	53.0
Height at withers, in inches	43.5	47.5	48.0
Depth of chest, in inches	32.5	26.5	31.5
Width of hips, in inches	13.25	16.0	17.5
Heart girth, in inches	56.0	62.0	66.5

MEASURE	At one year	At two years	Mature	Mature ox
<i>Males</i>				
Weight, in pounds	400.0	820	1200	1000
Length from shoulder point to pin bones, in inches	41.0	52	63	58
Height at withers, in inches	43.0	48	54	54
Depth of chest, in inches	22.0	25	32	28
Width of hips, in inches	12.5	16	19	19
Heart girth, in inches	57.0	66	80	72

Average data from the Records of the Indian Agricultural Research Institute, New Delhi, India.

male births was 286.38 days. It was observed that sex ratio in calves born was 105.73 males for 100 females. The incidence of twinning was 0.14 per 100 calvings.

Jamaica

This, the largest island of the British West Indies, lies about 18° north latitude and is mountainous, with a central range extending throughout its length. The maximum daily temperature on the plains ranges between 90° and 97° F., the minimum from 60° to 78° F. Rainfall varies from 25 inches in the southern plains to over 200 inches in the northeast.

A Sahiwal bull was imported from India in 1920. His dam gave 6,312 pounds of milk and his sire's dam's best lactation was 7,310 pounds. A system of line breeding to this bull was instituted (Lecky, 1949). Animals of Sahiwal and Jersey breeding were largely used to produce a breed which is now known as Jamaica Hope (Wright, 1952). The present standard of production in the herd is about 6,000 pounds of milk in 305 days, with 4.7 percent butterfat. Superior production is about 7,000 pounds with 5.0 percent butterfat. Average live weights of females have been 450 pounds at one year of age, 700 pounds at 2 years, and 900 pounds at maturity. Similarly for males, the weight at one year is 500 pounds, at 2 years 850 pounds and at maturity 1,300 pounds. It is observed in Jamaica that heifers calve at the age of 30 months: bulls start serving at the age of 15 months and they are in active service for a period of 10 to 11 years.

Further information regarding Jamaica Hope breed of cattle may be had from the Director of Agriculture, Hope, Kingston, Jamaica, British West Indies.

Kenya

Faulkner (1950) reports that Sahiwal cattle have been used for crossing with local East African Zebu types to improve milk production. It is observed that the crosses average at least 1,000 pounds more milk than the improved indigenous stock. The Sahiwal x Nandi grades averaged 3,099 pounds of milk in 275 days, with an average butterfat percentage of 5.1 at the Baraton Livestock Improvement and Animal Industry Center. At the same station it was observed that Sahiwal grades had a calf every 12.4 months.

Trinidad and Tobago

Sahiwal cattle are reported to have been successfully used in crossbreeding with temperate zone cattle. No exact records are available.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that the total number of Sahiwal cattle is about 952,000. Sahiwals are generally marketed in and around the Montgomery district of West Punjab (Pakistan). Several Sahiwal herds from which good breeding stock may be had are established in the Punjab (Pakistan) and Bhawalpur State. Further information regarding the breed may be had from the Animal Husbandry Commissioner to the Government of Pakistan, Karachi. Information about Sahiwal herds in India may be had from the Animal Husbandry Commissioner to the Government of India, New Delhi.



FIGURE 51. The Amrit Mahal breed was developed in Mysore in the eighteenth century for use in warfare. Though not large they have great stamina. The cows are poor milkers. Above: an Amrit Mahal bull. Below: an Amrit Mahal cow with calf.



Group IV

AMRIT MAHAL

in

Amrit Mahal literally means the department of milk. Originally the rulers of Mysore State had started an establishment where cattle collected from the prevalent types of cattle within the State were kept for the supply of milk and milk products to the palace; simultaneously the bullocks from this establishment were utilized for the movement of army equipage. The bullocks were regularly classified as gun bullocks, pack bullocks, plow bullocks, etc. They attracted great attention during the nineteenth century on account of their power of endurance and the speed with which they could move army equipment. It is claimed that they could cover a march of 100 miles in 21½ days.

Littlewood (1936), quoting an army officer who accompanied an army expedition to Afghanistan in 1842, says: "No draft cattle in the army were so efficient as the 230 (Mysore) bullocks which accompanied the troops to Afghanistan. It was entirely due to the superiority of these cattle that no part of the equipment was required to be abandoned when the troops were returning to India over the almost impracticable roads through the Tirah mountains. These cattle were frequently upwards of sixteen hours in the yoke".

Kristnasamiengar and Pease (1912) mention that cattle of the Amrit Mahal establishment originally comprised three distinct varieties: Hallikar, Hagalvadi and Chitaldroog. Prior to 1860, it

¹ See Figuree 51 and 52.

seems that these three varieties were maintained separate from each other. In 1860, the whole establishment was liquidated for reasons of economy. By the year 1866, it was realized that an establishment for the supply of cattle was a necessity, and during the year a herd was again re-established. Thus, the foundation cattle from which the Amrit Mahal breed was developed were of the Hallikar and closely related types.

Conditions in the Native Home of the Breed

Location, Topography and Soils

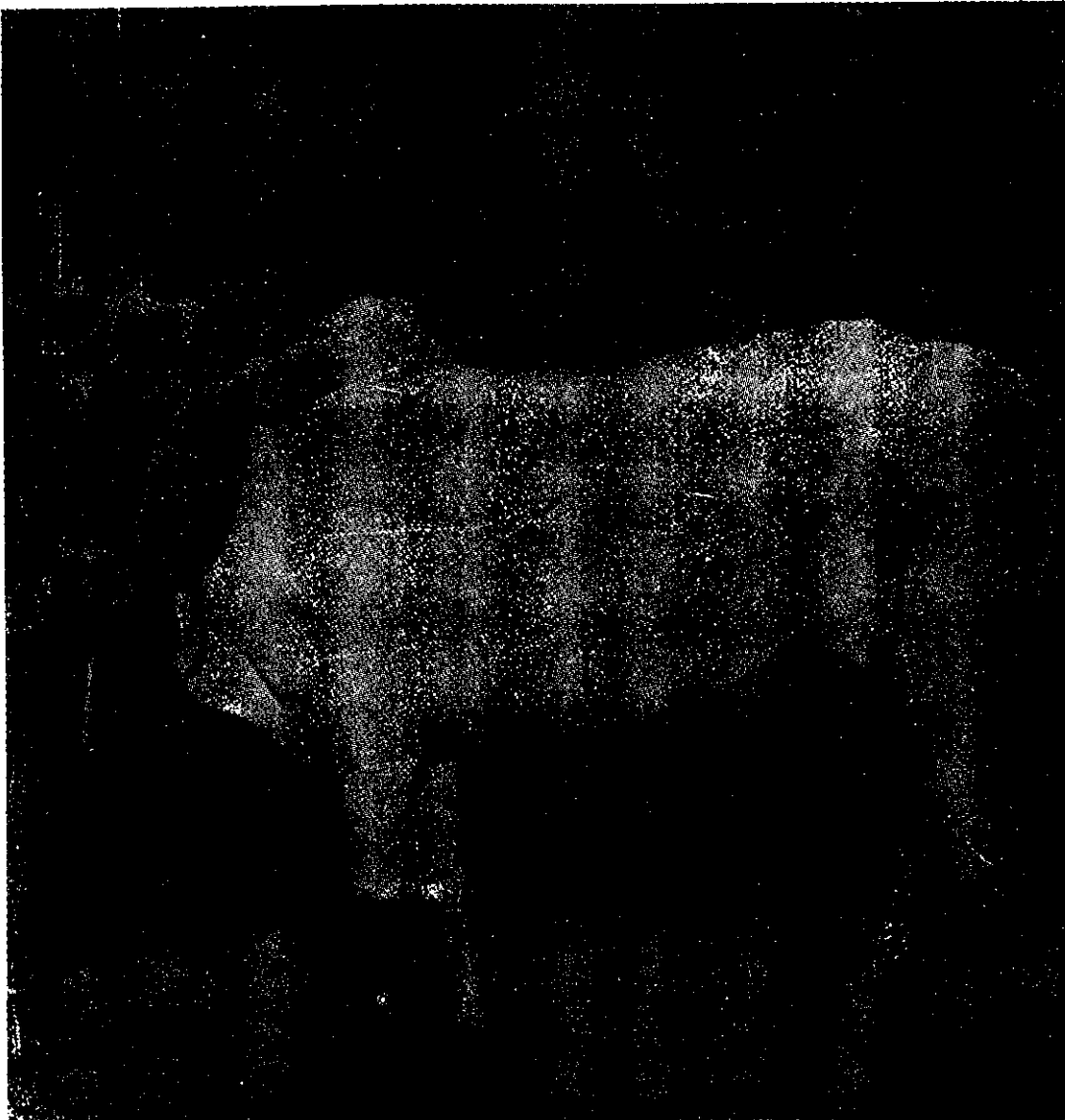
The home of Amrit Mahal cattle is in Mysore State, India. It lies between latitude $11^{\circ}36'$ and $15^{\circ}0'$ north and longitude $74^{\circ}4'$ and $78^{\circ}4'$ east. The area is an undulating tableland much broken up by chains of rocky hills and scored by deep ravines. Its form is that of a triangle with the apex to the south at the point where the western and eastern Ghat ranges of hills converge in the group of Nilgiri hills of the south. The general elevation rises from about 1,800 feet above sea level along the north and south frontiers to about 3,000 feet at the central water-parting area which separates the basin of the River Krishna to the north from that of the River Cauvery to the south. This separates the country into two nearly equal parts, a little north of latitude 13° and as far as longitude 77° , where a transverse line marks the eastern watershed. Mysore is naturally divided into two regions, the hill country called the Malnad on the west and the more open country known as the Maidan on the east.

The level plains of black soil in the north are used for crops such as cotton and millets. The tracts in the south and west, irrigated by channels drawn from rivers, are covered with plantations of sugarcane and fields of rice. The soils in the east are red colored loam or clay loam. It has been observed that these are generally deficient in phosphorus. The stony and wide-spreading pasture grounds in the central parts of the country represent very poor soil with coarse grasses.

Climate

The climate is pleasant and equable throughout the year. Mysore gets rains from both southwest as well as northeast monsoons. The rainy season begins in early June and continues with some intervals in August and September to the middle of November, closing with heavy rains of the northwest monsoon. These later rains are very useful for pastures. Then the cold season begins, which is dry and lasts until the end of February. The hot season then sets in and increases in intensity to the end of May with occasional relief owing to thunderstorms.

FIGURE 52. An Amrit Mahal bullock. This breed is famous for its great powers of endurance.



The temperature distribution for Mysore and Chitaldroog during the months of January, May, July and November set forth in Table 71, is characteristic. Climatological observations for this area are summarized in Table 72.

Table 71. Temperature Distribution for Mysore and Chitaldroog

PLACE	JANUARY		MAY		JULY		NOVEMBER	
	Mean °F.	Diurnal range	Mean °F.	Diurnal range	Mean °F.	Diurnal range	Mean °F.	Diurnal range
Mysore	72.5	24.5	80.9	22.6	75.0	15.9	73.3	18.4
Chitaldroog	73.5	22.0	82.7	22.9	75.3	13.6	73.5	18.0

Table 72. Climatological Observations of Mysore

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F.	80.8	86.2	91.1	93.5	91.7	84.9	82.2	82.0	82.3	82.1	79.8	78.9
Mean minimum temp. °F.	57.5	60.2	64.8	69.4	69.2	66.9	66.0	65.8	65.6	65.2	62.2	58.5
Humidity, per cent at 0800 hrs. I.S.T.	79.0	71.0	63.0	70.0	74.0	81.0	84.0	85.0	85.0	82.0	79.0	79.0
Rainfall, inches	0.26	0.17	0.50	1.33	4.36	2.89	4.18	5.38	6.98	5.90	2.94	0.48

Source: Indian Meteorological Department, Government of India, New Delhi.

Vegetation

Depending upon soil and water facilities, various crops are grown. In the black cotton soil in the northern area, cotton, millets, sorghum and oilseeds are extensively grown. In the south and the west sugarcane is produced. Rice is also grown in the tract. In the small gardens irrigated by tank waters, coconut and areca palms are cultivated. On the eastern side *Eleusine coracana*, millets and other dry-farming crops are grown.

Different parts of Mysore have pasture areas which are green during different seasons, depending upon the rainfall. Many species of *Andropogon* are found though the most extensively found grass is *Heteropogon contortus*. Some *Aristida* species are also encountered. In well-drained rice soils *Cynodon dactylon* is

preponderant. Varieties of sorghum and *Eleusine coracana* are specially grown as fodder by well-to-do farmers. Pulses such as *Dolichos biflorus*, *Cajanus cajan* and *Cicer arietinum* are grown and partly utilized for cattle feeding. Oilseed cakes of groundnut, sesamum and cottonseed, are extensively utilized for feeding bullocks and milking animals.

Management Practices

As is the usual practice in other parts of the country, calves are not artificially weaned; bull calves, in particular, are allowed to take all the milk from their dams, calves of cows which are very poor milkers are sometimes given extra quantities of milk. When the calves are 3 months old they are allowed to go to the grazing areas and begin to subsist partially on pasture. They are usually weaned when they are about 5 or 6 months old.

Amrit Mahal cattle are owned by well-to-do cultivators and large breeders who maintain herds in the vicinity of hills where ample grazing is available. These breeders sell their calves when they are about 1 to 1½ years old to cultivators. These cultivators, who usually own only a few cattle, rear these calves for the next 2 or 3 years and after training them for yoke, sell most of them at the cattle fairs. Their main purpose is to utilize the by-products of the farm, get manure, and meet the requirements of their own draft needs and sell any surplus stock.

The cattle of the state herds and also herds of large breeders are kept in the open all the time. The only protection from rain and sun they receive is from the trees. This weeds out any weaklings automatically. In these herds, the bull calves are castrated when they are about 18 months old, which is earlier than is customary in the village areas. Castration is usually done in the cold season.

