DEPARTMENT OF ANIMAL HUSBANDRY, U. P.

CATTLE DEVELOPMENT

IN THE

UTTAR PRADESH

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February, 1950

Printed by M. G. SHOME, *Superintendent, Printing & Stationery, U. P. Allahabad.*

FOREWORD

I AM most grateful to Dr. Kaura for asking me to write a foreword to this Bulletin which is intended to meet the need, long felt, for an authentic popular publication giving in a concise form as much information as possible on all aspects of cattle improvement and development, viz. breeding, feeding, management, control of diseases and pests, marketing and so forth. The Bulletin also includes chapters on dairying, improvement of *gaushalas*, mixed farming, first-aid, cattle fairs and shows. Descriptions of some indigenous breeds of cattle and buffaloes which had not previously been described have also been given.

Indian agriculture, in fact agriculture all over the world, must depend to a very large extent on cattle ; the most practicable means of keeping up the fertility of the soil is the use of farm manure, made possible by the keeping of a liberal number of livestock. Then again the only source of animal proteins for most of us is milk and its products. The importance of cattle to our economy cannot therefore be over-emphasized.

Dr. Kaura has nearly 25 years' experience of Animal Husbandry Research and Extension work under the Central and Provincial Governments. He could have published this Bulletin himself as a priced publication, but in the interest of livestock improvement, he has preferred to issue it as a departmental Bulletin so that even the poorest cultivator might be able to obtain a copy of it. The Hindi version is under preparation and will be out very soon. At the end of the Bulletin is given an illustrated chart giving details of the services rendered by the Animal Husbandry Department so that livestock owners might make full use of these facilities and be able to co operate whole-heartedly with the department in the work of cattle development.

This Bulletin is coming out at a time when the All-India Cattle Show is being held for the first time in Uttar Pradesh and at a time when the International Cattle Breeding Conference organized by the Food and Agriculture Organization of the United Nations is also being held. " Cattle Development in Uttar Pradesh " will therefore serve as a souvenir for those attending the show and the Conference.

A. N. JHA, I.C.S.,
Secretary to Uttar Pradesh Government
in the Agriculture and Animal Husbandry Departments.

ACKNOWLEDGMENTS

THE author wishes to record his great appreciation of the valuable assistance rendered by Sarva Shri S. S. Bhatia, Dairy Development Officer, P. D. Dhulia, Acting Deputy Director of Animal Husbandry, Bareilly, R. N. Mohan, Veterinary Disease Investigation Officer, H. C. Joshi, Goshala Development Officer, P. N. Nagar, Assistant Marketing Officer (Livestock), Noor-ul Haq, Assistant Marketing Officer (Animal Products), M. L. Verma, District Livestock Officer, J. S. Srivastava, Veterinary Assistant Surgeon (Headquarters), B. L. Shah, Artist, and Lakshmi Swarup, Stenographer, in the preparation of this bulletin.

He is also greatly indebted to his wife, Shrimati Prem Kaura, M.A., for kindly assisting in arranging the manuscript and the numerous illustrations.

A number of illustrations have been copied from the various journals of the Indian Council of Agricultural Research and a few other publications for which the author is extremely grateful to the original authors for the use of their illustrations.

Finally the author feels greatly obliged to Shri A. N. Jha, I.C.S., Secretary to Government, Agriculture and Animal Husbandry Departments, Uttar Pradesh, for the encouragement received in the preparation of this bulletin and kindly agreeing to write the foreword.

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Cattle Development in the Uttar Pradesh

1. INTRODUCTION

The development of cattle is one of our most vital problems of great national importance. In it are involved both the health and prosperity of the people. In spite of the existence of huge number of cattle in the Uttar Pradesh there is acute shortage of milk and bullocks of good draught capacity. They are generally in unthrifty condition with poor productive capacity, stunted growth, late maturity and long calving intervals. This state of affairs has resulted from their improper feeding, promiscuous breeding and lack of adequate control over the diseases and pests which are widely prevalent. The problem can therefore be tackled successfully only if it is attacked on its all fronts simultaneously. Although the value of India's livestock and their products as estimated by the Indian Council of Agricultural Research exceeds that of her crops, yet the attention given under the previous regime to explore this source of national wealth to the maximum advantage of the people has not been adequate. The present Government is fully conscious of this position and is now trying to explore it to the fullest possible extent.

It is a well-known fact that in India wherever the animal husbandry practices are better and the people grow fodder crops, their cattle are superior and more productive, their income from land is greater, they themselves are healthier and their economic condition is much better. Under the existing conditions and system of farming in India it is impossible to think of improving agriculture without improving the cattle required for agricultural operations. Adequate supply of milk and milk products which are the only source of animal proteins for our predominently vegetarian nation is of paramount importance for improving the health of the masses. Animal proteins are commonly known as the 'protective food' which greatly influence our physical development, power of endurance, resistance to disease, manliness, courage and soldierly instincts, etc. and no nation can afford to neglect their development and increased production. This clearly illustrates how intimately cattle are intertwined with the well being

of the Indian nation and why our ancestors declared 'cow' to be a sacred animal.

This bulletin has therefore been written with a view to enlighten the general public with regard to the improved animal husbandry practices as pertaining to cattle and to apprise them of the various ways and means by which they can take advantage of the provincial Animal Husbandry Department in the practical application of these methods and provide more and better food for the nation and ameliorate the economic distress of the masses.

2. MANAGEMENT OF CATTLE

(*a*) SELECTION OF ANIMALS—There are about 30 recognized breeds of cattle and buffaloes in India and they are distributed in comparatively drier areas where people grow or are forced to grow fodder crops due to non-availability of sufficient pasture. These breeds are classified under three heads, viz., Dairy breeds having high milk-yielding cows but comparatively poor draught bullocks, e.g., Red Sindhi, Sahiwal, etc., Dual or general utility breeds having fairly good milch cows and good draught bullocks, e.g., Hariana, Tharparker, etc. and Draught breeds whose cows are poor milkers but bullocks are excelent draught animals, e.g., Ponwar, Kherigarh, Kenkatha, Nagore, Amritmahal, etc. The Indian Council of Agricultural Research have published a number of bulletins (Miscellaneous Bulletins no. 17, 24, 27, 46 and 54) describing the various breeds of cattle and buffaloes in India. The breeds of interest to the Uttar Pradesh are briefly described later on under 'Breeding of Cattle.' In selecting milch cows and breeding bulls care should be taken that no new breed is introduced into the area except those recommended by the Department. The allocation of breeds suited to the local requirements, climatic and soil conditions, available feeds and fodder for them, and other environmental factors is discussed under 'Breeding of Cattle.'

(i) *Cows*—In selecting milch cows the following points should be noted :

(1) She should conform to the breed characteristics described under 'Breeding of Cattle' and have feminine appearance with docile temperament. A highly nervous cow or one which kicks when being milked is usually not an advisable purchase for a dairy herd.

(2) It is desirable to go in wherever possible for young cows preferably first calvers so that one may derive the benefit of a larger number of lactations and calves.

(3) She should appear wedge-shaped when viewed from the side, front and top (triple wedge-shaped) with wide and deep hind quarters and straight back. (Plate I, fig. 1).

(4) Her eyes should be large and bright indicating health, face of medium length and not fleshy, broad nose and large nostrils that take in plenty of air, big mouth and strong jaws that go with a good feeder and neck rather neat and slim. [Plate I, fig. 2].

(5) The skin should be soft, thin and pliable with a glossy coat. [Plate I, fig 3].

(6) She should have well sprung ribs and a big roomy barrel that will hold great quantities of feed.

(7) The udder should be well developed extending back and well up between the thighs, free from hard lumps, firm but not fleshy. When empty it should be soft and pliable to the touch. The teats should be of uniform size, set at equal distances, free from nodules which are likely to interfere with the flow of milk and hanging straight down. [Plate I, fig. 4). The milk veins should be large and tortuous bringing more blood to the udder [Plate I, fig. 5].

(8) Although milk and pedigree records when kept form a valuable guide in selecting a good cow, yet the actual pail test (three consecutive milkings) is the most important one. [Plate I, fig. 6]. For butter and ghee production fat test is also desirable. [Plate I, fig. 7].

(9) It is advisable that with the help of a veterinarian one should ensure the freedom of the cow from diseases especially tuberculosis, Johne's disease, contagious abortion (Bang's disease), mastitis, sterility, etc., for which special tests are available.

(ii) *Bulls*—Special attention should be paid to the selection of an individual sire, as his influence is equal to the combined influence of all the cows with which he is mated. Breeders and cattle-owners generally judge the value and importance of a herd by the quality of the sire at its head. In selecting bulls for breeding purposes the following points should be noted :

(1) Obtain a pure-bred sire from an established farm of the desired breed selected primarily on the basis of actual records of production of his immediate ancestors and where possible of his available daughters,

FIG 1.—*A triple wedge-shaped milch type cow*

FIG 2.—*A good feminine head of a dairy cow*

FIG 3.—*Soft, thin and pliable skin with a glossy coat indicating possibilities for milk*

FIG 4.—*A nice udder with well placed teats*

FIG 5.—*Showing prominent milk veins*

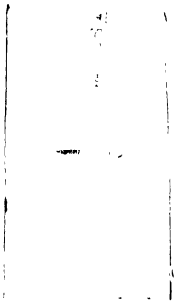


FIG 6.—*Pail test for milk*

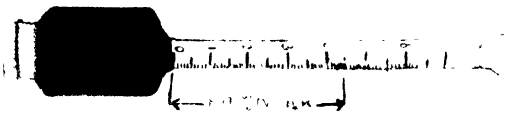


FIG 7.—*Fat test for yield of cream and butter*

(2) The bull should be of the desired conformation, size and type strictly conforming to the breed characteristics as described under ' Breeding of Cattle. '

(3) It is desirable to select a young bull aged about 3 to 4 years so that he can be used for stud purposes over a longer period.

(4) A bull must necessarily be fertile, possessing no anatomical, physiological or pathological abnormality which will prevent him from siring offspring. The testes should be of approximately equal size and consistence, carried level and be well developed without any signs of hardness or swelling. They should be freely movable in the scrotum. His ability to serve a cow in heat can be tested by actual trial.

(5) The sheath should preferably be tight.

(6) The seminal fluid should be normal with active healthy spermatozoa. This requires the aid of a microscope and the services of a Veterinary Assistant Surgeon.

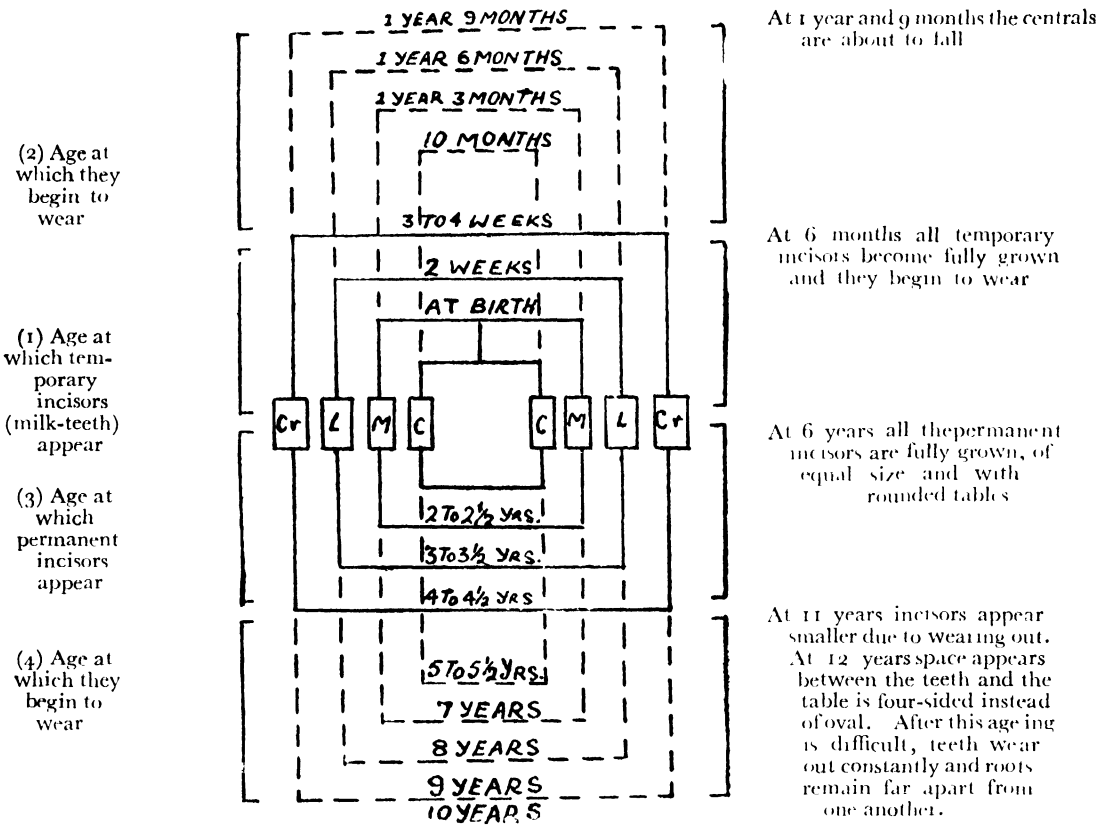
(7) The feet of a stud bull, especially hind feet, are important and they should be carefully examined since lameness due to overgrown or broken hoof, foul in the foot, etc., may interfere with his ability or willingness to serve cows successfully.

(8) Just as the cow, the bull should also be free from contagious diseases like tuberculosis, Johne's disease, Bang's disease, etc., for which suitable tests may be applied by a Veterinary Assistant Surgeon.

(iii) *Bullocks*—Since bullocks are required for draught purpose only, it does not matter much whether they satisfy the breed characteristics or not so long as they are well built, strong and active possessing sound feet preferably with black hoofs and strong and upright legs. Loose pendulous sheath, voluminous dewlap and fat and long tail are undesirable in draught cattle. The size and built of bullocks should be suitable for the type of work in view, viz., heavy draught, fast trotting or ploughing. A pair of bullocks should be uniform in age and appearance and capacity for work as far as possible. Besides veterinary inspection each bullock should be tested before it is purchased by actual trial for the work required of him, if possible.

(*b*) Determination of age in cattle—

(*i*) *By looking at the incisor teeth* (in the lower jaw)



C—Central Incisors, M—Middle Incisors,
L—Lateral Incisors, Cr.—Corner Incisors.

N.B.—Temporary Incisors may be distinguished from the permanent ones by being much smaller and possessing a distinct neck between the root and the crown.

(Plate II, Figs. 1,2 & 3)

(ii) *By examination of horn rings*—Generally the first ring appears at the base of the horns when the animal is three years old. So if there are six rings the animal is 8 years old. Sometimes cattle-dealers scrape off the rings in order to avoid detection of correct age. [Plate II, fig. 3].

(*c*) ESTIMATION OF LIVE-BODY WEIGHT – It may be necessary to determine the approximate body weight of an animal for meat purposes or for estimating the quantity of feed required for it or to calculate the dose of a drug to be administered. The body weight of cattle may be determined by the following formula :

$$\frac{Length\ in\ inches \times girth\ in\ inches}{A} = \text{Body weight in seers.}$$

N.B. –Length is measured from point of shoulder to pinbone and girth is measured just behind point of elbow (Plate II' fig. 4).

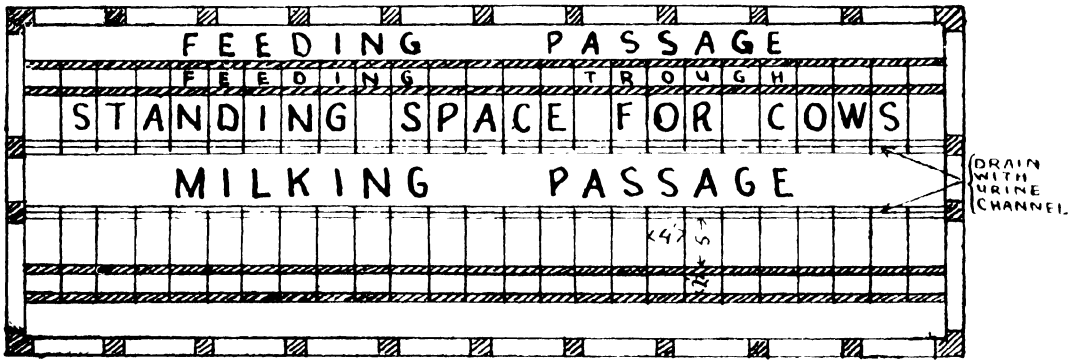
The value of A is :

–9 if the girth is less than 65 inches.
–8½ if the girth is less than 65—80 inches.
-8 if the girth is over 80 inches.

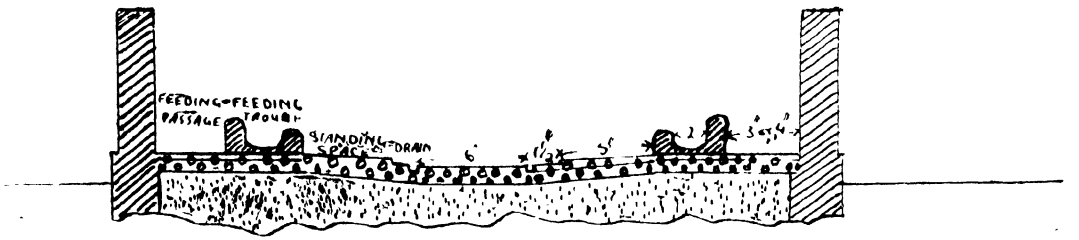
Cattle generally require fodder about 1-10th of its body weight and the weight of dressed carcase, blood, hide and fat is 2-5th, 1-13th, 1-8th, and 1-12th of body weight respectively.

(*d*) HOUSING—The object of housing is to provide shelter to the animals against sun, rain and other inclemencies of weather and in some cases against the ravages of wild animals. Exposure causes animals to take in more food to keep up their health and continued exposure will undermine health in the long run. An efficient cattle stall should provide shelter against the sun and rain for which a roof is necessary. It should be such as to avoid the setting in of insanitary conditions for which an impervious, gently sloping floor and drains (open) and provision for sufficient ventilation are necessary. The buildings on a dairy farm must be *pucca* in order to maintain that standard of cleanliness which is necessary from an economic as well as from a hygienic point of view. For the plains of India the best and most economical way to keep and rear dairy stock of all kinds in so far as housing is concerned is to permit the animals to be at liberty at all times except when being fed or milked and to provide for them roofed shelter from cold, wind and rain that they can take advantage of when they want to. It is unnecessary to incur heavy expenditure for the construction of hygienic buildings for cattle and in most cases it is usually possible to convert an old insanitary building into a sanitary one without great or unreasonable expense. When entirely new buildings are to be constructed they should be built economically on hygienic principles.

(i) *Cow sheds*—Cow sheds can be arranged in a single row if the number of animals is small, say up to 8 or 10, or a double row if the number is larger than that. In a double-row shed the animals should not stand face to face as in that case there is more risk of an infectious disease being spread from one to the other. Tail to tail arrangement is better so as to get the maximum benefit of fresh incoming air. A double-row cow shed with dimensions



PLAN OF A DOUBLE COW-SHED



CROSS-SECTION OF THE ABOVE

(ENLARGED)

is shown in the following plan and a single cow shed will be its longitudinal half retaining the milking passage about 4 feet wide. It is an open type shed with dwarf walls (3½ to 4 feet high) and roof supported on masonry, wooden or steel pillars suited for Indian plains conditions in general. In closed type cattle sheds required for hills the ideal cubic space required for efficient ventilation with suitable inlets and outlets is about 900 cubic feet, giving a floor space of about 70 square feet per adult cattle.

(ii) *Calf pens*—In the rearing of young calves it is desirable that an open exercise paddock directly communicating with their shelter and feeding house should be provided. The exercise yard should not be of a lesser area than 3 square yards for each calf and the calf shelters should provide 10 square feet of floor area for each animal. Calf pens should be located close to the cow sheds, and clean drinking water should always be accessible to them. If possible calves of different ages, viz., under three months, three to six months and over six months till they are weaned should be housed separately for better management and care.

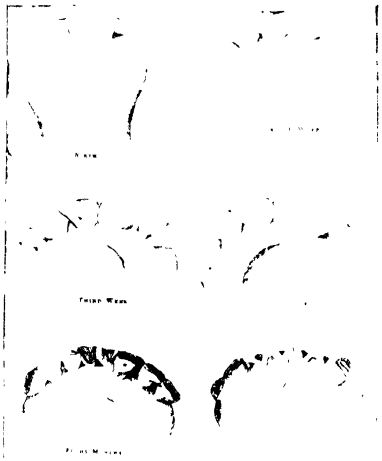
(iii) *Bull shed*—A bull should have the use of a loose box about 12 feet by 10 feet in dimensions, well lighted and ventilated. The house should be fitted with a manger and watering trough. The floor should be of concrete or be well paved with brick or stone. If a small yard or better still a paddock preferably facing south, be attached, to which the bull can have free access it will be of great advantage. It should be so located that the animal is not isolated but is able to see the other members of the herd.

(iv) *Cleanliness of premises*—For the maintenance of stock in health and for the clean production of milk it is of paramount importance that the dung and soiled litter should be removed from the byres twice daily, morning and evening, before milking and the floor should be washed at least once daily after the animals have been taken out for grazing. The urine and all the washings may flow into a covered cess-pit located at a suitable distance from the byres. The manure pit should be far away from the sheds. The feeding and watering troughs and drains should always be kept clean and so the surroundings of the byres. For the maintenance of proper hygienic conditions necessary for the prevention of diseases it is desirable that walls should be lime-washed once after every six months and the watering troughs after whitewashing should be allowed to dry before water is let in.

(*e*) MARKING – For identification purposes cattle may be either tattooed in the ear or branded with hot iron numbers as low as possible on the outer portion of the thigh. [Plate II, fig. 6]. Immediately after branding carbolic oil or ordinary sweet (til) oil should be applied locally. Branding with smaller sized numbers can also be done on the horns or hoofs. Before branding the animal should be properly secured. Branding on the skin is visible from a distance and is lasting and permanent. Branding irons can be prepared by an ordinary blacksmith. [Plate II, fig. 5]. Tattooing forceps, numbers and tattooing ink can be had from any dealer in veterinary instruments. For tattooing the inside of the ear is cleaned with a wet cloth and a little ink is applied before the tattooing forcep is used. The ink is then rubbed in with fingers. The forceps should be tried on a card-board or folded blotting paper before use to ensure the correctness of the number to be tattooed each time. [Plate II, fig. 7].

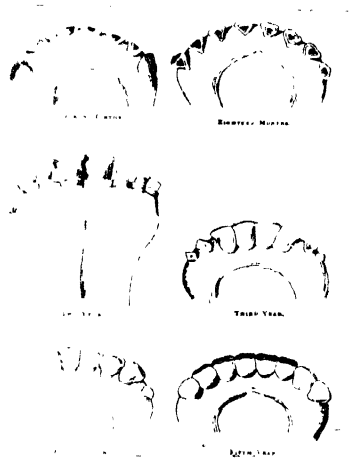
(*f*) UTILIZATION OF DUNG, URINE AND LITTER AS MANURE – Quite a good proportion of cattle dung is used at present in the form of "uplas" (dung-cake) as fuel, which is a wasteful and rather unhygienic practice. [Plate II, fig. 8]. The most profitable use of cattle dung is as farm-yard manure for increasing soil fertility. An adult cattle on an average yields about 3 tons of manure annually. In the Uttar Pradesh it is estimated that 132 crores maunds of manure can be prepared annually from the dung and urine of animals. By using this manure we can produce 8 crores maunds more of grains whose present value would be about Rs.132 crores. [Plate II fig. 11]. To provide the required quantity of firewood, fuel trees may be grown at suitable sites in every village. The manure is commonly kept in India in heaps exposed to the weathering agencies, e.g., rain, sun and wind in an unhygienic way, resulting in the loss of manurial ingredients, besides acting as breeding place for flies. Animal urine whose manurial value is four times that of dung is generally wasted and so are the farm-yard litter, dry leaves, etc. The solution lies in the proper use of these articles for manure which should be stored in pits located at a higher level. The dimensions of the pit should be according to the available quantity of dung and litter, etc. They are of two kinds :—

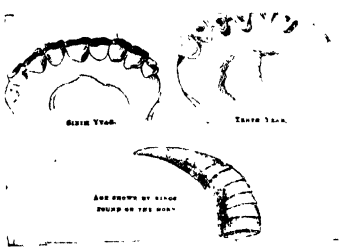
(i) *Manure pits*—They should be 4 to 6 feet deep so that they may take plenty of manure without occupying too much space. The less surface exposed to the air the better, for the flies and the wind to get



←FIG. 1.—*Age shown by incisor teeth (temporary)*

FIG. 2.—*Note two, four, six and eight permanent incisors at two, three, four and five years respectively*





←FIG. 3.—*Showing wearing of incisor teeth with age and appearance of rings on the horn*

FIG. 4.—*Showing points from where length and girth measurements are taken*

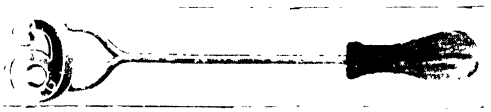


FIG. 5.—*Branding iron*

FIG. 6.—*Showing brand marks at the proper place*

FIG. 7.—*Tattooing forceps*

FIG. 8.—*Preparation of "uplas" from cow-dung (undesirable)*

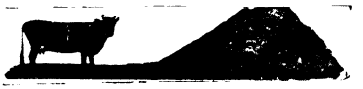


FIG. 9.—*An adult cattle yields 3 tons of manure annually*

FIG. 10.—*Conservation of cow-dung in compost pits (desirable)*

←FIG. 11.—*Manured (left) and unmanured (right) crops*

hold of. Some flies will breed even in pits but far fewer than if the stuff is left lying about in the open here and there. The animal and vegetable refuse should be covered daily with ashes and other dry rubbish. This will minimise fly-breeding and reduce odour. The pit should not be too far. Better to have a full pit nearby than an empty one far away. Pits should have a low mud wall round them and be sloped at one end to make them easy to empty. When full, they should be covered with several inches of earth and left to rot. To see if they are rotting well, scratch a hole and feel inside with your hand ; if it is hot and moist, all is well if not give it a good watering. Repeat this when necessary. While one pit is rotting dig and start filling another and don't pile fresh dung into a pit full of rotting manure. Don't go on filling your pit till it becomes a high mound ; start a second pit as soon as the first is full to a foot or so above the ground level.

Don't put unrotted manure on the fields. It attracts white-ants, and the moisture in the soil is used up in rotting it. That is why raw manure is *rightly* said to burn up the crops.

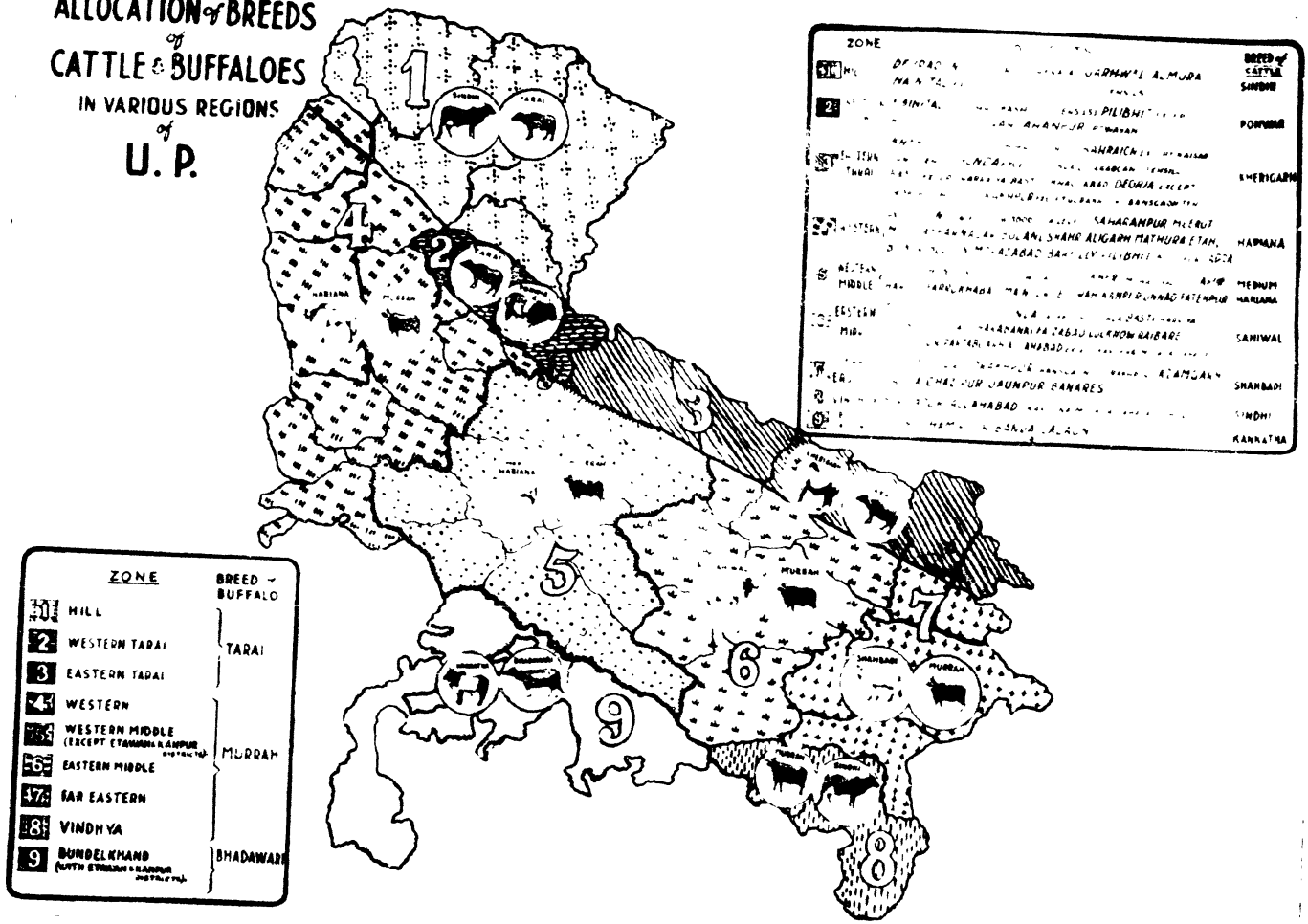
(ii) *Compost-pits* - [Plate II, fig. 10]--The proper conservation of all the waste vegetable matter found in the Indian villages into good compost is probably the easiest and best way today of supplementing the inadequate supplies of farm-yard manure generally available. The composting of waste vegetable matter into a valuable manure has been extensively developed of recent years. Briefly compost is prepared as follows :

The materials required are : (1) any form of vegetable waste, such as leaves, grass mowing, straw, etc., (2) dung of cattle and other farm animals, night-soils, urine, urine-earth, etc., and (3) wood ashes from the kitchen. These materials under (2) and (3) are made into an emulsion. The vegetable waste is first spread in a pit of a suitable size and the emulsion is prinkled over it. Over this is given a thin cover of earth, about $\frac{1}{2}$" thick, and gently pressed by means of a phowda (shovel). The process is repreated till the heap rises to a height of $1\frac{1}{2}$ to 2 feet above ground level when the heap should be made dome-shaped and the upper surface covered with a layer of earth about one inch thick and plastered with a mixture of dung and earth. A pit should be filled in without unnecessary delay. While filling in a new pit leaf mould from a pit of 21 days old may be put into the new pit over the rubbish layer in order to promote

the growth of moulds. Within a few days the temperature in the mass, caused by fermentation, rises to about 150°F. In such a high temperature most of the weed seeds and all forms of insect life are destroyed. The compost should be completely ready for use in about four months after packing. When it is ready the final level will remain about 6" above the ground level to prevent any run-off water entering the pit during rainy season. The resulting manure is rich in humus and is very good for increasing the fertility of the soil. Urine and urine-earth should especially be collected and sprinkled over the compost during its manufacture as by so doing the manurial value of the compost will be considerably enhanced. Urine can be collected from *pucca* buildings by draining it into a pit whereas urine-earth may be scraped from *kutcha* floor and replaced by fresh earth. It is desirable to have a sufficient number of pits on a farm to hold six months' refuse so that the process of composting and utilisation of compost will be continuous. Per acre holding the required space for compost making will be about 60 cubic feet per year.

N.B.—If the ground is stony or the sub-soil water level is near the surface build a small walled enclosure instead of digging a pit. For rainy season it may be more advantageous to use hard ground well drained and at a higher level or a platform especially made for compost making in preference to pits

ALLOCATION of BREEDS of CATTLE & BUFFALOES IN VARIOUS REGIONS of U. P.



3. BREEDING OF CATTLE

It is now a well established fact that size, draught ability, milk yield and its butter fat content are factors which are transmitted hereditarily to the progeny, in which the bull plays a more important role than the cow, and it is rightly said that bull is half the herd. There is no doubt that with better feeding and care the milk yield and draught capacity of our existing cattle can be considerably augmented up to a certain limit almost immediately but beyond that no further improvement is possible unless the inherent qualities and potentialities are developed by introducing improved blood.

(*a*) *Breeding tracts and the breeds allocated* [Plate III].—In view of the fact that Uttar Pradesh is a very large province with great variation in climatic and soil conditions, fodder and grazing facilities, and types of cattle in different zones, it is necessary that each zone or tract should receive separate treatment in respect to its scheme for the development of cattle to suit the local requirements and environmental conditions. For this purpose the Uttar Pradesh can be divided into six fairly well demarcated tracts and the Animal Husbandry Re-organization Committee has recommended suitable breeds of cattle and buffaloes for each in consultation with the Government experts and local cattle breeders as detailed in the following table :—

TABLE I—*Showing Allocation of the Breeds of*

Serial no.	Tract	District included	Soil and climatic conditions
1	Dry western ..	Meerut, Muzaffarnagar, Saharanpur, Mathura, Bulandshahr, Agra, Aligarh, Etah, Bijnor, Moradabad, Bareilly, Budaun, Lower Dehra Dun and Bilaspur Tahsil of district Pilibhit.	Wheat-growing, rainfall 20″—30″, soil and climatic conditions of the tract lend themselves to improvement being effected in the existing type of cattle.
2	Central Humid ..	Farrukhabad, Mainpuri, Sitapur, Hardoi, Etawah, Unnao, Kanpur, Fatehpur, Shahjahanpur (excluding Powayan Tahsil) and Mohammadi Tahsil of Lakhimpur-Kheri District.	Millet-growing, rainfall 30″—45″ ..
3	Eastern— (*a*) Middle-eastern.	Pratapgarh, Sultanpur, Faizabad, Bara Banki, Lucknow, Rae Bareli, Allahabad (excluding Meja, Karchhana and Allahabad tahsils), Kaisarganj Tahsil of Bahraich District, and Harraiya, Basti and Khalilabad tahsils of Basti District.	Paddy growing, rainfall over 45″ ..
	(*b*) Far-eastern	Ballia, Azamgarh, Jaunpur, Banaras, Ghazipur, Bansgaon and Gorakhpur tahsils of Gorakhpur District, and Deoria Tahsil of Deoria District.	..
	(*c*) South-eastern.	Mirzapur District and Meja, Karchhana and Allahabad Tahsils of Allahabad District.	..
4	Tarai Tract — (*a*) Western Tarai.	Pilibhit District (excluding Bilaspur Tahsil), Powayan Tahsil of Shahjahanpur District, Haldwani and Kashipur Tahsils of Naini Tal District.	Sub-mountain area, paddy-growing, rainfall 45″– 65.″ Plenty of pastures with coarse grass.
	(*b*) Eastern Tarai.	Lakhimpur District (excepting Mohammadi Tahsil), Bahraich District (excepting Kaisarganj Tahsil), Gonda District (except Gonda and Tarabganj Tahsils), Basti District (except Harraiya, Basti and Khalilabad Tahsils), Deoria District (except Deoria Tahsil).	..
5	Bundelkhand ..	Jalaun, Jhansi, Hamirpur and Banda ..	Millet-growing, rainfall 30″—40.″ Area of many soil formations, rocky at places with plenty of shrubs and coarse grass.
6	Hill	Almora, Garhwal, Dehra Dun (excepting Dehra Dun Tahsil), Naini Tal (excepting Haldwani and Kashipur Tahsils).	Rainfall 60″—80″ rock soil with plenty of grazing.

N.B.—Within the above tracts, however, there are to be found some areas which, though situated in [a] fodder conditions and are therefore able to produce within their circumscribed areas, cattle much superior in intensice cattle breeding work.

Cattle and Buffaloes in Various Tracts of U.P.

Types of cattle and buffaloes found	Breed recommended	
	Cattle	Buffalo
Cattle similar to Hariana though inferior, e.g. Kosi. Buffaloes possess a fair amount of Murrah blood in them.	Hariana	Murrah.
Cattle of moderate size and mediocre efficiency both in regard to milk production and capacity for draught.	Do.	Do.
Cows are poor milkers and bullocks are puny and weak. Better types of cattle tend to degenerate when introduced.	Sahiwal	Do
..	Gangatiri (Medium-Hariana)	Do.
..	Sindhi	Do.
Small type of draught cattle, viz. Kherigarh and Ponwar. Buffaloes (Tarai) are poor milkers. Better types of cattle rapidly degenerate when introduced.	Ponwar	Tarai.
..	Kherigarh	Do.
Type of cattle vary noticeably with the different types of soil ..	Kenkatha	Bhadawari.
Possesses the poorest and smallest type of cattle and buffaloes. Cattle from other areas tend to rapid degeneration if introduced.	Sindhi	Tarai.

tract where generally poor types of cattle are raised, are favoured in some way or other by suitable soil and type to the general type of the tract, These areas are therefore obviously suited to serve as selected areas for

(*b*) *Description of the breeds of cattle and buffaloes recommended.*

(i) *The Sahiwal*—[Plate IV, figs. 1 and 2]. These are essentially milch cattle which are raised in large numbers in the dry central and southern areas of the Punjab. They are usually long, rather fleshy cattle, short on the leg and comparatively lethargic and heavily built, but in the best milk strains the skin is fine. Owing to their milking capacity these cattle are largely exported to other areas for milk production in cities. The bullocks are useful for slow work but are not considered to be good draught animals. They are commonly of a reddish dun colour although in some animals, especially those of dark shade, patches of white colour may be found on the body. This breed of milch cattle has received a large amount of attention in India. Several pedigree herds exist and these have demonstrated the undoubted potentialities of the Sahiwal breed for milk production. Many cows have already exceeded the 10,000 lb. mark in a normal lactation, and the average of all farms in India is over 5,000 lb. In Uttar Pradesh herds of this breed are being maintained at the Bainti Farm of Raja Sahib of Bhadri in Pratapgarh District, Government Dairy Farm, Bhadruk, Lucknow, the Government Agriculture College Dairy, Kanpur, and the Saraiya Dairy Farm, Sardarnagar, Gorakhpur. The specimens of this breed which has become rare after the partition of the country are being withdrawn from the various jails to the Government Dairy Farm, Bhadruk, Lucknow, for careful breeding and propagation.

