Livestock breeds of China

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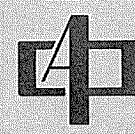

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TABLE OF CONTENTS

LIST OF TABLES

PREFACE

The world's animal genetic resources, while distributed widely in all countries, are a unique human heritage, offering benefits to mankind for improved standards of nutrition, reduced human labour, recreation and a variety of fibre and pharmaceutical products. In the earlier days of civilization only a relatively few species of animals and birds were domesticated. These accompanied races of people on their travels to new territories, where they were slowly selected for the special attributes and adaptations which enabled them to contribute to national and local lifestyles in a wide variety of climates and topographical conditions, using local feed supplies and being able to survive local diseases and pests. The result in the present day is a large number of different breeds of a small number of species, offering twentieth century man the opportunity to interbreed the local types, transfer breeds from one environment to another, and continue the process of exploiting genetic variation for modern needs at international as well as local levels and at a faster pace than in the past.

It is a prerequisite of such actions that animal specialists and producers know about the animal genetic resources available in other parts of the world. One of the aims of FAO is to promote this exchange of information and to support, where requested, the use of exotic germplasm in member countries for improved production and utilization of animals. It is also FAO's aim, working together with other international bodies such as the United Nations Environment Programme, to promote the preservation, for possible future use, of those indigenous breeds which have unique genetic characteristics and which are threatened in present day conditions.

FAO has issued a number of publications over the years, documenting the genetic resources of the developed and developing world on national or regional bases. The animal genetic resources of China still remain largely unknown in many parts of the world. Recently there has been a surge of interest, because of the reputation of some Chinese breeds for production patterns in excess of many breeds in other places. The prolificacy of some Chinese pig breeds is an example. Good communication is an essential part of good science and of successful development agriculture. FAO is therefore pleased to publish this volume on the livestock breeds of China. It has previously been published in Chinese by China Academic Publishers of Beijing. They and the author have agreed to make an expanded edition of the book available to a wider audience.

The problems of documenting the animal genetic resources of a country so vast as China are immense and require special skills. These must include a first hand knowledge of the breeds and of the environments and husbandry systems of which they are a part; knowledge of the published literature is also required, and an understanding not only of English, but also of the interests of readers outside China, are valuable strengths. The author, Professor Peilieu Cheng, possesses these. After a bachelor's degree in China, he lectured in Beijing and then gained an MS and a PhD in the USA. On return to China, after being Research Fellow in Nanking, he became Director of the Institute of Animal Science of the Chinese Academy of Agricultural Sciences until his retirement in 1983. His long association with the Chinese Association of Zootechnic and Veterinary Sciences, as Technical Secretary and Vice-President, has given him

widespread contacts throughout his home country. He has travelled widely and written many research papers and books in Chinese. He also translated this book into English. FAO is grateful to Dr. Helen Newton Turner of Australia who has edited Professor Cheng's manuscript and prepared it for publication.

We believe this book will contribute to a deeper knowledge of the unique animal genetic resources of China and also to better understanding and cooperation between those throughout the world who live by and work with animals.

H.A.Jasiorowski
Director
Animal Production and Health Division
FAO

FOREWORD

This book gives a brief account of the distribution of livestock in various regions of China, as well as the breed characteristics developed under different ecological conditions. An attempt is made to illustrate the influence on breed formation of environmental factors, in addition to those of genetics and selection. The livestock breeds enumerated include 14 horse, 2 camel, 14 yellow cattle, 4 dairy and milk/meat dual-purpose cattle, 8 water buffalo (types), 6 yak (types), 13 sheep, 18 goat and 15 swine. An understanding of animal ecology will undoubtedly guide plans for regionalization of livestock in our country.

It is also pointed out that our rich breed resources provide us with genetic material of great value in animal breeding. Our swine breeds influenced the improvement or formation of some foreign breeds in the past, and may have even more influence in the future, though this may not be foreseen at present. We should, therefore, promptly study breed characteristics, and work on the investigation, protection, selection, development and utilization of these valuable resources.

The present work is not merely an English translation of the author's recent book, published in Chinese in 1980. It is greatly expanded, and a new chapter on Goat Breeds has been added. Some revisions and necessary corrections have been made and more illustrations added to ensure that readers will more easily obtain a general idea of the ecological characteristics of livestock breeds in China.

Attempts made here to illustrate the relationship between our livestock breeds and their environments are restricted by the knowledge of the author and the reference data available. This book is just a beginning, and it is earnestly hoped that further systematic and intensive studies in the field of animal ecology will be made by others.

The author is deeply indebted to many people who kindly gave permission for the use of graphic illustrations, data and photographs; specific acknowledgement is included where relevant in the text, and there is also a list on the pages following. Special thanks must be given to Professor Jiang Ying, of the Beijing Agricultural University, for his kind cooperation in contributing the chapter on Goat Breeds, and to Mr. Shen Chang-jiang of the Commission for Integrated Survey of National Resources, Academia Sinica, for his reading of the Chinese manuscript, and his valuable suggestions, by which the book has greatly benefited.

Sincere gratitude is extended to Dr. Helen Newton Turner, of CSIRO Australia, for her painstaking revision of the manuscript, even before she undertook the task of final editing. Dr. Turner has visited China twice, and is familiar with livestock breed resources in our country.

Finally, the author would also like to thank Miss Huang Min for her laborious work in typing the original manuscript, and Mrs. Margaret Dowell, of Sydney, Australia, for preparation of the camera-ready copy. This would not have been possible without the cooperation of CSIRO's Division of

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Cheng Peilieu
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EDITOR'S NOTE

Valuable information on Chinese livestock breeds and their environments is given in this book, drawn from a wide range of sources. Most of the original information is in Chinese; some of it is in regular journals, but much is in institutional reports not readily available outside China. Because of the great interest in Chinese work, and the increasing contacts between Chinese scientists and those in other countries, an attempt has been made to help further interchange of ideas by documenting not only the organizations responsible for the work reported, but their location.

References are numbered, and listed in alphabetic order at the end of each chapter; most are referred to specifically in the text, but where they are not (as in Chapter 1), they relate to the chapter as a whole. References for tables are at the foot when they are few in number, and down the right-hand side when they are numerous. Dr. John Turton, of the Commonwealth Bureau of Animal Breeding and Genetics in Edinburgh, U.K. made helpful comments on their presentation.

The format has been standardized between chapters as far as possible, but the nature of the material available has led to some variation. Where there is a lengthy description of a breed, as with the cattle in Chapter 4, each has been given a decimal paragraph heading; where descriptions of individual breeds (or types) are shorter, as with the water buffalo in Chapter 6, decimal headings were not considered warranted.

There is no index; it is replaced by a very detailed Table of Contents, which includes the breeds mentioned in the relevant chapters. Further references to breeds are in Chapter 11, though these are not in the Table of Contents. Numerous plates illustrating the breeds are grouped at the end of each chapter. Maps showing various environmental features and the distribution of the various species are at the end of the book.

Many queries have arisen, and many discussions have been held, in preparing this book for readers of English; Professor Cheng has shown great patience throughout. Translation of Chinese names is never easy, particularly in view of recent changes, and I hope any remaining errors are few. We have discussed many points, such as the small numbers of animals sometimes represented in tables, but our joint conclusion is that as these are the only data available, they are worth presenting as an encouragement to others. Professor Cheng's concluding couplet at the end of Chapter 12 is an admirable summation of his attitude.

Helen Newton Turner,
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Sydney, Australia.
1984

CHAPTER 1

THE NATURAL ENVIRONMENT AND DISTRIBUTION OF DOMESTIC ANIMALS IN CHINA

1.1 THE NATURAL ENVIRONMENT

The distribution of numbers and classes of domestic animals in China is closely related to the natural environment, as is the formation of breeds. Firstly, the huge size of China's territory must be appreciated; it covers more than 5,000 kilometres from east to west, and more than 5,500 kilometres from north to south, with a total area of 9.6 million square kilometres, representing approximately one fifteenth of the total terrestrial area of the world. Secondly, complex topographic and climatic conditions within the country exert a great influence on livestock.

China's topography, climatic belts, annual mean temperature, annual precipitation, and division of pastoral and agricultural areas, are illustrated by sketch maps in Figures 1.1 to 1.5 (pages 218-222); the administrative regions are shown in Figure 1.6 (page 223). Temperatures for the climate belts of Figure 1.2 are in Table F1 (page 217).

For convenience in discussing the distribution of livestock, the Chinese animal industry may be divided, according to environmental and economic conditions, into two main areas, pastoral and agricultural (Figure 1.5). The pastoral areas occur in the plateaus of the north and west, noted for their high altitude and cold, arid climate. These have contributed to the formation of different types of natural grassland, and, in turn, shaped the conditions for domestic animals. The agricultural areas occur in the east and south, noted for their temperate, moist climate, fertile soil and well-developed agriculture, which have helped to form a very different livestock environment.

1.2 NUMBERS AND DISTRIBUTION OF DOMESTIC ANIMALS

The numbers and distribution of domestic animals in China are summarized in Table 1.1, which gives the general geographic areas in which various species are found. The pastoral and agricultural areas can be sub-divided more specifically.

1.2.1 Distribution within the pastoral areas

The Chinese pastoral areas may be tentatively divided into three main zones: Steppe, (mainly in the north); Desert, (mainly in the northwest) and Plateaus, (in the southwest), and may be further divided into seven regions according to type of grassland, as shown in Figure 1.5 (Regions I to VII). Remarkable differences in geographic and climatic conditions, as well as in soil and vegetation types, all contribute to differences in the distribution of domestic animals.

Table 1.1 NUMBERS AND DISTRIBUTION OF DOMESTIC ANIMALS IN CHINA

Classes	Numbers ('000) By end of year: 1980*	1982***	Main uses	Distribution≠≠
Large animals:	95,246	101,127		
Horse	11,042	10,981	Draught (farm work, harness, riding); milk in some areas	NE,NW,NC (including Inner Mongolia), SW
Ass	7,748	8,999	Draught	NC (including Inner Mongolia), NW
Mule	4,166	4,464	Draught	NC (including Inner Mongolia), NW
Camel	614	610	Draught, camel wool	Inner Mongolia, NW
Cattle:	71,676	76,073		
Yellow cattle	52,515	56,112	Draught, meat	North Agricultural Area, Pastoral areas
Water buffalo	18,520	19,114	Draught, meat	South Agricultural Area
Dairy cattle	641	817	Milk	Suburbs
Yak	12,300**	n.a.≠	Packing, meat, milk, fibre	Qinghai-Tibet Plateau
Sheep and goat:	187,311	181,790		
Sheep	106,627	106,568	Wool, meat, pelt	NE, NW, NC, SC
Goat	80,684	75,222	Meat, cashmere, pelt, milk	Throughout China
Pig	305,431	300,783	Meat, bristles, manure for fertilizer	Agricultural areas

Sources: * 6; **11; *** 7 (Numbers refer to references at end of chapter). ≠ n.a.= not available
≠≠NE = Northeast; NW = Northwest; NC = North China; SW = Southwest; SC = South China.

1.2.1.1 Steppe Pastoral Zone

The Forest-Steppe Region (Figure 1.5, I) is mainly distributed in the western part of Heilongjiang and Jilin Provinces, the northern part of Hebei Province and the eastern part of Inner Mongolia. The winter is long, cold and arid, and the summer short and humid; the soil is fertile and grasses grow well.

This Region contains 53.0 percent of the total rural population of the pastoral areas, and 40.7 percent of the arable land. It has more pigs than other parts of the pastoral areas (59.6 percent of the total), and a high proportion of the mules (49.2 percent), asses (30.8 percent), horses (17.9 percent) and cattle (23.3 percent), needed for farming and transport (Table 1.2).

The Dry-Steppe Region (Figure 1.5, II) lies mainly in the western parts of the Inner Mongolia and Loess Plateaus (Figure 1.2, II), with an altitude of 1,000 to 1,500 m, and an annual precipitation of about 250 mm. There are fewer vegetation types and grasses are not abundant. The area is mainly used for raising camels, mules, sheep and goats (Table 1.2).

1.2.1.2 Desert Pastoral Zone

The Mountains in the Desert Region (Figure 1.5, III) include the Altay, Tianshan, Qinling and Kunlun Mountains (Figure 1.1, 1), where temperature and rainfall conditions change with altitude and topography. The annual rainfall of the mountain pastures is about 400 to 500 mm (Figure 1.2, IIC), while in the desert basin it is only 50 to 100 mm (Figure 1.2, IIID). The area is mainly used for raising sheep, camels and horses (Table 1.2).

The Plain in the Desert Region (Figure 1.5, IV) is distributed from the west of the Helan Mountains in the Ningxia Hui Autonomous Region to the north of the Tibet Plateau (including part of the gobi desert). It is even more arid, with an annual rainfall under 150 mm (Figure 1.4, 1), but has 20.4 percent of the rural population of the pastoral zone and 26.7 percent of the arable land. Camels (60.5 percent), asses (53.6 percent), horses (40.1 percent) and cattle (36.1 percent) are needed for farming and transport. The area also has the highest proportion of sheep (42.4 percent) and goats (28.6 percent) of all regions of the pastoral areas (Table 1.2).

1.2.1.3 Plateau Pastoral Zone

The High Altitude Meadow (Figure 1.5, V) lies mainly in the northern and western parts of Sichuan Province; 70 percent of the yaks in the pastoral areas are raised here, and 22 percent of the sheep (Table 1.2).

The Tableland Steppe (Figure 1.5, VI) includes north Tibet and west Qinghai Province, with an elevation of 4,500 to 5,000 m, an annual mean temperature below 0°C and an annual precipitation 200 to 300 mm. It is high, cold and arid; yak and goat are the main livestock (Table 1.2).

Table 1.2

PROPORTIONS OF LIVESTOCK SPECIES IN DIFFERENT PASTORAL REGIONS*
(Percentages of pastoral total)

Pastoral region (Pasture types)			Rural population	Arable land	Horse	Ass	Mule	Camel	Cattle**	Yak**	Sheep	Goat	Pig	All livestock
Steppe Zone	I	Forest-Steppe	53.0	40.7	17.9	30.8	49.2	1.0	23.3	-	2.4	5.0	59.6	10.9
	II	Dry-Steppe	8.2	16.4	16.4	5.5	28.4	24.0	11.7	-	12.8	17.5	18.9	13.3
Desert Zone	III	Mountain	5.6	8.8	14.6	2.9	3.9	14.1	5.1	7.7	11.8	5.2	1.4	8.6
	IV	Plain	20.4	26.7	40.1	53.6	10.7	60.5	36.1	-	42.4	28.6	13.5	33.7
Plateau Zone	V	High Altitude Meadow	8.7	5.3	9.0	3.4	5.9	0.4	15.1	70.0	22.0	11.8	5.9	20.4
	VI	Tableland Steppe (N)	1.0	0.1	1.1	-	-	-	1.6	13.6	3.0	24.5	-	7.5
	VII	Mountain Steppe (S)	3.1	2.0	0.9	3.8	1.9	-	7.1	8.7	5.6	7.4	0.7	5.6
Pastoral areas (total)			100	100	100	100	100	100	100	100	100	100	100	100

Sources: *9; **12.

Table 1.3

COMPOSITION OF THE LIVESTOCK POPULATION IN EACH PASTORAL REGION*
(Percentages of regional total)

Pastoral region (Pasture types)			Horse	Ass	Mule	Camel	Cattle**	Yak**	Sheep	Goat	Pig	Total
Steppe Zone	I	Forest-Steppe	6.8	6.4	0.7	-	17.4	-	10.8	8.9	49.0	100
	II	Dry-Steppe	5.1	0.9	0.3	0.6	7.2	-	47.1	26.0	12.8	100
Desert Zone	III	Mountain	7.1	0.8	0.1	0.5	4.9	6.3	67.0	11.9	1.4	100
	IV	Plain	5.0	3.6	-	0.6	8.8	-	61.7	16.7	3.6	100
Plateau Zone	V	High Altitude Meadow	1.8	0.4	0.1	-	6.1	24.4	53.2	11.4	2.6	100
	VI	Tableland Steppe (N)	0.6	-	-	-	1.8	13.0	19.6	64.9	0.1	100
	VII	Mountain Steppe (S)	0.7	1.6	-	-	10.4	11.0	49.0	26.2	1.1	100
Pastoral areas (total)			4.2	2.3	0.1	0.3	8.2	7.1	49.1	19.7	9.0	100

Sources: *9; **12

The Mountain Steppe (Figure 1.5, VII) includes the area from south Tibet to the northern side of the Himalaya Mountains. It varies greatly in topographic and climatic conditions, being temperate and humid in the valleys, with an annual mean temperature above 5°C and an annual rainfall about 350 mm; it contains different classes of livestock, but only 5.6 percent of the total in the pastoral areas (Table 1.2).

Table 1.2 shows species in each of these seven pastoral regions as a percentage of the total in the pastoral areas, while Table 1.3 shows the composition of the livestock population in each region. Sheep constitute nearly half the total number of animals in the pastoral areas, followed by goats with nearly 20 percent.

The pastoral areas of our country are mainly in the north, northwest and southwest, where the national minorities dwell; they keep animals to produce meat, milk, fibre and pelts. The animals graze on grasslands year round, with very little feeding or management care. The nomadic way of life still prevails in some areas, and the animals are still subjected to the menace of either drought or heavy snow. Animal husbandry is still in the state of "relying on heaven".

1.2.2 Distribution within the agricultural areas

The agricultural areas in our country are found largely in the northeast, North China, and the middle and lower regions of the Changjiang River, i.e., the "Three Great Plains", and also on the Loess Plateau (Figure 1.1). We may subdivide this vast area into North and South Agricultural Regions by drawing a line along the Qinling Mountains and the Huaihe River at about 33°N (Figure 1.5). Farm animals found therein have their own particular characteristics.

The North Agricultural Region belongs to the Temperate Belt, mainly producing wheat, corn, sorghum and beans; it thus provides a variety of agricultural by-products for livestock. The main draught animals are horses, donkeys, mules and yellow cattle. The small animals are predominantly pigs and sheep.

The South Agricultural Region belongs to the South Temperate and North Subtropical Belts, characterized by plentiful rainfall. This is the basic rice-producing area of the country. The main draught animals are water buffaloes and yellow cattle. Small animals consist mainly of pigs and poultry.

Characteristics of animal industries in the agricultural areas, compared with those of the pastoral, are: more intensive management, higher husbandry standards, and housing of animals in sheds. Animals are used to provide draught power and manure for the farms, as well as meat, eggs and milk for the cities and countryside.

1.2.3 Comparison between numbers of livestock in pastoral and agricultural areas

Although the pastoral area is larger in size than the agricultural, about three-fourths of China's total livestock are distributed in the latter. This total includes about 96 percent of the nation's swine, most

of the draught animals, about 75 percent of the cattle, more than half of the horses, 75 percent and 92 percent of the nation's donkeys and mules, more than one-third of the sheep, and about 70 percent of the goats (Table 1.4).

Table 1.4 DISTRIBUTION OF DIFFERENT CLASSES OF LIVESTOCK IN PASTORAL AND AGRICULTURAL AREAS
(Percentages of national total)

	Pastoral areas(%)	Agricultural areas(%)
Nation's terrestrial area	52.0	48.0
Nation's arable land	10.4	89.6
Agricultural population (human)	3.2	96.8
Livestock population:		
Horse	43.8	56.2
Ass	24.9	75.1
Mule	7.6	92.4
Camel	73.1	26.9
Cattle	25.1	74.9
Sheep	63.6	36.4
Goat	29.4	70.6
Pig	3.7	96.3
National total	22.1	77.9
In terms of sheep units	19.7	80.3

Source: 9

1.3 INFLUENCE OF ECOLOGICAL CONDITIONS ON BREED CHARACTERISTICS

In addition to genetics and breeding, ecological or environmental conditions have exerted a great influence on the formation of livestock breeds.

China has mountains and plains, plus temperate, subtropical and tropical belts. These natural conditions are varied and complicated; there are pastoral and agricultural areas, and also areas which are a mixture of the two. Feeding and management practices, therefore, differ widely. Animal production requirements of the people also vary, leading to differences in the direction and methods of selection. Various animal breeds have thus gradually formed with different heritable characteristics and productive abilities.

Examples from each class of livestock will be taken to illustrate how different animal breeds were formed under different ecological conditions.

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CHAPTER 2

HORSE BREEDS

The population of horses in China by the end of 1982 was 10.98 million (3). They are distributed in Inner Mongolia, the Northeast, North China, the Northwest and Southwest, (Figure 2.1).

China has a long history in horse breeding, and various indigenous breeds have been developed by selection under different ecological conditions (Table 2.1). They may be roughly grouped into three main categories, according to region: North Pastoral Grassland, Northwest Plateau and Southwest Mountain Area.

2.1 HORSES OF SPECIFIC REGIONS

2.1.1 North Pastoral Grassland

In the vast North Pastoral Grassland, there are the Mongolian horse in the north and the Kazakh in the west. They share the valuable characteristics of remarkable adaptation to unfavourable environments, and ability to graze year round while withstanding harsh feeding conditions; they can survive with neither sheds nor supplementary feed even in temperatures below -40°C in severe winters.

2.1.1.1 Mongolian

The Mongolian horse (Plates 2.1 and 2.2) is one of the most important and numerous among the indigenous horse breeds. It is widely distributed throughout the Northeast, North China and the Northwest (Figure 2.1). It is dual-purpose, primarily used for riding (including Mongolian traditional racing) and carting. The average wither height of males is 128 cm, females 127 cm, but body size varies with environmental conditions. The Ujumqin horse (1 - Plates 2.3 and 2.4), a type of Mongolian which is on better pasture, is taller (male 135 cm, female 129 cm), with better conformation (Table 2.2).

The breed is used for meat and milk as well as for riding and carting.

Work: Mongolian horses possess remarkable working ability. For carting, four horses, with a load of 2,000 kg, can walk 50-60 km a day.

Milk production: During the grass-growing season, mares are milked 4-5 times a day, producing 0.5-1.0 kg of milk each time. Yearly production is 300-400 kg.

2.1.1.2 Kazakh

Kazakh horses are taller and more durable than Mongolian (male 136 cm, female 133 cm, Table 2.2), and can be used in harness or for riding. They also produce meat and milk.

Table 2.1 LOCAL NATURAL CONDITIONS - INDIGENOUS HORSE BREEDS

Regions and breeds	Climate belts and topography	Altitude (m)	Temperature* Annual mean (°C)	Lowest (°C)	Annual* precipitation (mm)
North Grassland:					
Mongolian	Middle temperate High plains, highlands	1,000-1,500	1.8	-39.0	270
Ujumqin	Middle temperate High plains, highlands	800-1,200	0.7	-39.5	248
Kazakh	Middle temperate Mountain, valley and plain	550	6.2	-39.2	280
Northwest Plateau:					
Hequ	Middle temperate High, cold, mountain pasture	3,500	0.9	-29.9	560
Southwest Mountain:					
Jianchang	Subtropic Mountain	1,800-2,300	16.9	-3.4	990
Lijiang	Subtropic Mountain	2,000	12.6	-7.0	982
Guangxi	Subtropic Mountain	740	19.1	-1.9	1,546

* Ten year averages of local or neighbouring weather stations.

Milk production: The local inhabitants traditionally drink mares' milk. During the grass-growing season (which lasts about 120 days), mares are milked during the day, while foals suckle at night. The average production per lactation is about 500 kg.

Reproduction: Most mares are bred in May, June and July. They usually give one foal every year or second year, and 10-15 foals may be obtained in a reproductive life.

2.1.2 Northwest Plateau (High and cold)

The Hequ (Plates 2.5 and 2.6) may represent horses of this region. The breed is distributed mainly in the eastern part of the Qinghai-Tibet Plateau, which is the border area of the Provinces of Gansu, Qinghai and Sichuan. There the altitude is high (about 3,500 m), and the temperature is low (annual mean 0.9°C), but the climate is temperate and moist in the summer (annual precipitation about 560 mm), and grasses grow well in the pastures. Under these conditions, the Hequ horse has developed a comparatively large body size (average height: male 141 cm, female 134 cm, Table 2.2). It is of a saddle/harness dual-purpose type.

Table 2.2 BODY MEASUREMENTS OF INDIGENOUS HORSE BREEDS

Regions and breeds	Sex*	Number	Body measurements			
			Height at withers (cm)	Body length (cm)	Heart girth (cm)	Cannon-bone girth (cm)
North Grassland:						
Mongolian	M	n.a.**	128	136	158	17.8
	F	n.a.	127	134	155	16.2
Ujumqin	M	22	135	143	169	18.8
	F	20	129	138	164	17.7
Kazakh	M	60	136	141	160	19.0
	F	355	133	139	163	18.0
Northwest Plateau:						
Hequ	M	160	141	143	174	19.1
	F	1,243	134	139	169	17.5
Southwest Mountain:						
Jianchang	M	106	115	114	126	14.4
	F	827	116	115	124	14.3
Lijiang	M	49	117	115	132	14.0
	F	727	115	117	132	14.0

* M = male; F = female ** n.a. = not available

Sources: Various, checked by Wang, T.Q., Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing.

Work: Some riding speeds are:

(a) Short distance (for a Dongke type of Hequ - 7)
1,000 m - 2'24"
1,600 m - 5'11"

(b) Long distance
50 km - 3 hours 15'
100 km - 7 hours 20'

Reproduction: Mares mature at 2, and are bred at 3 years. Most come on heat in May and June. The length of the oestrous cycle is 22 (15-28) days, and of the oestrous period, 4-6 days; the first ovulation occurs within 10 days of foaling. The conception rate under year round pasture conditions is 70 percent, but may be as high as 80-90 percent under good feeding and management (4). Mares may produce 12-13 foals in a lifetime.

2.1.3 Southwest Mountain Area

Although the altitude is fairly high (about 2,000 m) on the Yunnan-Guizhou Plateau of the Southwest, this area is temperate and moist year round (annual mean temperature, 13-15°C; annual precipitation about 1,000 mm). The topography consists of high mountains interlaced with arable lands in the valleys. The mountains are steep and the paths rough; historically, the people have to depend on horses as pack animals for transport, and the animals have gradually developed an adaptation to these local conditions and requirements.

2.1.3.1 Jianchang and Lijiang

The common features of horses in the Southwest, such as the Jianchang horse of Sichuan Province (Plate 2.7) and the Lijiang horse of Yunnan Province (Plate 2.8), are small size (height at withers: male 115-117 cm, female 115-116 cm - Table 2.2), with narrow chest, slender limbs (cannon-bone girth 14 cm), but strong joints and hard hoofs. The adaptability of these horses (or ponies) to climbing steep paths swiftly makes them suitable as pack animals for long distance transport in mountainous areas.

Work: The main use of these breeds is in packing or riding.

Reproduction: Age at first breeding is 3-4 years for males, 3 years for females; most mares come on heat from March to May. Lijiang mares, located at 2,800 m in high, cold mountains, come on heat about one month later than those in lower areas (10). Breeding is usually by natural mating, but AI has also been practised, with a conception rate of 80 percent. Mares may give one foal every year, or every other year.

2.1.3.2 Guangxi

The Guangxi pony (Plates 2.9 and 2.10) is distributed in the Yunnan and Sichuan Provinces and the Guangxi Zhuang Autonomous Region. It is even

smaller than the Jianchang and Lijiang, with a wither height of about 100 cm, the lowest being 86 cm, as observed in a survey conducted at Jingxi (6). Further studies are necessary on these interesting ponies.

2.2 NEW HORSE BREEDS

Horse breeding programmes have been carried out in various parts of the country since the beginning of this century, exotic breeds being crossed onto indigenous (mainly Mongolian and Kazakh) to improve the native animals and to develop new breeds. Some new horse breeds have already been established, while others are still under development (Tables 2.3 and 2.4).

2.2.1 Established new breeds

Examples of established new breeds are the Sanhe, developed from Mongolian and many exotic breeds, mainly Orloff, Percheron and Arab, the Ili, from Kazakh and some light Soviet breeds, mainly Orloff, and the Jinzhou, from Mongolian and many exotic breeds, such as Percheron.

The Sanhe (Plates 2.11 and 2.12), located in the northeast of the Inner Mongolia Autonomous Region, is used mainly for riding and carting. Most of the mares come on heat from April to July.

The Ili, in the northwest of the Xinjiang Uygur Autonomous Region (Plates 2.13 and 2.14; background Plate 2.15) and the Jinzhou, in the Jin County of Liaoning Province (Plate 2.16), are used mainly for riding and carting, but also for milk and meat production. The Ili has an average milk production of 650 kg in a lactation period of 120 days during the grass-growing season.

2.2.2 Breeds under development

Further crossbreeding has been practised extensively during the last 30 years to develop other harness breeds of strength and speed, to meet the needs of agriculture and transport in the great Northeast Plains. Examples are the Heilongjiang in Heilongjiang Province, (Plates 2.17 and 2.18), the Jilin Harness in Jilin Province, (Plates 2.19 to 2.22) and the Tieling in Liaoning Province, (Plates 2.23 and 2.24). All are being developed by crossing native mares with stallions of various Soviet breeds and selecting among the progeny.

2.3 SUMMARY

In developed countries, horse populations have declined markedly, being replaced by mechanical power. But in developing countries, particularly those with very variable terrain, horses are still extremely important, as witnessed by the attention paid in China to forming new breeds.

Table 2.3 LOCAL NATURAL CONDITIONS - NEW HORSE BREEDS

Breeds	Altitude (m)	Temperature* Annual mean (°C)	Temperature* Lowest (°C)	Annual* precipitation (mm)
Established:				
Sanhe	660	-3.1	-44.0	335
Ili	800-3,000	2.9	-30.6	510
Jinzhou	90	10.1	-21.1	671
Under development:				
Heilongjiang	150	3.4	-37.2	397
Jilin	240	4.9	-36.5	571
Tieling	100	6.4	-34.2	653

*Ten year averages of local or neighbouring weather stations.

Table 2.4 BODY MEASUREMENTS OF NEW HORSE BREEDS

Breeds	Sex	Body measurements: Height at withers (cm)	Body length (cm)	Heart girth (cm)	Cannon-bone girth (cm)
Established:					
Sanhe*	M	155	161	189	20.9
	F	146	150	173	19.9
Ili**	M	154	n.a.	178	19.4
	F	144	n.a.	178	18.8
Jinzhou	M	156	157	183	20.7
	F	148	158	180	19.8
Under development:					
Heilongjiang***	M	156	162	187	21.5
	F	150	155	181	20.1
Jilin	M	156	163	192	22.8
	F	n.a.	n.a.	n.a.	n.a.
Tieling	M	156	165	194	22.6
	F	154	164	190	21.3

Sources: *9, **5, ***8

2.4 REFERENCES

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9. Zhang, N.W. [A brief introduction to Jilin horse breeding]. Shandong 1977 Horse 1977 (2):31-32. [Ch.].
10. Zhang, B.N. and Zhou, J.M. [A survey of the Lijiang horse]. Horse 1980 1980 (1) 48-52. [Ch.].

MONGOLIAN HORSE
Inner Mongolia

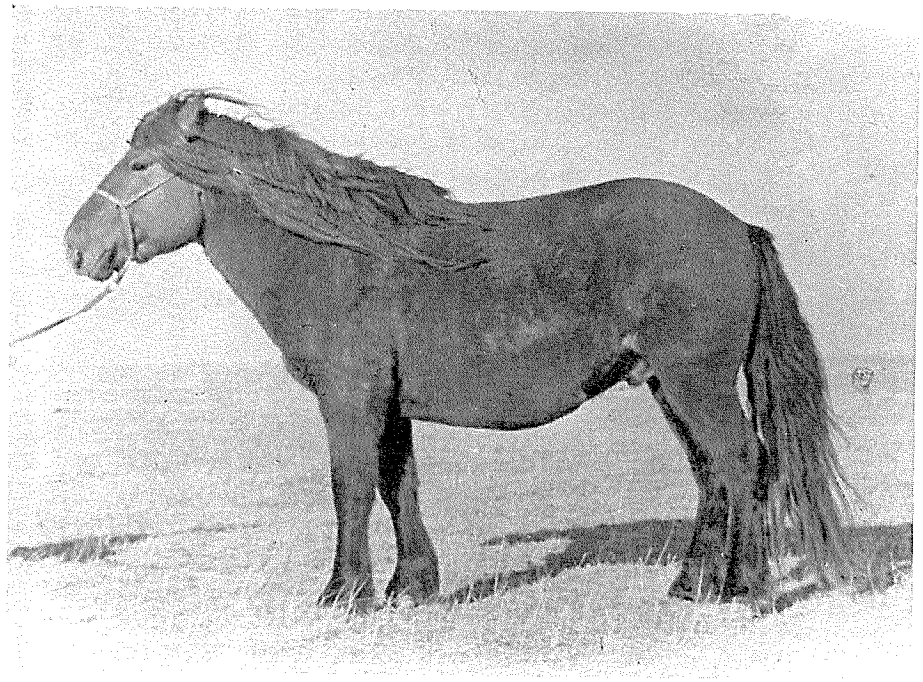

Plate 2.1 Stallion

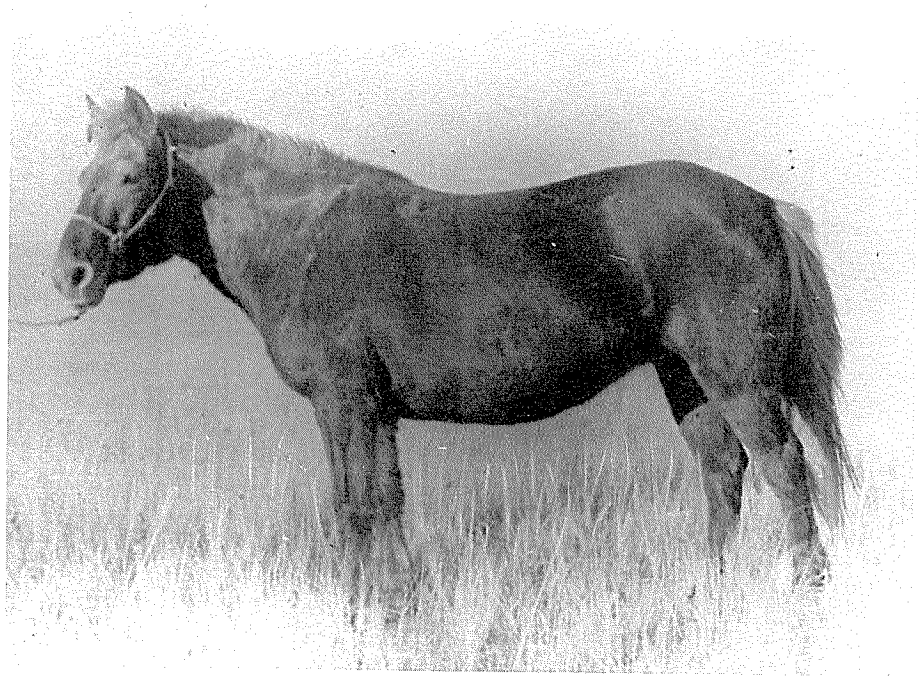

Plate 2.2 Mare

UJUMQIN HORSE (Riding/carting)
A type of Mongolian (Inner Mongolia)

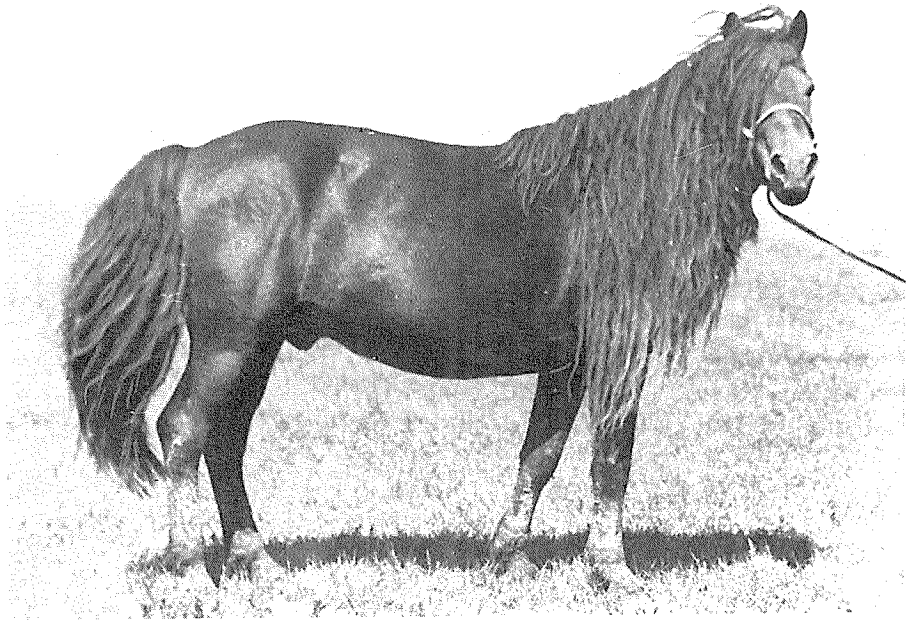

Plate 2.3 Stallion

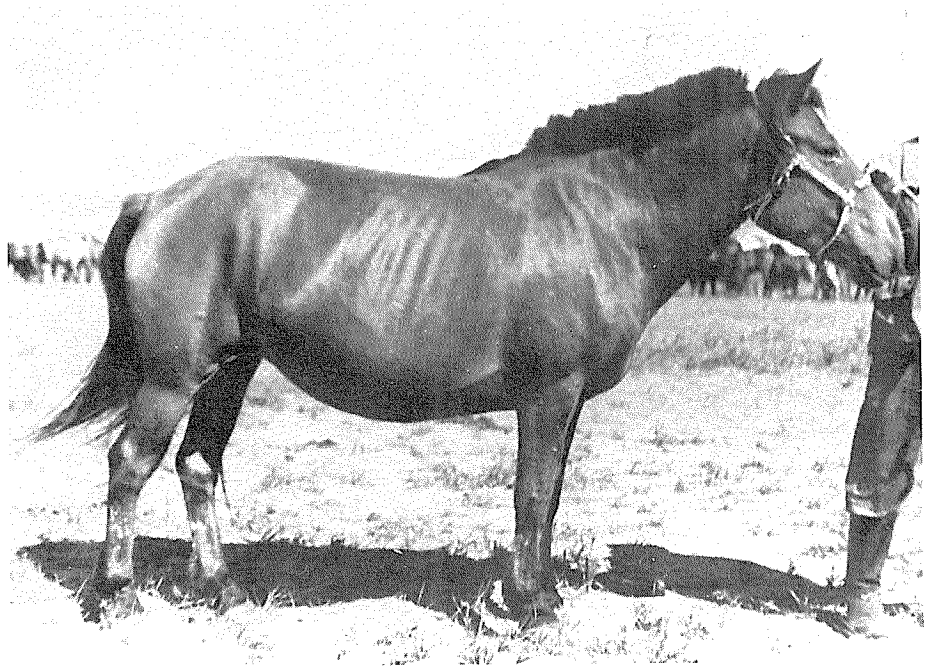

Plate 2.4 Mare

HEQU HORSE (Saddle/harness)
Gansu Province

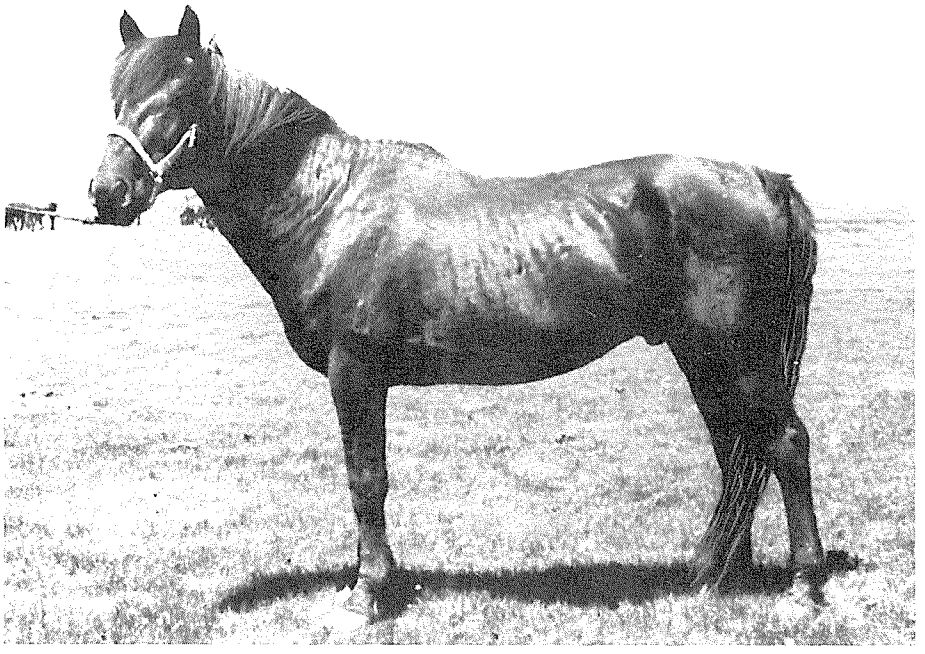

Plate 2.5 Stallion

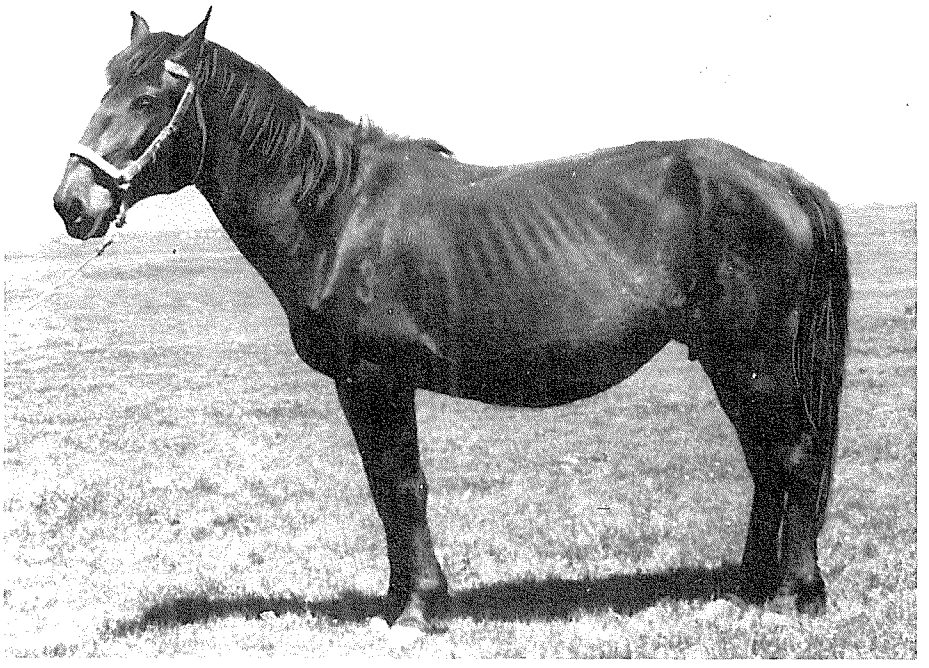

Plate 2.6 Mare

JIANCHANG HORSE (Riding/packing)
West Sichuan Province

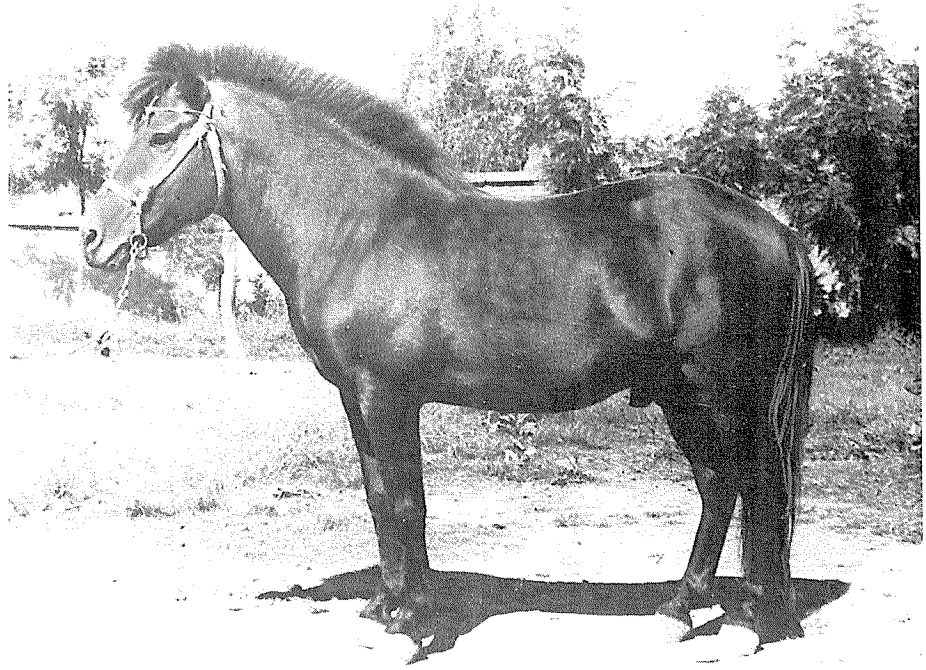

Plate 2.7 Stallion

LIJIANG HORSE (Packing/riding)
Northwest Yunnan Province

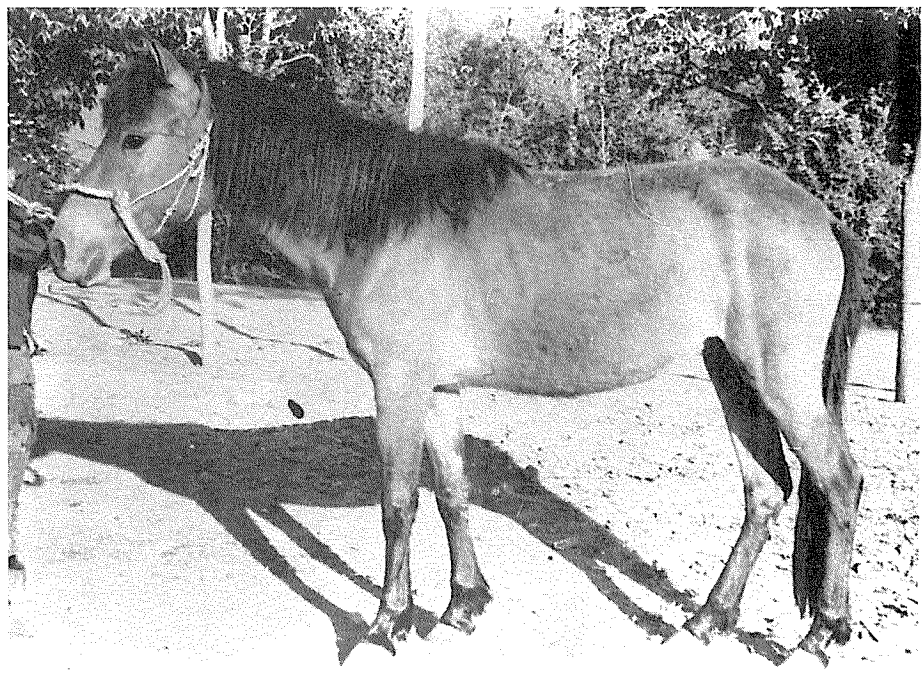

Plate 2.8 Mare

GUANGXI PONY
West Guangxi

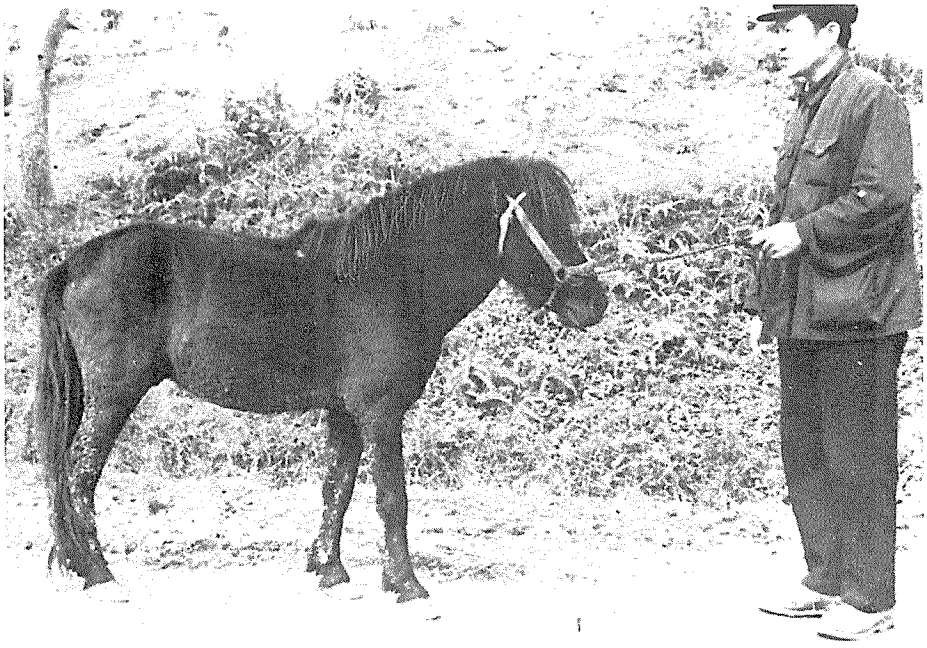

Plate 2.9 Stallion

Plate 2.10 Mare and foal

SANHE HORSE (Riding/harness)
East Inner Mongolia

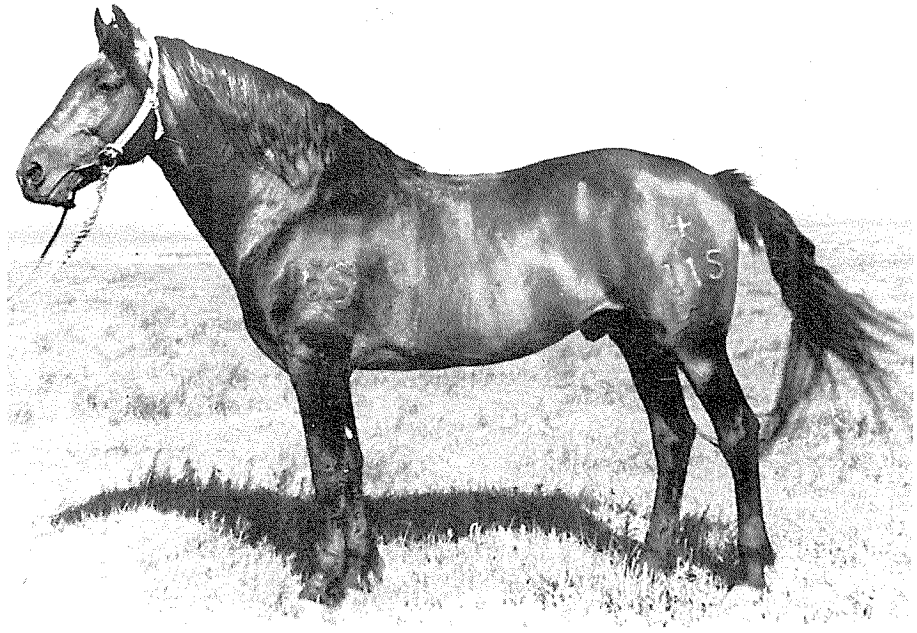

Plate 2.11 Stallion

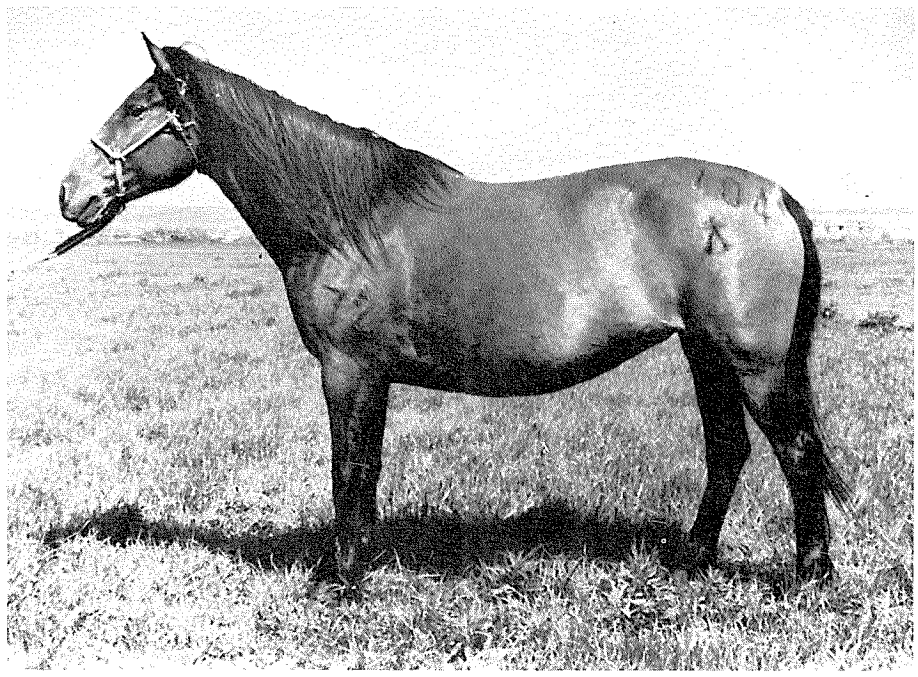

Plate 2.12 Mare

ILI HORSE (Riding/harness)
Ili District, NW Xinjiang

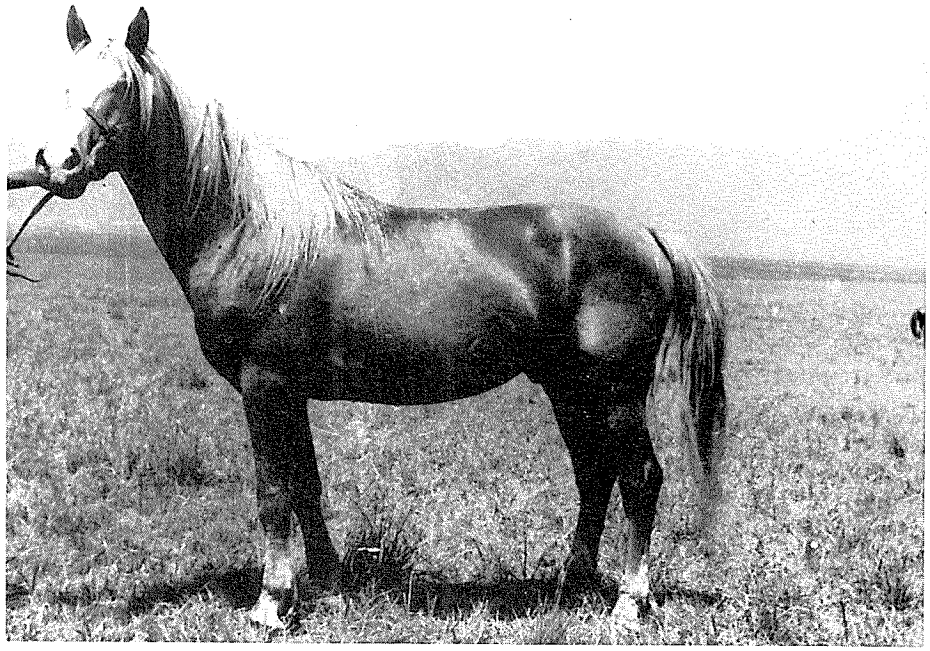

Plate 2.13 Stallion

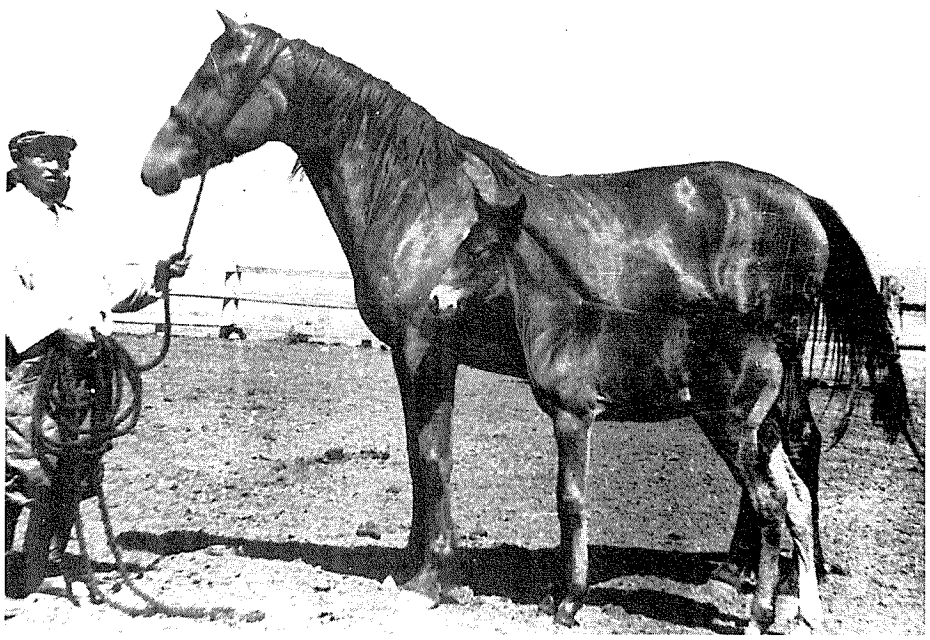

Plate 2.14 Mare and foal

HORSE PASTURES

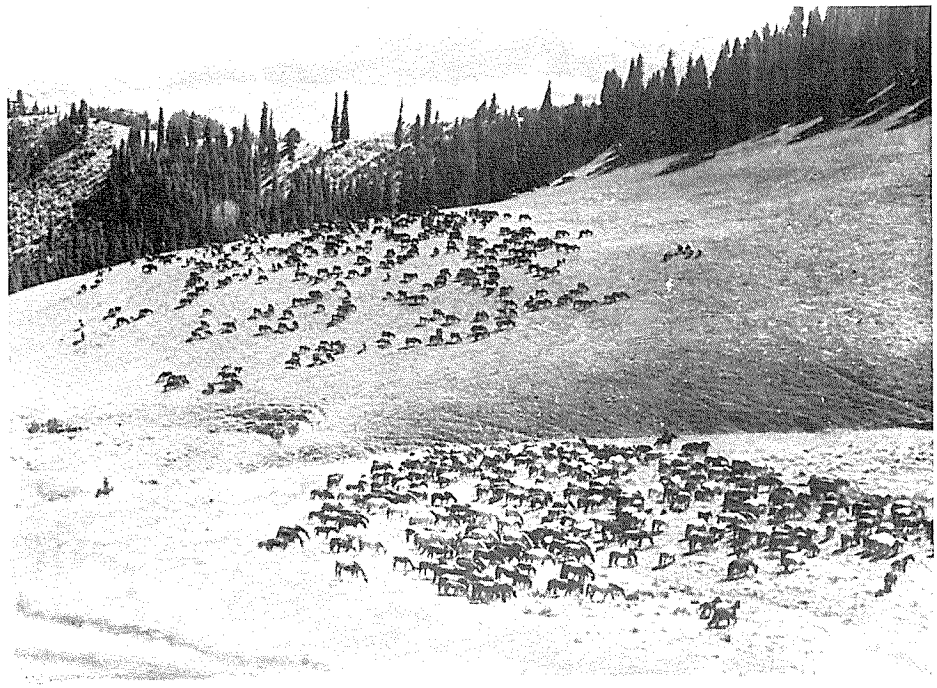

Plate 2.15 Tienshan Mountains, Xinjiang

JINZHOU HORSE (Riding/harness)
East Liaoning Province

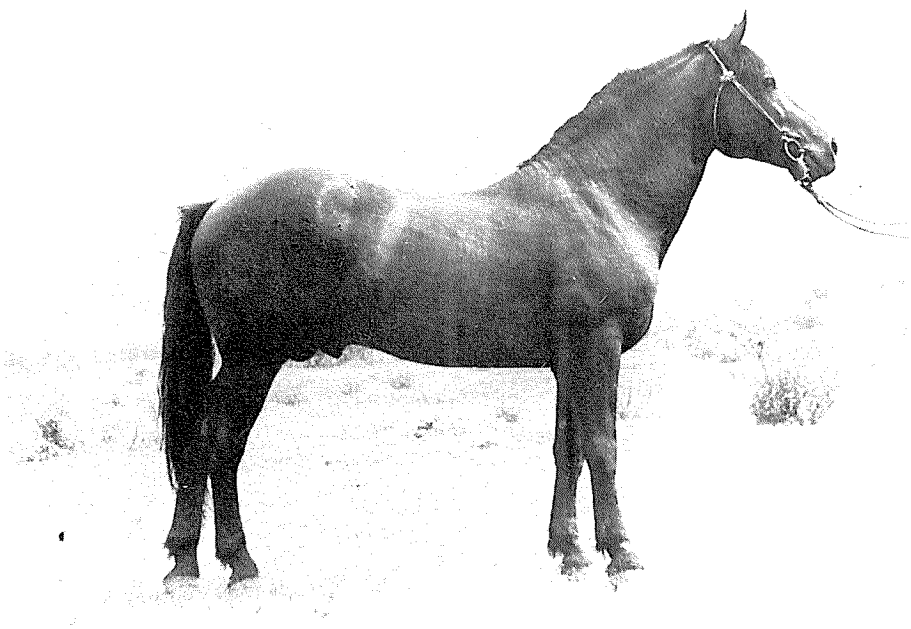

Plate 2.16 Stallion

HEILONGJIANG HORSE (Harness)
Heilongjiang Province

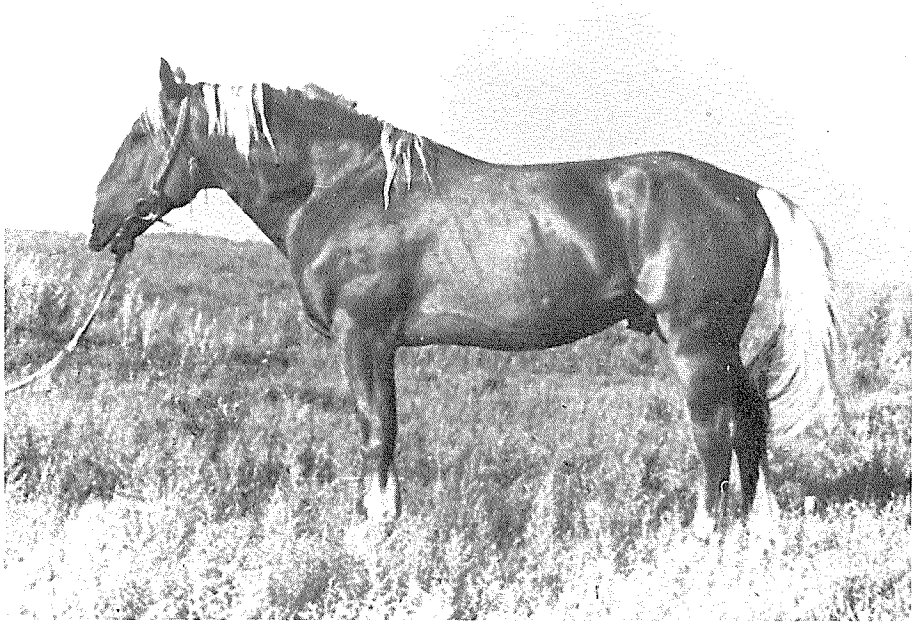

Plate 2.17 Stallion

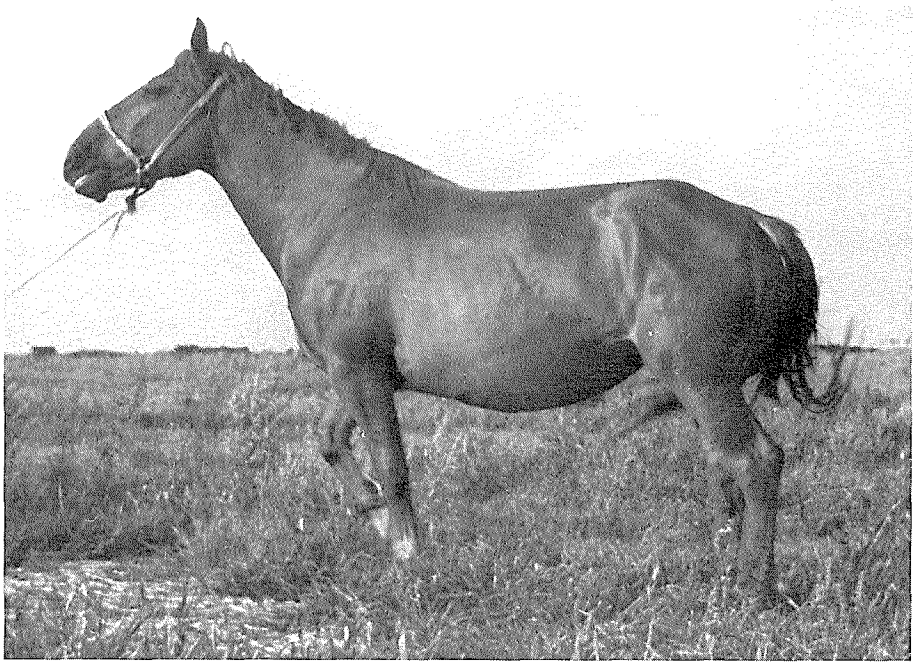

Plate 2.18 Mare

JILIN HORSE (Light type - Harness)
Jilin Province

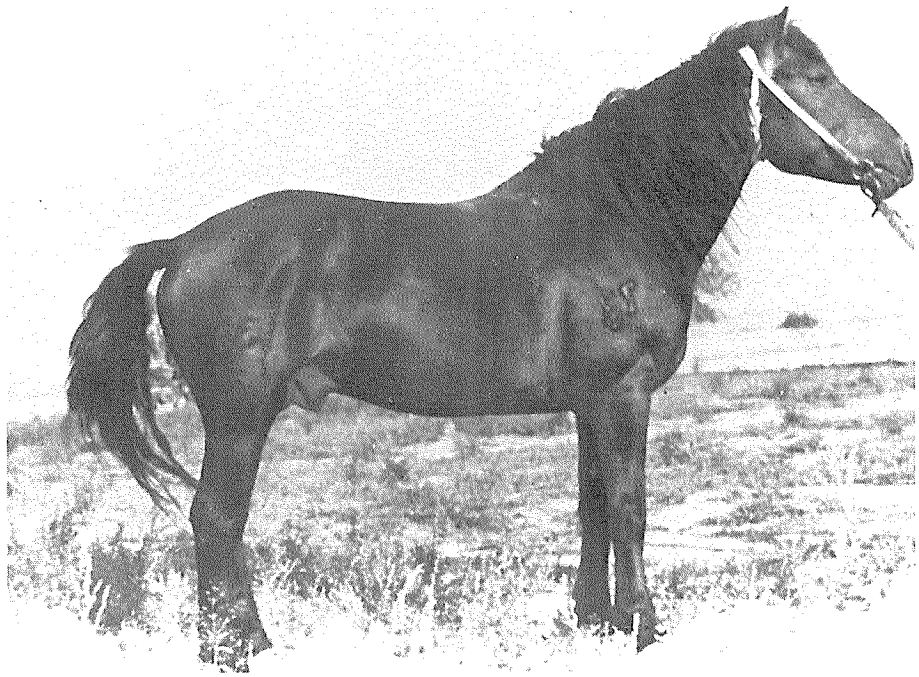

Plate 2.19 Stallion

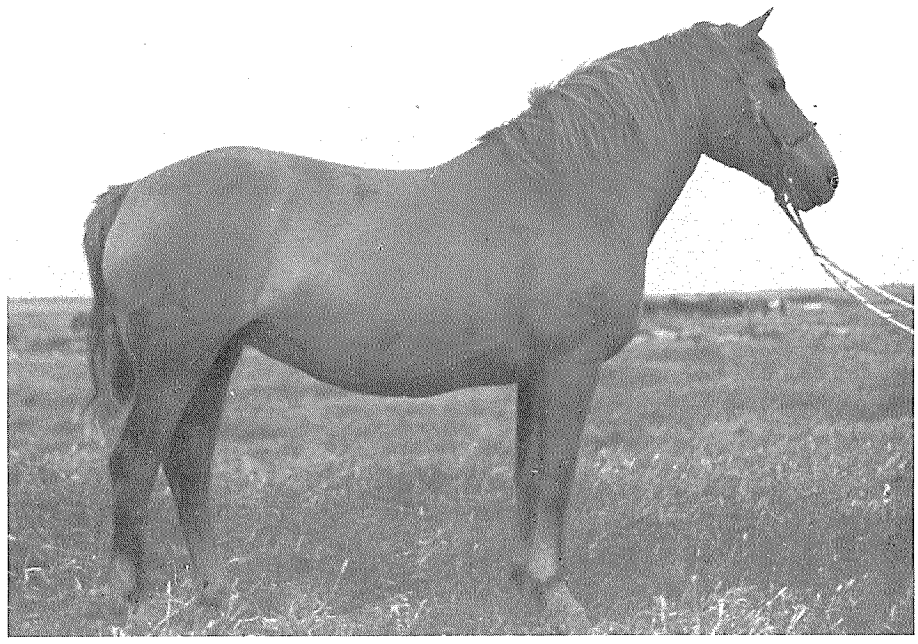

Plate 2.20 Mare

JILIN HORSE (Heavy type - Harness)
Jilin Province

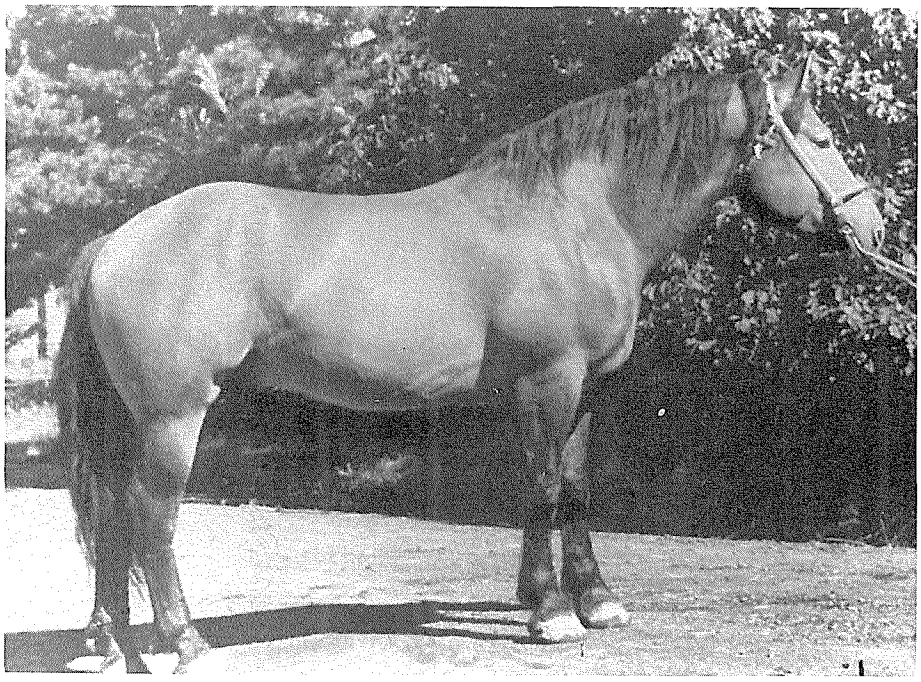

Plate 2.21 Stallion

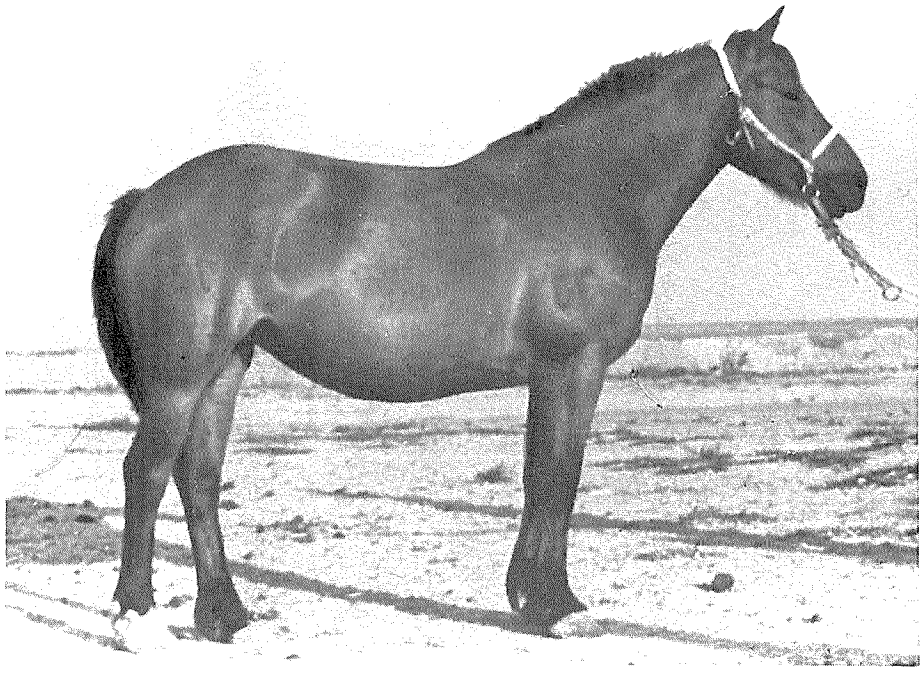

Plate 2.22 Mare

TIELING HORSE (Harness)
Liaoning Province

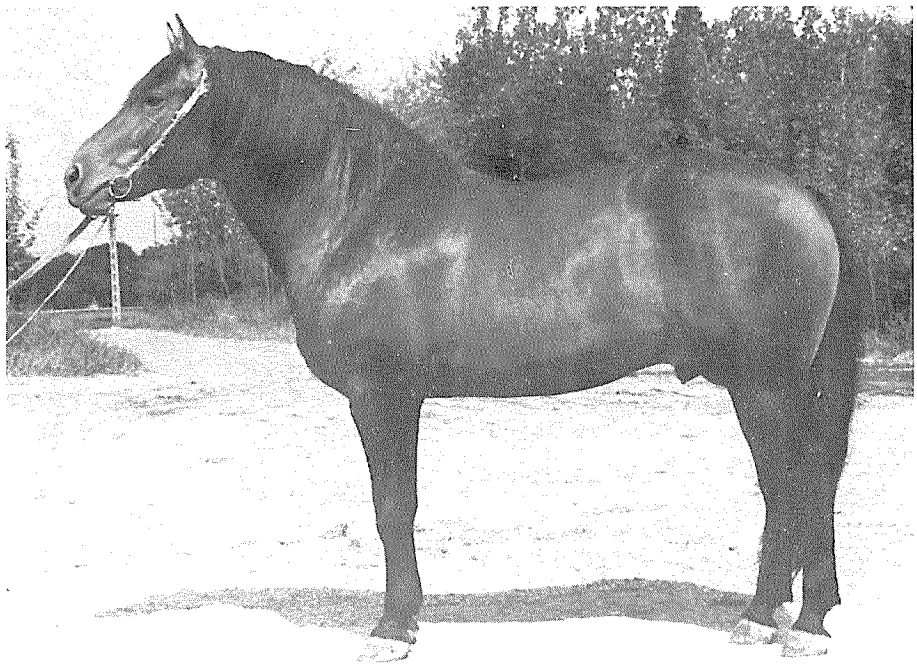

Plate 2.23 Stallion

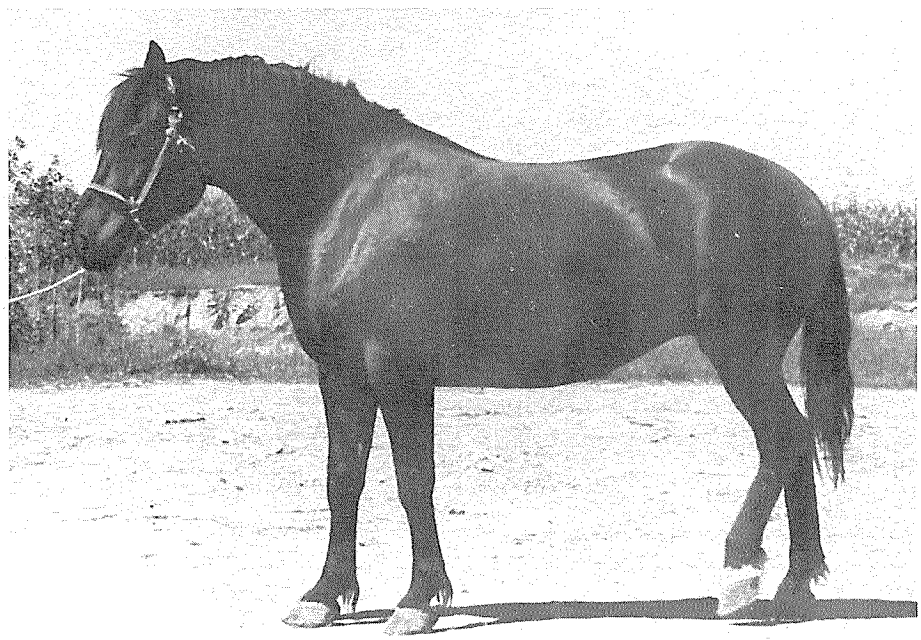

Plate 2.24 Mare

CHAPTER 3

CAMEL BREEDS

There are about 600,000 camels in China (Table 1.1), all of the bi-humped, Bactrian type (Camelus bactrianus). Examples are the Alxa, of Alxa County (Zone IV, in the west of Inner Mongolia, Plates 3.1 to 3.4) and the Sonid, of Sonid County (Zone II, in the north of Inner Mongolia, Plates 3.5 and 3.6).