Physical Characteristics of the Breed

The coloring of Amrit Mahal cattle is usually some shade of gray varying from almost white to nearly black, and in some cases white-gray markings of a definite pattern are present on

the face and dewlap. The muzzle, feet and tail switch are usually black, but in older animals the color looks lighter.

The most striking characteristic of these cattle is the formation of the head and horns. The head is well-shaped, long and tapering towards the muzzle. The forehead bulges out slightly and is narrow and furrowed in the middle. The horns emerge from the top of the poll, fairly close together in an upward and backward direction, and terminate in sharp points which are usually black. In old animals the long sharp points approximate each other and may even interlace to some extent. The eyes look bloodshot. The ears are small and taper to a point, being carried in a horizontal position. They are yellow inside.

The dewlap is thin and does not extend very far. The sheath and navel flap are very small and close to the body. The hump is well-developed and shapely in the bulls, rising to a height of about 8 inches. The average height of this breed behind the hump is 50 to 52 inches. The body is compact and muscular with well-formed shoulders and hindquarters. The neck is strong and fairly long. The back is level, with broad loins and level rump. Legs are of medium length and well-proportioned. The fetlocks are short and the hooves are hard, close together and small. The skin is thin, mellow and jet black in color, with short glossy hair.

Functional Characteristics of the Breed

As the cattle are maintained in the pasture areas without any restrictions and handling, they show a very impatient, wild and unruly disposition. They are at times dangerous, particularly to strangers. They need patience and care in training; hard treatment makes them stubborn. Once they are well trained they are extremely fine bullocks, particularly for quick transportation. They are observed to have great endurance. The working life of these bullocks is usually 7 to 8 years.

Heifers are usually bred from the age of 24 to 30 months. In their native tract there are said to be three different periods of the year when they come in heat; during the months of April and May when early spring showers bring forth abundance of pasturage, between October and December when the pasture is at its best in the area, and from January to February when the

cattle are fed on the refuse of the threshing floors; but definite data on the occurrence of oestrus and intervening periods are lacking.

Bulls are not put to service till they are about 4 years of age but after that they are in active service for 6 to 7 years: they are quick breeders. In the Amrit Mahal herds, bull calves are castrated when they are about 18 months old, but in the villages they are castrated much later, when they are about 4 years of age. Well-trained pairs of bullocks will carry ordinary loads of $\frac{3}{4}$ to 1 ton at the rate of 3 to 4 miles per hour. They are known to keep going with such loads for a period of 8 to 10 hours without rest (McIsaac, 1941).

The cows are very poor milkers, though more recently some attention has been paid to milking these animals systematically. At the Mysore State Cattle Breeding Station at Ajjampur, where the cows are maintained on pastures with very little concentrated feed, the cows yield 6 to 9 pounds of milk per day after feeding their calves. At the Mysore Palace Dairy Farm, 20 cows yielded from 9 to 27 pounds of milk per day in addition to that taken by the calf. An average of 14 records gives an average lactation yield of 2,210 pounds of milk exclusive of that consumed by calves. The average calving interval is estimated to be about 600 days (McIsaac, 1941-42; Sastri, 1943).

Performance in Other Areas

Amrit Mahal cattle, being primarily draft animals, have spread to other nearby areas wherever there was good demand for draft. In the southern districts of Bombay State, Amrit Mahals are bred to some extent, but it must be noted that the variety principally bred in this area is the Hallikar.

Sources of Breeding Stock and Information Regarding the Breed

For further information it is possible to apply to:

1. Animal Husbandry Commissioner to the Government of India, New Delhi, India;
2. Director of the Veterinary and Animal Husbandry Department, Mysore State, Mysore, India.

HALLIKAR

Origin

Ware (1942) mentions that the origin of most of the so-called South India breeds centers around the Hallikar breed of Mysore State¹. Kristnasamiengar and Pease (1912), from a study of historical records, state that between 1572 and 1600 A. D. a state herd establishment consisted of Hallikar cows imported from the then existing State of Vijayanagar. This very herd was later transferred to the rulers of Mysore State and was eventually known as Amrit Mahal.

Conditions in the Native Home of the Breed

Location, Topography and Soils

Hallikar cattle are bred mainly in the Tumkur, Hassan and Mysore districts of Mysore State. Apart from this area, they are also bred in the Dharwar district of Bombay State where they are known as Amrit Mahal on account of their originating from the Amrit Mahal herds of the state establishment. There is also an isolated collection of these in the Amrabad subdivision in the southern portion of Hyderabad State. Littlewood (1936) states that the chief centers where Hallikars are extensively found are Nagmangal, Kunigal, and Gubbi subdivision of Mysore State.

The country where the Hallikars are bred is undulating with an average altitude of 2,500 feet above sea level. On this western side the area approaches the precipitous hilly ranges of the Western Ghats. This hilly area is known locally as Malnad, while towards the east the country is at a slightly lower level and is a plain but with undulation known as Maidan. The principal rivers which run through the areas are the Cauvery, the Hemavati and their tributaries. It is observed that the southern part of this territory resembles in scenic effects the richest park scenery in England.

¹ See Figures 53 and 54.

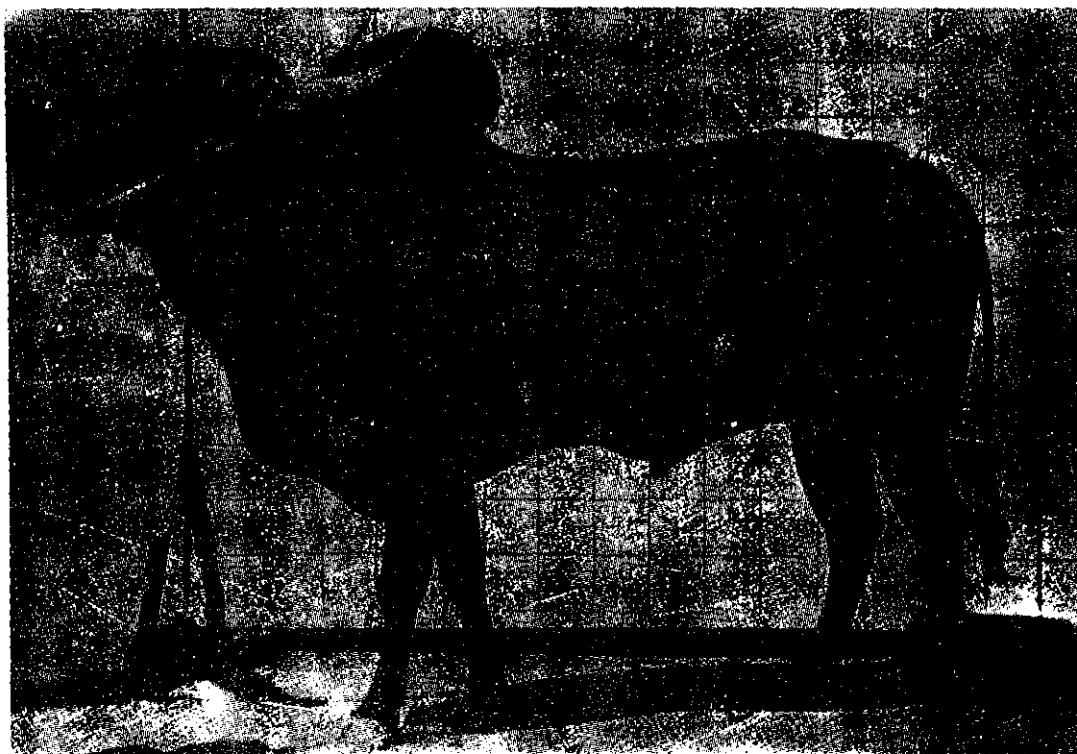
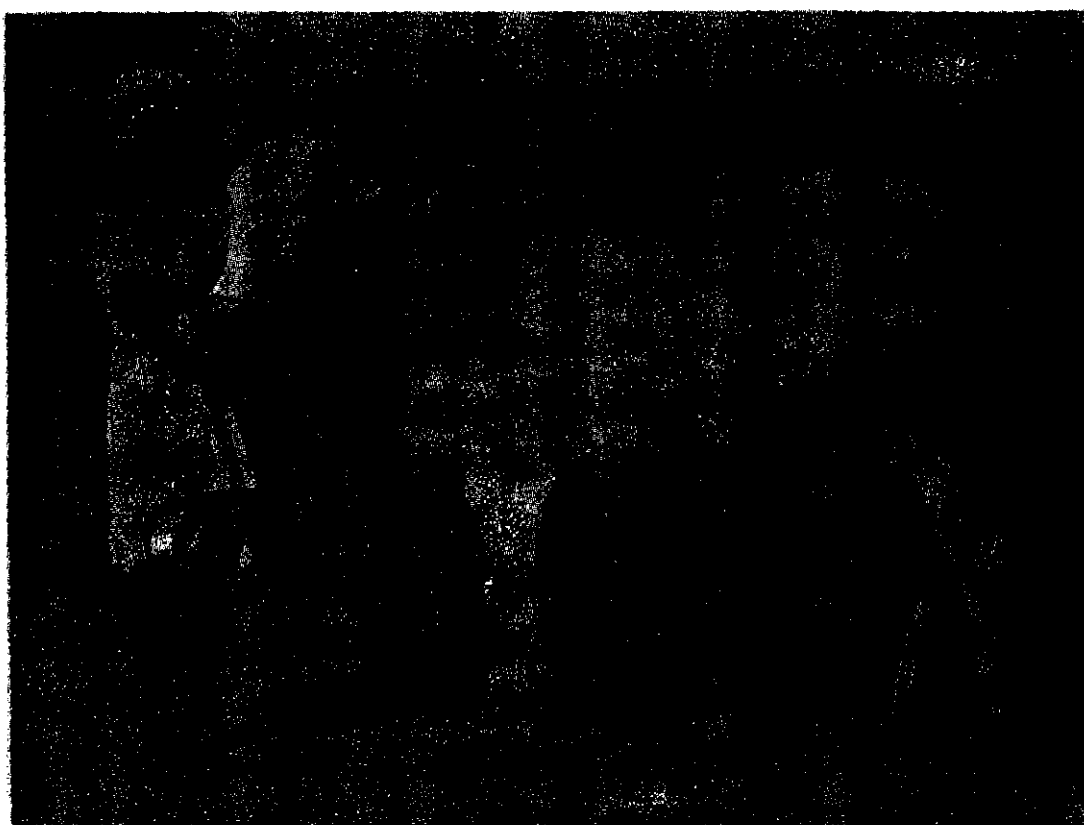


FIGURE 53. Hallikar cattle are bred chiefly in the Tumkur, Hassan and Mysore districts of Mysore State. Their head and horns are characteristic. The cows are said to be poor milkers. Above: a Hallikar bull.
Below: a Hallikar cow.



In the west and south there are extensive pasture areas while the east is intensely cultivated. The soil in the depressions of the undulations is composed of rich red sedimentary deposits while on the grass covered hills the soil is red laterite. There are also extensive tracts with gravelly sandy soil, particularly on the tops of the rising grounds. It is observed that most of the soils in the east are deficient in nitrogen.

Climate

The climate of the area is equable and temperatures are moderate. The high elevation and the greenness of the surface among the hills contribute to moderate the temperatures. The heat during the months of March and April is much modified by sea breezes from the western coast and by light fogs in the mornings and evenings. During the southwest monsoon from May to August the rainfall, though not heavy, is a continuous drizzle which is good for vegetation. The area also gets rain from the northeast monsoon during the months of September to November, the greatest precipitation being in the month of October. Climatological data based on averages for 10 years for the area are summarized in Table 73.

Table 73. Climatological Data for the Hallikar Tract

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F. . . .	84.0	88.8	93.5	94.7	91.8	84.5	82.4	83.2	84.2	84.3	82.4	81.8
Mean minimum temp. °F. . . .	60.2	63.6	67.4	70.2	69.7	68.1	67.1	66.7	66.5	67.8	64.4	60.4
Humidity per cent at 0800 hrs. I.S.T. . . .	72.0	68.0	68.0	73.0	75.0	80.0	81.0	81.0	81.0	82.0	78.0	75.0
Rainfall, inches	0.13	0.22	0.34	2.31	5.18	2.93	2.63	3.27	4.93	6.46	2.55	0.37

Source: Indian Meteorological Department, Government of India, New Delhi.

Raman and Satkapan (1948) have estimated evaporation for Hassan (Mysore State) in India calculated from other meteorological factors. These are summarized in Table 74.