(ii) *The Sindhi*—[Plate IV, figs. 3 and 4]. The home of this breed is the country around Karachi and north-west of it, including the Las Bela area of Baluchistan. The animals are of red or fawn colour, frequently with some white on the face and dewlap and are among the most efficient milch cattle of India and, though comparatively small, the bullocks make very useful animals for light draught work. As they are capable of adapting themselves to varying conditions of soil and climate, they are now extensively used for grading up local stock in other parts of India where, owing to the poor conditions under which cattle are bred and maintained, larger animals would not be suitable. Moreover, cattle of this breed have been largely exported to countries like Burma, Ceylon, Malaya States, Japan and the Phillipine Islands. There are several farm herds of carefully bred Sindhi cattle in India and many high yielders have been obtained, the highest in the latest returns being 9,283 lb. milk in a lactation of 351 days.

PLATE

FIG. 1 *Sahiwal bull*

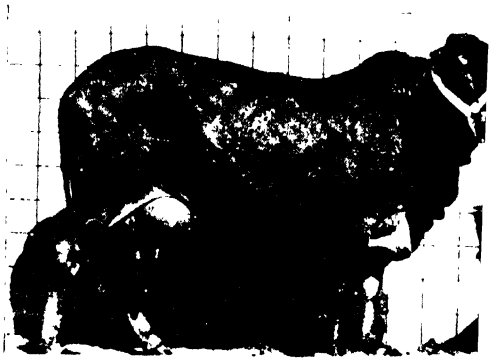


FIG. 2—*Sahiwal cow*

FIG. 3—*Sindhi bull*

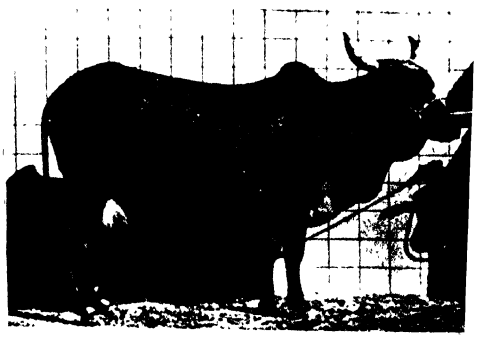


FIG. 4—*Sindhi cow*

FIG. 5—*Hariana bull*

FIG. 6—*Hariana cow*

FIG. 1.—*Kosi bull*

FIG. 2.—*Kosi cow*

FIG. 3.—*Gangatiri bull*

FIG. 4.—*Gangatiri cow*

FIG. 5.—*Ponwar bull*

FIG. 6.—*Ponwar cow*

The average yield of farm herds is about 4,000 lb. milk in 325 days. In Uttar Pradesh herds of this breed are being maintained at the Allahabad Agricultural Institute, Allahabad, and Uttar Pradesh College of Veterinary Science and Animal Husbandry, Mathura. The latter herd is awaiting transfer to the cattle breeding farm at Hawalbagh near Almora in the Kumaon hills.

(iii) *The Hariana*—[Plate IV, figs. 5 and 6]. The home of the breed is in the Rohtak, Hissar, Karnal and Gurgaon Districts of the Punjab and in Delhi Province, but animals of this type are produced over a wide area to the south of these districts, particularly in the east Uttar Pradesh, Alwar, and Bharatpur. Hariana bullocks are valued as powerful draught animals and are particularly good for rapid ploughing and road transport. At the same time the cows are fairly good milkers. According to the latest returns from farms, Hariana herds average about 3,500 lb. milk in a normal lactation of 300 days and calve fairly regularly at intervals of about 15 months. They are of a hardy constitution and can thrive in a variety of climates. They are therefore used extensively for milk production specially in cities and a large number of cows are regularly exported from the Hariana breeding area in Punjab to cities like Calcutta, Bombay, etc. The combination of draught and milk qualities in this breed has led to its wide use in other provinces particularly Uttar Pradesh and Bengal for grading up local inferior cattle. These cattle are white or light grey, with a dark grey head, neck, hump and quarters in the bull. The face is long and narrow with a flat forehead and a well-marked bony prominence at the centre of the poll. The horns are never heavy in the true Hariana and are often somewhat stumpy. In Uttar Pradesh pure-bred herds are being maintained at the Government Farms at Babugarh, Madhurikund, Mathura, and Aligarh.

(iv) *The Kosi* (*Mewati*)—[Plate V, figs. 1 and 2]. These cattle are bred in large numbers in the districts of Mathura and Agra and western portions of Alwar and Bharatpur States. They are valued as powerful, docile cattle useful for heavy plough and carting. Their daily average milk yield is about 8 to 10 lb. They are similar in type to the Hariana breed but show some evidence of an admixture of Gir blood in their composition. As a rule they are white in colour with the usual dark head, neck, shoulders and quarters as commonly seen in the grey breeds. Like the Hariana they are somewhat high on the leg but are generally more loosely

built with a higher carriage of the head and neck. They have a comparatively long narrow face with somewhat bulging forehead and horns which emerge from the outer angles of the poll and inclined to turn backwards at the points. They have a comparatively long frame with the drooping quarters, light limbs and pendulous but not over-developed sheath. The large hump is placed in front of the withers and the dewlap is well developed. The tail is of moderate length with black switch reaching about half-way between the hock and the ground.

(v) *The Gangatiri* (*Shahabadi*)—[Plate V, fig. 3 and 4]. The home of this breed is the Doaba area between Ganga and Ghaghra rivers in the Ballia District although specimens of this breed are also found in the adjoining districts of Ghazipur and Banaras in Uttar Pradesh and Shahabad District in Bihar. The animals of this breed are of medium size with an average height of about 50" and weighing about 600 to 700 lb. (Plate V, Figs. 2 and 4). They are of docile temperament and are easily manageable. They are generally of white or grey colour with a fairly long head which tapers to the nose and is carried fairly erect. The forehead is broad with bright eyes and thick horns which are blunt at the point. The neck is short and thick with dewlap of medium size. The shoulders are well defined ; legs are proportionate to the body and are carried well apart. The hoofs are black and hard and so are the horns. In bulls hump is very prominent. The hind quarters are well developed with tail having black switch, reaching just below the hocks. In cows udder is well developed with properly placed teats and prominent milk veins. The average milk yield is about 10 lb. a day with a maximum of 24 lb. a day in rare specimens. The bullocks are good draught animals and are liked by the cultivator both under the plough as well as in the cart. They maintain their health and working capacity for a fairly long period and individual specimens have been found to serve the cultivator even up to the age of 20 years. Being a medium-sized animal its maintenance is comparatively less expensive to the cultivator.

(vi) *The Ponwar*—[Plate V, figs. 5 and 6]. These cattle are found in Puranpore Tahsil of Pilibhit District as well as in the north-western part of Kheri District in Uttar Pradesh. Pure-bred animals possess a small narrow face, small active ears, big bright eyes, long upstanding horns measuring 12 to 18 inches. They are generally black and white in

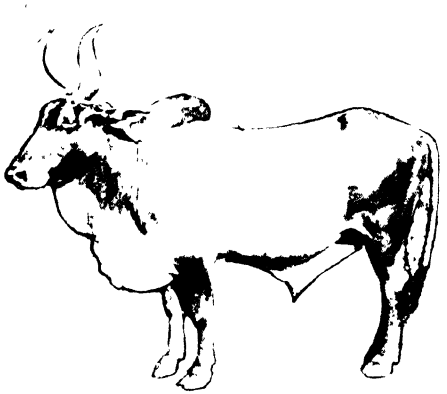


FIG 1—*Kenkatha bull*

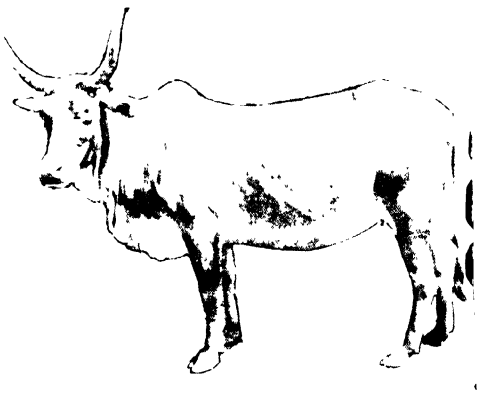


FIG 2—*Kenkatha cow*

FIG 3—*Khenigarh bull*

FIG 4—*Khenigarh cow*

colour. The barrel is moderately long while the sheath is short and tight. Hump is well developed in bulls but it is small in cows. The tail is long and tapering with a white switch. The average height of a bull is about 50 inches while that of a cow is about 45 inches. A bull weighs about 700 to 800 lb., while the average weight of a cow is about 650 lb. The cattle of this breed are active and often furious, and like free grazing. They reach maturity after five years. The bullocks are good for draught purposes. The cows are poor milkers. A herd of this breed is maintained at the Government Cattle Breeding Farm, Hempur, district Naini Tal.

(vii) *The Kherigarh*—[Plate VI, figs. 1 and 2]. This breed is found in Kherigarh Pargana of Kheri District in Uttar Pradesh. These cattle are generally white with a small narrow face and thin upstanding horns measuring about 12 to 18 inches in the bulls but smaller in cows. They have bright eyes, small active ears, short neck and a well-developed hump in the male. The barrel is well ribbed up and the sheath moderately tight. The tail is long, ending in a white switch. They are very active cattle and thrive on free grazing. The bullocks are good for light draught and trotting purposes, but the cows are poor milkers. They are well suited to the Tarai tract. A pure-bred herd of this breed is being maintained at the Government Cattle Breeding Farm, Manjhra, district Kheri.

(viii) *The Kenkatha* (*Kenwariya*)—[Plate VI, figs. 3 and 4]. This is a well-known breed of Bundelkhand and is found along the Ken River in Banda District of Uttar Pradesh. Cattle of Kenkatha type are also bred in the territory of Panna, Bijaigarh, Charkhari and Ajaigarh States of Central India, in Uttar Pradesh. These animals are very popular for light draught on the road and for cultivation. They are small, sturdy and fairly powerful animals, well suited to the work of the tract. The cows are poor milkers. The colour varies from grey on the barrel to a dark grey or rufous colour on the rest of the body. The chief characteristics of the breed are : a short, deep, compact body, straight back and drooping quarters, powerful short limbs and good hard feet, a medium sheath with black tip and dewlap of moderate size, short broad head with dished forehead, strong pointed horns which emerge from the outer angles of the poll in a markedly forward direction to terminate in a sharp point, sharp-pointed ears and a tail of medium length with black switch reaching below the hock. The Government have recently purchased a pedigree herd of this breed from the

Ajaigarh State which will be maintained at the Government Cattle Breeding Farm, Bharari, Jhansi.

(ix) *The Murrah buffaloes*—[Plate VII, figs. 1 and 2]. Their home is in Southern Punjab and Delhi Province, but they are bred in large numbers in the whole of the Punjab, Northern Uttar Pradesh and Sind for milk and ghee production. They are the most efficient milk and butter fat producers among Indian cattle. They have been introduced in many other parts of India to improve the local stock.

They are usually black in colour though a fawn grey colouring of the hair is not uncommon and white markings may be found on the face, legs or tail. They are very massive, stockily built animals with deep wide frame, short massive limbs, well developed udder and short tightly-curled horns.

The Murrah breed like the Sahiwal breed of cattle has received special attention. The average yield of farm herds is over 4,000 lb. of milk in 281 days and individuals have yielded up to nearly 10,000 lb. In Uttar Pradesh Murrah herds are maintained at the Government Farms at Babugarh, Madhurikund, Mathura, Aligarh, Lucknow, and Gokulnagar.

(x) *The Tarai buffaloes* -[Plate VII, figs. 3 and 4]. As the name implies these animals are found in the Tarai area of Uttar Pradesh, particularly, between Tanakpur and Ramnagar. Very little attention has been paid towards its systematic development through selected breeding and none towards its proper feeding. Generally they are kept on grazing and are let loose in the jungle. The breed is not famous for its milk yield which ranges from two to three seers per day, the average milk yield being about one thousand pounds in a lactation period of about 250 days. A typical Tarai buffalo possesses a moderate body, not very massive, with coarse head slightly convex at the centre, drooping towards the base of the horns, with a prominent nasal bone with slight depression under the eyes. The eyes are rather small but ears are long. Horns are mostly long and flat with coils, bending backwards and upwards. The legs are short but strong. The tail is long running below the hocks with a white switch. The colour varies from black to brown. In some cases there is a white star on the forehead but that cannot be taken as a characteristic feature. There has been frequent crossing with Murrah and other local breeds of the adjoining localities. The special feature of this breed is that it could easily stand the Tarai climate with abundance of biting flies which is not very suitable for the finer breeds.

FIG. 1 *Murrah buffalo-bull*

FIG. 2 *Murrah she-buffalo*

FIG. 3 *Tarai buffalo-bull*

FIG. 4 *Tarai she-buffalo*

FIG. 5.—*Bhalwari buffalo-bull*

FIG. 6.—*Bhadwari she-buffalo*

(xi) *The Bhadawari (Etawah) buffaloes*—[Plate VII, figs. 5 and 6]. The home of this breed is the Bhadawari Estate, part of Bah Tahsil in Agra District and the adjoining areas of Gwalior State. Etawah District is not the original homeland of this breed although Bhadawari buffaloes are found scattered here and there in the riverine of Jamuna and Chambal rivers and individual specimens are found in other parts of the district as well.

Bhadawari buffaloes are medium-sized with wedge-shaped bodies. Mostly they are copper coloured with scanty hair that are black at the root and reddish brown upwards. In some case the hair are completely brown. Generally all the four legs from hooves to knees and hocks are found to be partly brownish white. The head is comparatively small, light and bulging out between the horns but sloping down slightly towards the forehead. In the males it is a bit heavier and coarse. The horns are characteristically placed, flat, compact and of average thickness, growing backwards and then upwards turning inwards with slightly pointed tips. Forehead is slightly broad and deep in the middle. Face is comparatively narrow with slightly marked nose and nostrils well apart. Generally white markings on the face are not seen. Eyes are prominent, active and bright in females but not so in males. Ears are of average size, rough and pendulous. The neck is medium-sized, well placed and thin in females but slightly massive and thicker in the males. Dewlap is non-existent. Chest is well developed. Barrel is short but well developed with short and stout legs having black hooves. The hind quarters are heavier and higher than the fore quarters in the female. Loins are broad and straight in the male. Flanks are wide and deep. Thighs and buttocks are flat and muscular. Twist is well arched in the females to provide sufficient room for the udder. The tail is long, thin and flexible running down the hocks with black and white or pure white switch. The vulval opening is situated not so close to the anus as is found in the other breeds of buffaloes. The udder is not so well developed as in the case of Murrah buffaloes but the milk veins are fairly prominent. The teats are of medium size though not of uniform length. The average milk yield of Bhadawari buffaloes is about 7 lb. per day but the fat percentage may go as high as 13 per cent. Its milk is therefore highly suited for ghee-making which is the common village industry. Its males are frequently used for draught and can stand heat better than the other breeds of buffaloes, e.g., Murrah. This breed is therefore more suited

to the needs of the villagers. The popularity of this breed is confined to the districts of Agra, Kanpur, Etawah, Orai and partly Jhansi. In Etawah District people generally prefer buffaloes of black colour as they yield more milk and they call it Bhadawari. In fact it is an admixture of Murrah and Bhadawari which has resulted in the increase of milk yield with proportionate decrease in fat percentage.

(*c*) *Policy of breeding*—When dealing with pure or fairly pure breeds maintained at the Government or private stud farms (e.g., Murrah buffaloes, Sindhi or Sahiwal cattle) or in the homes of the breeds [e.g., Tarai buffaloes, Ponwar cattle, etc.], we should attempt to improve the milk yield and draught capacity of the stock and fix the desirable characters in them by selecting suitable bulls and cows for breeding. But, when it is intended to improve non-descript cattle as in the middle eastern districts, hills, etc., the method to be adopted is that of upgrading them with pure-bred pedigree bulls of a suitable breed possessing the desired qualities and suited to the local environmental conditions. These two systems of breeding are briefly described below :

(i) *Selective breeding*—The main object of making a selection of livestock for the purpose of breeding is to modify the type to better suit one's purpose, to prevent so far as possible the production of undesirable individuals and to reduce the population as near as may be possible to those that are useful in the highest attainable degree. The probability of finding all desirable qualities in a single individual reduces rapidly as the number of characters multiplies. The practical way to " fix " a large number of desirable characters is to do it with one or two at a time, or at the most a few at a time, adding others as it then becomes comparatively easy to secure them all in the same individual. Commonsense dictates that we should begin with the important ones from the utility stand-point, e.g., milk yield, butter fat content and draught qualities. When a family becomes famous for its qualities, it is generally bred with less ability and care than before, whereas it is deserving of greater and more careful attention to prevent deterioration. It is not a continually recurring strain of new creations that is most needed, but rather well protected and solidly bred lines of long established excellence and unquestioned ancestry.

(ii) *Grading*—By grading is meant the mating of a common or relatively unimproved parent with one that is more highly improved, i.e., a

pure-bred. The mating might be either way, but in practice the male is taken for the pure-bred parent for economic reasons, firstly a large number of progeny with greater chances of uniformity can be had from a male than from a number of females and secondly most of the good qualities, e.g., milk and butter fat production and capacity for draught are generally transmitted through the sire. Its purpose is to develop uniformity and to increase productivity and quality in the offsprings. The pure-breds are generally capable of producing these results because they have been selected for many generations for particular points and purposes within rather narrow limits and specification. The mathematics of mating shows that if the practice is continued for six generations, only one and a half per cent. of the original unimproved blood will remain when selected graded, male progeny may be used for breeding purposes but till that stage is reached they should ordinarily be castrated and used for draught purposes only. The chief drawback in grading is that it is likely not to be followed up. The breeder is almost certain to choose some promising half or three-quarter bred for a sire because he looks as good as pure-bred. For economical purposes the earlier grades may be equal to pure-breds but they cannot be relied upon for breeding purposes, although they would be everytime better than the ordinary scrub cattle in the villages from which they have been evolved. By the use of a single pure-bred individual it secures at once something more than half of the total excellence of the breed, and if followed up it will secure in time, through sires alone, practically all of it.

If the herd producing the sires for upgrading work is also simultaneously improved by constant selection in breeding, the amount of improvement in grading will also be proportionately greater. (Plate IX, fig. 4).

(iii) *Policy of breeding to be adopted in the various tracts*—Our attempt should be to make each tract self-sufficient in respect to stud bulls which should be produced under local conditions instead of importing them annually at huge expense from the other provinces. This necessitates the opening of at least one Government Livestock Breeding Farm in each of these tracts, where one does not already exist and stocking all such farms as well as private farms (where available) including Dairy Farms and important goshalas with large number of breeding stock of the desired breeds. This would result not only in meeting our requirements of bulls produced economically under local conditions but would also increase the quantity of milk produced in the Province.

Table II showing the policy of breeding to be adopted in the

Serial number	Tracts	Location of Government or other recognised stud farms	Plan and objective of breeding at the Government or other recognised farms
1	2	3	4
1	Dry Western Tract	(1) Babugarh Farm .. .. (2) Madhurikund and Mathura Farms.	Murrah buffaloes and Hariana cattle. .. Improvement of herds by selective breeding for production of milk and pedigree Hariana bulls and Murrah buffalo-bulls.
			For Murrah same remarks as against item 1 above.
2	Central Humid Tract.	Nilgaon Farm (Sitapur) ..	Improvement of medium sized Hariana (Kosi type) cattle by selective breeding for the production of medium sized milch type Hariana bulls.
			For Murrah same remarks as against item 1 above.
3	Eastern Tract—		
	(*a*) Middle eastern.	1. For Sahiwal and Murrah Bhadruk Farm at Lucknow and Niblet Farm (Jahangirabad) in Bara Banki District. (At Bhadruk only milch stock will be kept.) 2. For Sahiwal Bainti Farm in Pratapgarh District.	Improvement of Sahiwal herd by selective breeding for milk and issue of pedigree bulls.
	(*b*) Far eastern	For Gangatiri cattle Araziline Farm has been established in Banaras District.	Improvement of herd by selective breeding for milk and issue of pedigree bulls.
	(*c*) South eastern.	For Sindhi Allahabad Agricultural Institute Farm.	Ditto.
4	Tarai Tract—		
	(*a*) Western Tarai.	(1) Manjhra Farm in Lakhimpur-Kheri District.	Improvement of Tarai buffaloes by selective breeding for the production of suitable buffalo bulls. Improvement of Kherigarh and Ponwar by selective breeding at Manjhra and Hempur Farms, respectively, especially in regard to milk and production of pedigree bulls.
	(*b*) Eastern Tarai.	(2) Hempur Farm in Naini Tal District.	

various cattle breeding tracts in Uttar Pradesh

Source of improved blood for improving the quality of stock at the stud farms	Places to which pedigree bulls will be supplied from Government or other recognised farms	Plan and object of breeding in rural areas	Remarks
5	6	7	8
Hariana bulls from the Government Livestock Farm, Hissar and the All-India Cattle Show auction Murrah bulls from a Military Dairy Farm or A. I. C. S. auction.	Bulls will generally be supplied for the intensive cattle breeding work in the selected areas, key villages, development blocks and milk zones, preferably those which are round about the Government or recognised farms where good cattle are found.	The intensive cattle breeding areas referred to in the previous column will supply bulls to the rest of the areas in the respective tracts with the object of mass improvement of cattle in the villages both in regard to milk and draught.	Selected Goshalas that maintain cows of the recommended breed and use only pedigree bulls supplied by the department may also serve as small bull-producing farms. At Government Farms where Tarai and Bhadawari buffalo-bulls are produced on occasional cross with Murrah to push up the milk yield of the herd may be desirable.
Ditto	Ditto	Ditto.	
Murrah as against item I above.	Ditto	Ditto.	
Sahiwal—Indian Agricultural Research Institute, New Delhi or M. D. F., Meerut.	Ditto	Ditto.	
Medium sized Hariana (Kosi type) as against item 2 above.	Ditto	Ditto.	
Sindhi—From the Allahabad Agricultural Institute.	Ditto	Ditto.	
Murrah as against item I above. Kherigarh and Ponwar only by selection from the farm stock	Ditto	Ditto.	

Serial no.	Tracts	Location of Government or other recognised stud farms	Plan and objective of breeding at the Government or other recognised farms
1	2	3	4
5	Bundelkhand Tract	Bharari (Jhansi) ..	Improvement of Kenkatha cattle and Bhadawari buffaloes by selective breeding for the production of suitable Kenkatha bulls and Bhadawari buffalo-bulls.
6	Hill Tract ..	Site yet to be decided. (Narendarnagar in Tehri-Garhwal District is in view).	Improvement of Sindhi cattle and Tarai buffalo herds by selective breeding under local conditions for milk and the production of pedigree bulls and buffalo-bulls.

Source of improved blood for improving the quality of stock at the stud farms	Places to which pedigree bulls will be supplied from Government or other recognised farms	Plan and object of breeding in rural areas	Remarks
5	6	7	8
Murrah— As against item I above. *Kenkatha* by selection from the farm stock.	Ditto	Ditto.	
Murrah –As against item I above *Sindhi*—From the Allahabad Agriculture Institute.	Ditto	Ditto	In Uttar Pradesh Hills the upgrading of indigenous cattle had previously been done by Lohani and Afghan bulls imported from the North-West Frontier Province. Due to the partition of the country it is now rendered difficult to obtain further supplies of these bulls. It has now been decided by the Animal Husbandry Re-organization Committee that the upgrading work should be done with locally produced Sindhi bulls which is a small sized milch type breed that adapts itself more easily to new environments.

The manner in which pedigree bulls will be issued for stud purposes and the way in which improvement will be effected in the stock with improved blood are diagramatically represented in the following two illustrations :

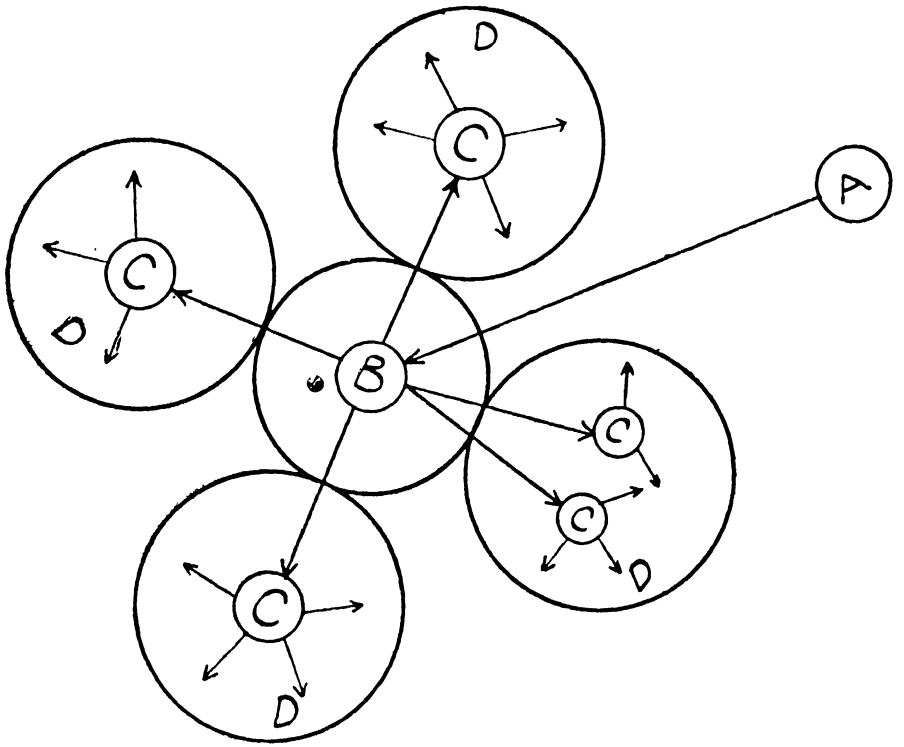


Fig. 1.— Diagram showing the manner in which bulls should be issued.

A— Original home of the breed (private breeders or well established Government Farms where the breed has been developed over a long period).

B—Government and well established private cattle breeding farms.

C—Key village development blocks, goshalas and the selected cattle breeding areas.

D—Other rural areas.

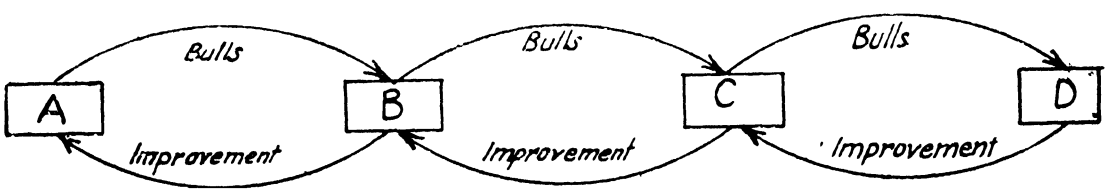


Fig. 2.—Diagram showing the introduction of improved blood from A to D through B an C and the improvement achieved thereby in the quality of cattle, their milk yield and draught capacity.

As the cattle industry in the Province has received a great setback in the past due to frequent changes in the breeding policy following the change of officers responsible for the work, it is highly desirable that the policy now decided upon by the Government in this respect on the recommendations of the Animal Husbandry Re-organization Committee who drafted it in consultation with the available Government experts on the subject and the private breeders in the country, must not be altered in future and be pursued consistently and persistently to achieve appreciable and lasting improvement in the stock. It takes about five years to judge the effect of a good sire on milk yield of the progeny even in the first generation and it is only after the fourth generation that characters introduced through grading (which gives the quickest results) get fixed. That shows that one has to wait for a number of years to see the real improvement effected in cattle through any systematic breeding policy and how necessary it is to safeguard against any possibility of a change in the breeding policy.

(*d*) *The Key Village Plan*—Under the various cattle development schemes initiated by the Indian Council of Agricultural Research and the Provincial Government a great deal of work of an exploratory nature has been carried out over a number of years, and in the light of experience gained and in order to make the best use of the limited number of pure-bred bulls available in the country the only practical course that would give us the best results under the circumstances, would be to establish key villages in different parts of every Province and State, where intensive cattle breeding work should be undertaken. The size of these areas will automatically depend upon the number of pure-bred bulls that can be supplied from the Government Farms and such private farms and goshalas where pure-bred stock is maintained. The cattle breeding activities should radiate from these areas into the remaining parts of the Province or State for which selected bulls should be purchased by Government from the key villages for the upgrading work.

All the available pure-bred bulls should be concentrated in the selected key villages according to the breed allocated for the area. To start with the key villages may be selected round about the existing Government Farms or in selected development blocks where comparatively better cattle exist. Wherever possible Artificial Insemination Centres should be set up in these areas to make the most extensive use of the available number of pure-bred

bulls. In these areas people should be encouraged to maintain pure-bred cows for which the Government may grant taqavi loans. The Livestock Improvemet Act, enforcing compulsory castration of all scrub bulls should be applied to all the key village areas where only approved pure-bred bulls should be allowed to operate. In those areas where cattle breeding farms do not exist young pure-bred male calves of the breed selected for the area, should be purchased and reared at calf-rearing centres for issue as bulls. The key village areas where the cattle would become, after the fifth generation, as good as pure-bred should be extended in due course depending upon the number of such bulls available.

(*e*) *Age of maturity* (*puberty*)—A heifer reaches maturity under Indian village conditions at the age of about 2½ to 3 years. On farms where the young stock is liberally fed and well looked after a heifer may attain maturity about 6 to 12 months earlier. A young bull attains sexual maturity when about 1½ to 2 years old but under village conditions it is better not to use him for breeding purpose until about 2½ to 3 years old.

(*f*) *Oestrum*—When a heifer reaches sexual maturity she comes into oestrum or heat showing desire for the male. It is exhibited by—

(i) The heifer or cow will be restless and will switch its tail frequently from side to side and will turn her head towards its hind-quarters.

(ii) It will go off its feed for a day or so.

(iii) The external genital organ (vulva) will be slightly swollen and there will be a slight discharge of a white slimy mucus.

(iv) It will stand with its tail raised and ears erect and will stare at individuals.

(v) Frequent passing of urine.

(vi) Milk yield will decrease for two or three days due to restlessness and she may not allow the calf to suckle properly.

(vii) If tied in a stall she will be restless and will bellow frequently.

(viii) If allowed to graze or exercise with other cows, she will be seen to jump on them or allow others to jump on her.

All cows should be taken to the bull immediately these signs appear except those which have calved recently, less than two months ago. It is no use waiting until the next day as this may be too late.

The above symptoms become more pronounced in an adult cow than in a heifer or first calving cow.

This period lasts for about 2 to 3 days but she generally accepts service for 24 hours only which necessitates early mating with a bull after oestrum is noticed. If such a female is not mated or does not conceive after service the oestrum recurs regularly once after about three weeks till she conceives.

(*g*) *Service of cows* –Before a cow is allowed to be served it must be ensured that she is free from any contagious infection of the genital tract, e.g., contagious abortion (Bang's disease) which may infect the bull and also spread to other cows served by him. In such cases or where a doubt exists the genital organs of the cow should be washed and disinfected by a Veterinary Surgeon before permitting service. Cows with an abnormal discharge from the vagina should not be allowed to be served by a bull. Ordinarily for a cow in heat only one service is necessary, so double service should not be allowed as this practice exhausts the bull to no purpose, and the cow in such cases may not prove in calf and the number of cows that the bull can serve in a year will be reduced. A young bull under three years may be allowed to serve 50 to 60 cows in a year, but a fully matured bull, i.e., above three years may be bred to 100 cows a year. The services should be well distributed throughout the year, i.e., not exceeding 10 to 12 per month. During actual service every care should be taken to avoid injury to the bull. A desirable bull should be retained as long as his services are effective. In constructive breeding it is better to record the date of service and the sire. On certain farms a service crate is used to facilitate service by the bull but it does not seem to be necessary.

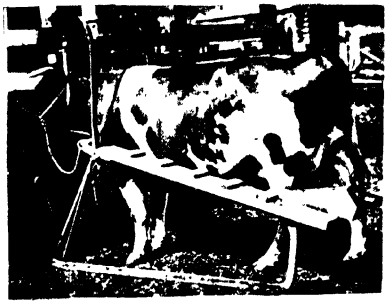
(*h*) *Control of sex in the offspring* –There is experimental evidence to show that if one hour before mating the vaginal passage is freely irrigated twice with a 2 per cent. solution of lactic acid, taking care that the solution reaches all the vaginal folds, the offspring will be a female On the contrary, if 2 per cent. solution of sodium bicarbonate is substituted for lactic acid solution the offspring will be a male. It is necessary that the solution should be of the exact strength to get satisfactory results.

(*i*) *Artificial insemination* –Artificial insemination is the art of collection of the semen from the male and its introduction into the female passage by injection with a syringe or other means when she is in heat. A cow can however be inseminated even within six hours immediately after the end of the

heat period. This method which should be practised by specially trained staff helps not only in solving the problem of shortage of pedigree bulls in the country by multiplying the impregnations from them but it also overcomes certain forms of sterility in the cow and checks the spread of infectious genital diseases of the female, e.g., contagious abortion. Semen from a valuable sire can be flown to far off places and cows inseminated without taking the trouble of bringing them to bull over long distances.

The actual method consists in putting a quiet cow (not necessarily in heat) in the service crate [Plate VIII, fig. 1] and when the trained bull jumps on her the penis is guided into the artificial vagina held on one side and he serves into it [Plate VIII, fig. 2] so that the semen is collected free from contamination. The artificial vagina [Plate VIII, fig. 3] is cleaned and sterilized before use and is maintained at body temperature by pouring hot water into the hollow space surrounding the vaginal wall. The semen is ejaculated into the (graduated) glass test tube to be provided at the end of the artificial vagina. A drop of it is examined under the microscope to see that it is a good sample with normal sperms [Plate VIII, fig. 5]. If it is a poor sample [Plate VIII, fig. 6] it is rejected. The seminal fluid is usually diluted with egg-yolk phosphate solution to about 3 to 6 times and stored at 35° F. Bull's semen preserved in this manner will remain potent up to the fourth day after collection. For inseminating a cow, about 1 c.c. of semen is taken into the narrow bore thick glass tube of the inseminating apparatus [Plate VIII, fig. 4] which, with one hand in the rectum, is inserted through the vagina by the inseminator into the cervix of the uterus and injected into it. The inseminating apparatus should be sterilized after inseminating each cow. In normal mating only a fraction of the ejaculated semen finds its way into the cervix. By artificial insemination the semen is thus used more economically and from one jump of a bull it is possible to inseminate as many as 10 to 40 cows [Plate VIII, fig. 7].

(*j*) *Training of bulls for artificial insemination*—Young bulls as soon as they are two years old should be trained. They should have nose rings put on at an early age and be always kept under control. They should be used in the cart for light work to give them exercise and keep them in good physical vigour. The bull is trained in three easy lessons at several days' intervals. A cow or buffalo in heat, as the case may be, is tied in the breeding rack and the bull, with a muzzle of soft rope over his mouth and tied



←FIG. 1 *Service crate*

FIG. 2 *Collecting semen from the bull in an artificial vagina*

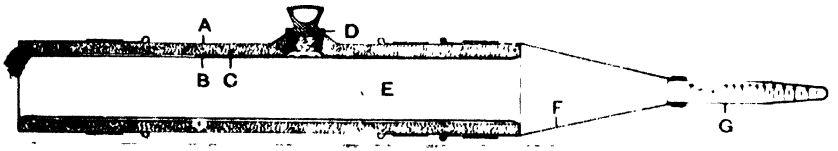
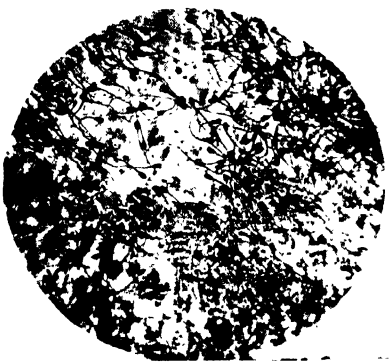


FIG. 3—*Diagram of Artificial Vagina—A cylinder (A) fitted with a rubber tube (B) folded over the ends forming a space (C) in which water at body temperature is poured through the top (D). The inner side of the rubber tube (E) is lubricated with white vaseline. A soft rubber funnel (F) is bound over one end of the cylinder. Into the end of the funnel a graduated glass tube (G) is inserted*

FIG. 4—*Apparatus used for insemination. A small (2 c.c.) glass syringe (Z) is fitted with a short piece of thick rubber tube (Y) into which is fitted a thick glass tube (X) with a narrow lumen*



←FIG. 5 *Semen from a fertile bull swarming with actively motile spermatozoa seen under the microscope*

FIG. 6—*Semen from a sterile bull with only an occasional dead spermatozoa seen under the microscope*

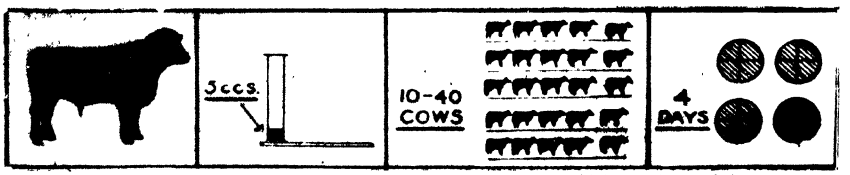


FIG. 7—*At each service a bull yields about 5 c.c. of semen which can be used for 10-40 cows by the artificial insemination method, and can be kept for 4 days in fit condition*
(After F. H. A. Marshall and John Hammond)

behind his horns and two ropes tied in the nose ring, one held tight on either side by an attendant, is led up to the cow and allowed to smell her. The muzzle prevents his licking the cow and thus saves a great deal of time and prevents the spread of disease from the cow to the bull. The bull staff should not be left attached to the nose ring when the bull is brought near the cow. He is then led forward so that his head is over her back and is encouraged to mount her. If he refuses he is then taken away for a little walk and brought back again a second time and the procedure repeated. He is never left with the cow more than two minutes at a time.

If the bull refuses to mount the cow in the breeding rack the cow is led in front of him slowly until he shows signs of sexual desire when she is held still and he is encouraged to mount her which he usually does immediately. The man who plans to collect sperm later is at his side, holding the cow's tail out of the way and caressing the bull lightly.

If the bull shows interest in mating with the cow a second time she is returned to the breeding rack for the second service which is usually quickly consummated. The bull is then rested several days before he is given lesson number two.

The second lesson is similar to the first except that the cow is not removed from the breeding rack even though the bull does not serve her at once. He is taken for short walks every two minutes until he serves her. He is again rested several days.

The third and last lesson differs from the second only in that this time the bull's penis is not allowed to enter the cow but is deflected into the artificial vagina by the attendant gently grasping the sheath. As the penis enters the artificial vagina the attendant brings the apparatus down to meet the bull's thrust and a fine sample of sperm is collected in the test tube. If the apparatus is not brought against the bull at the psychological moment he may withdraw without ejaculation.