Camels are mainly distributed in the high plains, deserts and semi-deserts of the north and northwest, in the Inner Mongolia and Xinjiang Uygur Autonomous Regions and Gansu and Qinghai Provinces, at an altitude of about 1,000 to 1,500 m. Temperature variations in these areas are great; the annual mean reading ranges from 0-2°C in the gobi desert to 14-16°C in the Turpan Depression, while there is a difference of about 70°C between summer and winter, and a diurnal variation of over 30°C. The annual precipitation ranges from 100 to 250 mm, but the evaporation rate is very high; the vegetation is poor, consisting mainly of sandy plants and shrubs.

These ecological conditions shape the peculiar characteristics of the camel; their distribution is shown in Figure 3.1.

3.1 BIOLOGICAL CHARACTERISTICS*

3.1.1 Endurance

Camels can stand extremely hot weather (air temperature 40-42°C, ground surface temperature 65-70°C, temperature under direct sunshine 70-80°C). They can suffer thirst, going without watering for 7-8 days, even under the sun, and may lose as much as 100 kg of water, or about 22 to 25 percent of their body weight.

The following regulating measures may be taken to reduce loss of water from the body:

(i) Breathing is done without opening the mouth, and respiration rate is reduced to a minimum, (16/min in hot and 8/min in cold weather).

(ii) Body temperature increases during the day, possibly up to 40°C, but falls at night, possibly down to 34°C, to reduce sweat evaporation rate to a minimum.

(iii) A woollen under-coat covers the body surface, serving as an insulating layer to protect the animal from direct sunshine, so that the body temperature will not exceed 40°C.

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* Sources are the references at the end of the chapter.

(iv) The faeces are as hard as a chestnut to minimize water loss in excretion.

(v) Watering is done whenever there is a chance; as much as 100 litres can be drunk in one day, the water being stored in the body tissues, including even the erythrocytes.

(vi) Hunger can be endured by consuming the fat and connective tissue of the humps to supply energy. The humps serve as a storehouse of body nutrients; this is confirmed by the fact that the humps stand up when the animal is in excellent body condition, and fall down like empty bags when it is in poor condition. Fat tissues of other parts of the body, of course, may also be consumed to supply energy. This is one reason why camels can survive and work as usual, even if not fed for 5-6 days.

3.1.2 Reproductive pattern

(i)	Age at puberty:	Male 4 years, Female 3 years.
(ii)	Age at first mating:	Male 4 - 5 years, Female 4 years.
(iii)	Mating:	
	Season:	December to April.
	Behaviour:	
	Male	Foaming of saliva from the mouth, groaning, loss of appetite, crossing legs on female, biting female's tail, mounting.
	Female	Lying down when male is approaching during courtship; acceptance of mating.
	Duration:	2 - 4 minutes.
	Semen:	Ejaculated into vagina. Sperm density: Average 615 mil/ml, Range 220 - 1,550 mil/ml. Sperm mobility 0.7 - 0.9.
(iv)	Ovulation:	Occurs about 32-48 hours after mating (induced ovulation). The female will refuse to mate again for between 2 and 8 days after the first mating (average 5 days). Follicular growth may occur in non-conceived females out of the breeding season, but the growing follicles do not ovulate.
(v)	Gestation period:	347 - 419 days (average 402), Male foetus 400 days, Female 405 days.
(vi)	Reproductive life:	About 20 years.

3.1.3 Body conformation

Body measurements for camels of some areas and strains are in Tables 3.1 and 3.2. Special body features are:

(i) There are cornified cushions on elbow, pastern, chest and hind knees (for protection during kneeling).

(ii) The body is relatively short and the limbs long.

(iii) The anterior hump is higher and narrower (height: 20 to 30 cm, width: 14 to 30 cm), than the posterior (height: 15 to 22 cm).

(iv) The hoofs are composed of cornified tissue, for ease in walking on sandy deserts and muddy paths.

3.2 PERFORMANCE

The Bactrian camel is a multi-purpose animal, mainly used for working and producing wool (from the undercoat), meat and milk.

Work:

Riding: At ordinary speeds, the camel can travel 25-40 km per day for one month; at fast speeds, 65-70 km can be covered in one day, but the animal should then be rested for several days.

Packing: A load of 150-180 kg can be carried for 7-8 hours a day, at an ordinary speed of 25-35 km per day.

Carting: A load of 750 kg can be pulled by one camel, or 1,500 kg by two, per day at normal walking speed.

Camel-wool production:

Total production per annum, including camel-hair and woollen undercoat, is 5-6 kg.

The woollen undercoat alone may weigh 3.5-5.5 kg (average 4.5 kg).

Fibre length of the undercoat is 7-8 cm, and diameter 17-19 µm.

Clean fibre percentage of the whole coat averages 68.

Meat production:

Dressing percentage ranges from 39 to 59 (average 51).

Meat (as a percentage of carcase) ranges from 25 to 42 (average 36).

Meat and fat weights per animal, under average or good body condition, may have the following ranges:

	Body condition	
	Average	Good
Meat (kg)	170 - 200	210 - 250
Fat (kg) (including hump)	15 - 20	22 - 30

Table 3.1 BODY MEASUREMENTS OF BACTRIAN CAMELS

Areas	Sex	Body Measurements*			
		Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)
Xinjiang (southern)	M	181	152	216	21.0
	F	171	148	210	19.1
Inner Mongolia	M	172	146	209	20.5
	F	170	145	211	18.0

Source: 9.

* Body height - From halfway between the two humps to the ground surface.
Body length - From the anterior end of shoulder bone to pin bone.
Heart girth - At the posterior base of anterior hump.
Cannon-bone girth - Shank circumference.

Table 3.2 BODY MEASUREMENTS AND ESTIMATED LIVEWEIGHTS OF TWO STRAINS OF INNER MONGOLIAN CAMELS.

Strains (locality)	Sex	Number of camels	Body Measurements* Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)	Estimated average liveweight (kg)
Alxa (west)	M	24	171	144	204	20.3	450
	F	531	168	143	201	18.0	400
Sonid (north)	M	11	176	158	250	24.0	650
	F	251	172	153	233	20.3	550

Source: 8
*As defined in Table 3.1

Milk production: Camels may be milked when nursing young, lactation lasting about 14-16 months. The Alxa camel can produce 1.5 - 2.0 kg daily in addition to the milk suckled by the young. Milking is not common for the Sonid, which may produce 1-2 kg of milk daily, 3-4 kg being the highest. Mongolian camels can produce 1.5 kg of milk in one milking, or 4.5 kg a day with 3 milkings.

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ALXA CAMEL
(West Inner Mongolia)

Plate 3.1 Male

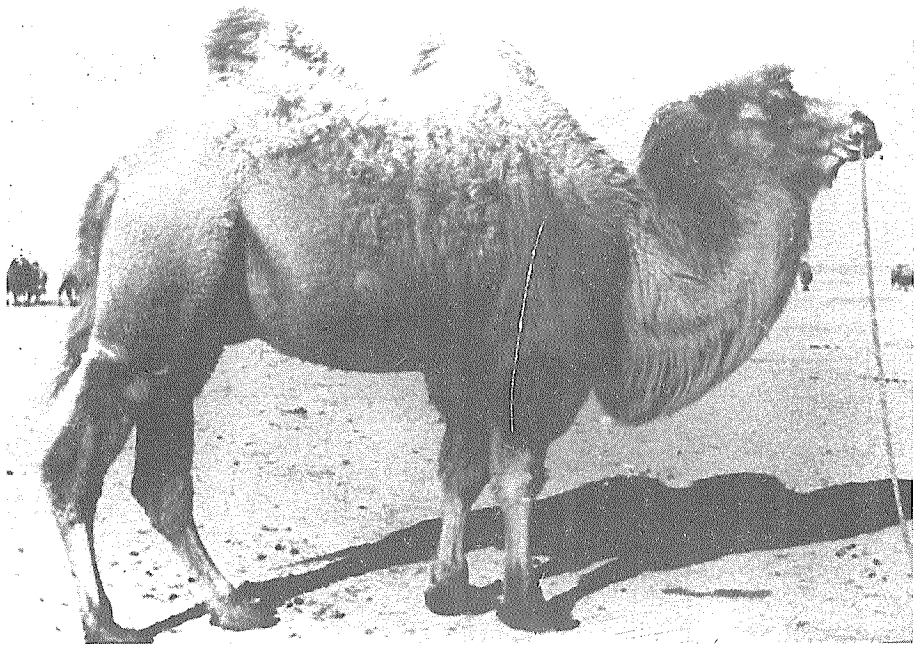

Plate 3.2 Female

ALXA CAMEL - BACKGROUND
Alxa County, Inner Mongolia

Plate 3.3 Camel "Chain"

Plate 3.4 Camels on desert

SONID CAMEL
North Inner Mongolia

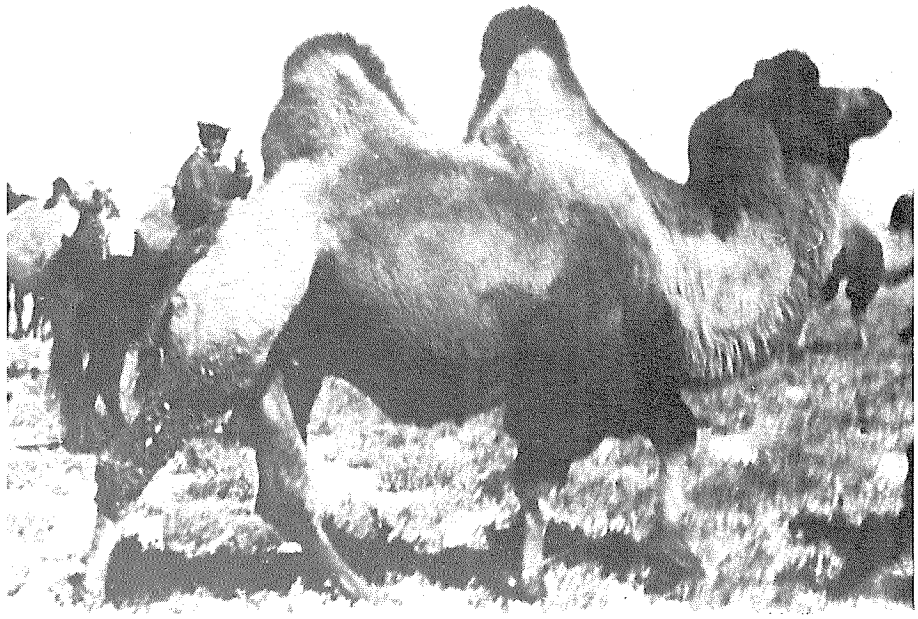

Plate 3.5 Male

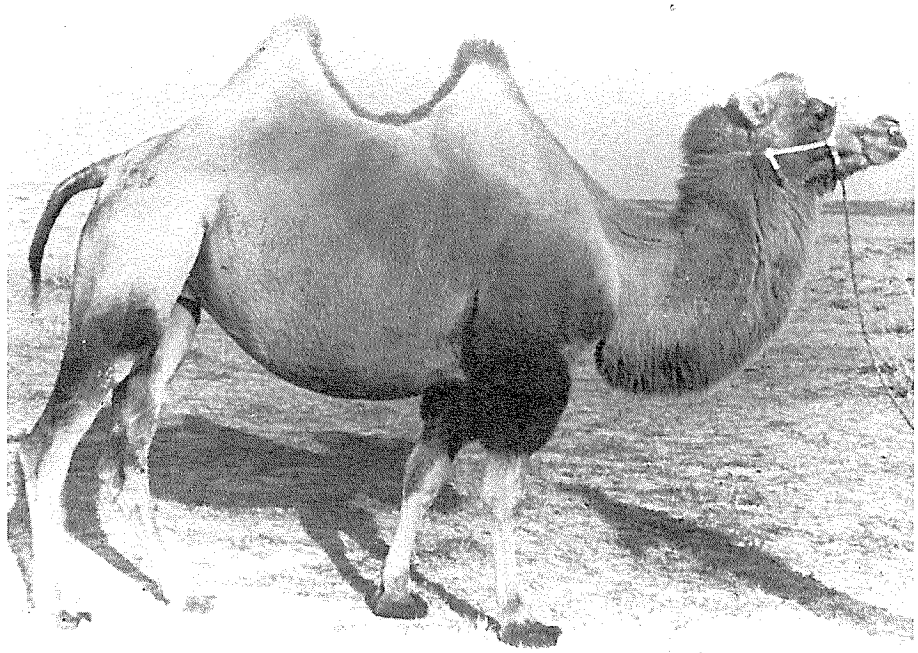

Plate 3.6 Female

CHAPTER 4

YELLOW CATTLE BREEDS*

The total number of yellow cattle in China by the end of 1982 was 56.1 million (2), their distribution in different parts of the country being shown in Figure 4.1.

Yellow cattle in China can be classified into two main types, common yellow (Bos taurus) and humped (Bos indicus), with their crossbreds. The majority, however, are common yellow cattle, which may be roughly divided into 4 categories on the basis of their natural distribution and ecological conditions (Figure 4.1):

- North Pastoral Grassland,
- North Agricultural,
- Central Agricultural,
- Southwest and South (including both the yellow cattle of the Yunnan-Guizhou Plateau in the southwest and the humped cattle in the south).

Natural conditions for some yellow cattle breeds are shown in Table 4.1 and the body measurements of these breeds in Table 4.2.

4.1 CATTLE OF SPECIFIC REGIONS

4.1.1 North Pastoral Grassland

Yellow cattle breeds of the North Pastoral Grassland are mainly Mongolian in the north and Kazakh in the northwest.

4.1.1.1 Mongolian

The Mongolian (Plates 4.1 and 4.2) is one of the most popular among Chinese indigenous cattle breeds. It is located mainly in Inner Mongolia, but is also widely distributed in the northeast (Heilongjiang, Jilin and Liaoning Provinces), north (Hebei Province) and northwest (Gansu and Qinghai Provinces and Ningxia Hui Autonomous Region).

Body measurements are shown in Table 4.2. Body weight and conformation of Mongolian cattle are influenced greatly by the type of natural grassland on which they are reared. Cattle kept on pasture, steppe, semi-desert-steppe and desert have a tendency to become increasingly smaller in that order, as illustrated in Chapter 11, Table 11.4.

Milk production is influenced by natural conditions and nutritional level, as well as by calving (lactation) number and stage of lactation. Ujumqin cows (Plates 4.3 and 4.4), a type of Mongolian, may produce 500-600 kg of milk in a 5-month lactation with good nutrition in

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* All indigenous cattle in China are commonly referred to as "Yellow Cattle", a term which distinguishes them from water buffalo and yak.

Table 4.1 LOCAL NATURAL CONDITIONS - YELLOW CATTLE BREEDS

Regions and breeds	Climate belts and topography	Altitude (m)	Temperature* Annual mean (°C)	Lowest (°C)	Annual* Precipitation (mm)
North Pastoral Grassland:					
Mongolian	Middle Temperate High plains	1,000-1,500	1.8	-39.0	270
Ujumqin	Middle Temperate High plains	800-1,200	0.7	-39.5	248
Kazakh	Middle Temperate Mountains, plains	550	6.2	-39.2	280
North Agricultural:					
Yanbian	Middle Temperate Hilly	180	4.9	-32.0	526
Central Agricultural:					
Qinchuan	South Temperate Plains	400	13.3	-18.7	584
Nanyang	South Temperate Plains	130	14.9	-17.6	813
Jinnan	South Temperate Plains	370	13.4	-18.2	553
Luxi	South Temperate Plains	50	13.7	-15.6	672
Southwest and South:					
Dengchuan	South Subtropic Hilly	1,990	14.9	-3.0	1,145
Wenshan	South Subtropic Hilly	1,250	17.8	-2.8	986
Hainan	South Subtropic and North Tropic Hilly	170	23.2	+2.9	1,758
Yunnan Zebu	South Subtropic and North Tropic Hilly	1,460	17.2	-0.7	1,200

* Ten year averages of local or neighbouring weather stations

Table 4.2 BODY MEASUREMENTS OF YELLOW CATTLE BREEDS

Regions and breeds	Sex	Number	Body measurements				
			Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)	Live weight (kg)
North Pastoral Grassland:							
Mongolian	M	n.a.*	120	147	180	17.5	396
	F	n.a.	113	134	167	15.9	306
Ujumqin	M	n.a.	119	145	185	18.3	475
	F	n.a.	113	135	171	16.1	374
Kazakh	M	n.a.	124	150	182	n.a.	498
	F	461	112	132	164	16.1	330
North Agricultural:							
Yanbian	M	82	131	152	187	19.9	465
	F	268	122	141	171	16.9	365
Central Agricultural:							
Qinchuan	M	23	140	158	198	19.9	575
	F	211	125	141	167	16.7	366
Nanyang	M	44	142	148	186	19.4	517
	F	710	122	132	161	15.9	347
Jinnan	M	5	140	173	201	21.5	650
	F	179	120	148	167	16.5	380
Luxi	M	29	135	147	184	18.2	450
	F	256	120	133	162	15.2	350
Southwest and South:							
Dengchuan	M	n.a.	129	118	160	n.a.	269
	F	n.a.	107	121	146	14.0	252
Wenshan	M	n.a.	117	125	162	17.5	299
	F	n.a.	109	114	148	15.1	230
Hainan	M	n.a.	124	134	155	17.0	294
	F	n.a.	112	130	150	15.2	259
Yunnan Zebu	M	70	116	130	159	n.a.	301
	F	30	107	115	142	n.a.	213

Sources: 3, 6, 11, 15, 16.
*n.a. = not available

the grass-growing season, the fat content being about 5 percent. Table 4.3 shows how milk production varies at different lactations.

Table 4.3 UJUMQIN COWS
MILK PRODUCTION FOR DIFFERENT LACTATIONS
(100-day lactation)

Lactation	Number of cows	1975 Milk yield (kg)	Number of cows	1977 Milk yield (kg)
1st	5	502	13	400
2nd	5	580	14	410
3rd	6	637	37	471

Source: 5 (Two surveys in Inner Mongolia).

Daily milk yield is highest in the first month, then gradually declines during the 5-month lactation period, as shown in Table 4.4.

Table 4.4 UJUMQIN COWS
DAILY MILK YIELD DURING A 5-MONTH LACTATION

	Month of lactation				
	1st	2nd	3rd	4th	5th
Average daily milk yield (kg)	4.82	4.77	4.11	3.61	3.74
As % of first month	100	99.0	85.3	74.9	77.6

Source: 5

Reproduction: Mongolian heifers first come on heat at the age of 8-12 months, but are not used for breeding until 2 years of age. There is a breeding season from April to November, but most cows are bred from May to September because of marked seasonal differences in climate and condition of the grassland.

4.1.1.2 Kazakh

The Kazakh, located mainly in north Xinjiang, is a meat-draught-milk multi-purpose breed (Plates 4.5 and 4.6). Most of the cattle are at pasture all the year, with very little supplementary feeding; they are well adapted to the local unfavourable climatic, feeding and management conditions.

Body measurements: Kazakh cattle are about the same size as Mongolian (Table 4.2).

Milk production during a lactation of 5-6 months is about 880 kg, with a fat content of 5 percent. Cows are on pasture only during summer and autumn, and receive a little supplementary feeding during winter and spring.

Reproduction: Kazakh heifers mature at one year of age, begin to breed at 2, and calve at about 3. Most females are bred from May to September.

4.1.1.3 Common features of North Pastoral Grassland cattle

The common features of North Pastoral Grassland yellow cattle, such as Mongolian and Kazakh, are:

(i) They are well adapted to the local conditions, and graze year round in severe weather, with unfavourable feeding conditions.

(ii) They are able to fatten quickly; they may consume their body reserves in a severe winter, leaving them weak and poor, but recover very quickly after fresh grasses come in May and June.

(iii) Breed characteristics, such as body weight and conformation, are influenced greatly by the type of natural grassland on which the cattle are reared. Body weights and measurements of cattle decrease as the nutritive value of the grassland becomes poorer.

(iv) Production of meat and milk and capacity for work are often limited by small size. Because body size varies with ecological conditions, however, Mongolian cattle may be grouped into three types, large, medium and small (11).

(v) Dressing percentages range from 40-50, and meat percentages from 29 to 47.

(vi) Milk production is low; Mongolian cows produce approximately 600 kg in a 5-6 month lactation period, though Kazakh cows produce more (about 880 kg). The fat content of the milk in both breeds is comparatively high (about 5 percent).

4.1.2 North Agricultural

4.1.2.1 Yanbian

Yanbian cattle (Plates 4.7 and 4.8) are mainly distributed in the North Agricultural Area, (the Yanbian Korean Autonomous Prefecture in the southeast of Jilin Province), and have entirely different ecological conditions from those of the North Pastoral Grassland cattle (Table 4.1). They are also found in other Provinces of the northeast, such as Heilongjiang Province, and in Liaoning Province in the south, where Korean minorities dwell.

Yanbian cattle are mainly used for draught, and serve as an important source of farm power for the rice-producing areas in the northeast.

Body measurements: Mature Yanbian cows are much taller and heavier than Mongolian and Kazakh (Table 4.2), females having an average wither height of 122 cm and body weight of 365 kg.

Meat production: Dressing percentages range from 40-48, with a meat percentage of 35.

4.1.3 Central Agricultural

The environmental conditions and, therefore, the breed characteristics of the yellow cattle of the Agricultural Area of Central China are entirely different from those of the Pastoral Area. The lower basin of the Huanghe (or Yellow) River is the chief yellow cattle producing area; the altitude is comparatively low (50-400 m), while the climate is temperate (annual mean temperature 13-15°C) and moist (annual precipitation 550-800 mm). Agriculture is well developed, and many different agricultural by-products are used as animal feed. The cattle are well fed and managed, and all have housing; some regions grow alfalfa (lucerne) for cattle feed.

Yellow cattle are the main draught power for agriculture. Since the soil is heavy, deep clay, there is a demand for bigger, stronger animals with more muscle, and so local yellow cattle have been bred and selected as work/meat or meat/work dual-purpose animals.

Some of the famous work/meat cattle breeds of the Central Agricultural Area, which are more or less of the same origin, are:

- Qinchuan of Shaanxi Province (Plates 4.9 and 4.10),
- Nanyang of Henan Province (Plates 4.11 and 4.12),
- Jinnan of Shanxi Province (Plates 4.13 and 4.14),
- Luxi of Shandong Province (Plates 4.15 and 4.16).

Body measurements: Central Agricultural cattle are, in general, bigger in body size than the North Pastoral Grassland breeds (Table 4.2). Bulls have a wither height averaging around 140 cm and a liveweight around 500-600 kg, while cows have a wither height of 120 cm or more and a liveweight of 300-400 kg.

Work: The maximum draught capacity of Qinchuan cattle is about 71 percent of their liveweight (8), as shown in Table 4.5, while constant capacity is about 30 percent, 1.19 mu (=0.08 ha) of land being worked per hour by males and 0.80 mu (=0.05 ha) by females and castrates (Table 4.6).

Meat production: Central Agricultural cattle are all noted for their meat production, as are the Yanbian cattle in the North Agricultural Area, which have similar ecological conditions, feeding and management, as well as selection aims. For example, Qinchuan cattle yield an average dressing percentage of 60 and meat percentage around 50 (12). Jinnan castrates at 18 months of age gave an average dressing percentage of 55 and a meat percentage of 40-44, after a fattening period of 61-80 days (9,14).

Table 4.5 QINCHUAN CATTLE
(INSTANT) MAXIMUM DRAUGHT CAPACITY

Sex	Age (yr.)	Number	Liveweight (kg)	Maximum draught capacity (kg)	(% of liveweight)
Male	6.4	5	651	476	71.1
Female	7.2	37	366	281	70.0
Castrate	7.2	53	466	334	71.7

Source: 8

Table 4.6 QINCHUAN CATTLE
WORKING PERFORMANCE IN THE FIELD

Sex	Number	Liveweight (kg)	Constant draught (kg)	(% of body wt)	Working in the field (mu/hr)	(ha/hr)
Male	1	771	250	32.4	1.19	0.08
Female	10	352	107	30.4	0.80	0.05
Castrate	10	522	144	27.5	0.80	0.05

Source: 8

Milk production: These breeds have a short lactation period, during which yield decreases drastically. For example, Qinchuan cattle have an average lactation period of 222 (203-240) days; the highest milk production occurs in the first month, decreases rapidly to about half in the fifth month, and then to a quarter in the eighth month, as shown in Table 4.7.

Table 4.7 QINCHUAN COWS
MILK PRODUCTION DURING AN 8-MONTH LACTATION

	Month of lactation 1st	2nd	3rd	4th	5th	6th	7th	8th
Milk yield (kg)	148	133	109	93	79	66	59	38
As % of total lactation	20.7	18.6	15.3	13.1	11.1	9.2	8.2	5.3
Compared with highest month*	100	89.5	73.7	62.5	53.5	44.4	39.5	25.4

Source: 1 * Calculated by Cheng, P.L.

Reproduction: Central Agricultural cattle attain their sexual maturity at the age of 8-12 months and breed at two years of age, with a calving rate (calves born/cows available for breeding) of 60-80 percent. The average gestation period is 285-290 days, but it is reported that cows carrying a male foetus have a gestation period about 4 days longer than those with a female foetus.

4.1.3.1 Common features of Central and North Agricultural cattle

Due to the similarity of their environmental conditions and selection aims, the four Central Agricultural cattle breeds (as well as Yanbian cattle in the North Agricultural Area) are all work/meat dual-purpose cattle, and have the following common characteristics:

(i) Body size is comparatively large, and the animals have good strength for draught. Body measurements of these breeds may be briefly summarized as follows:

Sex	Body measurements			
	Height at withers (cm)	Heart girth (cm)	Liveweight Average (kg)	Liveweight Maximum (kg)
Mature bulls	about 140	about 200	500-650	983
Mature cows	120-125	160-170	350-400	728

(ii) Bulls have a small hump, the forequarters being more developed than the hindquarters.

(iii) Animals are well muscled with fine-quality meat (e.g., the meat of the Luxi yellow cattle is well marbled and delicious).

4.1.4 Southwest and South

This area includes the South Subtropic and North Tropic Belts, and is highly humid (annual precipitation 2,000 mm and over; relative humidity about 85 percent). The South Subtropic Belt includes Guangdong, Yunnan and Taiwan Provinces and the Guangxi Zhuang Autonomous Region. The North Tropic Belt includes the southern part of the Leizhou Peninsula, Hainan Island of Guangdong Province and the Xishuangbanna Dai Autonomous Prefecture of Yunnan Province.

The South Subtropic Belt (for example, the Yunnan-Guizhou Plateau) has topographical features of high mountains and deep valleys. The cattle under such ecological conditions are naturally small in size, and light in body weight, with slender limbs, and so are able to move more easily round the mountain areas for grazing. Their characteristics may be illustrated by the following breeds:

- Guanling of Guizhou Province (Plates 4.17 and 4.18),
- Wenshan (former name Guangnan) (Plates 4.19 and 4.20),
- Dengchuan of Yunnan Province (Plates 4.21 and 4.22),

The North Tropic Belt cattle can be represented by the following breeds:

- Xuwen Humped, at the north of the Leizhou Peninsula (Plates 4.23 and 4.24),
- Hainan High-hump of Hainan Island, Guangdong Province (Plates 4.25 and 4.26),
- Yunnan Zebu (or Yunnan High-hump) of Yunnan Province (Plates 4.27 and 4.28).

4.1.4.1 Wenshan, Dengchuan and Guanling

Available information on body measurements for these breeds is in Table 4.2. They are smaller in body size than breeds of the North and Centre. (There are no measurements for Guanling).

4.1.4.2 Humped breeds

The Xuwen Humped and Hainan High-hump are presumably of the same origin, since their two habitats are at opposite sides of the Qiongzhou Channel of the South China Sea. The High-hump cattle are now on the verge of extinction; in fact, in both locations most cattle are of the common yellow type.

The Yunnan Zebu* (or Yunnan High-hump) are mainly distributed in the Tropic (and Subtropic) Belts of south and southwest Yunnan Province.

Conformation and body measurements: (16) Bulls have humps 10-15 cm (or even as much as 17-18 cm) high, but these are less prominent in cows. The cattle have short horns, stretching laterally, and a long, wide dewlap, hanging from neck to chest. The coat colour is predominantly black, brown or grey. Body measurements are in Table 4.2.

Work: (16)

(i) Draught: 2.5 mu (0.17 ha) can be ploughed in a 6-hour day.

(ii) Packing: With a load of 50-60 kg, an animal can walk 30 km a day.

Meat production: (16) Two Yunnan Zebu castrates, with an average liveweight of 358 kg, yielded a dressing percentage of 52 and a meat percentage of 40.

Reproduction: (16) Cows mature at the age of 1.5 years and breed at 2. The length of the oestrous cycle is 18-25 days, and of the oestrous period 1-1.5 days; gestation lasts about 9 months. Cows may have 8-10 calvings in their lifetime.

A survey on 68 cows in the Linzan County of Yunnan Province showed that 82 percent give one calving and 18 percent two calvings in three years.

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* According to (16) Yunnan High-hump cattle are "zebu" (Bos indicus), different from the common yellow cattle (Bos taurus) as evidenced by karyotype analysis, although the numbers of chromosomes are the same (2n = 60).

4.1.4.3 Common features of cattle in the Southwest and South

Yellow cattle of the Subtropic and Tropic Belts have the following features in common:

(i) They are small, the wither height of cows being less than 110 cm, and liveweight about 220-250 kg.

(ii) All bulls have humps.

(iii) They graze year round, and can withstand harsh feeding conditions.

(iv) They have poor working ability.

(v) They are low in meat production, dressing percentage, meat percentage and eye-muscle area.

4.2 SUMMARY

From the above, we find that influences of different climates, feeding, management and selection systems have resulted in obvious breed differences in yellow cattle, from the North Pastoral Grassland (North Temperate Belt), to the Agricultural Region of Central China (North and Middle Subtropic Belts), and further to the south (South Subtropic and North Tropic Belts). These differences are illustrated in Table 4.2, and may be briefly summarized as follows:

(i) Yellow cattle of the North Pastoral Area are well adapted to their local environments, especially to the severe climate and poor quality pastures. They are thus comparatively smaller in body size and lower in productivity.

(ii) The Agricultural Areas of North and Central China have a favourable climate, and agriculture is well developed. Thus, large, strong cattle have resulted from better environmental and feeding conditions, and selection for larger body size, muscling and strength.

(iii) Further south, there is a tendency for body size to be smaller as the ambient temperature gradually increases. Cattle of the Southwest have a smaller body size and finer bones, and are well adapted to the mountainous, vertical topography of this area.

4.3 FURTHER INVESTIGATION NEEDED

There are still more cattle breeds to be investigated and identified, and their characteristics must be fully documented. For example, Dulong cattle (Plates 4.29 and 4.30) were found in the northwest of Yunnan Province, and captured by local hunters in the mountainous area of Dulong Autonomous County, (27.7°N, 98.3°E), at an altitude of 1,500-3,000 m, with an annual mean temperature 14.8°C, and annual precipitation 1,570 mm (10). They feed on bamboo, reed, weeds, etc., and

graze on the mountains all year round. Whenever these animals encounter danger in meeting wild beasts, they can swim across the Dulong River.

Dulongs have a larger body size than the local yellow cattle (height: male 134 cm, female 128 cm; liveweight: male 400-600 kg, female 350-450 kg); they have a black or brown hair coat, white feet and short horns (length: 30-45 cm) stretching laterally (17).

Dulongs are late in maturity (age at first mating: male 3.5 years, female 4 years). The F1 males obtained from crossing with yellow cattle are infertile, as are the F_1 males from the cross between yak and yellow cattle (Chapter 7). The chromosome number (13,17) has been estimated at 2n = 58, which differs from those of yellow cattle (Bos taurus, 2n = 60) and wild cattle (Bos gaurus, 2n = 56). This kind of semi-wild animal is therefore considered as another cattle breed (Bos frontalis).

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MONGOLIAN CATTLE
Inner Mongolia

Plate 4.1 Bull

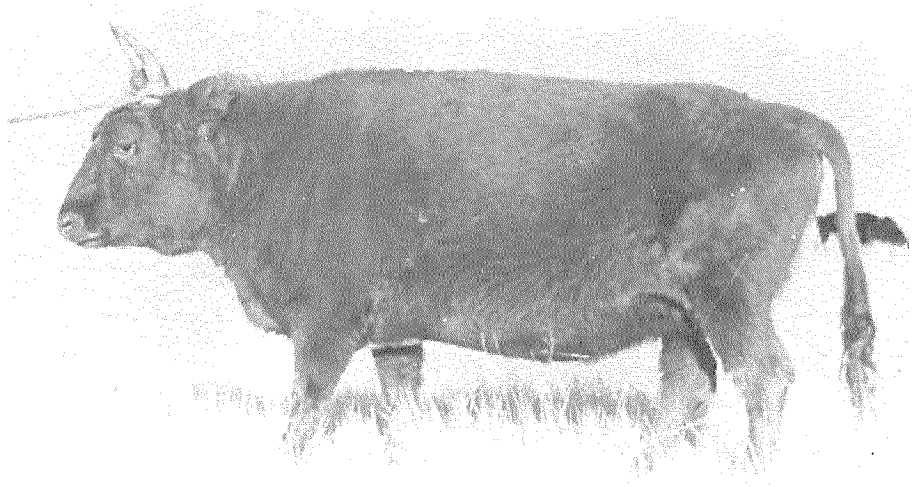

Plate 4.2 Cow

UJUMQIN CATTLE
A type of Mongolian - Inner Mongolia

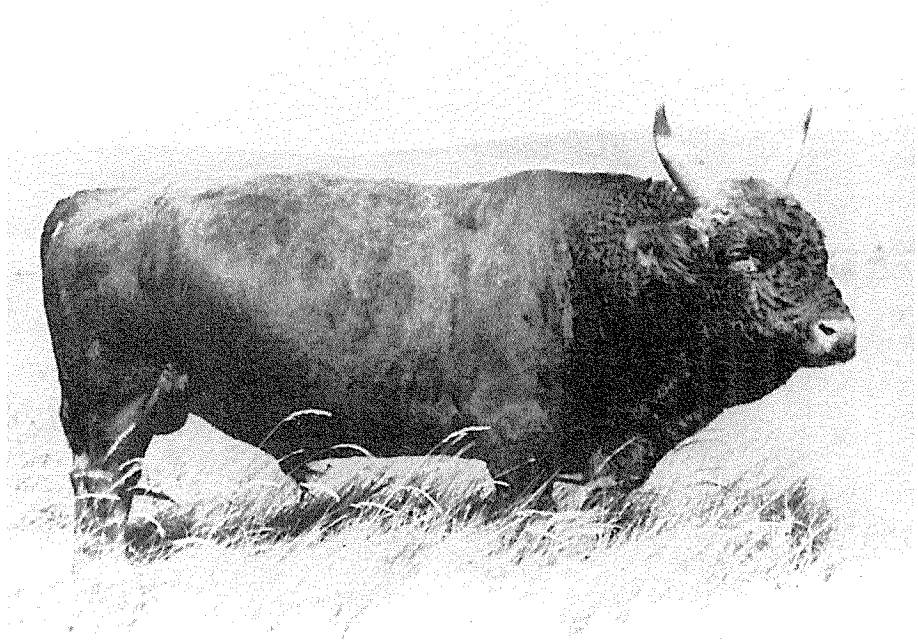

Plate 4.3 Bull

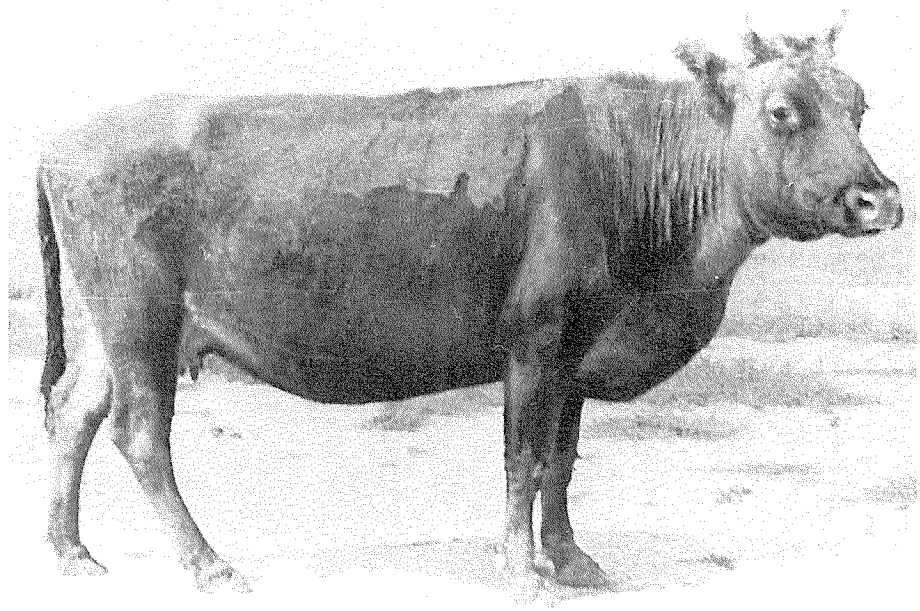

Plate 4.4 Cow

KAZAKH CATTLE
Xinjiang

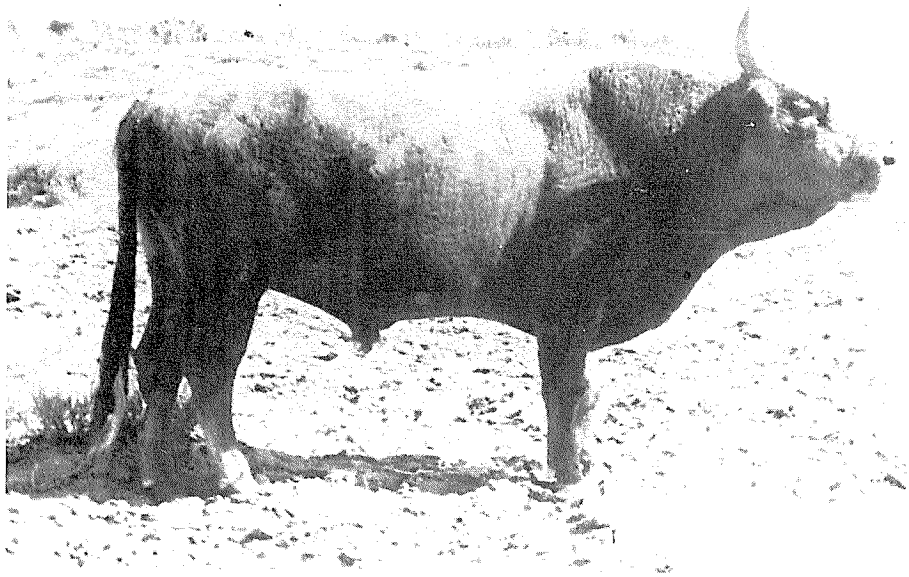

Plate 4.5 Bull

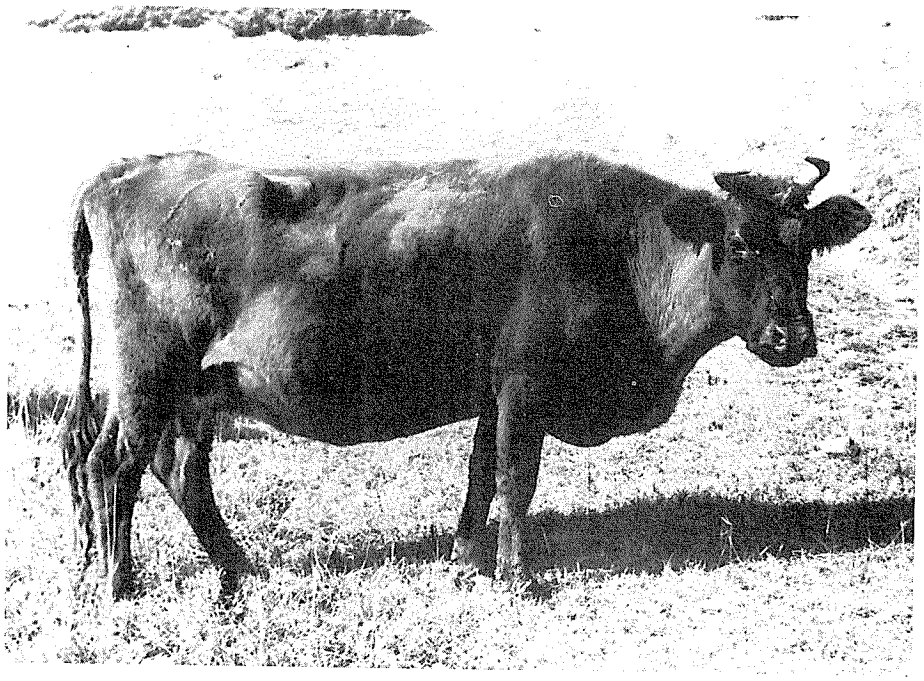

Plate 4.6 Cow

YANBIAN CATTLE
Jilin Province

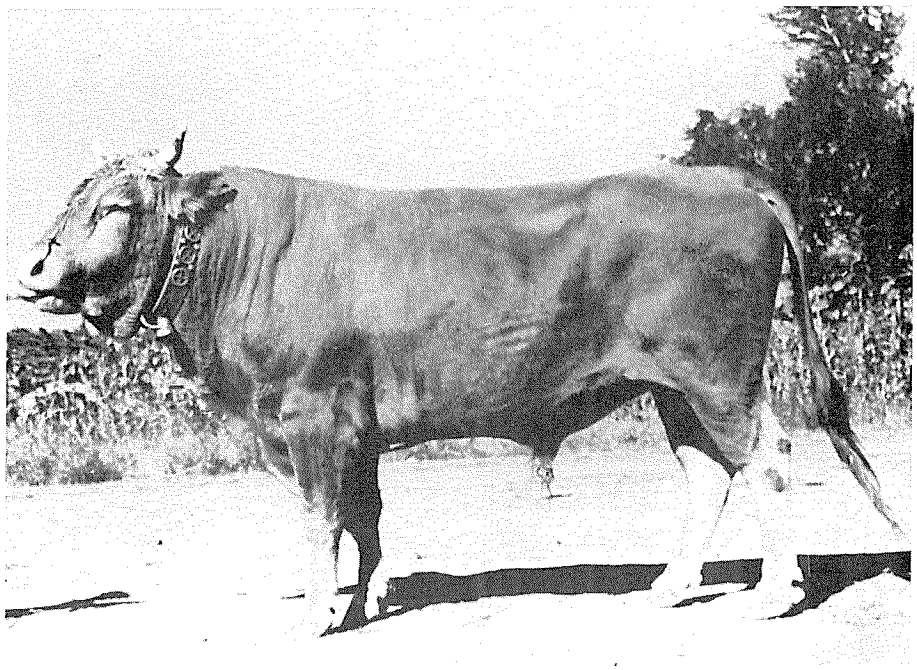

Plate 4.7 Bull

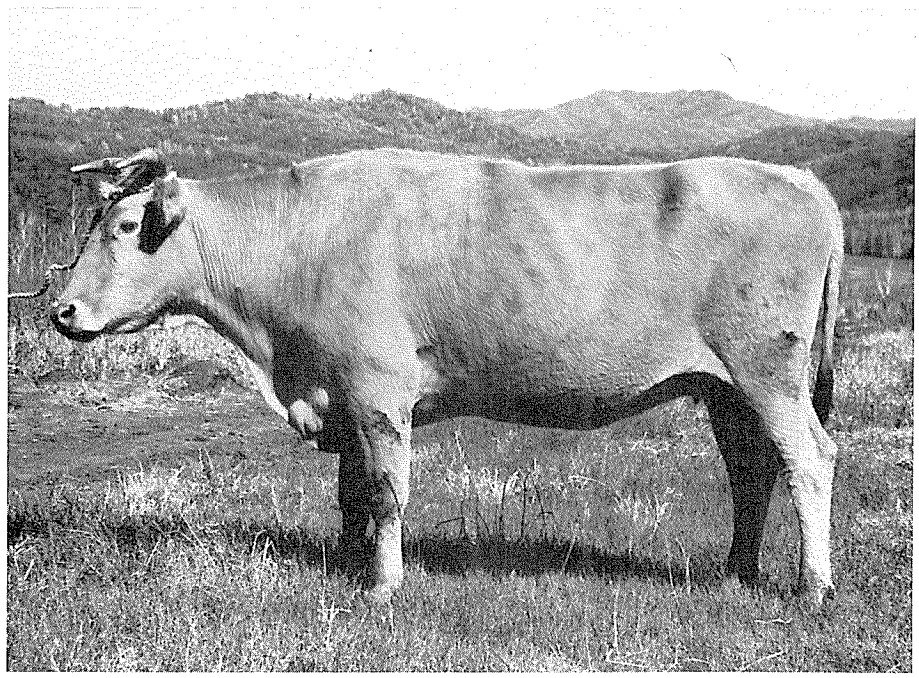

Plate 4.8 Cow

QINCHUAN CATTLE
Shaanxi Province

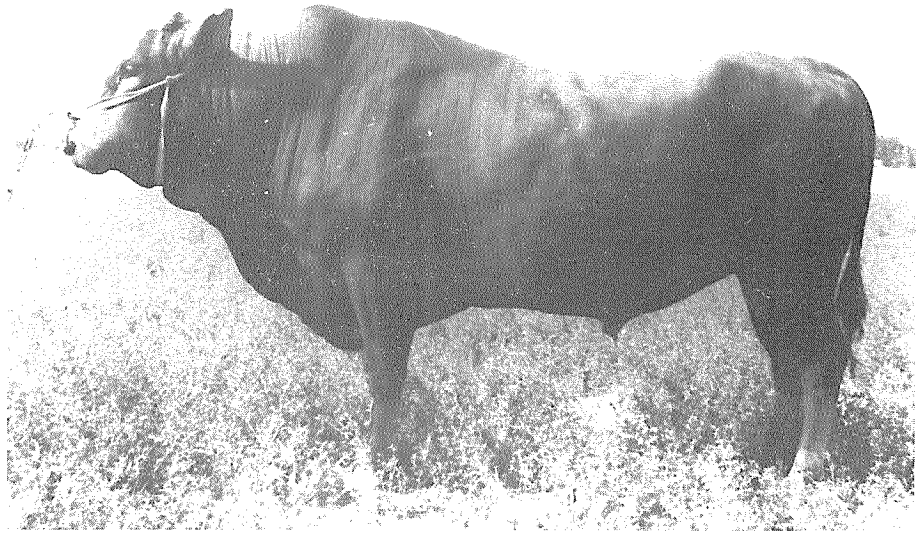

Plate 4.9 Bull

Plate 4.10 Cow

NANYANG CATTLE
Henan Province

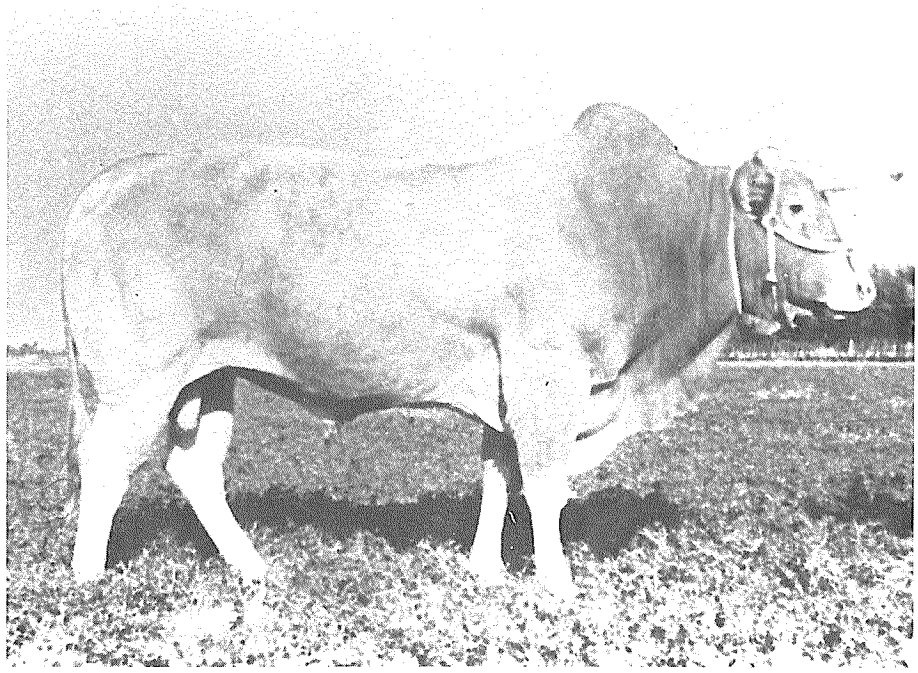

Plate 4.11 Bull

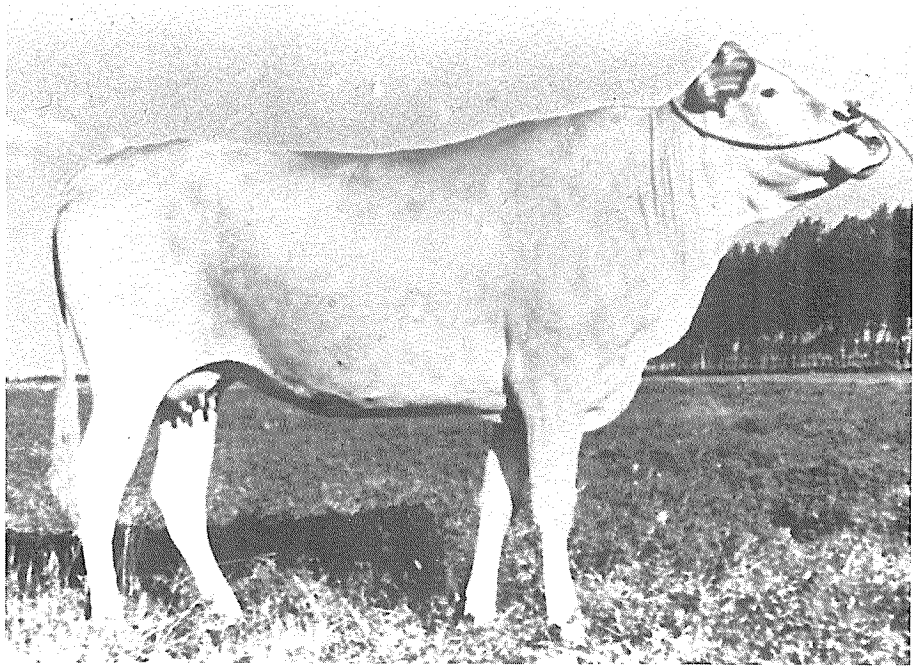

Plate 4.12 Cow

JINNAN CATTLE
South Shanxi Province

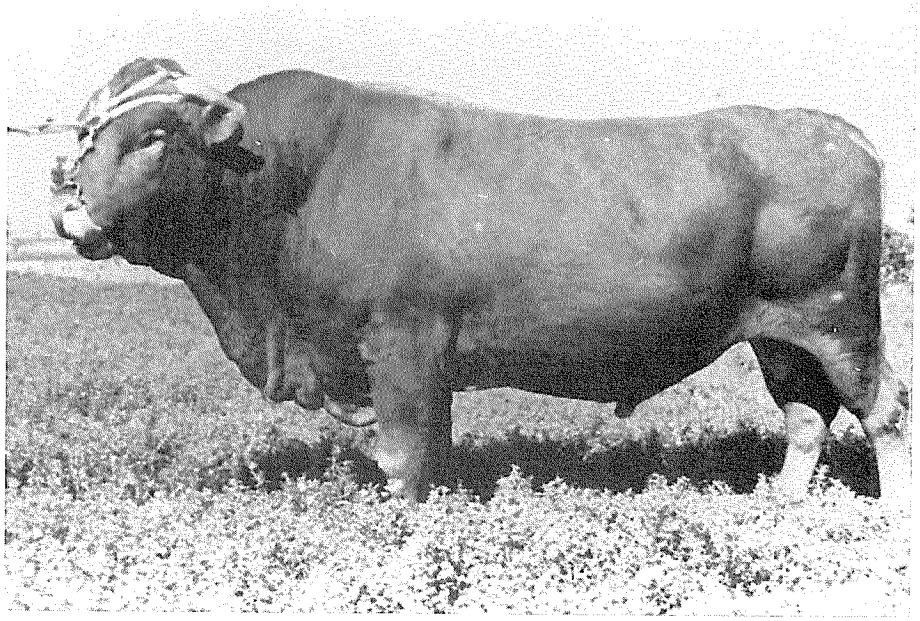

Plate 4.13 Bull

Plate 4.14 Cow

LUXI CATTLE
West Shandong Province

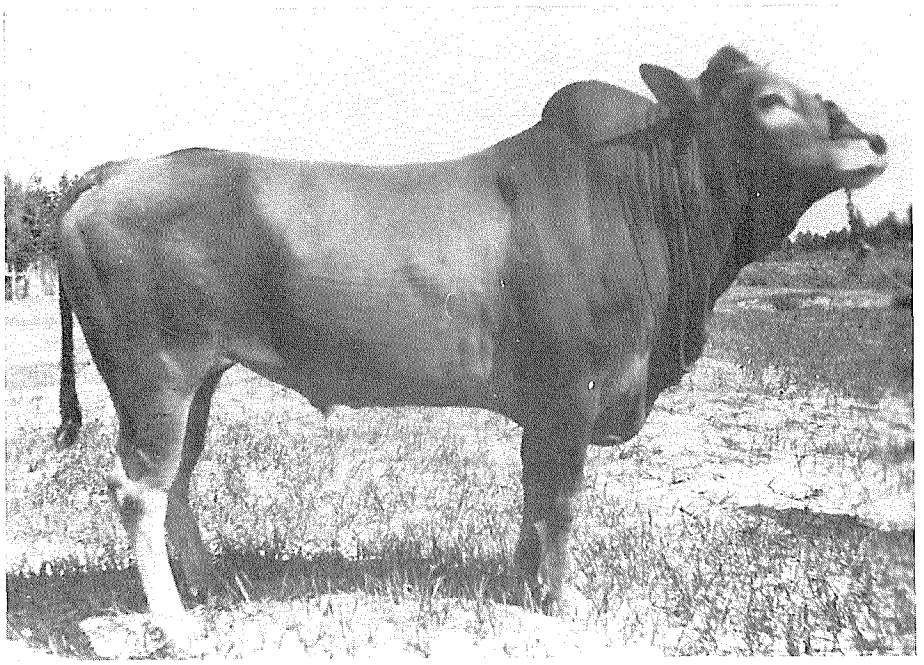

Plate 4.15 Bull

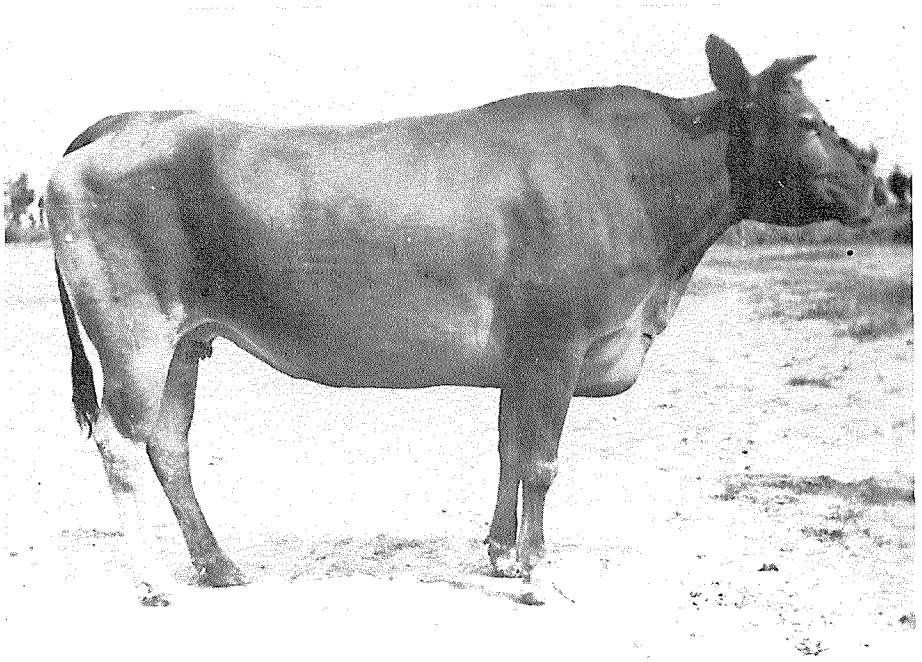

Plate 4.16 Cow

GUANLING CATTLE
Guizhou Province

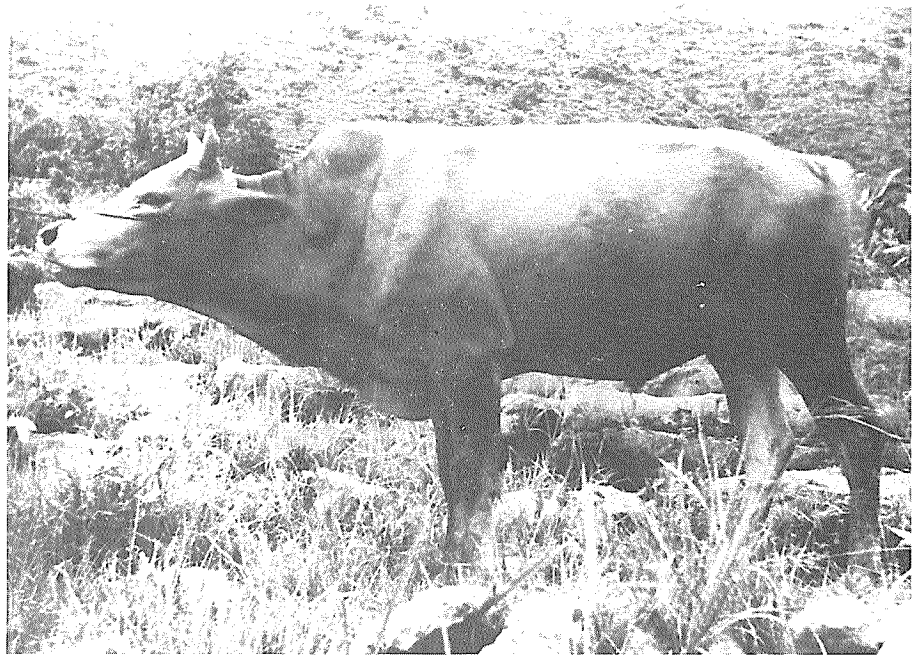

Plate 4.17 Bull

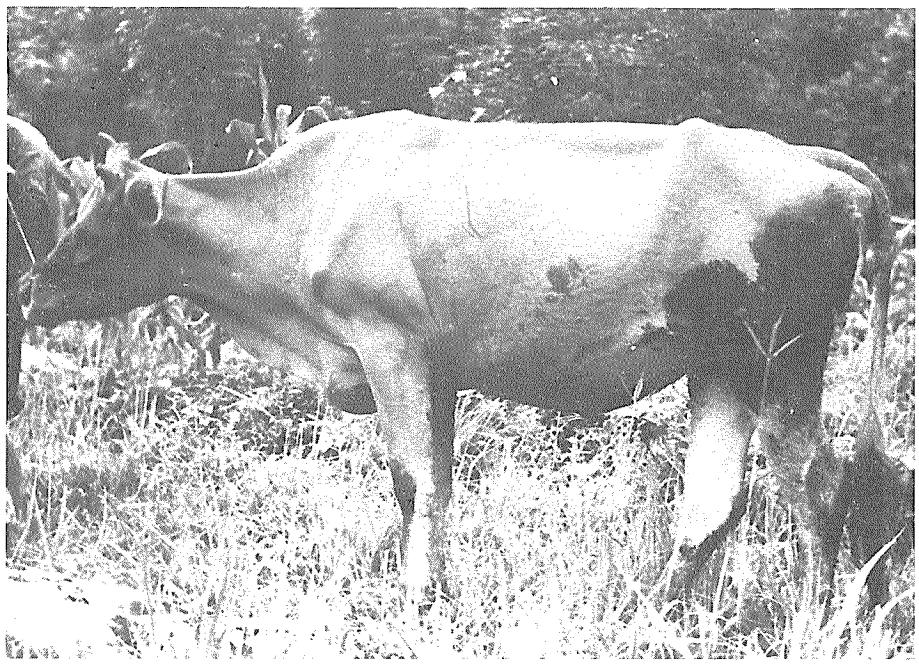

Plate 4.18 Cow

WENSHAN (formerly GUANGNAN) CATTLE
South Yunnan Province

Plate 4.19 Bull

Plate 4.20 Cow

DENGCHUAN CATTLE
Northwest Yunnan Province

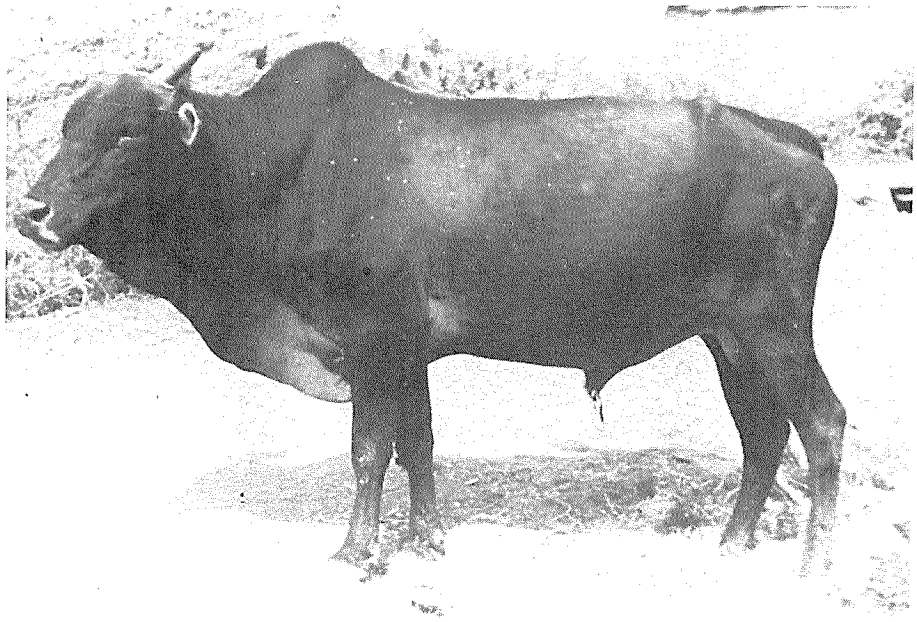

Plate 4.21 Bull

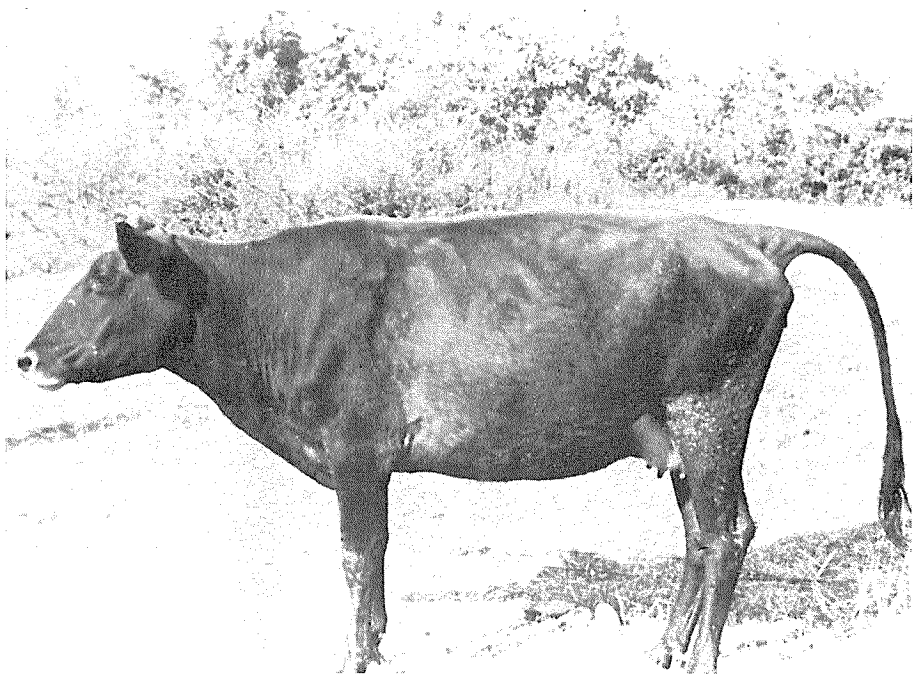

Plate 4.22 Cow

XUWEN CATTLE
Leizhou Peninsula, Guangdong Province

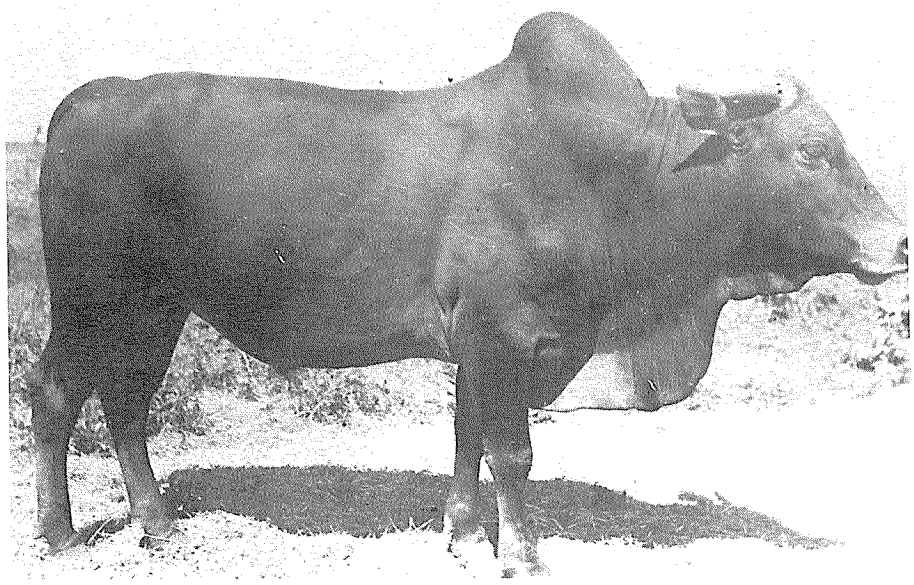

Plate 4.23 Bull

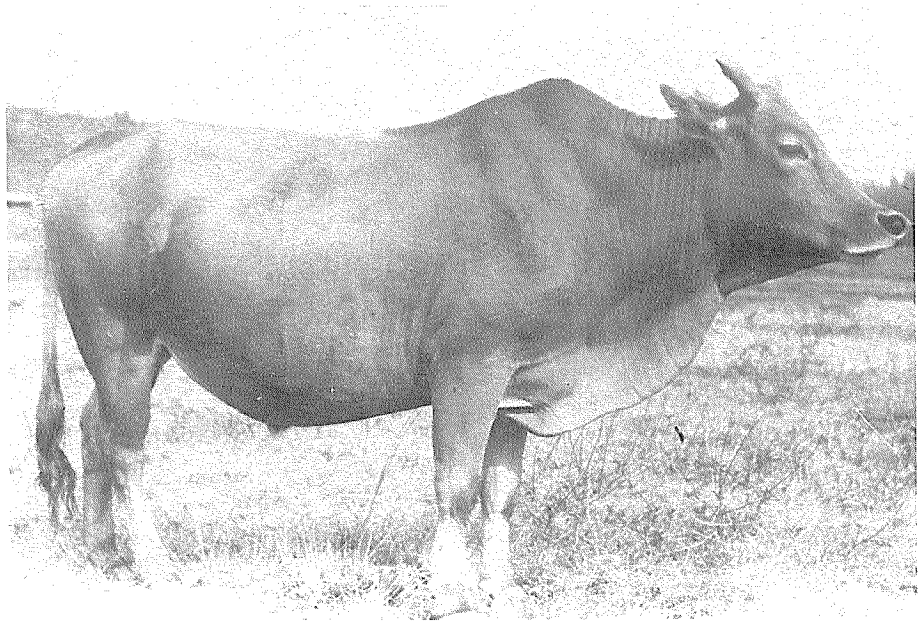

Plate 4.24 Cow

HAINAN HIGH-HUMP CATTLE
Hainan Island, Guangdong Province

Plate 4.25 Bull

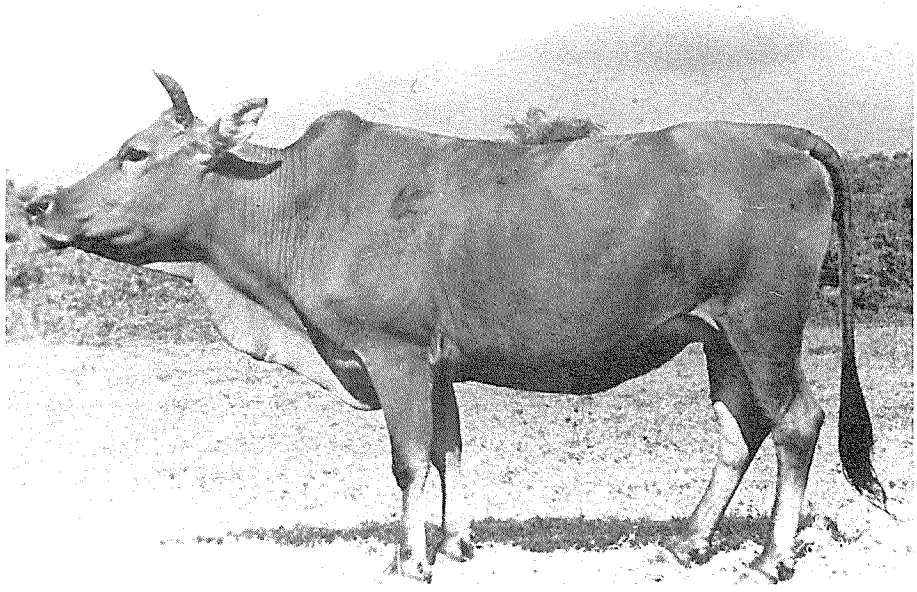

Plate 4.26 Cow

YUNNAN ZEBU CATTLE
Yunnan Province

Plate 4.27 Bull

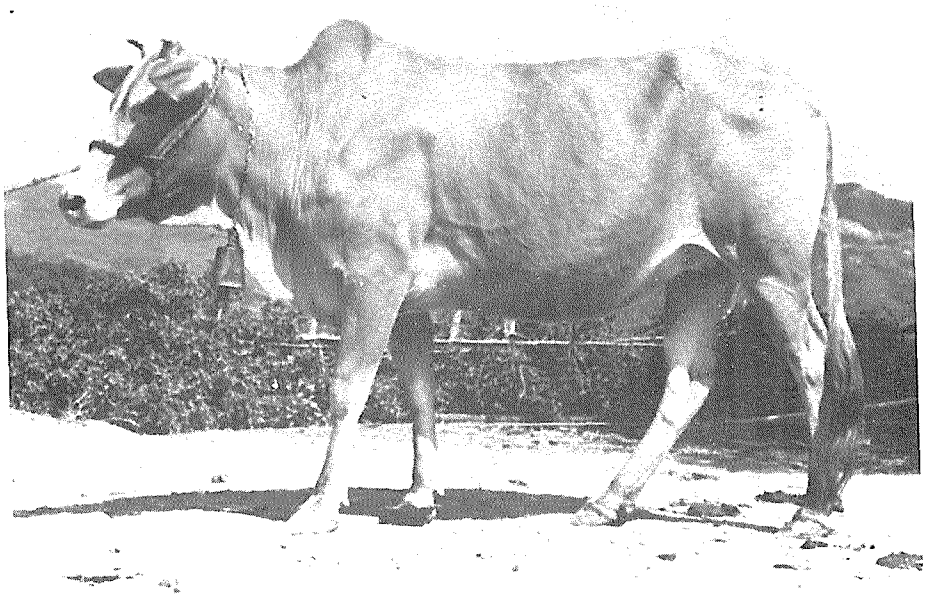

Plate 4.28 Cow

DULONG CATTLE
Northwest Yunnan Province

Plate 4.29 Young bull (2 years)

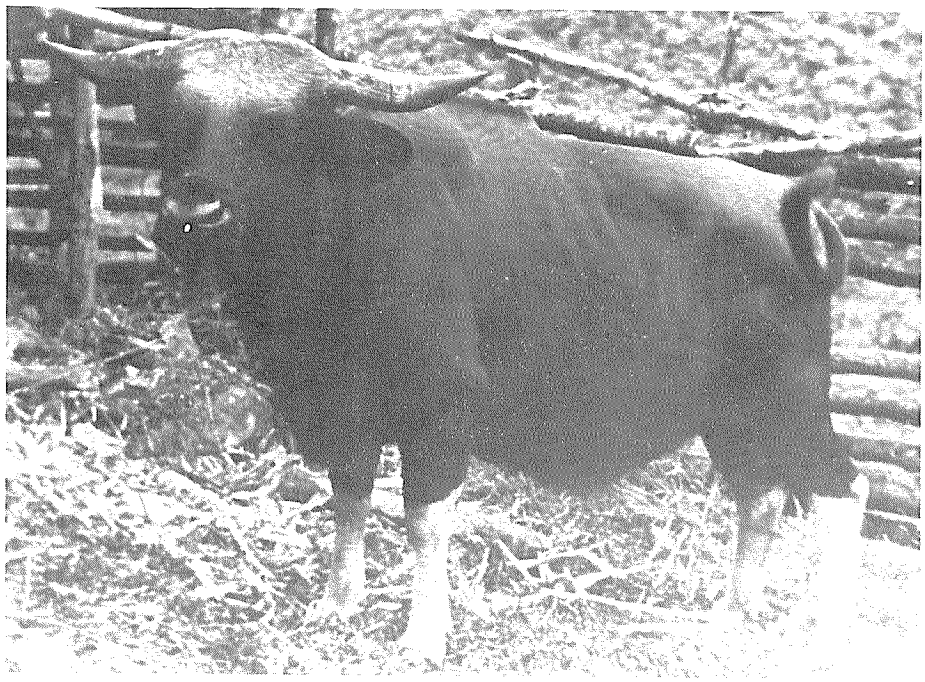

Plate 4.30 Cow

CHAPTER 5

DAIRY AND MILK/MEAT DUAL-PURPOSE CATTLE BREEDS

5.1 DAIRY CATTLE

The "specialized" dairy breeds in China were originally developed from either foreign purebreds, or crosses between exotic breeds and native yellow cattle, subjected to continuous selection for generations. They are now well-adapted to their local climatic conditions. At present, dairy cattle are relatively small in number (under one million), compared with other types of cattle (Table 1.1). Their distribution is in Figure 5.1.