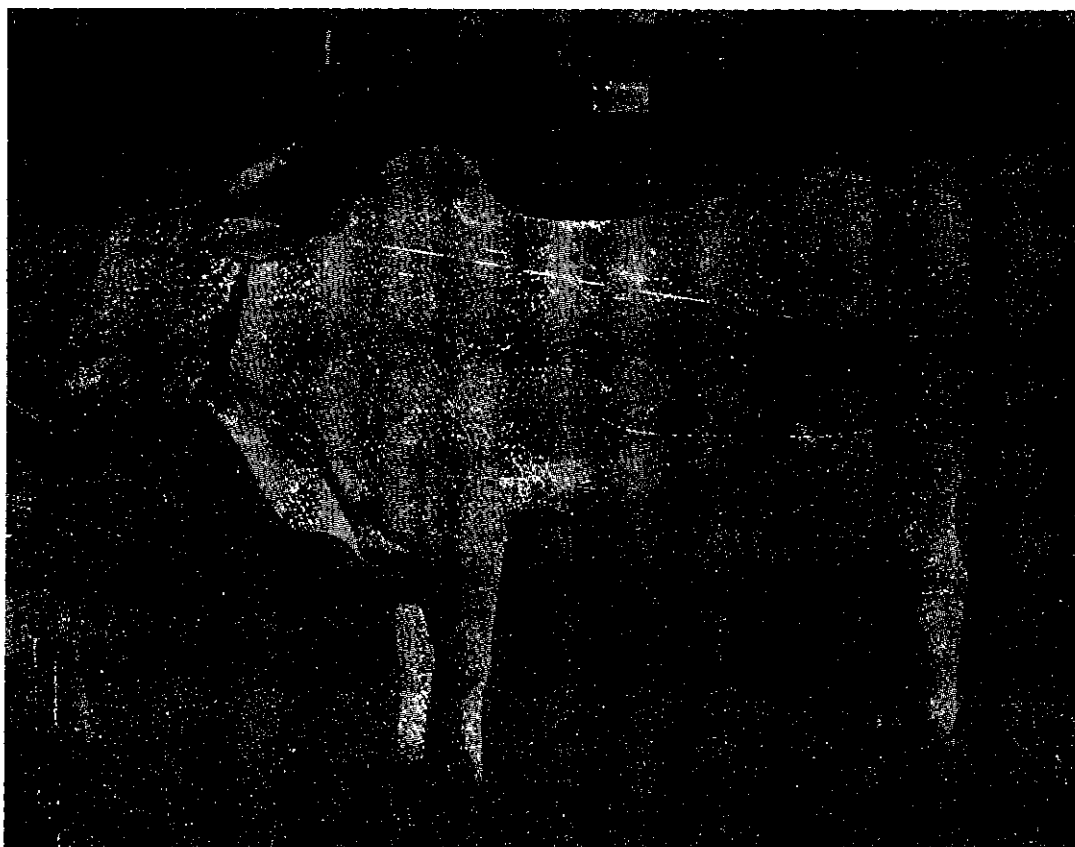


FIGURE 54. A Hallikar bullock. The animals of this breed are known as excellent draft cattle.

Table 74. Evaporation in Hassan, Mysore State

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Barometric pressure reduced to 32 °F.	26.85	26.83	26.80	26.76	26.73	26.67	26.67	26.70	26.73	26.77	26.80	26.84
Mean wind velocity in miles per hour	1.59	1.59	1.72	2.08	2.70	3.56	3.49	3.13	2.51	1.72	1.53	1.50
Vapour pressure in inches of mercury	0.450	0.521	0.607	0.673	0.704	0.638	0.619	0.615	0.608	0.613	0.539	0.470
Humidity, per cent	35.0	69.0	65.0	72.0	78.0	83.0	86.0	85.0	83.0	79.0	73.0	71.0
Mean monthly rainfall, in inches	0.07	0.17	0.33	2.01	4.69	4.01	5.40	3.66	4.27	6.67	3.38	0.67
Mean monthly evaporation, in inches	4.50	3.98	6.29	5.19	6.42	3.27	2.60	2.64	2.61	3.16	3.57	3.60

Calculated from other Meteorological Factors from Scientific Notes Vol. VI, No. 61
India Meteorological Department.

Table 75. Average Measurements of Hallikar Cattle

MEASUREMENTS	Male	Female
Height at shoulders, in inches	53-56	47.0
Length from poll to buttock, in inches	77-80	68.0
Length of horn, in inches	10-17	17.0
Length of ear, in inches	9-11	8.5
Girth of chest, in inches	70-80	60.0
Length of neck, in inches	17-19	16.0

Functional Characteristics of the Breed

The Hallikar is one of the best all-round draft types that is available in southern India. It is strong, spirited and quick. Thirty to forty miles a day on rough road is a common day's work. In the field it is a fast and yet steady worker, being useful for all types of cultivation. Males are castrated when they are 3 to 4 years old and then gradually broken to yoke. Prior to this period, living in a semi-wild state, they are extremely unruly and vicious. It requires several months of kind treatment and patient training to develop them into fine bullocks.

The cows are usually poor milkers. Reports from the Livestock Research Station, Hosur Cattle Farm, (Madras - 1943-44), show that 69 cows averaged 3.5 pounds of overall daily yield, after allowing milk for the calves.

Provided that the heifer is well-fed, she is bred first when she is about 30 months old. Otherwise, heifers which are not so well cared for usually are bred from when they are 5 years old. The bulls are usually not used for service until they are 4 years old. They are used in a herd for 9 to 10 years and then castrated.

Performance in Other Areas

The breed has spread into Dharwar district, the adjoining area of Bombay State. It is mainly used for draft purposes. Bombay State has a Government farm in the Dharwar district for the production of breeding stock (Anonymous, 1926 - e).

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are about 1,794,000 cattle of the Hallikar breed. In Mysore State there are some 22 cattle markets annually held where up to 50,000 cattle are put up for sale. The three most important ones are held at Doddbellapur in January, Harihar in February and Chickbellapur in March (Anonymous, 1946).

Further information on the breed may be had from the:

1. Director of Animal Husbandry, Mysore State, Mysore;
2. Livestock Expert to the Government of Bombay, Poona;
3. Animal Husbandry Commissioner to the Government of India, New Delhi.

KANGAYAM

Origin

Kangayam cattle¹ conform largely to the Southern Indian Mysore type, though there is evidence of the blood of the gray-white Ongole cattle in their composition (Phillips, 1944). Possibly this mixture has given the breed its larger size in comparison with other cattle of the Mysore type. This breed, in its native area, is also known by other names of Kanganad and Kongu though the name Kangayam is well-known. These cattle are bred in the southern and southeastern area of the Coimbatore district of Madras State in India. It is observed that there are two varieties of Kangayam cattle, one small and the other large. The smaller variety is found to be more numerous in the Kangayam, Dharampuram, Udmalpet, Pollachi, Paddadam and Erode subdivisions, while the larger variety is found in the areas of Karur, Aravakurchi and Dindigul subdivisions. The breed is found in its pure form in the herds of some large breeders, notably the Pattagar of Palayakottai, who is supposed to have one of the best herds of the breed in the country (Pattabhiram, 1943).

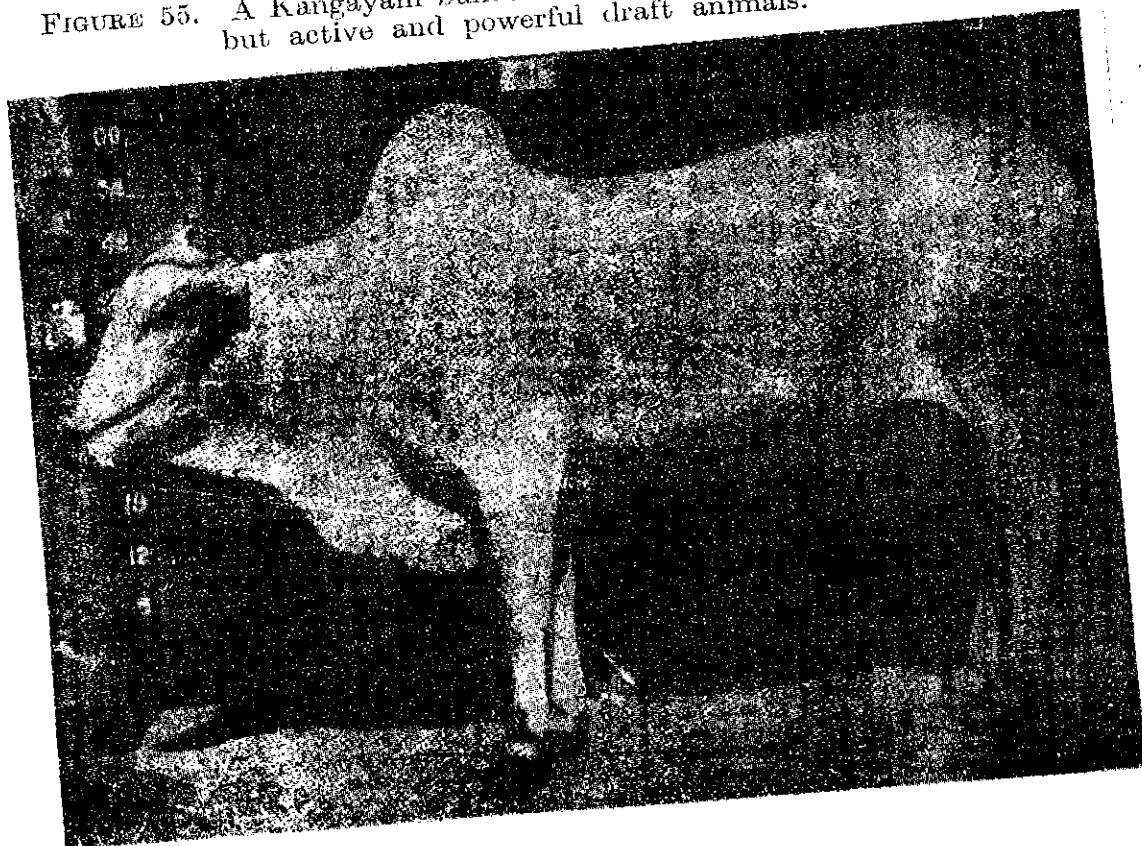
¹ See Figures 55 and 56.

Conditions in the Native Home of the Breed.

Location, Topography and Soils

The Kangayam breeding tract is in the district of Coimbatore of Madras State. This area lies approximately between latitude $10^{\circ}15'$ and $11^{\circ}18'$ north and longitude $76^{\circ}39'$ and $78^{\circ}14'$ east. The area is on a plateau with undulations with an average altitude of about 1,300 feet above sea level. On the west and south it is bounded by the high hills of Nilgiri and Anaimalai. The River Cauvery is on the eastern side of the area while the Rivers Bhavani and Noyil run through the tract. The tract is also well-known for the large number of wells. The soil is red loam full of canker and gravel. These are usually shallow soils but are known to retain sufficient moisture for pasture production. The soil has a calcareous substrata which is reported to be favorable to pasture production.

FIGURE 55. A Kangayam bullock. These cattle are medium in size but active and powerful draft animals.



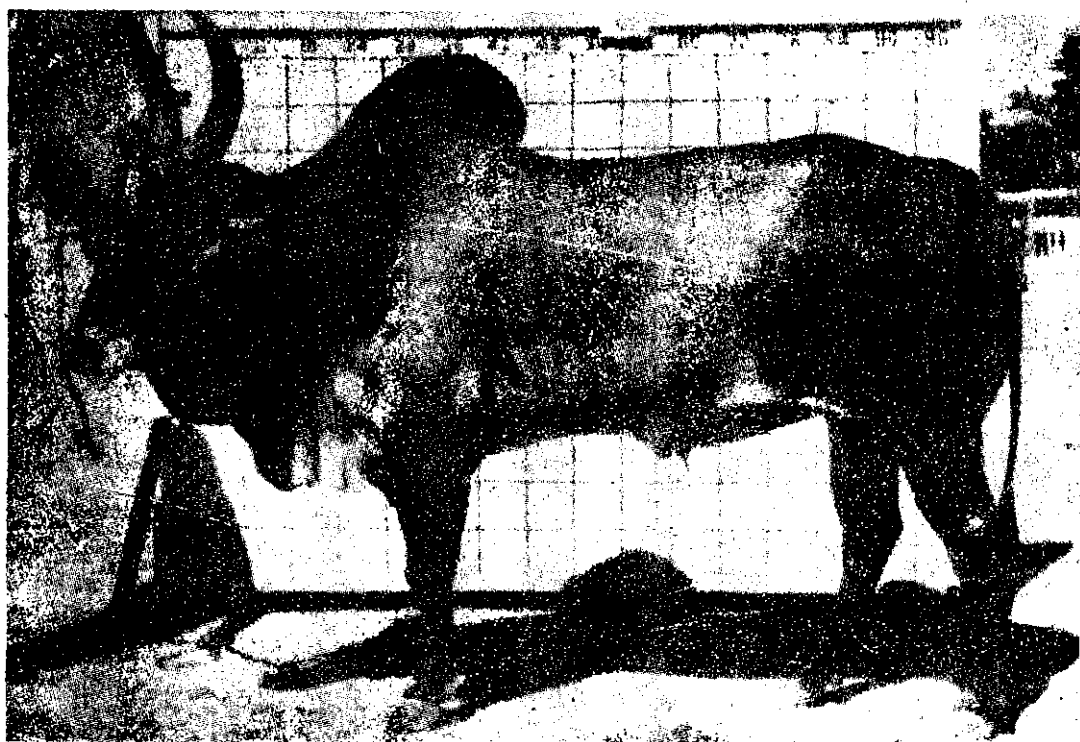
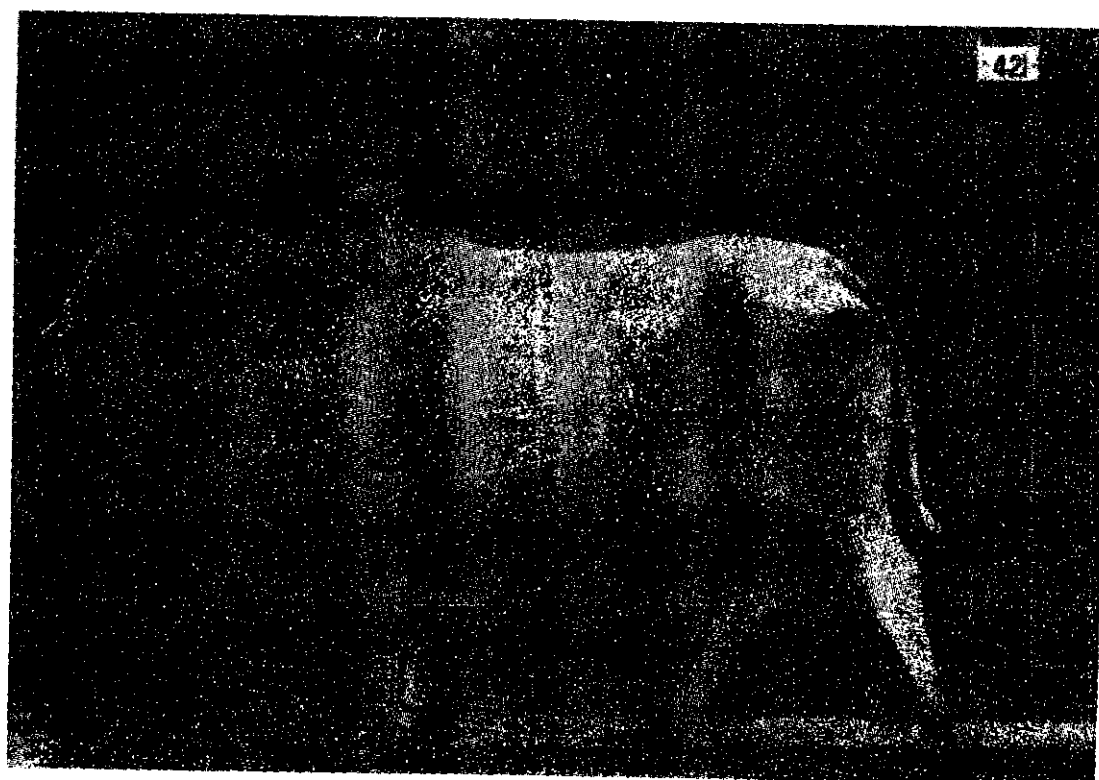


FIGURE 56. Kangayam cattle, bred in the Coimbatore district of Madras State, are very similar to Mysore type cattle. The cows are poor milkers. Above: a Kangayam bull. Below: a Kangayam cow.