If this procedure is followed in all subsequent breeding and collection of semen the bull will remain a rapid breeder. Many times cows that are not in heat can be tied in the breeding rack and a sample collected in the artificial vagina before the bull has found out that the cow is not in heat as he has never been allowed to form the habit of licking her before mounting and he knnows that he will be taken away promptly if he does not get the work in hand done.

(*k*) *Signs of pregnancy*.—Pregnancy in a cow is generally indicated by the cessation of oestrum or heat periods ; she refuses males, becomes more quiet and tends to lay on flesh. As the pregnancy advances the abdomen is enlarged and so do the mammary glands (udder). The foetus in such cases may even be palpated on the right side of the abdomen. Sometimes the movements of the foetus may also be noticed especially if cold water is given to drink after fasting. In case of doubt the help of a Veterinary Surgeon may be sought who may be able to diagnose pregnancy by feeling the foetus per rectum even in early stages of pregancy and examining the cervix in which a characteristic uterine seal is formed in the case of pregnant animals.

(*l*) *Period of gestation*.—The period of gestation, i.e. the number of days between the day of service and the day of the birth of the young in the case of cows is 240—320 days with an average of about 285 days. The variation in the period of gestation may be due to the effect of disease or nutritional and climatic factors, etc. It is desirable to know the date of service and the normal period of gestation so that the farmer may give the necessary attention to the pregnant cow approaching parturition. In cattle generally one calf is born at each calving, twins being rather uncommon. When twins are of the same sex they are usually normal but when they are of the opposite sex the female is invariably barren (free-martin) due to the influences of the male foetus.

(*m*) *Care of the pregnant cow*—All pregnant cows should be treated kindly. They should not be made to walk long distances, run fast, be chased by dogs, frightened or allowed to fight with other animals. Any kind of violent exercise should also be avoided. Their feeding and general management must be regular and based on sound lines. Turning the cow out for grazing is the best form of exercise while she is pregnant. They should not be allowed to mix or tied in the same stalls with animals that have aborted. Heavy milkers should be dried off about 8-10 weeks before the expected date of calving.

A few days before calving the udder fills and becomes enlarged and prominent. The teats also swell up and actual milk flow is not altogether uncommon. The vulva becomes enlarged, loose, soft and to a certain extent inflamed, and muscles and structures on either side of the root of the tail become relaxed and appear to fall. At this time the cow should be kept

in a clean, comfortable, calm and quiet place with plenty of clean dry bedding underneath her. Her hind-quarters should be washed and kept clean. Hair from these parts may be clipped if necessary. Her feeding should be of a soft and laxative nature, e.g., bran-mash, linseed meal or oat meal and green fodder. For two or three days before calving she may be given lukewarm water to drink and should be protected from cold wind and extremes of temperature. A cow with a history of abortion, still birth or retention of placenta during previous calving should be isolated in a separate stall which should not be used for other cows and be thoroughly disinfected after each use, burning the after-birth and soiled litter, etc. In the absence of a suitable calving stall a cow may be allowed to calve on a clean uninfected pasture. At the time of actual calving any kind of interference with her should be avoided and nature should be allowed to take its course. But one should watch carefully and help should be provided in case there be any difficulty in calving. The most natural presentation of the foetus at the time of calving is head, neck, and fore-limbs coming out first, fully extended with soles of the fore-feet directed downwards and nose resting on or near fetlocks. In all serious and difficult cases of delivery the help of a Veterinary Surgeon should be sought and inexperienced gowalas with all their unclean habits should not be allowed to interfere with the most delicate genital organs of the animal. In the case of heifers enlargement of the udder is usually more prominent and they may sometimes become very irritable at this time. Udder in such cases should be thoroughly but gently rubbed at each milking, using camphorated oil as a lubricant to relieve congestion. In some of these cases pre-milking, i.e., milking before parturition may be resorted to on the advice of the local Veterinary Surgeon.

As soon as the cow has calved, she should be cleaned with a moist cloth dipped frequently in a basin containing warm water, and clean dry bedding should be provided to her. A careful watch should be kept on the after-birth or placenta which in most cases comes out within 24 to 36 hours. If it is retained the help of a Veterinary Surgeon should be sought. Most of the gowalas can easily remove the after-birth but their methods are too rough and insanitary, leading to infection and subsequent troubles. The placenta should be buried and not allowed to be eaten away by the animals. Within 1 or 2 hours after parturition a refreshing and stimulant mash consisting of wheat, barley or bajra with a little quantity of gur, ginger

powder and salt should be given to her. Later she should be fed on soft and laxative diet for a few days after which the concentrated ration should be gradually added according to milk yield.

Careful nursing and proper feeding of the cow during her dry period and both before and after calving is of paramount importance. It gives her a good start for her yield during the lactation period and one gets a strong healthy calf.

(*n*) *Care of the newly-born calf*—A newly-born calf should be attended to at once. Any membranes of sticky matter adhering to the nostrils, eyes, ears and body should be carefully removed so that the calf may breathe freely. Usually if the cow is indifferent and does not lick its calf immediately after delivery, it is customary to sprinkle a little common salt on the calf to stimulate the dam to lick. If the calf is to be taken away and weaned immediately after birth it should be cleaned and rubbed dry with a clean dry straw wiper or a sponge, and kept warm and protected from extremes of climatic conditions. The place provided to the newly-born calf should always be clean, well ventilated and provided with plenty of fresh clean straw bedding. Some of the still-born calves may respond to artificial respiration which should be done by pulling out the tongue, moving the fore-limbs forwards and backwards and by applying friction to the body with straw wisps. The revival to life and the beginning of respiration is often indicated by a gasp or a little cough by the calf. Occasionally the anus may be imperforated for which proper veterinary aid should be obtained to make the necessary surgical incisions. The navel or the umbilical cord with which the calf is attached to its dam is generally found severed. It should be ligatulated about one inch below the abdominal wall and cut about 2 inches below the ligature [Plate IX, fig. 1]. The stump is then steeped in tincture of iodine and covered with tar. If not covered with tar the application of tincture of iodine may be repeated for a few days once or twice daily and the stump should then be dusted with a dusting powder or boric acid till it is dried up. Attention to navel is essential to prevent joint-ill, scours, etc. Under normal conditions the calf will try in about an hour to stand itself and make its way towards the udder to suckle. It may have to be helped on to the teats. It is essential that the bowels of the young animal move fairly soon. To accomplish this nature provides colostrum, the first milk, which is not only highly nutritious and rich in

FIG. 1.—*Attention to the navel soon after birth*

FIG. 2.—*A bull pen with service paddock*

FIG. 3.—*The use of nose-ring in bulls*

FIG. 4.—*Upper figure shows the degree of improvement in stock through successive generations by using bulls of uniform quality. Lower figure shows accelerated improvement by constantly improving the quality of purebred bulls used for upgrading*

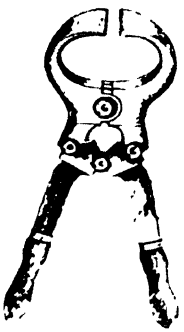


FIG. 5.—*Burdizzo Castrato*

FIG. 6.—*Painless and bloodless castration of undesirable male progeny*

protective antibodies against common infections but has also a laxative effect. Even those calves that are weaned at birth should be given colostrum for the first few days. If for any reason colostrum is not available, cow's milk may be substituted and about an ounce of castor oil administered in order to avoid the danger of constipation. Young animals do best if fed regularly, moderately and often. The details of feeding calves are given on page 44-45. During cold weather weak calves and those up to 3 months age should be rugged during night with gunny bags. They should be brushed well once or twice daily to keep away ticks, lice and skin troubles and should be taken out in the field and made to run about for exercise.

From the stand-point of safety it is always desirable to deborn the calves both male and female excepting perhaps valuable pedigreed breeding stock and show animals so that they may be handled without danger, transported by rail or steamer more conveniently and rendered unable to cause horn injuries to the udder, etc., of other cattle. The operation should be performed by a Veterinary Surgeon using either a hot iron or a stick of caustic potash when the calf is from two to seven days old so that it may be done comparatively painlessly and quickly.

(*o*) *Care of the bull*—(i) *Segregation of a newly purchased bull* -A newly purchased bull should be kept segregated for at least ten days to make sure that the animal is not infected with any contagious disease which would in the case of acute infections develop and the symptoms would become apparent during this period. He should be tested by a Veterinary Surgeon preferably before purchase for freedom from chronic insidious infections, e.g., Brucellosis (contagious abortion), tuberculosis and Johne's disease.

(ii) *Housing*—It is of great importance in the successful management of a bull to provide him with a suitable house [Plate IX, fig. 2]. The type of bull pen and paddock considered suitable is given under 'Housing of cattle.' Rather than confining the bull in isolation it is well to locate his stall in such a way that he can see the other members of the herd. The walls of the bull pen and manger should be lime-washed, at least twice yearly, to keep the surroundings healthy and to prevent disease. The floor of the house should be thoroughly cleaned out, swept every morning and fresh litter supplied for no animal can thrive well in a dirty house. A careful man should always be put in charge of the bull ; boys often tease the animal and develop vicious habits in him.

(iii) *Feeding*—The bull in service should be fed with regularity both as regards quantity and time and judiciously with sufficient concentrated food and good roughage including plenty of greens in order to keep him in good condition for service. The details of feeding bulls are given under 'Feeding of cattle.' A lump of rock salt should be left in the manger for the bull to lick when he desires.

(iv) *Exercise*—To keep a bull healthy and a sure breeder it is essential that he should have plenty of exercise. When a paddock is not available and the bull is confined to the stall, he should be regularly led out for exercise about one mile a day. The use of a nose ring is very helpful in keeping the bull under control [Plate IX, fig. 3]. In summer he should be allowed to go out at night into his paddock or some conveniently enclosed field. This will give him the necessary exercise and maintain him in health. The hoofs of the bull spending most of his time in the stall should be trimmed regularly otherwise he cannot stand, walk or serve properly due to the overgrowth of the hoofs.

(v) *Grooming*—It is necessary to brush the bull properly and regularly in order to keep his skin and coat in good condition. An occasional wash with soap and water at about mid-day is also beneficial. After the wash the animal should be properly dried with a clean cloth. This causes a healthy action of the skin and prevents vermin which would otherwise keep the bull in a constant state of irritation and restlessness.

(*p*) *Castration*—Just as good bulls beget good progeny similarly bad bulls transmit bad characters to their offspring. It is therefore necessary that undesirable male pregeny and all scrub bulls should be castrated where approved bulls are available. Painless and bloodless castration in all weathers is possible with the help of a Burdizzo castrator. [Plate IX, figs. 5 and 6].

(*q*) *Breeding records*—For a breeder the maintenance of pedigree and performance records is essential in order to enable him to improve the herd by proper selection. Specimen copies of the various forms recommended by the Indian Council of Agricultural Research in this connection may be obtained from the Director of Animal Husbandry, United Provinces, Lucknow, or any of the Circle Officers of the Department.

(*r*) *Pedigree registration in Central Herd Books*—For the registration of Sahiwal, Sindhi and Hariana cattle and Murrah buffaloes which are the

breeds of all-India importance a Central Herd Book has been established by the Indian Council of Agricultural Research at New Delhi. Pure-bred cows conforming to the respective breed characteristics with a minimum recorded yield of 3,000 lb., 2,500 lb., 2,000 lb., and 3,000 lb., in the case of Sahiwal, Sindhi, Hariana, and Murrah respectively are eligible for registration in the Central Herd Book. Their progeny sired by pure-bred bulls of the respective breed are also eligible for registration.

(*s*) *Livestock Improvement Act*—The Uttar Pradesh Livestock Improvement Bill (1948) is before the Provincial Legislature and it is hoped that it will be enacted before long. It consists of two parts, viz. Part I dealing with compulsory castration of all defective, diseased and scrub bulls and the use of only approved bulls for breeding purposes and Part II dealing with prevention of indiscriminate slaughter of cattle with a view to protect useful stock from destruction. It is intended to introduce Part I of this Act, when passed by the Legislature in all " Key Villages " to begin with where pure-bred bulls will be supplied by the Animal Husbandry Department and it will be gradually extended to other areas. Part II will be specially operative in large towns where big slaughter houses exist. Such Acts are already in force in many of the other provinces.

4. FEEDING OF CATTLE

(*a*) *Introduction*—Our cattle suffer essentially from food shortage which is mainly due to their over-population and inefficient utilization of our fodder resources. The slow process of starvation to which our cattle are thus exposed is evident from their unthrifty condition, poor productive capacity, stunted growth, late maturity and long calving interval. Due to their low milk yield and poor draught capacity we require a larger number of them to meet our normal requirements necessitating the consumption of a larger proportion of maintenance ration and causing thereby still greater strain on the available fodder resources of the country, resulting in their further deterioration and thus creating an ever-widening vicious circle. The solution therefore lies in putting the old and useless stock in concentration camps in jungle areas where they should be kept on bare maintenance ration consisting mainly of jungle grazing and hay and not allowed to breed and multiply, and in mobilizing scientifically all the feeds and fodder resources of the country to the best advantage of our efficient and productive stock. As far as possible all cultivated feeds and fodders and edible oil-cakes should be reserved for feeding the useful cattle. Oil-cakes provide the cheapest source of protein food required for cattle especially the milch and growing stock.

Improvement effected in our stock through pedigree bulls both in regard to milk yield and draught capacity can only be maintained if they are adequately fed with economically balanced ration otherwise they will soon deteriorate and revert to the original poor quality. Increased production and greater working capacity in improved cattle necessitates more food for them which must be provided. It is more advantageous and economical to feed well a high yielding milch cow and a good draught bullock and to get proportionately more milk and work to their maximum capacity than to underfeed them and get a smaller quantity of milk and less work from them.

In India good breeds of cattle with high milk yield and excellent draught quality are found to be restricted only to such areas as grow or are forced by circumstances to grow fodder crops as in canal irrigated areas with practically no pasture land. It is therefore obvious that cultivation of fodder

crops more specially leguminous crops, which not only supply highly nutritious fodder for cattle but also enrich the soil fertility, is the secret of successful cattle husbandry and cheap milk production. It is certain that by appropriate feeding with economically balanced rations both the milk production and bullock power of the average Indian cattle can be substantially increased, which are so badly needed for improving the nutritional standard of our people and increasing the production of food grains in the country respectively.

(*b*) *General hints on feeding cattle*—The profit and loss side of feeding cattle should always be calculated and a properly organized system of feeding economically balanced ration to them according to their milk yield or work to be performed should be followed. Haphazard methods always mean haphazard results entailing more cost and waste. Proper feeding should mean no waste of food and the food fed should bring forth maximum results and keep the animal in a sound and healthy condition. A perfect food must contain all the elements present in the animal's body in proper proportions. The essential ingredients of a complete food be grouped up according to the functions they perform in the animal's body into water and dry matter consisting of proteins or albuminoides, carbohydrates including starches and sugars, fat, mineral matter and vitamins. It is only when a ration is properly balanced, i.e., containing all the essential ingredients both organic and inorganic in the proper proportions that the maximum economic effects can be expected from the animal. The following hints on feeding cattle should be kept in mind :

(i) The ration must be economically balanced with food stuffs available in the locality [Plate X, figs. 1 and 2]. It is not what the cow eats, but what she digests and assimilates that produces milk and with a balanced ration maximum digestibility and minimum wastage of the feed is ensured. It is necessary to include green fodder and mineral matter in sufficient quantities. If required the help and advice of the local Animal Husbandry Officer may be sought in the matter.

(ii) The ration must consist of a variety of foods to make it more palatable and to provide all the nutrients in the desired proportion. Variety in the rations should not be mistaken for sudden change in the diet from day to day which should be strictly avoided.

Any change in diet should be gradual and slow so that the animal's digestive system is not upset.

(iii) Obviously the ration should be composed of clean, wholesome and of good quality foods.

(iv) The feed should be properly prepared in order to render it more easily digestible and palatable. Hard grains should be given ground or crushed and bruised so that their mastication may become easier. Dry foods like grains, cakes, cotton seed, etc., may be moistened with advantage for a few hours so as to render them softer and more palatable. Oversoaking especially during summer months may cause too much fermentation which should be avoided. Cooking, heating or boiling of vegetable feeds for healthy cattle is not necessary. Coarse forages and roots should be given cut or chopped so that they may be more efficiently utilized. By chaffing nearly 30-40 per cent. of fodder that is otherwise wasted can be saved. Depending upon the number of animals to be fed one may use hand chaff-cutter or the one driven by bullocks or mechanical power.

(v) The ration should be sufficiently bulky and fairly laxative. The bulk provided by roughages gives the animal a sense of repletion and enables the distribution of the concentrate ration necessary for proper digestion. A fairly laxative diet is more completely digested and constipation which is the proverbial cause of most of the digestive troubles is avoided. All green fodders have a laxative and cooling effect.

(vi) Liberal feeding is necessary if continued heavy milk production is in view throughout the cow's period of lactation, otherwise milk yield usually goes down a few weeks after calving. It is more uneconomical to underfeed a producing cow than to feed her properly. But, overfeeding which is doubly wasteful as it wastes food and injures the animals, should be avoided.

(vii) Cows should be fed individually according to their individual production and requirements instead of allowing the same ration to each animal in the herd in order to obtain maximum profits.

(viii) Maintain regularity in feeding so that the productive powers of an animal may not be affected. The dietary should be

distributed evenly throughout the day so that the animals are not kept too long without food. Time should be allowed between the meals so that they may get sufficient rest and quietitude to chew their cud. The following routine timetable may be adopted with slight modification, if necessary, to suit local conditions :

4 a.m. to 8 a.m.	..	Feeding of concentrates and morning milking of cows.
8 a.m. to 9 a.m.	..	Feeding of roughage (green and dry).
9 a.m. to 10 a.m.	..	Watering.
10 a.m. to 2 p.m.	..	Grazing in the fields.
2 p.m. to 3 p.m.	..	Watering.
3 p.m. to 7 p.m.	..	Feeding of concentrates and evening milking of cows.
7 p.m. to 8 p.m.	..	Feeding of roughages (green and dry).

N.B.—(1) During summer months cows may be watered third time at about 7 p.m. after the evening milking.

(2) The roughages should not be fed prior to and during the process of milking since they raise a lot of dust in the air which may contaminate milk, and foods liable to impart their characteristic odours like cabbage, turnips, etc. should also be given only after milking. The concentrates should always be given first and then the roughages.

(ix) Cows must get enough of clean and wholesome water—Drinking water for cattle should be obtained from a well, stream or clean tank. Allowing cattle to drink water from a dirty pond or a ditch will result in increased incidence of contagious and parasitic diseases amongst them besides lowering their general health, milk production and working capacity. The quantity of water consumed will vary somewhat according to the nature of the food (dry or succulent), temperature of the surroundings and seasonal variations. Roughly speaking a cow weighing 650 lb. and receiving about 13 lb. of hay will usually consume about 50 to 60 lb. of water, or say, about 4 lb. of water to each pound of dry matter consumed.

She will require an additional quantity of about 2 lb. of water for each pound of milk yielded, i.e., a total of 70 to 80 lb. (about 8 gallons) per day if she is giving 10 lb. of milk. At least 7 gallons more should be allowed

per cow per day for general cleanliness of the cow-shed, the cow herself and other purposes.

(*c*) *Balanced rations for cattle*—(i) *Cattle or buffaloes*—Daily ration. Feed half in the morning and the other half in the evening regularly.

Feed	Bulls	Bullocks	Dry cows and heifers	Young stock	Remarks
	Lb.	Lb.	Lb.	Lb.	
Roughage—					
I—Straw and green fodder (combined).	6 to 8 and 20 to 30.	6 to 8 and 20 to 30.	6 to 8 and 20 to 30.	4 and 10 to 20	According to live-weight.
II—Straw only ..	16	16	16	8	
II—Green fodder only.	40 to 45	40 to 45	40 to 45	20 to 30	
Concentrates—					
Concentrate mixture	4 to 6 (according to body weight).	8 (heavy work) 6 (medium work). 5 (light work).	3	3	A concentrate mixture may be prepared from the following and fed as directed : Wheat or rice bran 4 parts. Oil-cake (mustard til, etc.) 2 parts. Any pulse husks (mung, arhar, gram or khesari) 2 parts. Gram, peas, barley or biri 2 parts.
Salt	1 oz.	1 oz.	1 oz.	1 oz.	

N.B.—To milk yielding cows feed an additional quantity of 1 lb. of the mixture for every 2 lb. of milk yield subject to a minimum of 3 lb. of the mixture and for buffaloes 6 lb. of the mixture for every 10 lb. of milk yield.

Cows and heifers in calf require an additional supply of concentrate mixture from ½ to 1 lb. according to live-weight over and above that prescribed for dry cows or heifers in the above table.

In mineral deficient areas 1 oz. of sterilized bone-meal flour may be fed daily to each cattle.

(ii) *Suckling calves*—(1) *Under farm conditions*—

First month .. Whole milk 6 lb. a day (3 lb. morning and 3 lb. evening).

Two to six months .. Whole milk 4 lb. a day (2 lb. morning and 2 lb. evening) besides 3 lb. gruel at noon. From the third month onwards if sufficient quantity of milk be not available a small quantity of concentrates may also be fed as stated in the table given below.

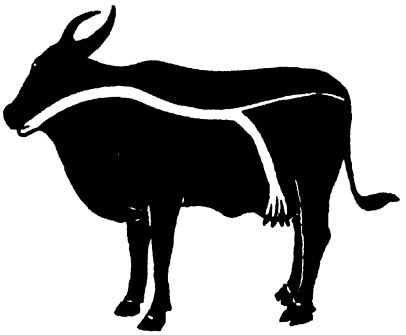


FIG. 1 *Utilization of balanced ration inside the cow (diagramatic). More goes to form milk and less passes out unutilized in the dung*

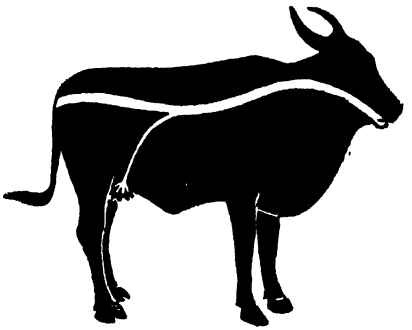


FIG. 2 *Utilization of unbalanced ration inside the cow (diagramatic). Less goes to form milk and more passes out unutilized in the dung*

FIG. 3—*Pica with tendency to lick walls, etc. due to deficiency of salts*

FIG. 4 *Rickets due to deficiency of calcium and phosphorus resulting in deformity of bones*

FIG. 5 *Ophthalmia (inflammation of the eye) and night blindness due to vitamin A deficiency*

FIG. 6—*Goitre due to iodine deficiency*

After six months .. No whole milk. Gruel if available plus concentrates.

N.B.—The gruel is made up of skimmed milk, ragi and linseed meal. To every 10 or 12 lb. of skimmed milk 1 lb. of ragi and 2 lb. of linseed is mixed, boiled, cooled and fed sufficiently warm after adding about an ounce of salt.

(2) *Under village conditions*—Allow the calves to suckle for a few minutes before and after milking both in the morning and evening. From the second month onwards gruel prepared from ½ lb. each of rice, *ragi* and linseed cooked in about 12 –15 lb. of water to which an ounce each of common salt and gur have been added may be fed at noon. From the third month onwards concentrates may be fed as stated in the table given below :

Concentrate ration for calves

Age	Oil-cakes	Arhar or gram chuni	Wheat or rice bran	Salt	Bone-meal	Remarks
Months ..	lb.	lb.	lb.	oz.	oz.	
3 to 6 ..	½	..	½	1	½	Feed half in the morning (6.30 a.m. to 7 a.m.) and the other half in the evening (3 p.m.).
6 to 9 ..	1	½	½	1	½	
9 to 12 ..	1½	½	1	1	½	

Plus hay and a little green grass.

(*d*) *Nutritional deficiency*—If the diet of cattle is not properly balanced more especially in regard to minerals (salts) and vitamins their growth, health, production, reproduction and efficiency are adversely affected and serious nutritional deficiency diseases may appear, e.g., congenital blindness, night blindness and sterility due to deficiency of vitamins, and bone deformities and pica (tendency to lick and to gnaw earth, wood and other foreign objects) due to deficiency of minerals, e.g., lime, phosphorus and common salt. These deficiencies lower animals' vitality and resistance to diseases and may also result in abortion, still-birth or birth of a weak and undersized calf which may die soon after birth. These conditions are rather difficult to cure but they can be easily prevented by feeding cattle on properly balanced diets containing suitable proportions of minerals (e.g., sterilized bone-meal flour and rock salt) and the necessary vitamins obtainable from green fodder. Deficiency diseases exhibited in young calves may be prevented by feeding their dams properly during pregnancy [Plate X, figs. 3 to 6].

(*e*) *Cultivation of fodder crops*—The importance of green fodder in the diet of cattle cannot be over-emphasized. The very fact that the best breeds of cattle exist only in those parts of India where cultivation of fodder crops is a common practice is self-explanatory. The fodders may be divided into leguminous and non-leguminous. The leguminous crops (pulses), e.g., berseem, lucerne, cow-pea, guar, etc., not only provide a highly nutritious ration for cattle but they also enrich the soil by virtue of their root nodules in which nitrifying bacteria constantly convert the atmospheric nitrogen into nitrates [Plate XI, fig. 6]. Berseem can replace up to 75 per cent. of concentrates, calculated on dry basis, and thereby effect economy in cattle feeding [Plate XI, figs. 5 and 7]. The non-leguminous crops are maize, jowar, oats, elephant and guinea grass, etc. Fodder crops may be grown with advantage as a second crop after the harvest of main paddy or other crops. Certain fodder grasses when once grown will remain for years provided proper manuring and irrigation are carried out and will give six to eight cuttings per year, e.g., guinea grass, elephant grass, etc. A great deal of research work on common cattle feeds and fodders of Uttar Pradesh has been carried out and is still in progress at the Animal Nutrition Research Station, Bharari (Jhansi) [Plate XI, figs. 1—4]. Details in regard to the cultivation of fodder crops are given in the following tables :

FIG. 1—*Digestion room of the Animal Nutrition Laboratory, Bharari (Jhansi)*

FIG. 2—*Main analytical room of the Animal Nutrition Laboratory, Bharari (Jhansi)*

FIG. 3 *Nutritional stalls for experimental animals at the Animal Nutrition Laboratory, Bharari (Jhansi)*

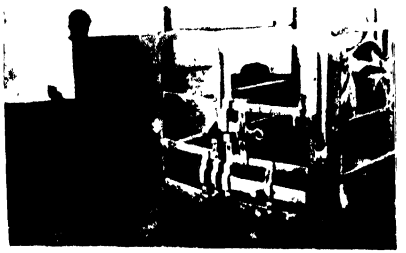


FIG. 4 *Weigh-bridge for experimental animals at the Animal Nutrition Laboratory, Bharari (Jhansi)*

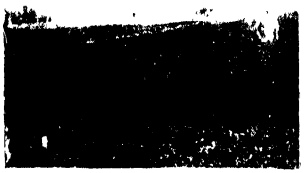


FIG. 5—A *luxuriant crop of berseem*

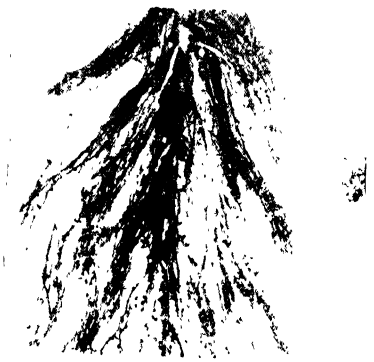


FIG. 6—*Roots of berseem plant on which nodules exist where nitrifying bacteria flourish*

FIG. 7—*Comparative yield of berseem crop from cultivated and untreated fields*

Table showing green feeds available during the different months of the year

(i) Kharif fodder crops

Serial no.	Names of crops: Hindi	English	Botanical	Soil requirements	Preparation of land, manuring, method of sowing and interculture	Time of sowing	Seed rate per acre (lb.)	Irrigation	Duration of green fodder	Average yield per acre (lb.): Green fodder	Nutritive value of green fodder: Per cent. protein on dry basis	Approximate digestible protein per acre	Approximate energy per acre (Therms)	Remarks on important diseases and pests	General remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
										Lb.					
1	Makai ..	Maize ..	Zea Mays ..	Well drained fertile soil. It will not do well on heavy clay soils nor on very light soils.	Plough the land after the first shower of rain 2—3 times. The land should be well manured. The seeds are sown in lines or broadcast. When sown in lines the distance is 18". It requires thorough weeding and usually 2—3 cultivation during its growth. It is sometimes grown as an irrigated crop specially near large cities where it is grown for green ears and when an early crop is wanted.	April-July	40–50	In the absence of rains it requires watering every 10 days. Barani in submontane tracts.	May to Sept.	16,400	7·18	182·0	2,182	(*a*) *Stem Borer*—Eats into the stem. Infected plants should be removed and burnt. (*b*) The crop is subject to several fungus diseases which are not very serious and can be prevented by the use of sound healthy seed.	
2	*Jowar* (for grain). *Chari* (for green fodder).	Great Millet	Sorghum Vulgare.	Jowar is generally grown on all kinds of soil, it does not thrive in sandy soils' and does better on heavier types.	Two or four ploughings before sowing. Generally sown broadcast and sometimes by "Pora" behind the plough. It requires occasional weeding when it is grown for fodder purposes. The seeds are usually broadcast and no thinning for weeding is ordinarily done.]	For early fodder March-April. For grain June-July	60–80	Mainly a Barani crop. When sown for grain in irrigated areas 2 or 3 waterings are given.	July to Oct.	20,500	3·76	102·5	2,307	Same diseases and pests as in maize. 2. *Birds*—Feed on grains. Scare birds by discharging pellets from a sling "Gophia" or rattling of tins, etc.	Stunted Jowar, resulting from lack of irrigation, if fed to cattle may cause poisoning in them.
3	Guar ..	Vetch field	Cyamopsis psoraloides	Light sandy loam to medium sandy loam.	One or two ploughings before sowing. Seed generally broadcast. No manure is applied and no weeding is done. In the Punjab the crop is usually sown alone but in United Provinces it is usually mixed with Jowar.	May to July	30–40	A Barani crop in submontane tracts. In irrigated areas 2—3 waterings given depending on rains.	July to Oct.	12,300	8·56	163·6	812	Hairy catter pillar or Kutra feeds on young plants. Light traps are recommended.	Causes tympanites in cattle if fed when the plant is ripe.
4	Lobia ..	Cow pea ..	Vigna catjang	It may be grown on different type of soils but will do best on well drained loam soils.	2–3 plohings at the Commencement of rains. The crop is usually sown mixed with juar and maize. When sown thick it usually does not require any weeding as the vigorous growth of the plants tends to smoother out the weeds. It is, for that reason, sometimes used as a cover crop in order to supress the growth of weeds.	May to July	16–20	Ditto ..	Sept. ..	10,941	18·45	251·6	1,040	Root-rot, rust, and powdery mildew which can be prevented by the use of sound healthy seed.	If the crop is grown as a vegetable, the pods are picked while still green and the stems and leaves may be fed either green or dry to cattle.
5	Suraj mukhi	Sun flower	Helianthus amnus.	Loam	4—6 ploughings' seed is broadcast.	All the year round.	30–40	The crop does best under irrigation.	Just before flowering.	17,016	11·94	364·2	1,713	..	..
6	Soya bean ..	Soya bean ..	Glycin Hypspida.	All soils ..	2—3 ploughings	Ditto	Ditto	March-July	20–30	2–3 irrigations ..	Sept.-Dec. ..	10,940	12·56	327·9	1,343	Grasshoppers. Care and watching of the crop from this insect.	
7	Moth ..	Moth ..	Phaseolus aconitifolius	Sandy loam and loam	2—3 ploughings	Ditto	Ditto	May-July	10–15	..	July-Sept. ..	13,335	12·12	..	..	Ditto ..	..
8	Bajra ..	Spiked Millet	Pennicetum typhoideum	Light sandy loam ..	5 ploughings	Ditto	Ditto	July-Aug.	10–12	A Barani crop in submountain tracts. In irrigated areas 2—3 watering given depending on rains.	Aug-Oct. ..	8,000—12,000	6·96	177·1	2,089	Kandua, Wilt, Mildew. Soak seeds in coppers-sulphate solution before sowing. Juar borer, grass hopper. Care and watching of the crop.	..
9	Teosinte	Teosinte or Rheana.	Euchlaena mexicaina.	Soils rich in lime ..	2—3 ploughings	Ditto	Ditto	June-July	3–5	2–3 irrigations ..	Aug to Oct. 2–3 cuttings.	26,000	7·98	260·0			The fodder is succulent and nutritive and is relished by all kinds of live stock. Stem is very pithy and is refused by the cattle if allowed to mature.

(ii) Rabi fodder crops

Serial no.	Name of crops: Hindi	English	Botanical	Soil requirements	Preparation of land, manuring, method of sowing and interculture	Time of sowing	Seed rate per acre (lb),	Irrigation	Duration of green fodder	Average yield per acre (lb.): Green fodder	Nutritive value of green fodder: Per cent. protein on dry basis	Approximate digestible protein per acre	Approximate energy per acre (Therms)	Remarks on important diseases and pests	General remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Jai	Oats	Avena sativa	It does best on heavy soils such as loams and clay loams.	Two or three ploughings before sowing. Seed is generally broadcast and rarely sown in lines. Seldom manured or intercultured.	Oct.-Dec.	80—100	2—3..	Dec.-March (2—3 cuttings).	16,400	146·3	431·3	2,049	*Smut*—Black powdery mass appears in place of grains. Treatment of seed with formalin under expert supervision is recommended.	Some varieties of French and Scoch oats remain green uptil May and give much heavier crops of fodder than Desi oats.
2	Berseem	Clover (Berseem).	Trifolium alexandrinum.	Requires heavy loam soil.	A fine seed bed should be prepared by giving 3 or 4 ploughings before sowing. Seeds are treated with berseem culture at the time of sowing.	Sept.-Oct.	20—25	Every month (5 to 6)	Dec. to middle of May.	28,700	166·3	580·0	2,440	..	Three or four cuttings. It adds nitrogen to the soil and thereby increases its fertility.
3	Toria	Rape-seed	Brassica napus var. Dichotama.	Ordinary loam soil is required.	Seed is broadcast in well cultivated beds. Sometimes sown in lines in wheat crop. No manure and no interculture.	Sept.-Oct.	..	2—3. In some parts grown Barani (unirrigated).	..	16,400	..	..	..	Downy mildews and Blight have been found to occur. In the case of the former, an abnormal deformity of stems, but usually not of the flowers whereas Blight attacks all the green parts of the plants but more specially the fruits. These can be prevented by using sound healhy seed. Aphides are the worst enemies of the crop. These small greenish and soft bodied insects suck out the juice from all parts of the plants and thus sometimes almost completely destroy the crop. Spraying with crude oil emulsion is recommended and also to sow the crop early.	It leaves in the soil a good deal of organic matter. Its oil cake is als used as a cattle fred.
4	Root crops—														
	(*a*) Shaljam	Turnip	Brassica rapa	Loam soil	Two or three ploughings before sowing. Well rotten farmyard manure to be applied. Seed is generally broadcast. No interculture.	Sept.-Oct.	6-8	4 to 6 times	Nov.-Jan.	33,000	14·73	328·9	2,805	*Aphides*—Suck juice from flowers and shoots. Spraying with crude oil emulsion is useful.	*Two varieties*— 1. Roots white 2. Roots red The former is considered better.
	(*b*) Gajar	Carrot	Daucus Carota	Ditto	Ditto	Sept.-Nov.	8	Ditto	Nov.-Feb.	40,000	10·09	320·0	3,841	Ditto.	
	(*c*) Ganth Gobi	Knol khol	Brassica Oleracea var. Calorapa.	Ditto	Ditto	Sept.-Dec.	4—6 oz.	Ditto	Ditto..	33,000	..	..	..	Ditto.	

(iii) *Perennial fodder crops*

Serial no.	Name of crops: Hindi	English	Botanical	Soil requirements	Preparation of land, manuring, method of sowing and interculture	Time of sowing	Seed rate per acre (lb.)	Irrigation	Duration of green fodder	Average yield per acre (lb.): Green fodder	Nutritive value of green fodder: Per cent. protein on dry basis	Approximate digestible protein per acre	Approximate energy per acre (Therms)	Remarks on important diseases and pests	General remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**Rizka** ..	Lucerne or alf alfa.	Medicago sativa.	Can grow well on most types of soil, but does best on a deep well-drained loamy soil. It does not do well on soils which are subject to water logging.	Two or three ploughings before sowing. Seed is sown either— (*a*) broadcast, (*b*) ridges' (*c*) in lines. Well rotten farmyard manure should be applied after every third or fourth cutting. Growth stops in July and August. Interculture should be given to encourage growth.	Oct. & Nov	10—12	Immediately after sowing one irrigation is given. Every fortnight in winter and every week in summer.	Jan. & July (5—7 cuttings).	49,200	20·07	1,737·0	4,428	Cuscuta or "Akash Bel" often attacks it. The parasite should be removed and destroyed as soon as it appears. The crop is frequently infested with a number of weeds such as "Dub" and "Motha" in the hot season and "Bathua" in the cold season. These should be removed carefully.	To get seed, stop watering at the flowering stage in April. Seed ripens in May.
2	**Guinea grass**	Guinea grass	Penicum maximum.	It does best in places where a fairly large amount of moisture is available in the soil. The crop will do well in water logged areas, while it may be grown in almost all types of soil. It will do best in light to medium loams.	The crop may be propagated by seed but is more commonly grown from root slips or sets. These are planted in lines about three feet apart. The soil needs to be manuerd heavily.	Feb.-March or July-Aug.	7,000 to 10,000 root stocks.	Irrigation is necessary if the crop is to be grown economically and commercially. In warm weather it grows rapidly if sufficient moisture is available.	Throughout the year (5—7 cuttings).	49,220	7·69	546·2	3,847	..	The crop once planted will last for several years. It is, however, advisable to break up the clumps after three or four years.
3	**Sudan grass**	Sudan grass	Andropogon sorghum var. Sudanensis.	Same as Jowar ..	The seed is broadcast ..	June-July	16—20lb.	..	Aug. to Oct. (3—4 cuttings).	50,000	5·68	195·0	3,830	..	This grass is becoming popular in northern India, where it is usually grown under irrigation. It spreads very rapidly through rhizomes which are developed and is thereby difficult to eradicate.
4	**Hathi ghas** ..	Elephant or Napier grass.	Pennisetum purpurum.	Does grow well in a deep well drained loamy soil.	As no mature seeds are produced, the plant is always propagated vegetatively. Rhizomes cuttings and root slips are used for the propagation of this crop. The root slips which give the best result, are planted in lines, three to four feet apart.	Jan.-March cuttings July-Aug. Rhizomes.	7,000 to 10,000 root stocks.	The crop does best under irrigation.	Throughout the year (6—8 cuttings.)	92,320	3·85	886·9	9,499	It is very susceptible to frost ..	The crop is ready for the first cutting in about four months, and successive cuttings after that at intervals of about a month depending on the water supply and season of the year. The crop responds very readily to irrigation but can stand draught fairly well. The grass is usually fed green to cattle immediately after cutting but it is known to make a fairly good silage.