5.1.1 Chinese Black-white

The most popular dairy breed in China is the Chinese Black-white (Plates 5.1 to 5.4).

Development (3): Black-white dairy cattle were first introduced to some large cities of the country in the 1870's, from USA, UK, Germany, Canada and Japan, and differed in body size and conformation according to country of origin. Large type Holstein-Friesians have been imported from USA since 1945, after the Second World War; small type Friesians have been introduced from the Netherlands since 1950. Purebred bulls were used in grading-up on local cows, continuous selective breeding then being practised among superior crossbred offspring for generations. Thus developed, the Chinese Black-white is now distributed throughout the country.

Body measurements: Body size of the Chinese Black-white varies according to the origin of sires used in crossbreeding, and the cattle may be roughly grouped into three types, large, medium and small. Large type cows, with an average height of 136 cm, mainly originate from the American and Canadian Black-and-white; the medium type, with an average height of 133 cm, are primarily developed from the Japanese and German Black-and-white, while the small type, with an average body height of 130 cm, are offspring from the Friesian sires of the Netherlands. The crossbreds are intermingled, however, and no definite ancestors can now be distinctly traced (2,3).

Body measurements of Chinese Black-white are shown in Table 5.1; the figures come from a preliminary survey made by the former Beijing Dairy Cattle Association in 1977 (2).

Milk production: The newly-established Black-white Dairy Cattle Association estimated an average of 4,461 kg per lactation for 270,000 mature cows (3). Average production at each of the first five lactations is shown in Table 5.2 for Beijing Black-white registered cows in 1977.

The highest individual record has been 16,090 kg (305-day basis), by Cow No. 1,098, in her 4th lactation at the East Suburbs Dairy Farm,

Table 5.1 BLACK-WHITE DAIRY CATTLE
BODY MEASUREMENTS

Sex	Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)	Liveweight (kg)
Bulls	157	203	246	24.3	1,142
Cows	136	160	204	19.9	615

Source: 2

Table 5.2 BEIJING BLACK-WHITE REGISTERED COWS
MILK PRODUCTION IN DIFFERENT LACTATIONS

Lactation	Number of cows	Average 305-day production (kg)
1st	1,687	5,104
2nd	999	6,031
3rd	938	6,560
4th	388	7,212
5th	478	7,450

Source: 2

Table 5.3 BLACK-WHITE COWS
WITH HIGHEST LIFETIME MILK PRODUCTION RECORDS

Dairy Farm:	Zhongshan, Nanjing	East Suburbs, Beijing	
Cow number	644	7,016	9,588
Number of lactations	10	13	11
Total days in milk	3,721	4,291	3,534
Total milk production (kg)	100,897	100,957	100,031
Average milk production per lactation (kg)	n.a.	7,776 (303-day)	9,433 (337-day)
Highest 305-day lactation	4th	8th	4th
Milk production (305-day) in highest lactation (kg)	11,745	8,748	11,425
Highest daily milk production (kg)	58	41	54
Sources:	9	12	12

Beijing, in 1970 (4). The highest lifetime record has been 100,897 kg of milk in 3,721 days over 10 lactations, by Cow No. 644, from the Zhongshan Dairy Farm, Nanjing (9). Another two cows from the East Suburbs Farm, Beijing, each gave a total milk production of more than 100,000 kg of milk in 11 and 13 lactations respectively (Table 5.3).

Average fat percentages are 3.3 (for southern 13 Provinces and Municipalities) and 3.4 (for northern 15 Provinces and Municipalities).

Meat production: An average dressing percentage of 51 and a meat percentage of 39 were obtained from 8 mature cows at the Central China Agricultural College, Wuhan (11).

5.2 MILK/MEAT DUAL-PURPOSE CATTLE

5.2.1 Sanhe

The Sanhe (Plates 5.5 and 5.6) are milk/meat dual-purpose cattle, the product of long-time selection and crossbreeding between native Mongolian cattle and exotic breeds (e.g. Simmental, Baikal, Shorthorn etc.), on the grasslands of the Hulun Buir Prefecture, in the northeast of Inner Mongolia.

The noticeable characteristic of Sanhe cattle is adaptability to the adverse environment, where the absolute temperature is as low as -50°C during the severe winter and there are six months with a monthly average temperature below 0°C, where the grassland is completely covered with snow for about 200 days and the grass-growing season is limited to five months in a year. Cows usually drink ice water during the winter, and are exposed to direct sunlight with an air temperature as high as 35°C during the summer. Furthermore, Sanhe cattle can stand harsh feeding and resist insect bites.

Body measurements: Sanhe cattle have about the same body size as Chinese Black-white dairy cattle (Table 5.4), cows having a height of 130 cm and a liveweight of 400-500 kg.

Table 5.4 SANHE CATTLE
BODY MEASUREMENTS

Sex	Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)	Liveweight (kg)
Bulls	150	195	212	23	850-900
Cows	130	151	192	18	400-500

Source: 1

Milk production: The length of lactation for Sanhe cows averages about 300 days, but varies according to the feeding and management conditions; cows kept under good conditions have a lactation period of 300-330 days, and under worse conditions, only 270-300 days.

Average milk production per lactation is about 3,000 kg, with an average fat percentage of 4.1-4.5.

5.2.2 Xinjiang Brown

The Xinjiang Brown (Plates 5.7 and 5.8) also results from crossing exotic (mainly Brown Swiss) onto the indigenous breed (Kazakh) in the Ili and Tacheng Districts of the Xinjiang Uygur Autonomous Region (topographic background, Plates 5.9 and 5.10). Crossing to the Brown Swiss was carried on for 3 successive generations, then followed since 1951 by selective breeding among the crossbred progeny.

Xinjiang Brown are characterized by their desirable milk/meat body conformation, and adaptability to the cold climate on the northern side of the Tianshan Mountains.

Coat colour is very variable, the majority of animals being brown, while others are yellow or of mixed colour.

Body measurements: Xinjiang Brown cows are usually smaller than Sanhe (Table 5.5) with an average height of 118 cm and a liveweight of 416 kg.

Table 5.5 XINJIANG BROWN COWS
BODY MEASUREMENTS

Age (years)	Height (cm)	Length (cm)	Heart girth (cm)	Liveweight (kg)
1	102	119	137	216
2	112	133	160	325
3	118	143	174	416

Source: 8

Milk production: The length of the lactation period is, of course, subject to the influence of feeding conditions. For cows out on the grassland year round, lactation is limited to the grass-growing season, i.e. from May to September (about 150 days) and the average milk production is about 1,600 kg. When put on supplementary feed, they may produce about 3,000 kg of milk (305-day basis). Some high producers, fed and kept in the barn, may yield even more. The average milk fat percentage is 4.0-4.1.

5.3 MEAT/MILK DUAL-PURPOSE CATTLE

5.3.1 Steppe Red

Steppe Red (Plates 5.11 and 5.12) are F_1 and grade animals from Mongolian cows crossed and upgraded by Shorthorn bulls on the grasslands in the north (the Inner Mongolian Autonomous Region and Jilin, Liaoning and Hebei Provinces). They show great improvement in both body conformation and production, compared with native Mongolian cattle.

Steppe Red are deep red in hair-coat colour, with a uniform appearance, and a meat/milk dual-purpose conformation. They are also well adapted to the local environment.

Body measurements: The Steppe Red is about the same size as the Xinjiang Brown (Table 5.6), cows having an average height of 124 cm and average liveweight of 430 kg.

Milk production: When out on the pasture and with supplementary feeding during the winter and spring, Steppe Red may lactate for about 210 days, and produce 1,500-2,000 kg of milk.

Table 5.6 STEPPE RED CATTLE
BODY MEASUREMENTS

Sex	Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)	Liveweight (kg)
Bulls	142	176	228	22.0	880
Cows	124	146	177	17.7	430

Source: 6

Meat production: In feeding trials in Inner Mongolia, 18-month old Steppe Red had a dressing percentage of 52-53 and a meat percentage of 42-43 (5). If Steppe Red are fed under the same conditions as Shorthorns, they may yield approximately the same meat percentage, as shown in Table 5.7.

Table 5.7 STEPPE RED AND SHORTHORN - MEAT PRODUCTION

Breed	Feeding level	Number of animals	Bodyweight before slaughter (kg)	Dressing percentage (%)	Meat percentage (%)	Eye-muscle area (cm^2)
Shorthorn	Good	4	369	55.9	46.4	82.0
Steppe Red	Good	5	380	53.8	45.2	67.0
Steppe Red	Fair	5	347	54.9	45.1	44.0

Source: 7

Reproduction: Cows attain sexual maturity at about 18 months. About 70 percent of them come on heat in June and July, though some may come as early as March-April.

5.4 SUMMARY

The above three milk/meat dual-purpose "breeds" - Sanhe, Xinjiang Brown and Steppe Red - are still in the process of development, and there are marked individual differences in colour pattern, body conformation and performance within the "breeds". Much work has still to be done in developing them.

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BLACK-WHITE DAIRY CATTLE
Beijing

Plate 5.1 Bull

Plate 5.2 Cow

BLACK-WHITE DAIRY CATTLE

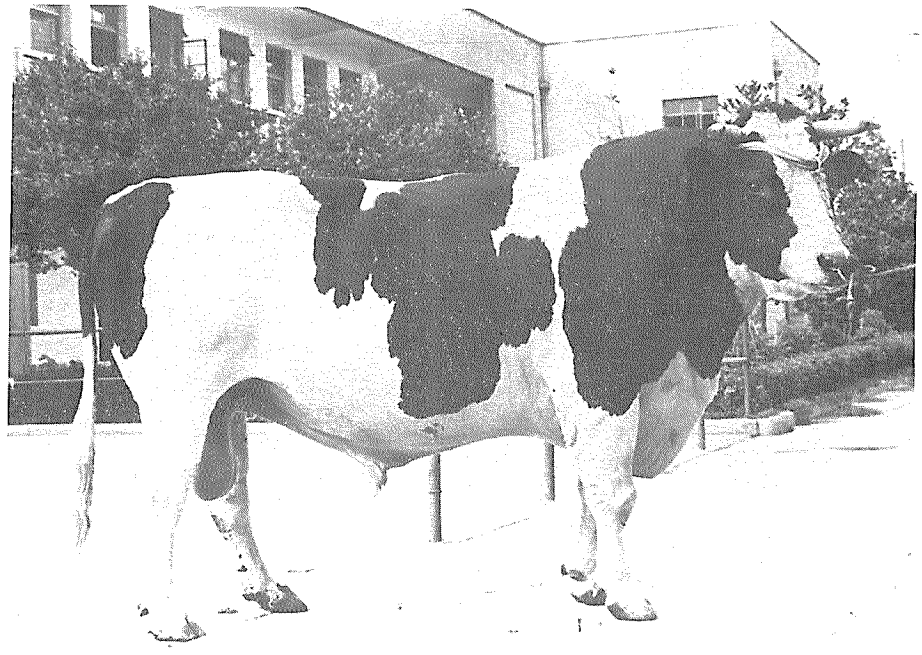

Plate 5.3 Bull (Shanghai)

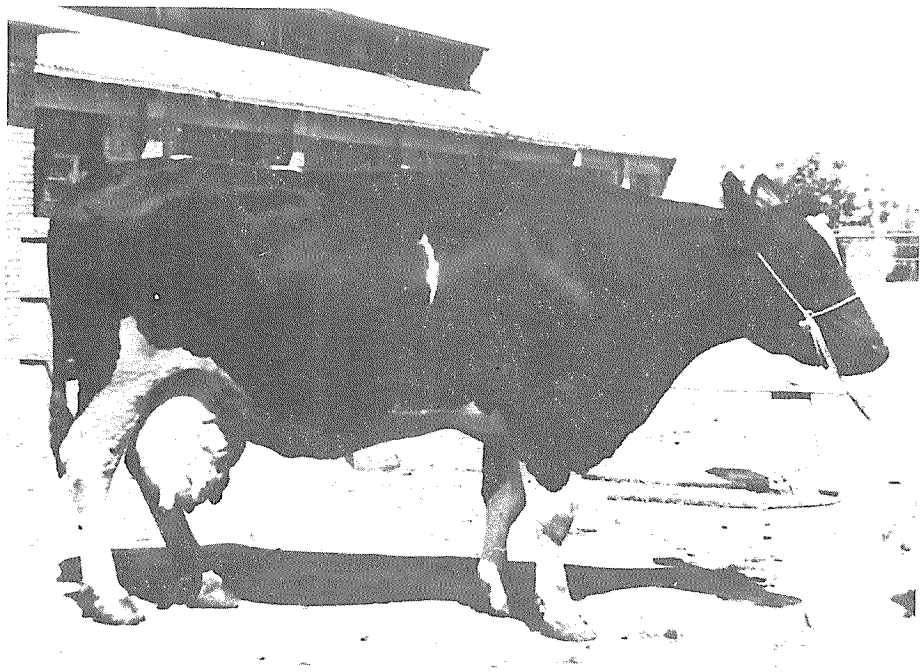

Plate 5.4 Cow (Nanjing)

MILK/MEAT DUAL-PURPOSE CATTLE - SANHE
East Inner Mongolia

Plate 5.5 Bull

Plate 5.6 Cow

MILK/MEAT DUAL-PURPOSE CATTLE - XINJIANG BROWN
Northwest Xinjiang

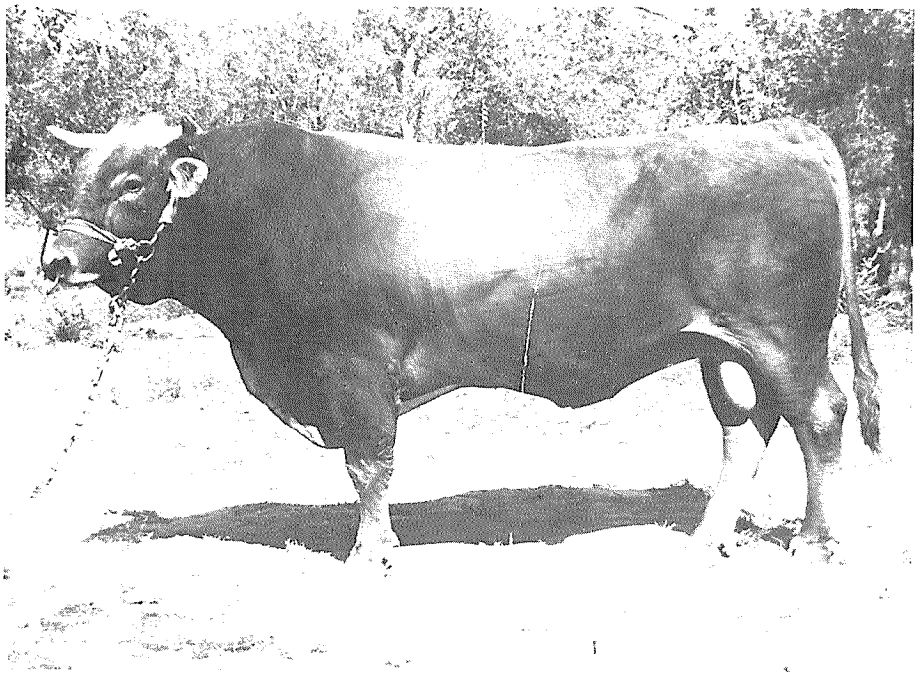

Plate 5.7 Bull

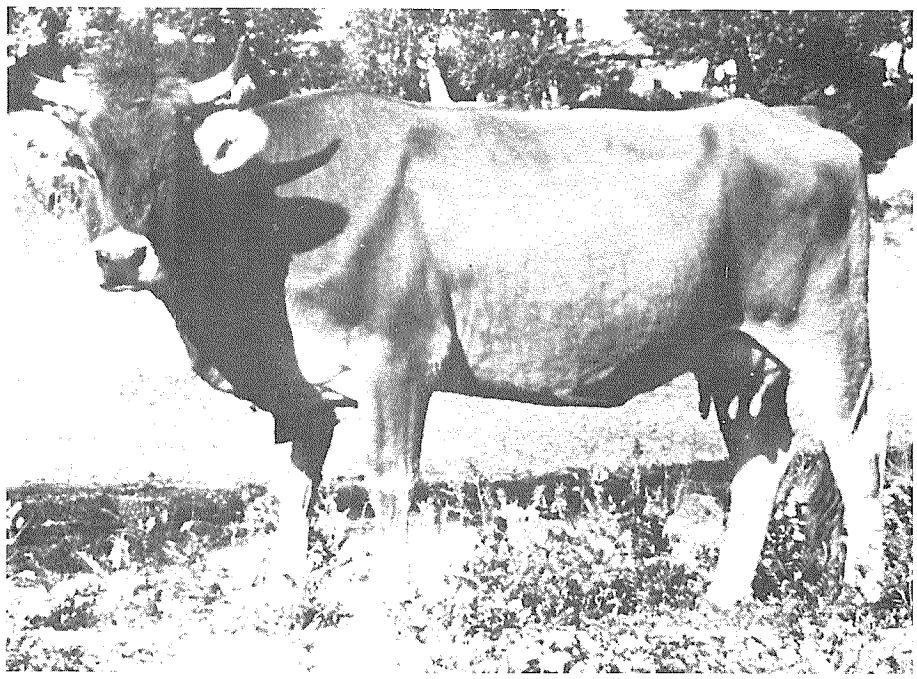

Plate 5.8 Cow

PASTURES
North side of the Tianshan Mountains, Xinjiang

Plate 5.9 Summer pasture

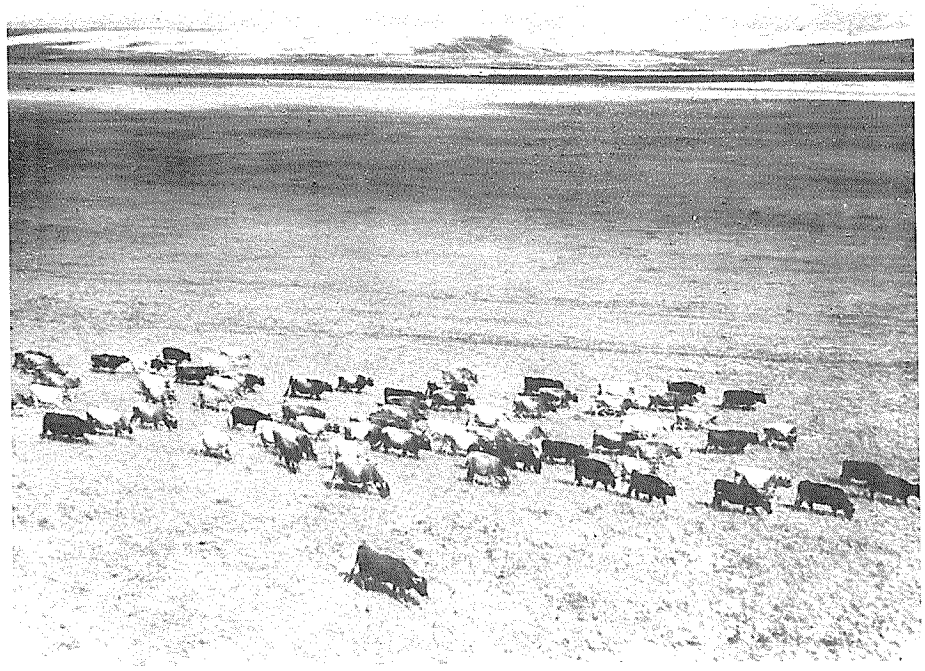

Plate 5.10 Winter pasture

MEAT/MILK DUAL-PURPOSE CATTLE - STEPPE RED
West Jilin Province

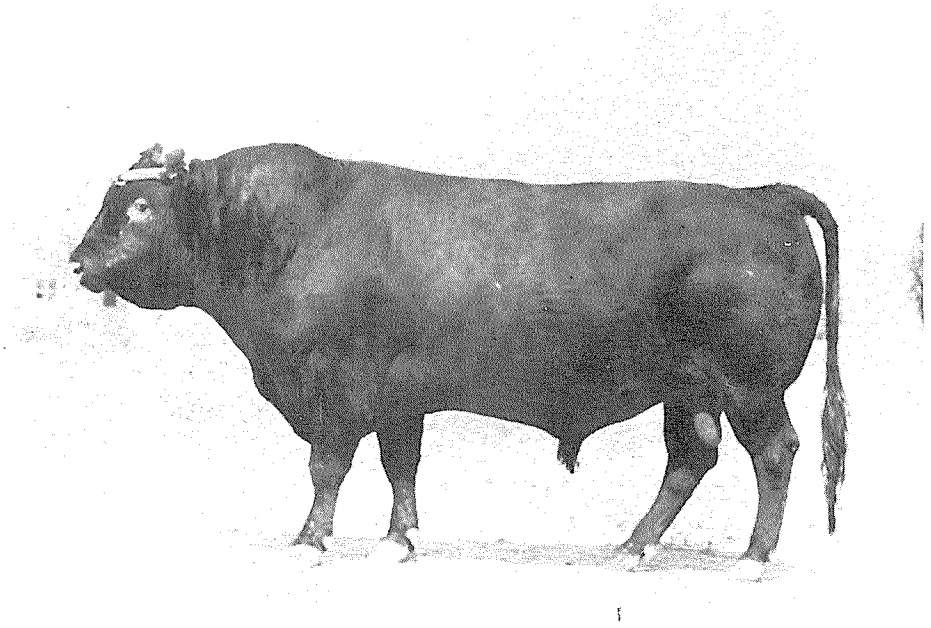

Plate 5.11 Bull

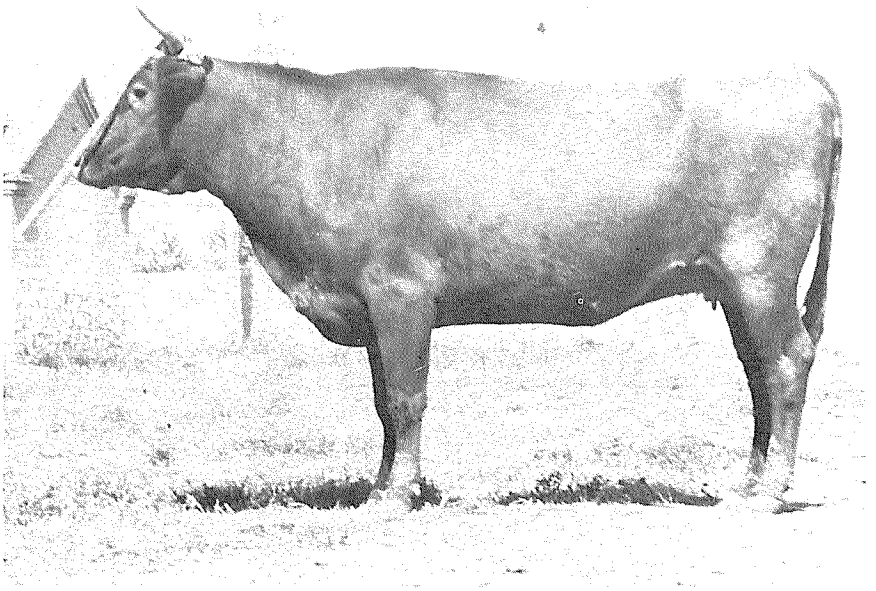

Plate 5.12 Cow

CHAPTER 6

WATER BUFFALO (TYPES)

China's population of water buffalo (19.1 million, Table 1.1) is second highest in the world, India's being highest.

Chinese buffaloes belong to the swamp type. They are the main draught power in the rice-producing areas, distributed primarily south of the Huaihe River (Figure 6.1) where the climate is warm and humid (annual mean temperature 13 - 15°C, annual precipitation 1,000 mm and over). Only in the buffalo-raising area of Yunnan Province is the elevation high (800 to 1,600 m), but even there, the climate is temperate and moist (annual mean temperature, 16 - 22°C, annual precipitation over 1,000 mm).

6.1 TYPES

The climatic conditions, feeding, and management practices of various buffalo-breeding areas are basically similar, and no differences have been noted in the body conformation of the animals. The differentiation of buffaloes into types is neither as obvious nor as complicated as that of yellow cattle. For instance, no difference has been observed between the Haizi of North Jiangsu (Plates 6.1 and 6.2) and the Xilin of the Guangxi Zhuang Autonomous Region (Plates 6.15 and 6.16) except in body size, which seems to decrease as the ambient temperature gradually increases from north to south.

Buffalo may be grouped, according to body size, into three types, large, medium and small (Tables 6.1 and 6.2). Those in Jiangsu Province are of the large type, cows having an average liveweight of over 500 kg (Haizi, Plates 6.1 and 6.2, and Shanghai, Plates 6.3 and 6.4); those in Hunan (Binhu, Plates 6.5 and 6.6), Sichuan (Dechang, Plates 6.7 and 6.8) and Yunnan (Dehong, Plates 6.9 and 6.10) Provinces are of the medium type, cows weighing about 500 kg, while further south, the buffaloes in Zhejiang Province (Wenzhou, Plates 6.11 and 6.12), in Guangdong Province (Xinglong, Plates 6.13 and 6.14) and the Guangxi Zhuang Autonomous Region (Xilin, Plates 6.15 and 6.16) are of the small type, weighing about 400 kg.

6.2 CHARACTERISTICS AND PERFORMANCE

Body measurements: There seems to be a relationship between body size and the climate and pasture conditions where the buffaloes are located. For instance, those in the Tuyang mountainous area, where the climate is cooler and the pasture is better during summer and autumn, are larger than those in the Yujiang Valley (Table 6.3).

Table 6.1 LOCAL NATURAL CONDITIONS - WATER BUFFALO

Buffalo breeds (or types) and body size	Areas	Altitude (m)	Temperature* Annual mean (°C)	Lowest (mean in Jan.) (°C)	Highest (mean in July) (°C)	Annual* precipitation (mm)
Large:						
Haizi	North Jiangsu	6	14.5	-11.5	38.6	1,054
Shanghai	Shanghai	5	15.7	-9.1	38.2	1,039
Medium:						
Binhu	Hunan	50	17.3	-9.5	39.8	1,450
Dechang	Sichuan	1,590	16.9	-3.4	35.8	990
Dehong	Yunnan	776	20.0	+1.2	36.5	1,400
Small:						
Wenzhou	Zhejiang	6	17.9	-4.5	38.1	1,533
Xinglong	Guangdong	14	23.3	+3.2	38.4	1,604
Xilin	Guangxi	82	21.8	+0.5	38.0	1,600

* Ten year averages of local or neighbouring weather stations.

Work: The work capacity of water buffaloes is closely related to their body size (Table 6.4). Large and medium sized buffaloes can work for 8 hours a day, covering 6-8 mu (=0.40-0.53 ha) in a dry field, or 4-6 mu (=0.27-0.40 ha) in a paddy field, and can pull a cart with a load of about 1,000 kg a distance of 20-30 km in a day. The small type of the south can work only 4-6 hours a day, covering 2-4 mu (=0.13-0.20 ha) in a paddy field; the load pulled in a cart is only 500-1,000 kg. Instant maximum draught capacity is about 45-60 percent of body weight.

Meat production: Available figures are in Table 6.5. Dressing percentages of 41-53, and meat percentages of 26-43 have been obtained for buffalo in different localities. An eye-muscle area of 73 cm^2 has been reported for Binhu (4) and 53 cm^2 for Dechang buffalo (7).

Milk production: Milking of buffalo is only practised on Chinese farms in a few localities which have types with a long history of relatively high production. Buffalo cows in Wenzhou and Guangzhou, for example, produce approximately 750 kg of milk in a lactation of 8-10 months, with a fat content as high as 9-11 percent (Table 6.6).

Table 6.2 BODY MEASUREMENTS OF WATER BUFFALO

Types	Sex	Number of animals	Body measurements				
			Height (cm)	Length (cm)	Heart girth (cm)	Cannon-bone girth (cm)	Live-weight (kg)
Large:							
Haizi	M	1	154	192	222	27.0	807
	F	114	132	167	206	21.6	626
Shanghai	M	5	143	160	216	23.2	649
	F	35	138	155	211	23.8	606
Medium:							
Binhu	M	57	134	151	203	23.2	548
	F	212	128	143	195	21.8	485
Dechang	M	57	131	153	198	22.3	540
	F	562	127	147	191	21.1	484
Dehong	M	115	131	155	199	24.4	571
	F	252	126	147	194	22.7	500
Small:							
Wenzhou	M	3	123	140	178	20.8	398
	F	287	121	140	180	21.1	383
Xinglong*	M	30	129	148	195	22.9	503
	F	150	124	144	188	21.6	457
Xilin	M	88	127	141	189	23.1	453
	F	438	120	133	182	20.9	402

Source: *12; remainder 11

Table 6.3 BODY SIZE OF WATER BUFFALO AS INFLUENCED BY CLIMATE AND PASTURE CONDITIONS

Distribution areas	Sex	Height (cm)	Liveweight (kg)
High and cold (Tuyang)	M	125	462
	F	122	412
Dry and warm (Yujiang)	M	120	432
	F	117	386

Source: 3

Table 6.4 WORK CAPACITY OF WATER BUFFALO

Types	Number of working hours per day	Area of field worked (ha/day) Dry	Paddy	Load in carting (kg)	Instant maximum draught capacity (as % live-weight)	Source
Large:						
Haizi	8	0.40-0.53	0.27-0.40	2,000-2,500 (2 animals)	n.a.	5
Shanghai	8	0.40-0.53	0.27-0.40	800-1,000	n.a.	6
Medium:						
Binhu	8	0.40-0.47	0.20-0.33	1,000	n.a.	4
Dechang	8	n.a.≠	0.20	n.a.	M 73* F 44 C 46	7
Dehong	n.a.	n.a.	0.20	n.a.	M 62** F 54 C 48	8
Small:						
Wenzhou	n.a.	-	0.20-0.27	n.a.	n.a.	10
Xinglong	6	-	M 0.20 F 0.13 C 0.20	n.a. 500-1,000 500-600	n.a.	2
Xilin	4-6	-	0.20	n.a.	n.a.	3

* M = male, F = female, C = castrate ≠ n.a. = not available
** Calculated by Cheng, P.L.

The indigenous Wenzhou buffalo in Zhejiang Province has been used for dairy purposes for many years. The average length of lactation is about 8 months or 240 (156-364) days, 77 percent of the cows lactating for 5-9 months (155-275 days). The average milk yield per lactation is 773 (437-1,509) kg, with a fat content of 9.5-10.5 percent and a protein content of 4.5 percent (10).

Milk production is highest in the 4th lactation, but no marked fall in milk yield has been noted in subsequent lactations (Table 6.7). However, a marked decrease in milk production is manifested from the 1st to the 11th month within a lactation period (Table 6.8).

Table 6.5 MEAT PRODUCTION OF WATER BUFFALO

Types	Sex	Number	Dressing percentage (%)	Meat percentage (%)	Source
Large:					
Haizi	M	1	42.9	32.8	5
	C	1	50.9	39.9	
Shanghai	n.a.	n.a.	n.a.	43.0	6
Medium:					
Binhu	M	2	46.2	37.2	4
	C	2	48.3	40.3	
Dechang	F	1	41.5	33.4	7
	C	4	44.7	35.6	
Dehong	C	2	48.0	39.1	8
Small:					
Wenzhou	M	1	43.0	33.0	10
	F	1	41.3	32.2	
Xinglong	n.a.	n.a.	46.9 (Xinglong Farm)	36.7	2
	n.a.	n.a.	52.6 (Lehe Farm)	41.4	
Xilin	M	n.a.	33.9	26.4	3
	F	n.a.	37.8	26.5	
	C	n.a.	42.8	35.6	

Table 6.6 MILK PRODUCTION OF WATER BUFFALO IN SOME LOCALITIES

Locality	Number of cows	Length of lactation (days)	Average milk production (kg)	Fat content (%)
Ruian County, Zhejiang Province, (Wenzhou)	25	n.a.	773 (437-1,059)	9.5
Xinzhou Farm, Guangdong Province	72	300	751	9.8
Fuan, Fujian Province	14	210	519	n.a.

Source: 10

Table 6.7 WENZHOU WATER BUFFALO COWS
MILK YIELD IN DIFFERENT LACTATIONS

Lactation	Percentage of 4th lactation
1st	76.6
2nd	84.2
3rd	94.6
4th	100.0
5th	98.0
6th	98.0

Source: 10

Table 6.8 WENZHOU WATER BUFFALO COWS
AVERAGE MILK YIELD IN DIFFERENT MONTHS
OF A LACTATION PERIOD

Month	Average monthly milk yield (kg)	Average daily milk yield (kg)
1st	128	4.16
2nd	122	4.01
3rd	104	3.41
4th	95	3.07
5th	82	2.64
6th	72	2.32
7th	62	2.05
8th	55	1.79
9th	52	1.71
10th	51	1.68
11th	48	1.60

Source: 10

Reproduction: Chinese water buffalo usually attain sexual maturity at the age of 1.5-2.5 years, and are bred at 3; most cows in the North and Middle Subtropic Belts, however, attain sexual maturity earlier than those in the South Subtropic and North Tropic Belts (Table 6.9). Cows come regularly on heat and can be bred all the year round, but most are bred from August to December.

Observations made at the Guangxi Institute of Animal Husbandry on Guangxi buffalo cows illustrate the reproductive pattern (Table 6.10).

Buffalo bulls have lower ejaculate volume and sperm density than yellow cattle.

Table 6.9 REPRODUCTION OF WATER BUFFALO COWS

Types	Age at first oestrus (yrs)	Age at first breeding (yrs)	Mostly bred in (mth)	Length of: Oestrous cycle (days)	Length of: Oestrous period (days)	Length of: Gestation (days)	First postpartum oestrus (days after calving)	Number of of calves in a lifetime	Reproductive* rate (Calves born / cows available for breeding) (%)	Source
Large:										
Haizi	1.0-1.3	2.5-3.0	n.a.	20.3 (18-22)	1-3	n.a.	n.a.	n.a.	n.a.	5
Shanghai	2.0	2.5	Mar.-May) Sep.-Nov.)	20.6 (18-21)	1-3	335 (323-363)	30-90	8	54.5	6
Medium:										
Binhu	1.3	1.7	Aug.-Dec.	22.2 (13-30)	2	320 (303-351)	63 (29-143)	n.a.	47.6-62.6**	4
Dechang	1.5-2.0	n.a.	n.a.	20-35	3	330	n.a.	n.a.	37.1	7
Dehong	2.0-2.5	3.0	Oct.-Mar.	(22.0 ((plains) (30.0 ((mountains)	3)) 2-6))	290-320	36	8	n.a.	8
Small:										
Wenzhou	2.0-3.0	3.0	n.a.	20.8	n.a.	n.a.	n.a.	n.a.	n.a.	10
Xinglong	2.0-3.0	3.0	June-July	20.0	2-3	330	n.a.	8-9	54.6-87.3**	2
Xilin	2.0-3.0	3.0	n.a.	20.0	2-3	330	n.a.	8-10	81.7 (state farm) 42.7-52.1* (commune)	3

* For notation concerning reproduction see page 216.

** Figures from different herds; range over herds.

Table 6.10 GUANGXI WATER BUFFALO COWS
REPRODUCTIVE PATTERN

Observation	Number of cows	Average performance
Age at sexual maturity	12	1,067 days (3 years) old
Age at first mating	14	1,404 days (3.5 years) old
Mostly bred in	707	August to November
Length of oestrous cycle	9,276	24 days
Duration of oestrus	86	43 hours and 10 minutes
Length of gestation	234	312 days
Reproductive life	n.a.	about 15-18 years
Calvings	n.a.	8-9 calves in a lifetime

Chinese buffalo cows are primarily bred by natural mating; AI has not been practised extensively, only 0.8 percent or about 40 thousand of the breeding females being bred artificially, with an oestrous conception rate of 33.1 percent, and a total (yearly) conception rate of 55.5 percent (1). Buffalo cows on state farms have a reproductive rate (calves born/cows available for breeding) of 60-80 percent, which is higher than in the communes (30-50 percent - 1).

6.3 CROSSBREEDING

Exotic buffalo breeds, the Murrah from India (Plate 6.17) and the Nili-Ravi (Plate 6.18) from Pakistan, were introduced in the southern Provinces for crossing to improve the native buffalo. The results of crossbreeding seem to have been very successful, the F_1 and grade females* from Murrah x Guangxi, for instance, showing marked improvement in body measurements, liveweight and milk production. Recently (1982), satisfactory results have also been obtained from three-breed crosses** (Plates 6.19 and 6.20), body size, liveweight and milk production of the crosses having attained levels similar to those of the Murrah, and close to those of the Nili/Ravi (11).

---

* Two-breed cross: Murrah (M)♂ x Guangxi (G)♀
↓
MG♀ F_1 x Murrah♂
↓
(1st grade)♀ or back cross

** Three-breed cross: Murrah (M)♂ x Guangxi (G)♀
↓
MG♀ x N/R♂
↓
♀N/R-MG (3-breed cross)

Body measurements are shown in Table 6.11, and milk production in Table 6.12.

Table 6.11 BODY MEASUREMENTS OF EXOTIC BREEDS AND THEIR CROSSES WATER BUFFALO COWS, 2 YEARS OLD

Breeds	Number	Height (cm)	Heart girth (cm)	Liveweight (kg)
M (Murrah)	28	129	186	422
MG (Murrah x Guangxi)				
F_1	24	111	154	265
Grade*	48	123	174	253
N/R (Nili/Ravi)	7	133	198	527
N/R-MG**	23	130	190	454

Source: 11, summarized and tabulated by Cheng, P.L.
* Two-breed cross; ** Three-breed cross. See footnote page 82

Table 6.12 MILK PRODUCTION OF EXOTIC BUFFALO BREEDS AND THEIR CROSSES

Breeds and dates of records	Number of cows	Number of lactation periods	Length of lactation (days)	Milk yield (kg)	Average daily milk yield (kg)	Milk fat (%)
Averages before 1980:						
M (Murrah)	20	31	228	1,428	6.5	n.a.
MG: F_1	60	87	271	1,154	4.3	n.a.
Grade	12	15	292	1,540	5.2	7.5
M (Murrah)	81	299	237	1,573	6.6	6.7
N/R (Nili/Ravi)	25	66	261	1,873	7.2	7.2
N/R-MG	10	15	288	1,981	6.9	7.9
1980-1981:						
M (Murrah)	20	n.a.	272	1,975	n.a.	6.7
N/R (Nili/Ravi)	10	n.a.	276	2,076	n.a.	7.2
N/R-MG	10	n.a.	220	2,120	n.a.	7.9

Source: 11, summarized and tabulated by Cheng, P.L.

Reproduction: The 3-breed cross cows come to first oestrus and first breeding earlier than the exotic breeds, Murrah and Nili/Ravi, and also the F_1 of Murrah x Guangxi. They reveal a much shorter length of post-partum anoestrus and calving interval, as shown in Table 6.13. These characteristics are certainly valuable to the crossing programme.

Table 6.13 REPRODUCTIVE PATTERN OF EXOTIC BUFFALO BREEDS AND THEIR CROSSES

Breeds	Age at first oestrus (days)	Age at first breeding (days)	Oestrous cycle (days)	Length of: Gestation (days)	Post-partum anoestrus (days)	Calving interval (days)
M	667	1,201	23.2	305	95	455
MG:						
F_1	667	979	21.5	310	171	539
Grade	489	1,002	27.0	312	168	483
N/R	915	1,048	23.7	304	128	466
N/R-MG	605	831	21.6	306	71	382

Source: 11. Numbers of animals for each observation and each breed are all different and have been omitted from this table.

A crossbreeding improvement programme has been carried out extensively in the water buffalo-raising areas of the country since the introduction of the exotic breeds, Murrah from India in 1957 and Nili/Ravi from Pakistan in 1974. About 118,000 crossbreds have been produced, according to an incomplete survey made in 8 Provinces in 1981 (11). Further studies are needed in the future crossbreeding improvement programme.

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HAIZI WATER BUFFALO
North Jiangsu Province

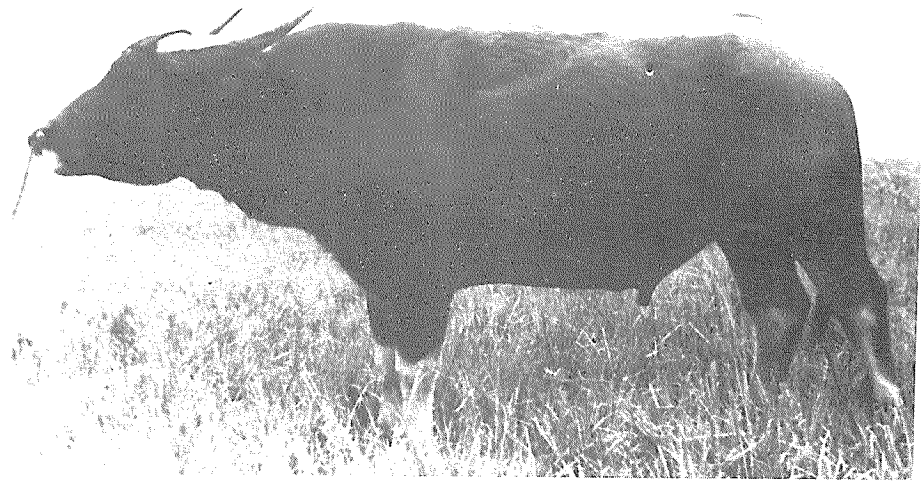

Plate 6.1 Male

Plate 6.2 Female

SHANGHAI WATER BUFFALO
Shanghai

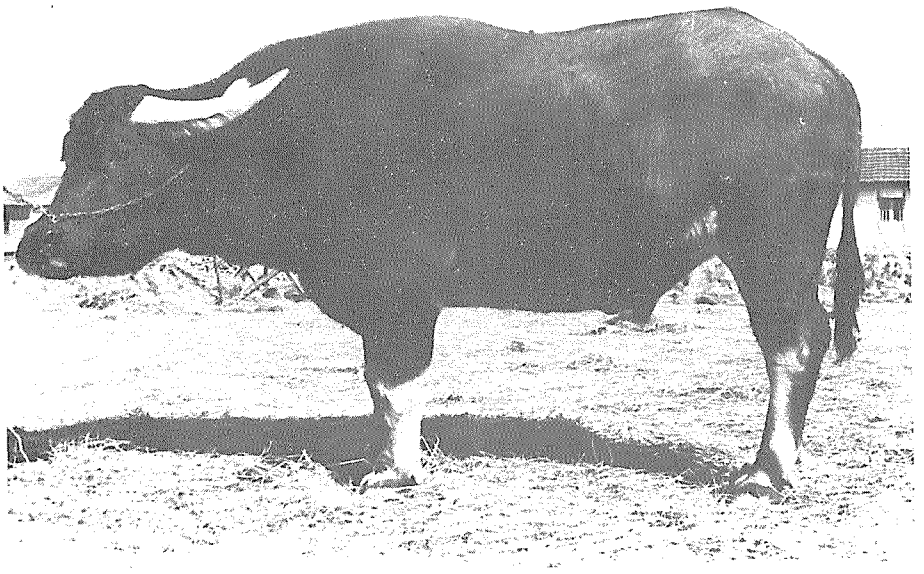

Plate 6.3 Male

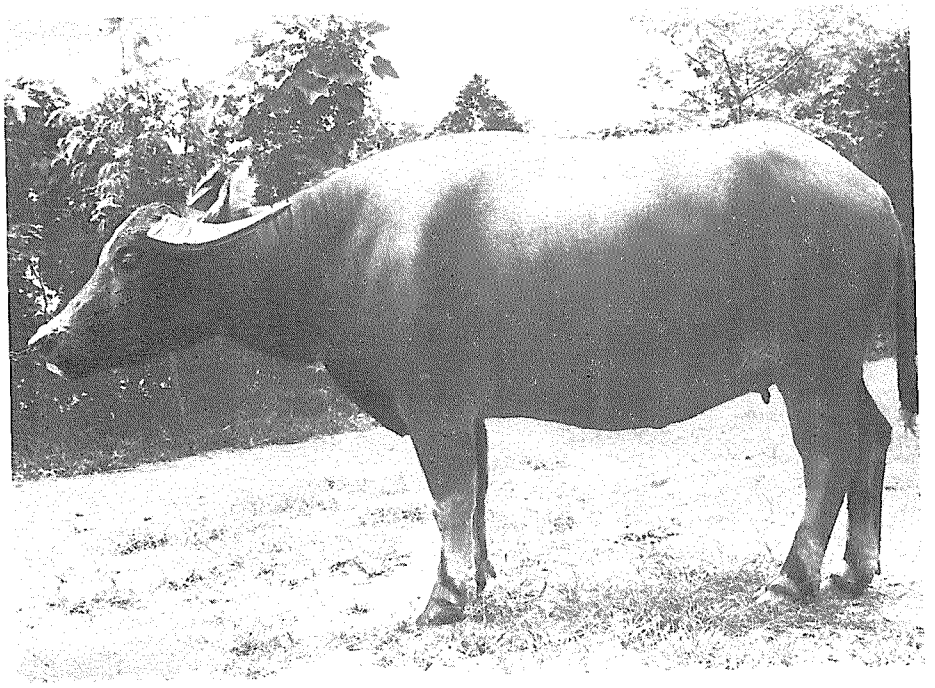

Plate 6.4 Female

BINHU WATER BUFFALO
Henan and Hubei Provinces

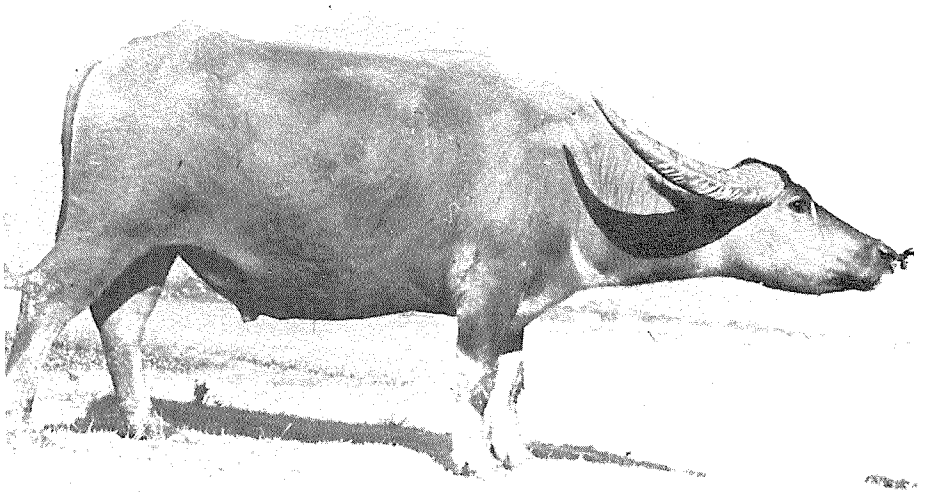

Plate 6.5 Male

Plate 6.5 Female

DECHANG WATER BUFFALO
Sichuan Province

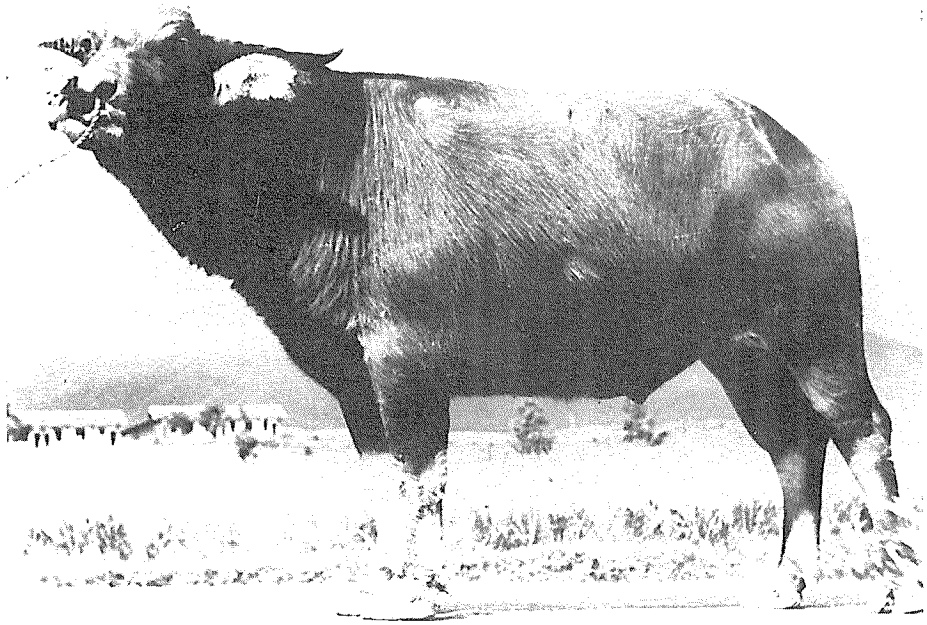

Plate 6.7 Male

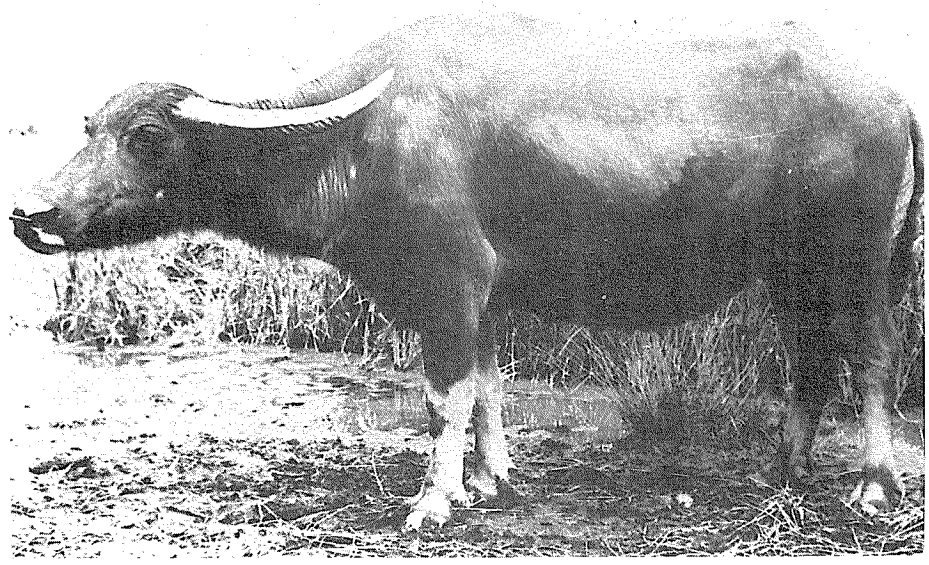

Plate 6.8 Female

DEHONG WATER BUFFALO
Yunnan Province

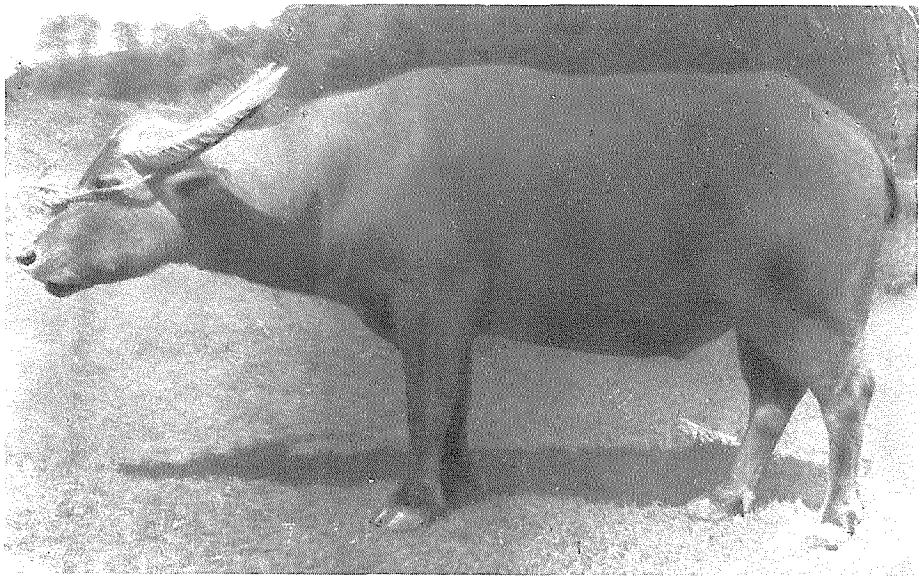

Plate 6.9 Male

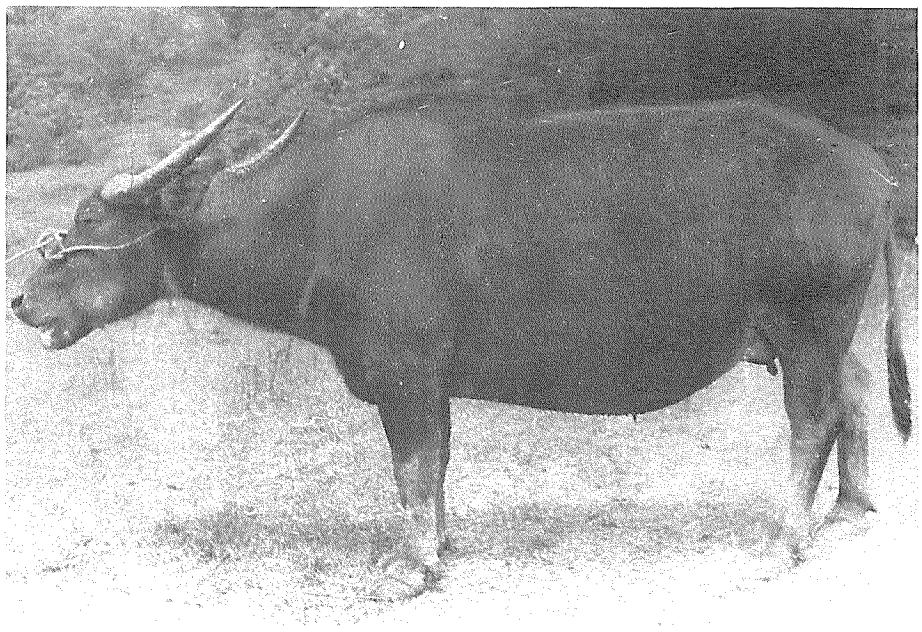

Plate 6.10 Female

WENZHOU WATER BUFFALO
Zhejiang Province

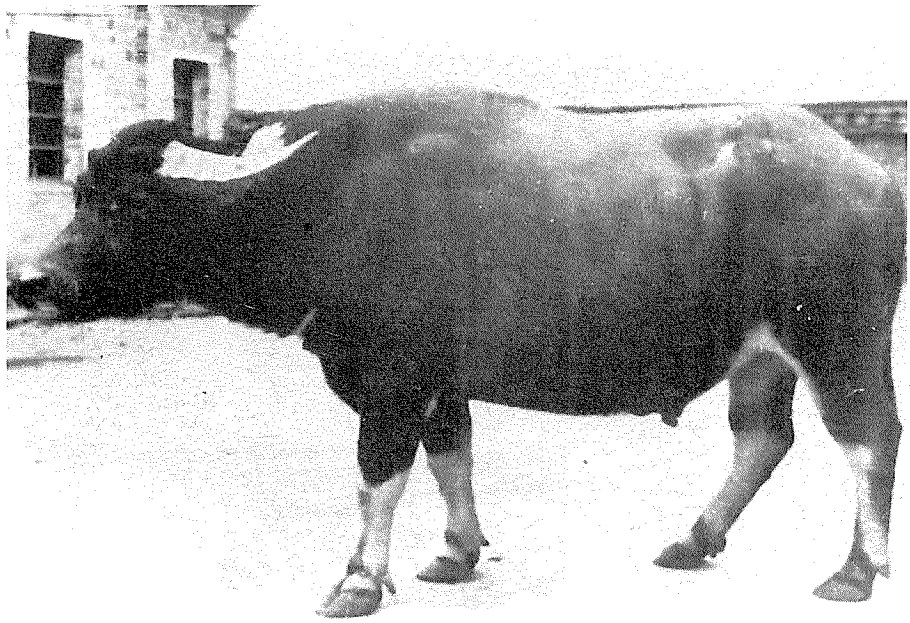

Plate 6.11 Male

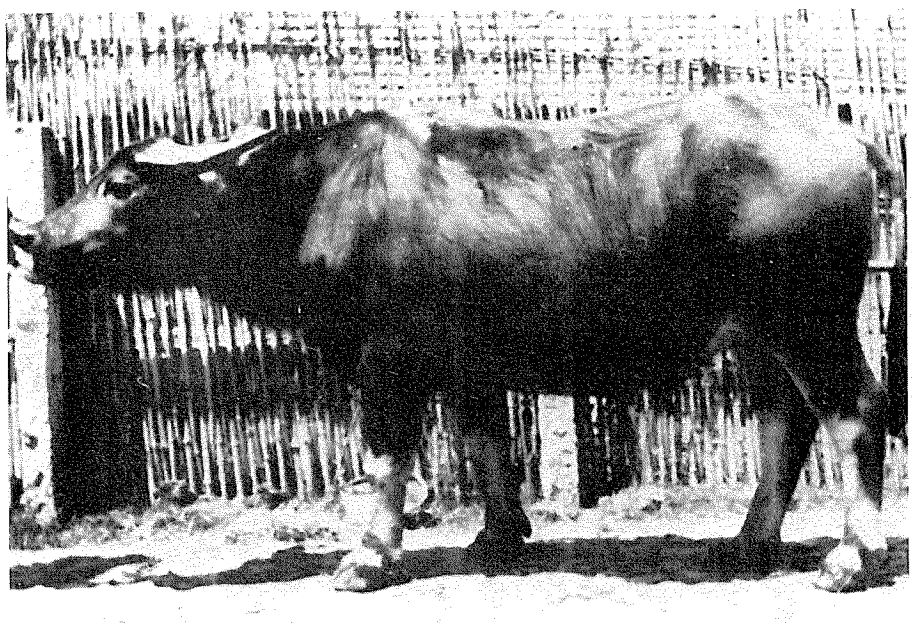

Plate 6.12 Female

XINGLONG WATER BUFFALO
Guangdong Provinde

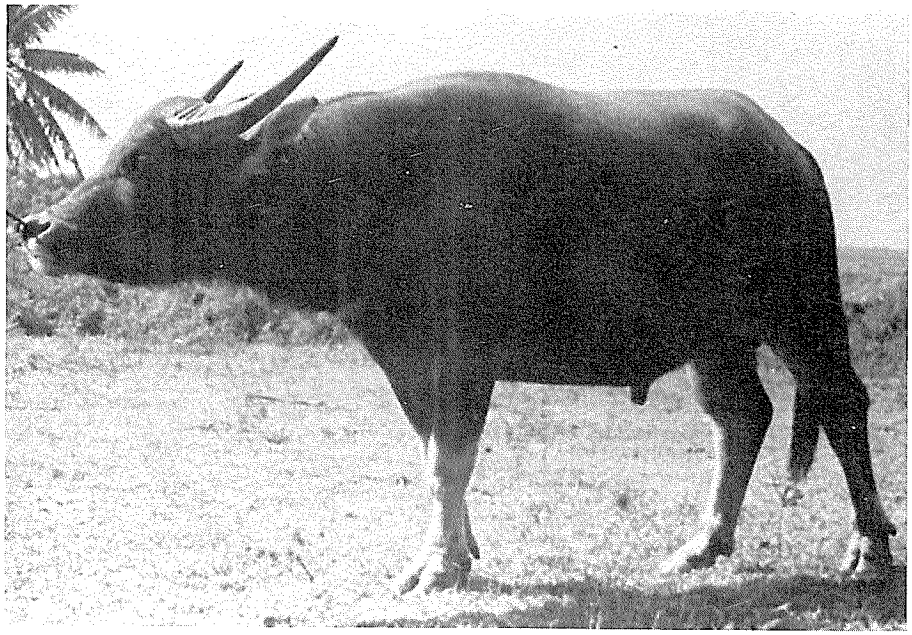

Plate 6.13 Male

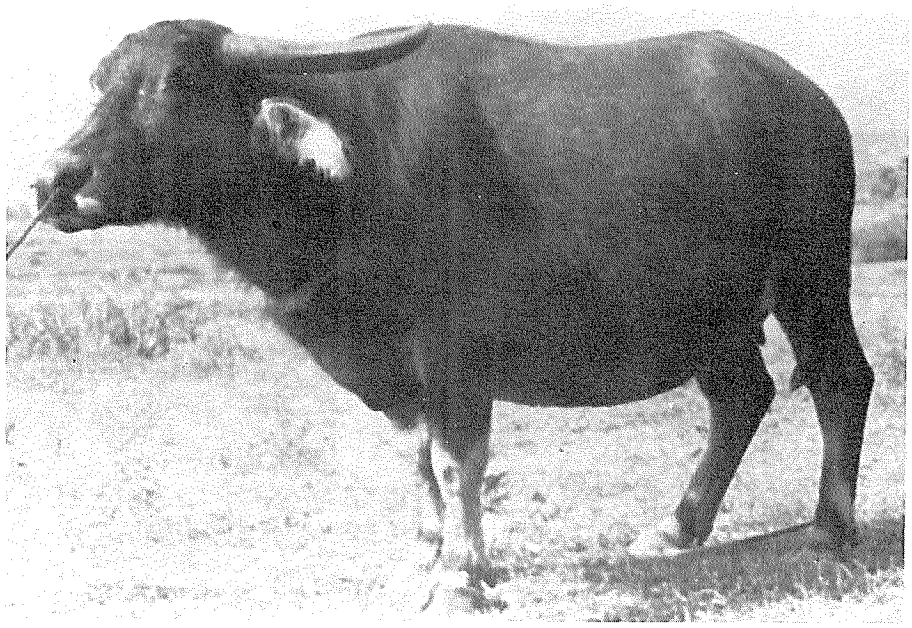

Plate 6.14 Female

XILIN WATER BUFFALO
West Guangxi

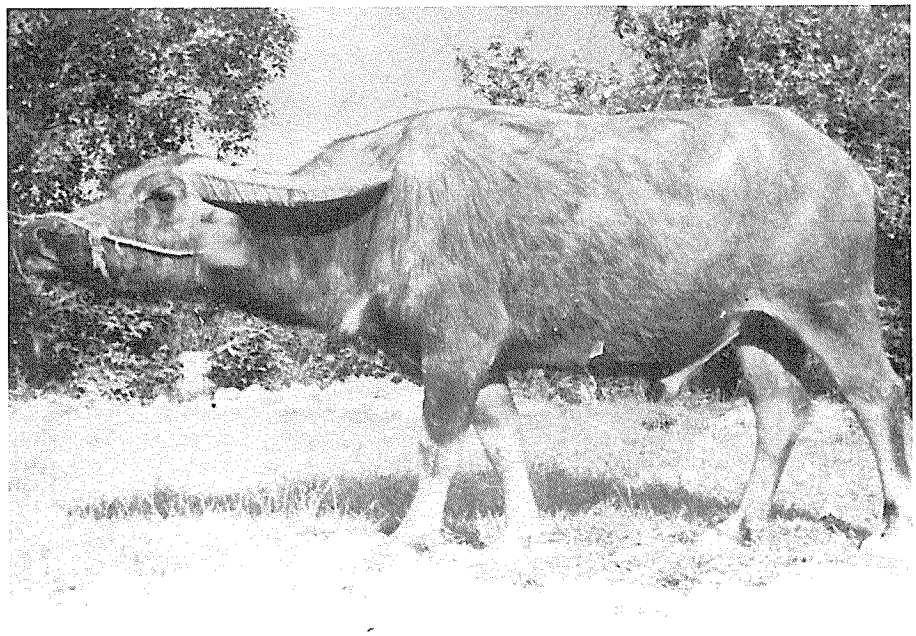

Plate 6.15 Male

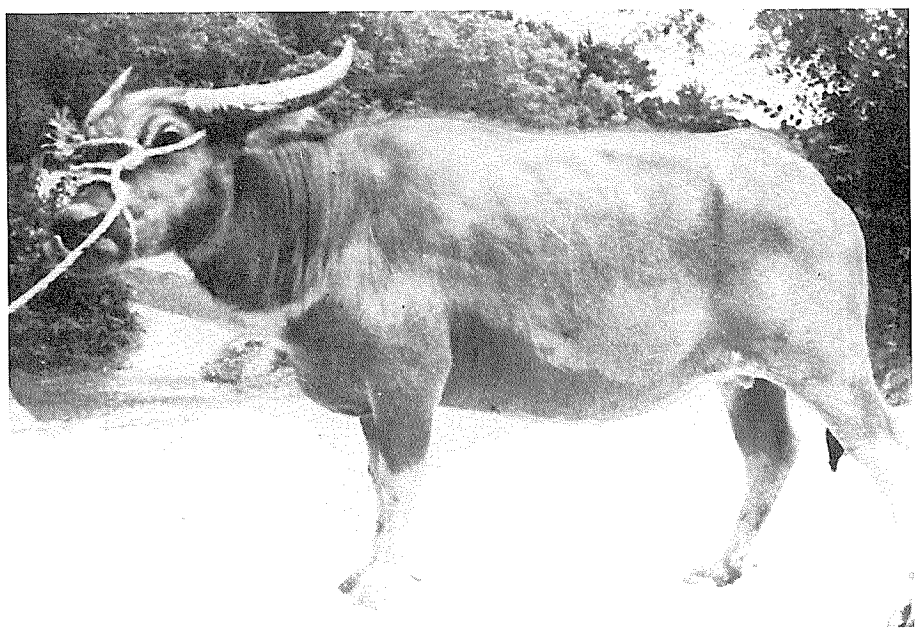

Plate 6.16 Female

CROSSBREEDING OF WATER BUFFALO
Exotic breeds

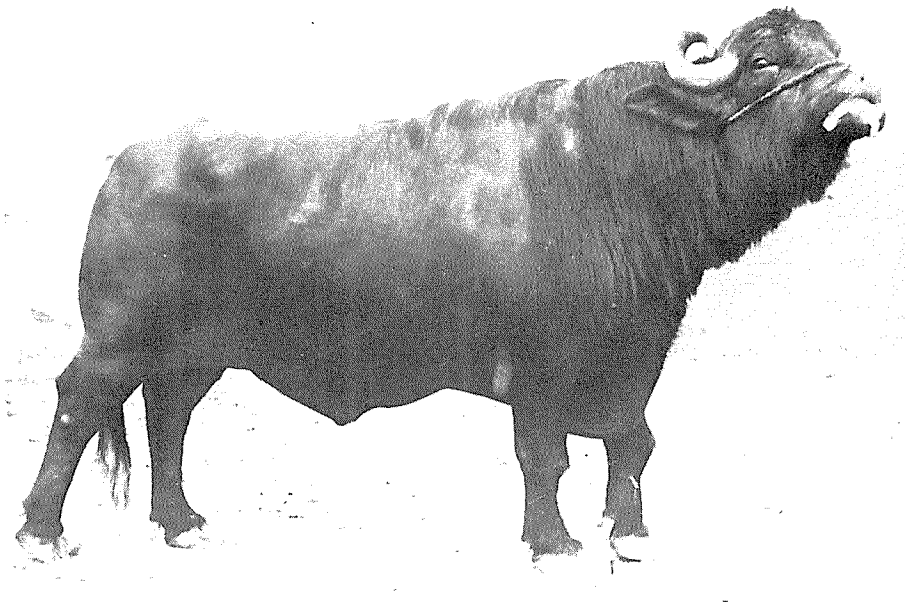

Plate 6.17 Murrah (male)

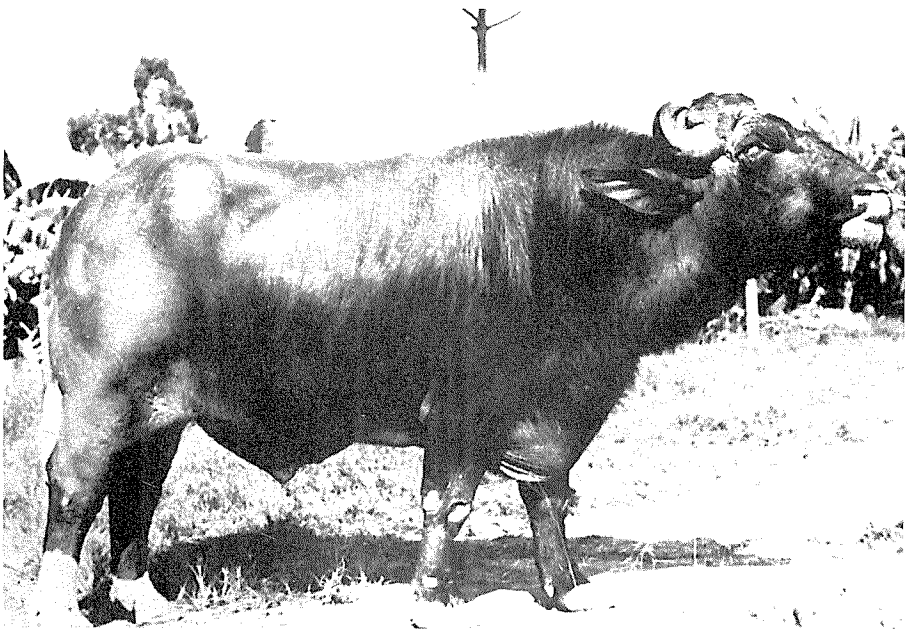

Plate 6.18 Nili/Ravi (male)

CROSSBREEDING OF WATER BUFFALO
Three-breed cross - Guangxi

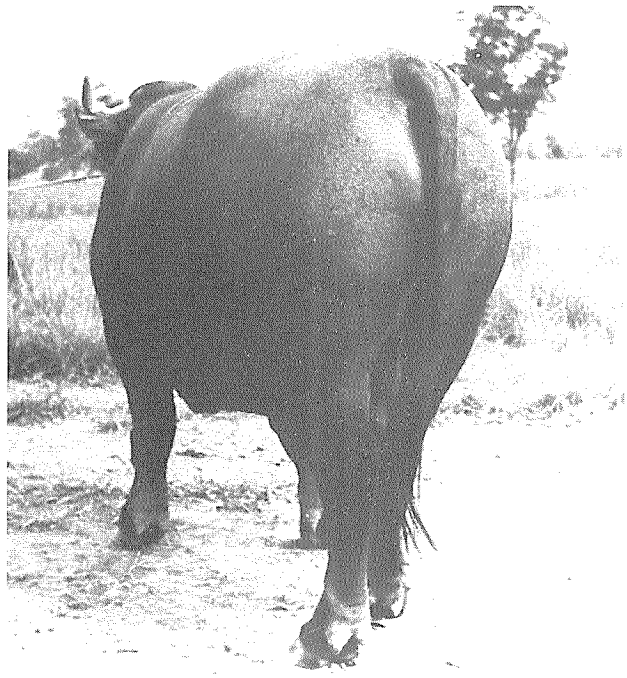

Plate 6.19 Progeny

Plate 6.20 Herd of cows

CHAPTER 7

YAK (TYPES)

The number of yaks in China is approximately 12 million (Table 1.1) or about 85 percent of the world total; China thus takes first place.