Climate

The area has a very equable climate. Winters are mild and summers are not excessively warm. The rainfall, though uncertain, is spread throughout the year. There are rains during the hot weather, also from the southwest monsoon in the months of July to September, and from what is known as the northeast monsoon during the months of October and November. This spread of rain gives, if timely, abundant moisture for growth of pastures.

Average climatological data for Coimbatore are summarized in Table 76. Evaporation data calculated by Raman and Satkapan, (1948), from other meteorological factors are also included.

Table 76. Climatological Data for Coimbatore

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F. . . .	56.4	91.5	96.1	97.3	94.8	89.3	87.5	88.1	89.1	88.0	85.8	84.7
Mean minimum temp. °F. . . .	64.3	66.0	69.9	73.5	73.5	71.8	70.9	70.0	70.8	70.6	68.9	65.7
Humidity, per cent at 0800 hours	82.0	80.0	78.0	79.0	80.0	80.0	81.0	83.0	83.0	84.0	83.0	82.0
Rainfall, in inches	0.59	0.32	0.48	1.44	2.36	1.66	1.46	1.13	1.51	6.41	3.75	1.18
Barometric pressure reduced to 32 °F.	28.62	28.60	28.55	28.49	28.45	28.41	28.42	28.45	28.47	28.51	28.56	28.60
Mean wind velocity, in miles per hour	1.54	1.48	1.48	1.54	2.22	3.58	3.83	3.33	2.78	1.48	1.30	1.48
Humidity, per cent	75.0	69.0	66.0	70.0	74.0	73.0	74.0	76.0	77.0	80.0	82.0	79.0
Vapor pressure, in inches of mercury	0.605	0.608	0.651	0.764	0.796	0.739	0.713	0.726	0.726	0.759	0.712	0.639
Mean monthly evaporation, in inches	3.63	4.40	5.98	5.70	5.67	6.63	6.48	5.55	4.68	3.38	2.58	3.04

Source: Indian Meteorological Department, Government of India, New Delhi, and Indian Meteorological Department. Scientific Notes, Vol. VI, No. 61. Average for 10 years.

Vegetation

The most prominent grass in all the pastures is *Pennisetum cenchroides*. As a matter of fact the seeds are regularly collected and pastures are seeded with this grass. The main unirrigated

cereal crop in the area is *Pennisetum typhoideum*. The grains are utilized for human consumption while the stalk is utilized for cattle fodder. There is a particular variety of *Pennisetum typhoideum* which has a branching habit and the leafy growth is also more abundant and the stalk is comparatively thin. It matures within a few months. The plant therefore gives very good quality straw and an abundance of leafy material. Along with this, *Cajanus indicus* or *Dolichos biflorus* is usually grown, so that the straw becomes very valuable. Wherever irrigation facilities are available, sorghum is sown thickly and then part of the plants used as fodder crop while the rest is allowed to produce grain. *Eleusine coracana* and *Paspalum scrobiculatum* are also extensively grown. Groundnuts, cotton, and sugarcane are also grown in parts of the area where water facilities are available. In the pasture areas wild *Acacia alba* is extensively grown. The trees provide shade, as well as the pods which are utilized as cattle feed.

Management Practices

Every breeder, whether small or large, keeps his cattle in the open in fenced fields. In Southern Coimbatore, though the cattle are not protected against sun and rain, they are protected against strong winds by screens of bamboo mats formed into a pen. Large breeders have the advantage of fencing their large pasture grounds into paddocks, thus maintaining the cattle of different sex and age groups separately. This gives the large breeders some control over the breeding of their cattle. These large breeders also take care that cows which are not regular breeders are disposed of. Such discarded cows are usually purchased by small breeders who use them for work. Occasionally they are bred. Use of cows for work and owning of small private pastures which are fenced are peculiar features of this tract.

The rearing and feeding practices are more or less the same among the large and small breeders. The calf is allowed to suck as much milk as it requires from its mother for the first six weeks. During this period the calf is kept tied up in the farmer's home and not allowed to go to the pasture grounds with its mother. The amount of milk after that period is gradually reduced and the calf is put to green grass and at times this is supplemented

by a gruel made of bean and lentil husks, bran, rice water and ground pods of *Acacia alba*. Male calves are weaned later than female calves.

Young bulls are castrated when they are about 2 to 3 years of age. They are also broken for light work at this age. Kangayam breeders always sell their bullocks well-trained (Littlewood, 1936).

Physical Characteristics of the Breed

Both varieties of this breed are strong and active, with compact bodies and short, stout legs with strong hooves. Horns in the smaller variety spread apart nearly straight, with a slight curve backwards. In the larger variety, the horns are much longer, curve outwards and backwards and almost complete a circle at the point where they approach the tips. The head is of moderate size with only slightly prominent forehead. The head is more proportionate to the body with a straighter profile than in most of the Mysore type cattle. The ears are small, erect and pointed. The eyes are dark and prominent with black rings around them.

The neck is short and thick. The back is short, broad and level. The body is compact, with well sprung ribs. The quarters are slightly drooping. The dewlap is thin and extends only up to the sternum. The sheath is well tucked up to the body. The hump in the bulls, though well-developed, is firm. The hair is fine and short and the skin is dark in pigment and fine in texture. The tail is of moderate length with a black switch reaching well below the hocks.

Kangayam color is usually gray or white; the males generally are gray with black or very dark gray coloring on the head, neck, hump and quarters. In the cows, the prevailing color is white and gray with deep markings on the knees, and just above the fetlocks on all four legs. Benjamin and Raju (1949) observe that the coat color in Kangayam cattle changes. The calves are light or dark brown with gray or white on the inside of the thighs, ears and forelegs, and occasionally with gray or white rings on the pasterns and fetlocks. At two years the heifer turns gray or dark gray and retains this color but with advancing age after maturity the color fades and becomes white. Male calves become dark gray or iron gray with black shading over the head,

neck, hump, dewlap, fore and hind quarters. With maturity the black shading becomes intensified. Castrated males, however, show fading of the color.

Average data on certain body measurements are summarized in Table 77.

Table 77. Average Measurements of Kangayam Cattle

MEASURE	At one year	At two years	Mature
Females			
Weight, in pounds	340 (20)	560 (20)	850 (20)
Length from shoulder point to pin bones, in inches	42 (20)	51 (20)	56 (20)
Height at withers, in inches	42 (20)	46 (20)	48 (20)
Depth of chest, in inches			
Width of hips, in inches	12 (20)	16 (20)	18 (20)
Heart girth, in inches	50 (20)	57 (20)	67 (20)

MEASURE	At one year	At two years	Mature Bull	Mature Bullock
Males				
Weight, in pounds	360 (20)	570 (20)	1 200 (8)	1 150 (16)
Length from shoulder point to pin bones, in inches	42 (20)	48 (20)	63 (8)	64 (16)
Height at withers, in inches	43 (20)	48 (20)	54 (8)	56 (16)
Depth of chest, in inches				
Width of hips, in inches	13 (20)	16 (20)	20 (8)	21 (16)
Heart girth, in inches	51 (20)	60 (20)	76 (8)	73 (16)

Numbers sampled are shown in brackets.

Functional Characteristics of the Breed

Kangayam cattle are of moderate size, active and powerful, and are highly prized draft animals. The cows are generally poor milkers though it has been observed that occasionally cows of fair producing abilities are encountered.

At the Livestock Research Station, Hosur Cattle Farm, Madras State, a herd of Kangayam cattle is maintained. The cows are milked to ascertain their producing capacity. The average yield of the foundation cows was 1,493 pounds with a daily

average of 6.2 pounds. The average yield of farm-bred animals is 1,615 pounds with a daily average of 6.6 pounds in 244 days, the average dry period being 184 days. The average production of 17 best cows was 2,627 pounds. The herd average of 187 cows was over 1,800 pounds during the year 1943-44. Another sample of 68 cows of the Kangayam breed averaged 1,910 pounds of milk in 289 days with 151 days dry. Superior production of the Kangayam is reported to be as much as 4,709 pounds.

The average weight at birth is 42 pounds for heifer calves and 46 pounds for bull calves. Heifers calve at the average age of about 39 months. Kangayam cattle are observed to be fairly regular breeders with a calving interval of about 15 months. Bhattacharya *et al.* (1950) report from a study of 590 calvings amongst 143 Kangayam cows that the average gestation period for male births was 288.21 days, while for female births it was 285.35 days. From the same study it was shown that for every 100 females born, the number of males born was 102.75. It has been observed that the largest concentration of calvings occur during the period January to March, and July to October. Well-fed male calves are ready for service when they are about 2 years of age. They are quick breeders and are observed to be in good breeding condition for a period of 10 years.

As draft animals they are trained for work when they are about 2 to 3 years of age. Usually the bullocks receive good training and as such they are very willing and active workers. They are used for all agricultural work including plowing, cultivation, drawing water from the wells, and carting. A pair of bullocks will carry a load of one ton in an iron-tired cart at the rate of about 4 miles per hour. Good specimens have carried such loads on a hard road for 38 miles in 8 hours at a stretch. Usually the bullocks are worked for 8 to 10 hours a day. Kangayam bullocks are observed to be very hardy and will actively work for a period of 10 to 12 years.

Performance in Other Areas

A large percentage of the bullocks produced in the tract are sold to the cultivators of black cotton soil of the south where there are a large number of wells for irrigation purposes. Cultivators of these areas (districts of Madura, Tinnevely, etc.) buy

these bullocks at high prices as they are observed to be good workers and last longer than other cattle prevalent in the area.

Kangayam cattle are also exported to Ceylon for draft purposes.

Sources of Breeding Stock and Information Regarding the Breed

It is estimated that there are over a million head of Kangayam cattle in the native area of the breed. There are two important cattle fairs held annually at Avanashit Titupur where Kangayam cattle are sold. The Pattagar of Palayakottai is the largest cattle breeder in the area and the family has been breeding Kangayams for over 100 years: he has supplied nucleus breeding stock to the Governments of Madras and Ceylon in the past. More recently a Kangayam Cattle Breeders' Association has been established at Erode, Coimbatore district, Madras State. Since 1949, the Government of India has initiated herd book registration of Kangayam cattle.

For further information, the Animal Husbandry Commissioner to the Government of India, New Delhi, may be approached.

KHILLARI

Origin

There is every reason to believe that the Khillari breed¹, with its several varieties, owes its origin to the Hallikar breed of cattle from Mysore State. Unlike some of the other breeds of cattle in India, it does not take its name from a geographical area. Khillar means a herd of cattle, while Khillari means belonging to Khillar, hence the herdsman is known as Khillari; in the Satpura range of hills, he is known as Thillari. There is a special tribe of professional cattle breeders in this region known as Thillaris [Anonymous, 1926 (d)].

There are four principal types of Khillaris prevalent in the different regions of Bombay State. The variety Hanam Khillar, or sometimes known as Atpadi Mahal (the word Mahal shows

¹ See Figures 57 and 58.

strong similarity to Amrit Mahal cattle of Mysore State), is prevalent in the southern Mahratta States of Bombay. In the districts of Sholapur and Satara and the adjoining areas the variety known as Mhaswad Khillari is prevalent. In the area of the Satpura range of hills comprising the West Khandesh district the variety prevalent is known as Tapi Khillari or Thillari. A variety of more recent origin known as Nakali Khillari — Nakali means "imitation" — is found in the adjacent areas of these regions.

In the southern Mahratta States and the districts of Sholapur and Satara the Khillaris are bred by cultivators. In these regions the size of the herd is small, usually not more than one or two cows. In the Satpura ranges the Khillaris are bred by professional breeders known as Thillaris. These breeders produce bulls and bullocks for which there is always a very good demand. Besides their extensive use in their home tracts they are used in the adjacent districts of Poona, Ahmednagar, Nasik and Bijapur. Khillaris are classified as "medium fast draft."

FIGURE 57. A Khillari bullock. This breed is well-known for producing powerful draft animals.