(iv) *Perennial fodder crops recently introduced in Uttar Pradesh*

Serial no.	Name of crops			Soil requirements	Preparation of land, manuring, imethod of sowing and interculture	Time of sowing	Seed rate per acre (lb.)	Irrigation	Duration of green fodder	Avergae yield per acre (lb.)	Nutritive value of green fodder			Remarks on important diseases and pests	General remarks
	Hindi	English	Botanical							Green fodder	Per cent. protein on dry basis	Approximate digestible protein per acre (lb.)	Approximate energy peracre (Therms)		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	..	Giant star grass.	Cynodon Plectostachyum.	Grows best in rich alluvial soil.	For establishing this grass weed competition and other grasses should be eliminated. Manuring will increase yield. Excess of nitrogen will increase hydrocyanic acid content. Therefore Superphosphate 500 lb. per acre should be used with ordinary manure. Root cuttings should be planted.	During the monsoon.	..	With a minimum rainfall of 35" per annum no irrigation is required after the grass is established.	In the hills up to January, in the plains throughout the year. 3 to 4 cutting can be obtained in a year.	Thirty to sixty thousand pounds of grass per acre in the plains.	..	With progressive maturity, the percentage crude protein value of star grass suffered significant losses, whereas after an initial fall, the other extract value remained stationary and the total carbohydrate value progressively increased up to six months of age and in the cut at seventh month, a significant difference in composition was noticeable. The former was definitely superior in quality to the latter.	The digestibility trial conducted with mature star grass hay showed that the hay is extremely palatable and the digestibility co-efficients of its important constituents are also fairly high. The results of digestibility experiments suggested that the mature star grass hay by itself could form a maintenance ration.	So far workers in U. P. have not found any pest.	
2	..	Kudzu Vine	Pueraria thumbergiana.	Can tolerate a wide range of soil conditions. Grows best in light soil. Care should be taken to establish the plant.	One to three tons of manure and about 200 lb. of 16 per cent. superphosphate per acre or its equivalent. Once established, the plant will take care of itself and will improve the soil, and control erosion. Difficult to get seeds. Propagated by crows.	Any time December to April.	..	Irrigation required only for establishing the plants. The vine is draught resistant.	Until the first tilling.	2 to 3½ tons per acres	Protein 17 to 30 per cent. with a carotene content running up to better than 400 microgram per gram.	..	..	..	
3	..	Venezuela grass.	Melinis Minutiflora Beauv.	Sandy type, low in calcium.	Can be propagated both by means of seeds and cuttings. When propagated by seed. the seedlings of 6" height are transplanted from the nursery bed and planted in parallel rows of about 2½' apart.	June before onset of rains.	..	Needs irrigation from time to time.	Three cuttings.	19 tons per acre	10·09 per cent.	..	..	..	The hay made in February, just a month prior to inflorescence emergence, serve as an ideal feed for growing calves and milch cow with a little supplementation of protein.

(*f*) *Preservation of fodder crops*—When plenty of green fodder is available over and above one's requirements it should be preserved as silage or hay for future use when green fodder may not be available. The methods of silage making and hay making are briefly given below and for details of these operations the nearest Animal Husbandry or Agricultural Officer should be contacted :

(i) *Silage making*—Ensilage is the process of storing green fodders in silos (towers or pits) for use as a succulent ration when green fodder is scarce. The silo-pit is merely a hole in the ground into which green fodders are packed and compressed so as to expel the air and then sealed up with a covering of earth to prevent contact with air ; and thus prevent or delay the decay of the fodder so preserved. The ration thus produced is called "silage". The silo-tower which is built above the ground and is made up of such materials as wood, brick or concrete. Silo-towers besides being very expensive do not give satisfactory results under Indian tropical conditions as the silage dries up and is spoiled by fermentation due to high temperature. The silo-pit is more economical, gives silage of good quality, can be managed by unskilled labourers and is therefore best suited to Indian conditions. At present the silage making is mostly restricted to Government Farms and only a very few private farms in India. It is necessary that this simple, cheap and useful method of fodder preservation should be widely adopted by private farmers in this country so that green fodder in a succulent condition may be available all the year round especially for milch cattle.

Expense and space required in preserving fodder as silage is less than that required for hay. There is no risk of fire or theft. There is much less loss in weight and all the materials remain practically intact. Weedy crops which could make poor hay may produce silage of a fairly good quality and the ensiling process kills practically all the weed seeds present. It offers a more palatable ration than dry fodder and there is little wastage in silage feeding even from plant with coarse stalks, e.g., maize and jowar. All surplus pasture grasses or green fodder in times of abundance can thus be economically and more advantageously preserved as silage for use when there is scarcity of green fodder. In districts subject to periodic famine it is of special significance as the fodder can be preserved in this state for years provided contact with air is excluded.

Fodder crops should be cut in the flowering stage for ensiling, the pit should be dug on a conveniently located uncultivable high and well drained land. The size of the pit varies with individual requirements depending upon the quantity of fodder to be preserved.

(ii) *Hay making*—The primary object of hay making is to sufficiently reduce the water content of the green plants so that the hay can be safely stored in mass without undergoing pronounced fermentation or becoming mouldy. For this purpose it is necessary to cut the grass and fodder crops, e.g., oats, berseem, etc., at the flowering stage. Cutting may be done either by hand or a mower driven by a pair of bullocks. It is advisable to make hay after the rainy season is over otherwise the nutrients may be lost through leaching and the hay may become mouldy. The cut grass or fodder after cutting should be allowed to remain in the field spread in thin layers for drying and should be turned once daily for 3 or 4 days in the morning after the dew has dropped off. If the hay is dried in the shade its carotene (precursor of Vit. A) content is not seriously affected. Sun curing destroys the carotene but enriches the Vit. D content of the hay. Vit. D however under tropical conditions as in India, is not so very important as the Vit. A. The hay thus produced may be collected either by hand racks or one that is driven by a bullock. It should then be carted and stacked in a shady place where there is no danger of its catching fire. Large hay stacks are usually made on the farms with the help of an elevator on a raised ground. Small hay stacks can, however, be made on a stage supported by posts or the branches of a tree so as to prevent its getting spoiled especially in inundated areas. High quality hay is leafy. It is not made from plants cut at too late a stage of maturity. It is greenish in colour. The stems are soft and pliable. It has but little foreign materials such as weeds and stubble. It is free from mould. It has an attractive smell typical of the particular crop from which it is made. Such a hay is nutritious and palatable.

(*g*) *Improvement of pastures*—Although a good pasturage is of an outstanding importance in rearing cattle yet in India generally best herds of cattle exist where people grow or are forced to grow fodder crops due to non-availability of sufficient grazing lands. Where grazing lands exist they are very badly neglected and are overgrazed so that they are reduced to mere exercising grounds where the animals get plenty of sunshine and

exercise but not enough of grazing as is erroneously thought by their owners. On the contrary in some of the remote forests there may be plenty of grass during the flush season which should be cut and preserved as silage or hay for future use. Wherever pastures exist they should be properly developed and grazing regulated so as to derive the maximum benefit from them. Their improvement can be effected by the introduction of improved varieties of pasture grasses, e.g., *anjan*, *dub*, spear, *palwan*, *bur*, etc., bunding for proper distribution of rain water and prevention of soil erosion, manuring especially if the soil is poor or deficient, removal of weeds and bushes, providing shade trees and wholesome drinking water for animals, rotation of pastures and restricting the number of animals to be grazed. For detailed information consult the nearest Animal Husbandry or Agricultural Officer.

(*h*) *Emergency fodders*—Some work on the nutritive value of certain emergency cattle feeds has been carried out by Dr. N. D. Kehar at the I. V. R. I., Izatnagar, and one should take maximum advantage of this wherever possible in order to supplement the existing inadequate feeds and fodder resources of the country. He and his associates have determined that " Kantiara " which is rich in crude protein and calcium and is free from any toxic component and which is not touched by the animals on account of the spinosed leaves, may be used with advantage after rounding off the spines of the dry plant by beating with sticks, as a supplement to the common straws in times of scarcity. He has also determined that mango-seed kernels which is a rich source of protein and carbo-hydrates can be fed to bullocks with advantage to the extent of 50 per cent. of the total digestible protein. He similarly advocates the use of Jamun-seed as cattle feed. During famine when home-grown feeds are rare he has suggested the use of " Munj " mixed with molasses, etc., in the following proportions and supplemented, if possible, with green leaves of *pipal* and *beri*, etc., or grass roots :

	lb.
"Munj"	7
Molasses	3
Mustard cake	2½
Wheat bran	2

"Munj" proved palatable to the animals after it had been chopped, beaten to remove dust and moistened for about 24 hours. On moistening 7 lb. of dry "munj" would weigh about 11 lb. Molasses is mixed with rape

cake, soaked overnight during water in winter or for about 4 hours during summer. This concentrate is thoroughly mixed with roughage and wheat bran is spread on the surface and lightly mixed. The animals should be freely allowed to lick rock salt. Molasses can also be mixed with bagasse in the proportion of 1 : 3 or 4 for feeding cattle in times of scarcity. In flooded areas flood-resistant varieties of fodder plants, e.g., *jayanti*, *agasthi*, etc., and grasses, e.g., Para grass, Reed grass, Elephant grass, etc., besides fodder trees, e.g., *babul*, *pipal*, etc., may be grown with advantage preferably at a higher level.

(i) *Shortage of cattle feeds and fodders with suggestions to overcome it*—In Uttar Pradesh we require 3,640 thousand tons of concentrates and 1,62,600 thousand tons of fodder to feed adequately our 30,800 thousand cattle in order to enable them to get their best to us. Against this requirement only 1,900 thousand tons of concentrates and 57,000 thousand tons of fodder are available to cattle in the Province. Due to this acute shortage it is necessary that besides increasing their production by bringing more and new areas under fodder cultivation and by adopting improved agricultural practices, viz., better seed, liberal use of manure and fertilisers, adequate irrigation facilities, etc., we should utilise the available cattle feeds most scientifically as detailed on the previous pages in order to derive the maximum benefit from them. No edible oil-cakes should be used as manure; and if area under oil-seeds is increased and oil-seed crushing industry is fully developed in the country it will provide more fat (oil) for human consumption and cheap protein (oil-cakes) for feeding cattle. We should encourage the cultivation of fodder crops on the vacant land lying on either side of canals, railway tracks and public highways. At least 10—15 per cent. of the newly reclaimed lands which were previously used as pasture lands should be compulsorily allotted for the cultivation of fodder crops. This problem of shortage of cattle feeds and fodders, how it affects the health and production of the animals which in turn is reflected in the poor physical pattern of our people and low yield from the land and how to remedy the situation are illustrated on Plate XII.

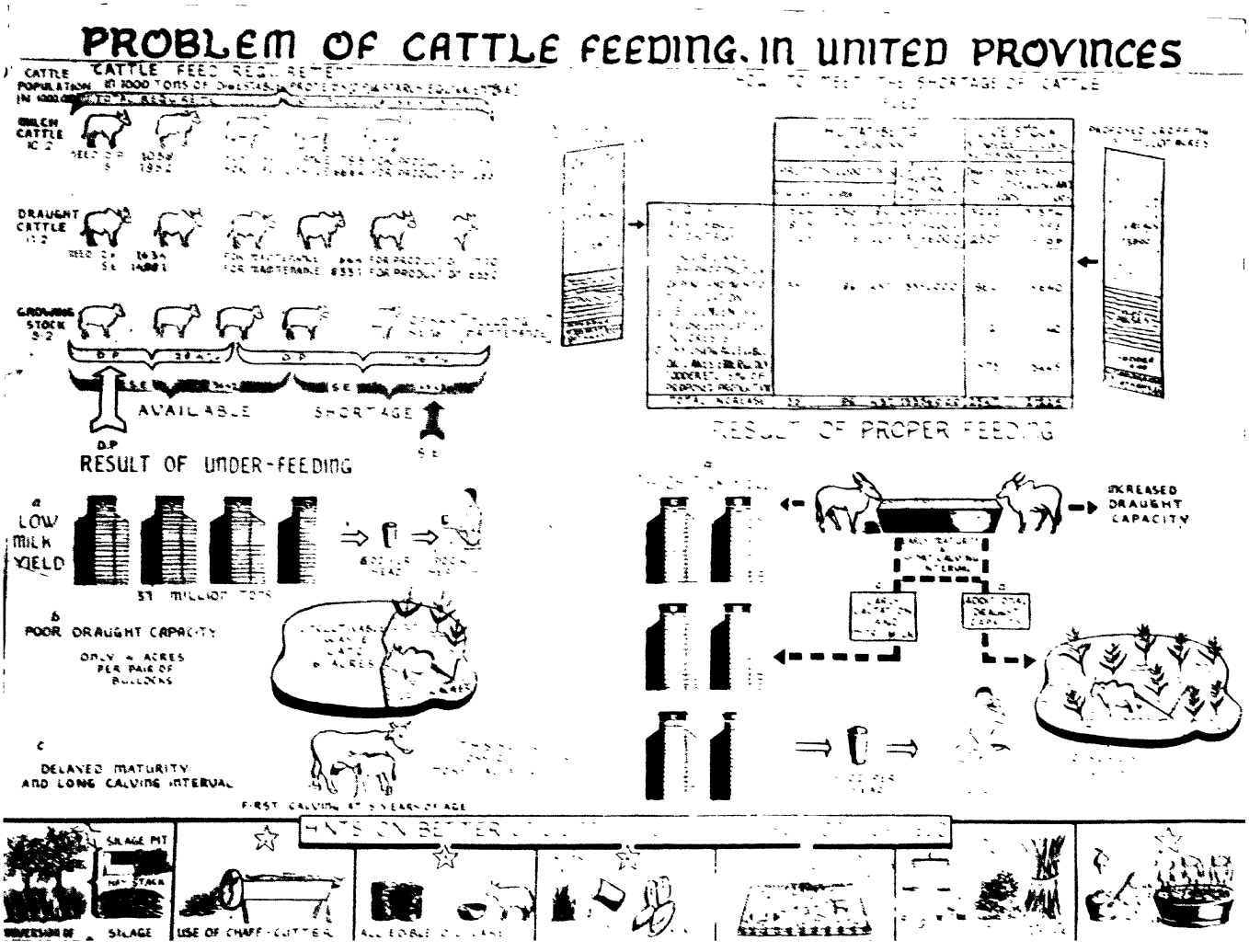

PROBLEM OF CATTLE FEEDING IN UNITED PROVINCES
CATTLE FEED REQUIREMENTS
MILCH CATTLE
DRAUGHT CATTLE
GROWING STOCK
AVAILABLE
SHORTAGE
RESULT OF UNDER-FEEDING
RESULT OF PROPER FEEDING
INCREASED DRAUGHT CAPACITY
a LOW MILK YIELD
31 MILLION TONS
b POOR DRAUGHT CAPACITY
ONLY 4 ACRES PER PAIR OF BULLOCKS
c DELAYED MATURITY AND LONG CALVING INTERVAL
FIRST CALVING AT 3 YEARS OF AGE
HINTS ON BETTER
SILAGE PIT
SILAGE
USE OF CHAFF-CUTTER

FIG. 1—*Showing the difference between a child having milk in his diet and the one getting no milk*

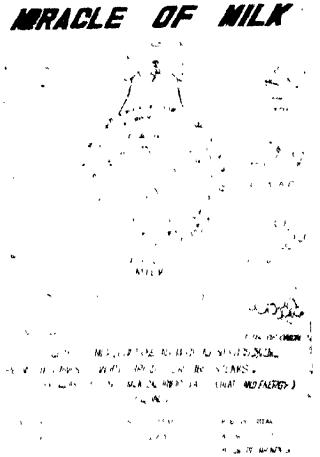


FIG. 2—*Miracle of milk, showing the equivalent of one quart of milk*

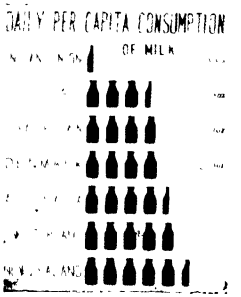


FIG. 3—*Showing comparative per capita daily consumption of milk in different countries*

FIG. 4—*Wrong method of milking, using pressure of thumb knot*

FIG. 5—*Right method of milking by holding the teats in the fists without using thumb pressure*

FIG. 6—*Stripping of end milk*

FIG. 7—*A general view of the main dairy building at the Central Dairy Farm, Aligarh*

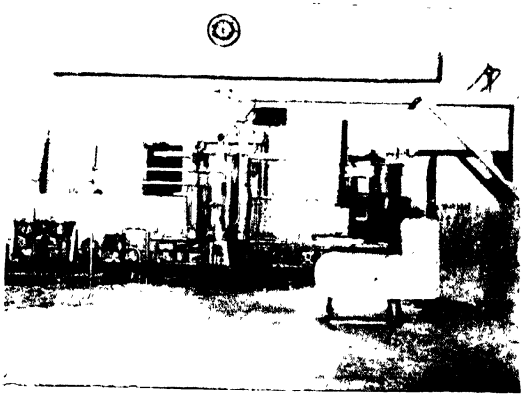


FIG. 8—*Interior of the milk pasteurising room at the Government Dairy Farm, Bhadruk, Lucknow*

5. HINTS ON DAIRYING

(*a*) *Introduction*—Milk is the nature's most perfect food. [Pate XIII, fig. 2]. It is rich in proteins, minerals and vitamins which are essential for the growth and normal upkeep of the human body. For majority of the population in the Indian Union who are vegetarians, milk and milk products constitute the only source of animal proteins which are known as the "protective" food. The fat and sugar contained in it provides heat and energy to the body. Its need for children is the greatest [Plate XIII, fig. 1]. In fact in some of the western countries during present shortage of foodstuffs milk ration has been allowed to the children and expectant mothers even at the exclusion of adults. In the Indian Union the daily per capita consumption of milk is only 5 oz. as against 50 oz. in New Zealand [Plate XIII, fig. 3]. It is therefore of utmost urgency and importance that for building up a healthy and strong Indian nation our milk production must be increased. With this end in view the Government of Uttar Pradesh have taken bold steps by establishing a number of new Government Dairy Farms, viz. at Lucknow, Aligarh, Mathura, Gokulnagar, etc. etc. [Plate XIII, figs. 7 and 8], organising a number of Co-operative Milk Supply Unions, viz. at Lucknow, Allahabad, Banaras, Meerut, etc., subsidising private dairy enterprize, granting taqavi loans for the purchase of milch cattle to individual farmers and private institutions, giving financial assistance and special facilities to goshalas for establishing Dairy-*cum*-Cattle Breeding units, etc. etc.

(*b*) *Art of milking*—This is an art requiring both skill and experience. The process must be conducted quietly, gently, quickly, cleanly and completely. An expert milker would not only draw a greater amount of milk but he will also do this work more conveniently for the animal. The interval between two milkings should be as even as possible. Dry hand milking should be adhered to as wet milking is unhygienic and needs over extension of teats. The milk should be squeezed out and not dragged and the first few streams of milk should always be discarded in order to exclude bacteria which might have gained entrance into the teats between the two milkings. The actual operation of milking consists of—

1. *Fisting*—[Plate XIII, fig. 5] is done by grasping the teat with the whole hand and pressing it against the palm with the fingers by maintaining a quick succession of alternate compressing and relaxation. The alternate

streams of milk from the two teats should be like a continuous stream. Fisting is more or less like suckling of the calf. There is equalized pressure put on the teats and at the same time pressure is steady. Some gowalas use the pressure of thumb knot in fisting [Plate XIII, fig. 4]. This is highly undesirable as it causes injury to the teat canal at the site of extra pressure resulting in its inflammation and obstruction.

2. *Stripping*—[Plate XIII, fig. 6] consists in firmly seizing the teats at the base between the front of the thumb and the first finger and then drawing down the entire length of the teat. Simultaneously, pressure on the teat is put with the result that milk flows down in a stream. This action is repeated quickly and both hands may be used each holding the different teat and working alternately. Generally the nearest teats are milked first and the two farthest later. Stripping is generally employed for drawing end-milk or where teats are too small to allow fisting. Incomplete milking tends to inhibit further formation of milk. Therefore complete milking is necessary. Massage of the udder stimulates secretion of milk and may be resorted to while stripping end-milk.

(*c*) *Clean Milk Production*—Milk should be free from visible and invisible dirt which may be present in it either in suspension or solution or as sediment. For it to be safe there should be a low bacterial content of non-pathogenic bacteria and the total absence of pathogenic ones. Freshly drawn milk is warm and is highly suited for the propagation of bacteria. It is therefore necessary that utmost cleanliness should be observed in its production [Plate XIV, fig. 5], handling and distribution. For the production of clean milk the following rules should be observed :

(1) A healthy cow is a prime requisite for safe milk. The milch animal should be sound and free from such communicable diseases as tuberculosis, actinomycosis, Brucellosis (contagious abortion), mastitis, etc.

(2) Much of the dirt in the milk comes from the body of the cow. If she is kept clean and her hind quarters, tail and udder are washed with clean water preferably containing a mild antiseptic, e.g., potassium permanganate and then wiped with a piece of clean cloth prior to milking, the purity of milk as well as its keeping qualities will be enhanced. [Plate XIV, figs. 2 and 3.]

CLEAN MILK PRODUCTION

FIG. 1 *Cleanliness of the milking shed*

FIG. 2 *Cleanliness of the udder*

FIG. 3 *Cleanliness of the hind quarters and tail*

FIG. 4 *Cleanliness of the milkers, their hands and utensils*

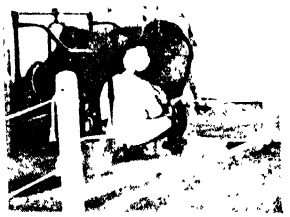


FIG. 5 *Cleanliness during actual milking*

FIG. 6 *Use filter-cloth to exclude dirt, etc.*

FIG. 7 *Hooded milking vessels to prevent dirt falling in*

FIG. 8 *Unhygienic milking vessels*

(3) The milker should be neat and tidy, free from communicable diseases and wear clean clothes while milking. They should wash their hands with warm water before commencing milking. [Plate XIV, fig. 4].

(4) The milking vessel should be a small topped or hooded pail with only a small exposed surface so as to keep off as far as possible the bacteria-laden dirt. [Plate XIV, figs. 7 and 8].

(5) All cans, buckets, and other utensils must be rinsed with warm water and scalded after use and frequently cleansed with soda, washing powder or lime.

(6) The byre should be well lighted, properly ventilated, efficiently drained and always kept clean. Roughages and bedding unless moist should be provided after milking so as to avoid disturbance of dust and dirt inside the byre. [Plate XIV, fig. 1].

(7) Dry hand-milking should be insisted upon.

(8) Discard the first few squeezes from each teat which have a comparatively higher bacterial content.

(9) It is advisable to remove by straining any particle of dirt which carries with it numerous organisms and thereby prevent deterioration of the milk. Sieves, whether of wire gauge or perforated metal, are ineffectual by themselves, as they remove only the larger particles. It is, therefore, advisable to tie muslin outside the sieve so that the finer part of the dirt may also be removed. [Plate XIV, fig. 6].

(10) Milk should not be allowed to remain in the byre longer than what is absolutely necessary.

(11) Milk should be cooled promptly and efficiently to about 50° F. soon after milking and delivered to consumers with the least possible delay.

The milking of cows which is an art requiring skill and experience, should be carried out regularly at the same time each day without pain or annoyance to the cow preferably by the same milker. By gentle treatment and kind words a cow will give her maximum yield of milk.

The average percentage composition of cow's milk is

Water	87·27
Fat	3·68
Proteins	3·39
Sugar	4·94
Ash (mineral)	0·72

(Specific gravity—1·0313).

Any adulteration in milk either through the removal of cream or addition of water, etc., can be detected by analysis in a milk-testing laboratory. The common practice of judging the quality of milk by means of a lactometer is not reliable unless the fat percentage is also determined simultaneously and taken into account. A sample of skim milk to which water has been added may give the normal lactometer reading in spite of double fault.

The indigenous method of preserving milk by boiling appears to be quite satisfactory under Indian conditions. If boiled milk is kept in a hot state its keeping quality is prolonged. Instead of keeping the milk hot over the fire, the heat in the milk can be retained by using the hay box method which does not require any fuel and is, therefore, more economical. It is simply a wooden box fitted with a lid made from an ordinary packing case in which the milk vessel containing boiling milk duly covered is placed surrounded on all sides with dry hay or straw.

(*d*) *Milk recording*—Milk recording is essential for profitable production and successful breeding. Such accurate records enable the farmer to eliminate the poor milkers from the herd in order to render production of milk more economical and to feed high yielding cows according to their milk yield so as to get the maximum output of milk. Milk recording also helps in the selection of animals for breeding. The progeny of recorded dams with high milk yield will fetch much higher prices. In the case of Sahiwal, Sindhi, Hariana, and Murrah only recorded cows are eligible for registration in the Central Herd Book provided they fulfil the requirements as given previously. The milk yield can be recorded by weighing it by means of a suitable spring balance and it is desirable to record the performance at least once a week if not daily in order to have an accurate idea. Besides milk yield, the fat percentage may be determined and recorded wherever possible. Feeding records if maintained will help one to work out the economics of milk production. Specimen copies of the various

forms in which these records should be kept may be obtained from the Dairy Development Officer, Animal Husbandry Department, Uttar Pradesh, Lucknow.

(*e*) *Processing and distribution of milk.*

(i) *Processing*—No milk, howsoever cleanly it is produced, is free from bacteria. In order to keep the bacterial content of hygienically produced milk as low as possible so as to keep it in a wholesome condition before it is consumed it is essential that it should either be cooled immediately after it is produced or it may be heated or pasteurized and then cooled to 45°-50°F. by means of a cooler and kept in a cold store until ready for distribution. Heating of milk is made use of in transporting milk from the collecting centres to the city distributing centre and is best done by putting the cans of milk in larger vessels of boiling water until the whole of milk reaches a temperature of 165° F. The milk is not cooled but is immediately covered and sealed and transported to the distributing centre where it is cooled to 45°-50° F. and stored for distribution. Under Indian climatic conditions transporting milk in a hot state is preferable and more economical than the use of cold storage milk vans. When milk is not previously heated it may be pasteurized and then cooled at the distribution centre before distribution. This may be done by the *flash* method of heating the milk to 165°F. by the cheapest means or by the *holding* method, i.e., milk held at 145°F. for ½ hour and then cooling down to 45° F. by means of a covered cooler. For advice in regard to pasteurizing and cooling plants for your dairy please consult the Dairy Development Officer, Animal Husbandry Department, Uttar Pradesh, Lucknow.

(ii) *Distribution*—Milk even if kept cool, should not be allowed to accumulate but it should be delivered to the consumers as quickly as possible every day. The milk may be distributed loose from sealed cans with a tap or in sealed bottles carried on cycles, delivery carts, or motor vans. When delivery cans are used they must be provided with plungers so as to stir the milk at the time of delivery for even distribution of fat which being lighter usually comes up to the top whereas the tap is provided at the bottom of the can. To further safeguard against any possible adulteration by adding water, the milk of any distributor from any of his cans may be sampled out at any time without warning and tested. At the Indian Dairy Research Institute, however, a tap has been evolved through which water cannot be forced in from outside and thereby it prevents adulteration of

milk in the can. All the milk cans and bottles should be thoroughly washed, cleaned and sterilised every day before use as otherwise they may be one of the most potent source of bacterial contamination in milk.

It has to be realised that processing and distribution are the two steps which are responsible for the high retail price of milk as compared with the price paid for raw milk. It is therefore necessary to keep the cost of these two items as low as possible without affecting the quality of milk.

(*f*) *Co-operative Milk Supply Unions*—Due to considerable exploitation of the milk trade by middlemen and the *halwais* the village milk produce does not get a fair price for the milk. It therefore becomes impossible for him to maintain big animals on satisfactory ration which results in their gradual deterioration, uneconomic milk production and his own poor financial position. On the other hand the middlemen and halwais are very unscrupulous in adulterating the milk before it reaches the consumers who therefore do not get the real worth for their money. In order to put a stop to such progressive deterioration of stock and increasing poverty in the rural areas and to ensure a constant supply of wholesome milk of uniform quality to the urban population at a reasonable price it is necessary that co-operative milk supply unions should be organised at all the big towns with branch societies scattered in the villages on all roads radiating from the town. By such an arrangement the small rural producer would greatly benefit from a regular and fair market for his milk. With the help of the Government such co-operative milk supply unions are already functioning at Lucknow, Kanpur, Allahabad, Banaras and Meerut and some more are in the process of formation.

To the members of each village society milch cows and buffaloes of the breed recommended for the area are supplied on taqavi loan, suitable pedigree bulls are provided free, concentrates are supplied at a reasonable price and the services of a Veterinary Assistant Surgeon or a Veterinary Stockman are made available to them. Each society constructs a cheap sanitary milking shed with a well nearby and is responsible for the collection and milking of the milch animals, measuring the quantity of milk produced in the presence of the carrier, bulking the same in 20 seers locally made cans w th locking arrangement and transporting them to the collecting centres [Plate XV, fig. 1] by head-load, cycle, pony or tonga, depending upon the state of roads, seasons, distance, etc.

FIG. 1—*A milk collecting centre of the Lucknow Co-operative Milk Supply Union*

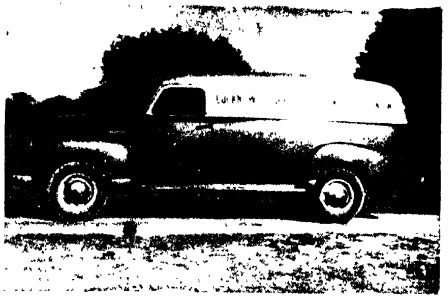


FIG. 2—*A milk collecting van of the Lucknow Co-operative Milk Supply Union*

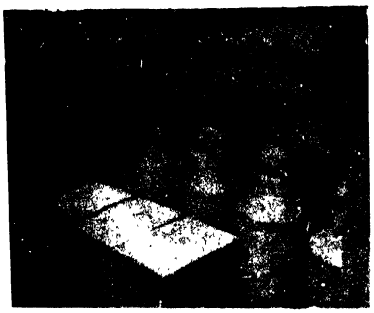


FIG. 3—*Storage of milk and milk products in the cold store of the Lucknow Co-operative Milk Supply Union prior to distribution*

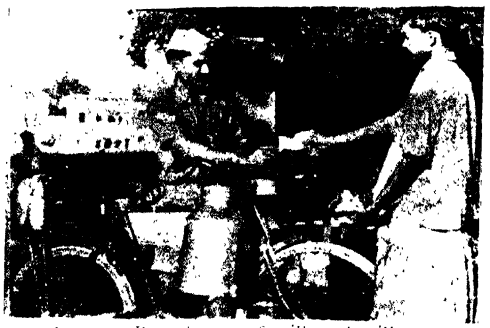


FIG. 4—*Distribution of milk and milk products by a delivery man of the Lucknow Co-operative Milk Supply Union*

VILLAGE MILK TRANSPORTATION TO TOWN BY ROAD

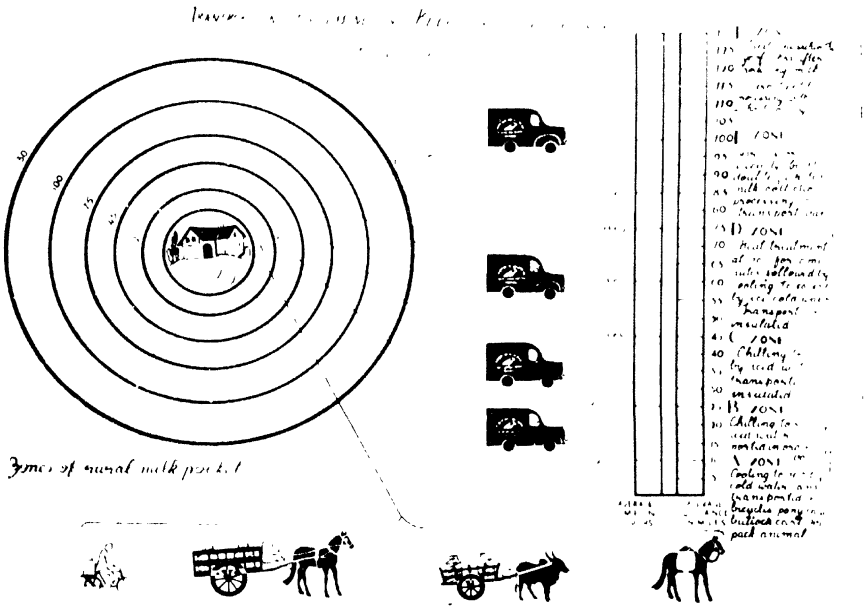


FIG. 5—*Means of transport and methods of processing village milk for safe transport to towns over varying distances*

At the collecting centres, which are located on the roadside or close to a railway station for quick transport to the distributing centre in the town, a representative sample of the milk is taken from the milk cans received from the various village societies for test for fat and total solids for the control of quality and the milk is measured and recorded. Milk from all the villages supplying the centre is then bulked into large cans holding one maund each and transported to the town by truck or rail. [Plate XV, fig. 2]. The treatment of milk depends upon the distance to be travelled and the time required to cover it. The chart prepared by the Indian Dairy Research Institute is very useful as one's guide in this respect. [Plate XV, fig. 5].

At the distributing centre in the town the milk is pasteurized and cooled if it has not been previously processed. Milk which has been transported in a hot condition from the collecting centre is cooled. The cooled milk is kept in a cold storage till it is distributed. [Plate XV, figs. 3 and 4].

(*g*) *Milk products and their comparative economics.*

(i) *Products resulting from souring of milk*—In a tropical country where milk has but a short life in the sweet condition, one of the simplest way of preserving milk for human consumption is to allow it to sour, since this checks putrifactive changes while giving an acid taste to the milk which is very refreshing in a hot climate and is a thirst quencher with a pleasant aroma. Though the nutritive value of fermented milks cannot be said to be superior to the raw milk from which they are made, yet it is claimed that by sterilising the intestinal contents and superimposing a predominance of lactic acid-producing organisms by drinking fermented milk, a number of digestive troubles can be overcome. The acidity in the lower intestine also causes precipitation of calcium phosphate and thus increases the availability of calcium and phosphorus to the body. The body becomes more efficient to cope with comparatively large quantities of lactic acid. This capacity enables the body to utilise the lactic acid formed rapidly in hard-worked muscular tissue which ordinarily causes fatigue in the untrained individual. The following are the common articles of food prepared from milk by this method :—

(1) *Dahi*—Milk is boiled to sterilise it and then cooled to body temperature. A small amount of the previous day's *dahi* is then added and the milk is mildly stirred and incubated by wrapping cloth or hay around the

container or placing it in a pack of straw or hay box, so as to maintain it at somewhat near body temperature by preventing the loss of heat. It is usually made in unglazed earthenware vessels (*handis*) which cannot be easily sterilised and contain live lactic acid bacteria in the pores which help in setting up the desired fermentation in the milk. In about 6 to 10 hours the *dahi* becomes ready for sale. The predominance of lactic acid bacteria prevent the growth of any other type of organism likely to make the product unwholesome (e.g. proteolytic bacteria); the lactic acid which is produced acts as a preservative and after reaching the maximum acidity (about 1·1 per cent. lactic acid) this strength of acid prevents the bacteria from carrying out further fermentation. The flavour, body consistency and non-whipping properties of the *dahi* are important. Sometimes for preference of taste and for the manufacture of some confectionary, sweetened *dahi* is prepared by adding 3 to 4 oz. of cane sugar per pound of milk. The indigenous method of *dahi* making is quite successful. However, maintenance of a uniformly high standard of hygiene in the handling of the milk and the washing and cleaning of the utensils with boiling water and the use of starters made from selected strains of pure lactic acid bacteria will ensure uniformity and wholesomeness of the product.

Good *dahi* should have a creamy and smooth surface free from bubbles (usually caused by the presence of undesirable gas-producing bacteria). The taste should be mild rather than sharp. It is also prepared from skimmed milk and sold but such a product lacks body and has no cream layer on the top.

Dahi forms the foundation of the indigenous butter and ghee manufacture in India. When the fat has been churned out from *dahi* and separated to be used as butter or for the manufacture of ghee, the remaining acid butter-milk is called *lassi*. A similar product can be prepared from skimmed milk by souring (lactic fermentation). The former product is however comparatively richer in fat, better in flavour and is more nutritious. Thus the indigenous method of manufacture of butter leaves the greater and very valuable part of the milk, contained in the *lassi*, for the use of the farmer's family who generally keep the whole quantity of butter produced for the manufacture and sale of ghee only. Sometimes in the villages the surplus *lassi* is put in a thick cloth tied and hung to drain out a large quantity of the watery portion, leaving behind a fairly thick curd which may be

used in the preparation of *raita* containing boiled vegetables with salt, pepper and spices. Some villagers also add cereal flours into the *lassi* and cook it and take it with salt and chillies.

(2) *Chhanna.*—It is formed by the precipitation of protein with entrained milk fat from milk by adding acid (citric acid) or acid liquids (citrus juices or sour whey) to boiling milk. About 2 lb. of milk is brought to the boil with stirring in a pan. When boiling, the juice of one ripe citrus lime, previously squeezed into a cup is distributed evenly over the surface of the milk, which is stirred vigorously. The milk will coagulate at once and the chhanna will collect into lumps. The chhanna is collected by straining off the whey through a cloth. The product is collected to a lump in the cloth and squeezed as free as possible of whey. More whey may be pressed out by wrapping the cloth round the lump and pressing between boards for 1 to 3 hours. The yield and conditions for the drainage of whey are best when the proper amount of lime juice has been added but this can only be learnt by experience. The operation can be better controlled by using citric acid solution instead of citrus juices. For every 100 parts of milk 0·6 parts of citric acid should be used. The citric acid should be dissolved beforehand in a little water and sprinkled on the surface of the boiling milk. Citric acid or citrus juice are harmless and can be used for this purpose with impunity. The practice of curdling milk with acetic acid or alum should be discouraged on hygienic grounds. It is used for making sweets as well as for cooking purposes.

(3) *Cheese*—The production of cheese in India either of indigenous or European varieties is extremely small. The indigenous varieties are curd cheese of very short ripening period usually preserved for short periods after smoking. The flavour is purely that of acid curd, or of smoked curd, without any mellowing due to protein breakdown either by bacteria or mould unlike the European varieties. Their manufacture is confined only to certain localities of India. They, however, provide a concentrated nutritious food. The use of hard cheese, e.g. Cheddar in India is limited to European tastes only.

Surati cheese - It is generally prepared from buffalo milk with the addition of crude rennet and salt and as a rule uncoloured. It is quite popular in the Bombay Presidency and is transported over long distances by rail and road steeped in whey in large earthen vessels secured with coir. The

indigenous method of its manufacture has been scientifically investigated at the Indian Dairy Research Institute, Bangalore, and the following improved method has been suggested.