Yaks in China are mainly located in the high, cold mountainous areas, at an elevation above 3,000 m, on the Qinghai-Tibet Plateau and in parts of the mountainous areas of Gansu, Sichuan and Yunnan Provinces and the Xinjiang Uygur Autonomous Region (Figure 7.1). Yaks can graze on the alpine grasslands in summer, and during winter on shrubs in deep snow, in temperatures (-40°C) which are rigorous even for Tibetan sheep. Although the yak will lose weight during winter, it recovers and gains weight rapidly with the coming of spring grass.

The yak has long, coarse hair all over its body, acting as insulation; this may even touch the ground, the shoulder hairs being about 20 cm in length (Plates 7.1 and 7.2). In addition, the animal grows a dense woollen undercoat for winter protection.

7.1 TYPES

Some research workers claim there are three types of yak in China (4), namely:

Valley, which is mainly distributed in the valleys of North and East Tibet, as well as in some parts of Sichuan and Yunnan Provinces. An example is the Jiulong (Plates 7.3 and 7.4).

Plateau Grassland, which is mainly distributed in the high, cold pastures and steppes, at an altitude of 2,700 - 4,000 m, with an annual mean temperature below 2°C (lowest -30°C), and annual precipitation 400-800 mm. Examples are the Maiwa (Plates 7.5 and 7.6) and Luqu (Plates 7.7 and 7.8).

White Yak, which is found in almost every region or district. An example is the Tianzhu White yak (Plates 7.9 and 7.10).

White yaks are frequently found in certain places in Tibet (8.1 percent of the Tibetan total), Qinghai (2.9 percent), and are especially numerous in the Tianzhu Tibetan Autonomous County of Gansu Province (43.9 percent). Tianzhu County is located east of the Qilian Mountains (about 36.3°-37.4°N, 102°-103°E); it is high (2,000 - 4,834 m), cold (annual mean temperature 0°C), semi-humid (annual precipitation 300 to 416 mm), and particularly characterized by erratic changes in diurnal temperature. However, this county is famous for producing Tianzhu White yaks (13), and a breeding programme has been carried out, with selection for a pure strain of white animals.

Some workers claim there are still other minor types with different features, such as the Long-hair-forehead yaks found in Qinghai Province (Plate 7.11).

7.2 CHARACTERISTICS AND PERFORMANCE

Probably because yaks have always lived in rarefied air at high altitudes, their hearts and lungs are more developed than those of yellow cattle. There is an increase in the volume of pulmonary alveoli and the weight of the heart compared with those of yellow cattle, while the number of red blood cells and the amount of haemoglobin are about 50 to 100 percent higher.

The yak is a triple-purpose animal, used for work, meat and milk. In addition, the long hair, especially from white yaks, is used extensively for making imitation beards or hair for actors or actresses in opera or other performances, as well as for Santa Claus in foreign countries.

Body measurements: Yaks are smaller in body size than yellow cattle, with lower liveweights. However, body measurements reported from different regions vary greatly (Table 7.1); for example, some body heights are:

Common yaks: Male 114 cm; female 105 cm.
Tibetan yaks: Male 122 cm; female 102 cm.

The Jiulong in Sichuan Province, however, is taller: Male 138 cm; female 117 cm.

At present, no conclusion has been reached as to whether the differences in body height or liveweight are attributable to "breeds" or to feeding and management practices.

Average liveweights for common yaks are (Table 7.1): Male about 400 kg; female about 300 kg.

Work: Yaks are mainly used for packing in transport; they may travel 20 to 30 km per day with a load of 60 to 80 kg, on the high, cold, steep mountainous paths. This is why they have a reputation as the "Ships of the Plateau".

Meat production: The dressing percentage is 45 to 54; yak meat, from either white or black yaks, has a special flavour, and if adequately processed and canned, is much appreciated both at home and abroad.

Milk production: Milk is of economic importance in yak raising. Milking generally starts 10-15 days after calving, which occurs in April and May, then continues for 5 months until winter comes. Production is closely related to time of year and pasture condition. Milking usually starts from June, when pastures begin to grow; production is highest in July, when grass is abundant and nutritious, then declines as the grass dries off gradually before or in October.

Estimates of total performance should include milk suckled as well as milked, but suckling estimates are rarely obtained, and production estimates usually refer to quantity milked. Both amounts were estimated, however, for 91 yak cows (3-14 years old, 1-6 calvings) during a 5-month period (Table 7.2).

Table 7.1 BODY MEASUREMENTS OF YAK

Types	Location	Sex	Number	Body measurements Height (cm)	Length (cm)	Heart girth (cm)	Live-weight (kg)	Source
Valley:								
Jiulong	Ganzhi Zhuang Autonomous Region, SW Sichuan	M	15	138	170	214	554	1,3,7
		F	708	117	140	178	314	8
Grassland:								
Maiwa	Aba Zhuang Autonomous Region, N Sichuan	M	17	126	157	193	414	1,3,7
		F	219	106	131	155	222	8
Luqu	SW Gansu	M	n.a.*	129	138	190	335	15
		F	n.a.	110	122	157	211	
Common	Qinghai	M	n.a.	114	125	167	300 - 490	2
		F	n.a.	105	117	156	210 - 350	
Haiyan (a form of common yak)	E Qinghai	M	28	114	125	165	237	18
		F	154	109	119	154	198	
Tibetan		M	n.a.	122	134	170	n.a.	11
		F	n.a.	102	112	152	n.a.	
White Yak:								
Tianzhu	Mid Gansu	M	17	121	123	164	264	13
		F	88	108	114	154	190	
		C**	37	114	117	161	221	

*n.a. = not available **C = castrate

Table 7.2 TOTAL MILK PRODUCTION OF YAK*

Month	Amount from: Milking (kg)	Suckling** (kg)	Total (kg)	Percent of 5 month total	Milk fat (%)
June	48.5	52.7	101.2	20.7	nil
July	52.8	59.3	112.1	23.0	nil
August	53.4	46.6	100.0	20.5	5.9
September	45.6	42.0	87.6	17.9	5.9
October	40.8	45.5	86.3	17.7	7.4
Average	48.3	49.2	97.5		6.4

Source: 16

* 3 times of measurement a day: morning, noon and afternoon

** Amount from suckling = Body weight of calf after suckling - body weight of calf before suckling

If the cow is not pregnant after calving, she may be milked the following spring when the grass grows, but production in the second year is only about two-thirds of that in the first year (Table 7.3). Milk production increases with parity (Table 7.4).

Table 7.3 COMPARISON OF MILK PRODUCTION IN THE CALVING YEAR AND THE FOLLOWING YEAR

Year of milking	Number of mature cows	Average daily milk production (kg)	Milking period (days)	Average yearly milk production (kg)	Milk fat (%)
Calving year	30	1.38	150	207.0	7
Following year	18	0.95	150	142.5*	7
Average		1.17	150	174.8	7

Source: 14
* 68.8% of calving year

Table 7.4 MILK PRODUCTION OF JIULONG YAK AT DIFFERENT CALVINGS

Calving	Number of cows	Milk production		Average milk fat (%)
		Daily average (kg)	Whole lactation period (kg)	
1st	11	1.15	433	7.4
2nd	7	1.18	444	7.3
3rd	26	1.50	562	7.4

Source: 7

There are marked differences in milk production between breeds. Tianzhu yak, located at an altitude of 2,000 - 4,830 m, with an annual mean temperature of -0.1°C to 0°C, is low in milk production. Two hundred and twenty-three cows had an average of 81.4 kg in 105 days, or 0.77 kg daily (one milking a day), with an average fat percent of 6.8 (5.0-8.2). Maiwa, located at about the same altitude (3,500 m) with an annual mean temperature of about 1.0°C, has a higher production of 225.5 kg, or 1.52 kg daily, in a 149-day milking period, (2-3 milkings a day), with an average fat percent of 7.3 (12).

The "Pian", a crossbred from yak cows inseminated with frozen cattle semen, produces more milk. Although the milk fat percentage is lower than that of yak, the total milk fat production is much higher, as shown in Table 7.5 (12, with a Black-white cross) and Table 7.6 (8, with a yellow cattle cross).

Table 7.5 COMPARISON OF MILK AND MILK FAT PRODUCTION PIAN AND YAK (149-DAY MILKING PERIOD)

	Age (yrs)	Number of cows	Total milk prodn. (kg)	Average daily milk (kg)	Compared with Yak	Milk fat (%)	Compared with Yak	Total fat prodn. (kg)	Compared with Yak
Pian (Black-white x Yak)	4	15	809	5.43	360	5.2	70.4	41.4	252
	3	26	687	4.61	305	5.3	72.7	36.3	221
Yak	4	6	226	1.51	100	7.3	100	16.4	100

Source: 12

Reproduction: Females are bred from June to November (mostly from June to September), with a conception rate* of 60 to 85 percent, and a gestation length of 402 days.

7.3 CROSSBREEDING

The hybrids, Pian, resulting from crossing yak (Bos grunniens) with yellow cattle (Bos taurus) have the following characteristics:

(i) They show marked increase over yak in body size, liveweight and milk production (Table 7.6).

(ii) They are especially adapted to the rigorous climatic conditions of the Qinghai-Tibet Plateau.

(iii) The female hybrids are normal in fertility (Table 7.7) while the males are infertile, no spermatocytes being found in the seminiferous tubules.

* For notation concerning reproduction see page 216.

Table 7.6 BODY MEASUREMENTS AND MILK PRODUCTION OF YAK AND THEIR CROSSBREDS (PIAN)
Mature cows

Species or cross	Body measurements				Milk production		
	Height (cm)	Length (cm)	Heart girth (cm)	Live-weight (kg)	Lactation period (days)	Milk (kg)	Fat content (%)
Yak	108	131	166	250	150-180	200-400	6.8
Pian (or F_1 of yellow cattle x yak)	112	138	171	294	200	600	6.0
Pian over yak (% change)	+3.5	+4.9	+2.8	+17.5	+21.2	+100.0	-11.8
Pian (or F_1 of Black-white x yak)	124	147	181	364	n.a.	n.a.	n.a.
Pian over yak (% change)	+15.0	+12.0	+9.0	+45.3	n.a.	n.a.	n.a.

Sources: Measurements and liveweight 2, 8, 17; milk production 8

Table 7.7 CONCEPTION RATES OF YAK AND PIAN
F_1 Females from yellow cattle x yak

Species or cross	Conception rates (%)	Source
Yak	61.4 (35.5-82.0) 87.8 (83.5-94.2) 59.1 (52.5-69.2)	5,6 9
Pian (Yellow cattle x yak)	76.3 64.5	5,6 10

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COMMON YAK
Qinghai-Tibet Plateau

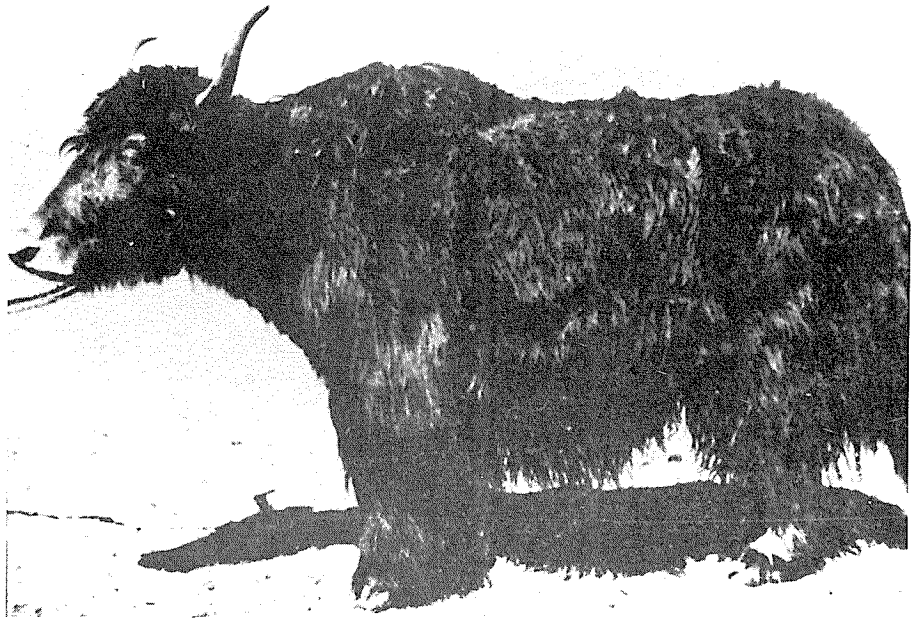

Plate 7.1 Male

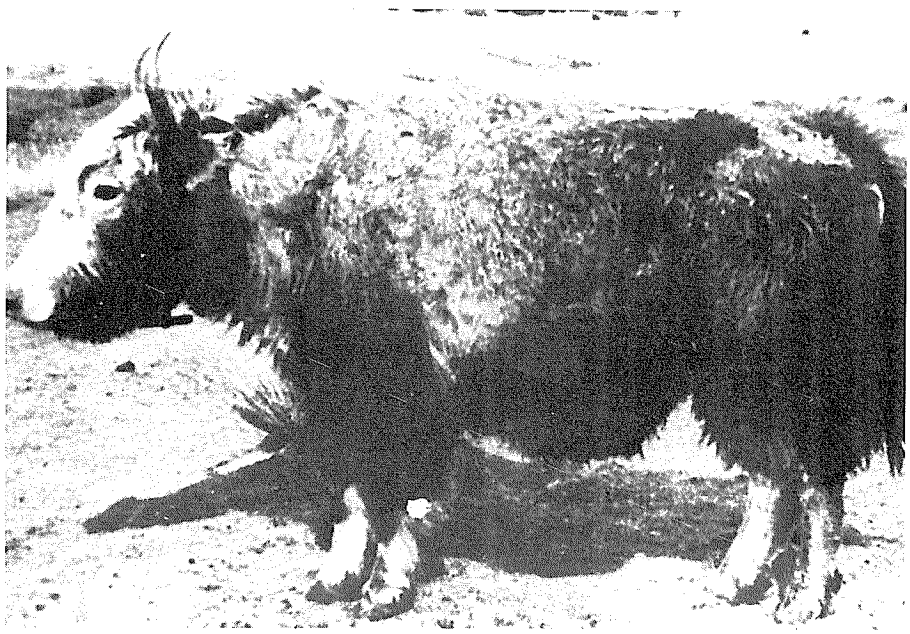

Plate 7.2 Female

JIULONG YAK (Valley Type)
Sichuan Province

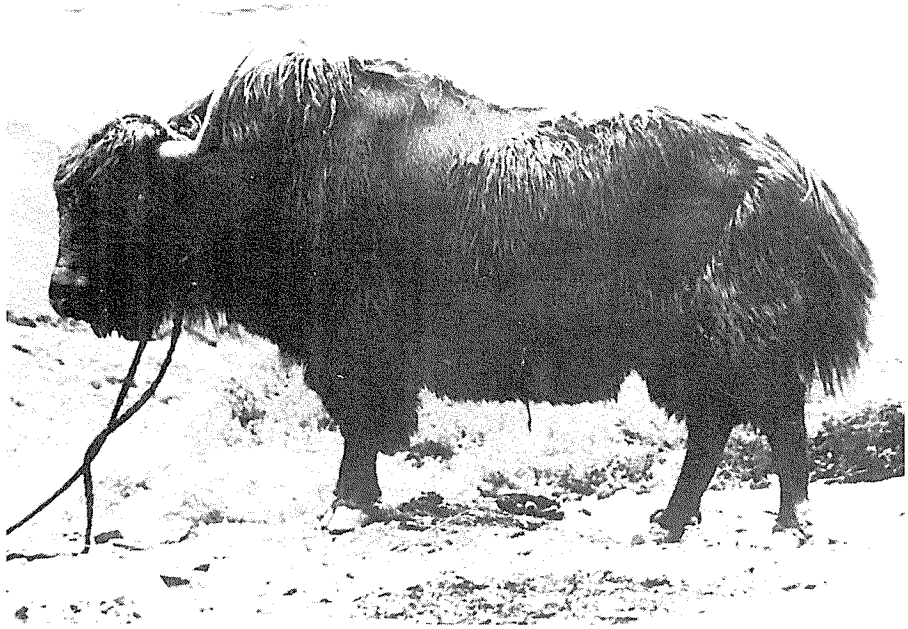

Plate 7.3 Male

Plate 7.4 Female

MAIWA YAK (High Grassland Type)
Sichuan Province

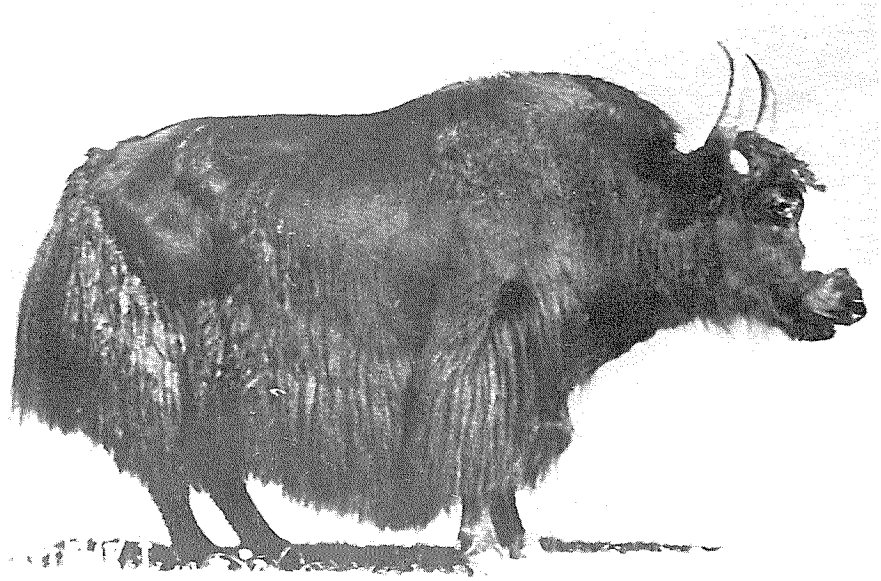

Plate 7.5 Male

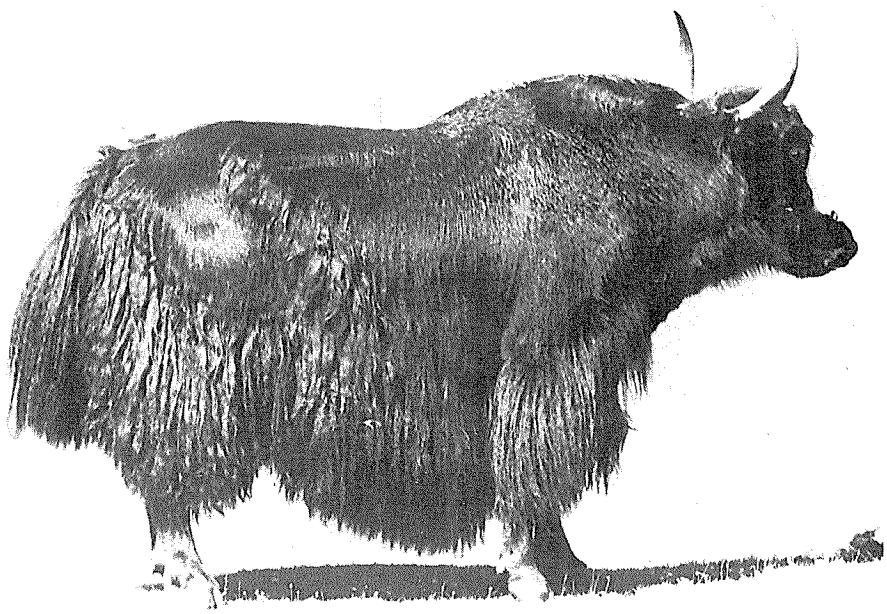

Plate 7.6 Female

LUQU YAK (Grassland type)
Luqu County, Sichuan Province

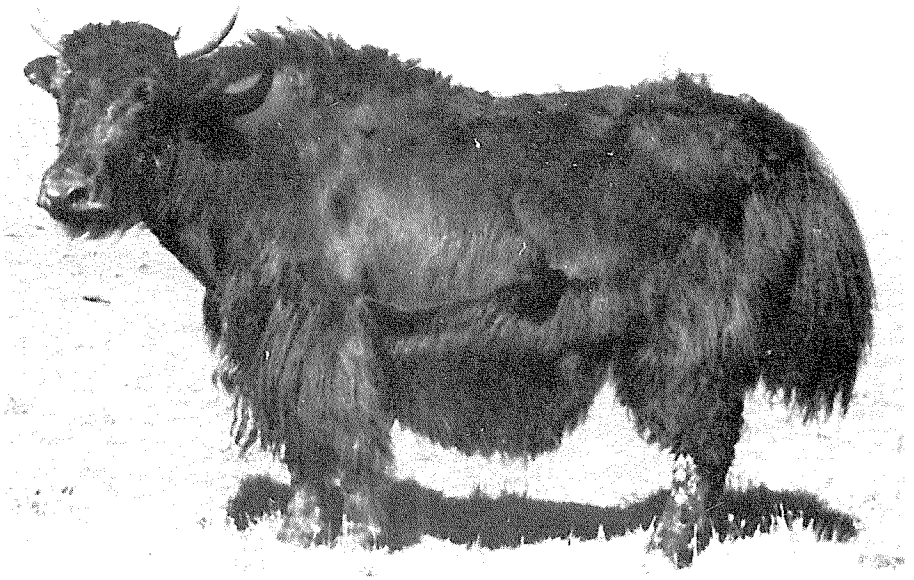

Plate 7.7 Male

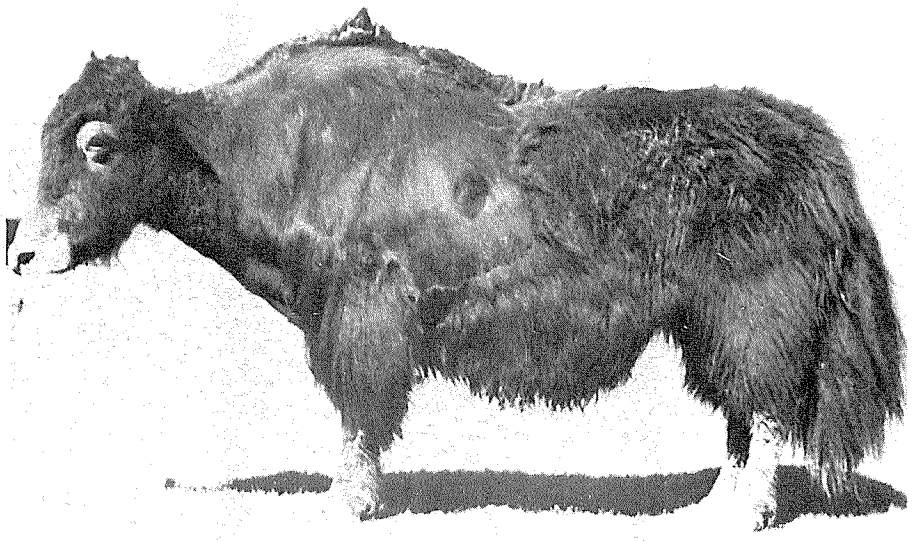

Plate 7.8 Female

TIANZHU WHITE YAK
Tianzhou County, Gansu Province

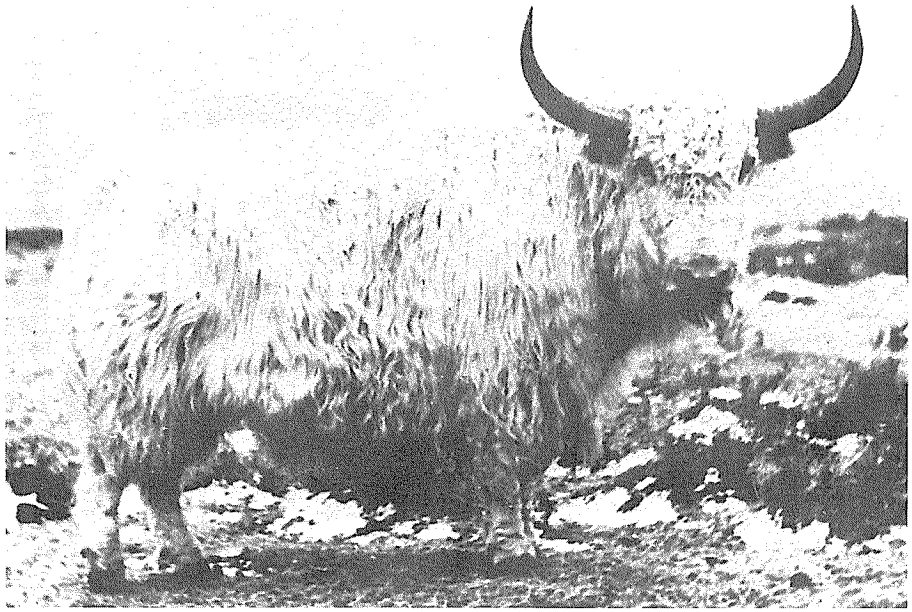

Plate 7.9 Male

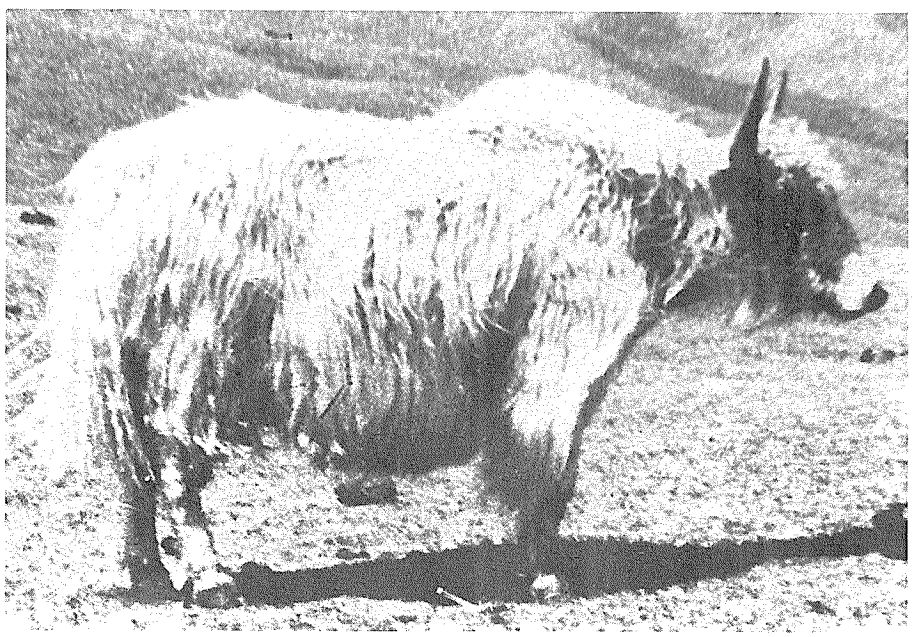

Plate 7.10 Female

LONG-HAIR-FOREHEAD YAK
Qinghai Province

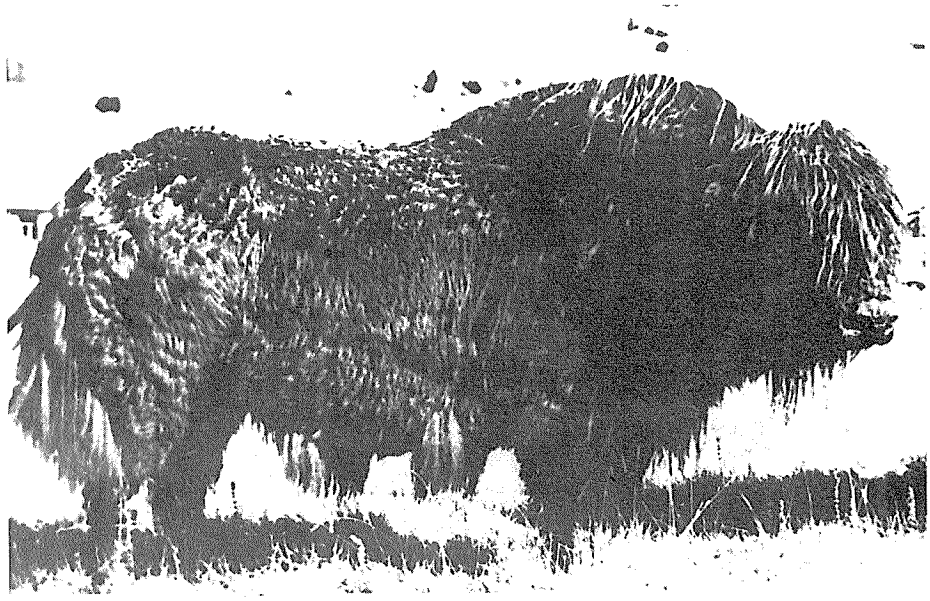

Plate 7.11 Male

Plate 7.12 Yak grazing on pastures in the Qaidam Basin, NW Qinghai Province. The Basin lies at 2,600 - 3,000 m at its lowest point, and is surrounded by mountains

CHAPTER 8

SHEEP BREEDS

8.1 MAIN CATEGORIES

China's population of sheep was 107 million at the end of 1982 (Table 1.1), their distribution being shown in Figure 8.1. Indigenous sheep may be divided into 3 main categories:

Mongolian (Plates 8.1 and 8.2) are mainly distributed in the Inner Mongolia grassland in the north, and also in the west (Figure 8.1); they belong to the fat-tail carpet-wool type. Rams have spiral-shaped horns, ewes are polled (hornless).

Kazakh (Plates 8.3 and 8.4) are found in the desert and mountainous areas in west Xinjiang (Figure 8.1); they belong to the fat-rump carpet-wool type. Rams are all horned; about 35 percent of ewes are polled.

Tibetan (Plates 8.5 to 8.8) are raised mainly on the Qinghai-Tibet Plateau, at more than 3,000 m of altitude (Figure 8.1); they belong to the small-tail carpet-wool type. All rams and ewes have horns, stretching laterally toward right and left. They have cone-shaped tails, and small body size.

8.1.1 Characteristics in common

These three types all have coarse wool of a type commonly called "carpet wool", i.e. with a proportion of medullated fibres. Though developed under different ecological conditions, they have the following features in common:

(i) Adaptation to the unfavourable local environmental conditions of the North and Northwest Pastoral Grasslands.

(ii) Ability to deposit fat in their bodies, though in different parts. The Mongolian deposits fat in the tail (fat-tail sheep), the Kazakh in the rump (fat-rump sheep), and the Tibetan in the viscera around the stomach and kidneys, as well as in the mesentery (small-tail sheep).

(iii) Low wool production, with an annual greasy fleece weight of only about 1 kg.

8.2 SHEEP OF SPECIFIC REGIONS

Since all these sheep have been subjected to the influence of their respective natural environments, many breeds (or types), each with its own particular characteristics, have evolved from these three categories in specific regions (Tables 8.1 and 8.2), such as:

- Pastoral Areas (including the Qinghai-Tibet Plateau),
- Mixed Pastoral - Agricultural Areas,
- Agricultural Areas.

Table 8.1 LOCAL NATURAL CONDITIONS - SHEEP BREEDS

Regions and breeds	Climate and topography	Altitude (m)	Temperature* Annual mean (°C)	Lowest (°C)	Highest (°C)	Annual* precip-itation (mm)	Tail pat-tern-
Pastoral Areas:							
Mongolian	Dry, cold High plain	990	1.8	-39.5	36.9	269	Fat-tail
Ujumqin	Dry, cold High plain	840	0.7	-40.5	37.9	300	Fat-tail
Kazakh	Dry, cold Mountain basin	550	6.2	-39.0	39.0	280	Fat-rump
Altay	Dry, cold Mountain basin	500	4.4	-49.5	37.6	160	Fat-rump
Tibetan, 3 types:**							
Plateau	Semi-arid, cold	4,500+	-1.9	-41.2	22.6	400	Small-cone-tail
Yarlung Zangbo	Semi-arid, warm-cold	3,500-4,000	2.4	-25.0	22.6	373	Small-tail
Sanjiang	Semi-arid, warm-cold	3,000-4,500	7.6	-19.3	33.4	495	Small-tail
Mixed Pastoral-Agricultural Areas:							
Tan	Arid Desert-steppe	1,185	9.0	-23.2	35.0	228	Fat-tail
Agricultural areas:							
Han	Warm Plain (hand-fed)	43	14.2	-22.6	39.5	869	Large-tail and Small-tail
Tong	Warm Plain (hand-fed)	370	13.3	-16.2	42.8	538	Medium-tail
Hu	Warm Plain (penned)	7	16.2	-9.6	38.5	1,246	Small-tail

Sources: * Ten-year averages of local or neighbouring weather stations;
** 8

Table 8.2 BODY AND TAIL MEASUREMENTS OF SHEEP BREEDS*

Regions and breeds	Sex	Number	Measurements				
			Body		Liveweight	Tail	
			Height (cm)	Length (cm)	(kg)	Length (cm)	Width (cm)
Pastoral Areas:							
Mongolian**	M	n.a.≠	67.0	68.0	45	n.a.	n.a.
	F	n.a.	62.2	65.3	39	20.1	15.7
Ujumqin	M	7	70.9	75.8	80	20.6	15.1
	F	241	67.5	70.0	55	15.0	14.3
Kazakh	M	n.a.	73.0	77.5	72**	19.5	24.0
	F	n.a.	66.8	72.1	42	17.0	22.5
Altay	M	29	77.4	83.1	82	16.1	30.5
	F	48	70.8	76.9	69	14.2	27.9
Tibetan***							
Plateau	M	n.a.	67.4	76.9	51	-	-
	F	n.a.	63.0	68.0	33	-	-
Yarlung Zangbo	M	n.a.	62.3	68.3	40	-	-
	F	n.a.	58.4	63.5	31	-	-
Sanjiang	M	n.a.	67.0	76.0	44	-	-
	F	n.a.	63.9	68.5	37	-	-
Mixed Pastoral-Agricultural Areas:							
Tan	M	299	65.6	75.5	47	32.9	11.8
	F	603	61.8	71.6	35	29.7	8.1
Agricultural Areas:							
Han:							
Large-tail	M	n.a.	75.2	72.2	60	48.8	33.1
	F	n.a.	65.9	69.3	42	32.8	21.2
Small-tail	M	n.a.	75.6	73.1	58	22.9	19.2
	F	n.a.	69.1	69.4	38	17.5	13.0
Tong	M	n.a.	63.6	66.7	40	31.2	16.2
	F	n.a.	58.6	64.5	37	27.0	13.4
Hu	M	n.a.	67.5	77.0	40	11.8	11.4
	F	n.a	63.7	75.6	38	n.a.	n.a.

Sources:* Various, checked by 9; ** Range given; means by Cheng, P.L.; *** 8; ≠n.a. = not available

8.2.1 Pastoral Areas

Due to the sharp seasonal contrast in plant growth in the pastoral areas, the sheep tend to deposit a large amount of fat in the body, in order to meet nutritional demands during winter and spring. In addition, the herdsmen working under those rigorous climatic conditions need fat as the main source of energy supply, and so have selected towards sheep with high fat deposits. These two factors, natural as well as artificial selection, were presumably responsible for the development of the fat-tail sheep on the pastoral grasslands in the north and northwest.

Examples of the breeds are:

The Ujumqin (Plates 8.9 and 8.10), of the Mongolian category, has a fat tail 28 cm long by 36 cm wide in the male, and 22 cm long by 28 cm wide in the female (Plates 8.11 and 8.12); when skinned, the tail fat weighs 2 kg or more.

The Altay (or Fuhai) (Plates 8.13 to 8.15), is a big-tail (or fat-rump) sheep of the Kazakh category which, for similar reasons, gradually formed its fat tail (or rump) as a biological characteristic (steatopyga); the tail (or rump) weighs about 7 kg (Plate 8.16).

The Tibetan, is raised under semi-dry conditions, but at different altitudes. There are three types:

(i) Plateau Grassland, found in the high, cold pastoral areas (over 4,500 m in altitude). This is the largest of the three in body size.

(ii) Yarlung Zangbo, located at over 3,500 m in altitude. It has a small body size.

(iii) Sanjiang, distributed in the forest areas, at about 3,000 m. It has a medium body size (Tables 8.1 and 8.2).

8.2.2 Mixed Pastoral-Agricultural Areas

The Tan (Plates 8.17 and 8.18), another type of Mongolian in the Ningxia Hui Autonomous Region, is raised in an arid and temperate climate (annual mean temperature 9°C, annual precipitation less than 300 mm), with year round grazing on a vegetation consisting mainly of sandy saline plants. This well-known breed is noted for the beautiful, evenly-crimped pelts of month-old lambs (Plates 8.19 and 8.20). Incidentally, Zhongwei goats, developed under similar ecological conditions, are also noted for the light and lustrous fur-pelts of the kids (See Chapter 9).

8.2.3 Agricultural Areas

Ecological conditions also vary greatly in the agricultural areas, and so do the breed characteristics of the sheep, for example:

The Han, another type of Mongolian sheep, was developed in the semi-humid agricultural areas (Henan, Hebei, Shandong, Anhui and Jiangsu Provinces - Figure 8.1).

There are two types of Han which, in 1982, were claimed as two different breeds (2):

(i) Large-tail Han (Plates 8.21 and 8.22): All sheep are polled, and are characterized by a long, broad, fat tail, with a thin twisted end turning upwards between two lobes (Plates 8.23 and 8.24), and broadest at the base. Maximum length and width of the tail for rams are 70 and 30 cm respectively, the maximum weight being 25 kg (1). Since the tail is too heavy for the sheep to move around easily during grazing, this type (or breed) is only adaptable to the plains (Plate 8.25).

(ii) Small-tail Han (Plates 8.26 and 8.27): All sheep are horned, rams' horns being large and spiral-shaped, and ewes' small. The tails are much shorter than those of the Large-tail Han (average length: rams, 23 cm; ewes, 19 cm). This type (or breed) is adaptable to hilly lands for grazing.

Han sheep are precocious and highly prolific, their fecundity levels being: Large-tail Han, 163 percent; Small-tail Han, 229 percent (Tables 8.3 and 8.4). Recent reports (2) have given even higher figures of 192 percent for the Large-tail Han and 270 percent for the Small-tail.

The Tong (Plates 8.28 and 8.29) is another type of Mongolian sheep. It is mainly located in the high plains of northern Shaanxi Province (annual mean temperature 13°C, annual precipitation 520 to 600 mm). The beautiful curls of the lamb pelt look like pearls, and a coat-lining made from it gives warmth with light weight.

The Hu (Plates 8.30 and 8.31; tail shape, Plates 8.32 and 8.33) is found in the Taihu Lake (or Great Lake) area in the east (Figure 8.1), where the climate is warm and humid (annual mean temperature 16°C; annual precipitation 1,000 to 1,200 mm); the soil is fertile, and agriculture is highly developed. It is one of the richest areas of the country, known as the "land of fish and rice" (background Plates, 8.34 and 8.35). The sheep are penned all the year round, because there is little or no spare land for grazing, and are supplied with a variety of feeds.

Hu sheep are especially noted for the following valuable attributes:

(i) The white pelt from 3-day-old lambs, with beautiful, curled patterns (Plates 8.36 to 8.39).

(ii) High fecundity; twins are very common, while triplets and quadruplets are not unusual (Table 8.3).

The formation of this well-known breed was presumably under the influence of the above-mentioned ecological conditions, and the specific ways of feeding and management, together with continuous selection through generations.

8.2.4 Performance data

Performance data for native sheep breeds are in Tables 8.4, 8.5 and 8.6.

Table 8.3 FECUNDITY* OF SMALL-TAIL HAN AND HU SHEEP

Lambs per ewe lambed	Small-tail Han		Hu**	
	No.of ewes lambed	(%)	No.of ewes lambed	(%)
Singles	48	11.1	26,281	17.4
Twins	243	56.4	93,836	62.0
Triplets	109	25.3	26,668	17.6
Quadruplets	28	6.5	4,589	3.0
Quintuplets	3	0.7	89	0.1
Total	431	100	151,463	100
Fecundity	229.1%		207.5%	

* For notation concerning reproduction see page 216

Sources: ** 6, 10

Table 8.4 FECUNDITY OF VARIOUS SHEEP BREEDS

Breeds	Number of ewes lambed	Fecundity (%)
Mongolian	n.a.	105
Ujumqin	3,467	100
Kazakh	7,177	102
Altay	3,999	103
Tibetan	n.a.	103
Han: Large-tail	65	163 (192)*
Small-tail	431	229 (270)*
Tong	n.a.	100
Hu	151,463**	208**

Sources: * 2; ** 10; remainder unpublished figures from various sources

Table 8.5 WOOL PRODUCTION OF SHEEP BREEDS

Breeds	Greasy wool weight (kg) Rams	Ewes	Fibre length (cm)		Types of fibre* True wool	Hetero-type	Hair	Kemp
Mongolian**	1.5	1.2	7-8	W (%)	75.6	8.2	4.8	11.4
				D (μm)	22.1	39.7	73.2	134.7
Ujumqin**	1.9	1.4	7.5-8	W (%)	53.0	0	1.7	45.3
				D (μm)	31.6	-	12.5	55.9
Kazakh**								
(Spring)	1.5	1.3	8-18	W	n.a.			
(Autumn)	1.0	0.8	n.a.	D	n.a.			
Tibetan***								
Plateau	1.5	n.a.	8.5-11.3	W (%)	73-86	8.1-9.8	4.7-17	0
Yarlung Zangbo	1.4	0.7	6-9	W (%)	90-95	5.1-6.8	0-4.6	0
Sanjiang	1.5	0.5	4-19	W (%)	60-75	2.5	24-40	0
Tan≠								
(Spring)	1.0-1.4	0.5-1.4	15	(W (%)	37.1	43.3	19.6	0
(Autumn)	0.6-1.2	0.2-0.6		(D (μm)	19.4	33.8	44.8	-
Han≠≠								
Large-tail	0.6-1.2	0.2-0.6	n.a.	W (%)	97.2	1.4	1.4	0
				D (μm)	14.5	34.6	57.4	-
Small-tail	2.0	1.3		W	n.a.			
				D	n.a.			
Tong	1.4	1.2		D (μm)	-	21.4	23.2	
Hu	2.0	1.2	5-7	W	n.a.			
				D	n.a.			

* Heterotype - with interrupted medulla; hair - with large continuous medulla; kemp - shed medullated fibre; W = weight; D = diameter

Sources: ** 9; *** 8: ≠ 4; ≠≠ 1

Table 8.6 MEAT PRODUCTION OF SHEEP BREEDS

Breeds	Sex	Liveweight (kg)	Dressing Percentage (%)	Tail and visceral fat (%)
Mongolian	M	73.0	51.4	8.3
	F	39.5	46.5	1.8
	W*	51.5	55.1	3.4
Ujumqin	F	50.0	51.5	n.a.
	W	73.0	51.4	8.3
Altay	M	63.8	51.5	1.9
	W	81.8	50.4	8.0
Tibetan	F	56.5	48.3	1.7
	W	65.0	54.0	2.7
Tan	F	39.7	39.6	1.5
	W	38.9	44.6	1.4
Han: Large-tail	n.a.	40.7	51.3	3.7
Small-tail	n.a.	32.4	50.7	1.3
Tong	M	39.6	47.1	-
	F	37.1	41.7	-
Hu	n.a.	31.1	45.2	-

* W = wether
Source: 9

8.3 CROSSBREEDING

8.3.1 Improvement of wool production

Improvement of sheep in China by crossing exotic over native breeds has made rapid progress, with reasonably good results. The average fleece weight of improved (crossbred) fine-wool and medium-fine-wool sheep is two to three times heavier than that of native coarse-wool sheep. There is also an improvement in wool quality (Table 8.7).

Table 8.7 IMPROVEMENT OF WOOL QUALITY IN F_1 FROM MERINO x INDIGENOUS EWES

Breeds	Wool quality							Fleece weight (kg)
	Types (% by weight)				Fineness(μm)			
	True wool	Hetero-type	Hair	Kemp	True wool	Hetero-type	Hair	
Mongolian*	48.6	2.2	49.2	0	26.2	37.9	109.5	1.1
Merino x Mongolian (F_1)	91.1	8.5	0.3	0	18.9	40.7	52.2	2.2
Tibetan** (Grassland)	43.5	15.4	31.2	9.9	26.2	66.6	n.a.	1.5
Merino x Tibetan (F_1)	n.a.	n.a.	n.a.	n.a.	27.7	40.8	n.a.	2.5
Kazakh	41.7	13.8	21.3	23.2	26.3	39.6	41.9	1.4
Merino x Kazakh (F_1)	84.1	10.6	4.4	0.9	21.9	34.6	49.7	2.4

Sources: *9, **11

8.3.2 New Sheep Breeds

The new sheep breeds established in China all result from crossbreeding and continuous rigorous selection for years. Three fine-wool breeds have been approved by the Government: Xinjiang Fine-wool, Northeast Fine-wool and Gansu Alpine Fine-wool (Table 8.8).

Table 8.8

NEW FINE-WOOL SHEEP BREEDS

Breeds	Liveweight after shearing Adults (kg)	Liveweight after shearing Y/lings (kg)	Number	Wool production: Greasy fleece weight (kg)	Wool production: Clean fleece weight (kg)	Wool production: Clean yield (%)	Wool production: Staple length (cm)	Wool production: Fineness	Meat production: Liveweight (kg)	Meat production: Dressing percentage (%)	Fecundity (%)
Xinjiang Fine-wool*											
M	86.1	43.5	13	12.4	5.7	46.0	10.8)	60-64's(20-25μm)	82.5)	47.6	
F	52.3	33.2	978	5.9	3.0	50.8	8.4)		60-65)		130
Northeast Fine-wool**											
M	81.8	44.6	166	14.1)	n.a.	32-37	9.1)	60-64's(20-25μm)	99.3)	48.0	
F	45.0	33.1	13,222	5.7)	n.a.		7.0)		52.7)		124
Gansu Alpine Fine-wool***											
M	84.8	n.a.	n.a.	9.4)	n.a.	39.2	8.8)	60-64's(20-25μm)	n.a.)	46.0	
F	43.5	n.a.	n.a.	4.6)	n.a.		7.9)		n.a.)		113

Sources: * 7; ** 5; ***3

Xinjiang Fine-wool (Plates 8.40 and 8.41). The wool is of 60-64's quality (20 - 25μm average fibre diameter), the average greasy fleece weight for ewes being 5.9 kg, with a clean yield of 47 to 54 percent.

Northeast Fine-wool (Plates 8.42 and 8.43). The wool is of 60-64's quality (20 - 25μm), the average greasy fleece weight for ewes being 5.7 kg. However, the clean yield is very low (32 to 37 percent).

Gansu Alpine Fine-wool (Reference 3 - Plates 8.44 and 8.45). This new breed was developed in the Huangchen District of Gansu Province, by crossing Mongolian or Tibetan with Xinjiang Fine-wool and then with some fine-wool breeds from USSR, such as Caucasian and Salsk. The Huangchen District is located in the pastoral area of the Qilian Mountains, about 37.5°N and 101°-130°E. It is high and cold, with an altitude of 2,600 to 4,000 m, an annual mean temperature 0° to 3.8°C (extreme lowest temperature -30°C), an annual precipitation of 257 to 461 mm, and an average humidity 35 to 58 percent. The sheep are well adapted to this particular ecological condition. The average weight of greasy wool in ewes is about 4.6 kg, and the wool quality is 60 - 64's (20 - 25μm). This new breed has been approved by the Gansu Provincial Government.

8.4 REFERENCES

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MONGOLIAN SHEEP
Inner Mongolia

Plate 8.1 Ram

Plate 8.2 Ewe

KAZAKH SHEEP
Xinjiang

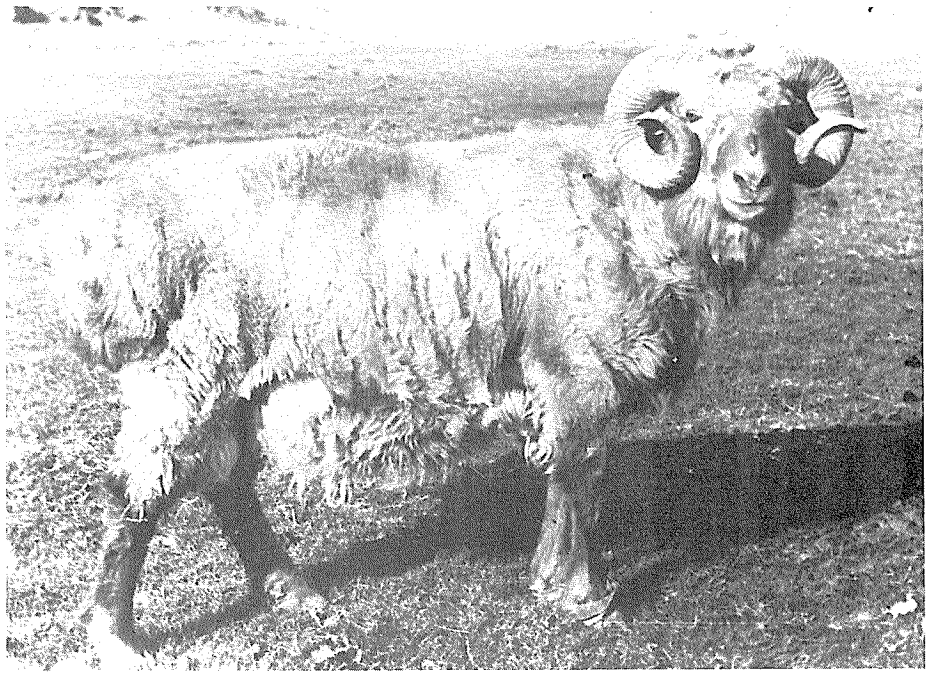

Plate 8.3 Ram

Plate 8.4 Ewe

TIBETAN SHEEP
Qinghai-Tibet Plateau

Plate 8.5 Ram

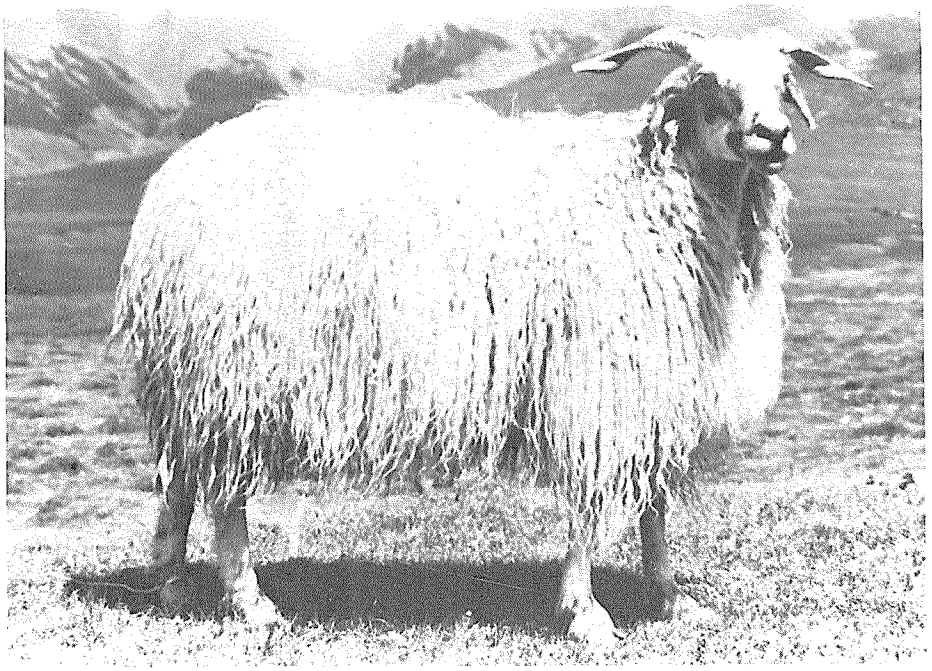

Plate 8.6 Ewe

WHITE TIBETAN SHEEP
Qinghai Province

Plate 8.7 Ram

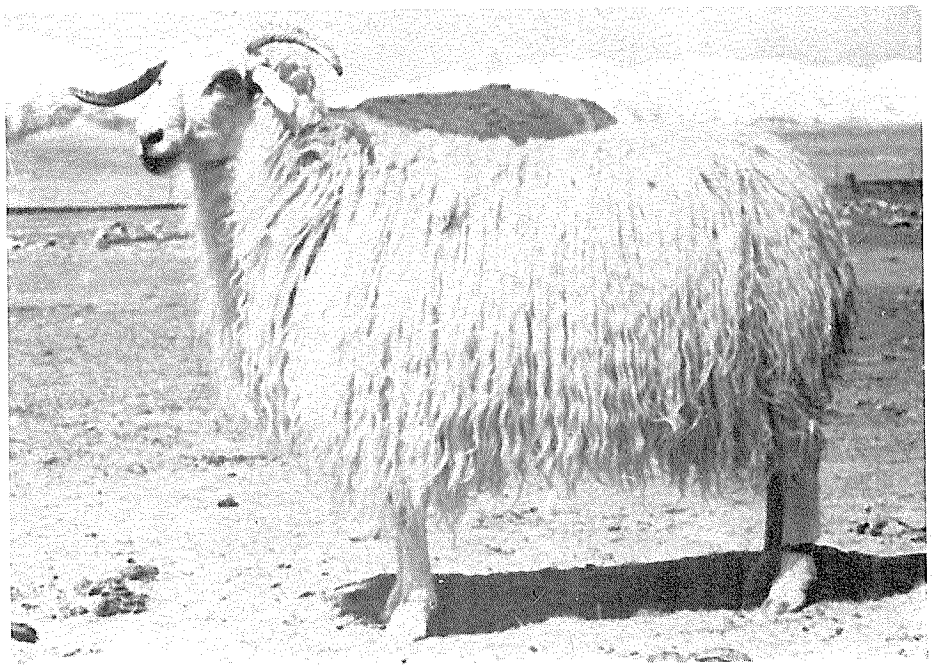

Plate 8.8 Ewe

UJUMQIN SHEEP (a type of Mongolian)
Inner Mongolia

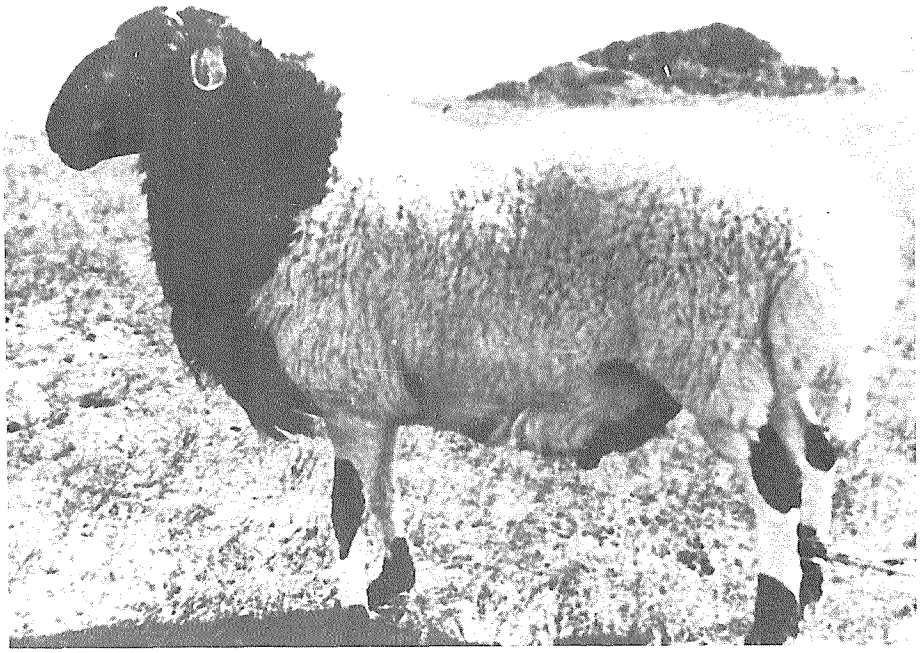

Plate 8.9 Ram

Plate 8.10 Ewe

UJUMQIN SHEEP - Tail Shapes
Inner Mongolia

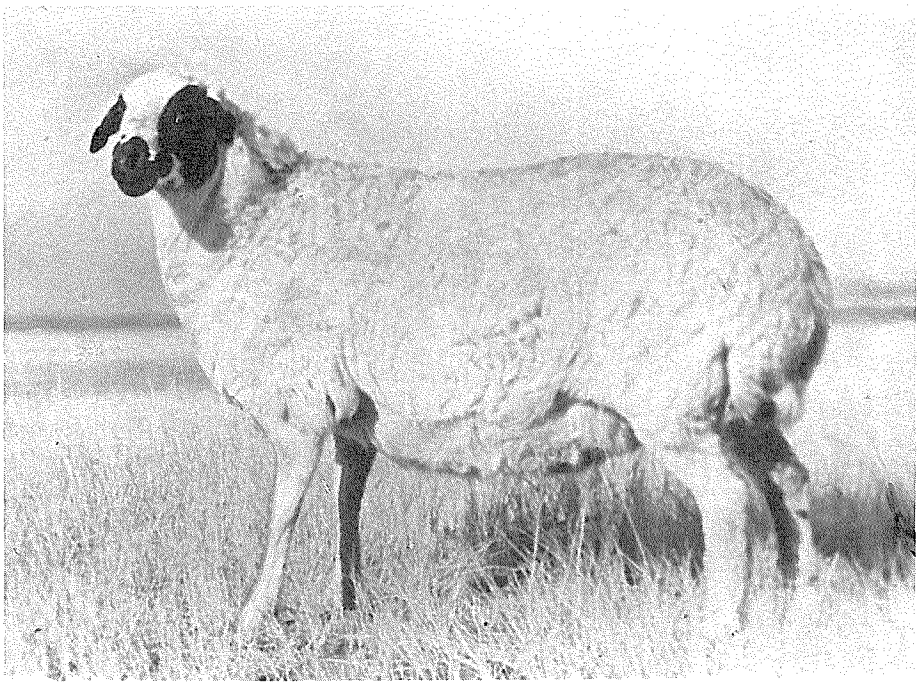

Plate 8.11 Ewe - Tail shape - Side view

Plate 8.12 Ewe - Tail shape - Back view

ALTAY FAT-RUMP SHEEP
North Xinjiang

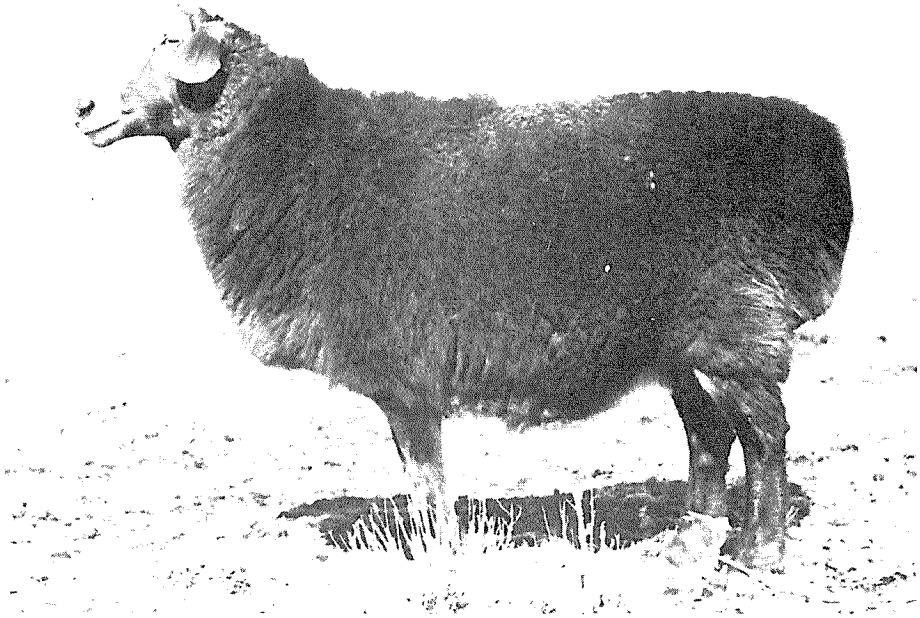

Plate 8.13 Ram

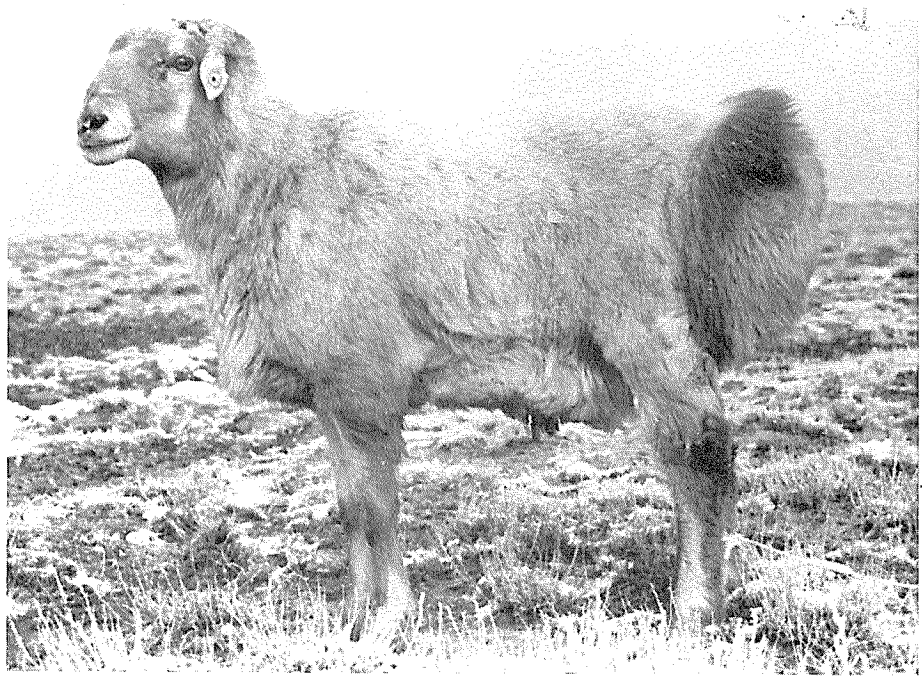

Plate 8.14 Ewe

ALTAY FAT-RUMP SHEEP
North Xinjiang

Plate 8.15 Sheep on pasture

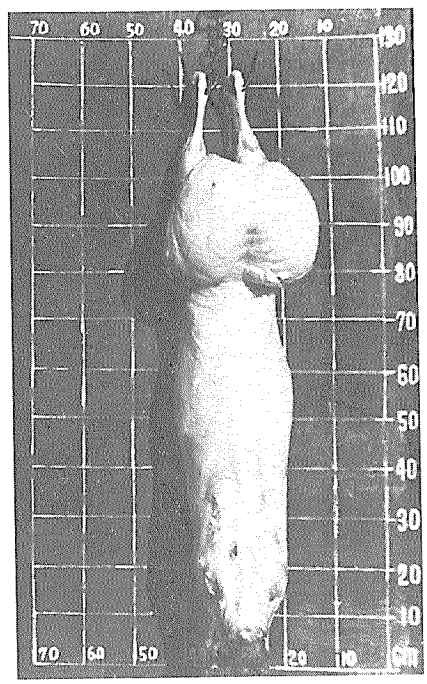

Plate 8.16 Carcase (showing fat rump - scale in cm)