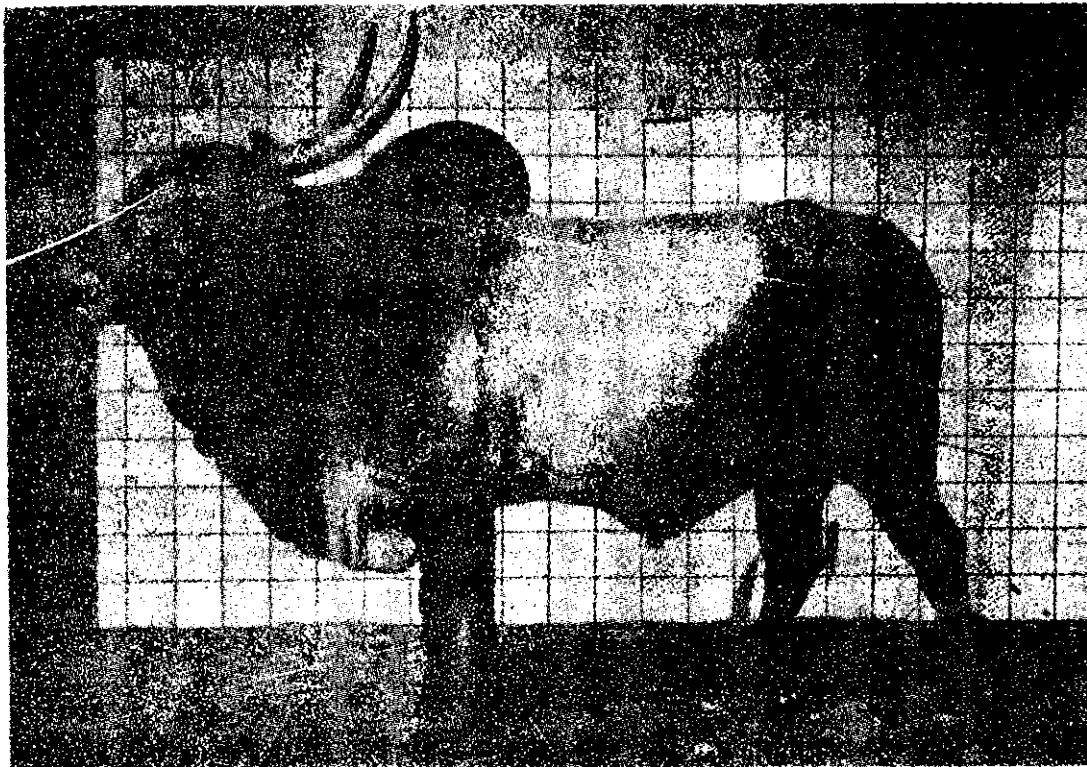
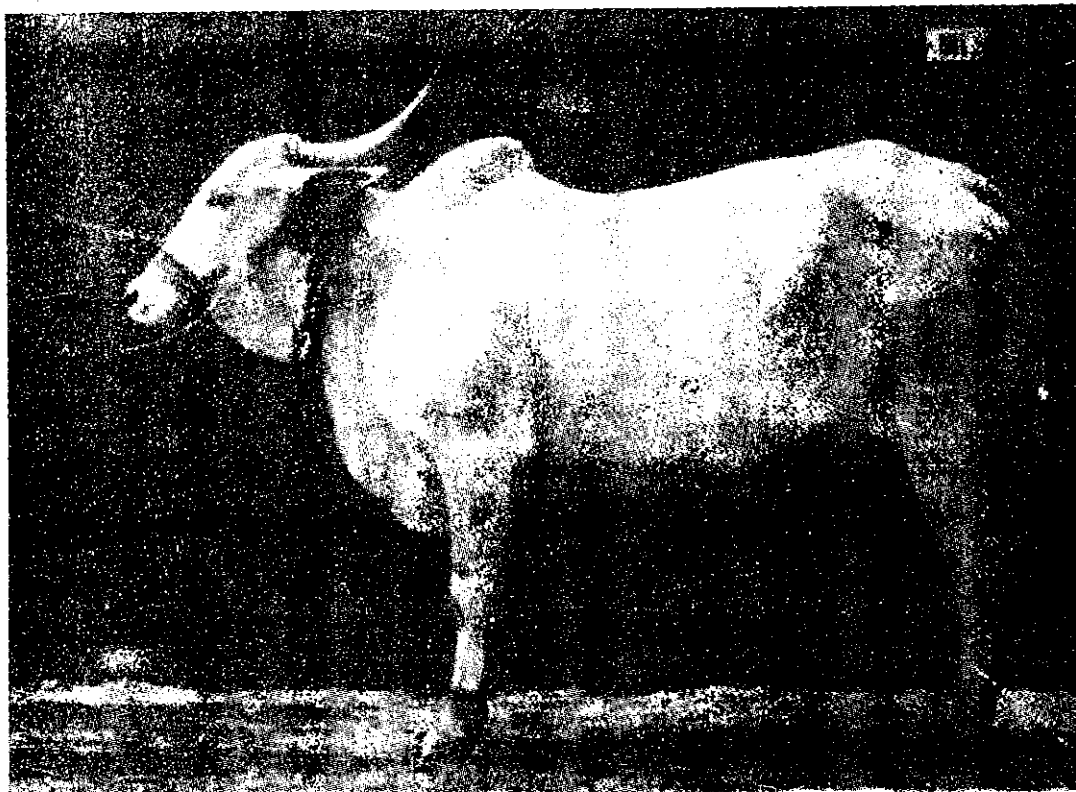


FIGURE 58. The Khillari, similar to the Amrit Mahal and the Hallikar, is found in the south of Bombay State. The type is not uniform: there is some fusion from the gray-white cattle of the north. The cows are poor milkers. Above: a Khillari bull. Below: a Khillari cow.



Conditions in the Native Home of the Breed

Location, Topography and Soils

Khillari cattle are spread over the Deccan plateau of Bombay State, particularly in the areas covered by the southern Mahratta States of Aundh, Jat, Sangli, Miraj and adjoining areas: Sholapur and Satara districts; the Satpura range of Khandesh district. This area lies approximately between longitude 73°25' and 76°24' east and latitude 16° and 22°2' north. The whole of the area is plateau land with an average elevation of 1,700 to 2,000 feet above sea level. On the northern side it is hilly, while in other parts it is undulating with small hillocks spread here and there. The uplands are gently rounded swellings of trap overgrown with stunted grasses. The geological formation is trap covered in most places with a shallow layer of very light soil and in parts with a good depth of rich loam having medium black to deep black hue and suited for cotton. Light soils sometimes mixed with gravel are good enough for growing millets, groundnuts and sorghum.

Climate

The climate on the average is mild and dry, and though summer temperatures during the day may go high, nights are pleasant and cool. The rainy season extends from June to October and is normally pleasant. Winters are very mild, minimum temperature rarely going below 55°F. The average climatological data for the area are given in Table 78.

Table 78. Climatological Data for the Khillar Area

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F. . . .	87.4	92.9	99.6	104.1	104.5	95.0	89.4	88.8	88.6	90.6	87.7	85.5
Mean minimum temp. °F. . . .	59.1	62.5	69.1	75.3	76.7	73.6	72.0	70.9	70.8	68.7	62.8	58.3
Mean daily relative humidity, per cent	48.0	58.0	33.0	36.0	47.0	68.0	75.0	76.0	77.0	61.0	53.0	50.0
Rainfall, in inch.	0.15	0.00	0.19	0.44	1.03	4.68	4.32	4.87	7.98	3.23	1.05	0.45

Average of 10 years supplied by the Indian Meteorological Department, Government of India, New Delhi, India.

Vegetation

Sorghum vulgare and *Pennisetum typhoideum* are extensively grown in the area covered by the breed. The grains are used for human consumption, while the stovers are utilized as cattle feed. Maize and certain varieties of sorghum are grown for fodder purposes as well: they are used as green fodder at flowering or after flowering. Maize is fed from May to August and sorghum is fed from April to July and also late sown sorghum is fed during the months of December and January.

Besides these crops, cotton, groundnut (*Arachis hypogaea*), pulses such as *Cajanus cajan*, *Cicer arietinum*, are extensively grown and by-products from these crops are used for cattle feeding. During recent years loppings of the fodder tree, *Hardwickia binata*, have been extensively used for feeding cattle. Also loppings of *Sesbania aegyptiaca*, particularly in the watershed of the River Krishna, are used throughout the year. The following are some of the important grasses which are available as green or semi-green from August to November: *Dichanthium* (*Andropogon*) *annulatum*, *Dichanthium caricosum*, *Sehima* (*Ischaemum*) *nervosum*, *Chloris virgata*, *Heteropogon contortus*, *Eragrostis bifaria*, *Ischaemum pilosum* and *Sehima* (*Ischaemum*) *sulcatum*. *Aristida* and *Indigofera cordifolia* are also extensively found in the area (Kumar, 1952).

Management Practices

The importance of the breed lies in the quick draft power it furnishes. Most of the area where this breed flourishes has scanty rainfall, and famines are quite frequent. Under such circumstances quick agricultural operations, such as plowing and sowing are of prime importance to make maximum use of rainfall.

Because of this, breeders have paid great attention to the feeding and care of bull calves and also to the selection of bulls for mating. When a bull calf is born his dam is not usually milked. The bull calf is allowed to have all the milk it can take until the cow goes dry. If a female calf is born then the cow is usually partially milked. Young stock are usually sold to well-to-do cultivators when they are about 1. to 1½ years old. With these cultivators they receive much better feed and attention. Possibly on account of this extra attention, Khillari cattle are observed to

be sexually mature earlier than some of the other breeds in the neighboring localities.

Physical Characteristics of the Breed

The typical Khillari animal is compact and tight skinned, with clean cut features. The whole appearance is like a compact cylinder with stout, strongly set limbs. There is a slight rise in the level of the back towards the pelvis. The ribs are well sprung and give the trunk a barrel shape. The hindquarters are squarely developed and the coup is well-moulded. The gait of the Khillari is quick and spirited.

The Khillaris of the Deccan plateau, the Mhaswad and the Atpadi Mahal types are grayish white in color. The color in the males is deeper over the forequarters and hindquarters, with peculiar gray and white mottled markings on the face. The Tapti Khillari is white with carrotty nose and carrotty hooves. The Nakali Khillari is gray with tawny or brickdust color over the forequarters. Newly born calves have rusty red colored polls, but this color disappears within a couple of months.

The forehead in Khillaris is long and narrow with a gradual convex bulge backwards towards the horns. A distinct groove runs in the center of the forehead from the nasal bridge to the center of the poll. The face is lean and long with smooth, tightly-drawn skin. The nasal bridge is sharp and prominent. The muzzle is frequently mottled in color, a pink muzzle is not liked by some breeders. Eyes are set in elongated fashion and are rather small, though prominent and often a little bulging; thick, wavy skin folds around the eyes give them a dull appearance and is not often liked. Ears are small, pointed and always held sideways. They are on an average 8.2 inches long in females and 9 inches in males, while the average greatest width is 5 inches in females and 4.5 in males. The ears are pale yellow colored inside. Horns are long and pointed and follow the backward curve of the forehead. They are placed close together at the root and grow backwards for half the length and then turn upwards in a smooth bow shape peculiar to this breed. The horns are thick at the base and taper to a fine point. Black colored horns are preferred though pink colored horns are frequently seen, especially in Tapti Khillaris.

The neck is rather short. The dewlap is light with very little fold. The hump in males is firm fleshed and of moderate size. The shoulders are tightly muscled, well set in and merge smoothly with the cylindrical shape of the body. The legs are clean cut, round and straight. The hooves are black with digits closely set. The base of the hoof is small. The barrel is cylindrical. The lines of the back and the belly are observed to be almost parallel. The navel flap, as well as the sheath, is tight and close to the abdomen. Hindquarters are well muscled. The tail is just touching the hock joint. The skin is soft and pliable though tightly drawn over the body. The hairs are fine, short and glossy.

The average measurements of typical Khillari animals are summarized in Table 79.

Table 79. Average Measurements of Khillari Cattle (Ware, 1941)

MEASURE	Maximum	Minimum	Average
Females			
Weight, in pounds	800	700	750.0
Length from shoulder point to pin bones, in inches	49	40	43.8
Height at withers, in inches	51	46	49.0
Depth of chest, in inches			21.4
Width of hips, in inches	20	15	16.0
Heart girth, in inches	77	60	66.0
Males			
Weight, in pounds	1 400	1 000	1 100
Length from shoulder point to pin bones, in inches	58	49	53
Height at withers, in inches	56	51	54
Depth of chest, in inches			26
Width of hips, in inches	21	18	19
Heart girth, in inches	83	74	78

Functional Characteristics of the Breed

Khillari bullocks are highly valued as fast powerful draft cattle, for they can travel miles without showing any signs of fatigue. Female stock, however, produce very little milk: besides nursing calves satisfactorily, they produce very little extra milk.

Heifers, when reared under favorable conditions, attain maturity early and are observed to calve as early as at 30 months. Female calves at birth weigh from 38 to 43 pounds, while male calves weigh from 40 to 45 pounds. Well-fed cows are observed to calve every 14 or 15 months.

Bulls are observed to start their first service when they are about 2 to 2½ years old and are quick breeders. They are known to have an active breeding life of 6 to 10 years.

Bulls are broken for yoke when they are between 2 to 3 years of age and have an average weight of 600 to 800 pounds. Though they are broken for work early they are not castrated till they are 5 to 5½ years old.

The bullocks are very active and willing workers but are apt to be vicious at times. On the average, a pair of bullocks will haul about 1,500 pounds of load in an iron-tired cart at the rate of 3 to 4 miles per hour and will cover within a working day a distance of 25 to 30 miles. It is observed that they are very good for all agricultural operations and perform work for 200 to 300 days in a year at the rate of 8 to 10 hours per day.

Performance in Other Areas

Ceylon

It is only recently that Khillari cattle were exported to the northwestern part of Ceylon, particularly with the intention of improving the draft qualities of the local cattle. So far, no records are available.

Sources of Breeding Stock and Information Regarding the Breed

The total Khillari cattle population is estimated to be 675,000 (Anonymous, 1946). During the last famine, though the total cattle population of the Bombay State went down, it was observed that the population of Khillari had gone up slightly. Khillari cattle can be bought at a number of local fairs in the tract. They are generally held from November to January each year. There are also fairs at Jath, Aundh and Chinchli. Hundreds of animals are also bought for sale at the Mhaswad and Nagoba fairs which are held during the months of November and December.