Fresh buffalo milk after being toned so as to contain 6 per cent. (which gives the best yield with the minimum loss of fat in the whey) by the addition of separated milk and filtered (strained) is pasteurized by heating it to 172° F. for about 20 seconds. This destroys the common bacteria contained in the milk and enables the lactic acid producting micro-organisms to be introduced through the addition of the starter to bring about proper fermentation in the milk and produce the desired flavour. The pasteurized milk is then put into a coagulating pan and temperature brought to about 95° F. Pure lactic starter is then added in the proportion of 0·5 oz. to 100 lb. of milk and well mixed. Immediately after adding the starter, the measured quantity of rennet (6·7 c.c. for 100 lb. of milk) diluted with water is evenly distributed into the milk and mixed for a few seconds. The renneted milk is then allowed 'to set' till a firm coagulation fit for basketing and draining is obtained. [Plate XVI, fig. 4]. It takes about 60 minutes to obtain the desired consistency, which is indicated by a clean cut obtained on the insertion of the forefinger into the curd. The curd is then ladled out in thin slices into specially made bamboo wicker or cane baskets which have previoosly been prepared by washing with hot water, keeping them soaked in a 10 per cent. solution of salt in luke-warm water for about 10 minutes, rinsing them out in hot water and finally thinly dressing them with salt on the inside. The curd put in the baskets is thus salted on the sides and at the bottom. It is also salted in the middle by dressing it with salt when the basket is half filled and again on top after the basket is completely filled. Thus a uniform distribution of salt in the body of the cheese is brought about using 2 lb. to the yield obtained from 100 lb. of milk or 4·75 lb. per 100 lb. of green cheese. The baskets are then placed on the draining rack to allow the whey to escape and the cheese to shrink. The escaping whey is collected in a tray put underneath the draining rack. The cheeses are allowed to drain for about 50 to 60 minutes till they are firm enough for being turned and handled without breaking. They are then carefully turned over by hand or a flat spoon in their respective baskets and again allowed to drain for another 35 to 40 minutes for obtaining the desired uniform firmness and consistency. The collected whey is then strained through

FIG. 1 —*Cream separator*

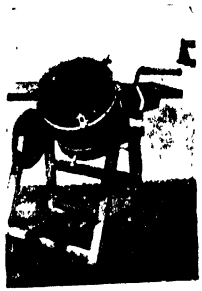


FIG. 2 *Butter churn*

FIG. 3 *Butter worker*

FIG. 4 *Equipment for making Surati cheese, ie coagulating pan, cane or bamboo wicker baskets, draining-rack buckets, filter-cloth, measuring-glass etc*

FIG. 5 *Ripening of Surati cheese in whey*

FIG. 6 —*A modern type of oven (I. D. R. I.) for heating butter which prevents charring and enables the ghee to flow out without disturbing the sediment*

FIG. 7 —*A. Wooden tub for curdling separated milk. B. Strong gunny bags for putting curd; C. Wooden rack for draining off whey from curd*

FIG. 8 *Hand press for pressing out the acid whey*

FIG. 9—*Reducing casein to granular form by rubbing over wire gauze seives*

FIG. 10 *Drying of casein on clean white sheets of cloth spread on floor or bamboo racks*

a clean muslin. The cheeses from the baskets are carefully put into the whey and left floating till required for further observations. The cheeses are weighed at various stages for observing their progressive shrinkage. The cheese is ripened in the whey for 12 to 36 hours depending upon the final acidity (commonly takes about 32 hours) and the yield is about 38 lb. from 100 lb. of milk. [Plate XVI, fig. 5.]

This cheese has a short keeping period and should be consumed before it is 10 to 14 days old. It has a flavour of acid curd. Cheese with a mild flavour is appreciated more and fetches better price. If kept too long it tends to dry on the surface and develop proteolytic and unwholesome flavours. Even small quantities of surplus milk can be profitably used by an average farmer or a dairyman to manufacture Surati cheese instead of their being converted into other more expensive and less remunerative dairy products. It requires small equipment and little time and labour but it fetches a profit higher than that one gets by the sale of fluid milk.

(4) *Butter*—

(*a*) *Desi butter* –This is the term used for the fat-rich fraction churned out from soured whole milk (*dahi*) by using the indigenous churn method. The *dahi* is made in a wide-mouthed unglazed earthen vessels (*ghara*) and when ready churned with a wooden paddle inserted in the liquid, the paddle being turned by a cord twisted round a spindle which is a prolongation of the paddle above the vessel, the curd being pulled with a reciprocating motion. After 15 to 20 minutes the *dahi* starts 'breaking' and water is added to assist the separation of fat, which rises to the top of the mass in the form of grains. This is usually over-churned to collect it into lumps. Excess butter-milk is pressed out by hand. The daily outputs of butter are allowed to accumulate over several days before conversion into *ghee*. In rich families the fresh butter is used up daily in place of *ghee*. It requires 14 lb. of milk to produce 1 lb. of butter. Buffalo butter is invariably, colourless but cows butter has a yellowish tinge depending upon the amount of carotene present. Owing to the fact that it cannot be collected into grains it is never washed during manufacture and it consequently contains a relatively large proportion of casein, and is greasy in appearance. It has an acid taste and aroma, the acidity increasing with the period of storage. Buffalo milk generally gives butter of inferior flavour and aroma to cow's milk.

(*b*) *Creamery butter*—The manufacture of butter as practised in the western countries with cooler climates requires certain fundamental conditions to be obeyed in order to obtain a product of good quality with maximum yield. The principal condition is that the cream must be conditioned by holding at a cold temperature (45 to 52° F.) for 12 to 24 hours before the fat globules are in the proper physical state for the churning process. At most seasons of the year, the cream under country conditions cannot be held at this temperature except with the use of ice.

The cream is first made from clean and wholesome milk by a separator. [Plate XVI, fig. 1]. It should contain from 25 to 33 per cent. of fat. The cream is then ripened at 60 to 70° F. by souring it with a pure culture starter (lactic acid bacilli). The quantity of the starter to be added is 2 to 5 per cent., if the cream is required to be ripened within 12 to 24 hours. If the quantity of cream is too small for churning on any one day, cream of two or three days may be added till the quantity is sufficient, but before churning the whole of it should be made uniform and homogeneous by mixing. The acidity of cream after ripening should be nearly 0·4 to 0·5 per cent. Over-ripening of the cream should be avoided. If acidity goes beyond 0·5 per cent., the final product will not give a pleasant aroma. The cream should then be hardened by cooling it at a temperature of 45° F. for 3 to 4 hours. The ripened cream at proper temperature is strained into the churn and the colour added, if required (20 to 40 drops of annatto seed butter colour per gallon cream). The churn is then worked keeping the churning temperature between 50 and 55° F. in summer, and 55 to 60° F. in winter. The cream should fill no less than one-third and no more than onehalf of the churn, otherwise agitation of the cream would be improper and the finished product will not be of good quality. Many types of churns are available in the market but ' end over end ' churns are best for the purpose. [Plate XVI, fig. 2]. After the first few revolutions of the churn the ventilator is pressed occasionally to release any gas in the churn. This is mostly water vapour. Churning is then continued at the rate of 30 to 40 revolutions per minute until the cream is ' broken.' This condition is seen through the transparent glass window provided for the purpose. It becomes clearer and clearer gradually. When the cream is properly broken, churning is stopped, temperature taken and enough cold water added to reduce the temperature of the churn contents to the original churn-

ing temperature. The temperature of the breaking water should be such that the quantity needed should not exceed one-fourth of the amount in the churn. Churning is continued again at a slow speed until grains of butter of the size of jowar grains or wheat kernels are formed. At this point churning should be stopped, a little ice-cold water added and a few more turns given. Over-churning results in the formation of lumps of butter and under-churning results in the poor formation of the butter grains and greater loss of fat in butter-milk. The butter-milk is then drawn off. Water is again added to the churn equal in quantity to the butter-milk removed and the churn rotated slowly five or six times and water drawn off again. Two or three such washings are generally sufficient to remove all butter-milk from the churn. A small quantity of cold water is then added and the butter grains removed by a scoop and transferred on to the butter worker. [Plate XVI, fig. 3]. On working the roller slowly most of the moisture in the butter is got rid of. The butter is then salted at the rate of about one ounce of salt to one pound of butter. Over-working the roller should be avoided. The butter, thus made, is weighed, moulded in wooden dies as required and packed in paper cartons for the market.

Precautions :—

1. Everything in connection with butter-making must be scrupulously clean.

2. See that the plug is fixed at its proper place before pouring any liquid into the churn.

3. See that the rubber ring, if one is a part of the churn, is on the lid before putting the lid on the churn.

4. The lid of the churn should always be carefully fixed and bolted before beginning to turn the handle.

5. See that a bucket is put under the churn all the time it is in use. This is to prevent wastage in case the plug comes out.

6. See that the ventilator is freely used in the early stages of churning.

7. Hold the hair sieve in front of the outlet always before taking off the plug.

8. Always use coarse linen for straining any liquid poured into the churn.

9. When boiling hot water is in the churn for cleaning purposes, press the ventilator frequently before revolving the churn.

10. Never put the rubber ring in scalding water along with other utensils. Hot water ruins India rubber.

11. Never over-work the roller.

(5) *Ghee*.—It is essentially clarified butter-fat and may be produced from 'desi' or 'creamery' butter. The latter is a relatively common procedure in certain districts of North Bihar, where mechanical cream separators have been extensively installed. The butter is boiled over a medium but steady fire, being stirred until the mass is melted. After boiling at a temperature of 100—123° C. for some time a muddy coloured scum gathers on the surface and is removed with a perforated ladle. The effervescence gradually diminishes as the moisture content is reduced, while particles of curd (casein) are seen to rise and circulate from the bottom of the pan. At this stage a characteristic aroma is noticeable, and this is an indication that the ghee has been sufficiently heated. After setting and cooling for some hours, the ghee is removed to separate containers (either to small earthen pots or clean kerosene tins) for sale. The casein residue is found as a semi-soiled mass at the bottom of the pan, and represents about 0·5 per cent. of the ghee.

For large supplies of ghee (for example, to meet army requirements) the product may need to be refined and blended. This is carried out by testing individual consignments of ghee, deciding the proportions of each necessary for the required blend, and then mixing the bulk in heating tanks. The reheating at a temperature of 70—85° C. not only enables blending to be effected, but assists in the refining process, the mixed product being refiltered before packing for storage or distribution.

It is estimated that ghee accounts for 53 per cent. of the total milk produced in India or for 77 per cent. of the milk used for the manufacture of milk products (which is 69 per cent. of the total production). The weight of ghee produced annually is 227·5 crores of maunds, valued at Rs.100 crores. This is on the basis of 16 lb. of milk giving 1 lb. of ghee. The approximate pre-war price realised as ghee is Rs.2-12 per maund of milk, or Rs.44 per maund of ghee. Ghee is thus the most important dairy product in India, just as butter is in western countries. Since butter has a low keeping quality and uncertain texture and solidity at ordinary temperature in India, the only alternative is ghee, which has a long keeping quality, is sterilized in its process of preparation and will resist spoilage through

contamination with bacteria, moulds and fungi and chemical action for a long period after manufacture.

Ghee is judged partly by its appearance and texture and partly by its taste and aroma. It should have a slight yellowish colour. It should have a fine granular texture and should be neither greasy nor waxy. The aroma of well made ghee is typical and its taste slightly acid. There should be no taints or abnormal flavours.

The yield of ghee is of great importance to the small producer and it is feared that with the desi methods used for churning milk (or *dahi*) into butter, preparatory to making ghee, there is a considerable loss of fat in the butter-milk or *lassi*, which may amount to 20 per cent. of the original fat as a cash product, but if the *lassi* is consumed there is no loss of nutritive value to the producer. Where cream separators and modern churns are used to get better yield of ghee the skim milk can be utilised by the farmer for his own use or when in large quantities it may be used for the manufacture of other products for sale, viz. casein or condensed milk. The use of a standard starter (culture of lactic acid bacteria) obtained from a reliable dairy will help in giving the desired flavour and aroma to the ghee which will be of a more uniform quality. Overheating should be avoided so as to prevent cooked flavour and any loss of nutritive value in ghee and extra expediture on fuel. The use of improved ghee boilers as shown in [Plate XVI, fig. 6] may be made use of where large quantities of ghee are produced. The exact details of this boiler may be had from the Indian Dairy Research Institute, Bangalore.

Ghee is frequently adulterated with cheaper fats. It may be adulterated at the butter stage by the addition of animal or vegetable fats before churning or after melting with vegetable ghee prepared from vegetable oils, particularly groundnut oil, by hydrogenation which converts them into a solid fat of the consistency of ghee or butter which is the most popular adulteration used. Adulteration unless it is very heavy, cannot be detected by simple tests. Samples must be examined in a fully equipped chemical laboratory.

(ii) *Products manufactured by partial desiccation*--

1. *Khoa*--It is usually made from small volumes of milk (4 to 5 lbs.) at a time. The milk is poured into a round-bottomed iron pan (*karahai*), and brought to the boil over a fairly hot and steady fire, stirring continuously

with a special scraper (a *khurpi* with a long handle) with a circular motion and lightly scraping all parts of the pan with which the milk comes into contact. The milk is made to boil vigorously with continuous stirring so as to prevent scorching on the metal surfaces. To prevent boiling over at the start, some agitation by pouring and raising off the fire may be necessary. When the milk becomes viscous it is vigorously stirred and moved continuously off the metal surface. The vigorous stirring of hot milk has an appreciable homogenising action so that when the stage of coagulation is reached all the fat globules are entrained in the coagulum and there is no trace of free fat. As soon as the mass takes a pasty consistency and begins to dry up the pan is removed from the fire, the residual heat of the iron being sufficient for the subsequent process and the pasty mass is well worked with the flattened end of the scrapper, being spread several times in a thin layer across the bottom of the pan. This gives the product a good grain. When the mass can retain its own form, it is considered to be ready and is made into a circular pat transferred to a large leaf which serves as the sole packing material. The pats are allowed to cool and then built up into tiers for transport to the market. Some makers of *khoa* add a small piece of alum about the size of a pea at the later stages of evaporation. This causes a more abrupt coagulation of the protein and gives a smoother texture to the product. On hygienic grounds this practice should be discouraged as it means the addition to a good product of a heavy metal the physiological action of which is not well known.

It should be white in appearance, and should have a smooth texture. The taste should be sweet and wholesome, with a slight but pleasantly cooked flavour. On keeping the surface becomes yellowish and dull in appearance, while deterioration which is entirely due to contamination from external sources, is judged by the presence of cobweb like threads (moulds and fungi) on breaking. *Khoa* itself keeps sweet for 4 or 5 days in the cold weather and 2 to 3 days in the hot weather but the addition of sugar in the making of sweetmeats prolongs the keeping quality to 3 to 4 months. It can also be prepared from skimmed milk. But as the mass is non-fatty it will have a tough and open texture, crumbling to the feel. It is not very suitable for manufacturing Indian sweets used as a whole, but can be mixed with *khoa* made from whole milk in certain proportion and used in the confectionery.

2. *Rabri*—It is a specially prepared product which requires a little skill and constant attention. While the milk is being slowly evaporated successive layers of clotted cream are skimmed off. During boiling the surface of the milk is fanned with the left hand while the skin on the milk is repeatedly removed with a thin wooden stick (bamboo or cane splints) by the right hand and collected on the cooler parts of the surface of the pan. When the volume of milk has been reduced to one-eighth its volume, sugar is dissolved in it and the cream is then scraped off the sides of the pan, where it has been collected and immersed in thick sweetened milk. Three seers of milk are convenient to work with in one batch ; two ounces of sugar are required per seer of milk for the making of the final milk sugar syrup.

3. *Nalai* (*cream*)—Fresh cream can be removed either by skimming off the top (cream) layer of the milk which has been poured into pans in a warm state and allowed to stand for 10 to 12 hours, or longer. The cream rises best in a falling temperature as fat retains heat longer than the other constituents of the milk, and is therefore, lighter owing to the alteration in the specific gravity and so comes to the top more rapidly. It can however be separated from milk more efficiently by the use of a cream separator in which centrifugal force is used. It can be obtained from the Government Central Dairy Farm, Aligarh. Fresh cream can be used on the table either with fruits or sweet dishes besides several other ways.

(*iii*) *Other products*—In the Tarai areas where milk is available in large quantities and several creameries are established for supply of cream to a number of large and small dairies in the towns, huge quantities of skimmed milk is available which can easily be converted into casein and condensed skimmed milk the manufacture of which can be profitably developed as cottage industries.

1. *Casein*—Ordinarily casein making is associated with the cream separator. It is the principal protein of milk, approximately 3 per cent. of the whole. Commercially it is used in the manufacture of paper, glue, paints, immitation ivory goods, textiles, polishes, face cream, medicinal foods, e.g., sanatogen, etc. There is a great scope for developing the manufacture of casein with a view to supplement the profits from the dairy industry in those areas where skimmed milk cannot be disposed of in any other more profitable manner. The indigenous method of its manufacture is given below;

The first essential in making casein of good quality is that the separated milk used for the purpose should be as free from fat as possible. The presence of fat, even in small quantities, not only makes the finished product greasy to the feel and yellowish in colour but it impairs the keeping quality of casein and renders it useless for many commercial processes. Consequently, it fetches a lower price. The separated milk is put in ordinary wooden tubs [Plate XII, fig. 7-A] and coagulation is brought about by the addition of whey or butter milk in quantities equal to 1—2 per cent of the amount of skim milk to be treated. The coagulation takes place in about twelve hours. The curd is ready when the whey separates and the curd is tough and spongy to the touch. It takes about 24—48 hours after the addition of whey or butter milk depending upon the weather. In the cold season it takes longer.

The coagulated milk is then ladled out by means of buckets [Plate XII, fig. 7-B] into strong gunny bags which are hung from wooden racks [Plate XII, fig. 7-C in order to drain off whey from the curd. This takes about four to five hours. The bags are then put in a hand press [Plate XI, fig. 8] and pressure applied gradually, say, every five minutes, in order to press out the acid whey. It is kept in the press for two to three hours. Where water is available, the washing of curd and its squeezing in the press is repeated two or three times before finally removing it from the bag. Cold water is preferable for this purpose. The presence of whey in the curd or casein gives the casein a yellowish colour which is undesirable.

When the curd is sufficiently hard it is broken up and reduced further to granular form by rubbing it on wire gauze sieves [Plate XII, fig. 9] to facilitate the evaporation of moisture. The granular substance thus obtained is casein in green form. It is then dried in the sun and for that purpose it is spread out on cowdung plastered floor. Although this kind of floor helps in absorbing the moisture from the casein, it adds several impurities to it and also affects its colour. Very often casein is dried on clean white sheets of cloth spread on the floor [Plate XII, fig. 10] or bamboo racks prepared for the purpose. This yields the best results. Where casein making is done regularly, cement floor can be used with advantage. The casein is left out to dry in the sun for six to eight hours when it is occasionally stirred. Before it is finally filled in bags and stored, it is spread out on the floor in the store or shed for at least a week and frequently stirred to aerate it,

FIG. 1 *The water-bath for finishing the condensed milk to the correct consistency. Note the metal strips placed crosswise for supporting the pan containing milk. (Initial boiling by direct heat over furnace as used in gur making)*

FIG. 3 *The filling of tins of condensed milk from a can in which the day's manufacture is bulked*

FIG. 5– *Self pollution*

FIG. 2 *The partially concentrated sweetened milk is finished off to correct consistency over the water-bath*

FIG. 4– *The soldering of tins*

FIG. 6– *Use of craddle to check self pollution*

If stored directly into bags, it gets into lumps and with the slight amount of moisture in it, it will start decomposing and giving out a bad smell. The casein may finally be stored either in granular form or ground as powder. In grinding there is a loss of about five per cent., but ground casein fetches anything from Rs.35 to Rs.45 more per ton than unground casein. The gunny bags used for the purpose of storing are double, or two bags put one into the other. If casein is well made, it can be stored for three years.

Unscrupulous manufacturers may adulterate casein by the addition of broken or powdered rice, ground tamarind seeds or quartz sand from river beds. The adulteration can however be easily detected by dissolving a small quantity of casein in a fifty per cent. solution of borax. If the sample is pure, it dissolves completely. If not, it leaves a precipitate the nature of which depends on the nature of the adulterant. This industry can be made much more remunerative by the invasion of foreign markets provided the existing drawbacks, e.g. the presence of fat in casein, want of grading, adulteration, etc. can be removed.

2. *Condensed milk*—It is a method of conserving surplus milk, whole or skimmed, with or without sugar for consumption during unproductive periods. Besides the longer keeping qualities of these products, the cost of their transport is also reduced and the injurious organism if any present in the milk are destroyed at the same time. It is a valuable concentrated food and its manufacture is a very promising and remunerative industry. The indigenous method of its manufacture is as follows :

Generally skimmed milk is used to which white sugar in the proportion of about 1 : 5 is added. It is then boiled over a direct fire for about half an hour and is allowed to cool. Thereafter, it is reboiled and re-cooled. This operation is repeated 3 to 4 times and the milk is kept stirred. The finishing pan is about 30″ in diameter and is made of enamelled iron in the shape of a wash basin. This rests on metal strips placed crosswise over a water-bath [Plate XVII, fig. 1]. The partially thickened milk is poured into the finishing pan [Plate XVII, fig. 2] and is heated over the water-bath. After the correct consistency is obtained, the day's manufacture is bulked in a large can from which the tins are filled [Plate XVII, fig. 3] The tins are hand-made and have a small opening for filling the condensed milk. They are closed by soldering and are sold unlabelled. [Plate XVII, fig. 4].

The skimmed condensed milk is generally sold to the tea-shops for

immediate consumption. Lack of uniformity in colour and tendency to form lumps are said to be the common defects which should be avoided. The product is usually not gritty although at times this develops under storage. The retail price before the war was Rs.3-12-0 per dozen of 1 lb. tins.

(*iv*) *Comparative economics of various milk products*—The following figures illustrate the comparative economics of various milk products :

Products	Outturn per 100 lbs. milk	Average retail price per lb.	Gross return per 100 lb. of milk
	Lb.	Rs. a. p.	Rs. a. p.
Ghee	6	2 8 0	15 0 0
Butter	7	2 12 0	19 4 0
Liquid milk	100	0 4 0	25 0 0
Dahi	85	0 6 0	31 14 0
Khoa	25	1 4 0	31 4 0
Chhanna	20	1 12 0	35 0 0
Malai	20	2 0 0	40 0 0
Rabri	40	1 8 0	60 0 0
Surati cheese	38	1 8 0	57 0 0

It illustrates a point of unique interest since it will be seen that the manufactured products with the exception of ghee and butter (not taking into consideration the value of *lassi* consumed by the farmer himself and his family) realise better financial return than from the sale of fluid milk itself. This is contrary to the experience of dairymen in other countries where the most profitable disposal of milk is as liquid milk.

(*h*) *Colonization of gowallas*—In all the big towns not only there is lack of suitable facilities for economical maintenance of cattle and cheap milk production, but their existence in thickly populated quarters results in insanitary conditions. Furthermore, due to the high cost of their maintenance under town conditions where cattle feeds and fodders are far more expensive, and cow-sheds are of high rental value it becomes difficult for the gowallas to maintain dry cows which consequently find their way to the slaughter houses,

That is how a large number of good cows are lost. It is therefore of paramount importance both from the point of view of cheap and wholesome milk supply to the town as well as its sanitation that from all the big towns gowalas should be shifted about 10 to 15 miles away and colonized. The availability of land for fodder cultivation, irrigation facilities, a road connecting the colony with the town are of primary importance for the establishment of such a colony. If some pasture land be available nearby it would be an additional advantage. If the Government and the Corporation or Municipalities of big towns join hands, this problem might be tackled successfully. Milk from such colonies may be collected by the co-operative town milk supply unions as from other milk collecting centres.

(*i*) *Self-pollution by cows* [Plate XVII, fig. 5]—It is an attempt on the part of the cow to suck her own teats to drink milk. This vice is acquired due to defective rearing and management of young stock, becoming a habit later on and is guided by sudden impulses. When weaning is delayed and a heifer is allowed to continue to suck the dam for an unnecessary longer period she may develop this vice on becoming a cow. Such a cow generally loses affection for her calf and consequently the nourishment of the poor calf is seriously affected unless special attention is paid to it. This vice may be remedied either by a cradle made of small bamboo sticks with rounded ends tied round the neck [Plate XVII, fig. 6] which prevents the animal to turn her neck on either side or by putting a light aluminium disc clipped into the nostrils which covers the teats when she attempts to drink her own milk but while feeding it simply remains on the food without interfering with feeding. Cows of nervous temperament may show some excitement in the beginning but later on they get accustomed to it. After the use of any of these appliances the milk yield of the cow may sometime go down because she gets accustomed to stimulate her milk secretion by licking with its own tongue, though it is gradually restored to normal. During the next calving the appliance should be put on soon after parturition and it is possible that by its use the cow may in due course forget the bad habit.

(*j*) *A scheme for a small sized model dairy farm*— It is suggested that a small sized dairy farm should be started with at least 50 heads of milch cattle (say 30 cows and 20 buffaloes) as smaller number will not be an economical unit. The area of the land should be about 50 acres and out of this at least 30 acres should be good fertile land for fodder production and should have a

good source of irrigation either canal or tube-well. The allocation of the land should be as follows :

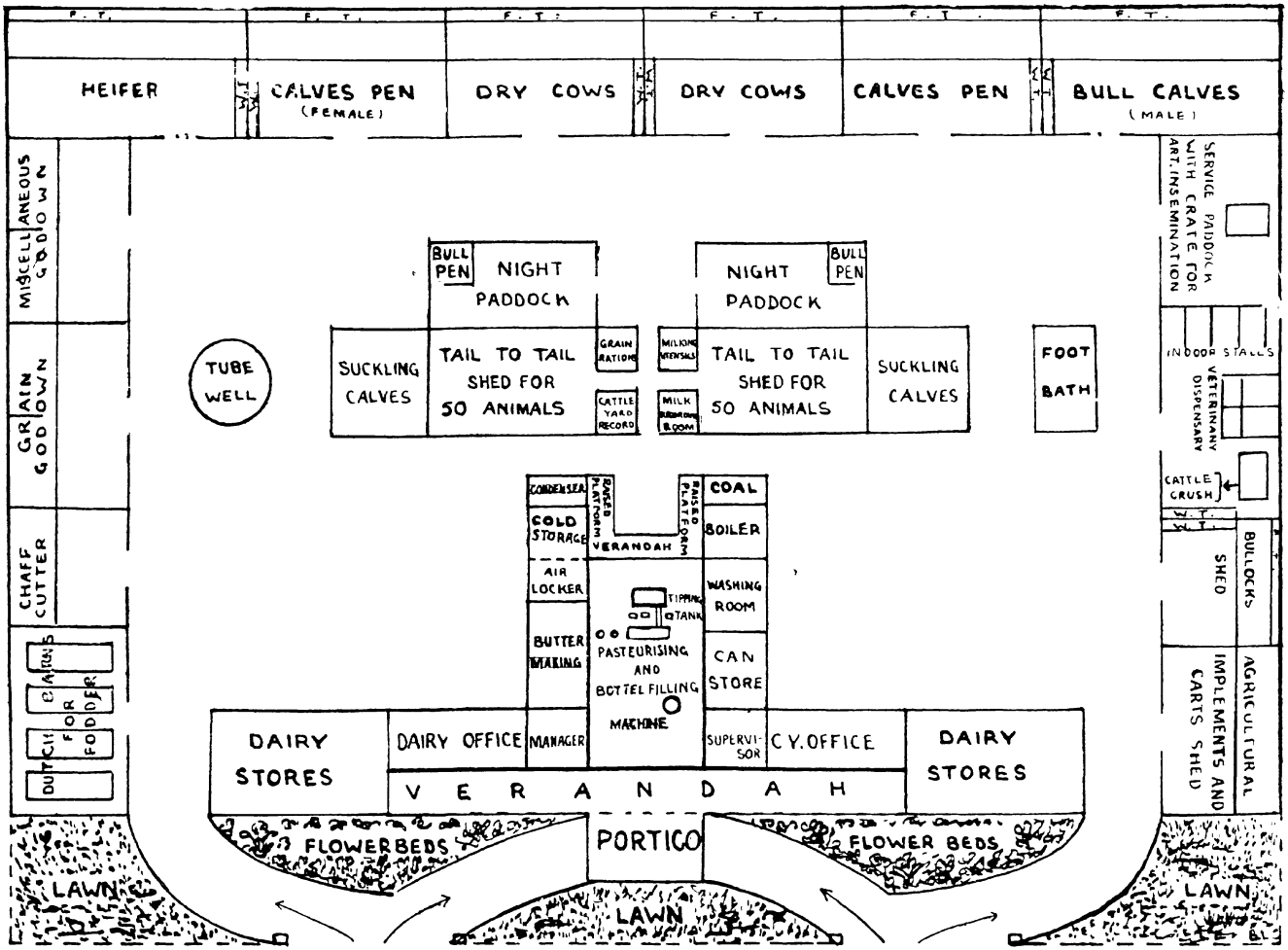
	Acres
Fodder production	25
Pasture Reserve	10
Buildings, paddocks and roads ..	10
Cash crops and horticulture ..	5
	50

It is expected that with 50 heads of milch cattle at least 350 to 400 lb. (about $4\frac{1}{2}$ to 5 maunds) of milk will be produced per day throughout the year. This figure is based on the fact that only 66 per cent. of stock will be in milk at a time and the average yield of milk per animal throughout the lactation will be about 10 lb. and 12 lb. per day per cow and buffalo respectively and that the cattle kept on the farm will be pure-bred and their breeding, management and feeding will be on scientific lines under the supervision of an experienced hand. The breeds of cattle and buffaloes to be maintained should be decided in consultation with the Department of Animal Husbandry so that it may fit in with the cattle development plan of the Province and the dairy may have the advantage of free bulls and buffalo bulls issued by the Department, and the male progeny may be purchased by Government at a good price for distribution as bulls.

The dairy farm should be established within a reasonable distance from a city so that milk may be transported from the farm to that city by means of a tonga, provision for which has been made in the scheme. Door to door delivery may be avoided for the sake of economy and milk should be distributed among the public at 2 or 3 suitable centres in different parts of the city.

The land required for the dairy farm may be acquired with the help of the Government, but if this be not possible the land may be taken on rent by private negotiation and provision for this has been made in the scheme. The dairy buildings should be constructed according to a suitable plan [Plate XVIII].

As it does not pay to turn the farm-produced milk into butter, it is suggested that all the milk produced on the farm should be sold to the public as fluid milk and for butter manufacture cream may be purchased once a week according to requirement on " butter-outturn basis " through a contractor, which should be pasteurized before churning. This method will not only save losses, but will actually give profit to the farm as there will be



LINE PLAN OF A MODEL DAIRY FARM WITH 100 MILCH CATTLE

margin of about six annas profit per lb. of butter or say Rs. 100 per month.

Plan of crop rotation to be followed for production of fodder for animals to be used as green fodder, silage, and dry fodder to make the farm a self-sufficient unit, is given below for fifty milch cattle with their followers.

Assuming the productive life of an animal to be five years on the average 1-5th of the herd (20 per cent.) will have to be replaced each year. Allowing a margin for some culling and selection, the following strength of the replacement stock will be maintained:

Heifers between 2 years and 3 years = 10.

Heifers between 1 year and 2 years = 12 (allowing for some losses).

Calves below 1 year of age = 15 (because of more deaths).

For breeding purposes 2 bulls be maintained if both cows and buffaloes are kept and for cultivation of land 3 pairs of bullocks will be required.

The total strength of livestock therefore will be :

Cows 50 each weighing 700 lb. (on average) ;

Bulls 2 each weighing 800 lb. (on average) ;

Bullocks 6 each weighing 1,000 lb. (on average) ;

Heifers (2-3 years age) 10 each weighing 500 lb. (on average) ;

Heifers (1-2 years age) 12 each weighing 350 lb. (on average) ;

Calves (below 1 year) 15 each weighing 100 lb. (on average).

Amount of fodder to be grown—On the assumption that about 6 lb. of green fodder per 100 lb. body-weight will be consumed (will differ a little on dry matter basis) our need for the stock will be roughly 45 maunds a day. This will cover the losses of feed left over by cattle in the manger as unconsumed.

This will mean a requirement of about 45 × 30 maunds = 1,350 maunds per month.

Selection of crops for supplying the required amount of green fodder throughout the year :

1. Napier grass (4 cuttings) .. (*a*) January—350 maunds per acre in this cutting.
   (*b*) May—350 per acre in this cutting.
   (*c*) August—500 maunds per acre in this cutting.
   (*d*) October—400 maunds per acre in this cutting.
2. Jowar—one cutting during the end of August and September yielding about 450 maunds per acre.
3. Cowpea (cuttings taken in rotation from different plots). April .. .. .. } About 100 maunds per acre.
   May .. .. .. }
   June .. .. .. }
   July .. .. .. }
   August .. .. .. }
   September .. .. }

4.	Maize (one cutting)	(*a*) September	200 maunds per acre.
		(*b*) October	
5.	Radish fodder (Sengri) ..	(*a*) November	100 maunds per acre.
		(*b*) December	
		(*c*) January	
6.	Sunflower	(*a*) September	100 maunds per acre.
		(*b*) October	
		(*c*) November	
7.	Oats (2 cuttings)	(*a*) February	100 maunds per acre.
		(*b*) March	150 maunds per acre.
8.	Lucerne (cuttings taken every alternate month in each plot).	(*a*) January	100 maunds per acre per cutting.
		(*b*) February	
		(*c*) March	
		(*d*) April	
		(*e*) May	
		(*f*) December	
9.	Berseem	(*a*) January	150 maunds per acre per cutting.
		(*b*) February	
		(*c*) March	
10.	Summer Bajra (2 cuttings) in alternate months from each plot.	(*a*) May	75 maunds per acre per cutting.
		(*b*) June	
		(*c*) July	
		(*d*) August	

These yields are on the average figures, but with proper tillage and heavy manuring from available farmyard manure the yields can be considerably increased.

The rotation of crops can be altered to suit individual conditions. Guinea grass can be grown with advantages in shady places where no other crop can be grown and with heavy application of farmyard manure very high yields can be obtained.

Cropping Scheme—Assuming that all land is under irrigation and is level, the following cropping scheme will help producing the total requirement:

Crops to cater for 5 months (August to December)	Total requirement 1,350 × 5 maunds = 6,750 mds.
	Yield expected Mds.
Napier grass 5 acres at 900 maunds per acre	4,500
Jowar 3 acres at 450 maunds per acre	6350
Cowpea 3 acres at 100 maunds per acre	300
Maize 3 acres at 200 maunds per acre	600
Radish fodder 3 acres at 100 maunds per acre	300
Fallow 8 acres.	
Total : 25 acres.	7,350
	(The excess will take care of losses in chaffing, hauling, etc.)

Crops to cater for 4 months (January to April)	Total requirement 1,350 × 4 maunds=5,400 mds.
	Yield expected Mds.
Oats 3 acres (in cowpea field) at 300 maunds per acre	900
Lucerne 5 acres (in maize field) at 300 maunds per acre	1,500
Berseem 5 acres (in Jowar field) at 300 maunds per acre	1,500
Napier grass 5 acres at 300 maunds per acre	1,500
Cowpea 3 acres (in radish fodder field) at 50 maunds per acre	150
Fallow 4 acres	..
Total : 25 acres	5,550

Crops to cater for 3 months (May, June, July)	Total requirement 1,350 × 3 maunds = 4,050 mds.
	Yield expected Mds.
Napier grass 5 acres at 350 maunds per acre	1,750
Cowpea 3 acres at 100 maunds per acre	300
Summer Bajra or early Maize 10 acres at 150 maunds per acre ..	1,500
Lucerne (May) 5 acres at 100 maunds per acre	500
Fallow 2 acres.	..
Total : 25 acres.	4,050

The total annual recurring expenditure under the scheme is estimated to be Rs.57,745 and the anticipated annual receipts are expected to be approximately Rs.63,800 when milk is sold at annas 10 per seer. This yields a net profit of Rs.6,055 or say Rs.6,000 annually.