TAN SHEEP
Ningxia

Plate 8.17 Ram

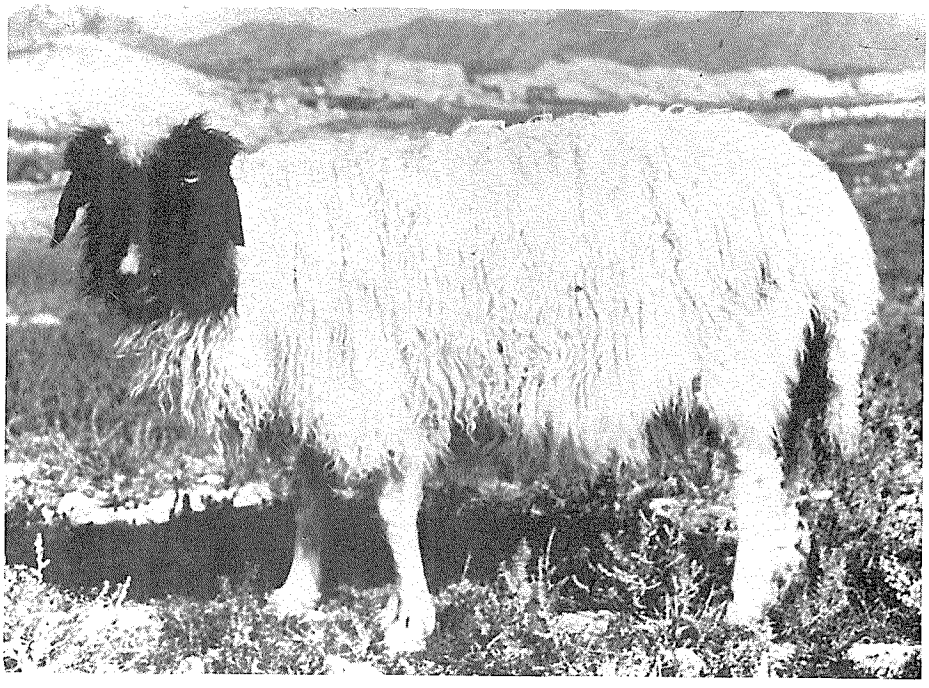

Plate 8.18 Ewe

TAN SHEEP
Ningxia

Plate 8.19 Lamb

Plate 8.20 Flock of lambs

LARGE-TAIL HAN SHEEP
East Henan and West Shandong Provinces

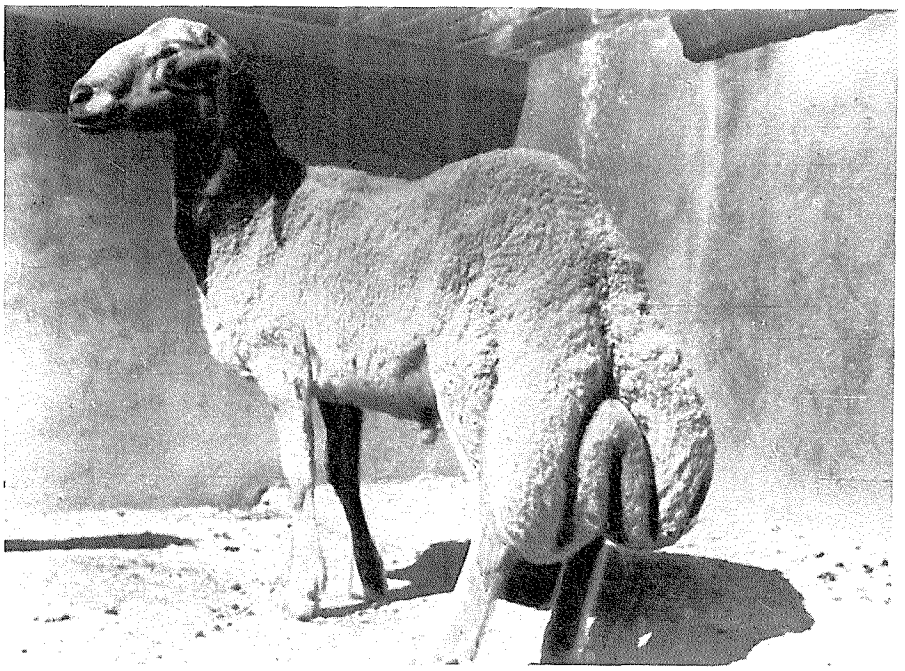

Plate 8.21 Ram

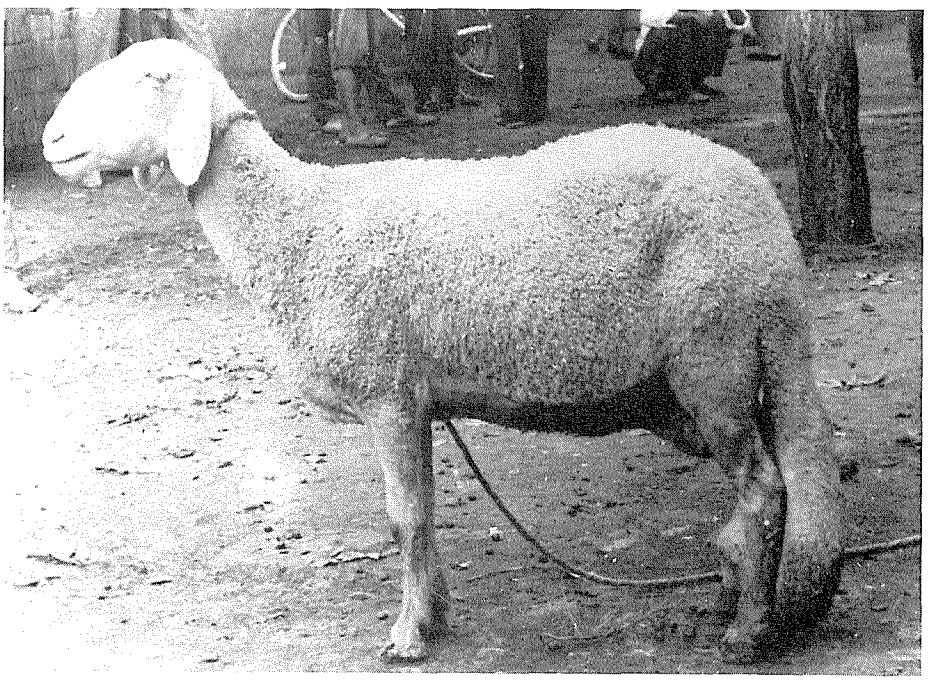

Plate 8.22 Ewe

LARGE-TAIL HAN SHEEP
East Henan and West Shandong Provinces

Plate 8.23 Tail shape (1)

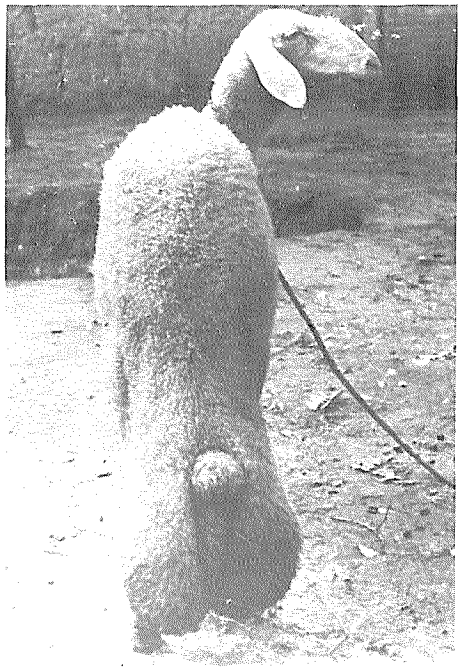

Plate 8.24 Tail shape (2)

Plate 8.25 Sheep on pasture

SMALL-TAIL HAN SHEEP
East Henan and West Shandong Provinces

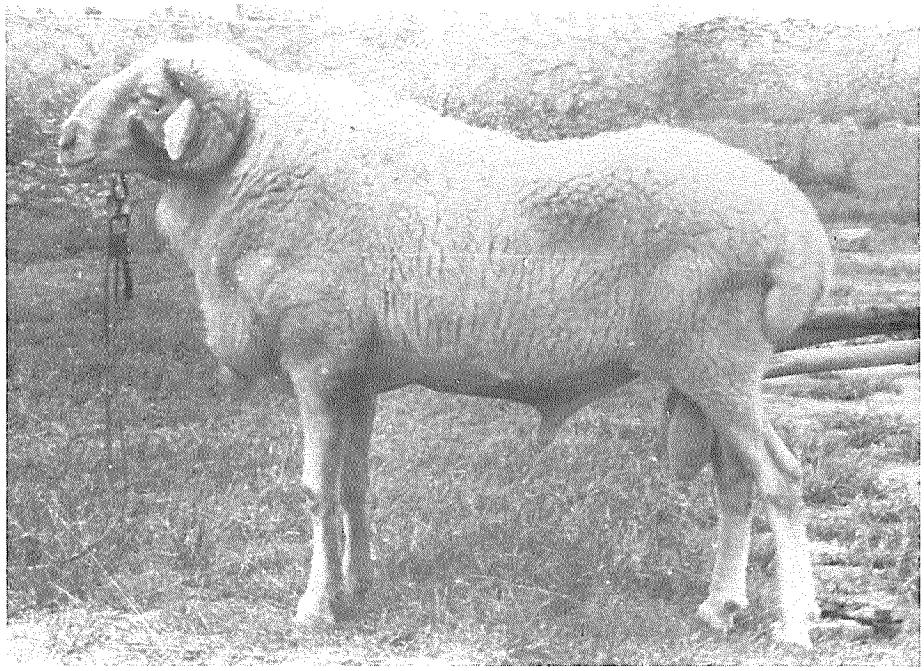

Plate 8.26 Ram

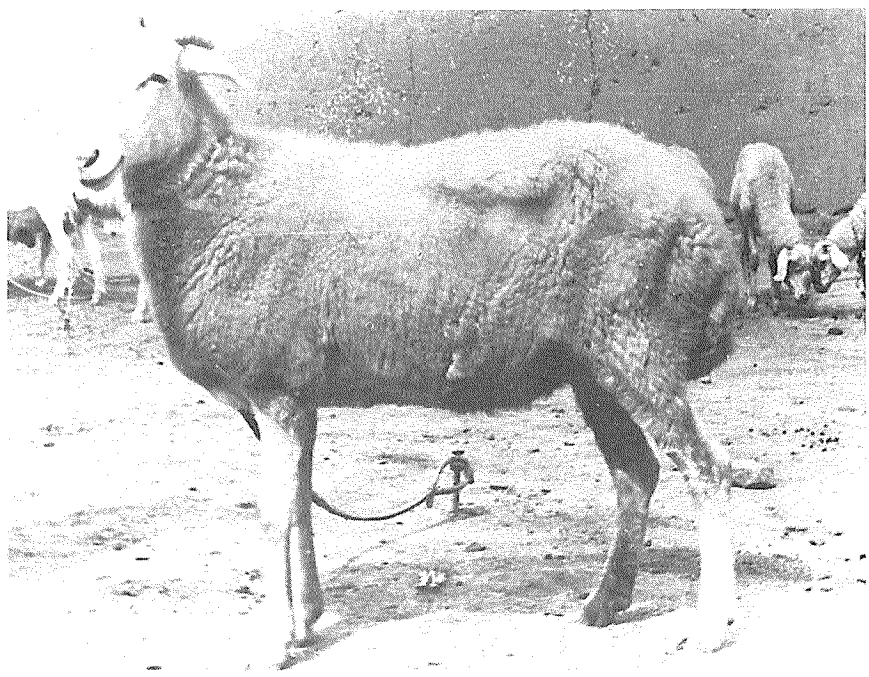

Plate 8.27 Ewe

TONG SHEEP
Shaanxi Province

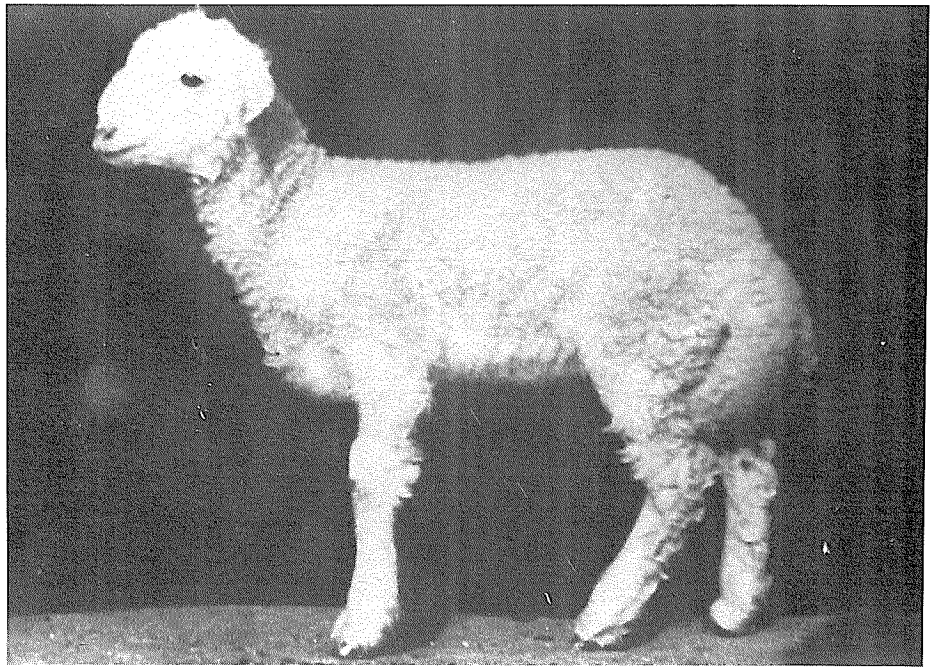

Plate 8.28 Lamb

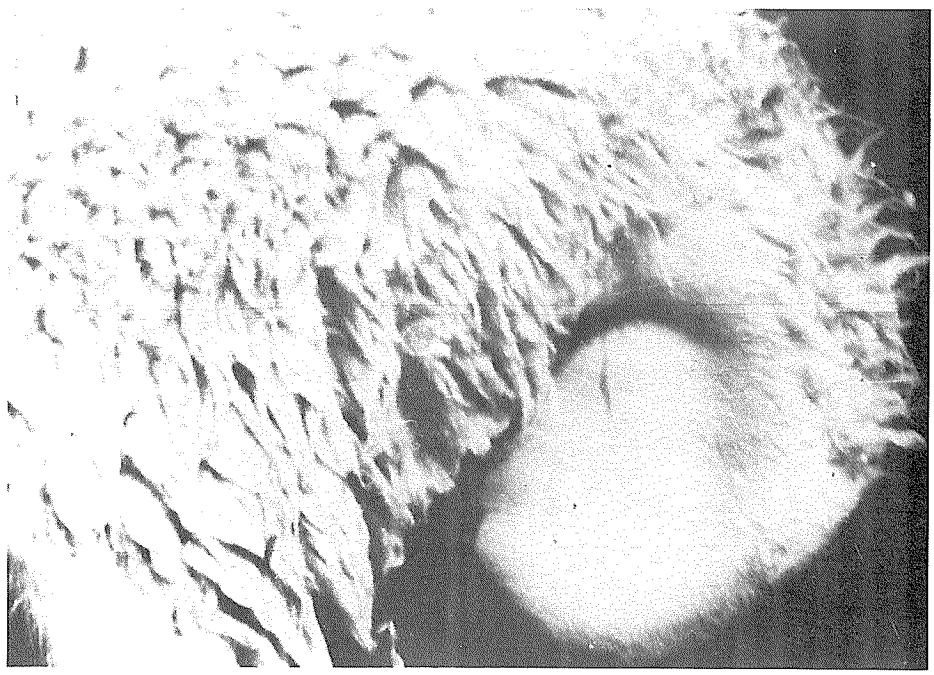

Plate 8.29 Tail shape

HU SHEEP
Taihu Lake Area, Jiangsu and Zhejiang Provinces

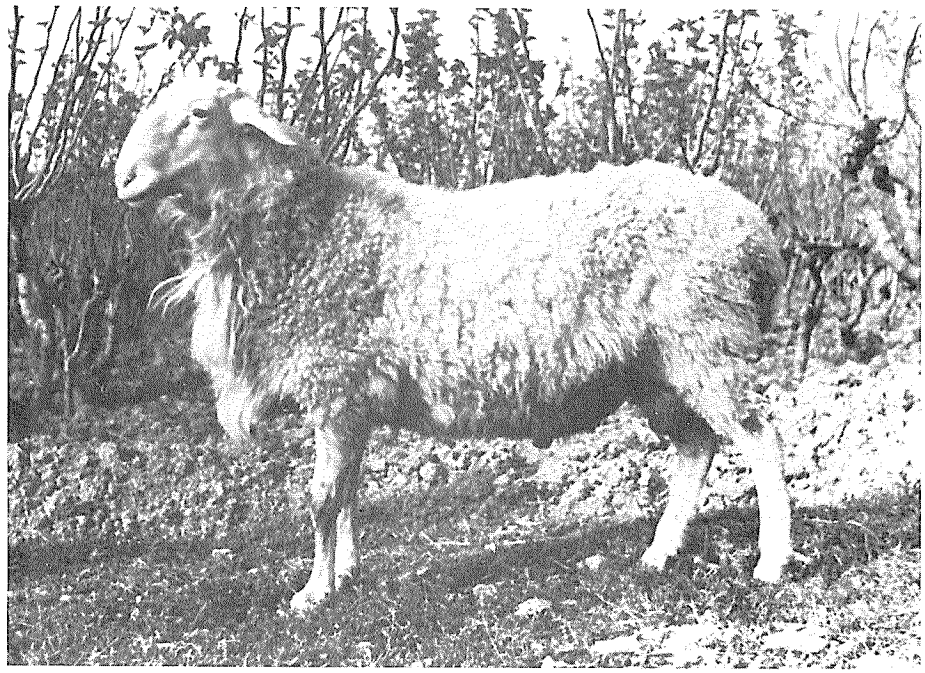

Plate 8.30 Ram

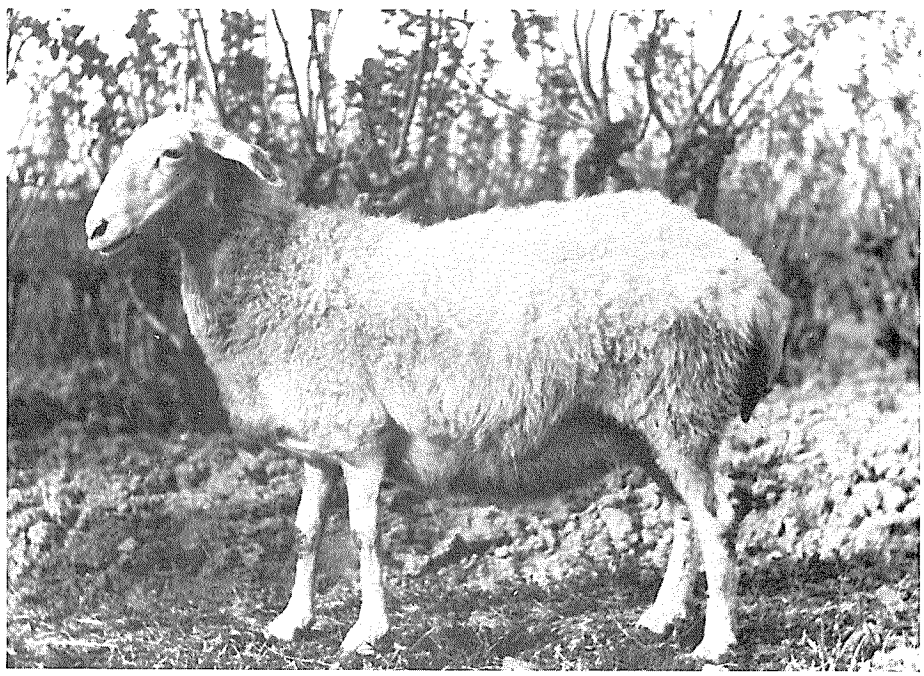

Plate 8.31 Ewe

HU SHEEP - Tail shape
Taihu Lake Area, Jiangsu and Zhejiang Provinces

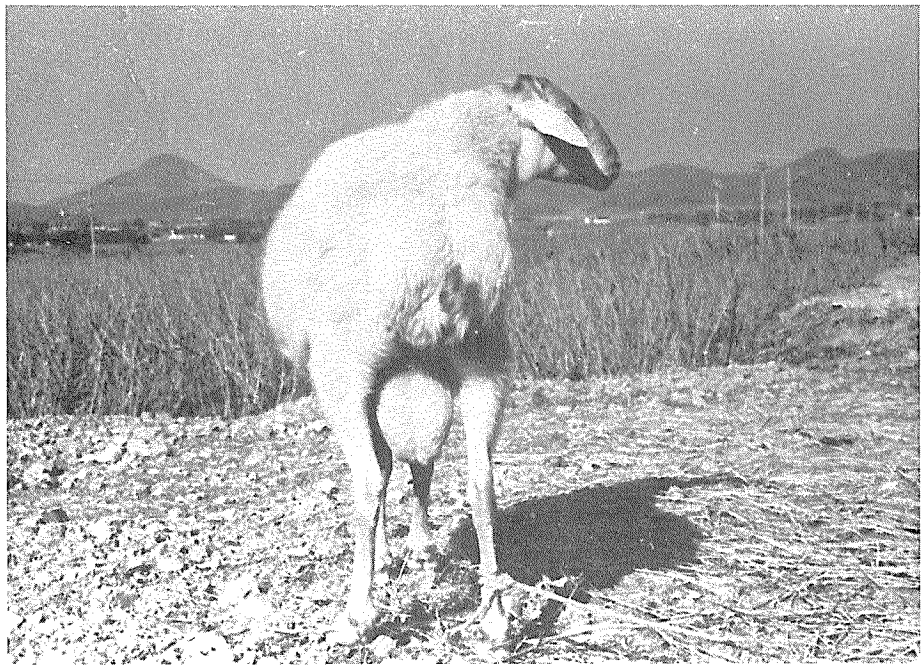

Plate 8.32 Ram

Plate 8.33 Ewe

BACKGROUNDS FOR HU SHEEP
De Qing Hu Sheep Farm, De Qing County, Zhejiang Province

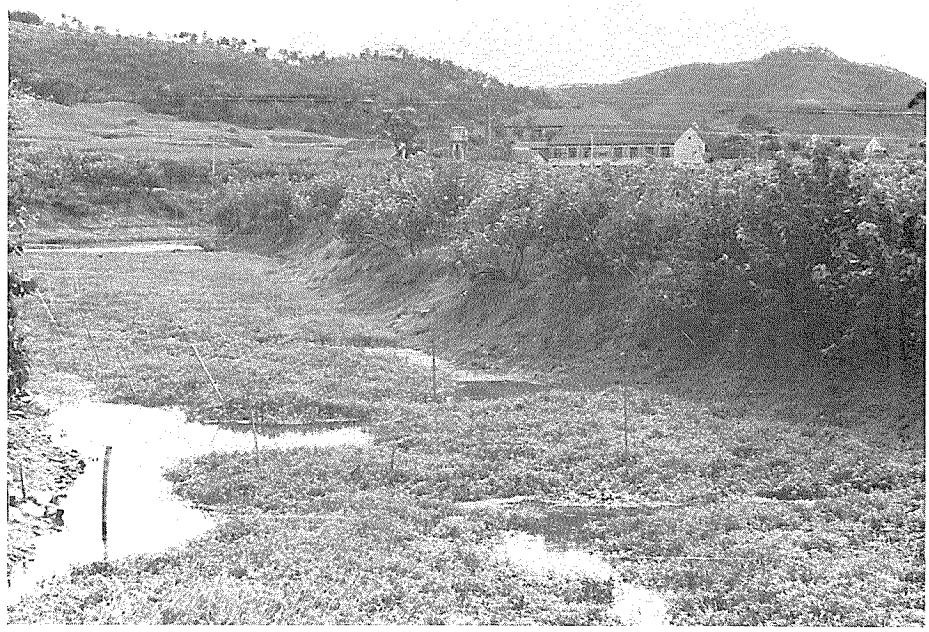

Plate 8.34 Mulberry field

Plate 8.35 Mulberry field and river

HU SHEEP
Taihu Lake Area, Jiangsu and Zhejiang Provinces

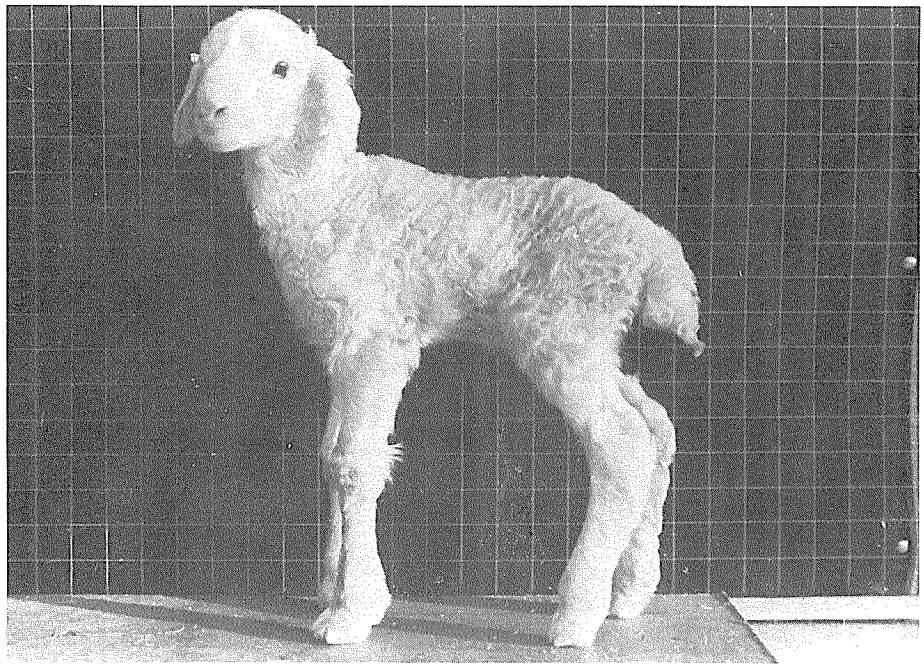

Plate 8.36 New-born lamb (Each square is 3 cm x 3 cm)

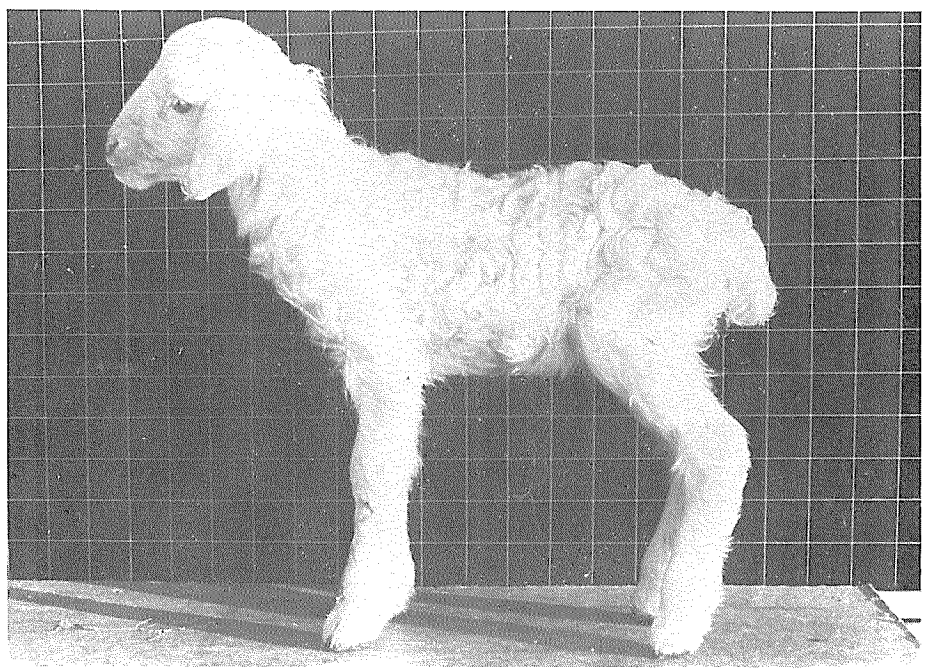

Plate 8.37 New born lamb: Quadruplet (Each square is 3 cm x 3 cm)

PATTERNS OF HU LAMBSKINS

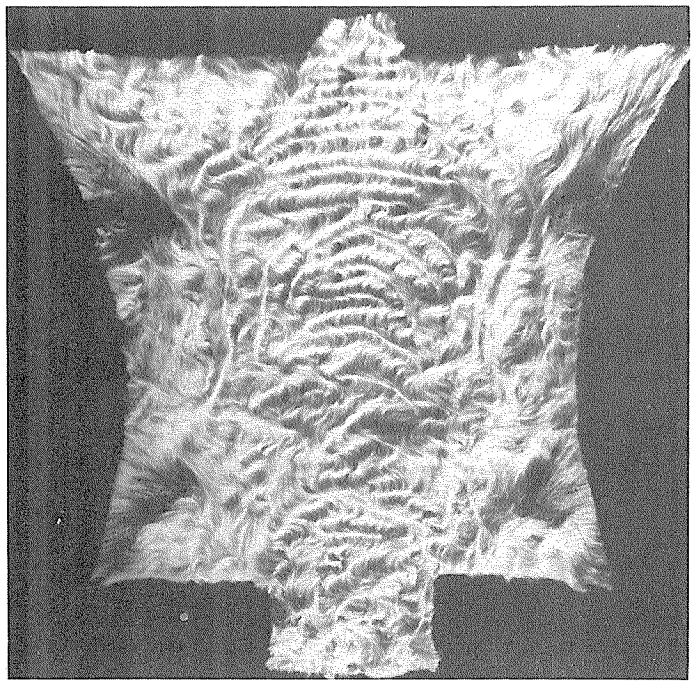

Plate 8.38 Lambskin (1)

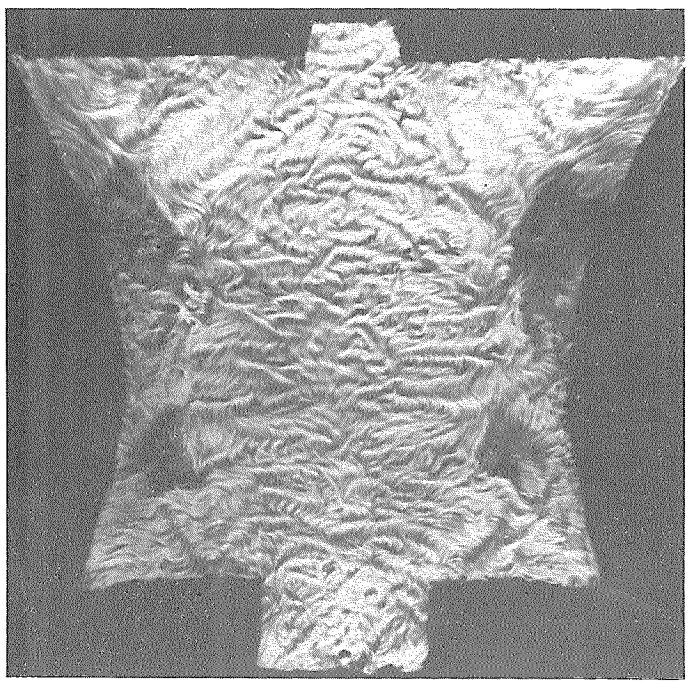

Plate 8.39 Lambskin (2)

XINJIANG FINE-WOOL SHEEP
Northeast Xinjiang

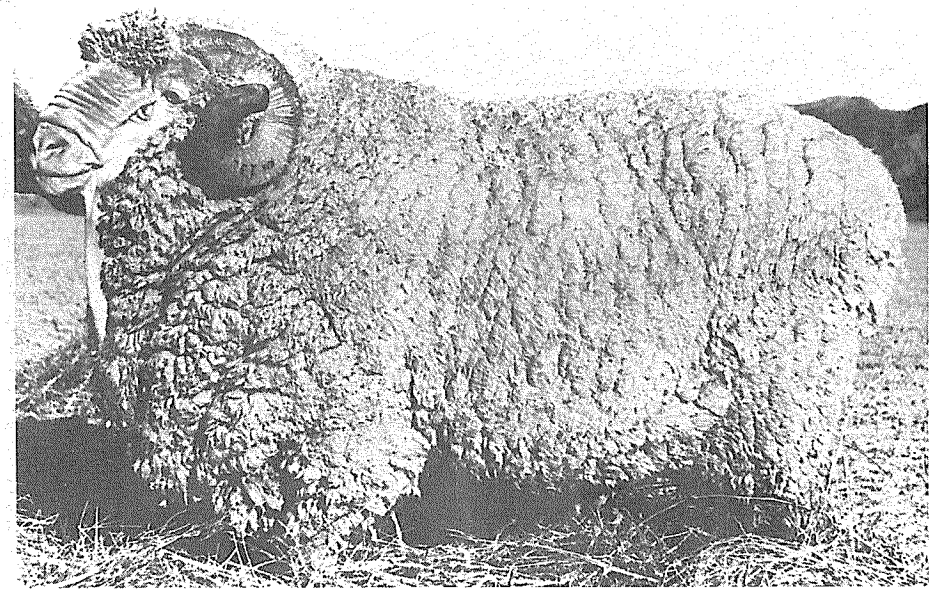

Plate 8.40 Ram

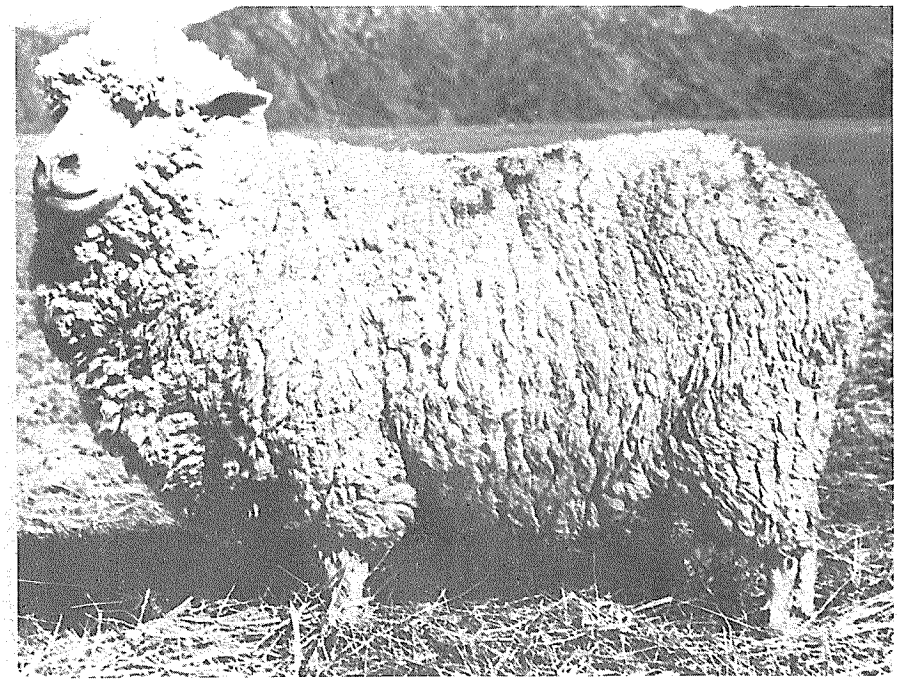

Plate 8.41 Ewe

NORTHEAST FINE-WOOL
Liaoning, Jilin and Heilongjiang Provinces

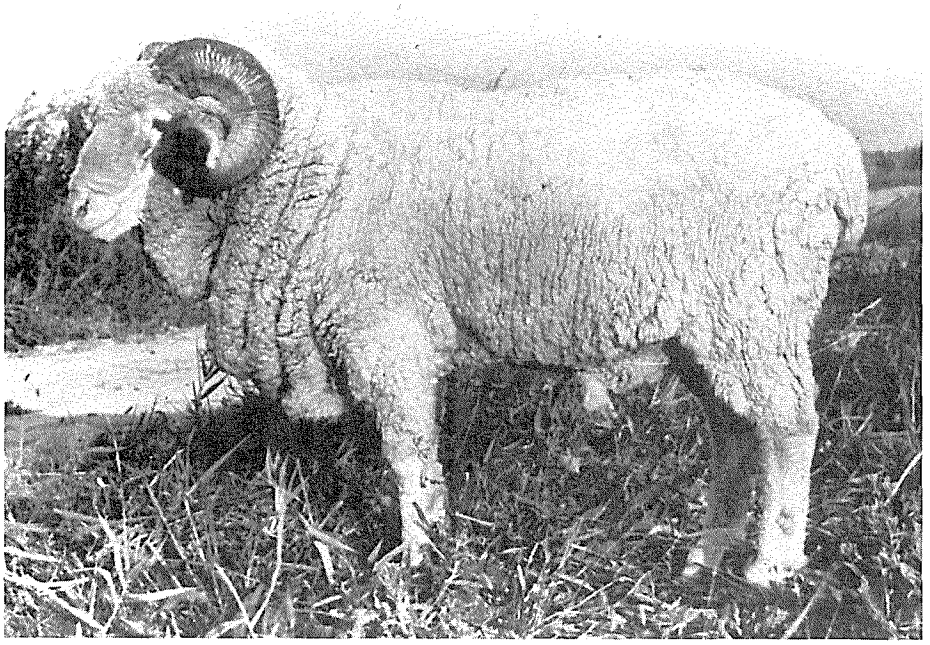

Plate 8.42 Ram

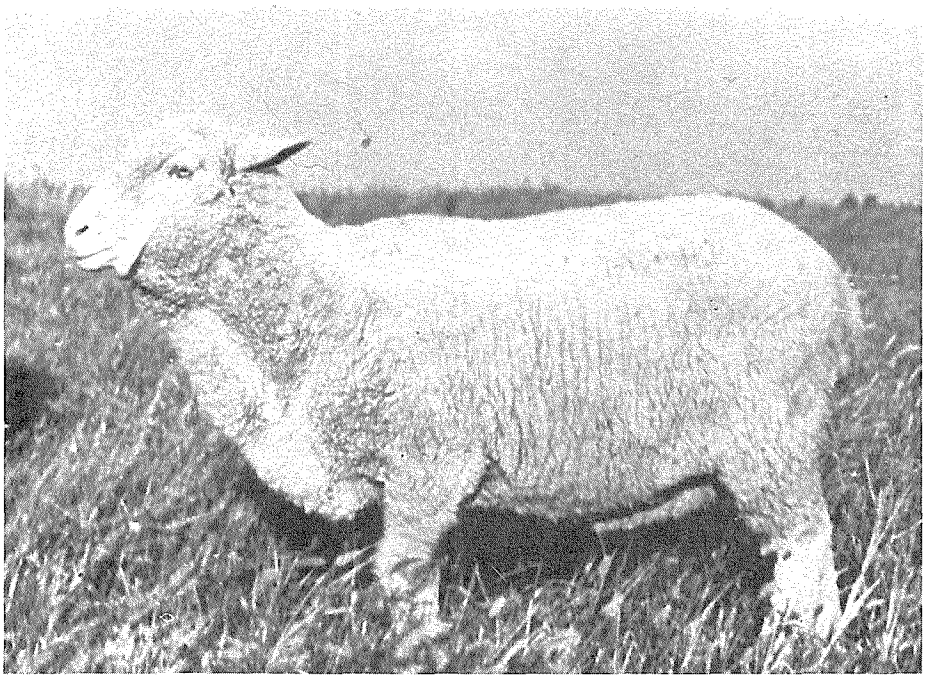

Plate 8.43 Ewe

GANSU ALPINE FINE-WOOL
Huangcheng, Gansu Province

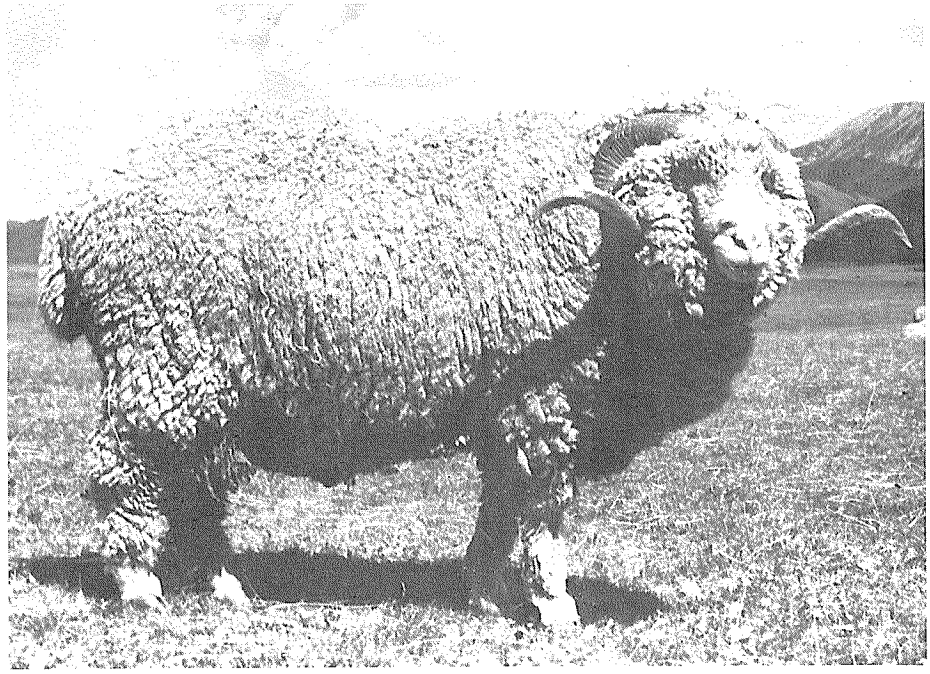

Plate 8.44 Ram

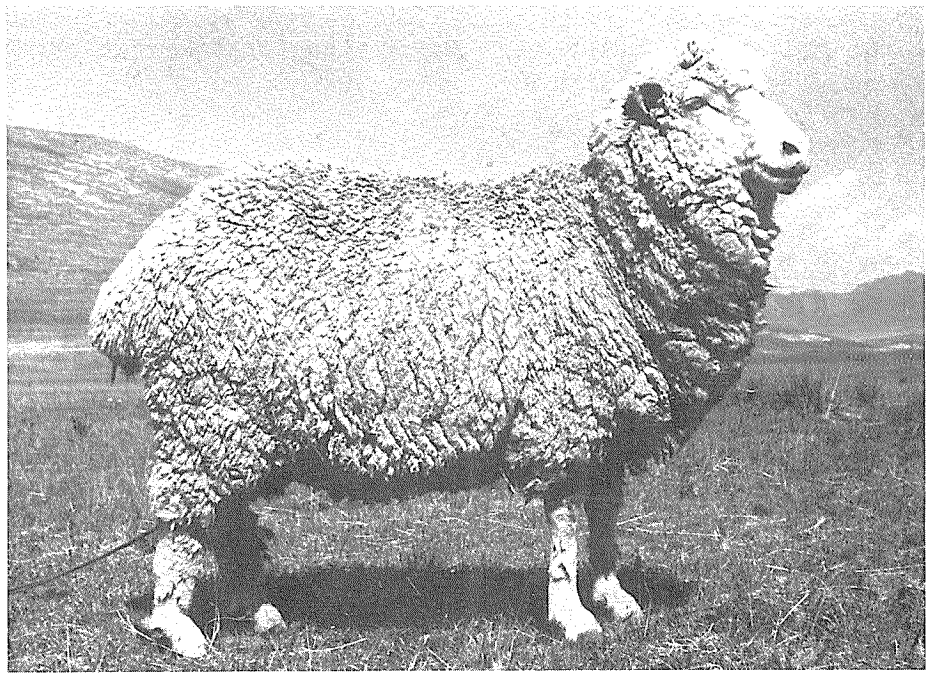

Plate 8.45 Ewe

CHAPTER 9

GOAT BREEDS*

9.1 NUMBER, DISTRIBUTION AND USES

The population of goats in China at the end of 1982 was 75.2 million (Table 1.1), higher than in any other country. They are widely distributed, 61.3 percent of the total being in the agricultural area, 23.5 percent in the pastoral, and 15.2 percent in the mixed pastoral-agricultural. There are many native goats; sixteen breeds (or types) will be taken as illustration.

The distribution of numbers and breeds of goats is shown in Figure 9.1. They are located in different climatic belts (Temperate, Subtropic and Tropic), at different altitudes (mountains, hills and plains) and in areas of different vegetation types. However, they are remarkably adaptable to unfavourable climatic and topographic conditions.

Goats in China may be grouped into six types according to their main uses, namely: (a) common native, (b) cashmere, (c) fur-pelt, (d) kid-pelt, (e) meat and skin and (f) milk goats. The common native goats are multi-purposed and low in productivity; others are more or less specialized for providing the products indicated by their names, as well as for goat-skin, noted for quantity or quality.

9.2 GOATS OF SPECIFIC REGIONS

China may be divided into the following five regions on the basis of ecological conditions for goats, each with its specific breeds: North Pastoral, Qinghai-Tibet Plateau, Mixed Pastoral-Agricultural, North Agricultural and South Agricultural.

9.2.1 North Pastoral

Examples of breeds in this region follow.

Mongolian (Plate 9.1) are distributed in the steppes of arid areas, including the Inner Mongolia Autonomous Region, south of the Ningxia Hui Autonomous Region, Gansu and Shanxi Provinces, as well as the plains and basins of the Qinghai-Tibet Plateau.

Xinjiang (Plate 9.2) are mainly distributed in the Altay, Tianshan and Kunlun Mountains of the Xinjiang Uygur Autonomous Region.

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* The author is greatly indebted to Professor Jiang Ying of the Department of Animal Science, Beijing Agricultural University, for his kind co-operation in contributing this chapter on Goat Breeds, in Chinese. It was edited and translated into English by Cheng, P.L.

Goats in the North Pastoral Region possess the following characteristics in common:

(i) They graze on pasture all year round without supplementary feeding, even in the severe winter and spring. They are well adapted to the unfavourable ecological conditions of steep mountains or poor vegetation.

(ii) They have remarkable ability to store fat (about 3 kg) around kidneys and mesentery, for winter and spring consumption.

9.2.2 Qinghai-Tibet Plateau

Tibetan goats, taken as an example, are mainly distributed in the high, cold steppes and pastures of the Qinghai-Tibet Plateau, north and west of Sichuan Province (the Aba and Ganze Tibetan Autonomous Prefectures), and also in the basins and valleys of the southern Qinghai-Tibet Plateau at an altitude of 4,500 m. They are small in body size, but produce quality cashmere as well as meat, milk, goat-skin or fur-pelts.

9.2.3 Mixed Pastoral-Agricultural Areas

The famous Zhongwei goats (Plates 9.3 and 9.4) are produced only in the arid desert steppes of some counties in the Ningxia Hui Autonomous Region and Gansu Province. They live chiefly, if not solely, on salty or sandy plants or shrubs. The kids (Plate 9.5) are killed and skinned at 35 days old for their fur-pelts, which have white, lustrous staples and attractive curls (Plate 9.6). Tan sheep are raised under the same ecological conditions, and are also noted for their famous lamb-pelts (Chapter 8).

9.2.4 North Agricultural

Examples of goat breeds in this region follow.

The Liaoning Cashmere (Plates 9.7 and 9.8) of Liaoning Province is noted for high cashmere production.

The Chengde Polled and the Wuan, of Hebei Province, both produce cashmere and meat, while the Guanzhong White (Shaanxi) produces meat.

The Jining Grey (Plates 9.9 and 9.10) of Shandong Province, is noted for the attractive wavy patterns of its kid-pelt, which is the traditional commodity in international markets. Does raised in temperate areas and with abundant feed are early in sexual maturity (3-4 months), and may give two kiddings a year, or three kiddings in two years. They are very prolific, with a fecundity of 293.7 percent (about 3 kids per kidding - Table 9.6).

Two other common goat breeds of this region are the Huaipi (Henan) and the Fuyang (Anhui).

9.2.5 South Agricultural

This region includes the Subtropic and Tropic Belts, with complex topography. However, the climate is mild (or warm) and humid, with abundant green feed all year round. Examples of breeds are:

The Matou (horse head - Plates 9.11 and 9.12) of Hubei and Hunan Provinces, which is of meat type (Table 9.3), with rapid growth, heavy liveweight and ease of fattening. It also has early sexual maturity, and may kid twice a year, with a fecundity of 196 percent per kidding (Table 9.6).

The Chengdu Grey of Sichuan Province, which produces not only meat and pelts, but also milk. It has early sexual maturity and is highly prolific, with an average fecundity of 215 percent (Table 9.6).

The Leizhou of Guangdong Province, and the Duan of the Guangxi Zhuang Autonomous Region, which are noted for their meat quality. The Leizhou, located in the North Tropic Belt, is also early in sexual maturity, and very prolific, with an average fecundity of 203 percent (Table 9.6). Another meat breed of the region is the Guizhou White, which matures later and is not as prolific as the Leizhou.

Goat populations are also high in the Yunnan-Guizhou Plateau, as well as in some mountainous areas of Sichuan Province; in spite of the high altitude (above 1,000 m), the climate is mild and humid (annual mean temperature 13° to 17°C, annual precipitation 1,000 mm). There are high mountains and deep valleys. Goats under such ecological conditions are all small in body size, with short hair and no cashmere underneath, due to the high air temperature and high humidity.

Goats in the South Agricultural Region are characterized by early sexual maturity (at 3-6 months old). Does can be mated all year round, usually with two kiddings a year, and are prolific, with an average fecundity (per kidding) of about 200 percent (Table 9.6).

Goat hair produced in certain areas (such as Jiangsu and Zhejiang Provinces) is considered the choicest material for making Chinese hair-pens, used for writing or drawing.

9.3 ECOLOGICAL CONDITIONS AND PERFORMANCE

Data on ecological conditions and performance of the 16 native goat breeds are summarized in Tables 9.1 to 9.6.

Table 9.1 LOCAL NATURAL CONDITIONS - GOAT BREEDS

Regions, breeds and types		Climate and topography	Altitude (m)	Temperature* Annual mean (°C)	Lowest (°C)	Highest (°C)	Annual Precip-itation* (mm)	Relative humid-ity* (%)
North Pastoral:								
Mongolian	(a) **	Dry, cold Highlands & hills	1,288	4.5	-33.4	37.0	220	48
Xinjiang	(a)	Dry, cold Mt. & plain	738	10.0	-43.4	43.9	79	40
Qinghai-Tibet Plateau:								
Tibetan	(a)	Semi-arid, cold Plateau	4,430	2.4	-25.0	22.5	350	44
Mixed Pastoral-Agricultural Areas:								
Zhongwei	(c)	Arid Desert Steppe	1,300-2,000	8.3	-29.0	35.9	190	55
North Agricultural:								
Liaoning Cashmere	(b)	Humid Plains and hills	1,120	7.5	-30.9	37.0	700-900	60
Chengde Polled	(a)	Humid Mountains	500-1,600	7.9	-29.9	37.9	500-726	54
Wuan	(a)	Humid Mountains	850-1,400	12.9	-21.0	37.0	600	69
Jining	(d)	Mild & humid Plains	46-54	13.6	-20.4	42.0	706	69
Huaipi	(e)	Mild & humid Mts. & plains	42-52	14.6	-17.0	42.0	742	70
Fuyang	(e)	Mild & humid Mountains	17-42	14-15	-20.0	41.8	100-800	73
Guanzhong White	(e)	Mild Hills & mts.	2,000	11-14	-18.0	40.8	701	79
South Agricultural:								
Matou	(e)	Mild Mountains	1,000	16.5	-11.5	39.2	800-1,600	75-80
Chengdu Grey	(e)	Mild Basin & hills	16	16.5	- 5.0	37.1	952	83
Guizhou White	(e)	Humid Hills & mts.	400-800	17-21	- 6.5	42.5	1,100	79
Leizhou	(e)	Warm & humid Hills	26	23.1	2.8	37.9	1,488	83
Duan	(e)	Humid Stony mts.	900-1,000	21.3	n.a.	n.a.	1,738	90

* Ten year averages of local or neighbouring weather stations

** a = common; b = cashmere; c = fur-pelt; d = kid-pelt; e = meat and skin; for f = milk see Table 9.7

Table 9.2 EXTERNAL FEATURES AND BODY MEASUREMENTS OF GOAT BREEDS

Breed	Main external features (Cashmere - see Table 9.4)	Sex	Body measurements Height (cm)	Length (cm)	Liveweight (kg)
Mongolian	All horned; with forelock, white hair, large body	M	65.8	73.8	53.7
		F	55.7	61.9	37.7
Xinjiang	All horned; white, black, brown in hair coat	M	67.3	71.7	58.4
		F	61.6	62.9	36.9
Tibetan	All horned; majority with white hair coat	M	56.5*	66.5*	36.5*
		F	52.5*	59.0*	23.5*
Zhongwei	All horned, buck's horns stretching upward, and twisted; white hair coat	M	61.4	67.7	39.0
		F	56.7	59.2	24.5
Liaoning Cashmere	All horned, buck's horns stretching laterally; white hair, large body	M	63.6	75.7	51.7
		F	60.8	72.8	44.9
Wuan	All horned, erect; black head, grey body; large body	M	63.3	69.6	51.0
		F	56.7	62.2	38.0
Jining	All horned, with forelock; black, white or black & white; hair length 8-15cm; small body	M	60.3	60.1	33.2*
		F	48.2	54.0	25.4*
Fuyang	All horned; white hair	M	62.3	74.0	36.3
		F	52.4	64.7	26.1
Guanzhong White	Horned or polled; long white hair on legs & belly — Horned	M	55.2	58.9	40.0
		F	51.7	56.7	23.8
	Polled	M	59.5	62.3	44.0
		F	53.6	57.7	31.5
Matou	All horned; white; with meat type body conformation	M	66.8	75.8	50.8
		F	57.0	63.9	32.7
Chengdu Grey	All horned; brown hair coat, 2 dark streaks on face, one over backbone	M	68.1	65.3	39.0
		F	63.2	63.2	29.0
Guizhou White	All horned; short hair	M	52.7	60.4	29.4
		F	49.4	56.7	26.3
Leizhou	All horned; black hair coat dominant	M	60.5	62.1	54.1
		F	55.9	58.1	47.7
Duan	All horned; white, black or black & white hair coat	M	58.9	72.3	43.1
		F	49.2	63.5	27.1

* Ranges were quoted; means calculated by Cheng, P.L.

Table 9.3 MEAT PRODUCTION OF GOAT BREEDS

Breed	Sex*	Liveweight (kg)	Carcase weight (kg)	Visceral fat weight (kg)	Dressing percentage (%)	Meat percentage (%)
Mongolian	F	37.7	15.1	3.2	48.7	30.3
	W	50.3	25.3	3.8	57.6	38.4
Xinjiang	W	36.6	13.4	1.3	41.1	n.a.
Tibetan	F	29.8	12.2	n.a.	40.9	n.a.
	W	34.3	16.0	n.a.	46.4	n.a.
Zhongwei	F	37.2	14.6	1.6	43.7	n.a.
	W	34.4	14.9	2.1	49.3	n.a.
Liaoning Cashmere	M	39.3	18.6	1.5	51.1	35.9
	F	43.2	19.0	2.3	49.2	37.7
Chengde Polled	M	44.7	21.5	0.9	49.9	34.9
	F	35.9	14.3	2.0	45.4	33.6
Wuan	F	n.a.	n.a.	n.a.	40.5	n.a.
	W	n.a.	n.a.	n.a.	43.3	n.a.
Jining	F	20.5	8.3	2.3	51.7	40.5
	W	20.3	9.4	2.1	56.7	35.9
Fuyang	F	25.0	10.2	2.8	51.9	n.a.
	W	36.3	10.4	1.7	45.9	n.a.
Guanzhong White	W: P**	36.5	19.3	4.2	64.1	n.a.
	H	32.0	16.0	2.3	57.0	n.a.
Matou	F	32.0	15.9	n.a.	49.8	n.a.
	W	44.0	23.0	4.2	62.5	43.2
Chengdu Grey	F	28.0	11.9	1.2	46.9	35.1
	W	36.2	16.5	2.1	51.4	43.9
Guizhou White	W	47.5	25.0	6.0	52.6	45.9
Leizhou	F	39.5	16.1	n.a.	40.7	n.a.
	W	46.2	21.3	n.a.	50.0	n.a.
Duan	F	31.9	14.1	n.a.	44.2	34.7
	W	42.3	20.9	n.a.	49.4	40.6

*M = male; F = female; W = wether; **P = polled; H = horned

Table 9.4 CASHMERE* PRODUCTION AND QUALITY OF SOME GOAT BREEDS

Breed	Sex	Production			Quality		
		Cashmere (g)	Hair (g)	Percentage of cashmere (%)	Hair length (cm)	Cashmere length (cm)	Cashmere diameter (μm)
Mongolian	M	290	610	32	16.0	5.0	16.0-17.0
	F	270	360	43	14.5	5.0	14.5-16.0
Xinjiang	M	310	590	34	14.0-18.0	4.0-5.0	15.0
	F	197	390	34			
Tibetan	M) F)	200-300	250-500	30-40	14.0-18.0	4.0-5.0	13.5-15.0
Zhongwei	M	140	430	25	)24.0-28.0	7.0	12.5
	F	120	360	25	)		
Liaoning Cashmere	M	565	474	54	20.0)	6.0	16.5
	F	491	402	55	17.8)		17.1
Chengde Polled	M	245	500	33	)11.0-21.0	4.0-5.0	14.0-16.0
	F	140	200	50	)		
Wuan	M	215	650	25	)13.0-14.5	5.0	18.0-20.0
	F	140	500	22	)		
Jining	M	50-150	230-300	18-30	)14.0-15.0	3-4	13.0
	F	25-50	130-280	16-20	)		

* Most cashmere is white, but appreciable quantities of coloured fibre (shades of brown and grey) are also produced.

Table 9.5 PELT AND SKIN QUALITY OF SOME GOAT BREEDS

Breed	Main uses	Characteristics	Size (cm^2)
Zhongwei	Fur-pelt	Killed and skinned 35-40 days after birth. Staple length 7-8 cm, with 5 or more waves, white, lustrous, attractive patterns.	1,360-3,392
Jining	Kid-pelt	Killed and skinned 1-2 days after birth. Greyish green, staples with attractive wavy curled patterns. Used for fur-coats.	800-1,000
Fuyang	Skin	Compact, with good quality.	2,300-5,000
Guanzhong White	Skin	Compact, with good quality. Used for leather.	n.a.
Chengdu Grey	Skin	Large, thin, with good elasticity.	4,754
Guizhou White	Skin	Compact, with good elasticity.	3,575-5,105
Leizhou	Skin	Black or brown, thin, with good elasticity.	3,000-4,500

Table 9.6 REPRODUCTION OF GOAT BREEDS

Breed	Age at sexual maturity (mths)	Age at first mating (mths)	Oestrous season	Number of kiddings per year	Gestation period (days)	Fecundity* (%)
Mongolian	7-8	18	Autumn	1	150	103
Xinjiang	6-8	18	Autumn	1	150	111
Zhongwei	5-6	18	Autumn	1	150	104-106
Liaoning Cashmere	5-6	18	Autumn	1	150	110-120
Chengde Polled	7-8	12-18	Apr.-Sep.	<1	145-150	121-144
Wuan	7-8	12-18	Autumn	1	151	102
Jining	3-4	5-8	All year	1-2	146	294
Huaipi	3-4	5-8	All year	2	145-150	258
Fuyang	3-4	8-12	All year	2	145-156	228
Matou	3-5	10	All year	about 1	143-154	196
Chengdu Grey	4-5	12-14	All year	2	142-145	215
Guizhou White	4-5	8-10	All year	2	150	184
Leizhou	3-6	5-8	All year	2	147	203
Duan	4-6	5-8	All year	2	152	129

* Fecundity: (kids per kidding) x 100. See page 216.

9.4 DAIRY GOAT BREEDS UNDER DEVELOPMENT

The development of "specialized" milk goat breeds in China may be traced back to the beginning of this century. However, rapid expansion did not occur until the last decade. In 1980 there were estimated to be about 2 million milk goats in China, mainly distributed in the following Provinces: Shanxi, Hebei, Shandong, Henan, Heilongjiang, Jilin and Shaanxi.

Examples of new breeds under development are:

Guanzhong Dairy (Plate 9.13) of Shaanxi Province, which is the result of crossing purebred Saanen with native does. Saanens were first introduced from Canada in the early 1940's. Upgrading and selective breeding were carried out for generations at the Northwest Agricultural College of Shaanxi Province. Goats of this breed are polled, with few exceptions. They have white hair, well-developed udders and high milk production. The Laoshan Dairy (Plate 9.14), of Shandong Province, was developed from Saanens of another type, first introduced to Loushan by German preachers early in 1904, and used for crossing with local does from 1919. Several later importations of Saanen were also made.

Laoshan milk goats have been developed from upgrading and selection during the past 70 years, and they are now similar to purebred Saanen in both body conformation and milk production.

These breeds are still under development. Their body measurements, milk production and reproduction are summarized in Table 9.7.

9.5 SUMMARY

China is rich in goat breed resources:

The Zhongwei, raised only in temperate and arid areas, with an annual mean temperature of 8.3°C and an annual precipitation of 190 mm, grazes on poor desert steppe with little vegetation except sandy shrubs. Nevertheless, this world famous fur-pelt breed is developed only under such particular environmental conditions.

The Jining Grey, a breed noted for its production of quality kid-pelts, is especially prolific, with a fecundity of about 300 percent; it produces occasionally 5 or 6 kids in one crop. These goats are raised only in the agricultural areas, with mild temperatures and adequate rainfall, at low altitudes (about 50 m), and are kept in pens, fed on a variety of farm by-products.

The Liaoning Cashmere, located at relatively high altitudes (about 1,000 m), in a cold and humid climate (annual mean temperature 7 - 8°C, annual precipitation 700 to 900 mm), is noted for high production of white cashmere (about 500 g per head per year).

These breeds are considered valuable assets in the goat gene pool, not only for China, but also for the world, and will probably make significant contributions to future goat development. Others are also

Table 9.7 BODY MEASUREMENTS, MILK PRODUCTION AND REPRODUCTION OF TWO DAIRY GOAT BREEDS

Breed	Guanzhong		Laoshan	
	M	F	M	F
Body measurements:				
Height (cm)	86	72	85	71
Length (cm)	94	80	90	75
Heart girth (cm)	100	88	95	82
Body weight (kg):	70-90	50-60	76	48
Milk Production:				
Length of lactation (months)		7-8		8-10
Milk production (kg)		400-700		about 800
Milk fat (%)		4.0		4.0
Reproduction:				
Age at sexual maturity (months)		6		4-6
Age at first mating (months)		18		18
Number of kiddings per year		1		1
Fecundity (%)		150-170		173

valued for their respective attributes. Mongolian goats are noted for white cashmere production, Tibetan, for cashmere quality (presumably due to the effect of high altitude) and Xinjiang, for milk production.

The multiplication of different goat breeds under their respective ecological conditions seems to be desirable and profitable for the rapid development of herbivorous animals in China.

9.6 REFERENCES

The information in Chapter 9 was collated from various sources by Professor Jiang Ying, Department of Animal Science, Beijing Agricultural University.

MONGOLIAN GOAT
Inner Mongolia

Plate 9.1 Doe

XINJIANG GOAT

Plate 9.2 Buck

ZHONGWEI GOAT
Ningxia

Plate 9.3 Buck

Plate 9.4 Doe

ZHONGWEI GOAT
Ningxia

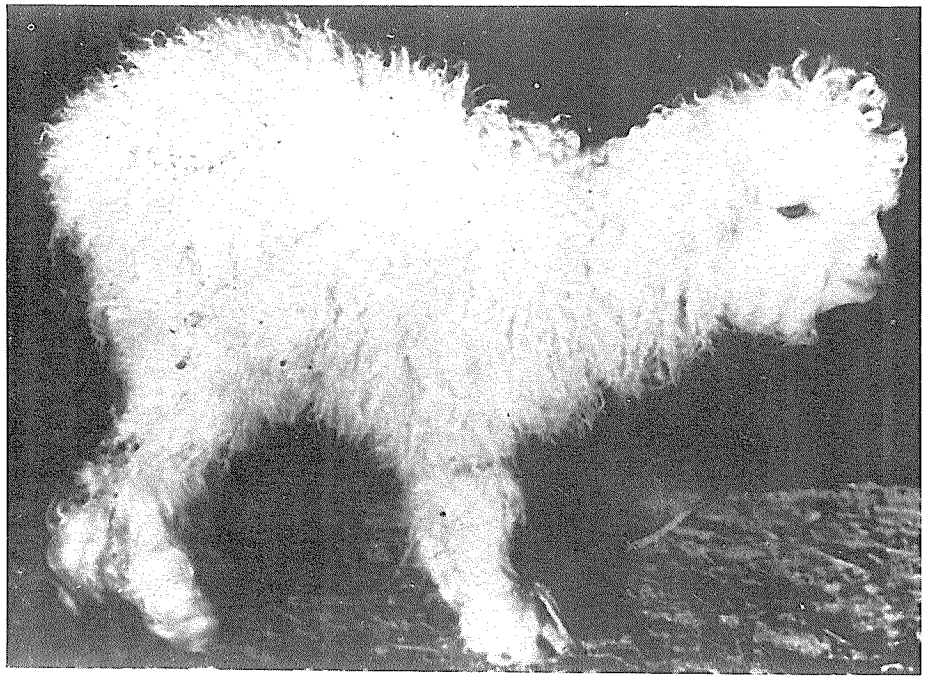

Plate 9.5 Kid

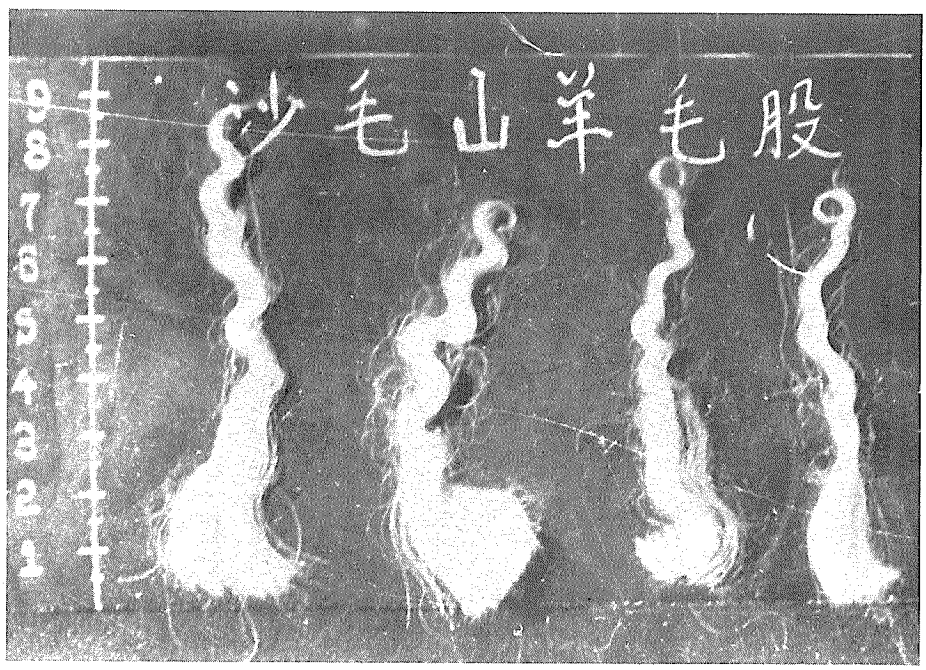

Plate 9.6 Staples (Scale in cm)

LIAONING CASHMERE GOAT
Liaoning Province

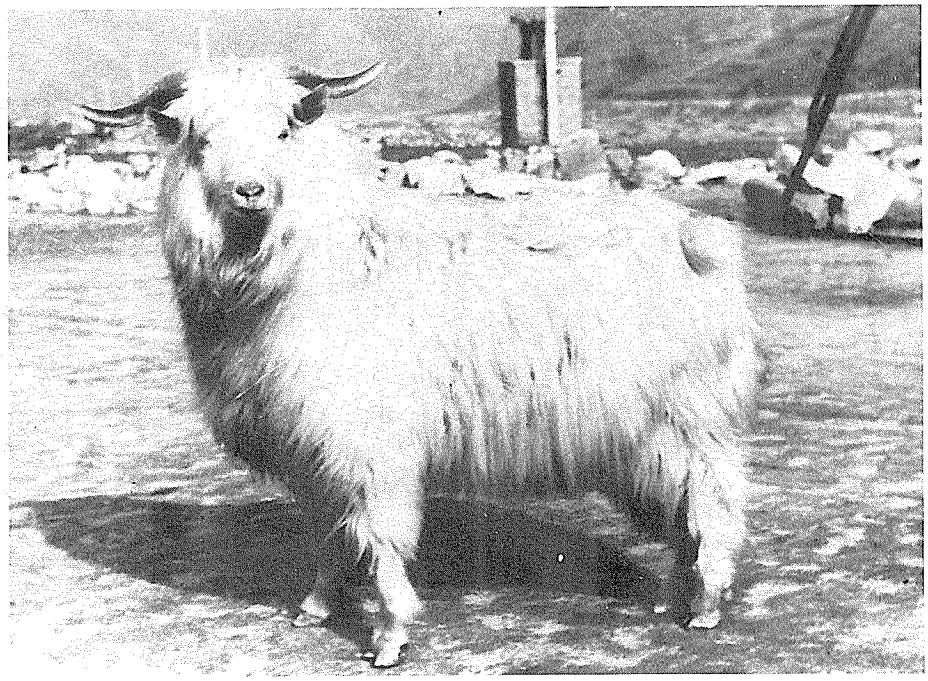

Plate 9.7 Buck

Plate 9.8 Staple (Scale in cm)

JINING GREY GOAT
Shandong Province

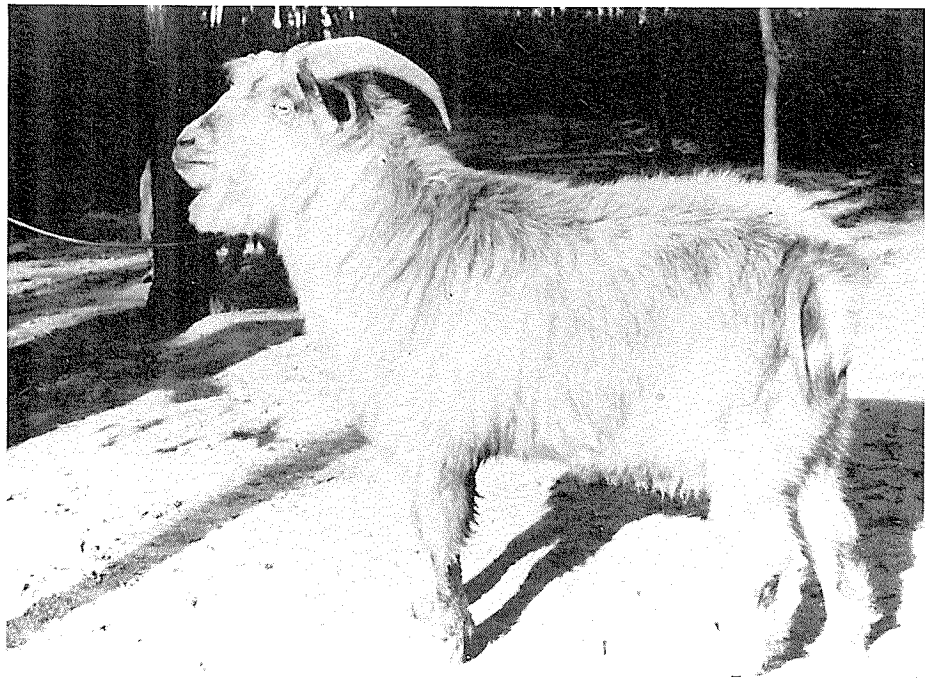

Plate 9.9 Buck

Plate 9.10 Doe

MATOU GOAT
Hubei and Hunan Provinces

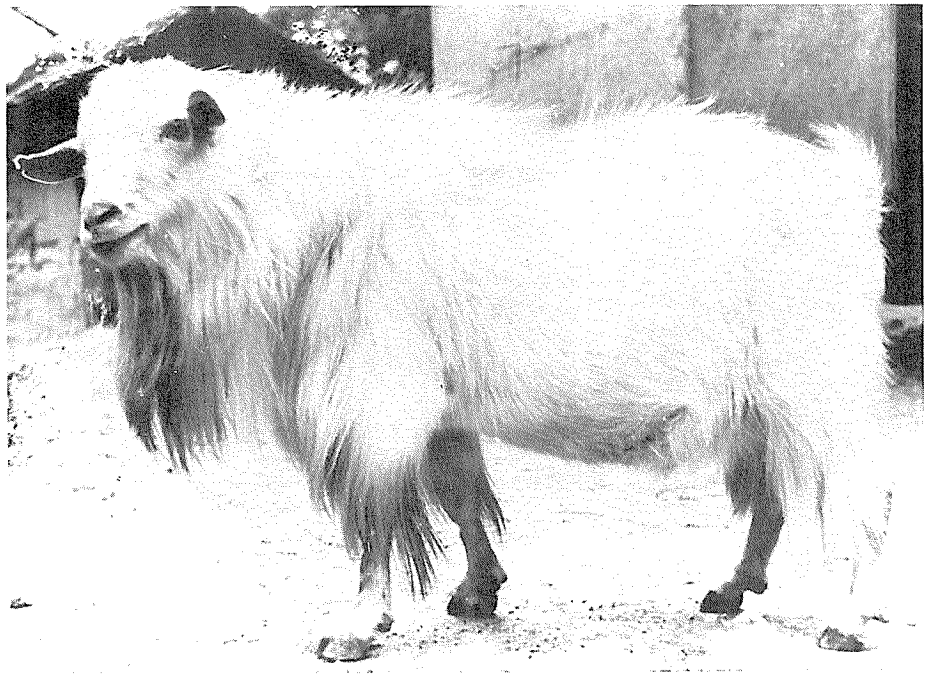

Plate 9.11 Buck

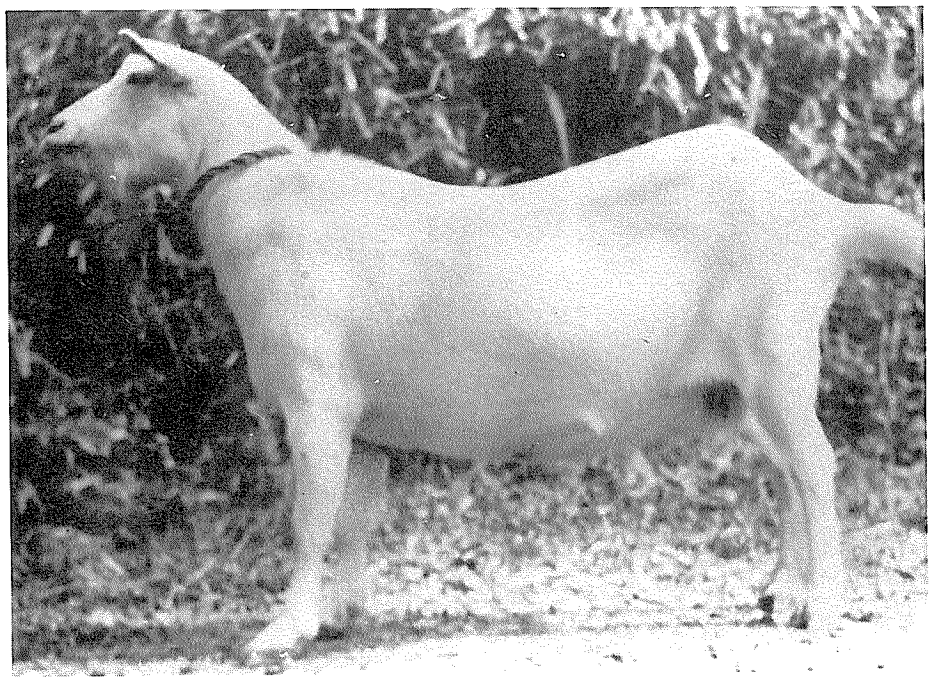

Plate 9.12 Doe

GUANZHONG DAIRY GOAT
Shaanxi Province

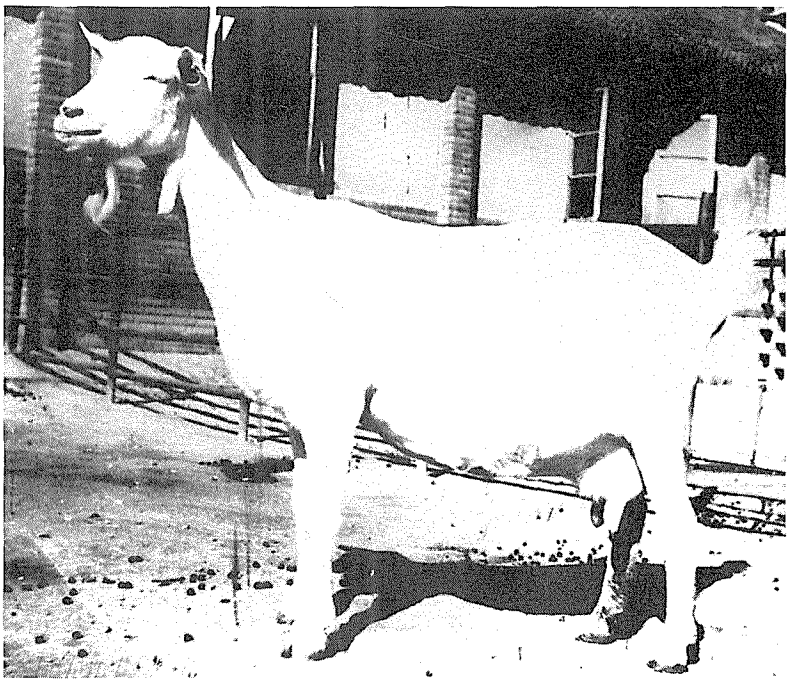

Plate 9.13 Doe

LOUSHAN DAIRY GOAT
Shandong Province

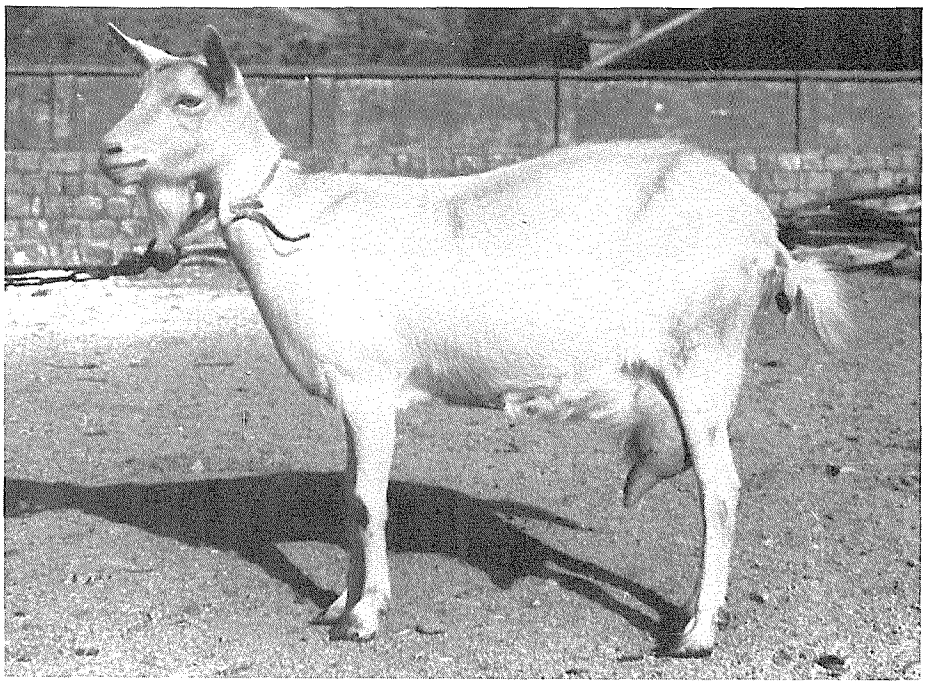

Plate 9.14 Doe

CHAPTER 10

PIG BREEDS

China has a long history in the domestication of pigs (15,17). This may be traced back for at least 6,000 to 7,000 years, as evidenced by the use of isotope C^{14} in the investigation of excavated bones in different parts of the country, such as those from Angangxi of Heilongjiang Province (north), Daiwenkou (11) of Shandong Province (east), Hemudu (13), Yuyao County, Zhejiang Province (east), Banpocun (10), Xi'an of Shaanxi Province (mid-west), Tanshishan (2) of Fujian Province (southeast) and Daxi (9) of Sichuan Province (southwest). Recent discoveries from the excavation at Zengpiyan (12), Guilin, Guangxi Zhuang Autonomous Region (south), have demonstrated that pigs were domesticated even as early as about 10,000 years ago.