Recently a Provincial Herd Book has been established for the registration of purebred Khillari cattle in the rural areas.

Further information regarding the breed may be had from the:

1. Livestock Expert to the Government of Bombay, Poona, Bombay State, India;
2. Animal Husbandry Commissioner to the Government of India, New Delhi.

Group V

LOHANI

Origin

The Lohani breed of cattle¹ belongs to that general class of Zebu cattle in India and Pakistan which are found in the hilly areas. These are a smaller type of cattle, which thrive well under poorer conditions of breeding and are able to render useful service as milch animals as well as working animals either for light plowing or for transporting goods in the hilly areas, which have poor roads. They have close resemblance to the Afghan type of cattle.

These cattle are bred in the Loralai district of Baluchistan. They are also widely distributed in the tribal areas of the North West Frontier Province of Pakistan where they are known as Acchai cattle.

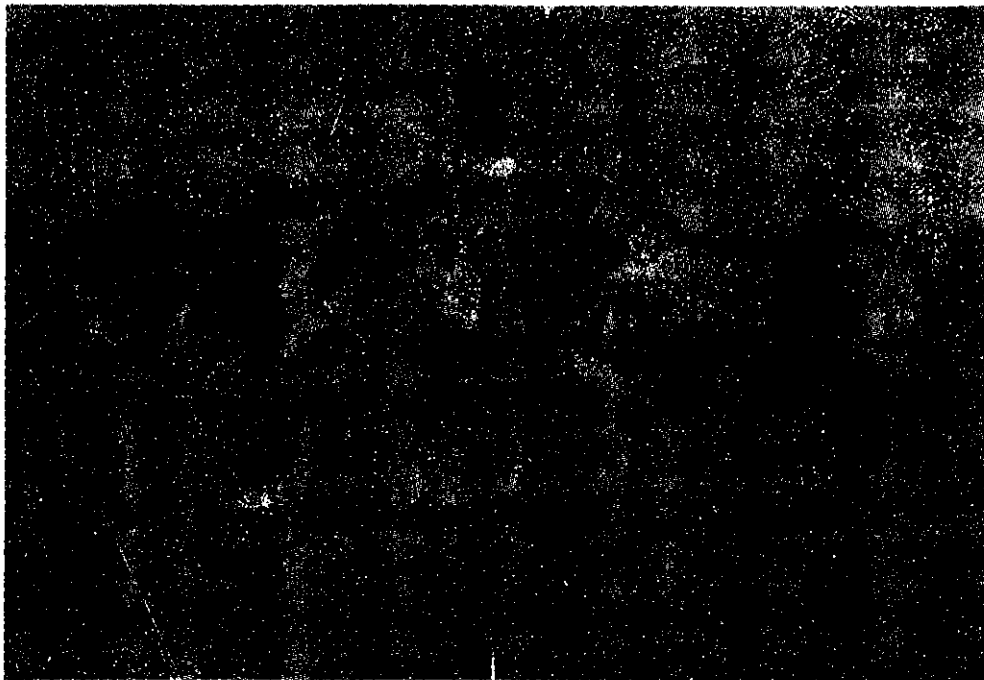
Conditions in the Native Home of the Breed

Location, Topography and Soils

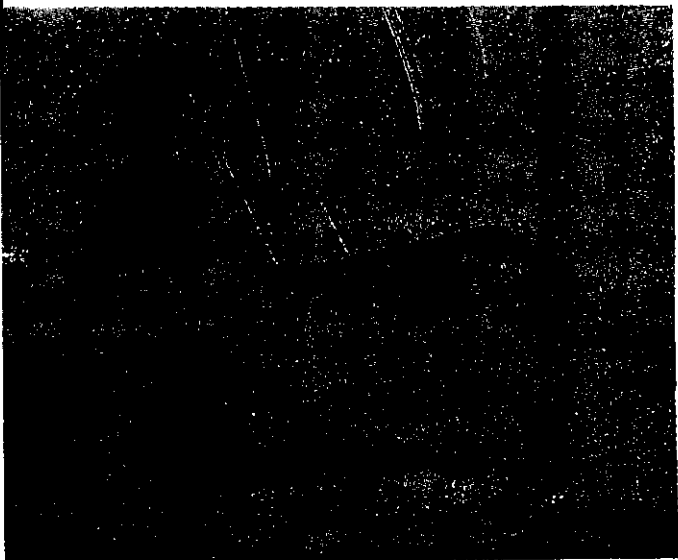
The native habitat of the breed is situated between latitude 29°3' and 31°2' north and longitude 67°4' and 70°1' east. The area is located in the northwest side of Baluchistan and also in the adjacent parts of North-West Frontier Province of Pakistan including the district of Dera Ismail Khan. The area consists of a series of long but narrow valleys hemmed in by rugged mountains, which vary in elevation from 3,000 to 10,000 feet. The soil of the valleys is reddish brown and is fairly productive. Gravel

¹ See Figure 59.

FIGURE 59. The Lohani breed, found in the Loralai district of Baluchistan, consists of small, compact and fast plow animals: they are also used as pack beasts. Right: a Lohani bull.



Lohani cows are fair milkers, producing about 2,000 pounds of milk per lactation. Above: a pair of Lohani bullocks: a Lohani cow with calf. Left.



deposits are met everywhere. On the mountain slopes very little soil deposits are met with, which restricts vegetation.

Climate

The climate varies with elevation but on the whole is dry. The summer is cool at higher elevations, but in the valleys the temperature goes as high as 110°F; there is plenty of air movement, however, which makes the climate not unpleasant. Winters are cold: frosts frequently occur and at higher altitudes snowfalls are common. The average rainfall of the area is from 7 to 9 inches and the greatest amount of rainfall occurs during the months of February and March, and again in the months of July and August.

Vegetation

Natural vegetation is restricted to trees such as those belonging to the class of juniper and pistachio at higher levels and acacia and olive at lower levels. Varieties of grasses grow at lower altitudes but there are hardly any grasses at higher altitudes. Various crops, such as maize, lentils, barley, wheat and oats are grown in the area. Straws, stovers and husks from these crops are used for cattle feeding.

Management Practices

On account of the demand for Lohani bullocks, every farmer keeps 3 or 4 cattle, although the question of fodder is most difficult in the area. Bullocks and milking cows are usually stall-fed with stovers. The other stock are taken to the grazing areas, but owing to the larger number of animals in proportion to the available pasturage, conditions for feeding the animals is not very satisfactory.

Physical Characteristics of the Breed

Lohani cattle are small in stature. The mature animal measures from 40 to 44 inches in height. The head is small in proportion to the body compared with other Zebu cattle. The face is flat or slightly convex between the eyes. Horns are short and slender, and emerge in an outward direction from the outer angles of the poll. Ears are short.

The body is well-rounded and moderately long. Legs are short and the bone is dense. The skin is slight and smooth. The sheath is very close to the body. The dewlap is thin and light. The tail is long and the switch almost touches the dewclaws. The udder in better specimens is symmetrical but small in size. The feet are small and hard. The characteristic color is red with white patches, especially on the head, neck and dewlap, although entire red color is not uncommon. Average data on certain body measurements are summarized in Table 80.

Table 80. Average Measurements of Lohani Cattle

MEASURE	Mature male	Mature female	Ox
Weight, in pounds	600	575	700
Length from shoulder point to pin bones, in inches	46.07 \pm 0.67	45.26 \pm 0.31	50.83 \pm 1.20
Height at withers, in inches	42.07 \pm 0.49	44.03 \pm 0.42	48.00 \pm 0.65
Depth of chest, in inches	19.64 \pm 0.27	22.23 \pm 0.34	25.60 \pm 0.30
Width of hips, in inches	12.21 \pm 0.17	13.53 \pm 0.24	16.41 \pm 0.33
Heart girth, in inches	52.64 \pm 0.70	55.03 \pm 0.62	63.00 \pm 0.81

Functional Characteristics of the Breed

This breed has not yet been much studied but preliminary observations show that the Lohani has potentialities of milk production and possesses at the same time good draft qualities for the hilly tracts. The bullocks are excellent workers in the plow and as pack animals, especially in hilly or arid tracts. They are said to be sure footed, quick-stepping and strong-hoofed. Carefully selected cows of this breed are reported to have yielded an average of 2,000 pounds of milk in a lactation period of 220 days with an average dry period of 140 days. The average calving interval is reported to be 14 months and the average number of lactations during the lifetime about 5.

Males are ready for service at the age of 3 to 3½ years and the average active breeding life of bulls is 5 years. Males to be used for draft are castrated and put to work when they are about 3 to 3½ years of age. A pair of bullocks can haul about 1,000 to 1,200 pounds and travel at the rate of 3 to 3½ miles per hour. They can cover a distance of 15 to 20 miles in an average working day.



FIGURE 60. The Ponwar breed, found in the districts of Pilibhit and Khan in Uttar Pradesh, are small, active and often vicious. The bullocks are good for draft purposes: the cows are poor milkers. Above: a Ponwar bull. Below: a Ponwar cow.



Performance in Other Areas

The breed is restricted almost entirely to its native area along with the adjacent areas of North-West Frontier Province.

Sources of Breeding Stock and Information Regarding the Breed

Lohanis are available in their breeding areas as well as in the cattle market at Kohat in North-West Frontier Province.

Further information about the breed may be obtained from the:

1. Animal Husbandry Commissioner to the Government of Pakistan, Karachi;
2. Deputy Director of Animal Husbandry, Quetta, Baluchistan.

PONWAR

Origin

Ware (1942) observed that the Ponwar breed¹ does not fit into any definite group of cattle though it is a separate breed of probably more recent origin. Phillips (1944), however, classifies it into the hill type of cattle which are found in the foothills of the Himalayas. As seen from the physical characteristics of this breed, one may be inclined to accept the latter view. It is small and compact with frequent white markings on the forehead, dewlap and limbs. Black and white color is often seen in the hill type of cattle and these features are also common in the Ponwar breed. However, the horns are inclined to be lyre-shaped, which may be due to some mixture of the nearby plains cattle. The breed is restricted to a small geographical area of Pilibhit district of Uttar Pradesh, India.

Conditions in the Native Home of the Breed

Location, Topography and Soils

Animals of the Ponwar breed of cattle are found primarily in the Puraupur subdivision of Pilibhit district of Uttar Pradesh. The area lies approximately between latitude 28°4' and 28°8' north

¹ See Figure 60.

and between longitude 79° and 80°4' east. The area is only a short distance from the outer ranges of the Himalayas. The whole area consists of a level plain with a few depressions but no hills. In the center of the district a long swamp called the Mala lies north and south dividing the district into eastern and western halves. The River Gomti rises from these swamps. The Puranpur subdivision is in the eastern portion. It contains large forest areas. The district consists almost entirely of alluvial soil.

Climate

It is a submontane area, having high humidity. Proximity to hills causes a more even temperature and even the summers are not as unbearable as in other parts of Uttar Pradesh. The annual rainfall ranges from 50 to 65 inches. Winter rains are heavy and occur during the months of November to February. Regular summer rains from the southwest monsoon occur during the months of July to September.

Vegetation

The grasses which are common in the area show remarkably rich vegetative growth, but they are observed to be coarse and not so nutritious. Paddy is extensively grown in the area. As the drainage is poor in most of the area, plants which can stand waterlogging are common. The cattle are maintained on grazing throughout the year.

Management Practices

As the cattle are maintained under ranching conditions they are not frequently handled and, being of nervous disposition, are relatively intractable. They are reared mostly on grazing in the forest areas. Only bullocks which are used for transportation or cultivation are retained in the villages and handled. Other stock is always out in the open and rarely handled.

Physical Characteristics of the Breed

The animals of this breed possess a small, narrow face, small ears and big, bright eyes. The forehead is slightly concave and often has white marking. The horns are long, upstanding and lyre-shaped. They measure from 12 to 18 inches in length.

The neck is short and powerful. The barrel is moderately long. The sheath is short and tight. The dewlap is light and thin. The hump is well-developed in bulls but it is small in cows. The cows have small and poorly developed udders. The tail is long and tapering with a white switch.

Ponwar cattle are usually black and white; the color markings do not have any particular pattern, but large patches of black and white are intermixed. The average height of a bull is 50 inches, while that of a cow is about 45 inches. Bulls weigh around 700 to 800 pounds, while the cows weigh about 600 to 650 pounds. The average measurements of Ponwar cattle are summarized in Table 81.

Table 81. Ranges in Measurements of Ponwar Cattle

MEASURE	At one year	At two years	Mature
<i>Females</i>			
Weight, in pounds	230	400	650
Length from shoulder point to pin bones, in inches	35-36	42-43	50-51
Height at withers, in inches	37	43	48-49
Depth of chest, in inches	13-14	18-19	21-22
Width of hips, in inches	11-12	13-14	16-17
Heart girth, in inches	43	53-54	62-63

MEASURE	At one year	At two years	Mature bull	Mature ox
<i>Males</i>				
Weight, in pounds	225	425	700	700
Length from shoulder point to pin bones, in inches	35-36	42-43	52-53	52-53
Height at withers, in inches	37-38	43-44	52	51
Depth of chest, in inches	13-14	18-19	20-21	20-21
Width of hips, in inches	10-11	13	16-17	16
Heart girth, in inches	43-44	51-55	65	63

Information supplied from the Government Cattle Breeding Farm, Hempur, District Naini Tal, United Provinces, India.

Functional Characteristics of the Breed

The cattle of this breed are active and often fiery-tempered. They are observed to thrive well under free grazing conditions. The bullocks are good for draft purposes. They are quick movers. The animals of this breed are observed to mature late and the majority of the heifers calve for the first time when they are 5 years old. The cows are poor milkers and are rarely milked even in the flush of their production. Though the Government of Uttar Pradesh maintains a farm for the breeding of Ponwar cattle at Hampur, Uttar Pradesh, very little information on the functional behavior of the breed is yet available.