The details of recurring and non-recurring expenditure required under the scheme and total annual receipts are given below :

I—NON-RECURRING EXPENDITURE—

A—Livestock :

	Rs.
30 Hariana cows at Rs.350 each	10,500
20 Murrah buffaloes at Rs.500 each	10,000
1 Hariana bull on Government contribution	30
1 Murrah bull on Government contribution	30
3 pairs of bullocks at Rs.1,000 per pair	3,000
1 Horse for tonga	1,000
Total ..	24,560
Or say ..	24,600

B—Dairy appliances and cattle-yard equipment: (*List of dairy appliances required for handling about 5-8 maunds of milk a day with their approximate prices*)		Rs.
(i) *Cattle-yard and dairy equipment:*		
Two sets of Dairy Herd Recorder complete with balance tripod stand and bucket, at Rs.150 each set		300
Two milk strainers complete with filters at Rs.25 each		50
One dozen milking pails seamless (10 quarts size) at Rs.20 each		240
One dozen milk pails seamless (4 gallons capacity) at Rs.20 each		240
Milk cans:		
Six—4 gallons capacity at Rs. 60 each		360
Six—8 to 10 gallons capacity at Rs. 80 each		480
Six milk delivery cans (4 gallons capacity) with faucets at Rs.65 each		390
One milk receiving tank 30 gallons capacity		150
Six milk measures (1 seer capacity) at Rs.5 each		30
Six milk measures (½ seer capacity) at Rs.3 each		18
Six milk measures (¼ seer capacity) at Rs.2-8 each		15
Hot water tank		500
Equipment for washing and sterilizing cans and buckets, etc.		500
One milk pasteurizer (50 gallons) capacity (direct heat)		1,650
One milk cooler (tubular) complete with pipes, milk pump and centrifugal pump for brine, capacity 50 gallons, per hour		1,500
One cream separator, 50 gallons capacity		350
One bottle filler with 4 valves		1,000
One bottle capping machine for aluminium caps (Alaka or Hygia milk bottles)		250
Milk bottles (English "Hygia" or "Alaka" 44 M.M.) or their Indian *substitutes* at a little cheaper cost:		
2 lb. size one cost	144	454
1 lb. size one gross	108	
½ lb. size one gross	72	
Aluminium caps 10,000 at Rs.13 per thousand	130	
(ii) *Butter making equipment:*		
One butter churn (end over end type) three gallons capacity		225
One butter worker		175
Two pairs scotch hands 10″ × 3″ at Rs.5 per pair		10
Two butter scoops 10″ × 4″ at Rs.5 each		10
Two cream squeezers 5″ at Rs.10 each		20
One butter mould round 2 oz.		3
One butter mould round 4 oz.		5
One butter mould square 1 lb.		10
One butter sieve (horse hair)		20
One dairy beam scale (10 lb. capacity complete with one set of weights 1 oz. to 2 lb.)		120
(iii) *Laboratory equipment:*		
4 Dairy thermometers (floating) at Rs.6 each		24
Two sets quevene or Gerber Lactometer with glass jars at Rs.25 per set		50
One Richmond scale at Rs.22		22
Two sets acidity test complete at Rs.25 each set		50
One set sediment test complete		50
One Gerber milk centrifuge machine complete (for 8 tests)		400
Total		10,511
Or say		10,500

	Rs.
C—Buildings and Paddocks :	
Dairy building with office and laboratory	4,000
Two cattle-sheds (one for cows and one for buffaloes) 70′×25′ each to accommodate 30 heads of cattle	4,000
Shed with enclosure for young-stock	1,000
Shed with enclosure for heifers	1,000
Bull pens—two	1,000
Bullocks shed for 5 pairs of bullocks	500
Feed store 25′×40′ with implement shed	2,500
Paddocks fenced (two) with water and feed troughs	2,000
Servant quarters for 12 servants	3,000
Manager's quarter	4,000
Supervisor's quarter	2,000
Total ..	25,000
D—Agricultural Implements :	
One bullock-driven chaff-cutter	700
One bullock cart (pneumatic tyres)	700
One hand chaff-cutter and 3 wheel barrows at Rs.100 each .. .	400
Ploughs, harrows, shovels and other miscellaneous agricultural implements ..	1,000
Platform weighing balance	400
Total	3,200
E.—Furniture for dairy and office and one cycle	1,400
F.—Veterinary Instruments	400
G.—Tonga with pneumatic tyres ..	1,000
H.—Fencing, land improvement, and unforseen charges	4,000
Summary of non-recurring items :	
A.—Livestock	24,500
B.—Dairy appliances	10,500
C.—Buildings	25,000
D.—Agricultural implements ..	3,200
E.—Furniture, etc.	1,400
F.—Veterinary Instruments ..	400
G.—Tonga	1,000
H.—Fencing, etc.	4,000
Grand total	70,000
II—Recurring Expenditure —	
A—Establishment :	
1 Dairy Manager at Rs.150—10—250	1,800
1 Dairy Supervisor at Rs.75—5—150	900
1 Cattle-yard Supervisor at Rs.75—5—150	900
1 Cultivation Supervisor at Rs.75—5—150	900
1 Accountant-*cum*-Cashier at Rs.75—5—150.. ..	900
1 Clerk-*cum*-Typist at Rs.65—5—120	720
1 Store-keeper at Rs.60—4—110	720
2 Sales Supervisors for city depots at Rs.50—2—80 each ..	1,200
1 Milk Recorder at Rs.40—2—60	480

	Rs.
1 Stockman at Rs.40 per mensem ..	480
5 Cattle Attendants at Rs.30 per mensem each	1,800
3 Ploughmen at Rs.30 per mensem each ..	1,080
1 Tonga Driver at Rs.35 per mensem ..	420
1 Syce for horse and 2 chowkidars at Rs.30 per mensem	1,080
Dearness and Travelling Allowances ..	2,620
Total	16,000

Feed Cost :

30 cows at Re.1-4-0 per day each	13,688
20 buffaloes at Re.1-8-0 per day each	10,950
2 bulls at Rs.2 per day each ..	1,460
6 bullocks at Re.1 per day each ..	2,190
1 horse at Rs.2-8-0 per day ..	912
Total	29,200

Charges under feed cost will be reduced considerably if the fodder produced on the farm is based on crop rotation plan given previously.:

C —Miscellaneous Expenses :

Chemicals, i.e., washing soda, chloride of lime, etc., at Rs.25 per mensem ..	300
Repairs on cycle, tonga and agricultural implements, etc., at Rs.25 per mensem ..	300
Repairs, white washing of buildings, etc.	1,000
Rent of two milk distributing depots in the city at Rs.30 per mensem ..	720
Rent of 50 acres of land at Rs.20 per acre	1,000
Veterinary medicines	280
Unforeseen charges	400
Total ..	4,000

D —Depreciation :

(*a*) On livestock (total cost Rs.24,560) at 12 per cent.	2,950
(*b*) On dairy appliances (total cost Rs.10,500) at 10 per cent.	1,050
(*c*) On buildings and paddocks (costing Rs.25,000) at 5 per cent.	1,250
(*d*) On agricultural implements (costing Rs.2,500) at 10 per cent.	350
(*e*) On furniture, etc. (costing Rs.1,500) at 15 per cent.	225
Total ..	5,825

E —Interest on capital :

Total investment under non-recurring items A to H. Rs.70,000, at 4 per cent. ..	2,800

Summary of annual recurring expenses :

A.—Establishment	16,000
B.—Feed cost	29,200
C.—Miscellaneous	3,920
D.—Depreciation	5,825
E.—Interest on capital	2,800
Grand total ..	57,745

				Rs.
III.—TOTAL ANTICIPATED ANNUAL RECEIPTS—				
1.	Sale of 5 maunds of milk a day at Rs.25 per maund or 125×365=	..	..	45,625
2.	Profits on sale of 10 lb. of butter per day at Re.0-6-0×10×365	..	..	1,370
3.	Calves (40 at one year of age)—			
	13 male calves at Rs.250 each	.. .. ..	3,250	8,375
	12 female calves at Rs.225 each	.. .. ..	2,700	
	8 male buffalo calves at Rs.150 each	.. ..	1,200	
	7 female buffalo calves at Rs.175 each	.. ..	1,225	
4.	Manure receipts (basis of 10 maunds per day at Rs.2 per maund or 10×365×2			7,300
5.	Return from 5 acres of "cash crops" and Horticulture	..	..	1,500
		Total	..	63,800

Net profit—Rs.63,800—57,745= Rs.6,055
Or say — Rs.6,000

6. DEVELOPMENT OF GOSHALAS

(*a*) *Introduction*—There are 166 goshalas in Uttar Pradesh which are maintained out of public donatiors. Most of these institutions have suitable housing accommodation for cattle, sufficient funds to meet their feeding expenses and land for grazing and cultivation of crops. Their total cattle strength is about 14,000 of which 60 per cent. consist of old, decrepit and useless cattle, 10 per cent. are pure-bred productive stock and 30 per cent. are non-decrepit productive stock which is fit for upgrading with suitable pure-bred bulls. They daily produce about 50 maunds of milk for supply to the public. Given necessary technical guidance, some financial assistance, encouragement and patronage from the Government, they can be made to play a very significant role in the country's drive for the improvement of its cattle wealth both in respect to increased milk yield and greater capacity for draught work. With this end in view the Government have launched in 1947 a scheme for the improvement of goshalas with financial assistance from the Central Government, for the appointment of a Goshala Development Officer and free supply of pedigree bulls to these institutions.

(*b*) *Re-organization of goshalas*—The Goshala Development Officer has since surveyed the whole province, visited practically all the goshalas, obtained every possible detail about the facilities available, existing livestock, production and disposal of milk, etc., and made a direct contact with their managements. He advised and helped them to keep their useless and unproductive stock separate from the productive stock both at the goshala and at pasture and stop their multiplication by castrating all the males. For the productive stock pure-bred bulls have been supplied to a large number of these institutions. Arrangements have been made for free veterinary aid for their animals and the various goshala managements have been assisted by the Department in obtaining help from other government departments in respect to the transport of cattle feeds and fodder, acquisition of land, irrigation facilities, seeds, building material, etc. The Goshala Development Officer has been greatly instrumental in knitting the goshalas into District, Regional and Provincial Federation. Each of the ten regions will have a Concentration Camp for old and useless cattle and a

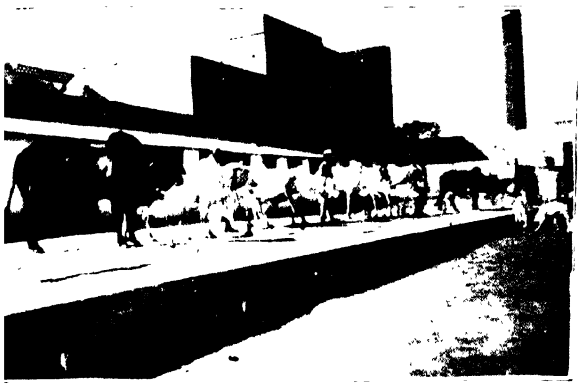


FIG. 1 *Cattle Breeding Section of the Hapur Goshala showing some of their best cows and the bull*

FIG. 2 *Dairy Section of the Hapur Goshala showing their highest milk yielding cow, milk recorder and the milk delivery van*

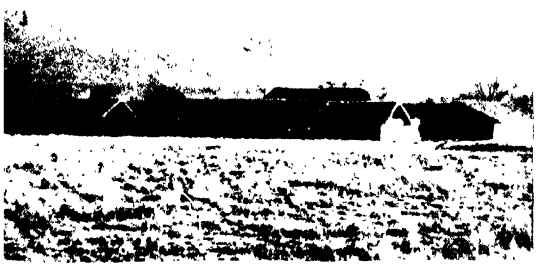


FIG. 3 *Concentration camp for old, invalid and useless cattle at Pashulok near Rishikesh under the charge of Shrimati Mira Behn*

FIG. 4 *Cattle inside he concentration camp with gosewaks*

FIG. 5 *Dry cows salvage centre (inside) at Pashulok near Rishikesh under the charge of Shrimati Mira Behn*

FIG. 6 *Animals at the dry cows salvage centre*

salvage centre for dry cows from the towns. Government have given a lead by establishing a Concentration Camp and Dry Cows Salvage Centre at Pashulok (Rishikesh) under the kind supervision of Shrimati Mira Behn Ji and the various Goshala Federations are following suit [Plate XIX, figs. 3—6].

(*c*) *A five-years' plan for goshala development*—(Including establishment of Concentration Camps, Dry Cow-Salvage Centres, and supply of pure-bred milch stock, etc., *vide* table given below).—For a systematic development of goshalas consistent with the availability of stock, funds, and other facilities a five years plan has been prepared. As shown in the following table it is envisaged under the plan that the Goshala Federations should be helped with non-recurring financial assistance to establish two Concentration Camps every year preferably in the forest areas where plenty of natural grazing be available, so that at the end of five years such a camp may be established in each of the ten regions. As and when these camps are established and the useless stock from the goshalas transferred there the latter will be supplied with 20 pure-bred cows each on an average at half the price and a pedigree bull free of cost provided they stick to the breed recommended by the Department and keep trained gosewaks, with a view to establish their cattle breeding and dairy centres [Plate XIX, figs. 1 and 2], for supply of milk to the towns where these are located and issue of pure-bred bulls for upgrading the indigenous stock in the surrounding areas. The consequent increase in the production of milk, bulls and bullocks, by these institutions will go a long way in increasing the milk production and improving the cattle wealth and agricultural production in the country.

At the Concentration Camps barren cows might be utilized for draught work and a Charmalaya provided for the proper and more efficient utilization of carcases in the most economical manner taking full advantage of all hides, bones, and other body tissues. For a Concentration Camp to be self-supporting it is necessary that it should be large enough to accommodate about 2,000 cattle at a time. This will approximately give 600 carcases annually for disposal.

Table IV A five years' plan of development

Items	Position to begin with	1st year (1948-49)	2nd year (1949-50)
Establishment of Concentration Camps	..	Pashulok (Rishikesh) and Garhmukteshwar (Meerut) in Meerut Region.	Imalia (Jalaun) for Bundelkhand Region and Bharapachpera (Pilibhit) for Bareilly Region.
Establishment of Dry Cow Salvage Centres.	..	One at Pashulok (Rishikesh) for Dehra Dun and Saharanpur districts, and another at Lucknow.	Ghaziabad for Meerut district and another at Bareilly.
Supply of pure-bred cows to goshala at half price.	..	118 ..	480 ..
Supply of pedigree bulls by the Department to the goshalas in Uttar Pradesh.	40	50 ..	60 ..
Annual production of pure-bred bulls by all the goshalas in Uttar Pradesh.	..	60 male calves 1 year old	60 young bulls 2 years old, 200 male calves 1 year old.
Annual production of bullocks by all the goshalas in Uttar Pradesh.	100	200 male calves 1 year old	200 bullocks at 2 years, 400 male calves 1 year old.
Daily production of milk by all the goshalas in Uttar Pradesh.	50 maunds ..	100 maunds ..	250 maunds.

of goshalas in Uttar Pradesh

3rd year (1950-51)	4th year (1951-52)	5th year (1952-53)
One in Banaras Region and another in Mathura Region.	One in Gorakhpur Region and another in Agra Region.	One in Allahabad Region and another in Faizabad Region.
One for Kanpur and another for Banaras	One for Agra and another for Gorakhpur.	One for Allahabad and another for Faizabad.
440 ..	540 ..	340
60 ..	60 ..	60
200 young bulls 2 years old, 400 male calves 1 year old.	400 young bulls at 2 years, 600 male calves 1 year old.	600 young bulls 2 years old, 750 male calves 1 year old.
400 bullocks at 2 years, 600 male calves 1 year old.	600 bullocks at 2 years, 800 male calves 1 year old.	800 bullocks at 2 years, 1,000 male calves 1 year old.
450 maunds	750 maunds ..	1,000 maunds.

(*d*) *Proper utilization of carcases*—After flaying the hide should be cured and dried on frames by the Java method as described in a subsequent chapter. The intestine in the case of fresh carcases should be removed and cleaned for use in the preparation of gut or for export for sausage making. The carcases should then be boiled in a large pan over an oven. Fat comes to the top and should be removed for sale to the textile mills and leather factories. It is then allowed to cool. The water can be used in the compost or directly as manure. The flesh which after boiling easily separates off from the bones is dried completely on slow heat over an oven and is ground for use as flesh manure or after sterilization as poultry feed. Horns can be used for making buttons, combs, toys, etc. in the horn works; hooves, tendens, etc. can be used for preparing gelatin and bones can be used for preparing bone-meal flour and bone manure.

Another method of disposal is to bury the carcase after flaying 2 or 3 feet deep. After three months the place is dug to remove the bones which should be used for preparing bone-meal flour and bone manure. The decomposed flesh with the surrounding earth should be used as manure.

The manufacture of sterilized bone-meal flour can easily be taken up under Indian village conditions without much expense and requires no such machinery as may have to be imported from abroad. The raw bones are to be boiled or steamed in order to sterilize them and to remove the soft tissues adhering to them. These are then dried in the sun and ground to powder. Sterilized bone-meal flour can be used to overcome the deficiency of minerals in the diet of cattle and other livestock and the surplus bones, if any, should be utilized for manuring the soil in mineral deficient areas. Bone-meal manure can also be prepared by charring sun-dried bones by means of direct fire using dried leaves and grass for the purpose. This makes the bones brittle and they can then be crushed easily with 'Chune-ki-chakki.' Animals obtain the minerals required for building up their bones, chiefly calcium and phosphorus, from their diet grown on the soil. These minerals must go back to the soil and should not be allowed to be exported from any area otherwise the mineral deficiency in the soil will be reflected in the food and fodder grown on it as well as in the human beings and animals fed on such diet.

(*e*) *Training of Gosewaks*—During 1946-47 and 1947-48 the Government provided a subsidy of Rs.7,100 to All-India Cattle Protection Society

at Agra and 18 candidates were trained under the scheme. The Government have now started a similar class at Mathura for the training of Gosewaks under the control of the Animal Husbandry Department.

(*f*) *Goshala Improvement Act*- A Goshala Improvement Bill has been prepared for the consideration of the Government which aims at the proper collection and full utilization of goshala cess or *dharmada* for the benefit of these institutions, their registration, better management, efficient supervision, etc.

7. MIXED FARMING

Mixed farming is the most profitable system of farming under Indian conditions. It consists in dovetailing of crop production and animal husbandry so that the by-products of crops may be fully utilized and converted into valuable animal products and draught power, farmyard manure may become available and the spare time of the cultivator and his family may be fully utilized [Plate XX, fig. 2.] Inclusion of leguminous fodders in the crop rotation scheme not only provides most nutritious fodder for cattle, rendering their rearing and milk production more economical but also enriches the soil fertility. In addition to cattle and buffaloes the mixed farmer may also keep with advantage sheep, goats, pigs, poultry and bees as an additional source of income [Plate XX, fig. 1]. Where water reservoirs, tanks or ponds are available on a farm, fish rearing may also be profitably introduced. Such a system provides a balanced combination of crops and animals raised on the available land to meet our multifarious needs and distributes the income all over the year thereby making the farmer self-contented and independent besides improving his economic position and health. His income from the sale of animals and animal products comes to his rescue when the return from the crops is low due to the inclemency of weather or poor market prices. As previously stated, cultivation of fodder crops, especially leguminous fodder, is the secret of successful cattle husbandry and cheap milk production. In fact all the recognized breeds of Indian cattle are localised only in those parts of India where people grow fodder crops [Plate XX, figs. 3 and 4].

For the success of a mixed farm it is necessary that a good cropping scheme suited to the local conditions and requirements should be followed so as to produce the required quantities of food including fruits and vegetables as well as sufficient fodder for the livestock besides such cash crops as will yield the largest profit to the farm. Model cropping scheme suited for wheat growing and rice growing tracts, which may be varied in consultation with the local agricultural and animal husbandry officers according to the local conditions and requirements and the size of the holding, are

FIG. 1 — *A mixed farmer ploughing his fields. Note his milch cattle, sheep, poultry, fruit trees and fish tank*

FIG. 2 — *Showing the importance of cattle in the rural economy of India. Cattle provide milk and milk products for the farmer's family and bullock power and valuable manure for his land which thereby yields foodgrains for his family and fodder for his cattle*

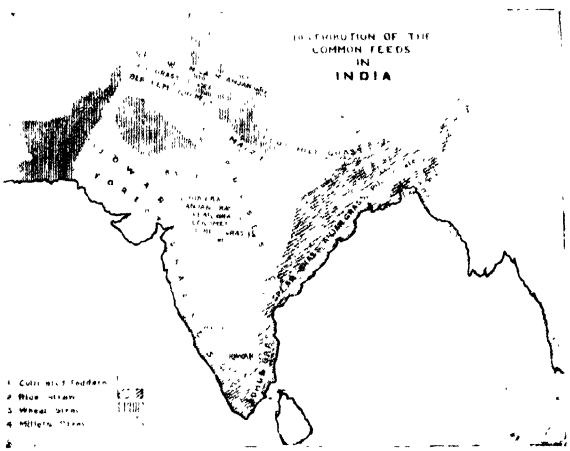


FIG. 3 — *Showing the distribution of common cattle feeds in India. Note the areas where cultivated fodders are grown and compare with the distribution of important breeds of cattle (Fig. 4) on which rural prosperity depends*

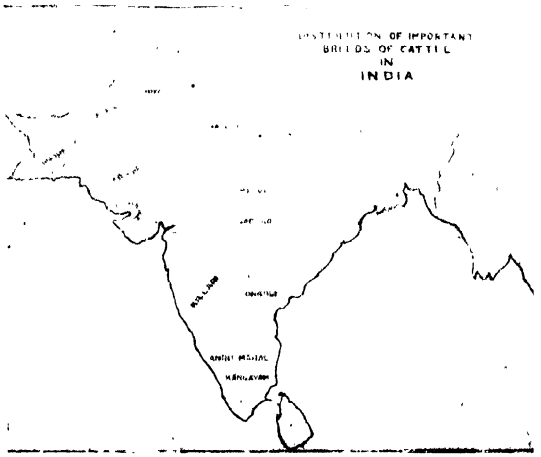


FIG. 4 — *Showing distribution of important breeds of cattle in India which coincides with the area where cultivated fodders are grown. This illustrates the secret of good cattle husbandry*

given in Table V. In order that the farmer may be able to use whole of the farmyard manure for compost making he should also grow fuel and fodder trees (e.g., babul, sheesham, etc.) on the side of roads, along the farm boundary and other convenient places in the farm.

Table V -Rotation of crops on a holding

For rice growing tracts

No. of plot (5 acres)		1st year		2nd year	3rd year	4th year	5th year
			Acres.				
I	Kharif	Sugarcane	= 1				
		Cotton	= 2				
		Maize and Jowar	= 2				
		A		B	C	D	E
	Rabi ..	Gram	= 2				
		Potatoes	= 2				
II	Kharif	Green manuring (Dhaincha) followed by paddy ...	= 5				
		B		C	D	E	A
	Rabi ..	Berseem	= 2				
		Oil-seeds (linseed, til etc.) ..	= 2				
		Winter vegetables, e.g., cawliflower, beans, cabbage, knolkhol, raddish, carrot etc.		— 1			
III	Kharif	Perennial grasses, e.g. Guinea grass, elephant grass, lucerne, etc.	= 1				
		Jute	— 1				
		Paddy	= 2				
		C		D	E	A	B
	Rabi ..	Mung and Biri	= 3				
		Potatoes .. .	= 2				
IV	Kharif	Green manuring (Dhaincha) followed by paddy.	= 5				
		D		E	A	B	C
	Rabi ..	Tobacco	= 1				
		Gram	= 2				
		Chillies	— 1				
		Onions	= 1				
V	Kharif	Fruit garden	= 1				
		Summer vegetables, e.g. bhindi, brinjals, gourd, pumpkins, cukumbers, etc.	= 1				
		Paddy	= 2				
		Jute	= 1				
		E		A	B	C	D
	Rabi ..	Mung and Biri	= 2				
		Oilseeds (mustard, groundnuts, etc.)	= 2				

N. B.—(1) The Kharif and Rabi crops given under A, B., C, D, and E may be rotated every year as given years and 1 acre under fruit garden which is more or less a permanent feature. Sugarcane although sown

(2) Maize and Jowar may be interspaced with cowpea and cotton may be interspaced with guara

(3) Gram, Mung and Biri, Bhusi forms a good cattle feed.

(4) According to the local market and suitability of the soil more of cash crops e.g. tobacco, sugar-

(5) The farmer should obtain seeds of the best variety suited for his locality from the nearest

of 25 acres under the Mixed Farming System.

No. of plot (5 acres)		For wheat growing tracts 1st year		2nd year	3rd year	4th year	5th year
			Acres.				
I	Kharif	Sugarcane	= 1				
		Maize	= 2				
		Cotton	= 2				
		B		C	D	E	A
	Rabi ..	Gram	= 4				
		Winter vegetables	= 1				
II	Kharif	Bajra and Jowar followed by green manuring (Sunhemp).	= 5				
		A		B	C	D	E
	Rabi ..	Wheat	= 5				
III	Kharif	Perennial grasses, e.g. Guinea grass, elephant grass, lucerne, etc.	= 1				
		Chillis	= 2				
		Groundnut	= 1				
		Mung and Urd	= 1				
		C		D	E	A	B
	Rabi ..	Barley	= 2				
		Soyabean	= 1				
		Oilseeds, e.g. Sarsoan, Toria and linseed	= 2				
IV	Kharif	Bajra and Jowar followed by green manuring (Sunhemp).	= 5				
		D		E	A	B	C
	Rabi ..	Wheat	= 5				
V	Kharif	Fruit garden	= 1				
		Summer vegetables ..	= 1				
		Maize	= 1				
		Cotton	= 2				
		E		A	B	C	D
	Rabi ..	Potatoes	= 2				
		Berseem	= 2				

in the above tables with the exception of 1 acre under perennial grasses which should be rotated once after 3
during the Kharif season is a one year crop.
for fodder purposes.

cane, cotton, etc. may be grown in order to get better profit from the farm.
Government Agriultural Farm.

8. FIRST AID

(*a*) *Introduction*—For places where veterinary aid may not be readily available first the following hints on aid may be found useful in cases of emergency till the help of a Veterinary Surgeon is sought. Under first-aid one has to consider restraint, attention to injuries and wounds, snake bite and poisoning, treatment of common ailments, care of the sick animal and finally humane destruction of incurable cases to end their pain and agony, e.g., following serious accidents. It is also desirable that the average cattle-owner should know about the common malpractices adopted by quacks and gowalas, so that he may not be misled by them.

(*b*) *Restraint.*—In all cases where first aid is to be given proper restraint of the animal is the first consideration.

(*i*) *In standing position*—(1) *Examination of the head and face*—If it is necessary to examine the head or face of a horned cow an assistant standing on her left side should first grasp both horns. The operator should then seize the nostrils with his left hand, putting the first and second fingers in the left nostril and thumb in the right. This steadies the head, and leaves the right hand free for other purposes. Unless the cow be very quiet, the horns should always be secured before attempting to take hold of the nostrils. If there be no assistant, the operator, standing on the cow's right side, should first seize the right horn with his left hand before grasping the nostrils with his right [Plate XXI, fig. 2]. "Bull-holders" or "bull-tongs" may be applied to nostrils if the examination is likely to be prolonged or if the animal is troublesome, as this relieves the strain on the fingers. If the beast has no horns and one merely wishes to examine its face or head, he can do so by holding the nostrils only. In every case it is best to speak to a beast and scratch its back while approaching it. To hold a quiet beast for a short time, one should get it into a corner, seize a horn with one hand and the nostrils with the other, pull the head round to the side, plant his feet wide apart, and press his back against the animal's shoulder. If the animal's head is tied to a post and its tail held straight it can be kept under moderate control [Plate XXI, fig. 1].

(2) *Manipulation of the feet and legs*—(*a*) *Fore-legs*—A rope is passed over the withers protected by a sack down to the cannon above the fetlock, where it is tied. While the operator leans against the beast on the same side as the leg being handled, an assistant on the opposite

FIG. 1 *Controlling the animal in standing position by securing the head to a post by means of a rope and firmly holding its tail straight*

FIG. 2 *Controlling the animal in standing position by properly holding the head with one hand on the horn and the other on the lower jaw and giving a twist to the neck*

FIG. 3 *Lifting the hind foot with the help of tail for examination, dressing, etc.*

FIG. 4 *Lifting the front foot by means of a rope for examination, dressing, etc.*

FIG. 5 *Putting the rope properly for casting a bullock. One man on the head giving it a twist and the other on the rope pulling it*

FIG. 6 *When the animal falls, one man immediately controls the head and neck and the other pulls the tail under the upper hind leg. Another person ties both the hind feet with upper fore foot together to control the animal properly for shoeing or any other operation*

side pulls the rope as the beast makes a step to regain its balance. It is generally necessary to keep the animal leaning on the leg on the ground, as balance is not well maintained in cattle and they are apt to fall [Plate XXI, Fig. 4].

(*b*) *Hind-legs.*—A strong smooth pole about 6 feet long is necessary ; a broom or pitchfork handle will often do. It is placed in front of the hock to be lifted, and behind and above the other one. An assistant on each side grasps the pole with both hands and lifts the hock backwards and upwards, at the same time leaning hard against the animal's quarter to help it to keep its balance. The tail of the animal can also be used to lift its hind limb as shown in Plate XXI, Fig. 3.

A cow strap, hock strap or kicking strap may be applied above the hocks or the ordinary milkman's rope may be used in the figure-of-8-manner and tying a slippery knot outside. The tuft of tail may also be secured simultaneously within the knot. This is generally done while milking cows or when examining the udder, etc.

(3) *Bull ring and bull staff.*—To control a bull a ring is usually put to the nose by punching a hole in the nasal septum by means of a special " bull-puncher ". The rings are generally made in two semi-circular pieces hinged together and they may be of copper, aluminium or some alloy which does not rust. The help of the nearest Veterinary Assistant Surgeon may be sought in this connection.

Bulls, especially those over a year old, are often treacherous and should be very securely tied before being approached by a stranger. They are usually rung at about one year old, so that a bull staff may be snapped into the ring. This is a safe method of restraining and leading an otherwise unmanageable bull. The bull staff is a rod of about five feet length with a hook at one end.

(ii) *Free animals in a yard.*—If a beast has to be caught when loose in a cattle yard, it may be secured by a running noose round the horns, or round the neck if there are no horns. This can often be done with a noose held on the end of a pole or by throwing it over the head of an animal from a distance for which a little practice is needed.

When turning a savage bull loose in a field, it is a good plan to fix a length of chain or rope knotted at intervals to the nose-ring long enough to trail on the ground when he lowers his head to charge. He will then tread on the chain, which serves to check him.

To make a cow get up when lying, first try speaking to her and if necessary shove her hind quarter with your foot. If she refuses to rise, tread on her tail or pinch it between two sticks or with handles of long bull-holders. A strange dog brought into the byre will sometimes induce a cow to rise. If a cow has been lying down for a long time and is unable to get up by other means she may be assisted by passing a strong pole under her body in front of the udder and lifting it up on either side by a strong man, another one pulling up the tail. The cow after rising may be supported for a few minutes by hand on the hind quarters and holding the tail, and her body especially the hind quarters and limbs should be massaged with a wisp.

(iii) *Casting.*—A running noose is made at one end of a 30-foot rope and passed round the base of the horns. In the case of polled cattle, the noose should either be fixed and placed round the neck, or the end of the long rope should be attached to the poll-piece of a stout halter. A half-hitch is next made round the neck, a second round the chest immediately behind the elbows, and a third round the abdomen in front of the udder or scrotum. The rope is pulled by two assistants, and the beast will sink to the ground. The feet may then be secured to any fixed object. The first half-hitch, i.e., that round the neck, may be dispensed with if a sufficiently long rope is not available. After the beast is down, an assistant should keep its head on the ground to prevent it breaking a horn. If the head is forced round well into the shoulder of the same side as the ropes cross and all slack tightened before the assistants pull on the rope, the cow will certainly fall on the side opposite to that towards which her head is turned [Plate XXI, Figs. 5 and 6].

(c) *First aid treatment*

Serial no.	Conditions	Treatment
		(1) INJURIES AND WOUNDS
1	*Wounds and bruises.*—The nature and severity of the wound depends upon the cause and the circumstances under which it has been inflicted. It may be caused by horning, barbed wires, collisions, etc., accidentally or maliciously by means of a lathi or a sharp weapon or a fire-arm or by strong acids or alkalies.	Bruises may be cleaned with a piece of clean cotton wool dipped in a weak phenyle lotion, dried and painted with tincture of iodine. A dusting powder consisting of 1, 2, 3, and 4 parts of iodoform, zinc oxide, boric acid and starch respectively may then be dusted over the bruised part. This will also keep the flies off. Treatment of wounds will depend upon their nature and severity. Generally speaking the aid should consist of : (*a*) *Securing the animal* and preventing it from doing itself further injury. (*b*) *Arresting bleeding* by the application of direct pressure by plugging the wound cavity with antiseptic plugs and bandages or tourniquet tied above the wound as in the case of wounds on the limbs, etc., or by cauterising the blood vessels with hot iron. (*c*) *Cleaning the wound.*—Any foreign body should be gently removed, hair round the wound clipped and finally it should be washed with potassium permanganate lotion (1 in 1,000) or weak phenyle lotion. (*d*) *Dressing.*—Then the wound may be dried and dressed with any antiseptic like tincture of iodine, neem oil, etc., covered with a layer of cotton and a protective bandage may be fixed [Plate XXII, Figs. 1—3]. If maggots are found, they should be mechanically removed or the wound may be packed with a swab of strong phenyle lotion or turpentine oil. The following day the dead maggots should be removed and the wound dressed in the usual manner. All wounds should be maintained as clean as possible. Efficient drainage should be provided. Flies must not be allowed to settle on wounds. Only weak antiseptic lotions should be used and not too frequently. Wounds should be interfered with as little as possible. The surrounding parts should also be kept clean, and free from dung, dust, etc. The animal should be prevented from horning or otherwise injuring the wounded part by putting a bamboo craddle round the neck. Prevention of infection is most important. The animal should be kept in clean surroundings and, if the stall is not clean, it may be turned out to pasture. In gun-shot wounds veterinary aid should be obtained to take out the bullet as quickly as possible if the injury is not fatal. Attempts should be made to check the bleeding and cover the wound with an antiseptic pad till attended to by a Veterinary Surgeon. In the case of wounds caused by strong acids the affected part should be bathed with warm soap or soda solution and when caused by strong alkalies it should be bathed with vinegar.

Serial no.	Condition	Treatment
2	*Abscess.*—It may occur on any part of the body due to a localised infection.	Apply tincture of iodine and hot fomentations or linseed poultice to ripen, when it may be lanced with a clean sharp blade or knife previously sterilised by boiling in plain water. Pus should be evacuated thoroughly, inside cleansed and irrigated with a weak phenyle lotion, and dressed with a plug mildly soaked in tincture of iodine and the above-mentioned dusting powder and bandaged. Daily dressing is essential.
3	*Burns and scalds.*—These may be caused on any part of the body by coming in contact with actual fire or hot metals or boiling liquids.	Pain may be relieved by applying a thick paste of flour (dough) or white of an egg. A mixture of equal parts of lime water and linseed oil or milk, treacle, honey, warm vinegar, liquid paraffin or other useful dressings like raw potato paste may be applied. In the case of shock give some stimulant, e.g., 4 oz. of rum, brandy or country liquor, repeated if necessary.
4	*Injuries to horns.*—These may be caused by falls, blows or the animals fighting with each other. As the horn core is very rich in its blood supply the fracture usually bleeds copiously and may endanger the animals' life.	If the horn core (bone) is broken but the horn is not detached and there is no open wound the horn may be held in position and supported by a splint and bandage. Veterinary aid should be obtained to apply plaster of paris bandage properly so that the fracture may unite soon. When the horn has completely broken off and the core is left bare, the bleeding should first be checked by means of a pressure bandage or hot iron applied lightly to the spurting blood vessels and the injured portion dressed antiseptically. If the horn is not likely to stick the core should be painted with tincture of iodine and then apply stockholm tar with a little quantity of copper sulphate powder in it and bandage the same with soft cloth and cotton wool. When both the horn and core are broken off the irregular portion has to be sawed off, tincture of iodine painted and tarcum-copper sulphate dressing applied and repeated daily. Great care and cleanliness are necessary to prevent gangrene (Plate XXII, Fig. 2).
5	*Sore eyes.*—It may result from injury, presence of a foreign body or infection, The affected eye is painful, red and sensitive to light, the eyelids are swollen and there is profuse discharge.	It is essential in the first place to clean away the discharges by bathing the affected eye in warm water to which a little baking soda (soda bicarb.) or clean common salt has been added, and to search for any foreign body. After removal of the irritant body, if such exists, the eye should be washed 3 or 4 times a day with a lotion prepared by dissolving one dram of boric acid in a pint of warm water. The animal should be kept in a cool and shaded place and it may be necessary to provide an eye shade to protect from light. Owing to the complexity of the eye and delicacy of its structures, skilled advice should be sought in good time so that the disease processes are not allowed to progress to a stage which is likely to be followed by serious consequences.

Serial no.	Condition	Treatment
6	*Sore teats.*—This may be caused by the calf nipping the teats or through the nails of the milkers or by leaving the teats wet after milking, dirty floors, etc. The teats become chapped, inflamed and painful.	Check the cause. Wash the teats well with warm water containing a small quantity of common salt (1 teaspoonful in a pint of water). Then dry them with a clean cloth and apply gently boric ointment. The udder must be emptied twice daily to prevent mastitis. If necessary teat-syphon tube may be used carefully after boiling in plain water and lightly smearing it with vaseline.
7	*Sore feet.*—Cattle kept in wet and dirty places are likely to get this trouble. Sometimes foreign bodies like stone, thorn, etc. get into the cleft of the foot and cause the trouble. The affected part gets inflamed and painful and the animal goes lame.	The feet should be carefully examined, all dirt and foreign bodies removed and dead hoof pared properly. The affected feet should then be kpet immersed in warm 1 per cent. copper sulphate solution for half an hour. The affected part should then be dried and tincture of iodine painted and bandage applied. The bandaged foot may be protected by tying it in a small gunny bag. If there is no wound on the foot itmay be put in wheat bran poultice applied with warm copper sulphate solution and fixed in a gunny bag.
8	*Epistaxs.*—(Bleeding from the nose). It may be from one nostril or both.	It can be checked by gently syringing a strong solution of common salt or alum or vinegar in water into the affected nostril, taking care that the head is maintained in such a position that the solution does not flow back into the throat. Cold packs to the region of the face may also assist in checking the bleeding. The animal should be rested in cool and quiet surroundings. Epistaxis may often be caused by leeches. These should be looked for and removed carefully. On injecting a strong solution of common salt or rubbing some dry salt on the part, the leech will move when it may be drawn out with a pair of forceps.
9	*Sprains.*—The muscles, tendons or ligaments of joints more especially of the legs may be sprained as a result of fall or injury. The affected part becomes hot, swollen and painful and the animal goes lame.	In early stages irrigate the affected part with cold water and apply cold water bandages, giving the animal absolute rest. Subsequently ammonia, camphor or belladona or soap liniment may be rubbed two or three times a day till the animal becomes normal.
10	*Abortion.*—It is the expulsion of incompletely grown foetus. It may be caused as a result of a specific infection of the uterus, or due to mechanical injuries, excitement, severe purgatives, acute fever, etc. It results not only in the loss of calf but also a very serious fall in the milk yield as abortions occur in very many cases in the earlier stages of pregnancy. Cows which have aborted may become sterile and sometimes a cow aborts twice or even three times in succession.	Threatened abortion may be averted by keeping the animal undisturbed in a thoroughly quiet and comfortable stable. The abdomen may be very gently rubbed downward and forward for some time. The animal should be given easily digestible food and gruels for a few days. A dose of sedative like one dram of opium may be given. After an abortion has taken place, the hind quarters of the cow should be cleaned and the animal given some stimulant draught, say 2 chattacks of country liquor in ½ seer of water. It should be looked after well for some days. The aborted foetus and the foetal membranes should either be burnt or buried deep with a layer of lime. Veterinary help should be sought to test the animal against the possibility of contagious abortion in which case his advice in regard to segregation, disinfection and vaccination, etc., should be followed. The milk of cows suffering from contagious abortion should be used only after boiling otherwise it will cause undulant fever in human beings.

Serial no.	Condition	Treatment
11	*Retention of placenta or after-birth.*—Sometimes unusual delay occurs in the expulsion of the after-birth. It is generally either due to infection or debility which lowers the tone of the uterus. It may result into septic inflammation of the uterus and blood poisoning or sterility if not attended to properly and early.	Nothing should be done during the first 24 hours or so after calving (or abortion). If the foetal membrances are still retained, skilled help must be sought immediately. In the meantime, the hind quarters should be kept clean and precautions should be taken to see that any part of the membrances which may be hanging outside do not get pulled and injured by getting entangled into any object. In some cases it may be possible to remove the after-birth by gentle traction. If this fails force must not be used to pull them out as this may leave behind some portion which may give rise to serious inflammation of the uterus. Administration of a cleansing draught as given below may be helpful in such cases : Extracts ergot liquidum .. 60 minims. Common salt .. .. 3 chhattacks. Rum or country liquor .. 2 chhattacks. Water .. .. 10 chhattacks. Mixed and give by means of a drenching bamboo.
12	*Frolapse of the vagina and uterus.*—The organs are thrown inside out partially or completely and hang down. It occurs generally in old heavy cows and is due to severe straining to expel the foetus or dirty and rough handling while removing the foetus or after-birth. If it is not attended to early it may take a serious turn and spoil the cow.	Skilled aid should be sought immediately. In the meantime the inverted organs should be kept clean by frequently washing with clean cold water preferably containing a small quantity of some antiseptic like potassium permanganate so as to make a weak lotion. The animal should be kept in clean quiet surroundings and if standing the hind quarters should be raised say by providing extra bedding beneath them. Some opium (1-2 drams) may be given to relieve pain. In case veterinary aid be not easily available the inverted organ after thorough cleansing with pot. permanganate solution should gently be pushed in with lubricated hands while the animal is properly secured. A clean strong glass bottle having two long strings tied to its neck at the centre of strings should be inserted with its bottom inside pressing against the organ. The two ends of the strings on the top should be taken around the base of the tail and the lower ones around the udder and tied on to the strong circular string tide around the body in front of the udder. The hind quarters should be raised and opium dose given till veterinary aid can be sought.
13	*Fractures.*—It is a sudden and violent breakage of a bone generally resulting from a severe force acting from without. It may be simple or compound depending upon whether the skin is intact or broken.	If the fracture is a compound one or is in the region of pelvis, thigh or of shoulder bones the best is to destroy the animal painlessly to cut short its agony, there being no chance for its recovery. When the fracture is lower down the limbs and is a simple one it may be set by a Veterinary Surgeon and the chances of success are more in the case of youngstock as compared to adults. Pending the arrival of a Veterinary Surgeon the broken ends of the bone may be put in a position, supported by a bamboo splint covered in cloth or cotton wool and bandged. After the fracture is set and plaster of paris bandage applied the animal should be given complete rest for 3 or 4 weeks when the Veterinary Surgeon should examine again and remove the bandage.