The number of pigs in China was 301 million at the end of 1982 (Table 1.1), and the country takes first place in the world. The distribution of pigs is shown in Figure 10.1.

It is natural that China should have many breeds of pigs, because of topographic complexity, marked climatic variability and differing requirements such as lard, pork, salted pork, ham etc., by the people in various areas of the country. According to incomplete statistics from some inquiries made in 1960 (4) and 1979 (5), there are more than one hundred pig breeds (or types) in China. Different opinions exist concerning the names of pig breeds; one breed may have several names, or different breeds may have only one name. Further detailed investigations are needed to clarify the confusion surrounding nomenclature; this work is in progress, led by the Institute of Animal Science of the Chinese Academy of Agricultural Sciences.

10.1 PIGS OF SPECIFIC REGIONS

On the basis of topographic and ecological conditions, pig breeds in China may be divided temporarily into the following six regional types (16, 18 - Figure 10.2), namely: North China, Central China, Lower Changjiang River Basin, South China, Southwest China and Plateau (Table 10.1).

Performance data for the various types are in Table 10.2.

10.1.1 North China

This type is found in the vast agricultural area to the north of the Huaihe River Basin and the Qinling Mountains (including North China, the Northeast, Inner Mongolia and Xinjiang), located in the Middle Temperate Belt, where the climate is dry and cold, the soil is rich in calcium, and the main crop is wheat. Feeds for pigs consist mainly of farm by-products and other roughages; most of the pigs are out on pasture and concentrates are limited.

The main features of North China pigs may be summarized as follows:

(i) They can generally withstand cold weather and harsh feeding conditions. Examples are the Ming pig (Plates 10.1 and 10.2) in the Northeast and the Shenxian pig (Plates 10.3 and 10.4) in North China. The Ming pig, for instance, has a black hair coat with coarse, long bristles and a dense woollen undercoat in the winter; the sows can therefore farrow in an open shed at 4°C.

(ii) They have a relatively large body size, with a narrow, level back and loin.

(iii) They have the ability to deposit body fat; for example, Ming pigs can store 4.6 kg in the abdomen (18).

(iv) They are comparatively late in sexual maturity, but are fairly prolific, with about 12 pigs per litter, and have 7 to 8 pairs of teats.

10.1.2 Central China

Pigs of this type are found in the region between the Changjiang and Zhujiang Rivers, the Middle and South Subtropic Belts, where the climate is temperate (or warm) and moist, agriculture is highly developed, and the main crop is paddy rice, high in productivity. The area is rich in feed supply and especially abundant in the supply of green and water plants as pig feeds. Pigs are all penned and well managed. Conditions have favoured the development of some of the well-known breeds, such as the following:

The Jinhua pig (Plates 10.5 and 10.6) of Zhejiang Province, is characterized by its hair colour and meat quality. The animals have a white body, with black at head and rump, leading to the common name "two-end-black"; the back and loins are slightly curved. The breed is especially noted for its thin skin, fine bones and tender meat; after special processing, "Jinhua ham" (Plate 10.7) is favoured for its attractive flavour and rosy colour, and has a high reputation in the international market. Jinhua pigs are early in sexual maturity, and may be mated as early as 3 to 4 months old; they are fairly prolific, with a litter size of 13 (Plate 10.8), and 7 pairs of teats.

The Ningxiang pig (Plates 10.9 and 10.10), of Hunan Province in the Central Subtropic Belt, is housed and hand-fed year round. The hair coat colour pattern has been described as "black clouds overhanging snows with a silver ring around the neck"; the back is slightly concave, and the belly is pouched and pendulous. The back fat is 4 cm thick; the average litter size is 11.5 and there are 7 pairs of teats.

The Large Black-white pig (Plates 10.11 and 10.12), of the Zhujiang River Delta in Guandong Province (south), has a hair coat of black and white patches, a slightly concave back and pendulous, drooping belly. This breed is also precocious, with its first mating at 3 to 4 months old, and is prolific, with 13 pigs per litter; there are 7 pairs of teats.

Table 10.1 LOCAL NATURAL CONDITIONS - PIG BREEDS

Region	Pig breeds	Altitude (m)	Temperature* Annual mean (°C)	Lowest (°C)	Highest (°C)	Annual* precipitation (mm)
North China	Ming	240	4.9	-36.5	36.4	572
	Shenxian	22	12.6	-22.5	42.7	504
Central China	Jinhua	64	17.5	- 9.0	41.2	1,358
	Ningxiang	45	17.3	- 9.5	39.8	1,450
	Large Black-white	6	21.8	0.1	37.6	1,622
Lower Changjiang River Basin	Taihu: Meishan) Fengjing) Jiaxing)	4	15.7	- 9.1	38.2	1,039
South China	Luchuan	82	21.8	0.5	38.0	1,605
	Wenchang	14	23.6	3.2	38.4	1,603
	South Yunnan Small-ear	550	21.8	4.4	41.0	1,234
Southwest China	Neijiang	350	17.6	- 2.0	39.2	1,086
	Kele	2,230	10.5	-13.8	32.6	996
Plateau	Hezuo	1,920	6.8	-23.8	33.6	511
	Tibetan	3,500	8.3	-17.6	29.0	373

* Ten year averages of local or neighbouring weather stations

10.1.3 Lower Changjiang River Basin

Pigs of this type are distributed in the Lower Changjiang River Basin and Southeast Coast, a narrow region between North and Central China (Figure 10.2), which lies in the Mid Subtropic Belt, with mild climate, highly developed agriculture (intensive farming), and high crop production. Farm by-products and water plants are used for feeding pigs in addition to concentrates, and the pigs are well fed and managed.

These pigs are noted for their early sexual maturity and high prolificacy. The Taihu pig, for instance, has 8 to 9 pairs of teats, with an average litter size of 12 for first farrowing and 15 for subsequent farrowings; a litter of 20 is not uncommon. Two litters per year are the regular practice.

There are at least three main types among Taihu breeds, though some authors suggest more (1):

- Meishan (Plates 10.13 to 10.16 and 10.23),
- Fengjing (Plates 10.17 to 10.22 and 10.24),
- Jiaxing Black (Plates 10.25 and 10.26).

Table 10.2 BODY MEASUREMENTS AND PERFORMANCE OF PIG BREEDS

Regional breeds and types	Hair colour	Body Measurements (sows) Height (cm)	Heart girth (cm)	Live-weight (kg)	Performance Backfat thickness (cm)	Dressing percentage (%)	Reproduction (sows) Sexual maturity (months)	Litter size (n)	Pigs weaned (n)	Teats (pairs)
North China:										
Ming	Black	87.5	130	88.3	3.2	72.2	3-4	12.0	11.3	7
Shenxian	Black	60.1	109	75.0	3-4	65.0	3.3	12.0	11.0	8
Central China:										
Jinhua	White body, black head, tail	65.8	109	74.3	5.3	72.5	2.5	11.9	11.3	7-8
Ningxiang	White body, black neck	61.6	114	70.6	4.0	70.0	3.0	11.5	n.a.	7
Large Black-White	White-black-patched	60.4	110	68.1	3.9	69.1	3.0	13.2	12.3	7
Lower Changjiang River Basin:										
Taihu:										
Meishan	Black, white feet	57.8	100	61.6	2.5	66.8	2.5	14.3	13.3	8-9
Fengjing	Black	69.0	98	69.6	3.5	66.0	2.5	15.8	13.3	9
Jiaxing	Black	68.3	93	61.3	1.8	66.6	2.5	17.5	15.2	8-9
South China:										
Luchuan	Black head and back	51.6	103	79.0	4-6	69-74	4.0	11.5	9.8	6-7
Wenchang	Black back, white body	47.2	91	62.0	7.0	72.4	4.0	8-10	6-9	6-7
Denchang	Black back, white body	55.2	97	85.6	4-6	72.0	4-6	11.3	10.3	7
South Yunnan Small-ear	Black	59.6	105	63.4	5.5	74.4	2-3	11.1	8.4	5
Southwest China:										
Neijiang	Black	61.0	104	90.2	4.8	67.7	3-4	10.6	9.7	7
Kele	Black	54.0	92	63.2	7.2	74.6	3-4	8.7	n.a.	5-6
Plateau:										
Hezuo	Black	44.0	74	32.5	3.0	65.0	3.0	1-2(g)4-7(s)*3.3		5
Tibetan	Black	39.6	61	20.9	3.1	66.5	3-5	4.8(g)6.4(s) 3.5		5

Source: 16; * g = gilt; s = sow

10.1.4 South China

South China pigs are mainly found in South Subtropic and North Tropic Belts, where the climate is warm and humid, and the area is abundant in green feeds, being especially rich in water plants. The pigs are characterized by a low-set, concave back, a pouched, pendulous belly touching the ground, and thick back fat. Examples are:

The Luchuan (Plates 10.27 and 10.28) of the Guangxi Zhuang Autonomous Region (in the South Subtropic Belt), with back fat about 5 cm thick.

The Wenchang (Plates 10.29 and 10.30), Tunchang (Plates 10.31 and 10.32) and Lingao (Plates 10.33 and 10.34) of Hainan Island (in the North Tropic Belt), with back fat 7 cm thick. These three types may be grouped into one breed, Hainan.

The South Yunnan Small-ear (Plates 10.35 and 10.36) of Yunnan Province (in the North Tropic Belt), with back fat 5.5 cm thick. This breed lives in ecological conditions similar to those of Hainan Island; it is therefore, for the time being, grouped with the South China Type.

South China pigs are characterized by precocity, with their first mating at 3 to 4 months old, but are less prolific, with a litter size of 8 to 11, and only 5 to 6 pairs of teats.

10.1.5 Southwest China

Pigs of this type are mainly distributed in the Sichuan Basin and the Yunnan-Guizhou Plateau, in the Central and North Subtropic Belts. However, climatic conditions and feeding practices vary greatly from place to place. Most of the pigs are black, but some are black-and-white or even red. Hair coat colour seems to be influenced by pigs introduced from other localities.

Examples are:

The Neijiang (Plates 10.37 and 10.38), raised in the Sichuan Basin, where the climate is mild, agriculture is well developed, and the area is rich in feed supplies. The pigs are comparatively large in size, with strong body constitution, thick skin (about 0.7 cm) and thick back fat (3.4 to 5.7 cm (8)). They are also precocious; the young boar may mount the female at as early an age as 2 months, and mature spermatozoa are found in the epididymis at 71 to 78 days; gilts can be mated and become pregnant as early as 90 days after birth (7). The average litter size is 10.6, and there are 7 pairs of teats.

The Kele (Plates 10.39 and 10.40) is located in the Yunnan-Guizhou mountainous areas, where the altitude is high (1,700 to 2,400 m), the climate is dry and cold during the winter and humid in summer (annual mean temperature 15°C, annual precipitation about 1,000 mm), and characterized by erratic changes in weather. The main crops are potatoes and buckwheat; this area is relatively poor in feed supply, and the pigs are out on the plateau pasture with cattle and sheep. They generally have the following characteristics: arched back and loin, long straight snout, narrow chest,

wrinkled hind legs, strong feet, light body. All these may be attributed to the influence of ecological conditions. Kele pigs are also noted for their thick back fat (5.1 to 7.2 cm), and for more visceral fat (15.6 percent of carcase weight). This extra fat may be considered a result of continuous selection for lard type, since people in mountainous areas have a special demand for fat in their diet. Kele pigs are relatively low in prolificacy, with a litter size about 7 to 8 (5.7 pigs for the first farrowing, 8.7 pigs afterwards) and 5 to 6 pairs of teats (3).

10.1.6 Plateau

Pigs of this type are mainly distributed in the Qinghai-Tibet Plateau at an elevation of over 3,000 m, with a cold, dry climate, poor vegetation and short growing period; the area is deficient in feed supplies, and the pigs are at pasture all year round, living on wild plants. Under these environmental conditions the pigs are naturally small in body size, with long and dense bristles; they have small erect ears, straight and pointed snouts, strong feet and hard hoofs. They are very clever at jumping and running. Examples are:

The Hezuo (Plates 10.41 and 10.42) is located in the Gannan Tibetan Autonomous Prefecture of Gansu Province, where the altitude is high (2,600 m), and the temperature low (annual mean temperature 1.7°C). The pigs are out on pasture all year round, and are characterized by long, coarse and dense bristles, a slow growth rate, and low prolificacy, with a litter size of 4 to 7; there are 5 pairs of teats (6, 16).

The Tibetan (Plates 10.43 and 10.44) on the Qinghai-Tibet Plateau (4,000 m) is especially adapted to the high, cold climate and to being on pasture all year round. It is characterized by:

(i) Light body weight (about 35 kg in mature animals).

(ii) Alertness in running and jumping, with quick responses for guarding against attack from other animals.

(iii) Narrow head and long straight snout, to facilitate searching for feeds under the ground.

(iv) Black hair coat, with long and dense bristles (length 12 cm, about 2 to 3 times longer than other breeds; density 71/cm^2, approximately three times as dense as in Sichuan native pigs) which protect it from the strong solar radiation of ultra-violet rays and also from the cold weather (-20° to -30°C) on the plateau (14).

(v) Highly developed digestive organs; the length of the intestine is about 36 times its own body length (in Sichuan pigs, the intestine is only 28 times its body length). This is presumably a mechanism responsible for the pig's ability to utilize shrubs as feed, as well as the stems, roots and hard seeds of wild plants.

(vi) Ability to deposit fat in the body. The internal and visceral fat is about 15 percent of bodyweight (for other pig breeds, 7 to 10 percent).

(vii) Muscles with a marble appearance and meat with a special flavour.

(viii) Low prolificacy, with a litter size of 5, weaning percent of 69 (14), and 5 pairs of teats.

10.2 ECOLOGICAL CONDITIONS AND CHARACTERISTICS

Preliminary conclusions about the ecological characteristics of some of the native pig breeds in China have been reached from the preceding paragraphs, and from analyses of available data listed in Table 10.2.

(i) Pig breeds, from north to south, seem to demonstrate changes as follow:

(a) Body size: from large to small;
(b) Bristle: from thick (more dense) to thin (less compact);
(c) Topline (back and loin): from straight to increasingly concave;
(d) Prolificacy: highest in the Lower Changjiang River Basin type (in the east), more pigs per litter, more teats;
(e) Colour pattern of hair coat: from black to black-and-white.

(ii) The attractive features of most pig breeds in China are remarkable adaptability to unfavourable environments, and ability to consume roughages. However, they are in general low in productivity.

(iii) Some, especially the Tibetan pigs, are rather wild by nature and have a very different conformation, with a small head, pointed snout, small erect ears, light body, narrow chest, strong feet, slow growth rate and low prolificacy. These breeds, however, are extremely adaptable to unfavourable environments in which other breeds cannot exist.

An attempt has been made to summarize the ecological characteristics of the six main regional types, as shown in Table 10.3.

The above conclusions concerning the relationship between pig breeds and their ecological characteristics are preliminary and observational, no attempt having been made to elucidate mechanisms, as the data currently available are limited. More scientific information is needed for convincing conclusions, and further studies are in progress in various Chinese Institutes, including the Institute of Animal Science of the Chinese Academy of Agricultural Sciences, in Beijing.

10.3 NEW PIG BREEDS UNDER DEVELOPMENT

Pig breeding has been carried on in various regions of the country, with the aim of developing new breeds to meet the special demands of local conditions. Many breeds are being developed, and some are commonly recognized, although they are still in the process of improvement. Examples are:

Table 10.3 ECOLOGICAL CONDITIONS AND PERFORMANCE OF 6 REGIONAL PIG TYPES

Regional types	Distribution (areas)	Climate (Belts)	Feeding conditions	Performance				
				Body size	Backfat (cm)	Dressing percentage (%)	Sexual maturity (months)	Litter size
North China	North of Huai River and Qinling Mountains	Dry, cold (North Temperate)	Poor	Large	3-4	72	3-5	12
Central China	Between Changjiang and Zhujiang Rivers Rivers	Mild (South Temperate)	Rich	Medium	4-5	70-75	2.5-4	10-13
Lower Changjiang River Basin	Mid-east	Warm, humid (North & Mid Temperate)	Rich	Medium	3-5	65	2.5-4	13
South China	South of Yunnan, Guangxi & Guangdong Provinces	Hot, humid (South Subtropic & North Tropic)	Good	Small	5-6	70-74	2.5-4	8-10
Southwest China	Yunnan, Guizhou & Sichuan Provinces	Warm, humid (South Subtropic)	Good	Medium	4-5	68	3-4	8-10
Plateau	Qinghai-Tibet Plateau	High, cold	Poor	Small	3-4	65	3-5	4-7

The Harbin White, a meat/lard dual-purpose type (Plates 10.45 and 10.46) of the Northeast, results from crossing the white crossbred pigs of unknown origin owned by the peasants, first with Yorkshire and then with Russian Large White. Backcrossing among the crossbreds and selection have been practised for a long period. The pigs of this breed are characterized by rapid growth, large body size and thick back fat.

The New Huai, a meat/lard dual-purpose type, (Plates 10.47 and 10.48) is the product of selective breeding from the crossbred progenies of Yorkshire and native Huai pigs in the Lower Huaihe River Basin, in the North of Jiangsu Province.

Body measurements and performance for these two recently developed pig breeds are shown in Table 10.4.

Table 10.4 NEW PIG BREEDS UNDER DEVELOPMENT
BODY MEASUREMENTS AND PERFORMANCE

Breeds	Sex	Body measurements			Carcase quality				Reproduction		
		Height	Heart girth	Live-weight	Dressing percent		Back fat thick-ness	Flare fat	Sexual mat-urity at	Teats	Litter size
		(cm)	(cm)	(kg)	No.	%	(cm)	(kg)	(mths)	(pairs)	
Harbin White (North)	M	84.7	144	n.a.*	n.a.	n.a.	n.a.	n.a.	-	-	-
	F	75.6	132	n.a.	n.a.	n.a.	n.a.	n.a.	5-6	6-7	11.3
	C	n.a.	n.a.	113	6	72.6	4.4	3.2	-	-	-
New Huai (Black) (Central)	M	87.3	154	n.a.	n.a.	n.a.	n.a.	n.a.	-	-	-
	F	70.6	121	n.a.	n.a.	n.a.	n.a.	n.a.	4-5	7	12-13
	C	n.a.	n.a.	99	2	72.6	4.8	2.8	-	-	-

Source: 16, Vol.1. *n.a. = not available

Another new breed, Beijing Black, (Plates 10.49 and 10.50) was approved by the Beijing Municipal Government in 1982. It was developed by selective breeding from crosses among Berkshire, Yorkshire and some Chinese breeds, and has the following characteristics:

Colour:		Black
Liveweight (kg):	M	240 - 260
	F	200 - 220
Average daily gain to slaughter:	C	550 - 670g
Feed conversion ratio:	C	1:3.3 - 3.9

Carcase quality (slaughter at 90kg - from 90 Castrates):

Dressing percent	73.2
Lean meat percent	50.3
Back fat (cm)	3.5
Eye muscle area (cm^2)	27.5
Meat quality	Excellent

Reproduction:

M:	Mature at	4.5 months
	Bred at	6.5 - 7.5 months
F:	First oestrus	201 - 226 days
	Oestrous cycle	19.8 - 21.8 days
	Oestrous period	5.2 - 7.8 days
	Ovulation rate:	
	Gilts	13.6
	Sows	16.0
	Litter size:	
	At birth	10.1 live piglets
	At weaning	9.2 live pigs

The breed has demonstrated good performance in 3-way crosses, as shown by the following results from the Beijing Animal Husbandry Bureau:

Table 10.5 BEIJING BLACK
PERFORMANCE IN THREE-WAY CROSSES

Cross	Average daily gain (g)	Feed conversion ratio	Dressing %	Lean meat %
Large White x (Landrace x Beijing Black)	669	1:3.04	n.a.	58.5
Duroc x (Landrace x Beijing Black)	623	1:3.35	75	58.5

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MING PIG
Northeast China

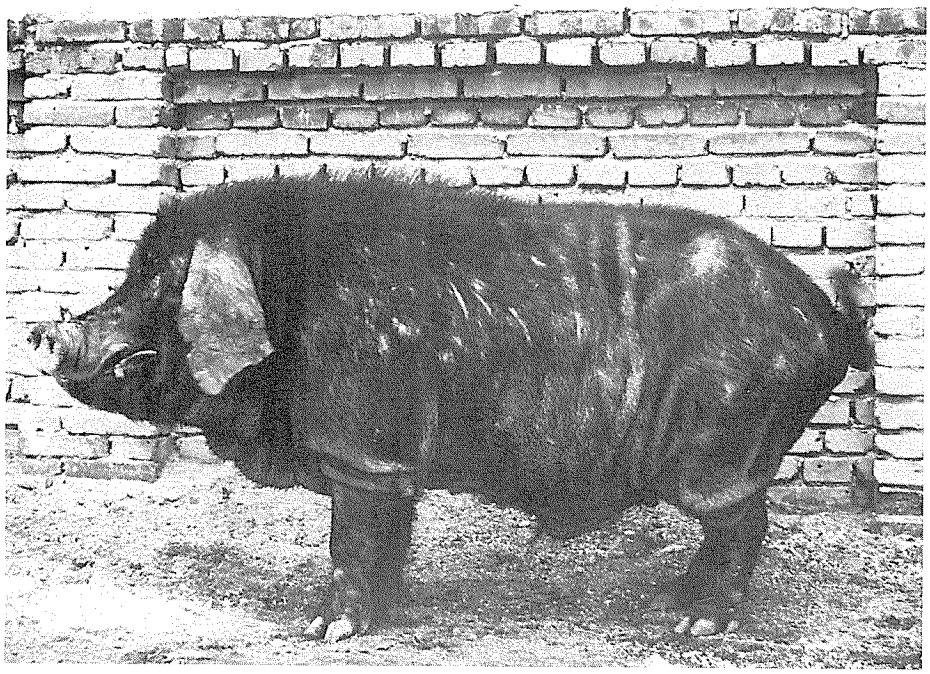

Plate 10.1 Boar

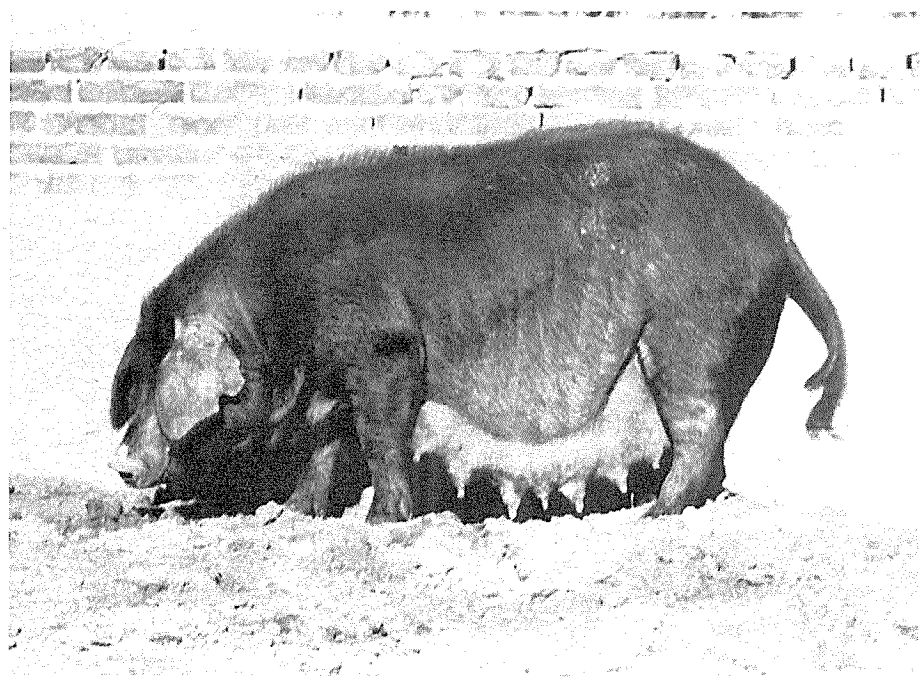

Plate 10.2 Sow

SHENXIAN PIG
Hebei Province

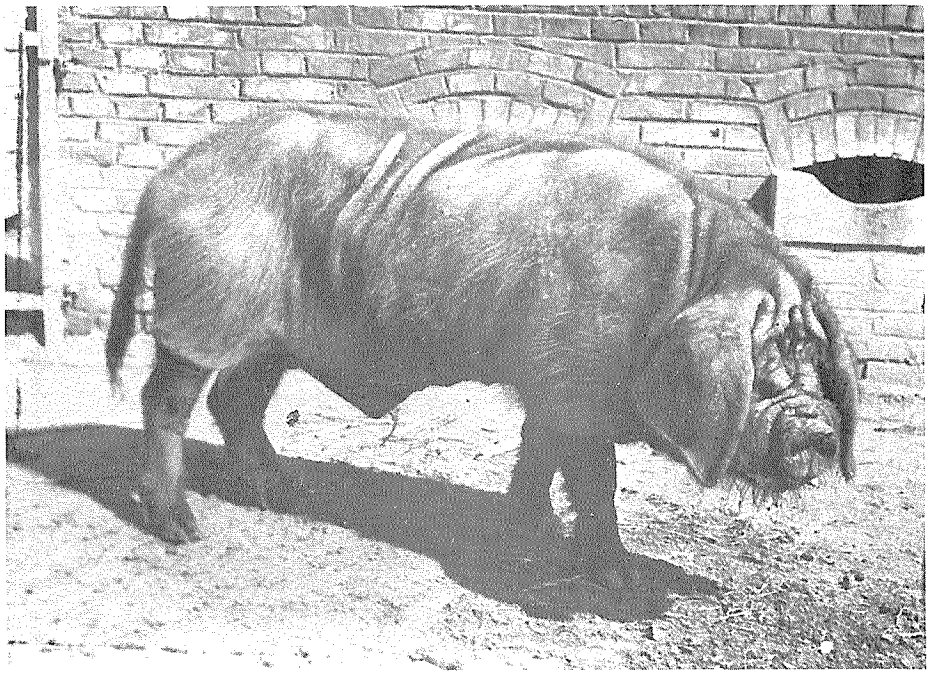

Plate 10.3 Boar

Plate 10.4 Sow

JINHUA PIG
Zhejiang Province

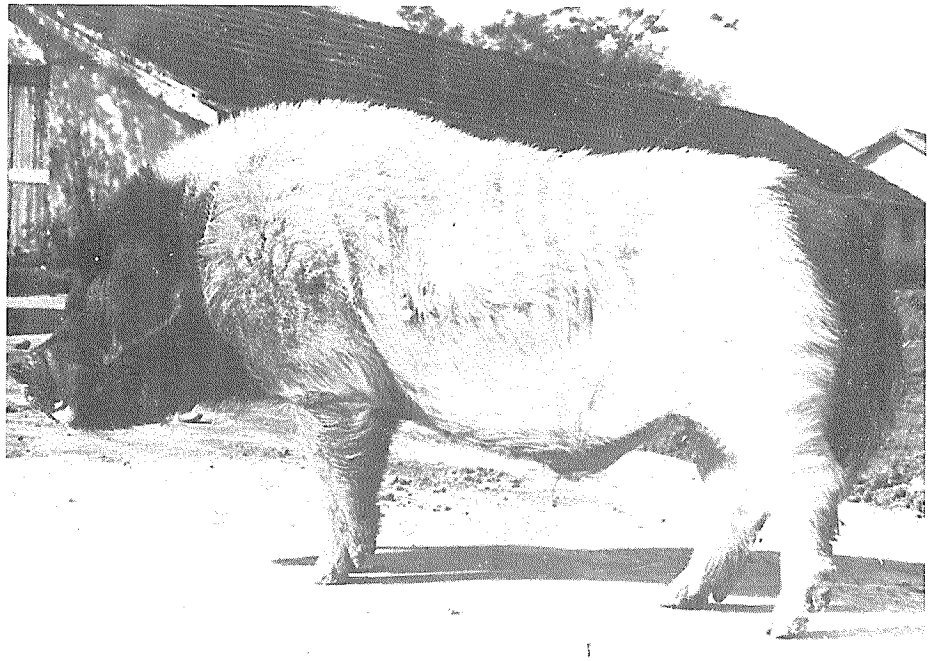

Plate 10.5 Boar

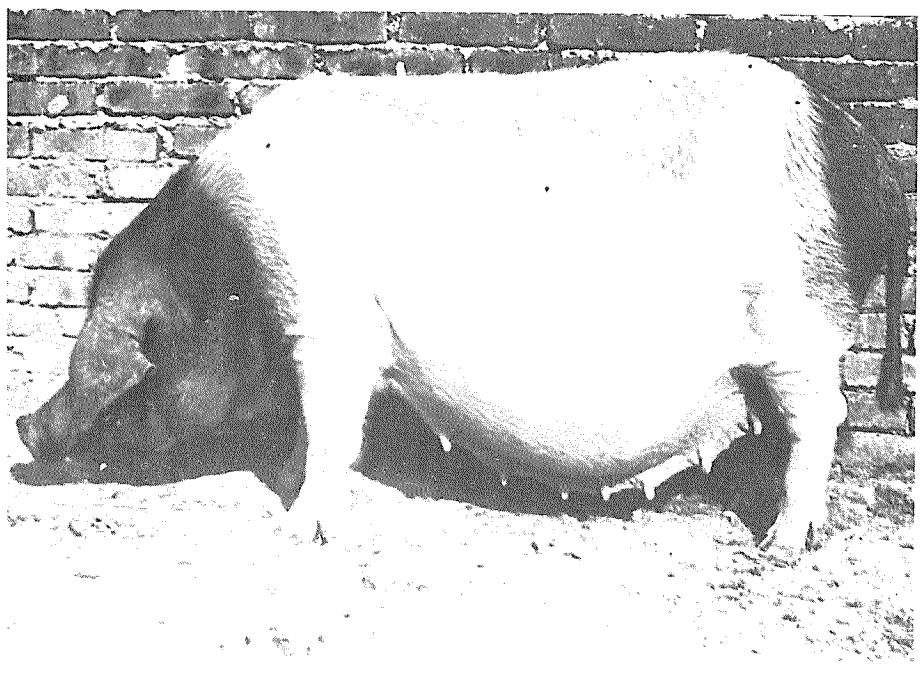

Plate 10.6 Sow

JINHUA PIG
Zhejiang Province

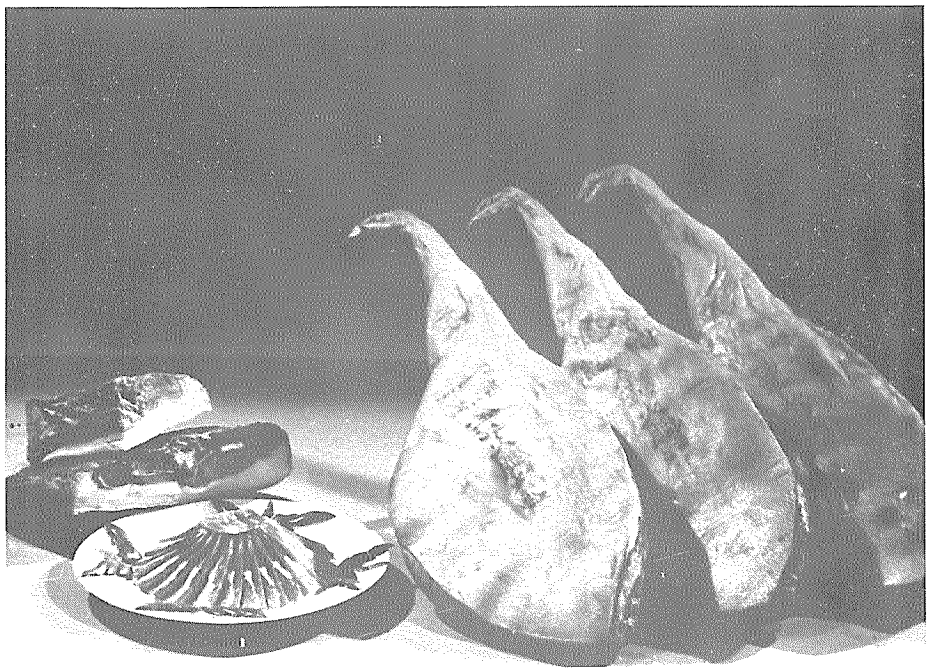

Plate 10.7 Ham

Plate 10.8 Sow with 13 piglets

NINGXIANG PIG
Hunan Province

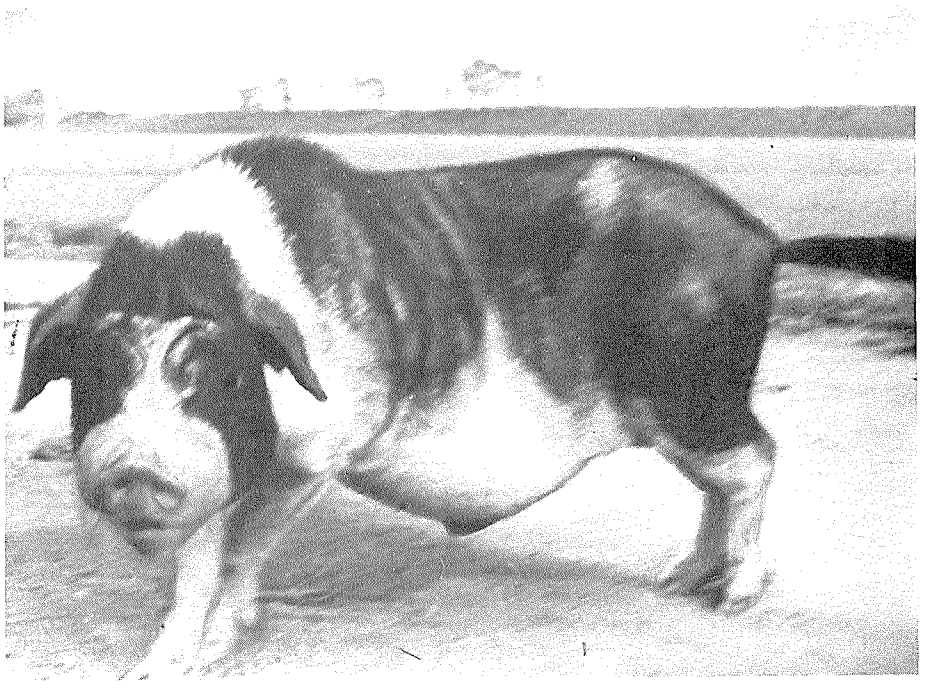

Plate 10.9 Boar

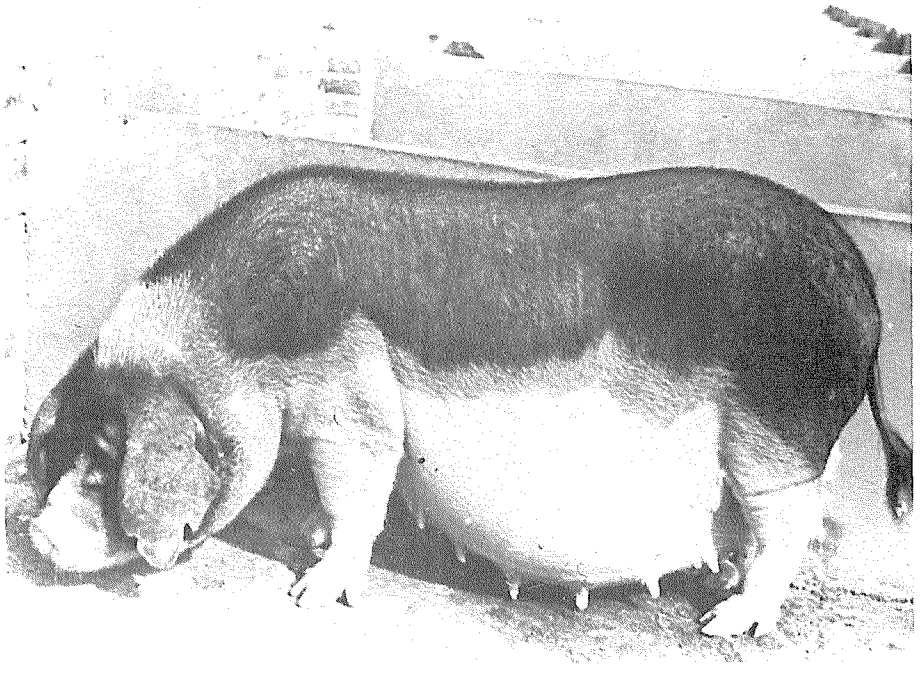

Plate 10.10 Sow

LARGE BLACK-WHITE PIG
Zhejiang River, Guangdong Province

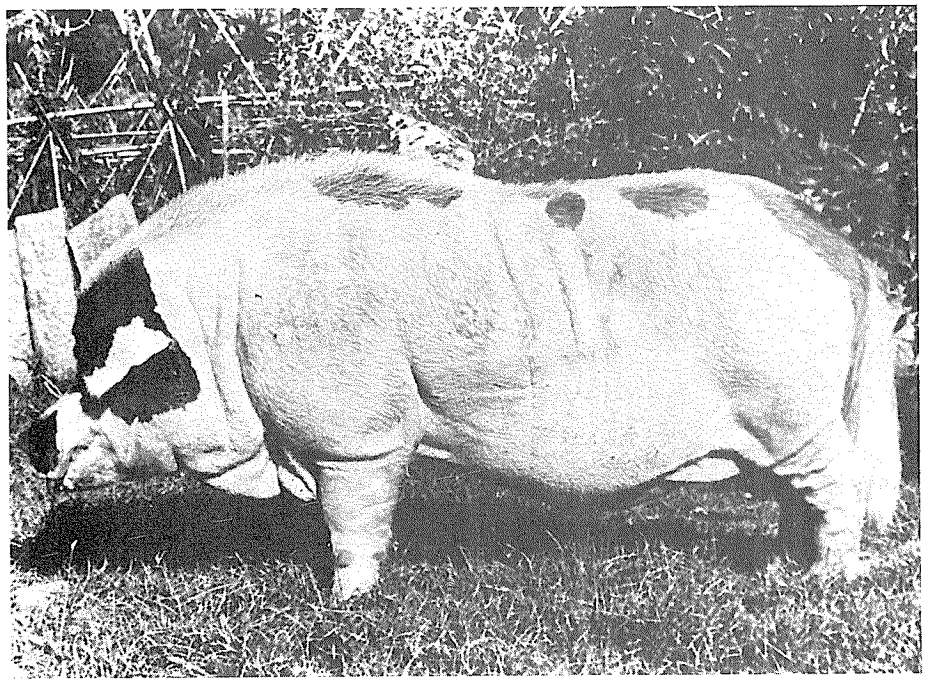

Plate 10.11 Boar

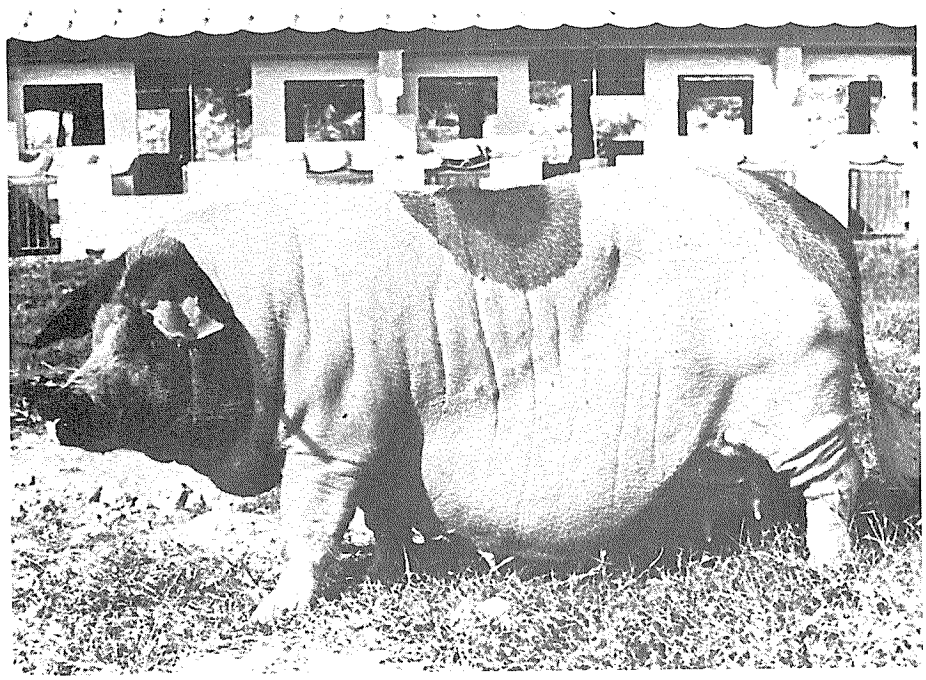

Plate 10.12 Sow

MEISHAN PIG (Type of Taihu)
North Shanghai

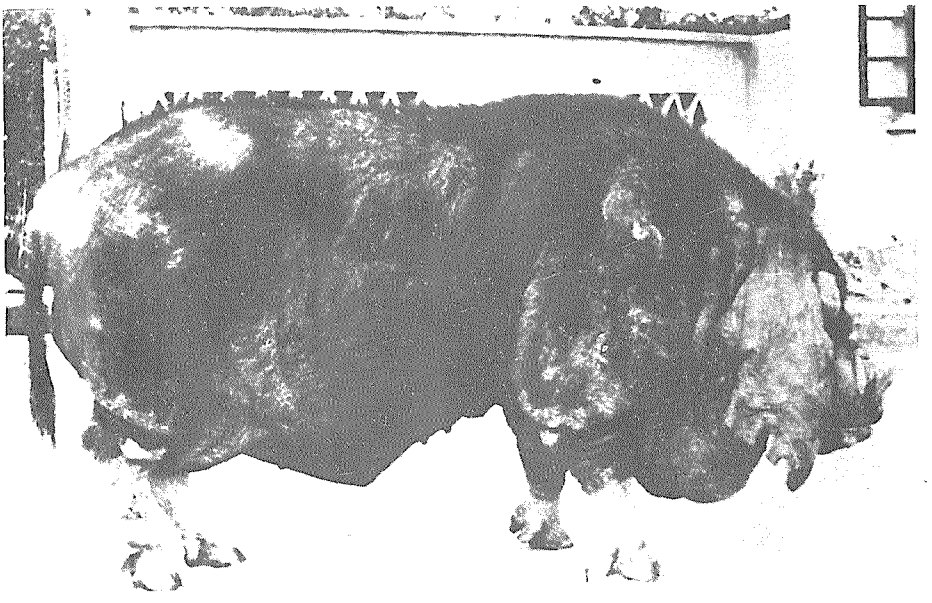

Plate 10.13 Boar

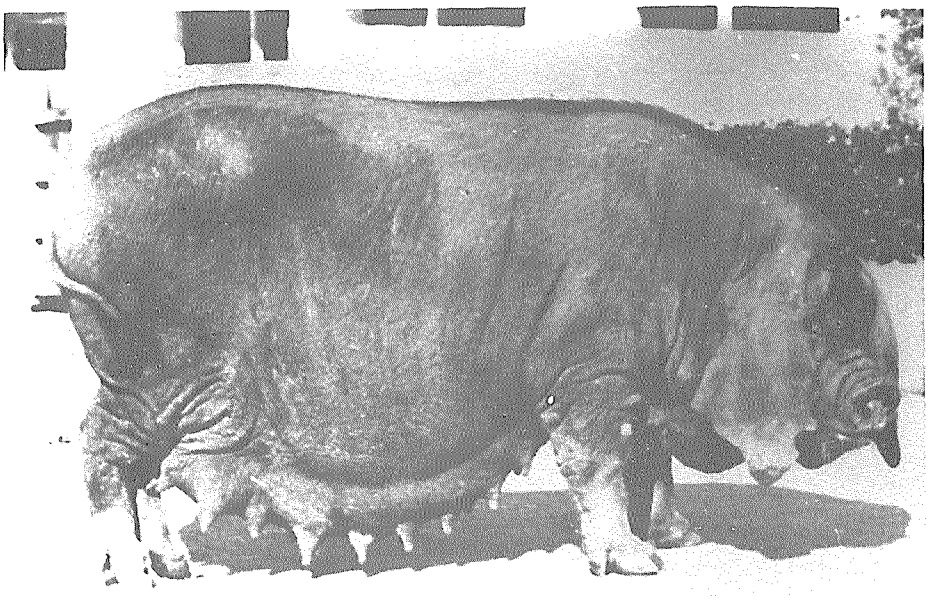

Plate 10.14 Sow

MEISHAN PIG (Type of Taihu)
North Shanghai

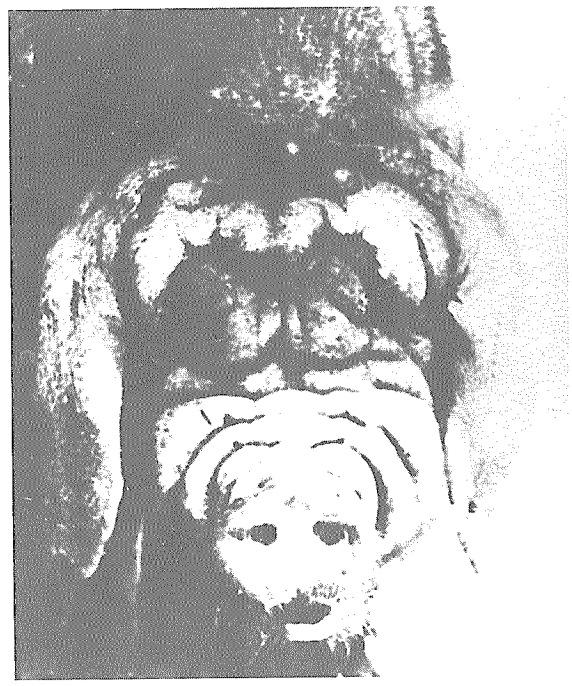

Plate 10.15 Face wrinkles

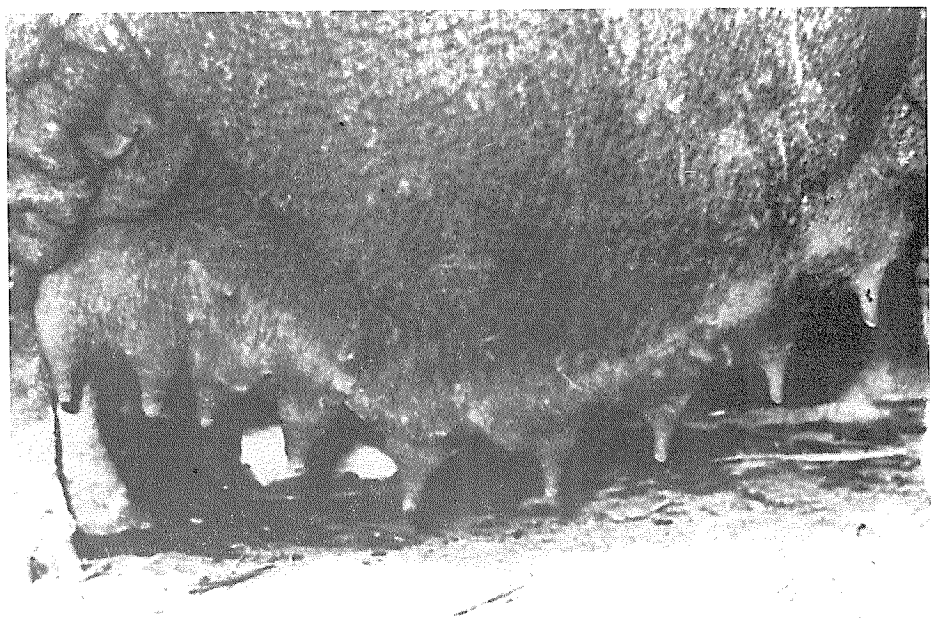

Plate 10.16 Nine pairs of teats

FENGJING PIG (Type of Taihu)
Lower Changjiang River Basin

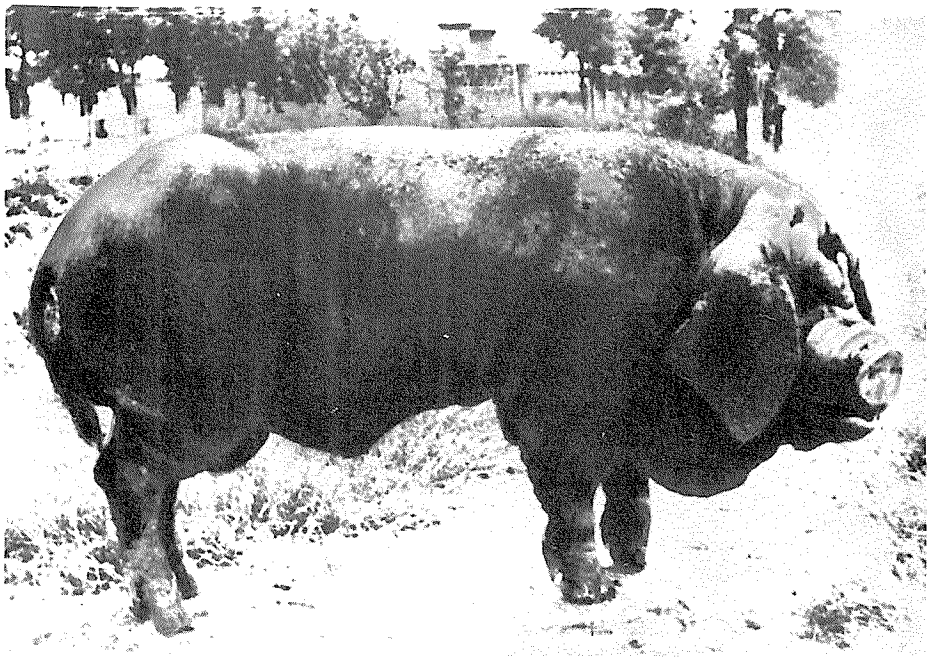

Plate 10.17 Boar

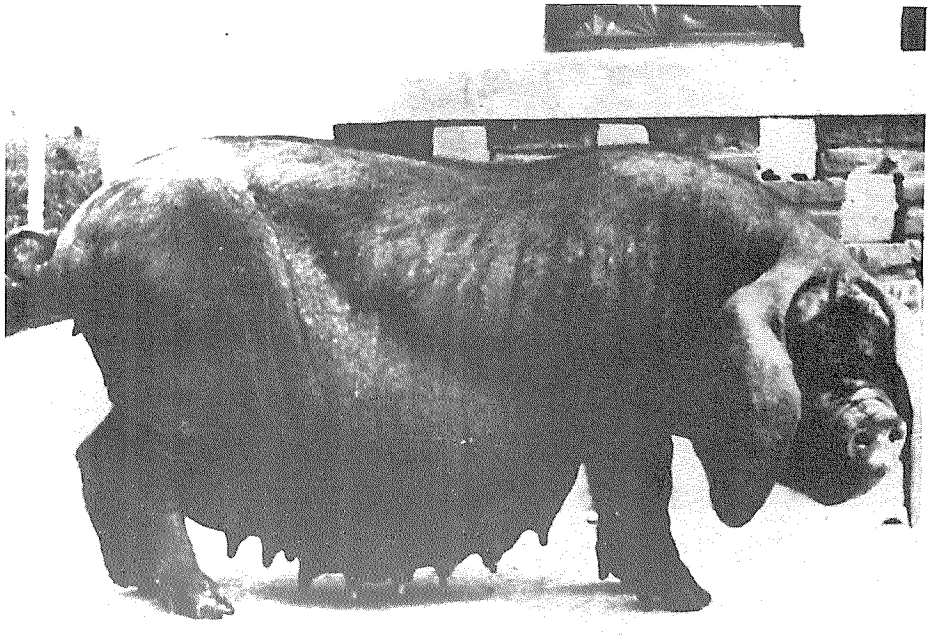

Plate 10.18 Sow

FENGJING PIG (Type of Taihu)
Lower Changjiang River Basin

Plate 10.19 Face wrinkles

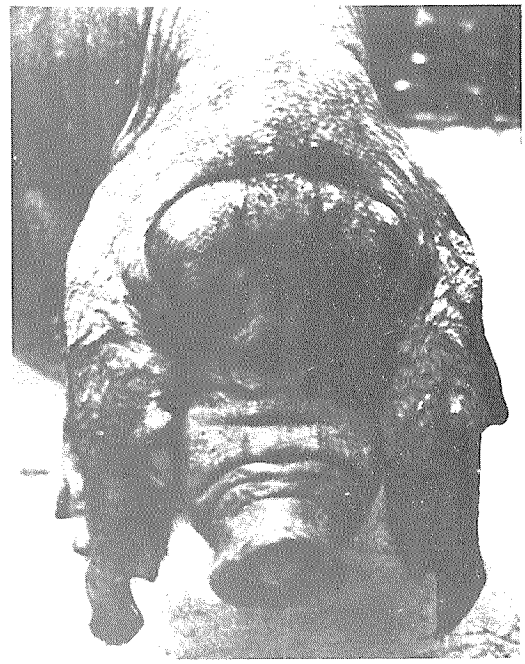

Plate 10.20 Large long ears

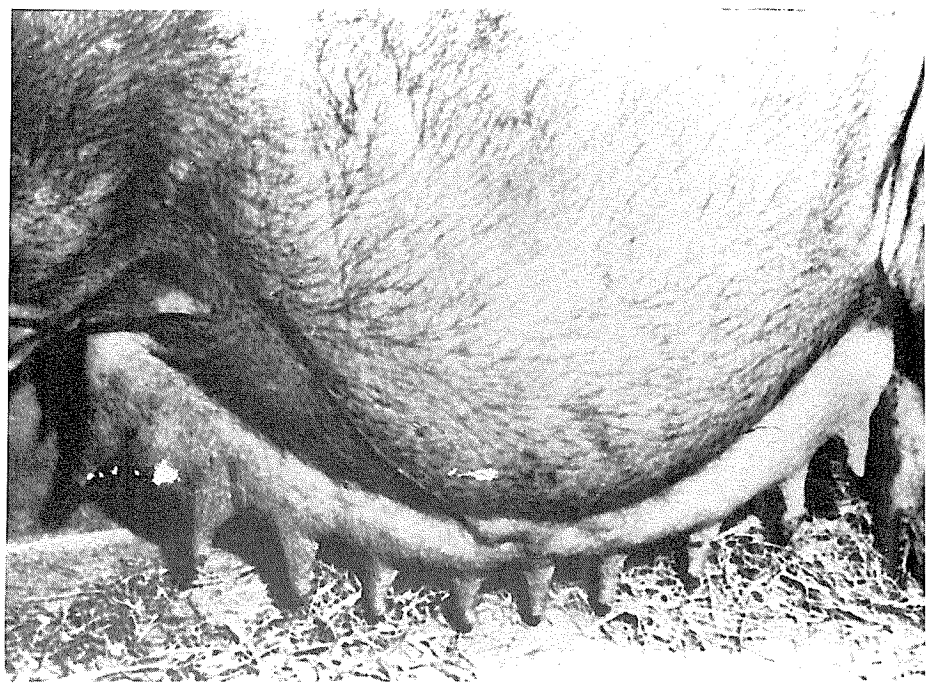

Plate 10.21 Ten pairs of teats

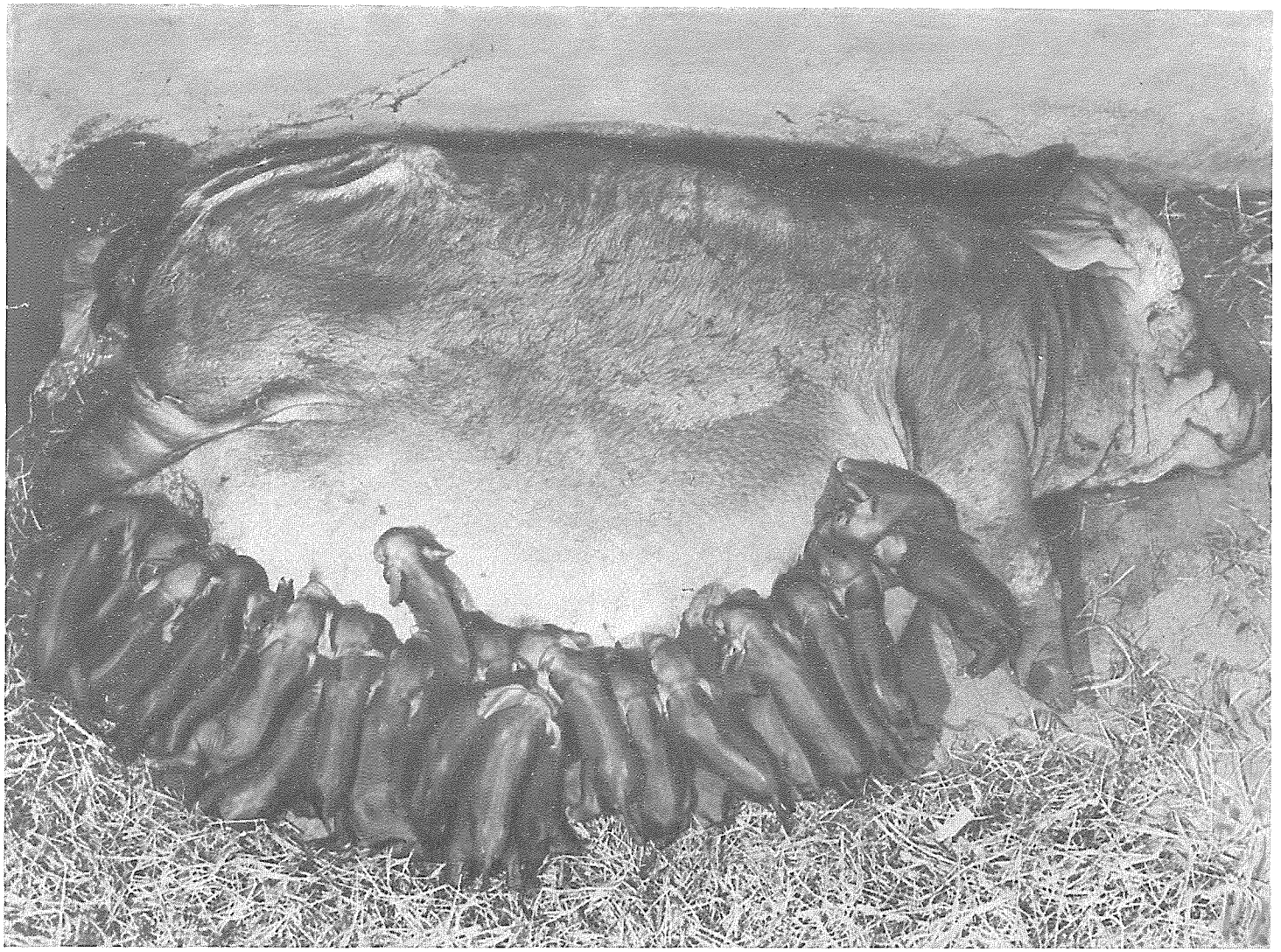

Plate 10.22 Sow with 31 piglets

PIG BREEDING FARMS

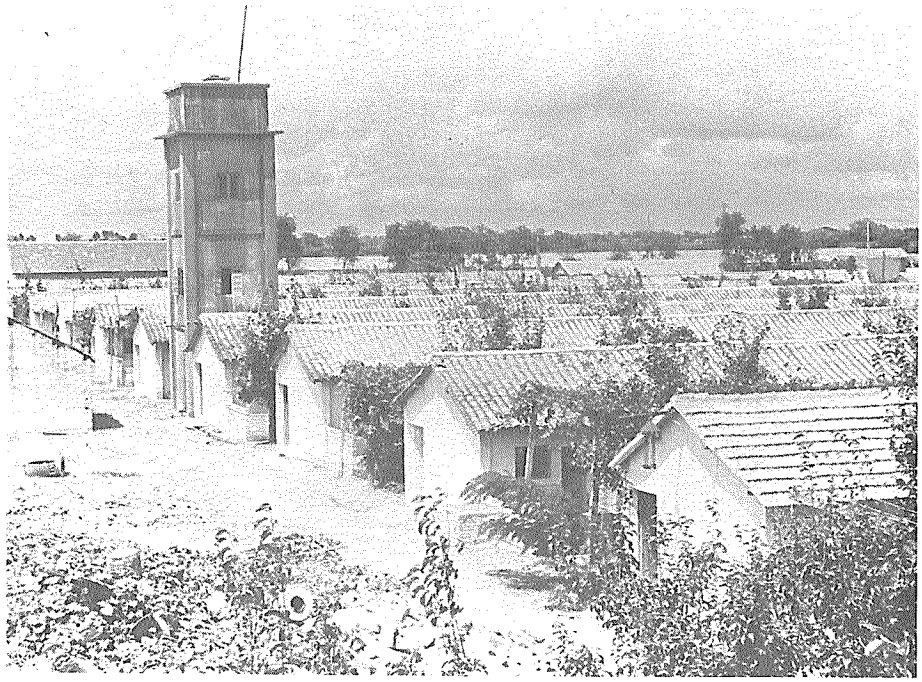

Plate 10.23 Meishan Pigs - North Shanghai

Plate 10.24 Fengjing Pigs - South Shanghai

JIAXING BLACK PIG
A type of Taihu (South Shanghai)