Performance in Other Areas

The breed has not spread to other areas beyond its native tract except to some nearby districts of Uttar Pradesh.

Sources of Breeding Stock and Information Regarding the Breed

Information regarding the breed may be obtained from the:

1. Animal Husbandry Commissioner to the Government of Uttar Pradesh, Lucknow, India.
2. Animal Husbandry Commissioner to the Government of India, New Delhi.

SIRI

Origin

Animals of this breed¹ are found in the hill tracts around Darjeeling (Bengal, India) and in Sikkim and Bhutan. Bhutan is said to be the real home of this breed. It is distributed from that area to the various parts of Sikkim and Darjeeling. Ware (1942) observed that if the Zebus of India were classified on the basis of their position of the hump, which may be either cervico-thoracic and muscular, or thoracic and muscular-fatty, the Siri will be the only breed in the former group. Presumably Siri cattle have some blood from the cattle in Tibet.

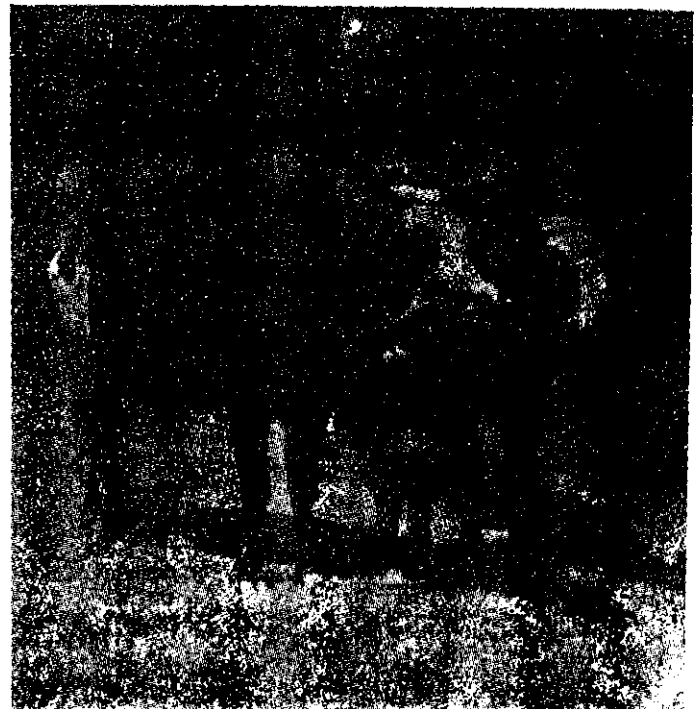
¹ See Figure 61.



FIGURE 61a. The Siri breed is found in the hilly areas around Darjeeling, India, and in Sikki and Bhutan. Above: a Siri bullock. Left: a Siri cow.



FIGURE 61b. Siri bullocks are good workers and the cows are fairly good milkers. Right: a pair of Siri bullocks. Below: a Siri herd at pasture.



Small cattle with similar black and white color markings are reported by Phillips, Johnson and Moyer (1945) to occur in Sikong Province of China, which occupies a portion of the Tibetan highlands northeast of Bhutan. Siri cattle crossed with Nepali cattle look like Siri, but they can be distinguished by their color pattern and position of hump and horns. These are known as Kachcha Siri or imitation Siri cattle.

Conditions in the Native Home of the Breed

Location, Topography and Soils

The whole area is hilly, with elevations from 3,000 to 12,000 feet above sea level. The hillsides are mostly steep and separated from each other by deep, narrow valleys. This mountainous region sends out numerous rivers. Owing to the configuration of the country regular crop production is limited to a comparatively few spots.

A distinctive feature of Himalayan agriculture is the terracing of the mountain slopes for rice cultivation. On steep slopes the labor of revetting the narrow terraces with stones is very great, but as the site of a rice field is always selected so that it can be irrigated from some stream, the crop is a certain one and amply repays the labor expended. The incline of the slope, the aspect and the elevation are important factors in the relative fertility of such lands. Many of the terraces are too narrow to admit the use of a plow; these are cultivated with a hoe.

Climate

At altitudes higher than 4,000 feet the climate throughout the year is pleasant. There is heavy rainfall during the months from June to October. The rain comes in heavy showers and skies clear within a short time thereafter. Winters are inclined to be chilly and severe.

Climatological data for Darjeeling and its surroundings are given in Table 82.

Table 82. Climatological Data for the Darjeeling Area

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean maximum temp. °F. . . .	47.3	48.9	56.5	62.5	64.6	66.2	66.8	66.5	65.4	61.7	55.6	49.4
Mean minimum temp. °F. . . .	35.1	36.1	42.3	48.4	52.3	56.5	58.0	57.6	55.9	50.1	42.8	36.7
Humidity, per cent at 0800 hours I.S.T. . .	81.0	82.0	73.0	78.0	88.0	94.0	96.0	95.0	93.0	86.0	78.0	76.0
Rainfall in inches	0.55	1.10	1.84	3.85	8.70	24.26	32.31	26.12	18.38	4.5	0.78	0.24

Information from the Meteorological Department, Government of India.

Vegetation

In the cultivated areas the chief crops grown are rice, maize, wheat, buckwheat, millets, mustard, potatoes and oilseeds. Tea is extensively grown in the area. The principal pasture grounds are the forest areas between the altitudes of 6,000 and 12,000 feet. In the cold and hot seasons the lower ranges provide ample grazing but during the rainy season it is impossible to graze in these areas because of leeches.

Management Practices

The animals are allowed to graze throughout the year, though the amount of pasturage is extremely scanty during most of the year on account of limited pasture area and the large number of animals. Milking cows and bullocks are stall-fed and they receive rice straw, maize stover or hay along with green grass. Very little concentrated feed is given. Dry animals and young stock are taken for pasturing in the government reserved forests at higher altitudes during summer months.

Physical Characteristics of the Breed

The color most frequently seen are black and white or extensive solid black, in color patterns similar to that of Holstein-Friesians. The animal carries a thick coat all the year round, and it is generally believed that this protects them from heavy rains and severe cold.

The general form of the animal is massive. The head is

small, square cut and well set on. The forehead is wide and flat. The horns are sharp and directed forward and slightly upward. The ears are small.

The hump is placed well forward and is usually covered with a tuft of long coarse hair. The position of the hump is slightly forward compared with that of other Zebu breeds. The dewlap is moderately developed and the sheath in the male is tight. Strong legs and feet are characteristics of this breed. The hooves are broad but strong. The udders of the cows are well developed. The measurements in Table 83 are taken from about 500 animals in the area where the breed is found.

Table 83. Ranges in Measurements of Siri Cattle

Table 83. Ranges in Measurements

MEASURE	At one year	At two years	Mature
Females			
Weight, in pounds	325-390	400-480	700-900
Length from shoulder point to pin bones, in inches	32-35	36-39	48-54
Height at withers, in inches	33-37	38-43	42-50
Depth of chest, in inches	16-20	22-25	26-29
Width of hips, in inches	10-12	10-13	15-20
Heart girth, in inches.	46-50	50-55	66-70

MEASURE	At one year	At two years	Mature bull	Mature bullock
Males				
Weight, in pounds	340-410	440-510	800-1200	700-1000
Length from shoulder point to pin bones, in inches	32-36	38-41	51-64	48-57
Height at withers, in inches.	37-40	40-44	43-54	42-53
Depth of chest, in inches	18-21	24-26	28-31	28-31
Width of hips, in inches	10-12	11-13	15-20	15-18
Heart girth, in inches	48-51	53-56	68-78	65-74

Functional Characteristics of the Breed

It is observed that the animals of this breed can stand the rugged conditions of the mountains very well. When the animals are brought down to the plains they do not seem to do so well. Bullocks of the Siri breed are eagerly sought after for draft

purposes owing to their size and reputed great strength. The animals have very strong feet and a pair of bullocks can haul a load of about 2,000 pounds at an average speed of about one mile per hour on steep hills. They are usually castrated and trained for work when they are about 4 years of age. They are also used for all agricultural work such as plowing, cultivating, threshing, etc. On an average they are observed to work for 180 to 190 days in a year, at the rate of 8 to 10 hours per day.

The Siri is a late maturing breed and it has been observed that females do not calve for the first time until they are 5 to 5½ years old. Though there is no definite breeding season, most of the animals are observed to be bred in summer. The average weight of female calves at birth is about 40 pounds, while male calves weigh about 50 pounds. Males are said to start serving at about the age of 4 years, and the average breeding life of well-kept bulls is about 8 years. It has been observed that Siri bulls tend to be shy breeders.

Average production of a few selected cows (records of 20 cows) has been 3,000 pounds in an average lactation period of 280 days. Superior production has been as much as 4,250 pounds. The fat percentage varied from 6 to 10 percent. Siri cows are fairly regular breeders and well-fed animals have an average calving interval of about 370 days, but average animals kept under village conditions usually produce a calf only once in 18 to 20 months.

Performance in Other Areas

The breed is restricted to the areas mentioned above.

Sources of Breeding Stock and Information Regarding the Breed

Further enquiries regarding the breed may be made to the Animal Husbandry Commissioner to the Government of India, New Delhi, India.

Group VI

DHANNI

Origin

The Dhanni breed of cattle¹ also known as Awankari, Pakhari and Pothwari, is produced in the Attock, Rawalpindi and Jhelum areas of the Punjab, Pakistan.

Originally the cattle found near Chakwal of Jhelum district were called Dhanni, while those in Tallagang Tehsil of Attock district were called Awankari or Pakhari, and similar cattle found near Jatli in Rawalpindi district were called "Pothwari". These distinctions, however, did persist for some time due to lack of communications between the different tracts. But later on, when communications improved and trade developed with the neighboring districts, the breed was studied more closely and the results clearly indicated that in essential features the breed was one, and that minor local variations of uneconomic importance did not justify the classification of these local variants as different distinct breeds. Consequently it was decided to group the black and white spotted cattle available in the above localities together and designate them collectively as Dhanni.

Conditions in the Native Home of the Breed

Location, Topography and Soils

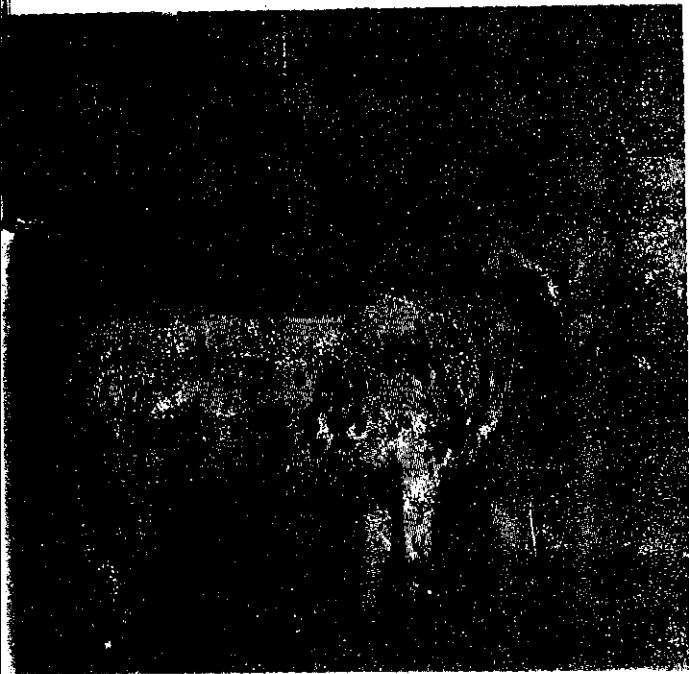
The area of this breed extends over the following parts of Jhelum district, Attock and Rawalpindi, the longitudinal position being 72° to 74° east and the latitudinal, 33° to 34° north:

1. Tehsil Chakwal of Jhelum district:

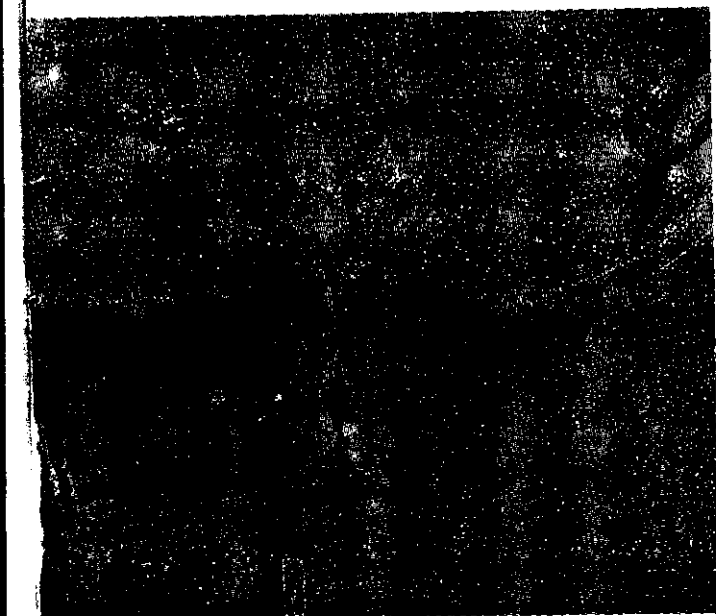
¹ See Figure 62.



FIGURE 62. Dhanni cattle, found in the districts of Attock, Jhelum and Rawalpindi of the Punjab, Pakistan, are medium in size and compact. Above: a Dhanni bull. Left: a Dhanni cow.



Active and fast moving, the Dhanni is essentially a draft animal. Right: a Dhanni cow. Below: a pair of Dhanni bullocks.



2. Tehsil Tallagang and a part of Tehsil Fatehjang of Attock district;

3. Tehsil Gujarkhan and the Jatli area of Rawalpindi district.

The boundaries of the Dhanni tract are, roughly, on the north, the line of Khairi Murat hill in Attock district; on the south, the line of the northern slope of the Salt range and the hills connected with it in Jehlum and Attock districts; on the east, a line about 10 miles west of the Lahore-Peshawar railway in Rawalpindi and Jehlum districts; and on the west, a line passing close to the hills in the west of Attock district.