Serial number	Condition	Treatment
14	*Dislocations*—Sometimes a bone of a leg may be put out of joint due to accident or over-extraction. It is very painful and may have serious consequences if neglected.	As a rule a Veterinary Surgeon should be called in at once. If one is not readily available then cast the animal gently so as to have the dislocated joint uppermost and then pull the leg and set the part. The bone will be heard to return to its socket with a snap. Then keep the animal at rest and irrigate the part with cold water. If there be much pain and swelling, ammonia, belladonna or soap liniment may be applied twice a day.
15	*Retention of urine*—The animal strains and makes frequent attempts to pass urine, but as a rule succeeds only in passing a few drops and shows evidence of pain during the act.	An effort may be cautiously made to expel the urine by gentle hand pressure on the bladder *per rectum*. Hot applications to the loins and the perineum will afford relief in painful cases. A smart purgative should be given and the water supply curtailed. If still not relieved, skilled help should be sought.
16	*Air-raid casualties* During the air-raid animals may be hit by different types of splints at varying velocity resulting in injuries the nature and severity of which would vary considerably. Stray animals and those that are not tied properly may run aimlessly due to fright during an air-raid and may injure themselves and be also source of danger to human life. When poisonous gases are used in such attacks, the nature and severity of injury caused to the animal will depend upon the type of gas used.	The first and foremost precaution to avoid such injuries is to keep the animals in air-raid shelters. If that is not possible, they should be tied securely in as safe a place as possible. In any case they must not be kept loose and similarly all ownerless stray cattles should be rounded up and kept in a goshala or a cattle pound. If an animal is fatally wounded or is incurable, e.g. bad fractures, it is better to end the agony of the animal by painless destruction. The carcases should be removed expeditiously on sanitary grounds and to keep up the morale of the people and buried away from the human habitations. The wounds and bruises should be treated as detailed under item 1 above and animals shifted to the emergency hospital. For such animals that have to be exposed to gas attacks, special gas masks are provided by the Air-Raid Precautions authorities. The treatment of injuries caused by poisonous gas should be left to the Veterinary Surgeon of the Air Raid Precautions Organisation, but the exposed animal should be given absolute rest and given warmth, plenty of fresh air and tempting food. Long convalescence is essential in such cases.

Serial number	Condition	Treatment
	(11) SNAKE-BITE, POISONING, ETC.	
	Snake-bite.—Sometimes animals may be bitten by snakes, which may be poisonous or non-poisonous which may be differentiated by examining the bite holes, if observable. Their teeth are so arranged that a non-venomous snake will generally produce two double rows of numerous punctures, whereas that of a venomous snake will cause two single rows of such small punctures and one relatively larger and deep puncture on each side, external to these single rows. The bite of a cobra exerts its chief and most noticeable action on the nervous system and particularly on the mechanism governing respiratory movements while in cases due to the bite of viper the local action is very well marked.	If the animal is bitten by a highly poisonous snake the symptoms may develop within 5 or 10 minutes and the animal may die quickly and be confused with an acute contagious disease like anthrax (*see* page 122). Differentiation however can be made by looking for the local swelling and discovering the fang punctures and the absence of any contagion. In other cases the symptoms may be delayed by a few hours and even for a day or longer. Where possible, a tight ligature should be applied above the bitten part immediately and kept tight for an hour. Two or more incisions about half an inch deep should be made through or over the fang punctures and the part compressed to squeeze out the venom. Crystals of potassium permanganate should then be rubbed well into the incisions and the fang punctures or the wound may be washed with some bleaching powder dissolved in water. The wound may then be covered with a pad of cotton wool or cloth soaked in strong solution of potassium permanganate or bleaching powder. Keep the patient warm and give some stimulants like alcohol or hot tea. If necessary, expert veterinary aid may be sought to inject anti-venom for combating the effect of snake venom.
2	*Stings by wasps, etc.* Occasionally animals may be stung by wasps and bees. The sting causes some local painful swelling which is very irritating and remains for a day or two. If they are inflicted in large numbers, there is considerable excitement, and later prostration, etc. If the head, mouth, throat and nose are affected it may cause difficulty in breathing.	Treatment consists in the application of weak solution of ammonia or a solution of soda to neutralize the formic acid which composes the sting. The application of a cooling lotion such as lead lotion is useful. Stimulants like rum or country liquor are useful where prostration is noted.
	Heat-stroke and sun-stroke. It is the effect of high temperature and hot sun, often associated with high humidity and fatigue. The attack comes on suddenly. The body temperature goes very high and gait becomes staggering. The patient may fall to the ground and thrown into muscular convulsions. The attack usually terminates fatally, sometimes very rapidly, and in other cases in from 1—3 days. In those cases where recovery occurs great depression remains for several days.	Remove the animal to a cool and shaded place and douche the head and neck with cold water and, if possible, use ice packs for the head. Later given saline purgative. If the animal recovers a course of tonics in consultation with a Veterinary surgeon should be given.

Serial number	Condition	Treatment
	Lightening stroke and electric shock.—Any animal in the open is liable to be struck by lightening. Electric shock may occur in towns as the result of contact with live wires. The effects vary with the intensity of the flash and the strength of the current to which they may have been exposed. An animal may be killed immediately if the shock is severe or rendered unconscious without fatal results. There may be singeing of hair along the track taken by the current, at other times the skin may be actually cut through and be severely lacerated. In some cases there may be a complete absence of any external lesion. In mild cases the animal may only be slightly dozed and recover rapidly.	If the animal is unable to rise, a straw bed should be provided and the victim made as comfortable as possible, turning on to opposite side if necessary from time to time. Stimulants, such as whisky, brandy, hot gruels and water should be given. Vigorous massage should be applied to the sides of the back and other regions. Wounds may be dressed with 2 per cent. carbolic lotion
	Poisoning.—A poison may be ingested by cattle accidentally with their food or be maliciously given to them. Sometimes during drought periods cattle may ingest even poisonous plants at pasture with scanty grazing. Stunted jowar in pre-flowering stage especially when grown on highly rich, nitrogenous soil may contain dangerous amounts of hydrocyanic acid and prove fatal to cattle if ingested in sufficient quantities. The village *chamars* who generally possess the right of taking all the fallen hides sometimes resort to malicious poisoning of cattle with arsenic which is either given in some attractive food, or spread over a nice pasture or introduced under the skin with a sharp instrument.	If possible, change the situation of animals, the pasture and also the food, especially if the latter be new. Offer only soft food, e.g., linseed gruel, bran mash, tender green grass till the animal recovers. Keep the patient quiet and unworried. Make an immediate search for suspicious articles, especially in places easily accessible to animals. Give plenty of clean drinking water to dilute the poison. For irritant and corrosive poisons causing purgation, etc., give demulcent drinks, e.g. rice gruel. Some opium may be given to relieve abdominal pain. For narcotic poisons, give stimulants, such as alcohol, brandy or whisky, ammonia inhalations, etc., and in case of drowsiness keep animals moving, give douches of cold water and apply some turpentine in oil. Oily purgatives may be given to remove the poison from the intestines. Jowar poisoning may be prevented by allowing the crop to reach the flowering stage before it is fed to cattle. To an actual case of jowar poisoning administration of hyposulphate of soda or freshly precipitated ferrous hydrate made from iron sulphate and liquor potasse may be helpful in neutralising hydrocyanic acid, but it is advisable to obtain veterinary aid at once. In cases of poisoning with arsenic an oily purgative and demulcent drinks, e.g., milk, white of egg and lime water may be given. The specific antedote for arsenic may be prepared by mixing tincture of iron percholoride with carbonate of soda and filtering the resulting precipitate through a handkerchief. This should be given *ad lib* in warm water. Very often the poisoning is malicious and the dose given is so large that the animal usually dies. In such cases the matter should be reported to the police and the nearest Government Veterinary Assistant Surgeon who would send the necessary material to the Chemical Examiner for detection of a poison.

Serial number	Condition	Treatment
	(iii) COMMON AILMENTS	
	Stomatitis.—Inflammation of the mucous lining of the mouth resulting in sore-mouth, excessive salivation, in tbility to eat normal food properly and consequent loss of condition.	In such cases nursing with special attention to food is most important. Only soft and laxative foods such as gruels, milk, bran mash, cut grass or green fodder should be given and dry food should be avoided. The mouth may be frequently washed with weak potassium permanganate lotion (1 in 1000) or boric or alum lotion (1 to 2 per cent.). A mixture of borax (burnt) and treacle or honey may be given as electuary. A mild laxative (4 oz. of mag. sulph.) may also be given in drinking water. Possibility of stomatitis due to contagious diseases should always be kept in mind.
	Choking.—Obstruction in the pharynx (throat) or oesophagus (gullet) caused usually by large sized hard food material. The animal coughs and salivates, shows signs of uneasiness and when drinking the water returns by the nostrils. Subsequently tympanites develops and left side of the belly becomes much swollen.	The animal should be turned loose in a stall and not tied up. After properly securing the animal and pulling its tongue well out to a side, a search should be made to locate the object in the mouth cavity. In many cases the obstructing object can be discovered in the throat just at the entrance to the gullet where it may be firmly fixed. It should be removed with lubricated fingers. In some cases the obstruction may be situated lower down causing a hard often painful swelling situated towards the left of the middle line in the neck above the wind pipe. The animal may be offered some oil mixed in the lukewarm drinking water and a little time should be allowed for the object to pass onwards if it will do so of its own accord. The head should be lowered and a drink of water may again be offered. If it still persists it will be wise to seek veterinary help. If tympanites develops as a result of choking the rumen should be punctured (*see* below).
	Tympanites of the rumen.– Distension of rumen with gases which may be felt by taping with fingers on the left flank producing distended drum like sound. There may be some respiratory distress due to distended rumen pressing against the lungs. It is caused by the ingestion of succulent foods in excessive quantities which rapidly ferment.	The rumen should be massaged by pressure exerted through the left flank. It may also be stimulated by throwing a stream of cold water and rubbing turpentine oil. Evacuation of gases from the rumen may be achieved by (*a*) passing a rope round the body and tightening it, (*b*) pulling the tongue forward in the mouth and (*c*) fixing a wooden gag in the mouth between the jaws and maintained in position by a cord passed around the base of horns. To check further fermentation, 1 to 2 oz. of turpentine oil in 1 to 2 pints of linseed oil may be given. This should after a few hours be followed by a saline purgative such as ½ lb. of mag. sulph. and ½ lb. of common salt. Powdered charcoal, old *am-ka-achar*, asafoetida, *kala namak*, mustard, ginger, etc., are some of the things which reduce fermentation. The animal should not be given any food until the acute stage is over and water should be given in restricted quantities only. In severe cases, the rumen may be punctured by a trocar or sharp knife plunged deep through the middle point in the left flank. [Plate XXII, Fig. 8].

Serial number	Condition	Treatment
4	*Impaction of the rumen.*—It is overloading of the rumen with solid, usually dry food accompanied by some loss of contractible power of the rumen. This develops slowly, the animal refuses food, is dull, shows evidence of abdominal discomfort and blowing respiration. On palpation of the abdomen on the left side the distended rumen can be felt and its contents are of a firm doughy consistency.	All food should be withheld for a day or so and the abdomen should be kneaded or massaged to stimulate the muscular activity of the rumen. This may be done with the closed fists pressing firmly on the left flank, and should be maintained for ten or fifteen minutes. It should be repeated several times a day. To stimulate the animal about 4 oz. of country liquor may be given in a little drinking water. Medicinally, the oily purgative (linseed oil with turpentine) may be administered, later followed by the saline purgative (*see* above). A course of tonics, such as ginger 4 drams, nux vomica (*kuchla*) one dram and *chirata* 1 drams given in food will assist the rumen in regaining its tone after the acute stage is over. Water should be given *ad libitum* and to stimulate thirst common salt may be applied in small amounts to the back of the tongue.
5	*Diarrhoea and dysentery.*—There is passage of loose watery stools which in the case of dysentery are mixed with mucous and blood and accompanied by straining. These conditions are due to irritation and inflammation of the intestine caused by bad food, bacterial infection, etc.	These conditions are often encountered in contagious diseases and they may also be due to poisoning. In simple acute cases, it is well to administer first a dose of linseed oil. Later, an astringent mixture (opium ½ to 1 dram, catechu 2 to 4 drams, and prepared chalk 1 oz. in rice gruel) should be given twice a day until diarrhoea ceases. Diet should be soft, demulcent and easily digestible (linseed meal, boiled milk, barley water, gruel, syrup of bel fruit, etc.). Water should be curtailed. Calves should be given castor oil emulsion, up to an ounce. Sucklings should not be allowed to gorge themselves.
6	*Constipation.*—Faeces passed at intervals longer than normal or in small quantities, firm, hard and mucous coated.	Faecal mass in the rectum should be removed by passing the well lubricated hand into the rectum. This may be followed by a hot soap water enema. Either the oily or the saline purgative (*see* above) may be administered. Diet should be of a laxative nature (linseed cake, green grass, etc.) and coarse rough fodders should be avoided.
7	*Bronchitis and pneumonia.*—Inflammation of the wind pipe and its branches extending to the lung tissue. It may result from sudden exposure to wet or cold or to sudden change of temperature resulting in flare up of bacterial activity. Sometimes these conditions are result of specific infections of a contagious nature. The animal appears anxious, coughs, refuses food, shows rise in temperature and signs of respiratory distress and there is mucous discharge from the nose, mouth, etc.	As soon as the signs of the disease are noticed the animal should be removed to a place where there is an unobstructed supply of fresh air and, if possible, sunlight, but well protected from cold draughts. A warm rug should be applied and fastened loosely over the chest. Owing to the possibility of a case being of a contagious nature the affected animal should be isolated. Light and easily digested food is essential. Dry roughage should be stopped for some days. Medicinally an electuary consisting of ½ dram of ext. belladona, 1 dram of camphor and 2 drams of potassium chlorate powdered and mixed up thoroughly in treacle should be administered every 5 or 6 hours, steam inhalations of oil eucalyptus or turpentine may be given twice a day. The application of hot clothes to the chest wall with or without turpentine sprinkled over them or alternatively the application of a stimulating liniment to the chest wall will afford relief. To the convalescent animal a tonic powder consisting of ½ dram of nux vomica (*kuchla*), 2 drams each of gentian, ginger, soda bicarb and ammonium chloride should be given with food twice daily.

Serial number	Condition	Treatment
8	*Milk fever.*—This condition may develop at varying intervals after calving and the severity of attack appears to be in direct proportion to the rapidity of its development after calving. It commonly occurs about the third calving and usually well nourished high yielding dairy cows that have calved easily indoors are affected. Generally there is no fever and the animal lies prostrate with loss of consciousness and head either turned round and resting on the chest wall with her nose pointing towards the flank or stretched out resting along the ground. There is a temporary cessation of defaecation and urination.	No drenching of medicines should be attempted. All the four quarters should be inflated with air after taking due antiseptic precautions. A cycle pump and sterilized teat-syphon may be utilised for this purpose. After inflation, the udder should be massaged. As a rule, the cow will rise to her feet within four hours after inflation, but occasionally some cases may require to be reinflated. The first sign of returning consciousness in such cases is the resumption of spontaneous defaecation and micturition. Little or no milk should be taken from the cow during the 12 hours subsequent to her regaining her feet and she should not be milked dry during the next two or three days. The earlier the treatment is adopted, the more certain is the recovery and the less likely are the complications which follow. Food should be soft, nutritious and easily digestible. If necessary a Veterinary Surgeon may be called in to give injections of calcium gluconate in order to make up the deficiency of calcium in the animal body.
9	*Acute mastitis.*—Inflammation of the udder is a very serious condition which if not attended to properly and efficiently may lead to severe complications and dry up the cow and may even prevent her from coming into milk again. It is generally caused by a bacterial infection but exposure to chill by lying on a cold floor or a bruise or some injury to the udder before or after calving may act as predisposing factors. If there is a great secretion of milk before calving and the milk is not extracted it is likely to coagulate and cause inflammation. The affected udder becomes hot, and swollen and painful. There may be some hard lumps that can be felt in the teats or in some part of the udder.	The animal should be at once segregated preferably with a separate attendant. The healthy cows should be milked first if the same milker is to milk the diseased ones also. Plenty of straw should be provided for bedding. A purgative (sulphate of magnesia, one pound in a pint of water) may be given internally. Any abrasions on the teat should be dressed, say with tincture of iodine or some ointment. The udder should be fomented with hot boric compresses and then cleaned dry. Whenever possible an antiphlogistic poultice should be applied daily until the acute symptoms have subsided, when the udder may be massaged with the oiled hand, and a liniment such as soap or belladonna liniment, should be applied twice daily. In the case of heavy pendent udders, suspensory bandage may be used. During the whole attack the affected quarters should be stripped at least every four hours, and oftener (every hour) if the secretion is profuse. Food should be light and easily digestible. In all cases, the owner of such a case is well advised to seek expert veterinary aid in view of the extreme delicate nature and economic importance of cow's udder involved in this disease. Drenching the cow with one dram of formaline dissolved in two pints of water is beneficial as this drug is excreted through the udder where it exercises its antiseptic properties. Infusion of the udder with 1 in 5000 watery solution of acriflamine followed by stripping is also advantageous.

FIG. 1 —*Bandage on the hock, shank and pastern and a four tailed bandage over the face*

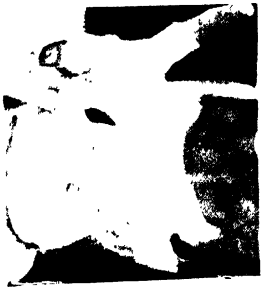


FIG. 2—*Bandage on the broken horn*

FIG. 3—*Four tailed bandage over the udder*

FIG. 4 *Drenching a bullock with a drenching bamboo*

FIG. 5—*Giving subcutaneous injection to a buffalo*

FIG. 6—*Foot-bath*

FIG. 7—*Gargling the mouth of cattle by means of an irrigator*

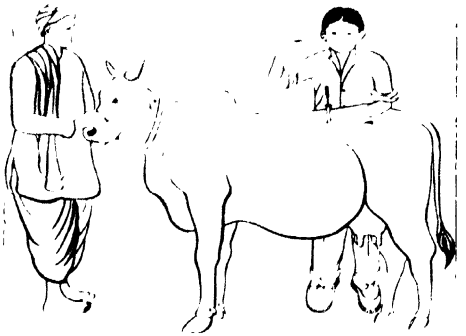


FIG. 8 —*Puncture of bloated rumen at the proper site*

FIG. 9 *Giving enema to cattle*

FIG. 10 —*Giving medicated steam inhalation to cattle*

(*d*) *Administration of Medicine*—(i) *Drenching.*—An assistant stands on the left side of the animal and holds its horns. The operator stands on the right side, puts his left arm across its face and opens its mouth by placing his thumb or fingers in it. The head should be raised only up to the level of the back. If the beast is inclined to resent being drenched, the operator may hold it by the nose with the first two fingers in its left nostril and thumb in its right nostril. He then pours the medicine down its throat a little at a time by means of a drenching horn or a bamboo tube. Care must be taken not to choke the animal. If he coughs or attempts to cough, the head should be released so as to allow him to depress the head and cough freely and thereby prevent the chance of any of the medicine passing into the windpipe. Holding a beast by the nose may tend to interfere with its breathing. An alternative and probably better way to hold the mouth with the left hand is to put the four fingers into the mouth behind the dental pad from the animal's left and use the thumb to steady the bridge of the nose [Plate XXII, Fig. 4].

(ii) *Electuary.*—In those cases where drenching is inadvisible, e.g., respiratory troubles or where local action in the mouth and throat is desired, the medicine may be administered in the form of a paste known as electuary which is prepared by mixing the medicine in a little quantity of treacle or honey. It is smeared on the back teeth or tongue of the patient by means of a thin flat stick or directly with fingers.

(iii) *Mouth-wash.*—In cases of sore mouth where there are lesions on the lips, gums, tongue, etc., mouth wash with a suitable antiseptic lotion, e.g., 1 or 2 per cent. boric or alum lotion is very useful. The lotion is put in an irrigator and the tube inserted into the mouth from one side through the intradental space. The head need not be held high and the tongue allowed to move freely so that the medicine may be diffused freely in the mouth cavity [Plate XXII, Fig. 7].

(iv) *Enema.*—First of all the animal should be properly secured and the hardened faeces removed from its rectum by means of a lubricated hand inserted through the anus by a rotatory movement of the closed fingers formed into a cone. Enema is then given by pouring about 1 to 2 gallons of luke warm soap solution into a funnel which has been fitted to one end of a rubber tube the other end ofwhich is passed into the rectum. When the tube is taken out the animal would in a few minutes expel the fluid out mixed with faecal material [Plate XXII, Fig. 9].

(v) *Foot-bath.*—In individual cases the affected foot may be cleaned and put in a strong bucket containing bearably hot 1 per cent. copper sulphate solution. After about 20 minutes the foot may be dresssed, bandaged and put in a gunny bag and tied. When a large number of animals are affected as in an outbreak of foot-and-mouth disease the animals may be passed through a cemented foot-bath containing 1 per cent. phenyle lotion or copper sulphate solution [Plate XXII, Fig. 6].

(vi) *Steam inhalation.*—In a bucket of steaming hot water sprinkle 20 to 30 drops of either turpentine oil or eucalyptus oil and allow the animal to inhale the vapour by covering the animal's face and the bucket with a piece of gunny bag. It is good for cough and respiratory troubles [Plate XXII, Fig. 10].

(vii) *Fomentation.*—It may be applied by means of a piece of flannel or blanket cloth soaked in about ½ gallon of boiling water containing about 4 chhataks of common salt and squeezed before it is put on to the surface of the body. This treatment should be carried out for at least an half hour at a time using two pieces of flannel or blanket alternately.

(viii) *Poultice*—Linseed poultice can be prepared by mixing powdered linseed with some hot water, placing it over a fire and stirring well until it thickens. It should be placed between the folds of a thick piece of cloth and applied to the affected part. Similarly bran poultice can be prepared by mixing bran with hot water so as to form a soft paste. It should then be placed on a cloth, a little mustard oil should be poured over the upper surface and applied to the inflamed area.

(ix) *Dipping.*—Cattle are dipped in cattle dipping tanks containing arsenical or Derris cattle dips with a view to destroy ecto-parasites, e.g., ticks, mite, lice, etc.

(x) *Inoculations.*—When quick action is desired certain drugs may be injected into the body by means of a record syringe. The medicine may be injected under the skin (subcutaneous), into the muscles (intra-muscular) or in the blood vessels (intravenous), etc. The intravenous injection produces instantaneous effect. These injections should be given only by qualified veterinarians [Plate XXII, Fig. 5].

(*e*) *Care of the sick animal.*—A sick animal should be kept in a clean, well-ventilated and comfortable place with plenty of bedding straw. During cold weather a "*jhool*" or an old blanket may be used to cover its body. Its diet should be soft and laxative, e.g., chaffed green fodder, linseed gruel,

rice gruel, bran mesh, etc. Gruel can be prepared by mixing one pound of well-ground linseed or rice with two parts of hot water and properly boiled for half an hour, and a desert-spoonful of salt added. The amount of concentrate and dry fodder should be drastically curtailed. The eyes, nostrils, etc., should be kept clean with a mild antiseptic like 1 per cent. boric lotion or 1 in 1000 potassium permanganate solution so as to keep off the flies, etc. If the animal is to remain confined to stable for a longer period it should be given occasionally, say once or twice a week, a small quantity, 4 oz. each of epsom salt and common salt in drinking water to keep the bowels moving and to eliminate toxic elements from the body. Enema, mouth gargles, inhalation, fomentation or application of poultices, etc., should be carried out as indicated under First Aid treatment.

(*f*) *Humane destruction.*—If it is desired to destroy an animal that has met with a serious accident the best is to place it against a wall and draw two imaginary lines joining the base of the horns with the inner canthus of the opposite eye, where these lines cross over the forehead a loaded revolver or pistol should be placed in immediate contact with the point of intersection and fired while the head is held tight. This would bring instantaneous and painless end of the animal and his agony. In the absence of a revolver or a pistol a gun may be used. Care should be taken that nobody stands behind the head when the animal is shot.

(*g*) *Certain malpractices by quacks and gowallas.*—It is not uncommon that when cattle become diseased their owners especially in the villages try all sorts of remedies suggested by quacks and at times the latter resort to such malpractices which do a great harm to the animal instead of providing relief. It is therefore necessary to acquaint the public with these malpractices and warn against them:

(1) Normally on the upper surface of tongue in cattle there are small black or brown protuberances known as papillae which the quacks mistake for ticks. When a diseased cattle refuse to take the normal food they wrongly attribute this to the presence of " ticks " which they remove with the help of a razor or a thin knife resulting in considerable bleeding and serious injury to the tongue, further complicating the existing illness. If one examines the tongue of a few healthy cattle it would become clear to him that these papillae are normal structures which should not be removed,

(2) Sometimes quacks also cut off thorny structures normally present in the numerous membrane of the tongue and inside the mouth, causing bleeding and wounds. These structures protect the mouth against injury from dry and coarse food and act as a comb thereby enabling the animal to clean and scratch those parts of their body where tongue can reach. On no account should these be allowed to be removed.

(3) Commonly quacks advise the use of pure phenyle (black) for the destruction of maggots present in wounds. Pure phenyle is too strong and injures body tissues thereby delaying the healing of wounds. It should always be diluted with sufficient water to give the solution a milky white appearance in order to prevent injury to the tissue but still retaining its insecticidal properties and effecting economy.

(4) Sometimes village quacks push a long thorny (scaling) leaf such as that of wild grass into the nostrils of the affected cattle and move it to and fro resulting in injury to the nasal mucous membrane which are very tender and sensitive, and bleeding. This practice is an act of cruelty, serving no useful purpose and should be stopped.

(5) In cases of yoke gall some villagers tie a strong piece of string tightly round the base of an ear with a view to reduce the swelling on the neck. This causes injury to the ear which may become necrosed. One should not resort to such a practice but instead foment the swelling on the neck and apply camphorated oil.

(6) Commonly in the villages if the horn of a cattle breaks due to accidental injury or as a result of fighting, people gather dirty hair from the heaps of village refuse and apply them over the broken stump of the horn and tie it with a filthy bandage. This may stop bleeding but badly contaminates the wound the healing of which is consequently delayed. On the other hand it would be much better if carded cotton dipped in some vegetable oil, e.g., linseed oil, cocoanut oil, mustard oil, groundnut oil, etc., is applied over the broken horn and a clean bandage is tightly put on till the animal is taken to the nearest veterinary hospital for treatment.

(7) Sometimes while ploughing, the hind feet of a bullock get injured with the metal point of the plough and the cultivator himself urinates over the wound in the hope that by so doing the wound will heal rapidly. This practice is undesirable and spoils the wound. The best way of dealing with an accidental wound is to apply tincture of iodine and put on a clean bandage till veterinary aid becomes available.

(8) Indiscriminate firing is a common tool in the hands of quacks for all sorts of inflammations and other body ailments. Sometimes it is resorted to with a view to keep off the evil eye. This practice should be stopped and only qualified veterinary surgeons should be allowed to perform firing in chronic cases of lameness, etc.

(9) Some people practice "phooka" on milch cattle in order to get more milk. They blow air by means of a pump into the rectum in order to bring pressure over the udder in the hope of getting more milk. This practice is utterly inhumane, injurious to the animal and uneconomical. It is punishable under the Cruelty Act and every effort should be made to stop it.

(10) As there are no upper incisors in cattle therefore nature has provided lower incisors a bit loose so that the fleshy dental pad in the upper jaw may not be injured. This fact is not generally known to the villagers and the quacks claim the loose condition of the lower incisors as a false proof of success of their act of surgery or medicine performed on cattle.

(11) In certain parts of India buffalo calves, specially the male ones are starved to death or as soon as they are born they are thrown away in a nearby river or stream or in the jungle. This is generally done as a measure of supposed economy. The villagers find it uneconomical to raise these calves. It is definitely very cruel to deal with the new born calves in this manner. This practice should be stopped by means of propaganda as well as by legislation and the surplus male calves may be economically raised for draught purposes or for beef. Male calves out of high milk yielding pedigree buffaloes will fetch a decent price if raised and disposed of as bulls.

(9) CONTROL OF CONTAGIOUS AND PARASITIC DISEASES

(*a*) *Introduction.*—By far the largest mortality amongst cattle is due to contagious diseases and the next in importace are the parasitic diseases which may either cause directly the death of the host or render it uneconomic, weak and emaciated falling easy victim to other diseases. The control of contagious and parasitic diseases of cattle is essentially a work which should be carried out by veterinary surgeons only and in dealing with these diseases, prevention by suitable vaccination and regular administration of parasiticides especially in badly infected areas is always better than waiting to treat the diseased animals when outbreaks occur. The object of including this chapter is to acquaint the breeders and others interested in the welfare of cattle with the predisposing causes of these diseases which should be avoided, their characteristic differentiating features and the general principles for their control so that they may be able to assist the veterinary surgeons called upon to control them amongst their livestock, more efficiently and expeditiously. The actual administration of drugs, sera and vaccines should be carried out by a Veterinary Surgeon or a duly qualified assistant, e.g., stockman, as otherwise harm instead of good may be done and effective forms of treatment and control thus discredited. All details in regard to their etiology, symptomatology, diagnosis, treatment and prophylaxis have therefore been purposely omitted as these are outside the scope of this Bulletin.

(*b*) *Organization.*—For the expeditious and effective control of contagious and parasitic diseases it is of paramount importance to introduce mass prophylactic immunisation of all useful cattle against all the preventible contagious diseases and ensure reasonable protection from endo- and ento-parasites by regular administration of cheap vermicides and use of cattle dips. For this it is necessary to have efficient organization both at the headquarters and in the field. At the headquarters the Biological Products Section is being expanded to meet the provincial demand for sera and vaccines for mass prophylactic immunisation of stock [Plate XXIII, Figs. 4 and 5], the Central and Circle Veterinary Laboratories have been reorganized to be more helpful in the quick and proper diagnosis and control of these diseases [Plate XXIII, Figs. 1 and 2], and arrangements have been

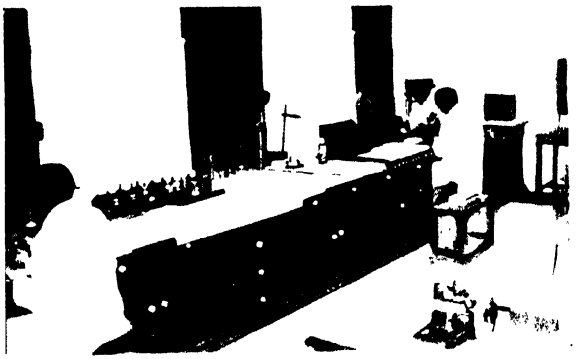


FIG. 1 *Central Veterinary Diagnostic Laboratory at Badshahbagh, Lucknow*

FIG. 2 *Library attached to the Central Veterinary Laboratory*

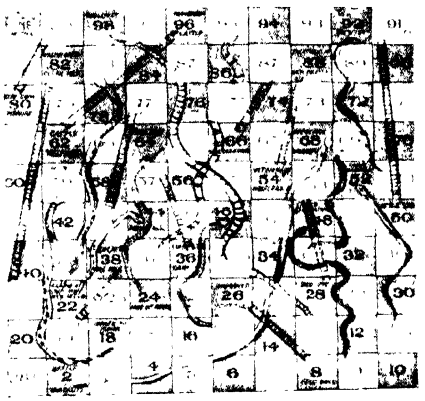


FIG. 3 *Animal Husbandry snakes and ladders.*

FIG. 4 *Manufacture of Goat Tissue Vaccine against Rinderpest at the Veterinary Biological Products Section, Badshahbagh, Lucknow.*

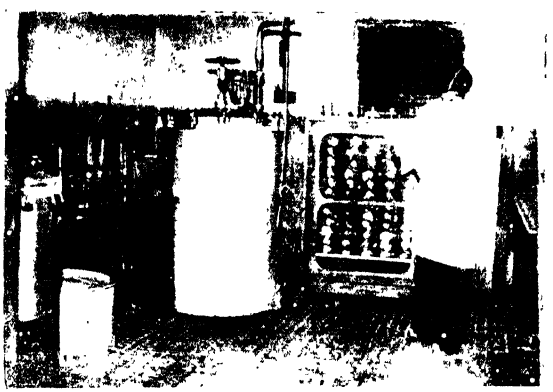


FIG. 5 *Manufacture of Haemorrhagic Septicaemia Vaccine at the Veterinary Biological Products Section, Badshahbagh, Lucknow*

made for augmenting the training of stockman so that more hands may become available. The Uttar Pradesh College of Veterinary Science and Animal Husbandry has also been established at Mathura with a view to overcome the acute shortage of veterinary graduates in the Province. The ultimate aim as recommended by the Uttar Pradesh Animal Husbandry Reorganization Committee is to provide one Veterinary Assistant Surgeon for each pargana and one Stockman for each development block. In the field the Government have sanctioned the provision of cold storage facilities for sera and vaccines, viz., a frigidaire and a serum-pit at each district headquarter hospital so that these products may be readily available to the field workers for expeditious control of contagious diseases. It is proposed to provide in each district one mobile veterinary unit fitted with a field diagnostic unit and necessary sera, vaccines, medicines, etc. for reaching the veterinary aid even to the remotest parts of the district till more veterinary hospitals and stockmen units are established. At present the number of veterinary hospitals is so small that in certain districts one veterinary hospital is shared by two tahsils.

(*c*) *Pre-disposing causes* (Plate XXIII, Fig. 3).—The following defects in the management of cattle lower their vitality and resistance to infection by disease-producing bacteria and parasites and cattle-owners should therefore try their best to avoid them as far as possible :

(1) *Insanitary housing.*—Damp, dirty, badly ventilated and ill-lighted buildings lower the general vitality of the occupants and pre-dispose them to infection. Cattle should therefore be housed hygienically avoiding droughts and providing plenty of sunshine and fresh air. For details chapter on the housing of cattle may be referred to.

(2) *Defective feeding.*—Feeding continuously on insufficient, ill-balanced diet especially in regard to proteins, minerals or vitamins results in deficiency diseases, but when the cattle are fed on such diets for a comparatively shorter period though deficiency diseases may not be apparent yet the vitality and resistance of the body tissues get deteriorated to such an extent that they become an easy prey to infection by bacteria and parasites with more disastrous results. It is therefore necessary to provide cattle with economically balanced rations in sufficient quantities which will not only prevent disease but also increase their efficiency and production. For details chapter on feeding of cattle may be referred to.

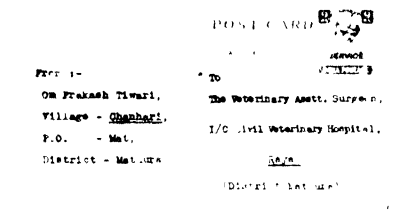
(3) *Defective breeding.*—Just as good qualities are handed over from the parents to the offsprings similarly bodily defects, increased susceptibility to a particular disease or even actual infection may be transmitted to the progeny. It has now been established that by careful selective breeding from animals resistant to a particular disease herds with increased resistance can be built up. In-breeding may result in loss of stamina, vitality and resistance to disease if proper selection of breeding stock is not made. Increased susceptibility to disease is therefore another factor which makes it incumbent on the part of cattle-owners to avoid indiscriminate breeding. For scientific breeding chapter on breeding of cattle may be gone through.

(4) *Close herding.*—Overcrowding and tying animals face to face assist in the rapid spread of contagious and parasitic diseases. For the control of these diseases it is necessary that the animals should be provided with sufficient floor space, they should be tied tail to tail in a byre and when the number is large they should be housed in small batches separately.

(5) *Unwholesome water.*—Just as dirty and unwholesome water is a potent cause of disease in human beings so is the case in animals. Quite a number of contagious and parasitic diseases of cattle are attributed to the supply of dirty stagnant water from filthy ponds. It is therefore desirable that cattle should be watered from a running stream, spring, well, etc., which supply clean and wholesome water.

(*d*) *General measures for the control of contageous and parasitic diseases*—(i) *Contagious diseases.*—There are certain general principles involved in the control of contagious diseases which if applied by the cattle-owners under the guidance of a Veterinary Surgeon in the event of outbreaks will result in the effective and more expeditious control of these diseases with minimum loss. The specific measures dealt with subsequently in regard to the control of various contagious diseases will not bear the desired fruits if the general measures for the control are not taken note of by the cattle owners and applied simultaneously. It will be of great advantage to divide the herd into small groups and rear youngstock which is more susceptible separatedly from the adults. In this connection the following precautions should be observed :

(1) *Isolation* [Plate XXIV, Fig. 2].—When there is a suspicion of any outbreak of a contagious disease or in an actual outbreak the entire herd should be carefully examined and all animals which show any unusual



POST CARD

From :-
Om Prakash Tiwari,
Village - Ghaghari,
P.O. - Mat,
District - Mathura

To
The Veterinary Asstt. Surgeon,
I/C Civil Veterinary Hospital,
Mat.
(District Mathura)

FIG. 1 - *Prompt reporting of outbreaks of contagious disease through printed Service cards*

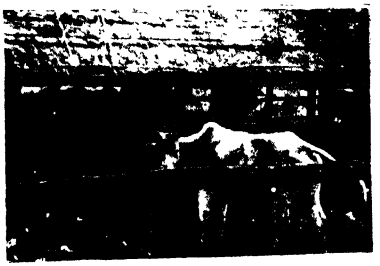


FIG. 2 *Isolation of all infected animals*

FIG. 3 - *Thorough disinfection of the infected premises*

FIG. 4 *Compulsory immunization of stock*

FIG. 5 -*Proper disposal of carcases and other infected materials by fire*

FIG. 6 *Quarantining of all newly imported stocks*

symptoms, e.g., inappetence, dullness, rise of temperature, discharge from the eyes or other natural orifices, e.g., nostrils, mouth, anus, vagina, etc., any abnormal swelling in the throat region or on the dependent parts of the body, etc., should be isolated at once from the herd. It is better to remove those that are apparently healthy to a clean and uninfected place at a distance from the infected place, if possible. The healthy herd should be watched carefully every day till the outbreak subsides and all suspected cases removed to the infected batch, thoroughly disinfecting the premises every time a suspected case is detected. The infected animals should not only be housed separately but they should be looked after by separate attendants, if possible. Otherwise the attendants should attend to healthy animals first and then go to the infected lot after which they should disinfect their hands, feet, etc. in a disinfectant fluid. Sending out the infected animals to common grazing fields or to cattle markets for disposal is the most dangerous practice. It results in the extensive spread of the disease. Proper check on the movement of infected animals and their food, litter and utensils by enforcing segregation is therefore of paramount importance.