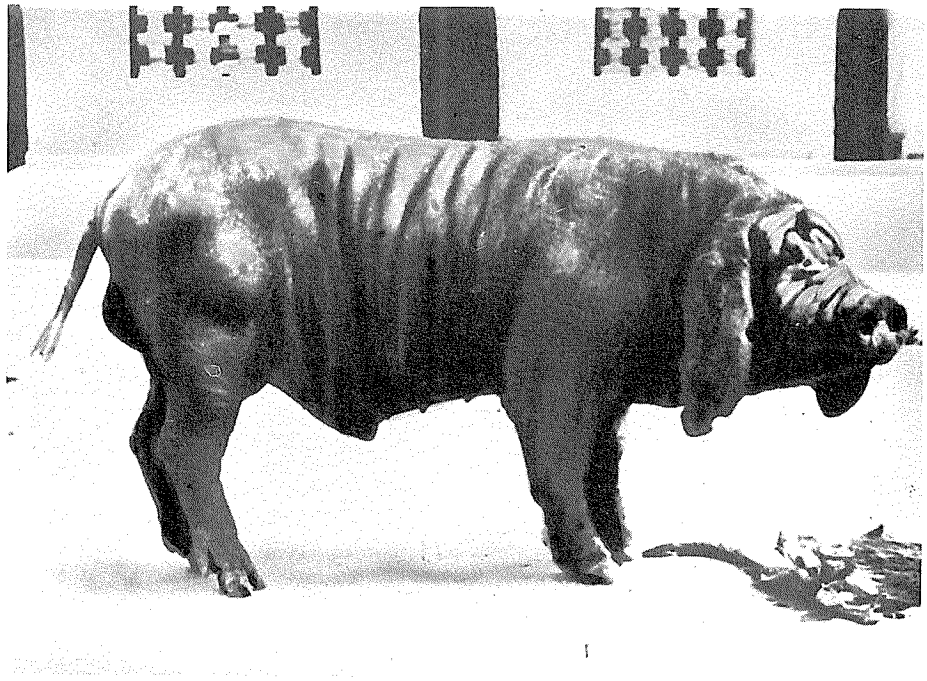

Plate 10.25 Boar

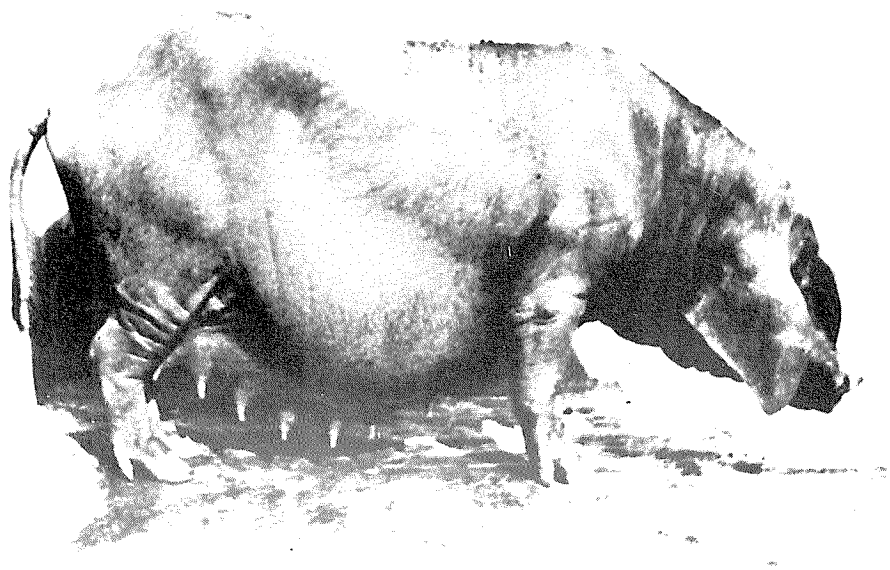

Plate 10.26 Sow

LUCHUAN PIG
Guangxi

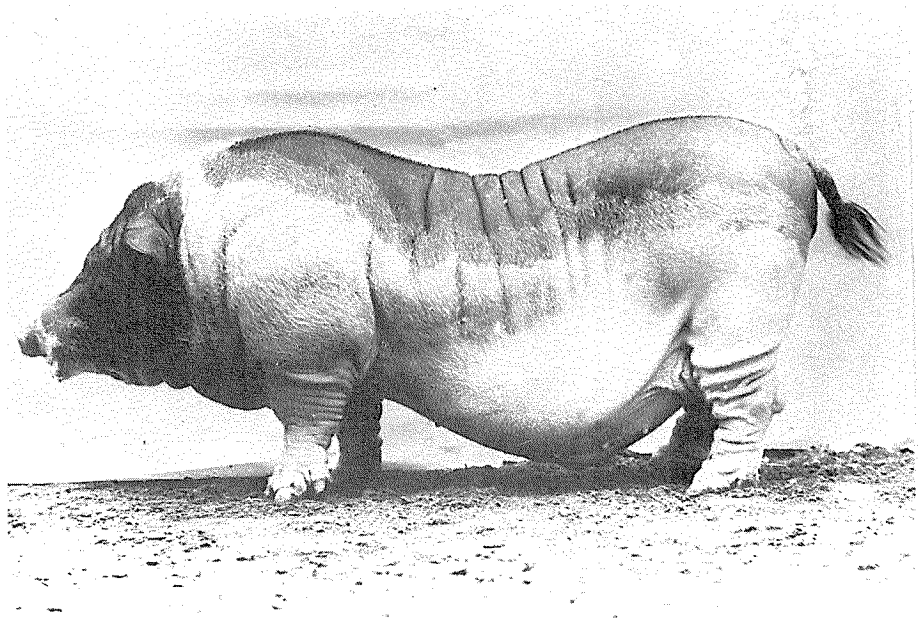

Plate 10.27 Boar

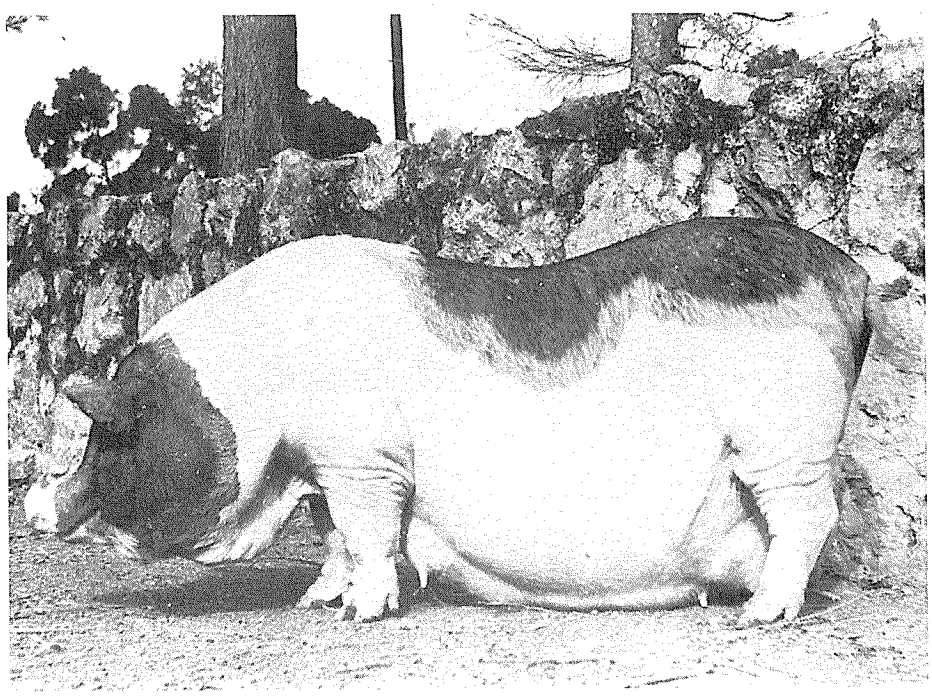

Plate 10.28 Sow

WENCHANG PIG
Hainan Island, Guangdong Province

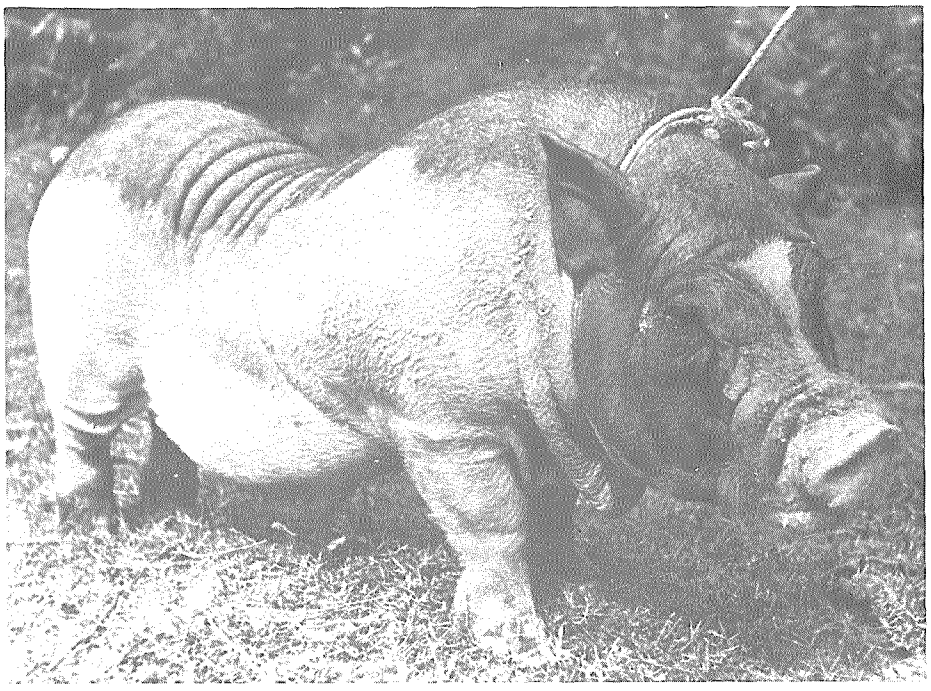

Plate 10.29 Boar

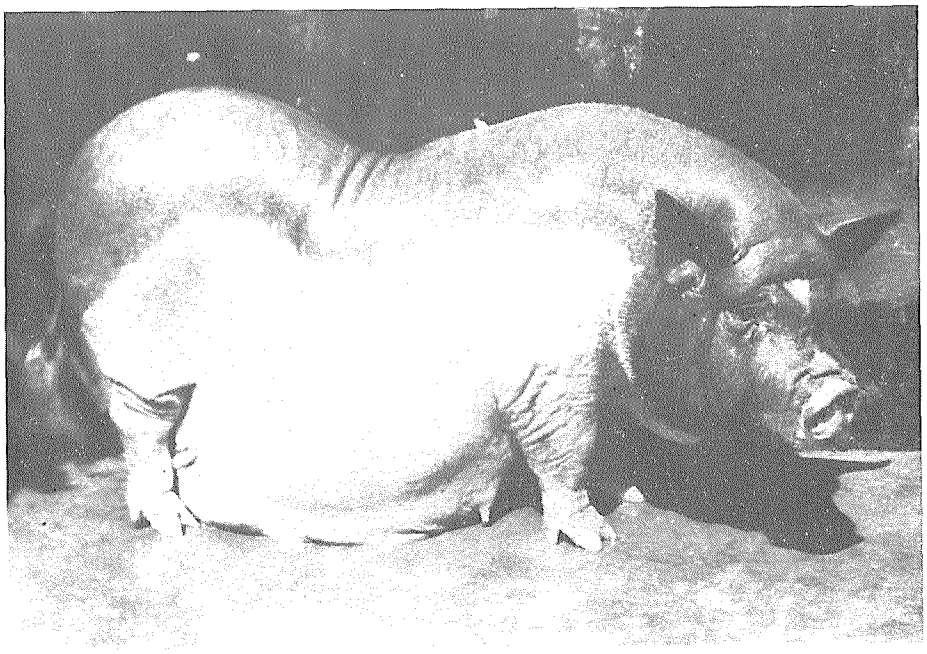

Plate 10.30 Sow

TUNCHANG PIG
Hainan Island, Guangdong Province

Plate 10.31 Boar

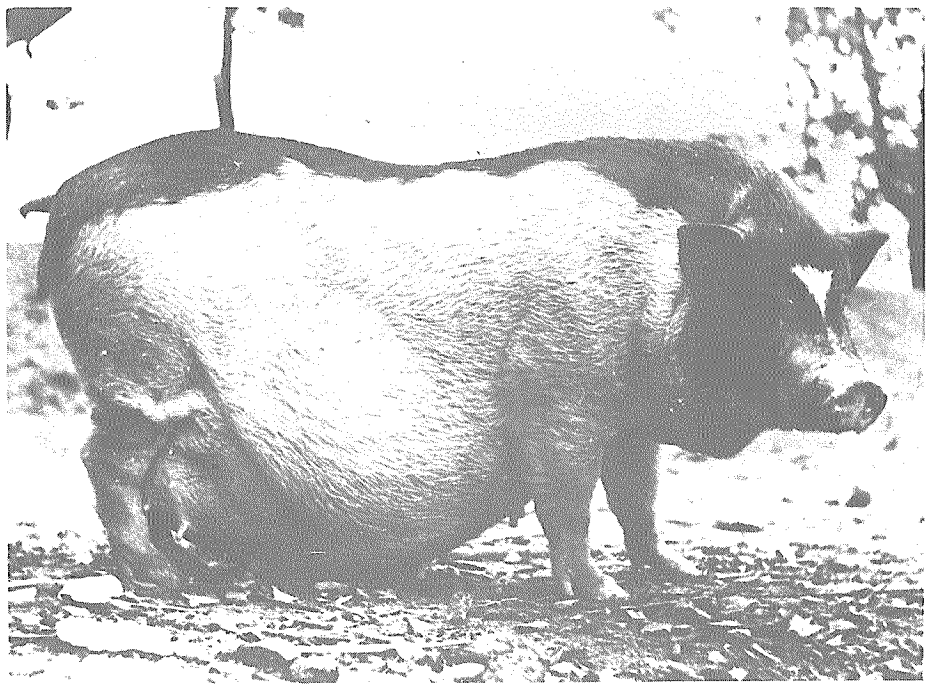

Plate 10.32 Sow

LINGAO PIG
Hainan Island, Guangdong Province

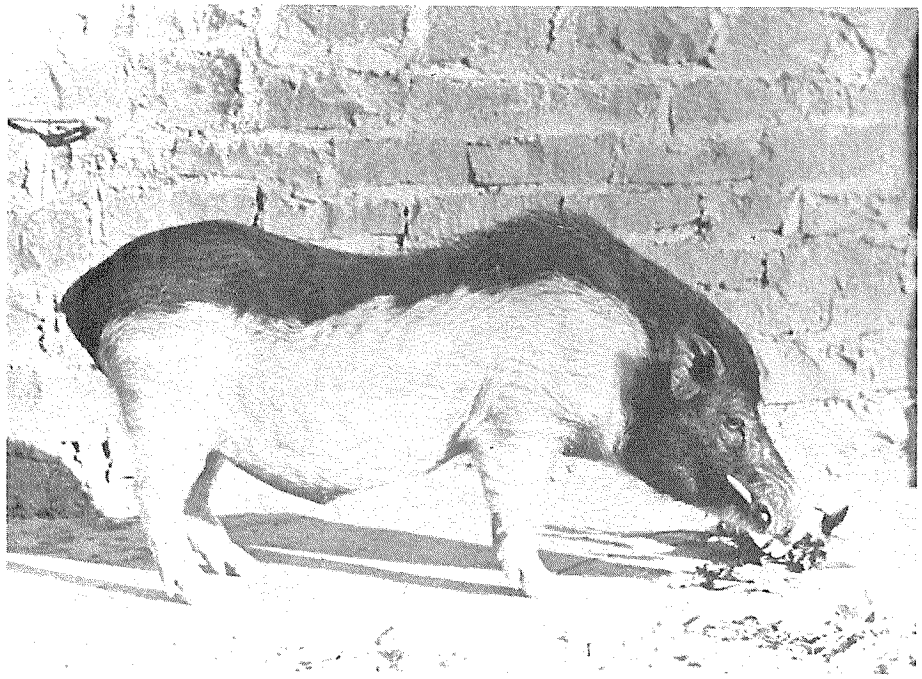

Plate 10.33 Boar

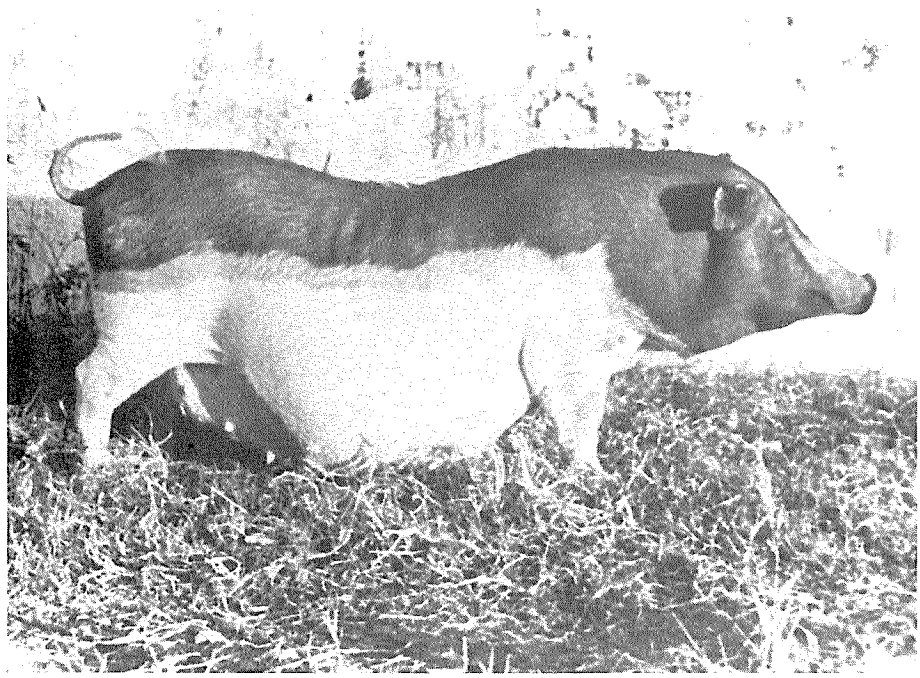

Plate 10.34 Sow

SOUTH YUNNAN SMALL-EAR PIG
Yunnan Province

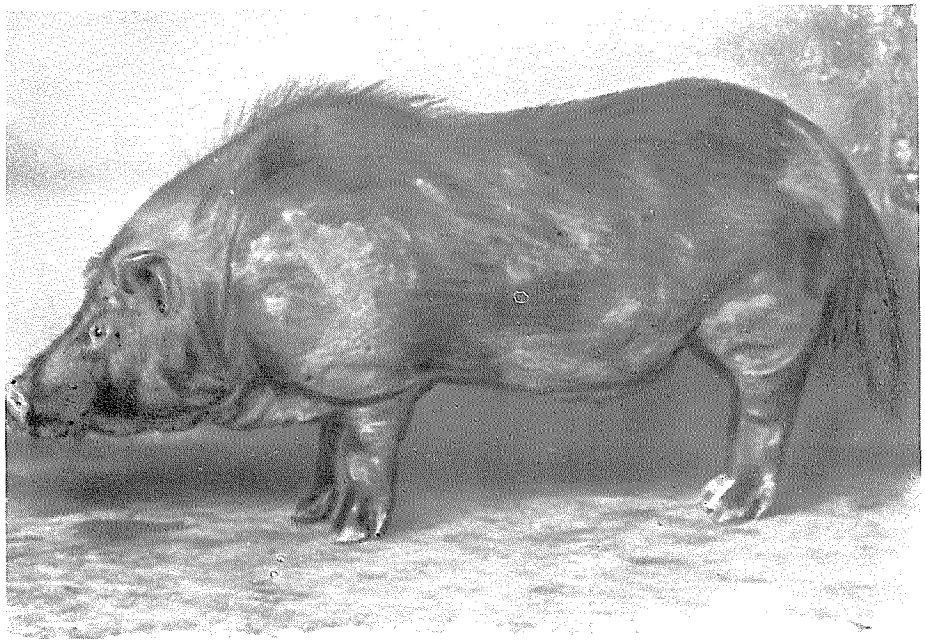

Plate 10.35 Boar

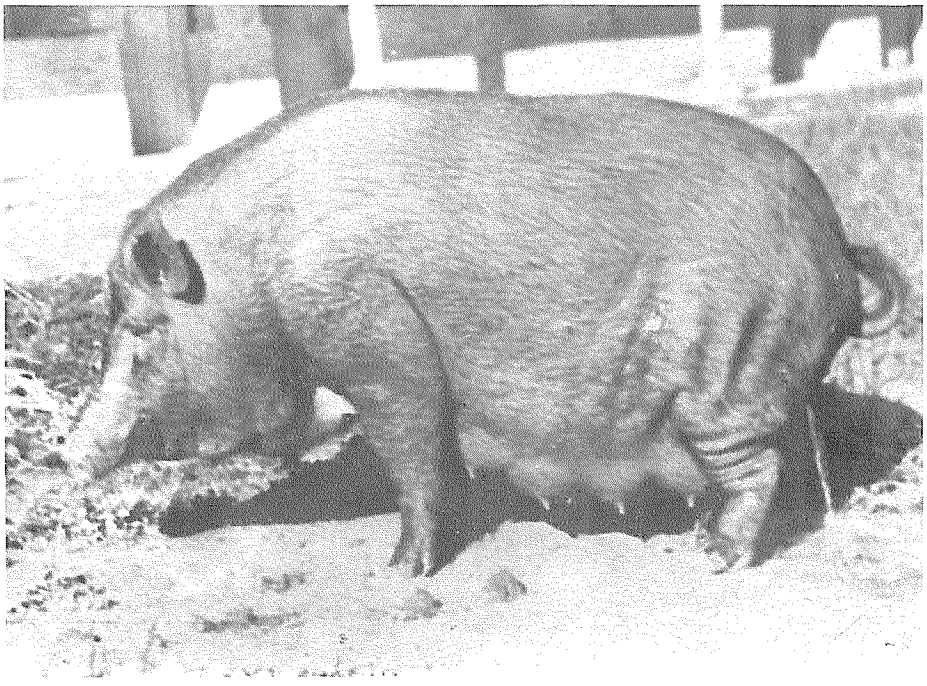

Plate 10.36 Sow

NEIJIANG PIG
Basin of Sichuan Province

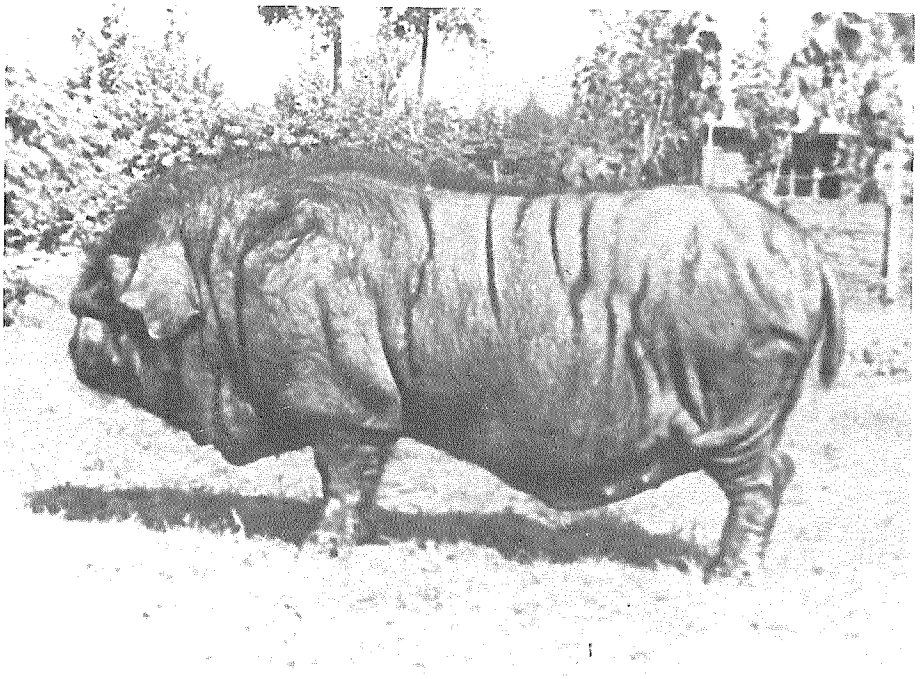

Plate 10.37 Boar

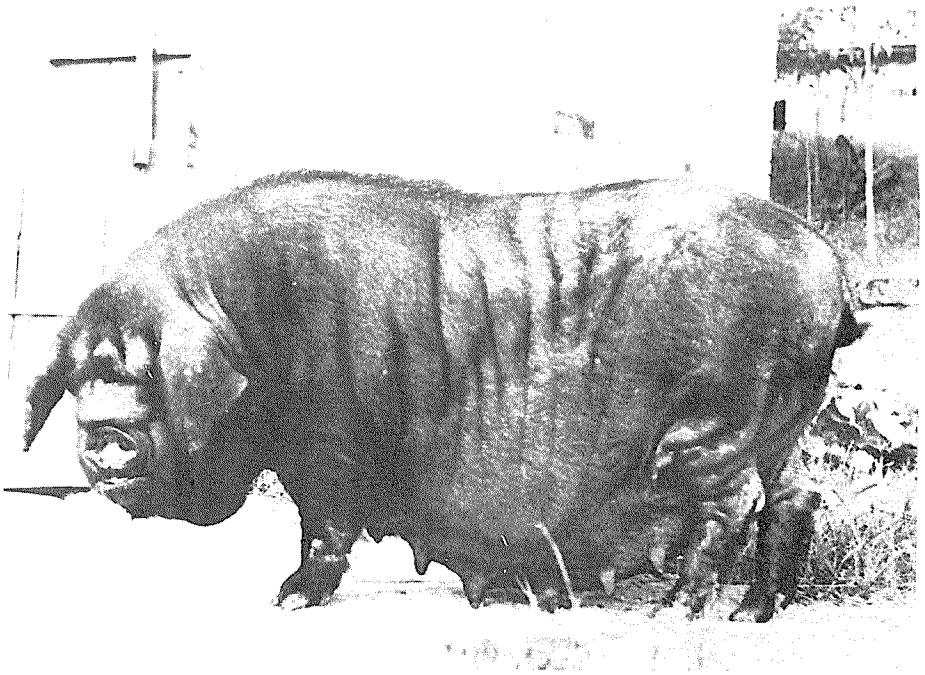

Plate 10.38 Sow

KELE PIG
West Guizhou Province

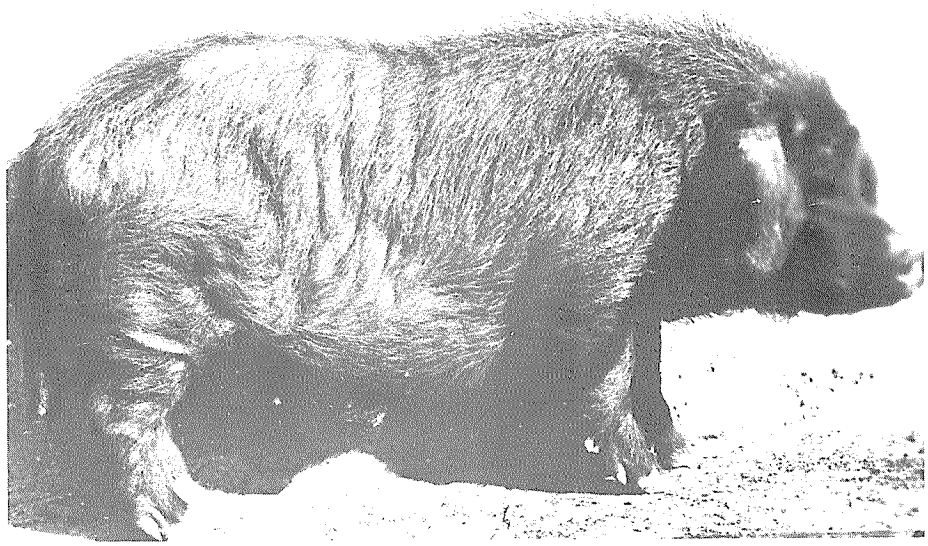

Plate 10.39 Boar

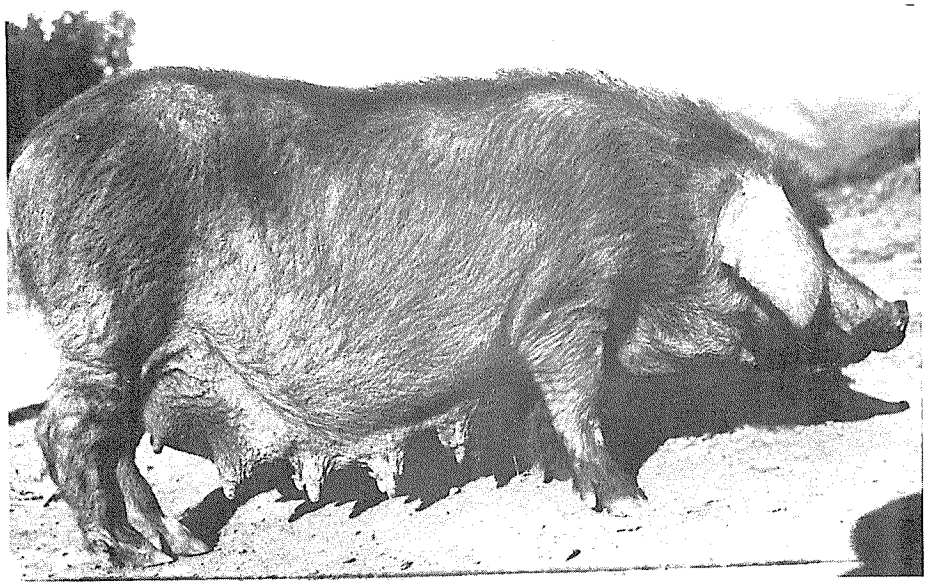

Plate 10.40 Sow

HEZUO PIG
Gansu Province

Plate 10.41 Sow

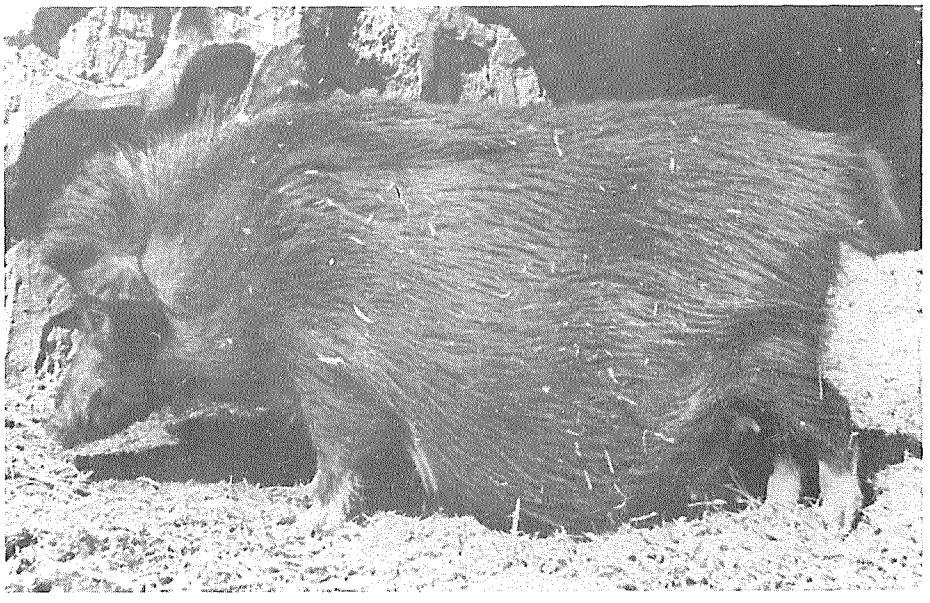

Plate 10.42 Sow in village

TIBETAN PIG
West Sichuan Province

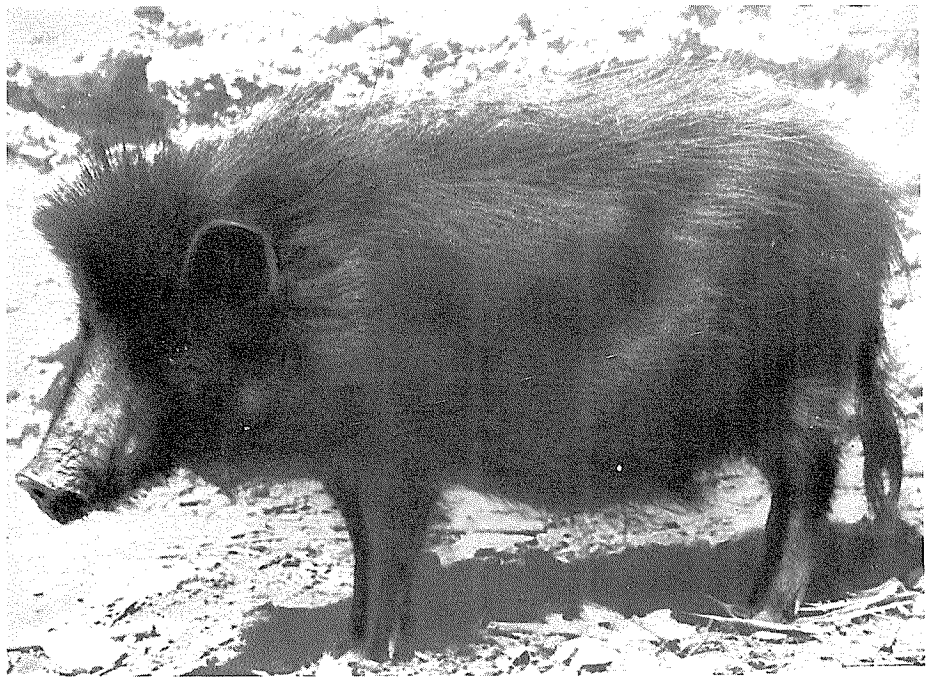

Plate 10.43 Boar

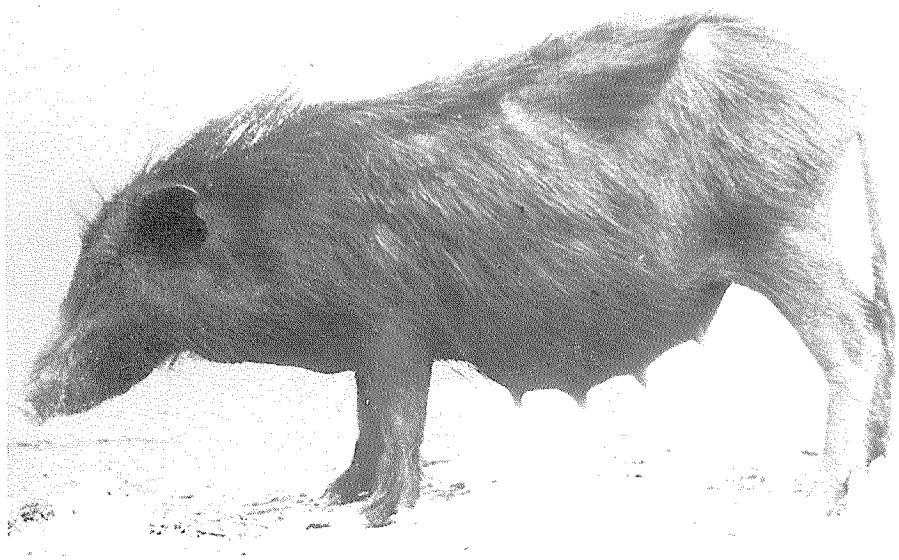

Plate 10.44 Sow

HARBIN WHITE PIG (Meat/lard type)
Heilongjiang Province

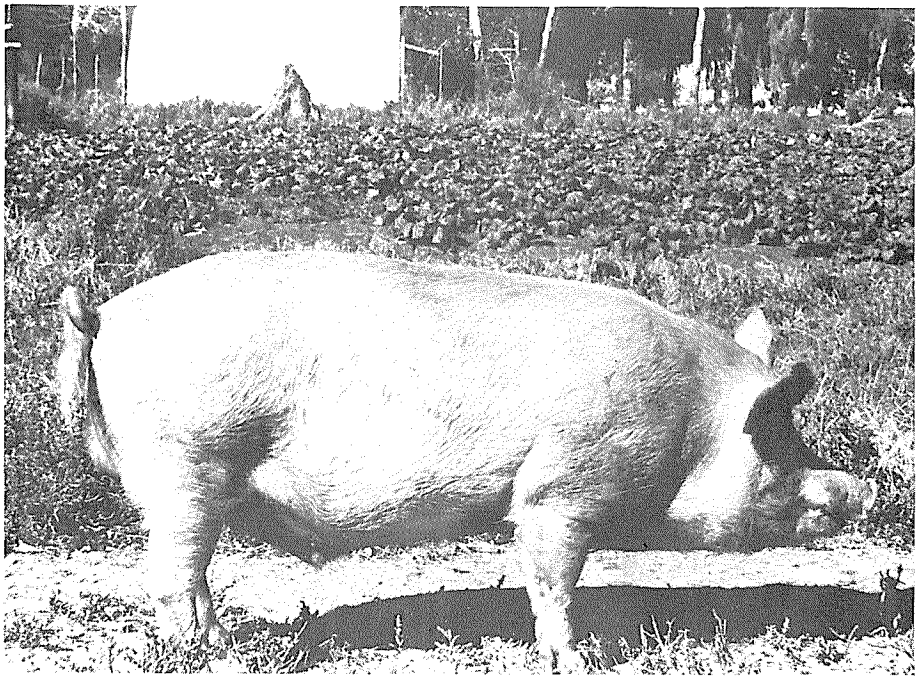

Plate 10.45 Boar

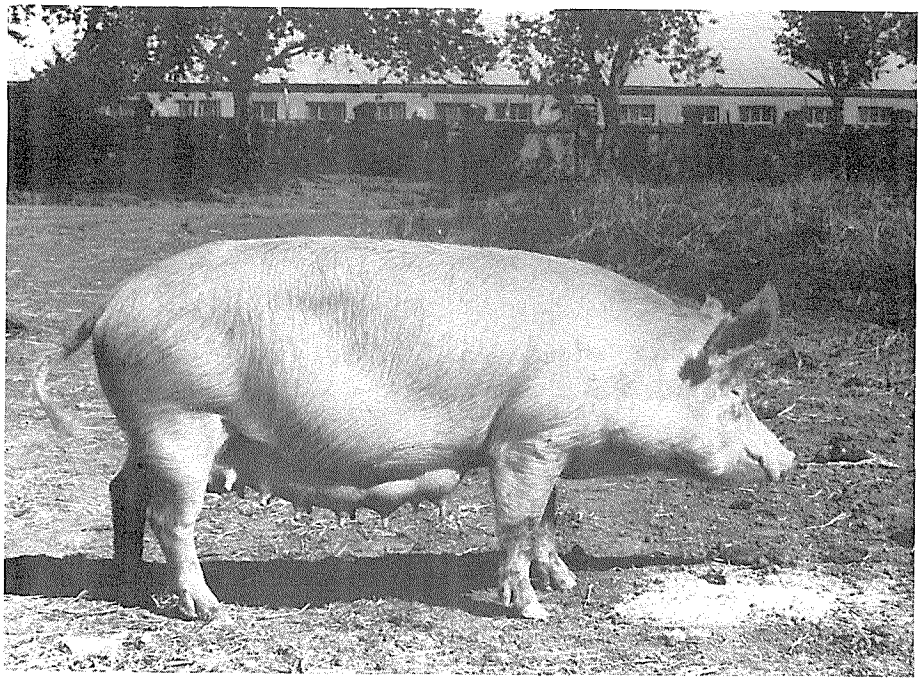

Plate 10.46 Sow

NEW HUAI PIG (Meat/lard type)
North Jiangsu Province

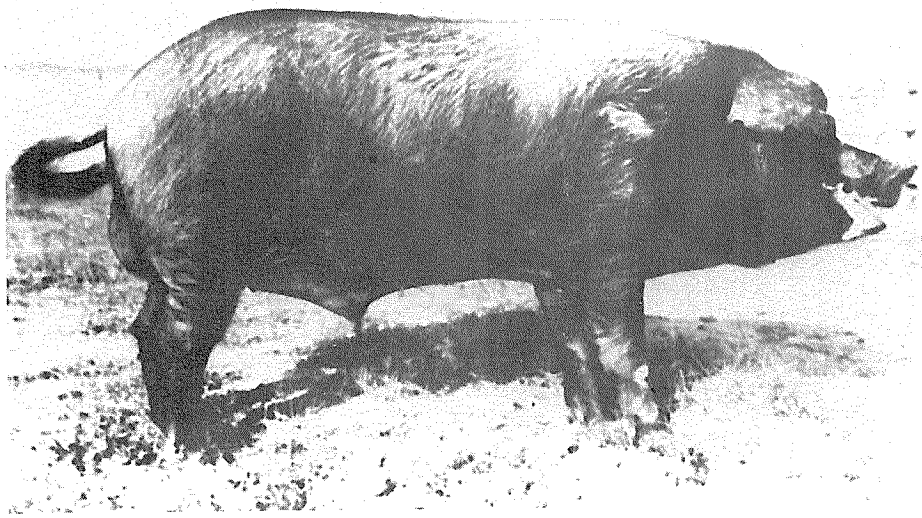

Plate 10.47 Boar

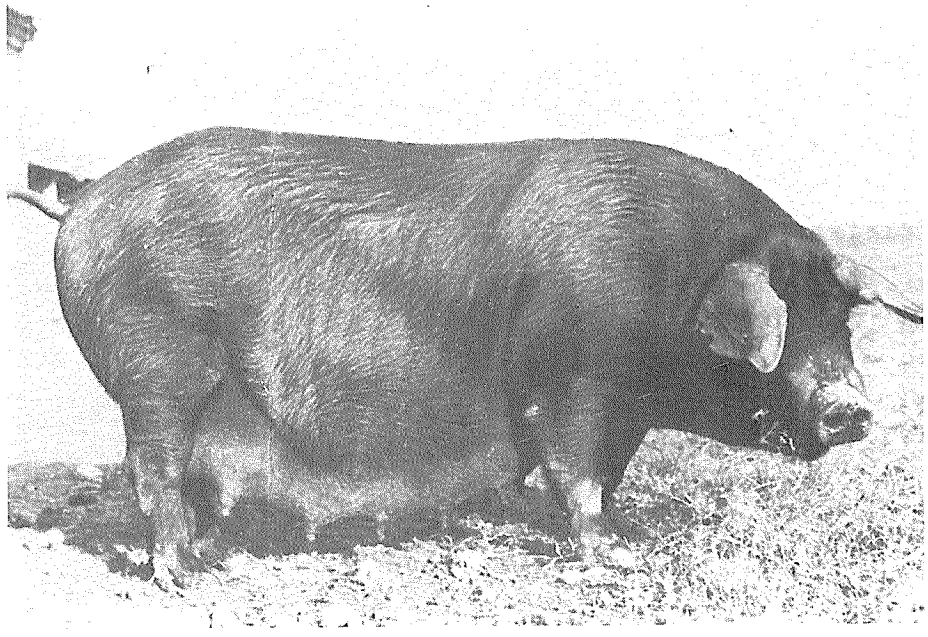

Plate 10.48 Sow

BEIJING BLACK PIG
Beijing

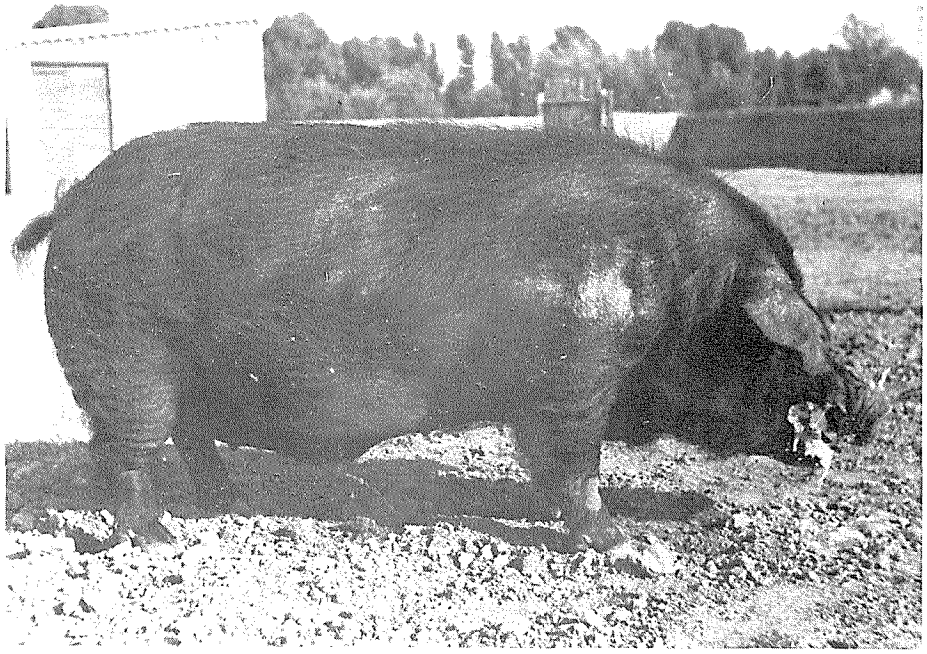

Plate 10.49 Boar

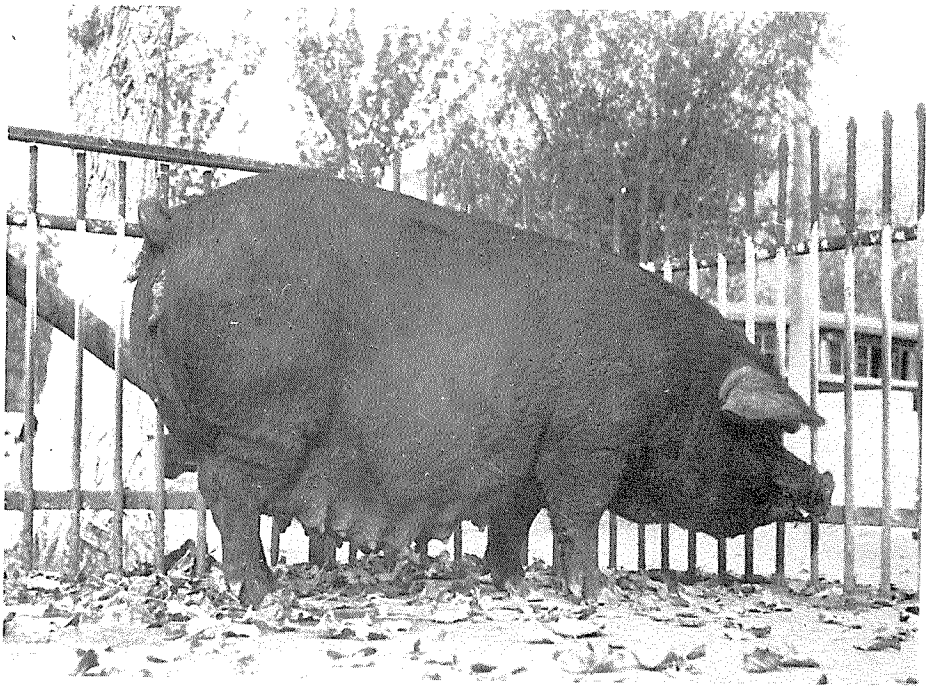

Plate 10.50 Sow

CHAPTER 11

SOME CONCLUSIONS

The breed traits of livestock are considered to be determined by three factors, heredity, breeding (including both natural and artificial selection) and ecological (or environmental) conditions. The importance of genetics and breeding are well recognized, but the influence of ecological conditions on breed characteristics is not always fully realized. The facts presented in the following paragraphs will further illustrate the close relationship between livestock and their ecological or environmental conditions.

11.1 RELATION BETWEEN DISTRIBUTION OF LIVESTOCK SPECIES AND ECOLOGICAL CONDITIONS.

The ecological conditions which influence distribution of livestock are climate, altitude and vegetation type. These factors are themselves closely related, but it is instructive to examine the influence of each within regions.

11.1.1 Climate

Since animals in the pastoral area graze all year round, the climate exerts a great influence on the distribution of livestock species. For instance, in the pastoral areas of Inner Mongolia (14), the climate, from east to west, gradually changes from semi-humid to arid, the vegetation types change from pasture to steppes, then to desert-steppes, and the

Table 11.1 CLIMATE IN RELATION TO LIVESTOCK DISTRIBUTION IN INNER MONGOLIA

Area	Humidity (Annual precipitation - mm)	Livestock species (% of total)						
		Horse	Ass & Mule	Camel	Cattle	Sheep	Goat	Pig	Total
Northeast (East of Hulun Buir Prefecture)	Semi-humid (300-500)	8.1	0.1	0.3	11.4	67.8	3.3	9.0	100
North (East of Xilin Gol Prefecture)	Semi-arid (250-300)	8.5	0.1	0.2	12.2	65.3	10.7	3.0	100
West (Bayannur & Alxa Prefecture)	Arid (200)	1.2	1.6	12.5	1.4	32.5	50.2	0.6	100

Source: 2; percentages calculated by Cheng, P.L.

livestock species change accordingly; the proportion of cattle and horses gradually decreases, while that of sheep gradually increases, and further on, in the desert-steppes of the west, the animals are mainly sheep and camels (Table 11.1).

11.1.2 Altitude

The distribution pattern of livestock species is closely related to altitude. Yaks and Tibetan sheep are mainly at higher (4,500-6,000 m), and cattle and pigs at lower altitudes (below 3,500 m - Table 11.2).

Table 11.2 ALTITUDE IN RELATION TO LIVESTOCK DISTRIBUTION IN CHINA

Species	Mainly located at altitude (m)	Percent of livestock species at high altitudes		
		5,000 m (%)	4,200-4,500 m (%)	4,000 m (%)
Sheep	4,500-6,000	40-65	50-60	20-30
Yak	4,500-6,000	25-50	4-10	3-5
Horse & ass	3,500-4,500	2-4	1-2	2-3
Yellow cattle	<3,500	nil	5-6	7-30
Goat	All altitudes	25-40	20-30	20-40
Pig	<3,500	nil	1-2	3-5

Source: 9

11.1.3 Vegetation type

In the pastoral areas of Inner Mongolia, there is little difference in altitude from east (900-1,300 m) to west (1,000-1,500 m). However, there are marked differences in climate, annual precipitation varying from 400 to 500 mm in the east to less than 150 mm in the west, and vegetation types varying from forest pasture to desert-steppe (Figure 11.1), while the coverage of grasses gradually decreases and the proportion of shrubs in plant communities gradually increases. Livestock species change accordingly; horses and cattle decrease in numbers, while goats and camels increase (Table 11.3).

In addition to the changes in species, the quality of livestock is also subject to change according to the types of grassland. For example, there are marked differences in the body size of mature Mongolian cows raised on different types of grassland (Table 11.4).

11.1.4 Joint effects

The joint effects of climate, altitude and vegetation type on livestock distribution are summarized in Table 11.5. Yaks and Tibetan sheep are mainly located on cold alpine pasture at an altitude of 4,500-5,000 m and Tibetan horses at 3,500 - 4,500 m; cattle and swine are

Table 11.3 TYPES OF GRASSLAND IN RELATION TO LIVESTOCK DISTRIBUTION IN INNER MONGOLIA

Type of grassland	Natural Conditions			Vegetation		Livestock species					
	Altitude (m)	Annual mean temperature (°C)	Annual precipitation (mm)	Coverage of grasses (%)	Shrubs in plant communities (%)	Horse (%)	Camel (%)	Yellow cattle (%)	Sheep (%)	Goat (%)	Total (%)
Forest pasture	900-1,300	0	400-500	60-80	0	9	2	13	67	9	100
Steppe	600-900	1-4	200-300	35-50	10	8	2	16	53	21	100
Semi-desert-steppe	900-1,500	6	150-200	15-25	56	4.5	1.5	6	60	28	100
Desert-steppe	1,000-1,500	6	< 150	5-10	90	1.5	6	2.5	35	55	100

Source: 13; data tabulated by Cheng, P.L.

Table 11.4 BODY SIZE OF MATURE MONGOLIAN COWS AS INFLUENCED BY TYPE OF GRASSLAND

Vegetation type	Cows (number)	Average height (cm)	Average weight (kg)
Pasture	17	n.a.	366
Steppe	30	114	290-350
Semi-desert-Steppe	15	111	270-330
Desert-Steppe	15	106	240-280

Source: 12

Table 11.5 ECOLOGICAL CONDITIONS FOR MAIN DISTRIBUTION AREAS OF TIBETAN LIVESTOCK

Species of livestock	Mainly distributed at altitudes (m)	Annual precipitation (mm)	Climate	Main vegetation Types of grassland
Yak	Above 4,500	Above 500	Cold, semi-humid	Alpine pasture
Sheep	Above 4,500	Below 500	Cold, semi-humid	Alpine steppe
Goat	All altitudes	Below 200	Arid	Desert-steppe, shrubs
Horse	3,500-4,500	Below 500	Semi-humid	Alpine pasture
Yellow cattle and pig	Below 3,500	500-1,000	Temperate, semi-humid	Same as agricultural areas

Source: 10

mainly located at an altitude of less than 3,500 m, where the climate is almost similar to that of the agricultural areas.

11.2 RELATION BETWEEN PHYSIOLOGICAL CHARACTERISTICS AND ALTITUDE

11.2.1 Weight of lungs

On the Tibetan Plateau, the lungs of livestock become heavier at higher altitudes, because they have to do much more work in taking up oxygen in the rarefied atmosphere. Changes in the ratio of weight of lungs

to body weight (as a percentage) for yak and Tibetan sheep at different altitudes are shown in Table 11.6; numbers, however, are small.

Table 11.6 RATIOS OF WEIGHT OF LUNGS TO LIVEWEIGHT FOR YAK AND FOR TIBETAN SHEEP AT DIFFERENT ALTITUDES ON THE TIBETAN PLATEAU

Livestock	Altitude (m)	Sex (number)	Weight of lungs / Liveweight %
Yak	2,200 - 3,200*	M and F (n.a.)	0.75
		F (n.a.)	0.98
	4,400	M (4)	1.40
		F (2)	1.16
Tibetan sheep	4,000	M(11)	1.41
	4,300	F (2)	1.46
	4,700	F (1)	2.45

Source: 9 (data collected 1974): * From USSR, quoted by (9)

11.2.2 Respiration and pulse rates and blood characteristics

There are remarkable physiological changes in both respiration and pulse rates and blood characteristics of animals at different altitudes, as shown in Tables 11.7 and 11.8 respectively. Some points may be summarized as follows:

(i) Respiration and pulse rates and the number of red corpuscles (RBC) and haemoglobin (Hb) content in the blood rise as altitude increases, up to a certain point. This seems to reflect a mechanism of physiological compensation.

(ii) Above 4,500 m, respiration rate appears to fall for goats, but is still higher than at altitudes below 1,000 m. For yellow cattle, the fall may be after 3,900 m, to values below those at low altitudes, but the numbers of observations so far are small. Pulse rates, on the other hand, do not fall at the highest altitudes for any species (Table 11.7).

(iii) RBC and Hb may show a slight fall at the highest altitudes for sheep, but not for goats, while for yellow cattle there is no consistent trend. RBC rise more rapidly than Hb with increasing altitude for sheep and goats (Table 11.8).

(iv) It is assumed there is a threshold for physiological accommodation to altitude, due to the inhibitory effect of lack of oxygen. This is only a supposition; the mechanism is not clear, and requires further investigation.

Table 11.7 CHANGES IN RESPIRATION AND PULSE RATES OF LIVESTOCK AT DIFFERENT ALTITUDES ON THE TIBETAN PLATEAU (as a percentage of values at lower altitudes)

Species		R (respiration) and P (pulse) rates at altitudes (m); Below 1,000	1,700-2,900	3,400-3,900	4,100-4,500	4,700
Sheep	(n)	(265)	(10)	(85)	(79)	(20)
	R	100	110	165	168	173
	P	100	109	111	126	146
Goat	(n)	(152)	(24)	(20)	(49)	(19)
	R	100	141	152	158	136
	P	100	112	119	128	126
Yellow cattle	(n)	(129)	(35)	(45)	(10)	(10)
	R	100	97	103	97	88
	P	100	102	105	103	110
Yak	(n)				(30)	(29)
	R				100	137
	P				100	105

Source: 9; percentages calculated by Cheng, P.L.

Table 11.8 CHANGES IN NUMBER OF RED BLOOD CORPUSCLES AND HAEMOGLOBIN CONTENT AT DIFFERENT ALTITUDES ON THE TIBETAN PLATEAU

Species		RBC and Hb content at altitudes (m) 1,000 (%)	1,700-2,900 (%)	3,400-3,900 (%)	4,100-4,500 (%)	4,700 (%)
Sheep	(n)	n.a.	(13)	(54)	(77)	(30)
	RBC	100	116	118	128	121
	Hb	100	103	102	111	107
Goats	(n)	n.a.	(24)	(29)	(48)	(29)
	RBC	100	109	113	128	149
	Hb	100	100	100	112	115
Yellow cattle	(n)	n.a.	(25)	(26)	(20)	(10)
	RBC	100	128	117	100	107
	Hb	100	107	115	100	110

Source: 9; percentages calculated by Cheng, P.L.

(v) Acclimatization to high altitude, as manifested by physiological changes, seems to differ between species and between breeds. Simmental and Sanhe cattle, introduced from the lower plains, were not adapted to an altitude of 3,820 m on a farm on the Tibetan Plateau, the death rate being 33 percent in Simmentals, 22 percent in Sanhe and 78 percent in Friesian dairy cattle, in a period of less than one year (9). No deaths occurred when the animals were moved from this farm to one at an altitude of 3,000 m. These breeds differed from Tibetan cattle in physiological characteristics.

Xinjiang Fine-wool sheep seemed to be well adapted to an altitude of 3,820 m, and showed the same physiological characteristics as Tibetan sheep (9).

11.3 RELATION BETWEEN BREEDS AND THEIR ECOLOGICAL CONDITIONS

The close relationship between livestock breeds and their ecological conditions is illustrated by the following examples:

11.3.1 Horses

Northern horse breeds are bigger in body size than southern breeds. This may be attributed to the fact that the north is cold and dry, while the south is temperate and humid (Table 11.9).

The correlation coefficients between body size and natural conditions are shown in Table 11.10.

11.3.2 Pigs

Recently, relationships were found between 48 pig breeds and their ecological conditions≠, as revealed by correlation coefficients from multiple-factor-analysis by using cluster techniques, to analyse body conformation, back fat and climate:

	Annual temperature (r=)	Annual precipitation (r=)
Body conformation (concave back and pendulous belly)	0.79*	0.76*
Back fat thickness	0.44*	0.51*

* $P < 0.05$

Incidentally, relationships were also found between characteristics within a breed to which not much attention has previously been paid, such as the phenotypic correlation between ear size and teat number ($r=0.68$, $P<0.05$).

≠ Based on data of 48 pig breeds taken from References 1 and 11. The author wishes to express his thanks to Hsu, K.Y. for his kindness in providing unpublished results from Reference 8.

Table 11.9 RELATION BETWEEN BODY SIZE AND NATURAL CONDITIONS IN NORTHERN AND SOUTHERN HORSE BREEDS

	Northern** horse breeds	Southern*** horse breeds
Natural conditions:*		
Altitude (m)	737	1,794
Annual mean temperature (°C)	5.0	14.6
Annual precipitation (mm)	378	1,107
Annual sunlight (hrs)	2,884	2,082
Average body measurements:		
Body height (cm)	128	115
Body length ratio (%)≠	105	99
Heart girth ratio (index)	123	111
Cannon-bone girth ratio (%)	13.4	11.7

Source: 16

* Ten year averages of local or neighbouring weather stations.

** Northern breeds: Ujumqin (Inner Mongolia), Beicha-tieti, a type of Mongolian, distributed in a restricted area in the north of Hebei Province, and Zhangbei, a cross between Mongolian and exotic light breeds, distributed to the north of Hebei Province and Inner Mongolia.

*** Southern breeds: Jianchang (Sichuan Province), Lijiang (Yunnan Province) and Guizhou (Guizhou Province).

≠ All ratios are to body height.

Table 11.10 CORRELATION COEFFICIENTS BETWEEN BODY SIZE AND NATURAL CONDITIONS FOR HORSE BREEDS

Body size (including both northern & southern horse breeds)	Altitude (r=)	Annual mean temperature (r=)	Annual precipitation (r=)
Body height	-0.84*	-0.90*	-0.94*
Body length ratio	-0.81	-0.88*	-0.69
Heart girth index	-0.77	-0.95*	-0.73
Cannon-bone girth ratio	-0.94*	-0.71	-0.71

*P <0.05

Source: 16

11.4 ADAPTATION OF INTRODUCED BREEDS TO DIFFERENT ECOLOGICAL CONDITIONS

The adaptation of domestic animals to a new environment is mainly reflected in body size, performance and health. Exotic animal breeds, such as the long-wool sheep breeds of Australia, New Zealand or England, if introduced to different parts of China, will certainly vary in their adaptability under different ecological conditions.

For example, the Border Leicester was introduced from Australia to the Linzhou Stud Sheep Farm in Tibet (15), which has a high altitude (4,200 m), low temperature (annual mean temperature 5.6°C), low rainfall and humidity (annual precipitation 533 mm, concentrated in August and September, annual relative humidity 52 percent) and a poor vegetation type of grassland, as compared with the ecological conditions of the breed's place of origin in Australia. In spite of efforts made to improve feeding and management practices, such as giving concentrates all year round, the purebred offspring produced in Tibet were small in body size (with a decrease in liveweight of 52 percent in rams, and 27 percent in ewes), and had a low fleece weight (with a decrease of 37 percent in rams and 20 percent in ewes). Similarly, the Romney Marsh from Australia and New Zealand was introduced to the Hudong Stud Sheep Farm on the Qinghai Plateau, which is higher in altitude (3,200 to 3,900 m), lower in temperature (annual mean temperature 0.47°C) and less humid (annual precipitation 394 mm) than their places of origin. Consequently, the offspring produced therein were lower in productivity and prolificacy (4) due to the marked difference in environmental conditions.

In a recent report (5), comparisons were made of the productivity and adaptability of purebred animals raised under different ecological conditions, and also of their descendents 12 years after their introduction. All the results revealed that they were less adapted to the new environment. The following tables serve as illustrations of differences in adaptation:

(i) Environmental conditions for New Zealand and the Long-wool Stud Sheep Farms (Table 11.11).

(ii) Performance of the long-wool sheep breeds raised under different ecological conditions (Table 11.12).

(iii) Performance of long-wool sheep breeds at introduction (1968) and their descendents 12 years later (1980) in Inner Mongolia and on the Qinghai Plateau (Table 11.13).

It is fully demonstrated in Tables 11.12 and 11.13 that the long-wools were not well-adapted to the local ecological conditions, either in Inner Mongolia or on the Qinghai Plateau, as evidenced by decreases in body size, productivity and prolificacy, and an increase in death rate (as high as 24 percent in the Border Leicester in Qinghai). However, purebred offspring produced at the Stud Sheep Farms in Anhui and Jiangsu Provinces almost maintained their original breed characteristics, when compared with the animals first introduced 12 years previously in 1968, as far as body conformation and productivity were concerned, because they were raised under approximately similar ecological conditions to those of their places of origin (Table 11.11).

Table 11.11

NATURAL CONDITIONS FOR LONG-WOOL SHEEP BREEDS IN NEW ZEALAND AND AT DIFFERENT LOCALITIES IN CHINA

	Altitude	Temperature		Annual precipitation	Relative humidity
		Annual mean	Coldest month mean		
	(m)	(°C)	(°C)	(mm)	(%)
Place of origin:					
New Zealand	200	n.a.	12 (July)	750-1,500	n.a.
Present localities:					
Dailiu, Anhui	100-200	15.3	2.1 (Jan.)	1,044	75.0
Xundian, Yunnan	1,900-2,800	14.4	7.0	997	71.4
Tongtaihuo, Inner Mongolia	1,290	4.7	-14.0	200	47.2
Hudong, Qinghai	3,200-3,900	0.5	-12.8	394	55.3
Binhuai, Jiangsu	2	13.4	0.2	879	78.3

Source: 6

Table 11.12 PERFORMANCE OF LONG-WOOL SHEEP BREEDS RAISED UNDER DIFFERENT ECOLOGICAL CONDITIONS

Long-wool breeds	Localities	Body weight (1977-80)	Fleece weight (1979-80)	Fibre length (1977-80)	Lambing rate (1977-80)	Survival rate (1977-80)	Weaning rate (1977-80)	Death rate (%) (1977-80)
N.Z.Romney Marsh (mature ewes)	Dailiu,* Anhui	46.6kg	5.4kg	13.9cm	126%	98%	101%	2.2%
	Compared with Dailiu, increase (+) or decrease(-) by percentage (%)							
	Xundian, Yunnan	-25.6	+3.9	-28.1	n.a.	n.a.	n.a.	n.a.
	Tongtaihuo, Inner Mongolia	-29.1	-36.0	-15.3	-14.8	-41.5	-59.8	15.3
	Manyuan, Qinghai	-25.6	+3.9	-28.1	n.a.	n.a.	n.a.	n.a.
	Hudong, Qinghai	-29.0	-24.4	- 5.6	-20.6	n.a.	-45.7	12.1
Border Leicester (mature ewes)	Xundian** Yunnan	67.0kg	5.4kg	16.6cm	141%	88%	64%	10.3%
	Compared with Xundian, increase (+) or decrease (-) by percentage (%)							
	Tongtaihuo, Inner Mongolia	-48.5	-40.6	-18.3	-12.2	-36.7	-33.9	12.0
	Manyuan and Hudong Qinghai	-42.3	n.a.	-24.4	-29.2	n.a.	-41.1	23.7

Sources: 3,4,5; tabulation by Cheng, P.L.

* Altitude and climatic conditions (temperature and rainfall) are close to those of the place of origin.

** Climatic conditions are close to those of the place of origin. (Ref. Table 11.11).

Table 11.13

PERFORMANCE OF LONG-WOOL SHEEP BREEDS AT INTRODUCTION (1968) AND OF THEIR DESCENDENTS 12 YEARS LATER (1980) AT TWO CENTRES
(Introduced animals and descendents measured at same age)

Long-wool (Breed and origin)	Tongtaihuo Stud Sheep Farm (Inner Mongolia)				Hudong Stud Sheep Farm (Qinghai Province)			
	Body weight		Fleece weight		Body weight		Fleece weight	
	1968 (kg)	1980* (%)	1968 (kg)	1980 (%)	1968 (kg)	1980 (%)	1968 (kg)	1980 (%)
Romney Marsh								
England	53.8	-26.9	4.0	-34.7	53.6	-20.6	3.7	- 6.2
New Zealand	40.7	-18.9	4.5	-22.9	43.8	-24.4	4.7	-12.8
Australia	43.3	-19.3	4.0	-12.4	-		-	
Border Leicester	45.1	-23.5	3.4	- 4.8	48.8	-23.0	4.9	-25.9
Lincoln	51.9	- 4.8	5.7	- 2.8	-		-	

Source: 4, 7;
* Tabulation and percentage change 1968 to 1980 by Cheng, P.L.

11.5 CONCLUSIONS

The preceding examples have covered distribution of livestock species and breeds, as well as breed characteristics such as body conformation, performance and reproduction. They have illustrated the relationship of these features to environment, and so enable conclusions to be drawn about future courses of action.

Since an organism cannot live without the influence of its existing environment, we have to take ecological conditions into consideration when planning a regionalization programme. That is, we must decide firstly, what species, and secondly, what breeds of animals will be most suitable under the specified environmental conditions. We cannot subjectively develop, or introduce, a certain species or breed of animals without considering these conditions. Failure has resulted, for instance, from the inappropriate introduction of Black-white dairy cattle to the high, cold plateau where yaks are raised, or the introduction of pigs from the Temperate to the Tropical Belt. "Regionalization" in animal husbandry means the best combination between the animal and its environment, so as to ensure the maximum animal products for human consumption. Studies on the ecological characteristics of livestock will undoubtedly speed up the development of animal industry.

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CHAPTER 12

RETROSPECT AND PROSPECT

12.1 STRESS ON THE IMPORTANCE OF LIVESTOCK RESOURCES

China is endowed with a rich variety of livestock resources. According to preliminary estimates, there are over 200 local breeds (or types) of different species of domestic animals, about half of them being pigs, of which 47 pig breeds have already been documented by specialists and the results published (3). Some livestock breeds, such as the Guangxi Pony (Chapter 2) and the Yunnan Dulong Cattle (Chapter 4) are awaiting further identification. Additional investigations seem necessary to determine precisely how many livestock breeds we have in China, and a nationwide survey is currently being carried out under the auspices of the Ministry of Agriculture, Animal Husbandry and Fisheries.

To illustrate the relationship between livestock breeds and their ecological conditions, 94 breeds (or types) are enumerated in this book: 14 breeds of horse, 2 of camel, 14 of yellow cattle, 4 of dairy and milk/meat dual-purpose cattle, 8 (types) of water buffalo, 6 (types) of yak, 13 breeds of sheep, 18 of goat and 15 of swine.

The term "livestock resources" (animal genetic resources) used in the book includes all breeds, types, varieties and populations of domestic animals (excluding birds) that inhabit the 9.6 million square kilometres of China's territory under both improved and unimproved conditions. The breeds (or types) listed, however, are only a part of China's total animal genetic resources.

The great variety of livestock breeds in China will undoubtedly provide valuable material for the advancement of animal genetics and breeding. They are not only an important treasure to China, but also a valuable asset to the world. Chinese pigs have already influenced the development of well-known pig breeds in other countries, such as the Large Yorkshire and Berkshire in England, and the Poland-China in the United States (4). Recently, scientists from other countries (for example, France, United States, Canada) have paid considerable attention to the native livestock breeds in China, such as Meishan, Fengjing and Jinhua pigs, and Hu sheep, because of their remarkable prolificacy. Some scientists have introduced these breeds into their own countries to improve their animals, while others have expressed their intention to develop cooperative studies on breed characteristics. For example, Meishan, Jiaxing Black and Jinhua pigs were introduced to France early in 1979.

So there is every reason to stress recognition within China of the value of her animal genetic resources.

12.2 PROGRESS OF LIVESTOCK IMPROVEMENT IN CHINA

Naturally we have to improve our indigenous animals, since most of them are low in productivity when compared with prominent exotic "specialized breeds", such as the Thoroughbred for racing, the Holstein-Friesian for milk, the Merino for fine-wool and so on. Different exotic "specialized breeds" have been introduced and used in crossbreeding for years, especially since 1949, immediately after the foundation of the People's Republic of China.

Artificial insemination (AI) in different species of livestock was widely applied in China in the early 1950's and was followed by extensive use of frozen semen (mainly in cattle) in the 1960's. This has led to epoch-making progress in livestock improvement. Incomplete statistics for some Provinces or Autonomous Regions in 1979 (1) show the percentages of females of various species on which AI was used, and the conception rates to first insemination and overall (Table 12.1).

AI can be, and has been, used not only for crossing but also for improvement within indigenous breeds. Its extensive application both in crossbreeding and upgrading has made possible an unprecedented rate of increase in the production of milk, meat and fibre per animal. Furthermore, many new breeds have been developed after long-term selective breeding under various local environmental conditions.

12.3 WHAT HAPPENED TO OUR NATIVE BREEDS?

The ease of replacing a population by AI makes possible a very rapid changeover of genetic composition of the native breeds. As a result, there is an attrition of genetic resources. Special attention should be called to the fact that many breeds of each species of domestic animals in the world are rare, endangered or vulnerable. It has been pointed out in (8) and (6), that there have been rapid changes in livestock in Europe and the Mediterranean Basin; of the total number of breeds which existed in 1970, 115 indigenous breeds are threatened by extinction and only 30 are holding their own. Rapid genetic improvements have not been achieved without paying a price.

China is facing the same situation as other parts of the world. Many indigenous breeds are declining in numbers, and some are on the verge of extinction. If they became extinct, some of the valuable genetic resources might be lost forever. It is an advantage to introduce certain superior exotic breeds for crossbreeding, and to use AI as a powerful means for rapid and extensive improvement of the productivity of native animals. However, there are two sides to a coin; the native breeds are the basis of national animal improvement programmes, and the fate of native breeds should be taken into serious consideration.

A well-planned and systematic crossbreeding programme may be essential for exploiting hybrid vigour to increase productivity. However, inadequate or uncontrolled crossings with many exotic breeds at the same time, or among the hybrids of unknown origin, would gain nothing in genetic progress. And even worse, they might ruin the genetic purity of the native breeds as a basis for crossbreeding.

Table 12.1 ARTIFICIAL INSEMINATION OF FARM ANIMALS IN CHINA (SEP.1979)

Class of farm animal	Areas (Year reported)	AI Females Number	% of total	Conception rate % 1st insemination	Final	No. of females per sire
Horse	Northeast 3 Provinces (1978)	432,180	30	40-50	70-81	86
Yellow Cattle	13 Provinces & Regions (1979)	655,155	12	37-75	37-85	934
Dairy Cattle	Northern	About 60,000)	94	40-50	85	1,000-4,000
	Southern (1977)	24,209)		42	82	153-354
Water Buffalo	13 Provinces & Regions (1979)	39,129	0.8	33	56	83
Yak	Sichuan Province (1976-77)	3,499	n.a.*	n.a.	45	n.a.
Sheep	9 Provinces & Regions (1978)	6,685,383	50	50-85	85-94	152
Dairy Goat	Shanxi Province (1978)	About 4,000	75	85	n.a.	n.a.
Pig	29 areas (1975)	970,019	4	n.a.	n.a.	n.a.
	4 areas (1975)	About 520,000	25-30	50-85	80-96	n.a.

Source: 1; * n.a. = not available

In some quarters the idea is held that native breeds should eventually vanish and be replaced by hybrids or exotic breeds. This might be of practical significance for improving dairy cattle and fine-wool sheep, but only to a certain extent, and would probably not be of value in swine production.

Even if some use of exotic breeds may be of value, it seems unwise to throw away the native breed as a foundation. There must be an awareness that care should be taken to evaluate national animal genetic resources in China, so as to avoid loss of potentially useful genetic material through replacement, crossing or indiscriminate breeding activities. Since the large numbers of native animals are the basis of national improvement programmes, ways and means must be found by which rapid genetic progress can be made, through intensive selection and/or adequate introduction of breeding material, without losing the valuable genetic resources of our native breeds.

12.4 APPROPRIATE EVALUATION OF NATIVE BREEDS NEEDED

The indigenous breeds are indeed low in productivity, but they are well adapted to stresses in environmental conditions, such as solar radiation, periodic drought and various diseases. All the desirable traits possessed by the indigenous breeds are needed in exotic "specialized breeds", especially adaptability to adverse environments.

It should be recognized that although genotypes may easily be changed, the environments to which they are adapted are less easy to reproduce. For example, Tibetan cattle and sheep are well adapted to high altitude, strong solar radiation and rarefied atmosphere, as a result of both natural and man-made selection for generations. These animals can exist and produce progeny under very specific ecological conditions on the Tibetan Plateau, where Holstein-Friesian and Simmentals cannot. Lincoln long-wools from a humid habitat eventually lost their lustre when they were introduced to an arid environment in Inner Mongolia. Border Leicester sheep on the Qinghai Plateau became low in fertility, or even infertile, and Romney Marsh sheep taken from New Zealand to Inner Mongolia suffered from respiratory tract diseases.

The valuable genetic material present in the native breeds is an asset to animal breeding under specific ecological conditions and may exert an influence in genetic progress which we cannot foresee at present. It will be too late to save these breeds if we do not take urgent measures to preserve them now. They should not be preserved only to save them from extinction, but should be selected, improved and developed to utilize their potential to the full.