The tract may be generally described as an undulating plain. The country is rocky in parts and intersected with large rough ravines and sandy riverbeds, which are most numerous in the west and north of the tract.

The tract is dry and cultivation depends almost entirely on rains. A very limited amount of land is, however, irrigated by means of Persian wheels along the large ravines and riverbeds mainly for the production of vegetables. There is very little land subject to inundation. A number of mountain torrents cut across the tract but so far this water, which is not available all the year round, has not been conserved to be utilized for cultivation purposes.

The soils in the Attock District are loam to clay loam to sandy loam and sandy; in the Rawalpindi district they are sandy loam to stony, and in the Jehlum district heavy loam to medium and light loam mixed up with different sizes of pebbles are found. In general, the soil is shallow with underlying rocks.

The altitude of the tract varies from 800 feet to about 1,600 feet above sea level.

Climate

The cold weather period extends from December to March. Average rainfall during this period is $7\frac{1}{2}$, $5\frac{1}{4}$ and $4\frac{1}{2}$ inches in Rawalpindi, Attock and Jehlum districts respectively. December and January are the coldest months, while the hot weather extends from April to June, which is the hottest month, the highest temperature recorded being 118°F . Dust and thunder-

storms with occasional rain commonly occur. Mean relative humidity ranges from 36 to 50 percent and the mean daily range of temperature during these months may be between 25° and 30°F.

July to September is the rainy season. During the earlier part it is hot. Mean daily relative humidity is between 62 and 82 percent. Climatological data are summarized in Table 84.

Table 84. Climatological Data for the Dhanni Area

MEASURE OF CLIMATE	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<i>Rawalpindi District</i>												
Mean maximum temp. °F. . . .	62.3	65.2	75.1	86.2	97.7	103.5	97.8	93.7	93.4	88.6	77.7	66.8
Mean minimum temp. °F. . . .	37.9	41.7	50.4	59.3	63.7	75.9	77.1	75.5	69.3	57.0	44.4	37.0
Relative Humidity at 0800 hrs. I.S.T. . . .	83.0	81.0	63.0	51.0	36.0	39.0	68.0	76.0	62.0	58.0	68.0	77.0
Precipitation, in inches	2.36	2.07	2.11	1.66	1.17	1.99	6.89	7.83	3.17	0.53	0.31	0.99
<i>Jhelum District</i>												
Mean maximum temp. °F. . . .	66.5	66.8	80.1	91.7	100.2	104.7	96.8	94.1	95.5	92.7	81.0	69.2
Mean minimum temp. °F. . . .	42.2	45.8	52.4	61.5	72.6	77.8	77.2	76.6	72.1	58.4	45.2	40.5
Relative Humidity at 0800 hrs. I.S.T. . . .	85.0	92.0	65.0	52.0	45.0	48.0	75.0	82.0	71.0	73.0	92.0	82.0
Precipitation, in inches	1.40	1.23	1.32	0.07	0.82	1.55	4.86	5.34	2.24	0.31	0.26	0.54
<i>Attock District *</i>												
Precipitation, in inches	1.41	1.36	1.80	1.37	0.90	1.34	4.14	5.15	0.41	0.40	0.23	0.66

Meteorological data furnished by the Director, Meteorological Department, Lahore, Punjab, Pakistan. * Other data not available.

Vegetation

There is only a very limited amount of land available for use as pasture. Uncultivable waste land produces some stunted grasses during the rainy season but hardly provides any substantial feeding. Preserved community areas known as Rakhs provide only light pasture and if properly maintained may be of great

use in providing grazing for the animals, though at present they do not supply adequate feeding. The forests in the tract are of submontane scrub type. There are, however, a number of fodder trees from which leaves and branches are lopped and fed to the cattle. As the tract is frequently subjected to famines due to scarcity of rains, once in every two or three years these fodder trees are of great importance in preserving cattle during lean periods. Some of the important fodder trees are: *Olea cuspidata*, *Acacia modesta*, *Acacia arabica*, *Bauhinia variegata*, *Celtis australis*, *Albizia sisir*, *Grewia species*, *Zizyphus jujuba* and *Zizyphus nummularia*.

Depending on soil and rainfall, the following crops are usually grown: wheat, barley, chickpeas, linseed, millets, maize, sorghum, *Phaseolus radiatus*, *P. mungo*, sesame and *Eruca sativa*. Wheat, barley, chickpeas, linseed and *Eruca sativa* or Taramira as locally known are winter crops and the others are grown in the rainy season. By-products from all of these crops are used for cattle feeding.

Management Practices

Almost every farmer in the area maintains a few animals for breeding. In view of the good demand for Dhanni bulls and bullocks from areas in Central Punjab and North-West Frontier Province, male stock is generally well looked after. Calves are not weaned and bull calves are usually allowed the entire milk of their mothers for a period ranging from 6 to 9 months. Heifers are allowed only about half the cows' production. Bulls are almost entirely stall-fed. They are given regular exercise and are groomed frequently to allow the formation of a lustrous coat. The same attention is not paid to females, and as a result growth is frequently slow and stunted. In most cases, cows are used extensively in the plow and are not too well-fed. As grazing is very limited cattle have to depend on home-grown feeds of the cultivators. The following is an approximate feeding schedule:

January to March — Green wheat and green barley.
April to June — Crushed wheat straw, chickpea flour and Taramira cake.

July to September — If rains are adequate and natural grazing is good cattle are usually carried on pastures with slight supplement of green millets, sorghum, maize and *Phascolus radiatus* or *P. mungo*. otherwise these crops supply bulk of feed.

October to December — Straws of millets, sorghum, maize, or wheat and oilcakes.

Common salt is generally given only once a fortnight but when green fodder is available salt is given more frequently.

During famine periods loppings from trees mentioned above are extensively used. Also a large number of cattle are moved to the canal-irrigated areas of the Punjab.

Physical Characteristics of the Breed

Dhanni cattle are medium-sized, compact, active animals and the bullocks are much prized as draft animals. The predominant color in the great majority of animals consists of black spots of varying dimensions scattered on a white coat, resembling that of a Dalmatian dog. These black spots are often seen with black hair in the center and white on the margin and at times are entirely covered with white hair. Animals with red patches are occasionally seen but are not liked by the breeders.

They have a comparatively long body with straight back. The head is moderate-sized with a straight profile and small horns which emerge laterally directed upward and outward. Horns are usually 3 to 5 inches in length. Ears are medium-sized, carried horizontally and pointing obliquely backwards and should not droop.

The hump is well-developed, upstanding and rounded, with firm fleshing. The skin is generally tight, with a barely perceptible sheath, and a thin, small dewlap. The hair is short and lustrous, but with advancing years and underfeeding, cattle usually show coarseness. Hoofs are black, medium-sized and strong. The digits are close together. The tail is thin and short and the tuft is usually white and extends up to the fetlock. In cows the udder is poorly developed, and the teats are small and usually black in color.

Large head, large horns, drooping ears, long legs, pendulous

sheath and dewlap, whole red or gray color are considered undesirable characteristics in the breed. Average data on certain body measurements are summarized in Table 85.

Table 85. Average Measurements of Dhanni Cattle

MEASURE	At one year	At two years	Mature
Females			
Weight, in pounds . . .	300 - 350	700 - 850	750 - 900
Length from shoulder point to pin bones, in inches	44.26±0.82 (16)	52.46±0.20 (78)	54.48±0.55 (100)
Height at withers, in inches	45.81±0.78 (16)	47.95±0.11 (80)	49.69±0.14 (100)
Depth of chest, in inches	20.64±0.24 (16)	23.70±0.59 (20)	23.41±0.23 (36)
Width of hips, in inches	14.03±0.72 (16)	15.59±0.22 (20)	17.41±0.04 (36)
Heart girth, in inches . .	53.42±0.46 (16)	64.15±0.23 (78)	66.41±0.62 (100)

MEASURE	At one year	At two years	Mature bull	Mature bullock
Males				
Weight, in pounds . . .	300 - 400	800 - 1000	1000 - 1200	1050 - 1300
Length from shoulder point to pin bones, in inches	45.31±0.96 (16)	57.22±0.23 (69)	58.64±0.71 (50)	60.32±0.82 (36)
Height at withers, in inches	47.62±0.96 (16)	50.98±0.15 (70)	53.32±0.34 (50)	53.64±0.41 (36)
Depth of chest, in inches	22.5 ±0.25 (16)	24.18±0.24 (25)	28.76±0.25 (50)	29.12±0.28 (36)
Width of hips, in inches	14.62±0.78 (16)	15.74±0.22 (25)	19.78±0.25 (50)	21.08±0.26 (26)
Heart girth, in inches . .	55.31±0.44 (16)	68.77±0.24 (72)	75.16±0.49 (50)	76.48±0.51 (36)

Numbers sampled are shown in brackets.

Functional Characteristics of the Breed

The Dhanni breed is used primarily for draft purposes, and milk production has not received the same amount of attention as draft qualities. As the cows are also used in the plow and are underfed, their milking potentialities seldom have a chance to develop. However, a Dhanni Cattle Breeding Herd Book scheme was started in the year 1938 and under this scheme purebred animals are registered and their milk production is recorded. Average data on milk production are presented in Table 86.

Table 86. Milk Production of Dhanni Cows per Lactation

REGION	Average production of tested cows	Average production of cows producing between 2,000-2,499 pounds.	Average production of cows above 2,500 pounds.
Chakwal	1 740 \pm 47 (87)	2 265 \pm 41 (17)	2 800 \pm 520 (4)
Tallagang	1 760 \pm 45 (95)	2 180 \pm 102 (18)	2 900 \pm 500 (6)
Jatli	1 520 \pm 48 (73)	2 250 \pm 247 (9)	—

Numbers sampled are shown in brackets.

The average production of Dhanni cows thus far recorded is 1,684 \pm 28.37 pounds in a lactation period of 228 \pm 2.18 days. However, there is considerable variation ranging from 1,520 pounds to 3,400 pounds. It is estimated that at least 25 percent of the cows are capable of producing 2,500 pounds of milk in a lactation period.

The average calving interval is 33.86 \pm 0.03 months, based on 459 records. Average number of lactations during life as calculated, based on 116 records is 5.12 \pm 0.17. Average age at first calving, based on 67 records is 40.33 \pm 0.24 months. About 10.4 percent of the animals calved at an age of about 30 months.

Except for a slight peak period of matings between the months of May to August, the distribution of matings is usually uniformly spread throughout the year. Usually the males are brought up with greater care and are better fed than females. Ordinarily the young bulls are allowed to serve when they are about 2½ years old. The breeding records of bulls working in Dhanni Cattle Breeding Scheme (88 samples) show that the active breeding life of bulls is 7.2 \pm 0.44 years. They are quick at breeding and apt to be vicious in handling.

Dhanni bullocks are strong, compact, active and fast moving. They are extensively used for lifting water from wells and for making embankments in the fields and also for the levelling of fields. Bullocks move in short but rapid steps, a characteristic feature of this breed. They are castrated at the age of 3½ to 4 years. As purebred Dhanni bulls are in great demand for breeding purposes in other areas, only second rate animals are used for bullocks.

A pair of bullocks can haul a load of 2,500 to 3,000 pounds in an iron-tired cart on uneven dirt track. In a working day of

8 to 10 hours they cover a distance of 25 to 30 miles. As a pack animal, a bullock carries anything from 300 to 500 pounds. Plow bullocks usually work 8 to 10 hours a day during winter months but during summer they are not worked for more than 5 to 6 hours a day.

Meat qualities have never been studied.

No genetic traits have yet been studied, but general observation suggests that Dhanni color markings are dominant over solid color. On the whole, Dhanni cattle are hardy, though no specific studies are available regarding resistance or otherwise to several cattle diseases.

Performance in Other Areas

In other areas not far removed from the Dhanni tract, Dhanni cattle are being introduced both for grading up the local cattle as well as for purebreeding of Dhanni herds. These areas include Mianwali district of Punjab, Pakistan; Shahpur district of Punjab, Pakistan; and in some adjacent districts of North-West Frontier Province of Pakistan.

In the Mianwali district, where the climatic conditions are a little more rigorous and feeding facilities are inadequate, these cattle have not achieved any progress. Average milk production of tested cows (118) was 1375 ± 8.2 lbs., while average production of the better cows (5) was 2140 ± 35.5 lbs.. The average lactation period was also of a shorter duration 192 ± 2.6 days (117 cases).

In the Shahpur district, on the other hand, where ample feed is available throughout the year on account of availability of irrigation facilities, the average production of tested cows (96) was $2,115 \pm 56$ lbs. while average production of superior cows (41) was $2,305 \pm 40$ lbs.. Average lactation period was 243 ± 3.4 days. Though the production was as good as or superior to the production in the home tract of the breed, it is claimed that the male animals in this area do not show the same finish as the animals in their home tract. It is suggested that ample supply of green roughages with very little concentrates make the animals slightly paunchy.

Since 1928, Dhanni bulls were introduced to grade up the local cattle of some of adjacent districts of North west Frontier Province. Wherever the climate was very cold and feed condi-

tions were poor Dhanni cattle did not do so well. However, in Haripura in the Hazara district, Dhannis have done well, partly due to better management on the part of the breeders and also due to better feed conditions.

Sources of Breeding Stock and Information Regarding the Breed

The total Dhanni cattle population is estimated to be 1,225,000, 70 percent of which is in the Punjab, while the balance is in North-West Frontier Province. Dhannis are mostly marketed in the cattle fairs at Gulshah (Sialkot), Lyallpur, Patehganj, Gondal, Tallaganj (Attock), Chakwal (Jhelum), and Rawalpindi.

For further information regarding the breed, enquiries may be made to the Deputy Director of Animal Husbandry, Rawalpindi, District, Rawalpindi, West Punjab, Pakistan.

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