12.5 CONSERVATION OF VALUABLE GENETIC RESOURCES

Various methods and measures can be used for the conservation of breed resources. Establishment of breeding farms is one measure, which has been put into action for certain native breeds, such as Qinchuan, Nanyang and Yanbian yellow cattle; Hu sheep; Neijiang, Meishan, Fengjing, Jinhua and Large Black-white pigs, and so on. Establishment of special farms or reservations for the maintenance of small herds or flocks of certain

native breeds, however, is not only costly, but also limits the number of breeds which can be maintained. It seems desirable to adopt modern biological techniques; preserving gametes and embryos of superior individuals by deep freezing is now an alternative method whereby a gene reservoir might be provided for future needs.

Deep freezing and long-term preservation of spermatozoa of some species of domestic animals have been very successful since the early 1950's, while preservation of embryos, at least for some domestic species, is a more recent achievement (7). To obtain more female gametes or fertilized eggs (embryos) from the donors, techniques for superovulation and collection of eggs from the reproductive tract have been developed, while methods for transferring embryos to recipients (foster mothers) have been applied successfully in horses, cattle, sheep, goats and pigs. Offspring have been produced from the transfer of frozen-thawed embryos in cattle, sheep and goats, but not so far in pigs. Embryo banks or reservoirs have been established in some countries (Canada, USA, West Germany, for example), and transport of embryos across countries has been commercialized. The embryo business seems to be very successful, a conception rate of about 60 percent having been achieved in transfers of 5,000 cattle embryos (5).

There is no doubt that biological techniques can (or should) be used for the conservation of breed or genetic resources in domestic animals. It is reported that the longest time for which spermatozoa and embryos have been kept frozen in liquid nitrogen at -196°C are 30 years and 7 years respectively (7). Experiments with mouse embryos suggest that genetic damage would not be expected during a period of at least 200 years.

Experimental trials on biological techniques have also been carried out in China. Offspring have been produced from the transfer of embryos stored in liquid nitrogen for a period of more than one year in cattle (9) and 49 days in sheep (10). Success also resulted from transfer of cattle embryos after a long-distance transport from Hanover in West Germany to Beijing (2). Although this is only a beginning, it seems very promising for the future development and practical use of biological techniques in the conservation of genetic resources of domestic animals in this country.

12.6 PROSPECT

The author's purpose in writing this book is to illustrate the close relationship between livestock breeds and their ecological conditions, since the development of breeds and their productivity is, to a great extent, subject to the influences of their specific environments. However, the present data are not sufficient to draw any definite conclusions, and the book is only an outline to indicate the need for further study.

Much research is needed on this relationship, and the following approaches are suggested:

(i) The relation between distribution of different species or breeds of livestock and their ecological conditions, including factors such as topography, climate, type of grassland, feed supply. Some preliminary attempts have been made along these lines, but they are only a beginning.

(ii) The influence of ecological conditions on the development of animal breeds and their special characteristics. The author's effort in the book is limited to the accumulation of some related data; no attempt has been made to investigate such relationships or derive any solid conclusions. More research is needed.

(iii) Intensive studies to elucidate the effect of different factors on breed characteristics would be best carried out under well controlled environmental conditions, such as in climatic chambers, under artificial lighting, and so on. Experimental environmental studies will no doubt provide scientific data for use in intensive or "industrialized" livestock production, yet no data are available for the present book.

The need for these studies is underlined by the fact that China is very rich in animal genetic resources, and may be considered one of the large "gene banks" of the world. In addition to the three approaches listed above, which should be carried out step by step, three more lines of work are essential:

(a) Breed evaluation and studies on utilizing heterosis.

(b) Application of modern biological techniques for conserving gametes and embryos.

(c) Establishment of a "gene bank" for conserving valuable genetic material for Chinese domestic animals.

It is very encouraging that, as mentioned earlier, a nation-wide survey of native livestock breeds (including poultry) is currently in progress, and breed characteristics are under systematic investigation, with objective evaluation by specialists. This unprecedented task will certainly provide much scientific data for further analysis, and the relationship between animal breeds and their ecological conditions will eventually be elucidated.

The author earnestly hopes that more enthusiastic researchers will devote themselves to intensive studies concerning animal genetic resources and their relation to ecological conditions. The present book is a first step, and the contribution of others will be immense.

The author's concluding words for the book are:

My effort is a humble beginning,
Others' will be immeasurable!

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APPENDIX 1
NOTATION FOR REPRODUCTIVE PERFORMANCE

Terms used for describing reproductive performance are:

1. Mating (or breeding) percentage

$$= \frac{\text{Females mated}}{\text{Females available for breeding}} \times 100$$

(where "mated" means mounted by the male in natural service, or hand-mated, or inseminated artificially).

2. Pregnancy (or conception) percentage or fertility*

$$= \frac{\text{Females pregnant or producing offspring}}{\text{Females mated (or bred)}} \times 100$$

(whether offspring are alive or dead)

3. Fecundity (or prolificacy) or lambing, calving, kidding percentage

$$= \frac{\text{Offspring born}}{\text{Females producing offspring}} \times 100$$

4. Weaning percentage $= \frac{\text{Offspring weaned}}{\text{Offspring born}} \times 100$

5. Reproductive rate $= \frac{\text{Offspring born}}{\text{Females available for breeding}} \times 100$

(whether offspring are alive or dead)

6. Reproductive efficiency $= \frac{\text{Offspring weaned}}{\text{Females available for breeding}} \times 100$

7. Lambing (kidding) frequency

$$=$$ Number of lambings (kiddings) per year

* It is not always possible in practice to know which females become pregnant.

Table F1 TEMPERATURE INDICES FOR CLIMATE BELTS

Climate Belts		Average temperature of coldest month	Absolute lowest temperature of the year
I	North Temperate	less than -30°C	less than -48°C
II	Middle Temperate	-30°C to -10°C	-48°C to -30°C
III	South Temperate	-10°C to 0°C	-30°C to -20°C
IV	North Subtropic	0°C to +4°C	-20°C to -10°C
V	Middle Subtropic	+ 4°C to +10°C	-10°C to -5°C*
VI	South Subtropic	+10°C to +15°C	- 5°C to +2°C**
VII	North Tropic	+15°C to +19°C	+ 2°C to +5/6°C
VIII	Middle Tropic	+19°C to +26°C	5/6°C to +20°C
IX	South Tropic	more than 26°C	more than 20°C
H	Plateau Climate Regions	n.a.	n.a.

Source: China [Climate Atlas of the People's Republic of China], 1979 pp.66, 115-116, 222-223. Map Publishing House, Beijing. [Ch.].

* Yunnan -10°C to -1/+2°C
** Yunnan -1/-2°C to +2°C

Figure 1.1

SKETCH MAP OF TOPOGRAPHY OF CHINA

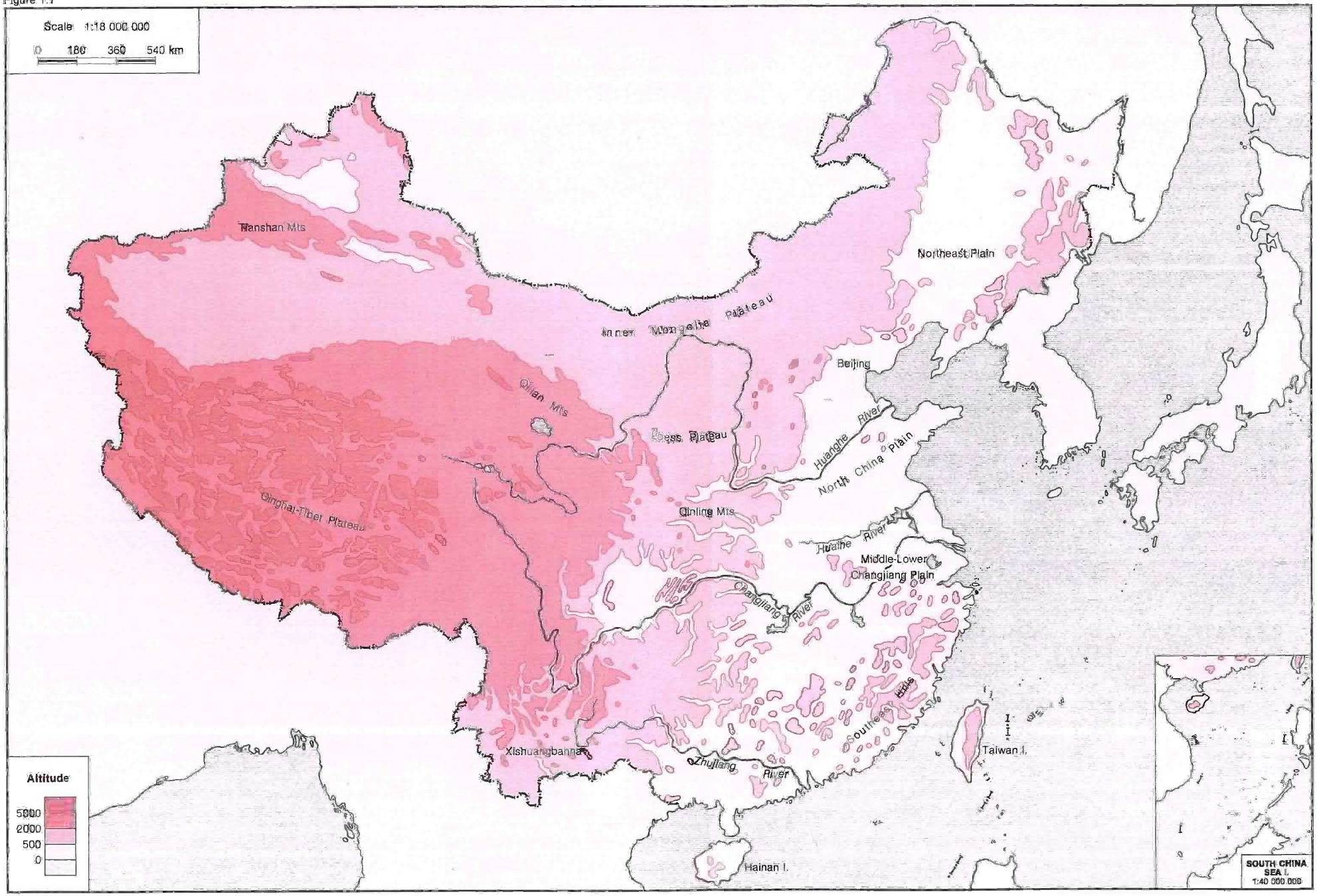


Figure 1.2

SKETCH MAP OF CLIMATE BELTS IN CHINA

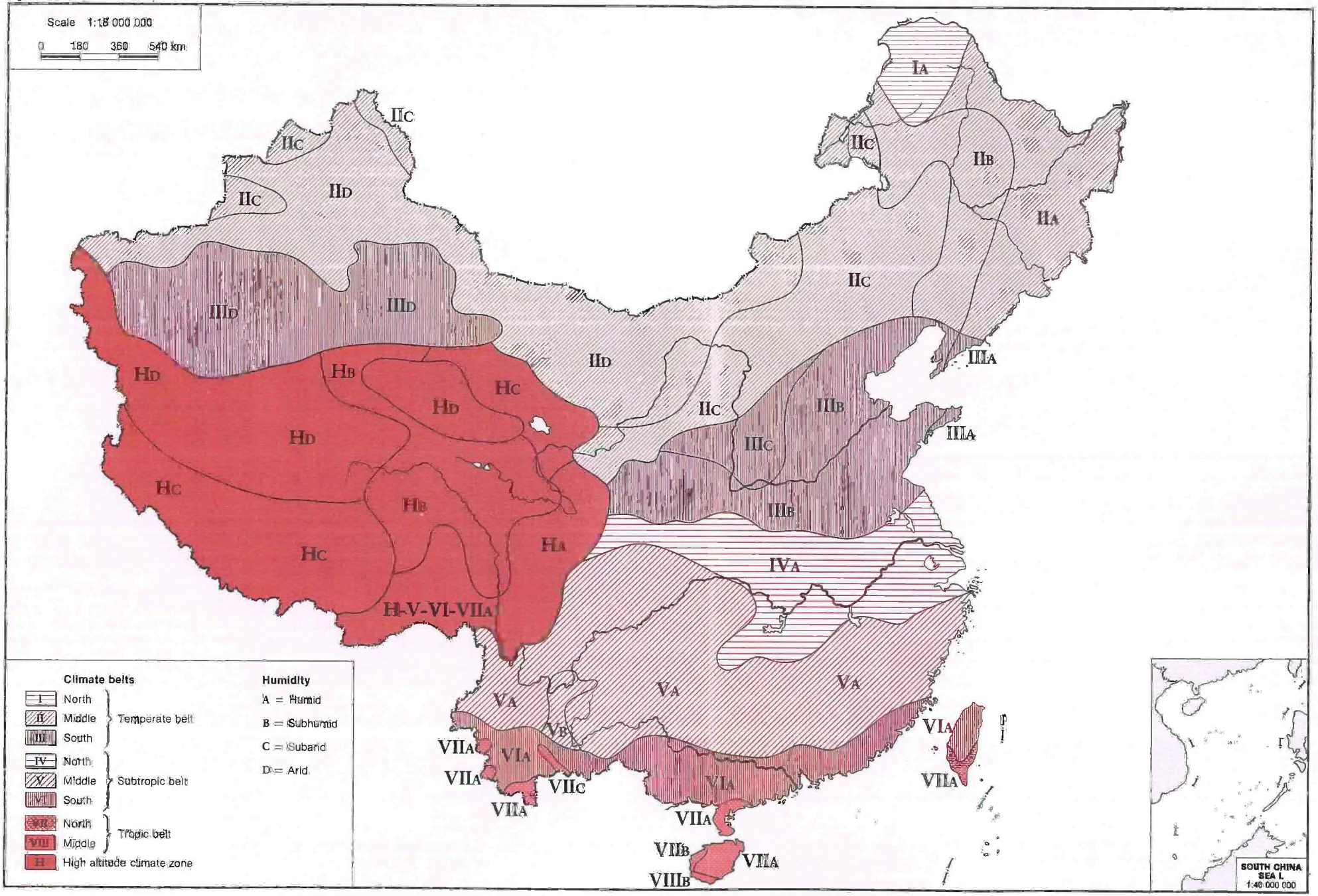


Figure 1.3

SKETCH MAP OF ANNUAL MEAN TEMPERATURE IN CHINA

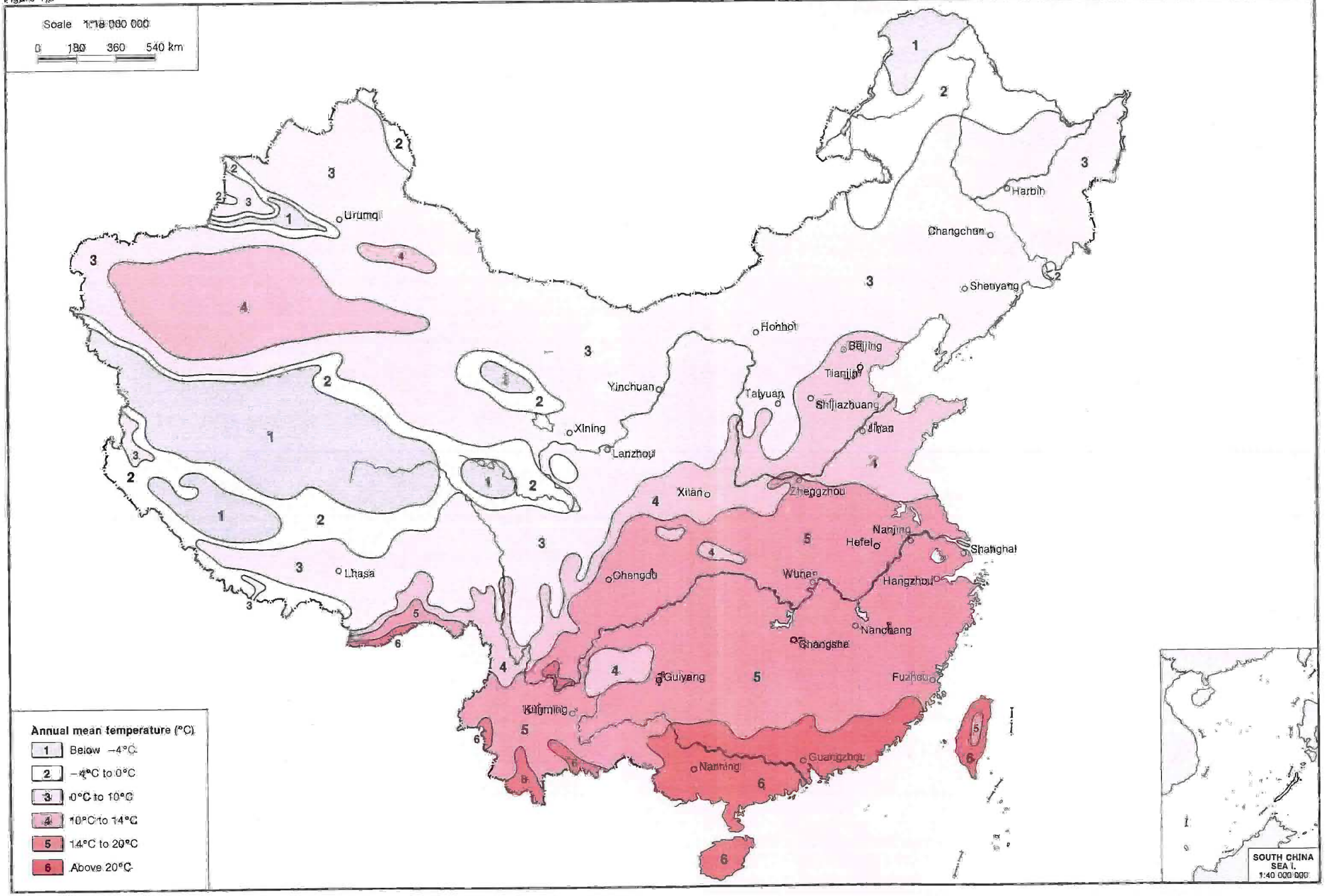


Figure 1.4

SKETCH MAP OF ANNUAL PRECIPITATION IN CHINA

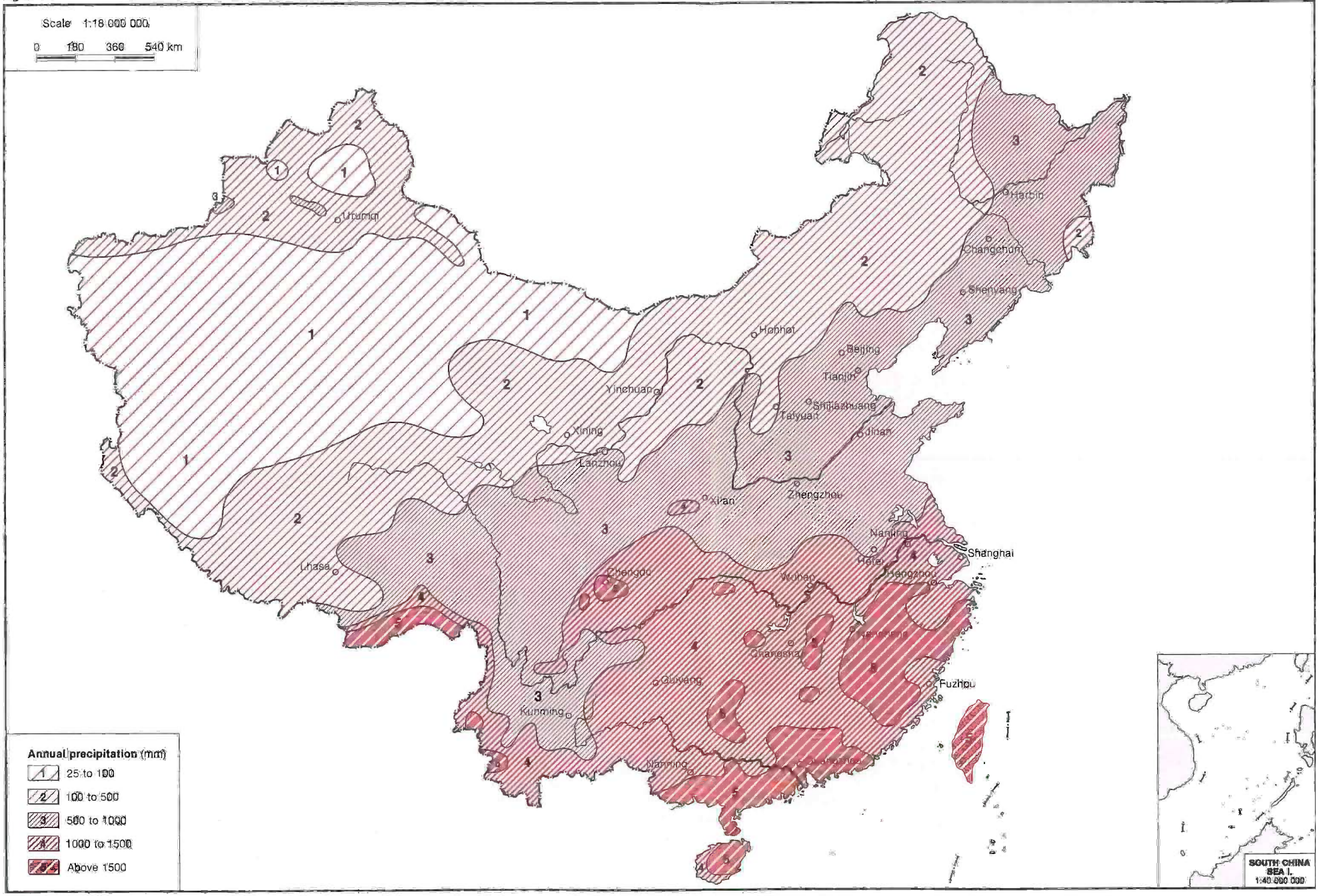


Figure 1.5

PASTORAL ZONES AND REGIONS IN CHINA

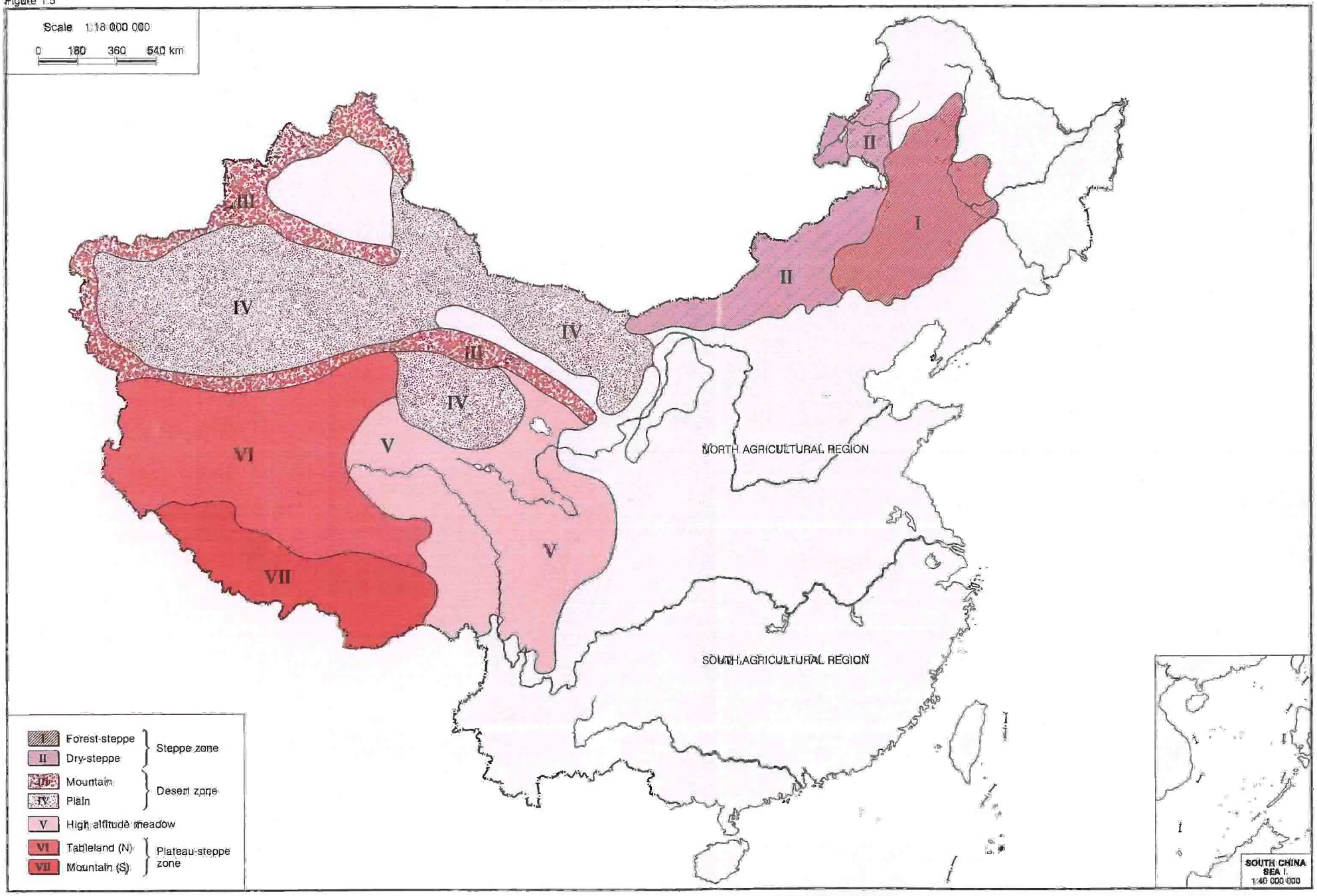


Figure 1.6

CHINA'S ADMINISTRATIVE REGIONS

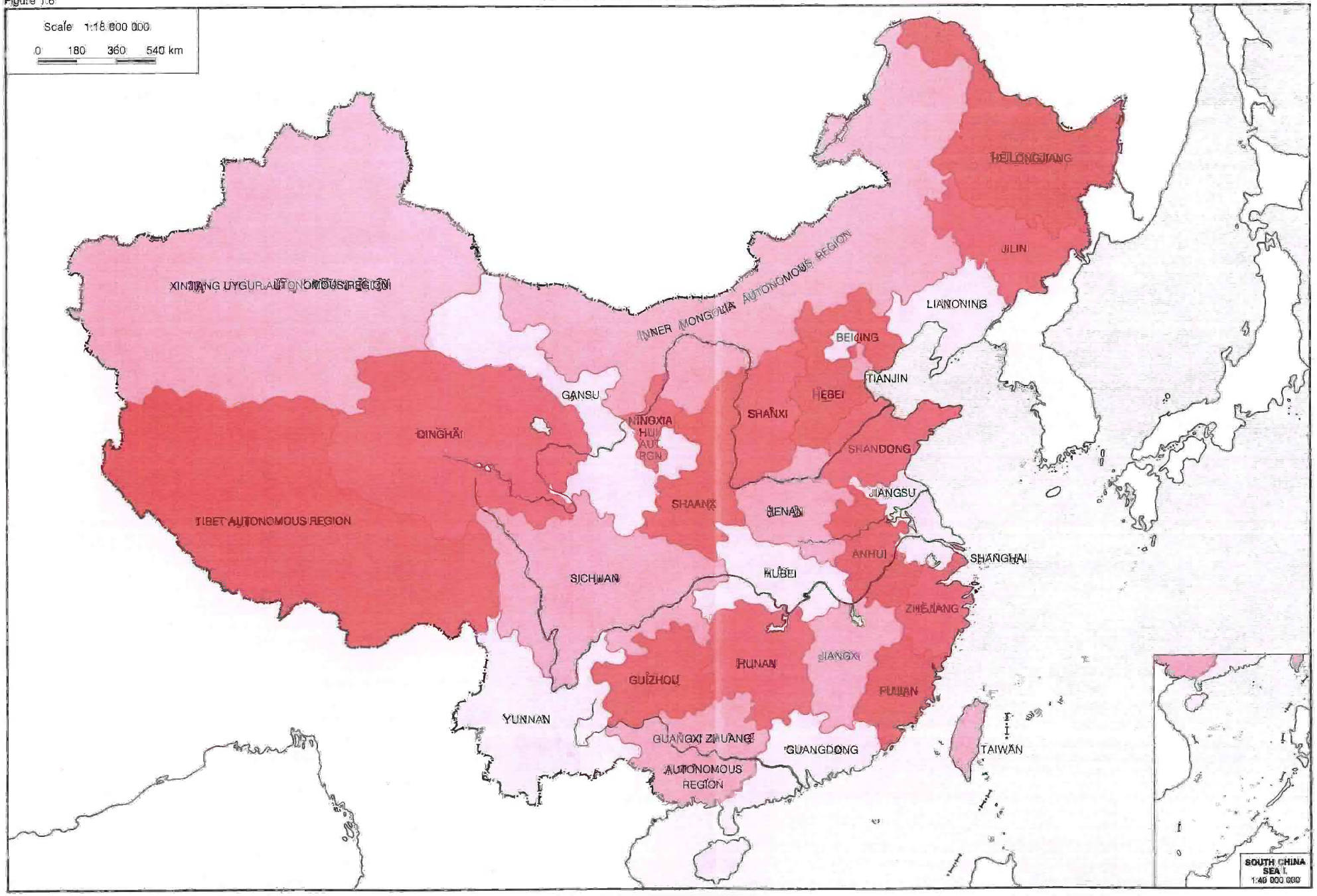
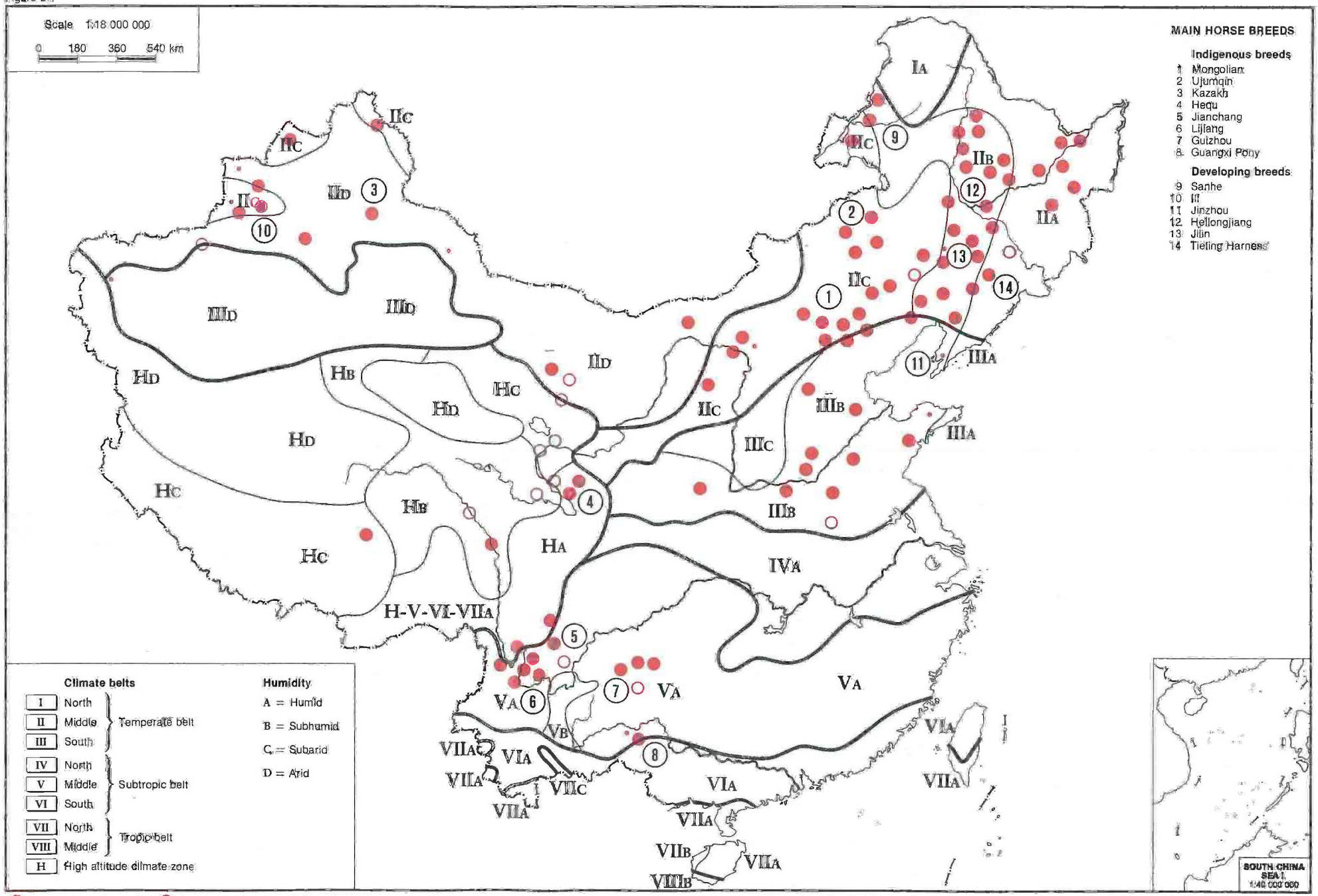


Figure 2.1

DISTRIBUTION OF HORSES IN CHINA



Represents about 1%, 0.5% and 0.1% of the nation's total.

Refers to the approximate locality of the breed.

Figure 3.1

DISTRIBUTION OF BACTRIAN CAMELS IN CHINA

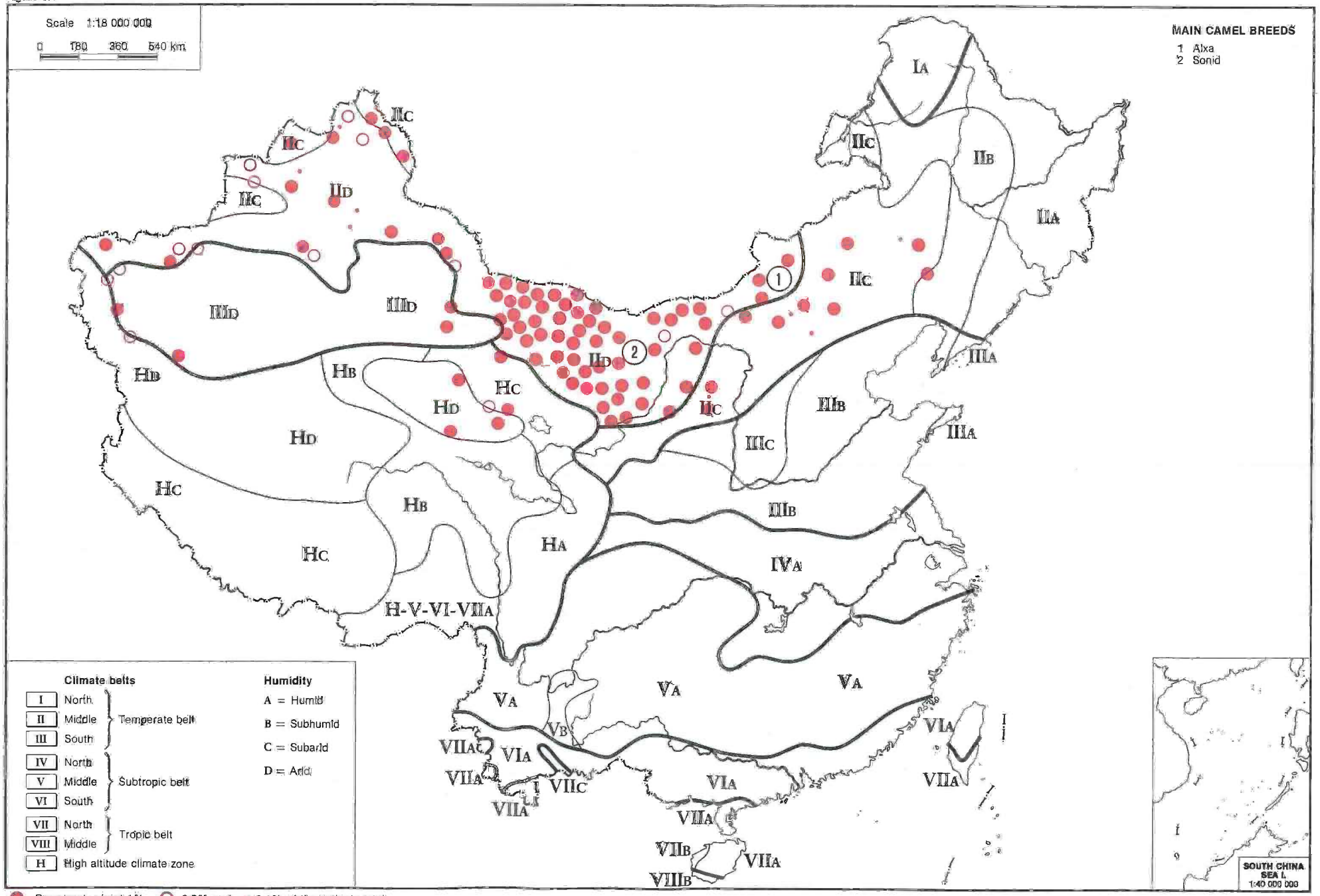
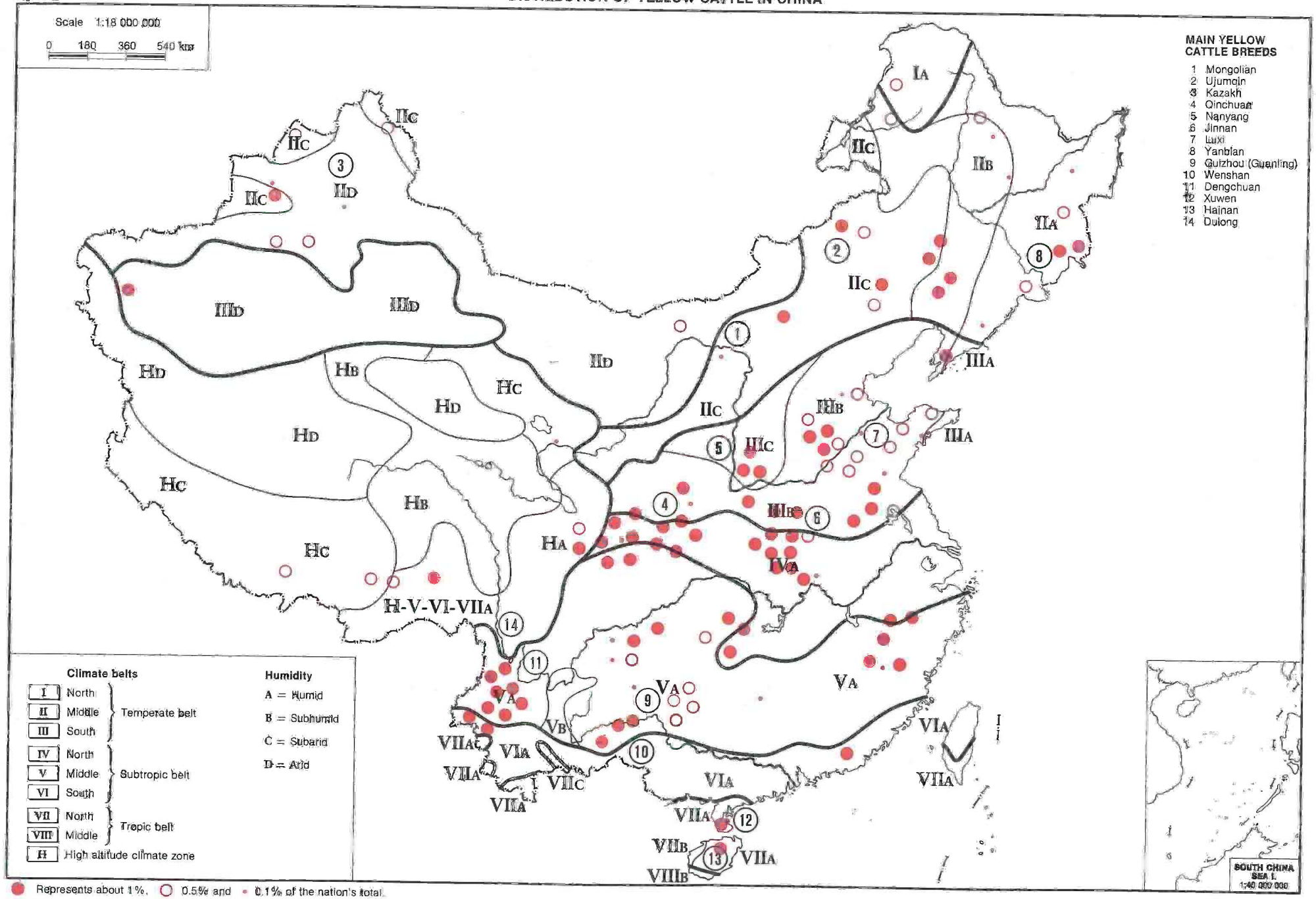


Figure 4.1

DISTRIBUTION OF YELLOW CATTLE IN CHINA

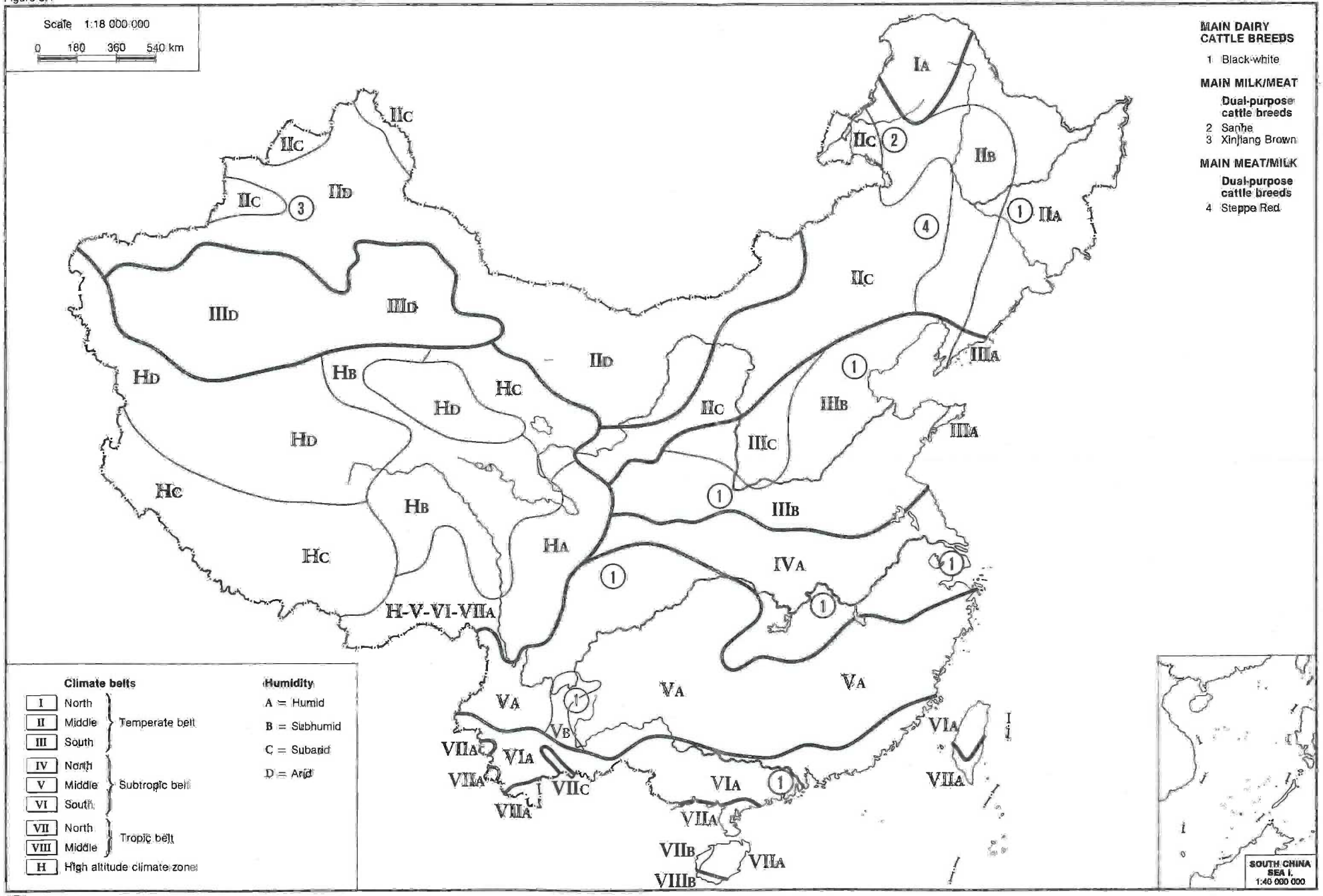


● Represents about 1%, ○ 0.5% and • 0.1% of the nation's total.

○ Refers to the approximate locality of the breed.

Figure 5.1

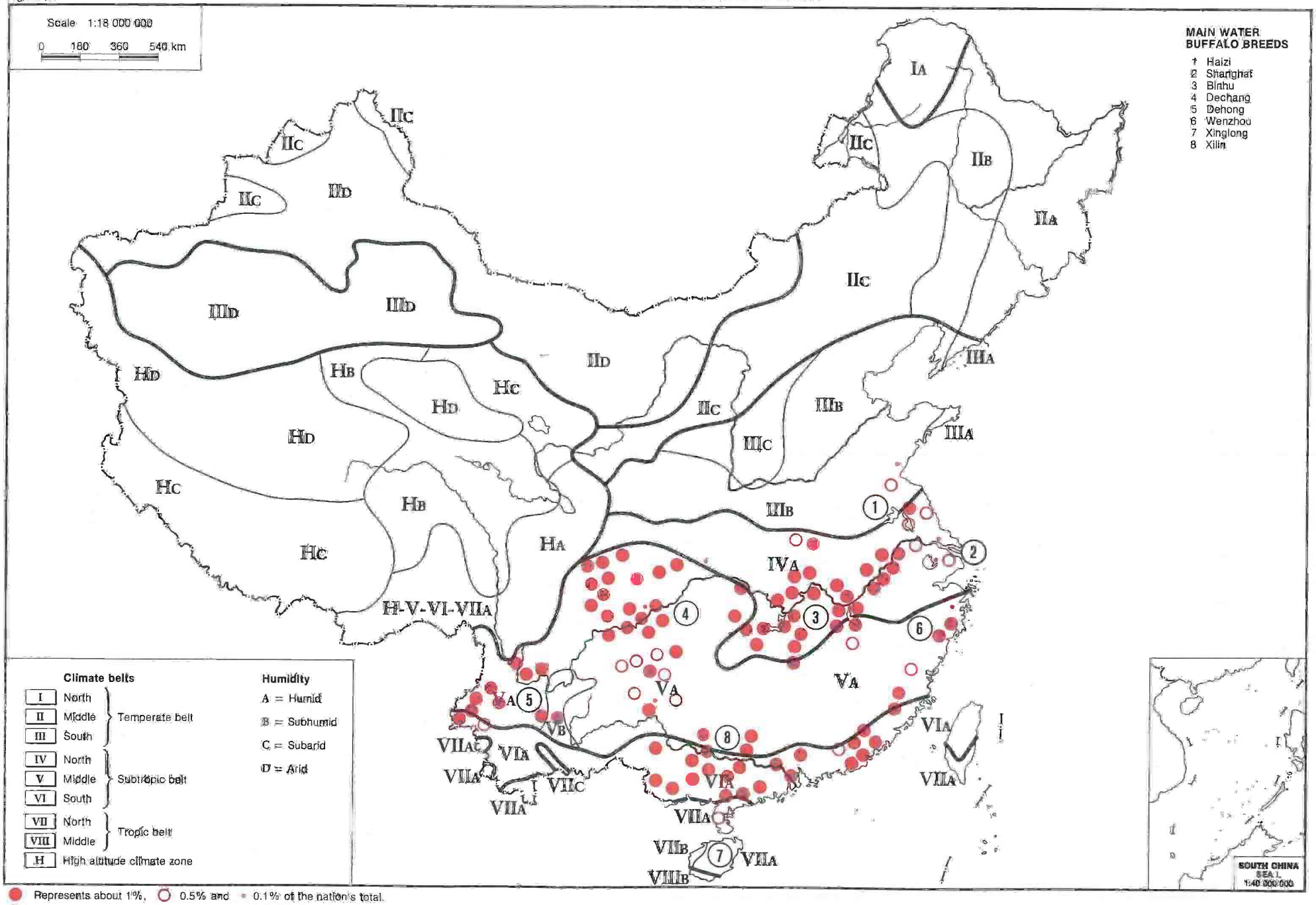
DISTRIBUTION OF DAIRY, MEAT/MILK AND MILK/MEAT CATTLE BREEDS IN CHINA



Refers to the approximate locality of the breed.

Figure 6.1

DISTRIBUTION OF WATER BUFFALO IN CHINA

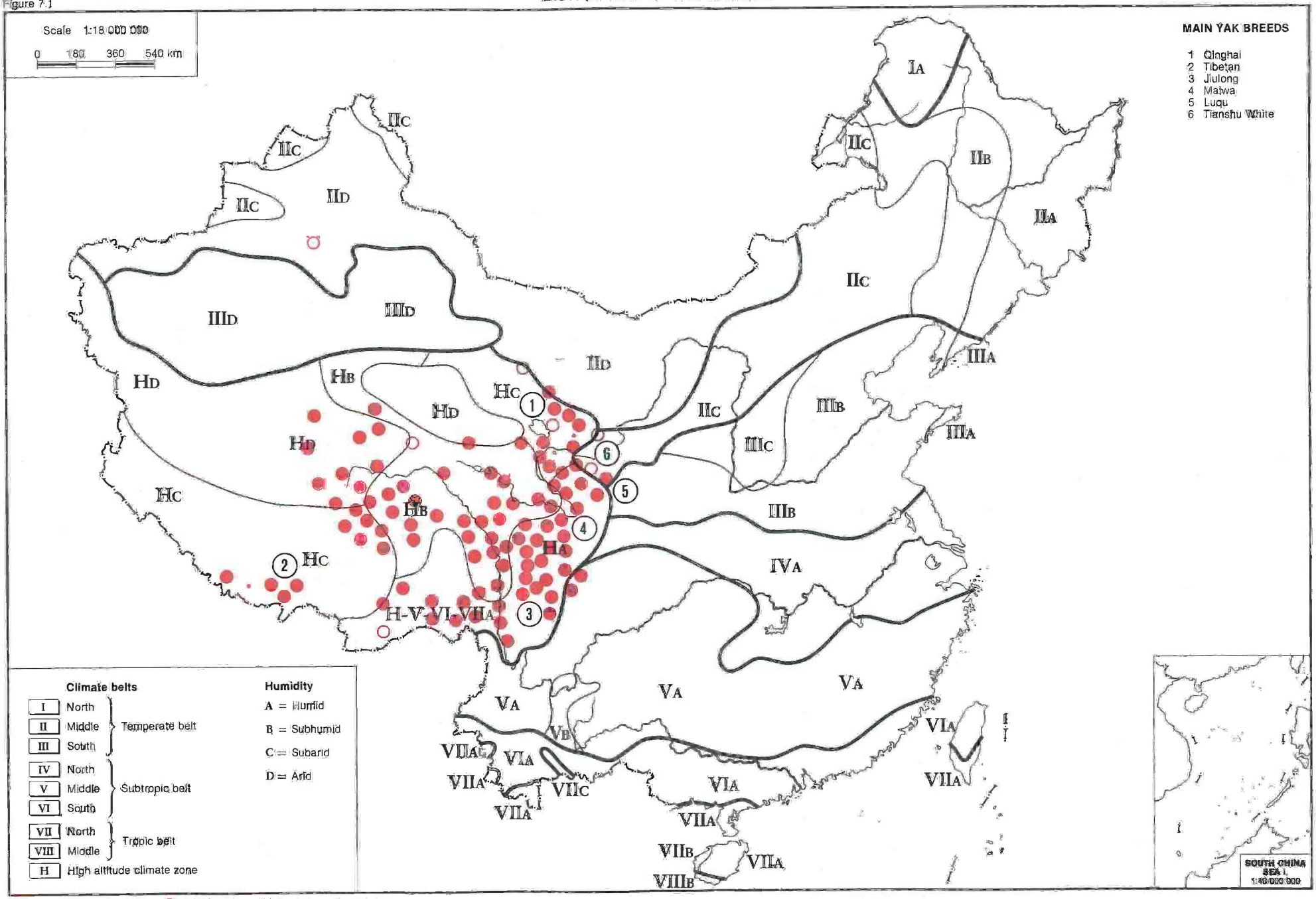


Represents about 1%, 0.5% and 0.1% of the nation's total.

Refers to the approximate locality of the breed.

Figure 7.1

DISTRIBUTION OF YAK IN CHINA

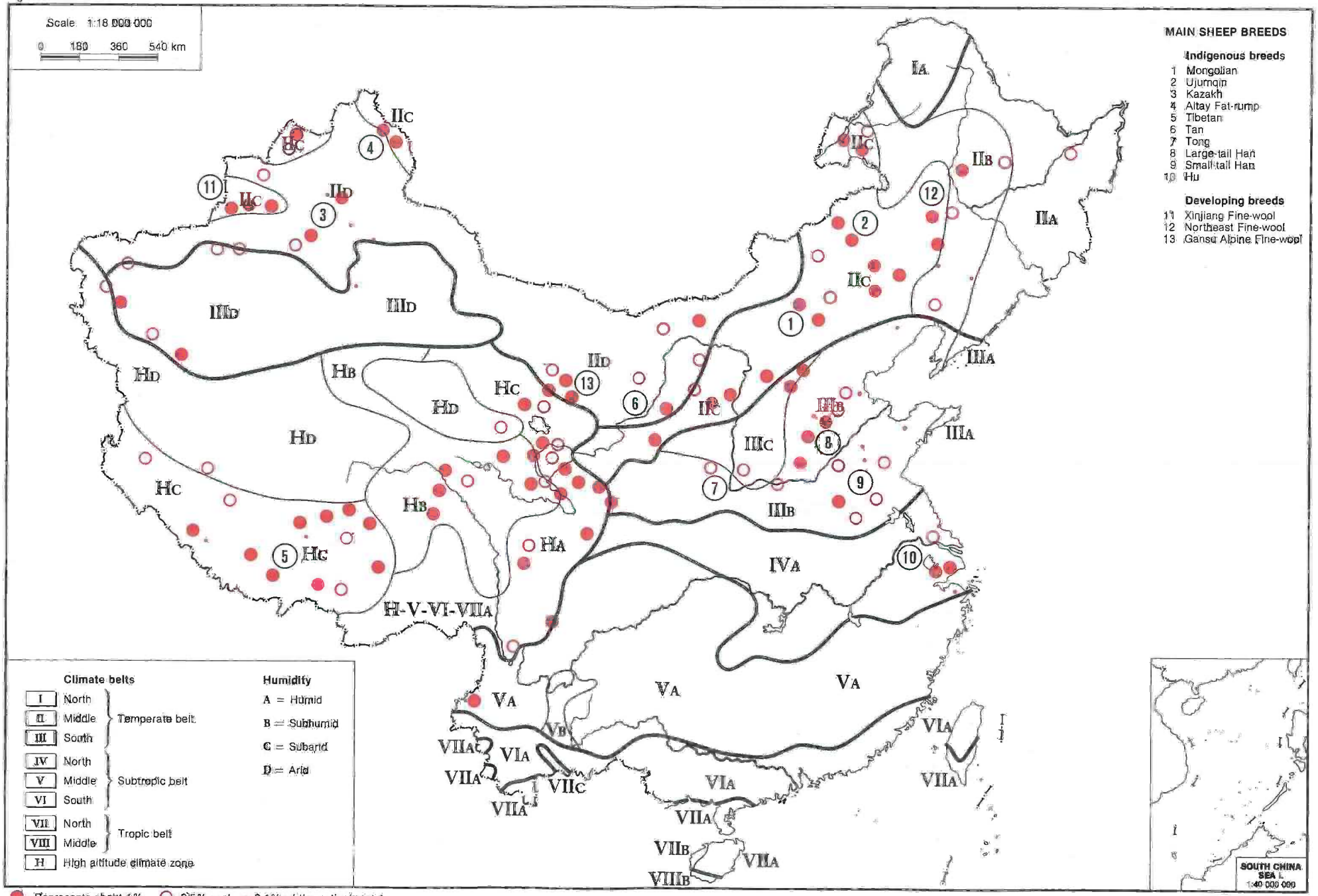


Represents about 1%, 0.5% and 0.1% of the nation's total.

Refers to the approximate locality of the breed.

Figure 8.1

DISTRIBUTION OF SHEEP IN CHINA

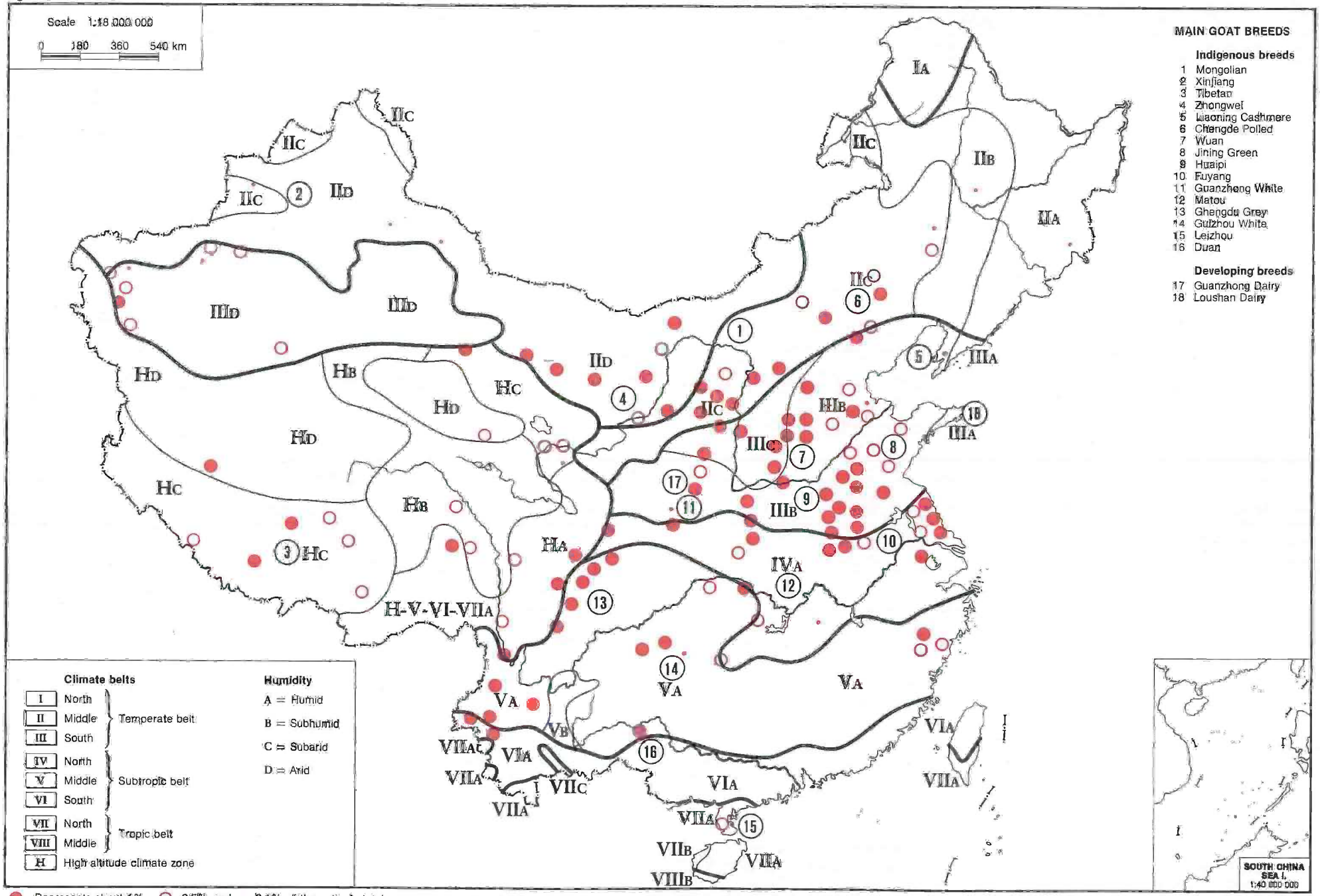


● Represents about 1%, ○ 0.5% and • 0.1% of the nation's total.

○ Refers to the approximate locality of the breed.

Figure 9.1

DISTRIBUTION OF GOATS IN CHINA



Represents about 1%, 0.5% and 0.1% of the nation's total.

Refers to the approximate locality of the breed.

Figure 10.1

DISTRIBUTION OF PIGS IN CHINA

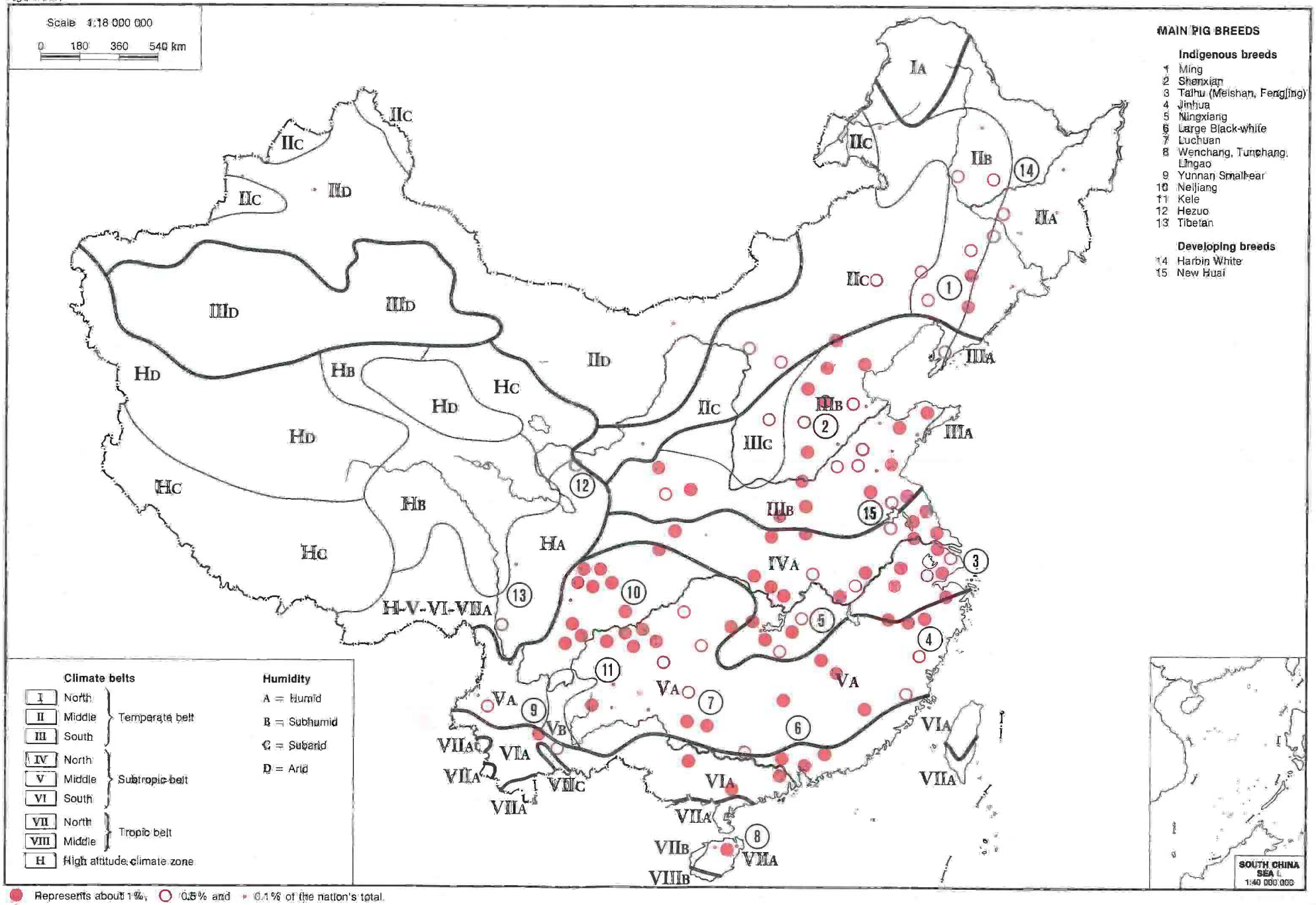


Figure 10.2

SKETCH MAP OF THE DISTRIBUTION OF SIX REGIONAL TYPES OF PIGS

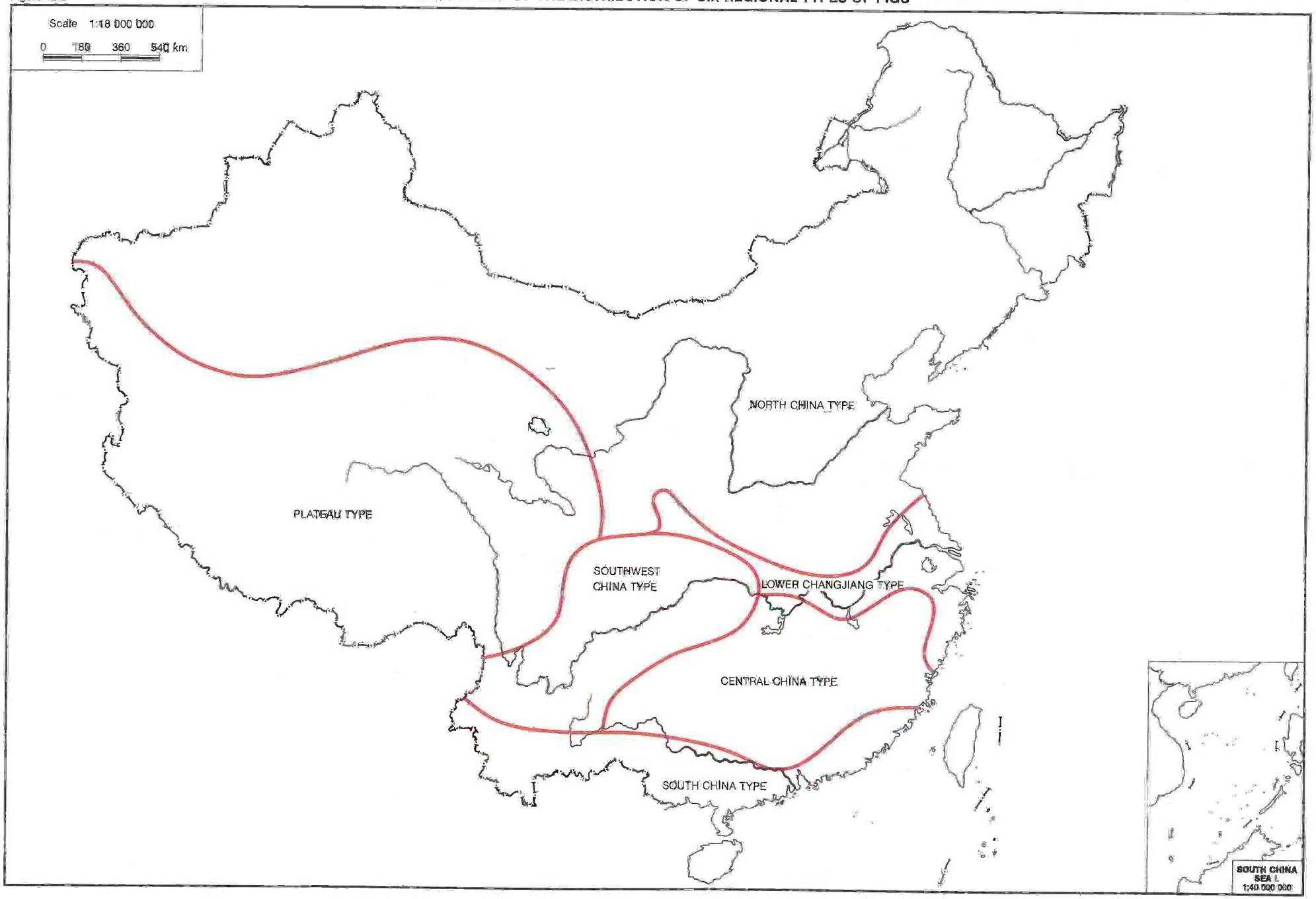
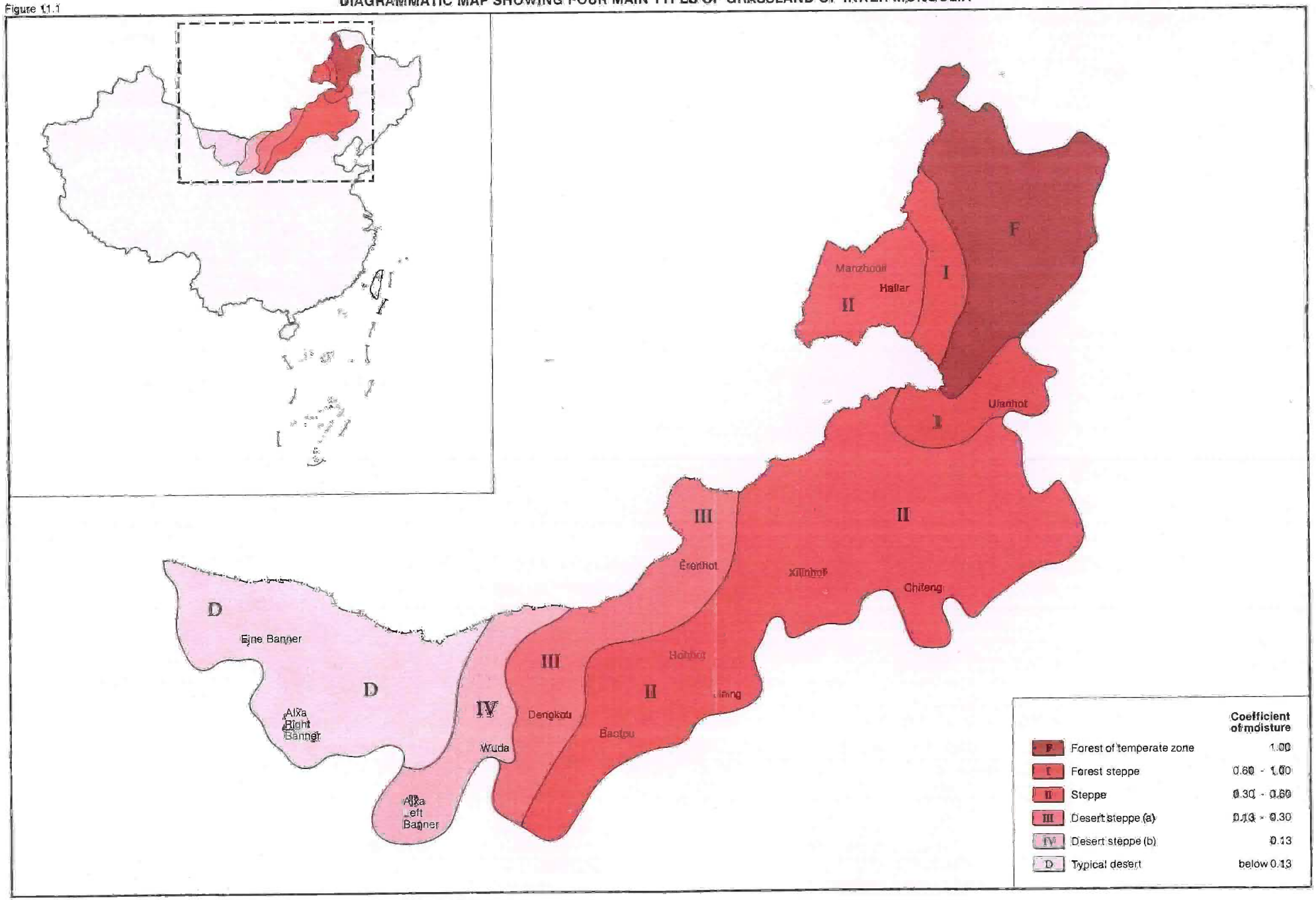


Figure 1.1.1

DIAGRAMMATIC MAP SHOWING FOUR MAIN TYPES OF GRASSLAND OF INNER MONGOLIA*



*Based on the sketch map of "Natural Zones of Inner Mongolia" provided by Tu, Y.R. (1982).

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