(2) *Prompt reporting of outbreaks* [Plate XXIV, Fig. 1].—As soon as an outbreak of a disease is suspected a report on a printed card available with the village headman or on any ordinary postcard should be sent to the Veterinary Assistant Surgeon of the *ilaqa* who would reach the place as early as possible to render the necessary help required for the control of the disease. Failure to report the outbreak of a contagious disease should be an offence under the law as it endangers the livestock of the neighbourers.

(3) *Proper disposal of carcases and infected litter.*—[Plate XXIV, Fig. 5].—To prevent the spread of infection the carcases of infected animals as well as the bedding, etc., used by them which would therefore be also contaminated should be burnt. The carcases may be buried deep with a layer of lime if cremation be not possible. The common practices of throwing carcases of infected animals a little away from the town or near a stream to be eaten away by jackals, vultures, crows and dogs, is highly objectionable and should be forbidden as it may contaminate the water supply and these birds and animals may also spread the disease to other villages.

(4) *Change of pastures.*—As soon as an outbreak of contagious disease is noticed the healthy animals should not be sent to the same pastures where they used to go before or at the time of occurrence of the outbreak. If possible, their pastures should be changed sending them out for grazing in a

different direction. A layer of slaked lime may be applied to the infected pasture or it may be ploughed up and kept unoccupied for a few months.

(5) *Disinfection of premises* [Plate XXIV, Fig. 3].—The inside of the byres and the equipments should be scraped using 3 per cent. hot watery solution of lye (crude soda alkali) and then spread with a 5 per cent. solution of cresol or phenyle. The walls should be whitewashed with the lime wash containing ¼ lb. carbolic acid per gallon. When whitewashing especially *kachcha* buildings see that all the crevices are properly filled in. Thorough cleanliness prior to whitewashing is very essential. Brazier's blow lamp's flame may be used for disinfecting the various fittings. All utensils should be scalded frequently.

(6) *Vaccination* [Plate XXIV, Fig. 4].—Protection of healthy animals which have been in contact with the infected ones and those in the neighbourhood of the infected place and in the surrounding villages should be carried out by a Veterinary Surgeon with the appropriate vaccine or serum. The use of these sera and vaccines does not usually interfere with the normal working or milk yield of the animals.

(7) *Quarantining of animals* [Plate XXIV, Fig. 6].—All newly purchased animals and those coming from cattle fairs and shows should be quarantined in a separate place for about 10 days before admitting them into the herd so that if they are harbouring any infection that will develop during that period and your herd will not be involved. The establishment of quarantine stations on the borders of a province or state on the principal cattle routes is also very helpful in checking the ingress of diseases from the bordering provinces and states. Necessary testing of animals passing through these quarantine stations, against tuberculosis, Bang's disease (contagious abortion or Brucellosis), Johne's disease, etc., and protection with Goat Tissue Virus and other vaccines against the prevailing contagious diseases, if desired, may also be undertaken at these stations. If a small fee is levied on each animal passing through these stations, the cost of their maintenance can easily be met from that income.

(ii) *Parasitic diseases.*—It is better to control these diseases by adopting the following general measures recommended for their prevention rather than waiting to treat the clinical cases when they occur, because by the time they attract attention the parasitic infestation in a herd may have become heavy and reached a serious stage ;

(1) Damp and low-lying places provide an ideal place for the development of worm larvae and the breeding of intermediate hosts or certain worms. Such places should, therefore, be avoided or drained. Ditches which cannot be drained properly may be filled in with earth.

(2) Keep the youngstock which are more susceptible to parasitic infestations away from the older animals which are often carriers of parasites and from the infected grazing areas used by them.

(3) In order to avoid over-stocking, which is liable to increase parasitic infestation, keep calves in small batches, according to age, in separate pens.

(4) Paddocks for calves should be used in rotation. The ground should be ploughed and used for cultivation when not required as a paddock. This procedure will kill the worm eggs and larvae.

(5) Frequent removal and proper disposal of the excreta is necessary. It may be stored in a pit and used as a manure in fields that are under cultivation.

(6) Watering and feeding troughs should be kept clean and be at a higher level than the ground in order to avoid contamination.

(7) Build up the resistance of the herd and that of the new progeny by feeding the cows on nutritious and well-balanced diet, paying special attention to its vitamin and mineral contents.

(8) Obviously affected animals should be isolated from the rest and the premises should be thoroughly cleaned and disinfected. Animals in both lots should be given a suitable treatment with vermicides.

(9) Regular drenching of the stock with vermicides, as recommended later, helps a great deal in keeping the parasitic infestations on a farm under control.

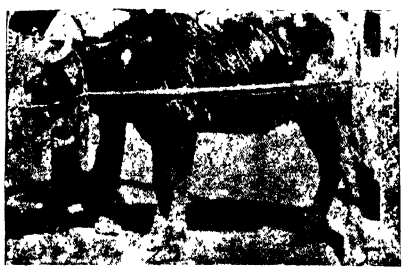
(e) *Hints on the Control of Common*

Serial no.	Name of disease	Characteristic features
1	2	3
		(i) *Virsus diseases*
1	Rinderpest (Pukwa). ..	It is characterised by fever and ulcers on the mucous membranes of the lips, gums, *under* surface of the tongue and the alimentary canal followed by foetid diarrhoea, rapid emaciation and death. It is a highly contagious and fatal disease which is responsible for over 50 per cent. of total cattle mortality in this country.
2	Foot-and-Mouth Disease. (Khur Moonh Pakka).	It is characterised by fever, profuse salivation and appearance of vesicles followed by ulcerations on the mucous membranes of the gums, lips and *upper* surface of the tongue, or on the skin of the feet particularly in the inter-digital space or both. It is the most highly contagious disease of cattle. Although it does not account for many deaths except in youngstock yet the country suffers a huge loss due to great reduction in milk yield and bodily condition and inability to take food and perform agricultural operations on account of the lesions in the mouth and feet respectively.

Contagious Diseases of Cattle

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *Mouth lesions due to rinderpest*	(1) Ant-rinderpest serum inoculations for infected and incontact animals. (2) Goat-tissue virus vaccination for healthy stock as a prophylactic measure. (G. T. virus may be replaced in future by Lapinised virus which is being experimented upon and appears to be safer and more promising). (3) Serum simultaneous method using both the virus and anti-rinderpest serum for pregnant animals or those in milk with a view to avoid any risk of abortion or temporary reduction in milk yield due to reaction to virus.
 *Dribbling of saliva due to Foot and Mouth disease*	(1) Two per cent. alum lotion gargles for lesions in the mouth and 1 per cent. copper sulphate or phenyle lotion foot-bath for lesions in the feet. (2) Application of saliva from a mildly affected case to healthy animals in the village where the outbreak has occurred in order to cut short the course of the outbreak. (3) Use of crystal violet polyvalent vaccine. (It is still in an experimental stage and cannot be applied on a large scale in the field).
 *Mouth lesions*	
 *Foot lesions.*	

Serial no.	Name of disease	Characteristic features
1	2	3
3	Cow-pox (Mata) ..	It is characterised by fever and eruptions over the skin occurring most commonly on the udder and teats which in a typical case pass through a series of five stages, viz : (1) Rasiola (redness) ; (2) Papular (papule formation) ; (3) Vesicular (vesicle formation) ; (4) Pastular (pastule formation) ; (5) Desquamative or crustaceous (crust formation). It is a very highly contagious disease and may become complicated with mastitis with serious consequences if not attended to properly and early.
4	Rabies ..	It is usually caused by the bite of a rabid dog or jackal. The nearer the bite to the head the sooner the disease develops. At first the animal becomes restless, furious, dashes against objects, attacks persons, kicks, salivates and its eyes become red and staring. Later paralytic symptoms develop and the animal dies. Once the symptoms have developed there is no treatment for this disease and the animal must die in 7 to 10 days The saliva of a rabid dog is infective even 2 or 3 days before the symptoms are exhibited by it. It is communicable to human beings so great care should be taken in handling such an animal which should be tied with chains in a safe place.
		(ii) Bacterial Diseases
1	Haemorrhagic Septicaemia.	It is generally an acute contagious disease of cattle and buffaloes caused by a bacterium (*Pasteurilla boviseptica*) and characterised by high fever, hot oedematous swelling in the throat region (cutaneous form) pneumonia with respiratory distress and protrusion of the tongue (pulmonary form) and diarrhoea or dysentery (intestinal form). Any one, two or all the three forms may be present in an animal. Young animals are most susceptible. It is a soil borne infection and most prevalent in low-lying lands subject to periodical inundation and serious outbreaks are generally experienced during the rainy season, but the disease may occur sporadically under any condition.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *Lesions of cow-pox*	(1) The affected animals should be separated from the rest of the herd and should be milked by separate attendants. If that cannot be done the healthy cows should be milked before the affected ones. (2) The udder should be stripped out completely 2 or 3 times daily, making use of a sterilized and lubricated teat syphon if required. (3) The udder should be fomented with warm water containing a few crystals of potassium permanganate. This should be followed by 1 to 10 boric acid in vaseline over the lesions after gently wiping them dry with a clean cloth. (4) If mastitis follows the treatment as indicated previously should be carefully adopted.
 *A Rabid buffalo calf.*	(1) In the case of a valuable animal (as in the case of human beings) which has just been bitten by a rabid dogs treatment with anti-rabic vaccine issued by a Veterinary In titute or Pasture Institute under the advice of a Veterinary Surgeon may save the animal. (2) Simultaneously the bite wound may be cauterised by a strong acid, e.g., nitric acid or carbolic acid preferably by a Veterinary Surgeon in order to destroy the available free virus present there. (3) Although there is no chance of recovery in a case where symptoms of rabies have developed yet it is better not ot destroy such an animal but to keep it under observation in a veterinary hospital for about 10 days. (4) If the animal dies within that period the brain of the rabid animal may be sent to a suitable Veterinary Laboratory for confirmation of diagnosis and no time should be lost in arranging for the protective anti-rabic inoculation of the bitten persons and valuable animals.
 *Symptoms of Haemorrhagic Septicaemia.*	(1) The disease may be prevented by yearly vaccination of the stock with Haemorrhagic Septicaemia vaccine in the badly infected areas prior to the onset of rainy season. (2) In the event of an outbreak the incontact animals should be inoculated with anti-haemorrahagic septicaemia serum and the others in the neighbourhood should be protected by vaccination. (3) Proper disposal of infected carcases and litter by cremation or deep burial with lime is essential for checking soil infection and spread of the disease.

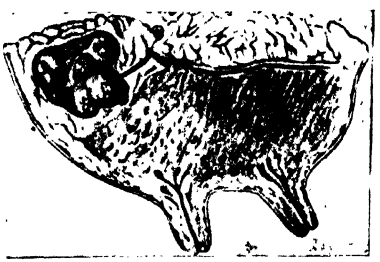
Serial no.	Name of disease	Characteristic features
2	Black-quarter	It is an acute enzootic bacterial infection of bovines caused by a bacterium (*Clostridium chauvei*) and characterised by high fever and rapidly increasing emphysematous swelling containing black extravasated blood and gases with rancid butter like odour, in the region of the hind and fore quarters, thighs, shoulders, neck, trunk and elsewhere except below the knee or hock joints. Young cattle from six months to two years old are most susceptible but the disease may occur even in younger calves and adult cattle. It is a soil borne infection and may be limited to a particular locality.
3	Anthrax ..	It is an acute, contagious and *rapidly* fatal disease of cattle and is caused by a bacterium (*Bacillus anthracis*). It is characterised by high fever, acute swelling of the spleen, tarry condition of the blood and haemorrhagic infilteration of body tissues. Whenever this disease is suspected the carcass should not be opened on any account even for post-mortem examination firstly because this fatal disease is communicable to human beings and secondly because if the blood is shed the micro-organism present in it form into very resistant spores which may maintain infection in the soil for years.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *Symptom of Black-quarter.*	(1) In badly infected areas the disease may be prevented by periodical vaccination of stock especially before the onset of rains. (2) In the event of an outbreak the animals should be inoculated with anti-blackquarter serum. (3) Proper disposal of infected carcases and litter is essential for checking soil infection and spread of the disease.
 *Lesions of Black-quarter.*	
 *An animal died of Anthrax (a quick death).*	(1) In badly infected localities the disease may be prevented by vaccination of stock with Bovine Anthrax Spore Vaccine once a year before the onset of rains. (2) In the event of an outbreak the disease should be controlled by the use of anti-anthrax serum. (3) Proper disposal of the infected carcases and litter is of paramount importance in dealing with this disease.

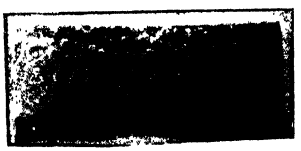
Serial no.	Name of disease	Characteristic features
1	2	3
4	Contagious bovine abortion.	It is a contagious disease of a chronic nature, caused by a bacterium (Brucella abortus Bang) and manifested by the premature expulsion of the foetus or untimely birth of the calf associated in many cases with retained after-birth and sterility resulting from infectious metritis (inflammation of the uterus). In a pregnant cow the seat of predilection is the gravid uterus and in a non-pregnant lactating cow the organisms reside in the udder thereby infecting the milk which if drunk unboiled or unpasteurized may result in undulant fever in human beings. Bulls may get the infection by association with an infected cow and harbour the organisms in its external genital organs especially testicles. Such bulls may transmit the disease to healthy cows at service. Working bullocks when infected show inflammation of leg joints specially hocks and knees in which the organisms are found. The disease assumes a much greater importance on a breeding farm where large number of cows are kept and facilities exist for its spread. Losses to breeders are immense not only through abortions and still-births but also through resultant sterility in the cow, loss of milk and a high mortality rate among young calves that are born alive.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *A cow with the aborted foetus.*	When a case of abortion occurs, the aborted foetus, after-birth and soiled litter, etc., should be burnt, the hind quarters of the cow should be washed with an antiseptic lotion, e.g., 1 in 1000 pot. permanganate and should be kept isolated till it is proved to be a case of non-contagious abortion, which can be done by sending with the help of the local Veterinary Assistant Surgeon either the heart-blood and stomach contents of the aborted foetus for cultural examination or blood serum of the cow preferably obtained 21 days after abortion for agglutination test to the nearest veterinary laboratory. If it turns out to be a case of contagious abortion get the serum tested from the entire herd in the laboratory and segregate the reactors. If the incidence of infection is high the cows may be vaccinated with a bacterial culture of low virulence and the heifer calves may be vaccinated with special calf-hood vaccine. For this purpose expert help from the nearest veterinary laboratory should be obtained. This will stop the abortions and the economic loss therefrom. If incidence of infection is low the positive reactors may be disposed of for slaughter or kept segregated and sent to a concentration camp when rendered sterile.
 *A sterile cow with previous history of contagious abortion.*	
 *A case of undulant fever.*	

Serial no.	Name of disease	Characteristic features
1	2	3
5	Tuberculosis	.. It is a chronic contagious disease affecting various species of animals including cattle, caused by a bacterium (Mycobacterium tuberculosis) which belong to a very resistant group of micro-organisms known as the acid-fast group. It is characterised by nodular lesions which may occur in almost any part of the body and have a tendency to undergo necrosis and caseation sometimes followed by calcification. In cattle the disease is mostly confined to the thorax (lungs and thoracic lymphatic glands) but in advanced cases the infection gets generalised through the blood and may reach any part of the body including the udder. When udder gets infected the tuberculous organisms are excreted in the milk. The disease spreads rapidly on a farm where cattle are housed in large numbers under insanitary conditions and tied face to face on a common manger. It is communicable to human beings either through infected milk or meat. Although thoroughly cooked meat and properly boiled or pasteurized milk is rendered safe yet before these articles are actually put on the fire they might have infected a number of persons engaged in their production, distribution, etc.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *A tuberculous animal.*	When a case of tuberculosis is detected in a herd or the disease is suspected the entire herd should be tested with tuberculin by a Veterinary Surgeon. Positive reactors should be destroyed or kept effectively segregated in a concentration camp till they meet their natural end. The premises should be thoroughly cleaned and disinfected. Errors in management and feeding should be rectified. The herd should be retested after every six months till declared free at two successive tests. The infected carcases and litter should be properly disposed of.
 *Tuberculous lungs with enlarged glands.*	
 *Tuberculosis of the udder.*	 *Tuberculosis in man*

Serial no.	Name of disease	Characteristic features
1	2	3
6	Johne's disease	It is a chronic contagious enteritis (inflammation of the intestine) caused by a bacterium (Mycobacterium paratuberculosis) which belong to the acid-fast group referred to above. It is characterised by loss of condition and general unthriftiness in spite of a good appetite and a plentiful supply of food, shooting bubbly diarrhoea with foetid odour and the thickening and corrugation of the intestinal mucous membrane. It is a disease of farms where a large number of cattle are kept together facilitating its spread.
7	Mastitis	It is a serious contagious disease of cows which spreads rapidly in a herd through milker's hands as well as infected floor, litter, etc., giving infection direct to the udder through abrasion on the teats, etc. It is caused by a variety of organisms but streptococcic mastitis caused by *Strepococous mastatidis* is the most widely prevalent and serious one. It is characterised by swelling of the affected quarter or quarters of the udder, fever and altered condition of the milk which may appear creamy, blood tinged and containing floculi, etc. It is of great importance from economic as well as public health point of view, since it causes reduction in milk yield, even permanent loss of one or more quarters of the udder and the infected milk may cause sore-throat, etc., in human beings if drunk in a raw state. Further seriousness of this condition lies in the fact that before the altered condition of the milk and inflammation of the udder (which is usually of a chronic nature) are detected by a milker the infection might have spread to a good number of other cows.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *A case of Johne's disease.*	The disease may be controlled by subjecting the entire herd to Johnir test and microscopical examination of bowel washings and rectal smears, elimination of reactors as suggested for tuberculous cattle, proper disposal of carcases and infected litter and thorough disinfection of the premises. Infected pastures should be ploughed up and left vacant for several months. Individual cases might improve with proper feeding and care and course of tonics and mineral supplements, etc., but they remain uneconomical and a potent source of infection for others.
 *Characteristic thickening and corrugation of intestinal mucous membrane.*	
 *A case of mastitis (inflammation of udder).*	It is desirable that whenever a case of mastitis is discovered in a herd milk from all the cows, separately from each quarter, should be tested microscopically in a laboratory in order to detect all the infected cases which should be kept isolated and suitably treated by a Veterinary Assistant Surgeon. If a separate milker for the infected animals cannot be had they should be milked after the healthy animals are milked. Intramammary infusion of the affected quarter or quarters with 1 in 10,000 watery solution of Euflavine is a specific cure for streptococcic mastitis especially in early stages. The affected quarters should be frequently stripped and fomented and all discharge and infected litter should be burnt. A purge and internal antiseptics are also given. In purchasing new cows one should make certain that all the fore quarters and teats of each cow are perfectly sound and functioning normally. Cows with deformed udders should not be obtained.

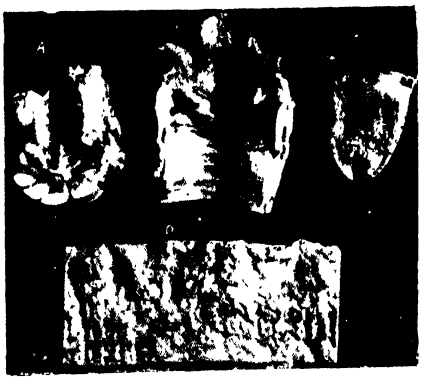
Serial no.	Name of disease	Characteristic features
1	2	3
8	*Diseases of new-born calves*	Bacterial diseases of young calves are mostly congenital, i.e. infection occurs inside the uterus and the symptoms are manifested shortly after birth. In such cases the same organisms which cause trouble in the young can usually be isolated from the uterus of their dams. Wherever genital infection of the cow, e.g. metritis (inflammation of the uterus), abortions and retention of after-birth are common, the congenitial infections of the calves are also found to be common. These infections may also take place after birth from external sources, and the earlier they appear in life the less are the chances of recovery.
(*a*)	Nave-ill[1]	.. In this disease, which is mostly congenital, he navel may be somewhat swollen with a foul-smelling discharge. There is fever, lassitude and weakness and the calf may remain lying down. Infection from the navel may extend to the liver and also to the various joints and these may form suitable sites for the propagation of bacteria. The affected joints become swollen, hot, tense and painful and there is marked lameness.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
	The saying "Prevention is better than cure" holds good in the control of congential bacterial infections for which the following general measures of prevention are recommended, and they may advantageously be combined, in the event of actual outbreaks, with the curative measures.
	1. Attention should be paid to the proper feeding and exercise of the herd and sanitation of the premises, as these factors have a great influence on the disease resistence of the herd and the production of healthy normal progeny.
	The mating of parents with diseased sex organs should be avoided. Cows with an abnormal vaginal discharge or sires with infected genitals or temporarily sterile cows should not be used for breeding.
	Cows should be dried six to eight weeks before they are likely to calve, in order to give them a chance to recover their health and vitality for the next parturition. They should be fed liberally on a well-balanced ration containing adequate proportions of minerals and vitamins. For the supply of the former, 3 to 4 oz. of bone-meal should be mixed daily with the concentrate ration to provide calcium and phosphorus. Small quantities of potassium iodide should also be added to provide iodine and rock salt to lick *ad libitum*. For the supply of vitamins green fodder should be provided throughout the year, if possible, and when green fodder is not available 2—4 oz. of codliver oil may be added daily to the concentrate ration just before feeding.
 *A case of navel-ill.*	Cows should be prepared for calving by clipping hair from the hind quarters and legs and by daily washing and cleaning the external genitals, tail, and hind quarters with an antiseptic lotion (e.g. 1 in 1,000 solution of potassium permanganate) for a few days before calving. When about to calve the cow should be moved to a clean stall which has been thoroughly disinfected previously.

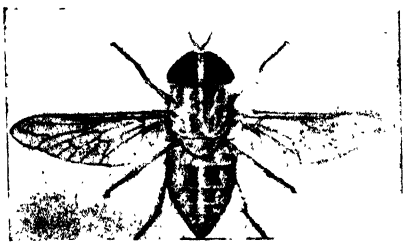
Serial no.	Name of disease	Characteristic features
1	2	3
(b)	White Scour ..	The calf shows a rise of temperature before manifesting scour and there is dullness, depression and disinclination for food. A few hours or a day later the faeces become thin and are of a yellowish or white colour with a foetid odour. The affected calf has a staring coat and cold limbs, is very weak and unable to stand. When young calves get white scour, older calves may subsequently contract the infection from them and an outbreak may result, but the younger calves are affected more seriously and the losses will be much greater among them than in the older calves. When the disease develops within a few hours of birth the calf may die within two days. In some cases there is tendency for white scour gradually to merge into calf pneumonia.
(c)	Calf-pneumonia ..	In this disease, which may accompany, or follow white scour, there is fever, nasal discharge, hacking cough and laboured breathing. The calf may be unable to rise and may develop dropsy of the dependant parts. Usually both the lungs are found to be affected.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *A case of white scour.*	The calf should be received on fresh and unsoiled straw and its umbilical cord should be immediately ligatured with carbolized twine about half an inch from the abdominal wall, cut with a sterilized pair of scissors about half an inch below the ligature and the stump dressed with a tincture of iodine followed in a few minutes by an application of Stockholm tar. Every calf should be allowed the colostrum of its dam for at least a few days. Colostrum is the most natural food for the calf, and is endowed with laxative property. It is also rich in minerals and contains certain substances (antibodies) which act as a preventive against various infections. When calves are weaned at birth they should be fed often, but with small quantities of milk at body heat. If they are fed with a large quantity of milk at one time it forms a big clot in the stomach which causes gastric irritation. If a calf is to be fed on separated milk instead of whole milk, this should not be done until the calf is four weeks' old and the change should be brought about gradually. The cream that has been removed by the separator may be *substituted* by giving 1-2 oz. of cod-liver oil daily.
 *A case of calf pneumonia.*	8. The dam's udder and feeding utensils should be kept clean in order to prevent infection taking place after birth through feeding. It is a good practice to scald the utensils thoroughly after cleaning. Regular exercise out-of-doors is essential for calves in order to keep them fit and to prevent them from catching cold and pneumonia.

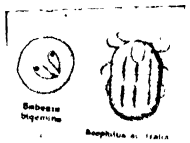
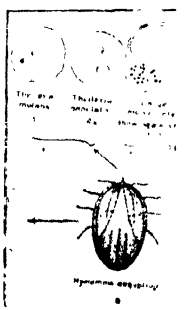
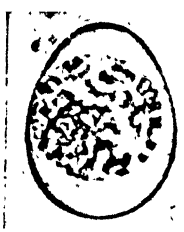
Serial no.	Name of disease	Characteristic features
1	2	3
	Calf-diphtheria ..	This is another contagious bacterial disease of young calves but the infection in this case is acquired after birth. It is characterized in its course by diphtheritic inflammation of the mucous membrane of the mouth, from where it may extend further. Generally the disease is confined to such farms or premises where calves are reared under insanitary conditions. It is quite distinct from human diphtheria and is usually conveyed through unclean milk pails and feeding utensils. The organisms of the disease remain alive for a considerable period in sheds and is therefore easily transmitted to healthy calves. Poorly fed calves are most susceptible and the disease is more common among pail-fed calves during early spring and late autumn months when the weather is changing and is rather cold. Infection is facilitated by the erruption of teeth which causes injuries to the mucous membrane of the mouth. The affected calves show a rise of temperature, unthriftiness, impaired appetite, salivation, coughing, dirty-yellow nasal discharge and red granulating ulcers and yellow patches on the mucous membrane of the lips, gums and inside the mouth. These mouth lesions bleed easily and make it difficult for the affected calf to pick up solid food. The infection may spread to the intestine and lungs. The bowels may become irregular, with a tendency to diarrhoea, and in some cases pneumonia develops and increases the mortality. Severe cases die in three to five days whereas mild cases may recover with suitable treatment in about three to four weeks but the animal's growth remains stunted.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *Diphtheritic ulcerations on the (A) gums and lip (B) larynx, (C) tongue and (D) intestine.*	10. The calf pens should be built hygienically with concrete floors and be kept clean, properly drained and occasionally disinfected and white-washed. If the calves are kept in small groups contagious diseases can be controlled more easily. On infected farms the temperatures of all the new-born calves should be taken for at least 7 to 10 days from birth as in most of the cogenital diseases the first indication is rise of temperature. Moreover, these diseases are more fatal to young calves, and the earlier these are detected the greater are the chances of their recovery with suitable treatment. Usually the normal calf is very active and vigorous and has a soft smooth coat. If it lies quietly or stands in a stupor or if the coat is rough, it may be taken that it is out-of-sorts and the source of the derangements should be ascertained. 13. The affected calves should be isolated immediately from the healthy and be provided with separate attendants. The premises and feeding utensils should be thoroughly disinfected. The healthy calves may be removed to fresh clean premises, preferably at a higher level. 14. The carcase of a calf that has died of any contagious disease should be either burnt or buried with lime six feet below the surface. 15. On the advice of a competent veterinary authority, calves born on farms infected with white scour or navel-ill may be given preventive inoculations against these diseases within a few days of the birth. Pregnant cows, especially those which habitually give birth to calves affected with these disease, may also be similarly treated. For curative measures to be adopted in the event of outbreaks of these diseases of new-born calves obtain the help of the nearest Veterinary Assistant Surgeon.

Serial no.	Name of disease	Characteristic features
1	2	3
		(*iii*) *Protozoan Diseases*
		N.B —Protozoa which means " primitive animal " or the lowest order of animal kingdom are unicellular organisms each consisting of a speck of living substance, the protoplasm, with a single regulating centre called the nucleus).
1	*Surra*	Surra is a Hindi word meaning " rotten" which represents the condition of a chronic case. It is caused by *Trypanosoma evansi* which is a blood flagellate having a way membraneous structure consisting of the undulating membrane and the bordering and a free flagellum to which the snake-like movements of the parasite are due. They are eelshaped and are comparatively larger than the other unicellular micro-organisms. The disease is transmitted through the agency of a biting fly, e.g., Tabanus (horse fly) which is a large sized, stout built fly of mottle brown, fawny or grey colour or Stomoxys (stable fly) which resembles the common house fly and breeds in dung and stable litter impregnated with urine. The eggs of Tabanus on the other hand are usually deposited on the leaves and stems of plants overhanging water or growing in marshy places, the larvae being found in a variety of moist situations and frequently in collections of water. The disease is therefore very liable to be transmitted from animal to animal in marshy lands and their immediate neighbourhood and the rainy season and the following one or two months are commonly known as the " Surra season ". The disease may appear in acute or sub-acute form or as a healthy carrier condition. The *acute form* is characterised by high fever, dullness, sleepy look with semi-closed eyes and leaning for support against the wall. The animal may move aimlessly in a circle and fall down for want of balance. In some instances symptoms of weakness in the loins and abdominal pain may also be noticed. Delirium is almost a constant symptom and this alternates with symptoms resembling coma. During the stage of delirium the animal dashes against the wall, or if the animal were in a recumbent position, it strikes its head against the floor and kicks about with its hind legs. The breathing becomes stertorous. The eyes remain wide open, and look wild. There is profuse salivation. Urination and defaecation are frequent and involuntary. In the semi-comatose condition that follows the animal relaxes fully and remains stretched on the ground. The animal continues to breathe hard. It grinds its teeth, groans and gulps in the air. After a few alternating attacks of delirium and coma, the animal becomes very exhausted and dies. The *sub-acute form* is characterised by a milder course and the duration is stretched over several days or weeks. The symptoms are those of dullness, intermittent fever, gradual loss of condition, progressive anaemia, tenderness over the loins and back, oedema of the eye, diarrhoea, prostration and death. In the *carrier condition*, cattle carry the trypanosomes for a considerable period without manifestation of clinical symptoms. If, however, the animal becomes debilitated or comes under the influence of an intercurrent infection the parasite may flare up and give rise to a clinical condition. This occurs more frequently in bullocks perhaps because they are put to hard work and therefore get run down in condition.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measure described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *A case of surra.*	Cattle may be treated by a Veterinary Assistant Surgeon with 50 c.c. of a 2 per cent. solution of tartar emetic or with 5 c.c. per 100 lb. body-weight of a ten per cent. solution of Bayer 205 (Naganol) given intravenously. In place of Naganol which is a German product, Antrypol (British Drug House product) or Moranyl (a French product) may be used at 5 grams. per 1,000 lb. body-weight, given intravenously. To prevent fly breeding dung and litter from animal habitations should be removed to a properly constructed manure or compost pit at a safe distance and low-lying marshy places should be drained and ditches filled in with earth. Generally speaking the blood sucking flies feed in the cool of the morning and in the evening before dusk and to avoid their attacks in badly infested areas people lit a smoky fire where the animals are tied both in the morning and evening during the surra season.
 *Trypanosoma evoni (the cause of surra) with red blood cells.*	
 *Tabanus fly, a vector of surra.*	

Serial no.	Name of disease	Characteristic features
	2	3
	Red water (Piroplasmosis).	It is a widespread disease in India and is caused by a pear-shaped blood protozoan parasite (Babesia bigeminum) which usually occurs in pairs inside the red blood cells. It is transmitted by ticks (Boophilus australis), hence called tick fever, and is characterised by high fever, general depression, hurried respiration, anaemia, destruction of red blood cells resulting in presence of free haemoglobin in urine (haemoglobinuria) giving it a red colour, hence called red-water, and the enlargement of spleen. Young animals are comparatively resistant to red-water and if they get the infection they usually overcome it and develop considerable tolerance to subsequent infection though they remain carriers. In imported cattle and in such indigenous cattle as may have escaped the infection in their early life the disease may appear in an acute form which is frequently fatal. In the mild form the disease is seldom fatal but the animal harbours the organisms and spreads the infection to others. The latent piroplasms may suddenly flare up and produce alarming complications if the " Carrier " animal's vitality is lowered by acute febrile diseases, e.g. rinderpest or parturition, etc.
3	Theileriasis	It is caused by Theileria parasites which also inhabit the red blood cells but are smaller in size as compared to piroplasms. These parasites show a multiplicity of forms, viz., round, oval and rod as comma-shaped and are transmitted by ticks (Hyalomma aegyptium). The disease is characterised by high fever, enlargement of the superficial lymphatic glands, e.g., prescapular, precrural, etc., flow of saliva, lachrymation, enlargement of liver and spleen and absence of red coloured urine (Haemoglobinuria) inspite of heavy destruction of the red blood cells. The acute cases usually succumb in about a week or ten days.
4	Coccidiosis	It is essentially an enzootic disease caused by a double-contoured oval parasite called Eimeria zurni inhabiting the intestine and setting up its severe inflammation. The disease is more common during the wet season in low-lying and marshy areas. The infection takes place by means of ingestion of contaminated food and water. The disease appears in an acute form in calves, but older animals show more resistance which is liable to be broken down by devitalising diseases, especially those which involve the digestive tract, e.g., rinderpest. The affected animal stands with arched back and head held forward and shows loss of appetite and severe watery diarrhoea accompanied by the passage of blood and mucus, and the rectum may prolapse on account of too much straining. Anaemia and emaciation may be present and there may also be febrile symptoms and the animal may succumb. The older affected animals, though they may not show any symptoms of the disease, contaminate the pastures and byres and thus spread the infection to young susceptible animals.

Specific lesions, etc. (Illustrations)	Specific control measures (In additi on to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necess ary
4	5
 *Piroplasms in a red blood cell and the vector tick (Boophilus australis).*	As the disease is transmitted by means of ticks its control lies in the destruction of ticks by dipping of cattle at regular intervals in infected areas, described later. The affected animals may be treated by a Vetrinary Assistant Surgeon using 100 to 200 c.c. of 1 per cent. solution of Trypan blue intravenously which is considered to be a specific remedy for this. If Trypan blue fails (as certain strains of Babesia may not respond to it) a proprietory preparation Acaprin may be tried. The administration of the drug is comparatively simple and one cubic centimeter per 100 lb. body weight injected subcutaneously has been found to be sufficient to effect a complete cure.
 *Theileria parasites in red blood cells and the vector tick (Hyalomma aegyptium).*	No specific remedy is known. Ticks should be controlled by regular dipping of cattle in infected areas anti-Theileriasis serum and a formalised vaccine have been tried with some degree of success. In the treatment of actual cases drugs like Plasmoquin (30 c.c. of 1 per cent. solution intravenously) or Atabrin may be tried for which the help of the nearest Veterinary Assistant Surgeon should be sought.
 *Coccidium (much enlarged).*	The disease may be controlled by examining all the cattle on a farm and separating the affected animals from the non-affected ones. They should be removed from the pastures where they developed the disease and kept on high grounds or in clean dry sanitary byres until they are satisfactorily treated. Young cattle should be separated both in the byres and at pasture from the adult cattle which may be the carriers of the infection. The byres should be kept clean and the litter should be removed frequently and burnt. The animals should be prevented from drinking stagnant polluted water. Medicinal treatment in some cases may prove useful. One to two table-spoonfuls of the mixture containing two parts of ferrous sulphate, two parts of sulphur, and six parts of common salt may be given in the grain feed. Enema with lukewarm one per cent. solution of alum and tannic acid is also recommended. During the course of the treatment the animal should be kept comfortable and well protected from the weather and be fed on dry nutritious diet.

(*f*) *Hints on the Control of*

Serial no.	Name of disease	Characteristic features
1	2	3
		(*i*) *Diseases caused by internal parasities (worms)*
1	Round worms ..	(*a*) *Parasitic gastro-enteritis.*—This is caused by two species of wire worms (Haemonchus contortus and Mecistocirrus digitatus) in the stomach, large round worms (Ascaris vitulorum), hookworms (Bunostomum) and nodular worms (Oesophagostomum radiatum) infesting the intestines. Any of these worms may be present singly or in combination and young stock is generally more susceptible. Their eggs are passed out in the faeces and hatch under suitable conditions of warmth and moisture, and the young larvae crawl up the grass blades and infest cattle ingesting them. The parasite when present in large numbers cause marked digestive disturbances, loss of appetite and constipation followed by diarrhoea. There is progressive loss of condition and animal becomes dull and anaemic and its coat becomes dry and harsh. In the case of young stock the growth is arrested and they become pot-bellied. In advanced cases swellings develop on dependent parts of the body, the animal may show convulsions and die of extreme emaciation. The condition can be diagnosed by clinical symptoms, detection of worm eggs in the faeces under the microscope and the adult parasite in the infested portion of the digestive canal on post-mortem examination

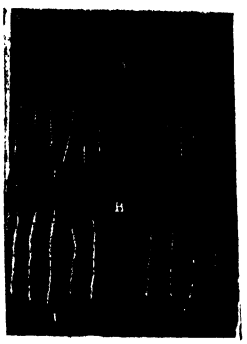
Parasitic Diseases

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5

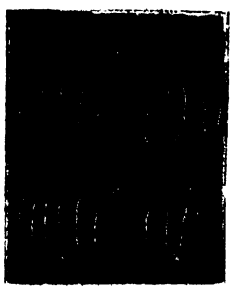
Condition produced by a heavy parasitic infestation of the disgestive tract in a calf.

(*a*) For large round worms oral administration of an ounce of turpentine oil in about a pint of linseed oil is quite effective. For other worms about 12 ounces of 1 per cent. solution of copper sulphate may be drenched. The dose should be reduced to 3 or 4 oz. for calves according to age. After the drench the animals should not be given any feed or water for 2 to 3 hours. Nodular worms cannot however be satisfactorily treated since its larval stages are located in the substance of the intestinal wall giving rise to nodules where no drug can easily be brought into contact with them. Infestations by these worms may be prevented by adopting the general measures for their control, already described.

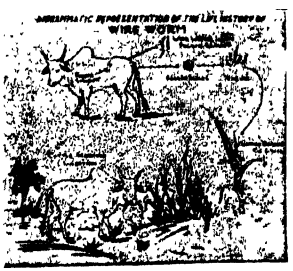
Large raund worm



Wireworms
A. Haemonchus contortus
B. Mecistocirrus digitatus.



A. Hook worms.
B. Nodular worms.



Life histrry of wire worms.

Serial no.	Name of disease	Characteristic features
2		3
		(*b*) *Parasitic bronchopneumonia.*—This is caused by a threadlike round worm, known as Dictyocaulus viviparous, which is of the thickness of twine and is about 1¼ to 5 inches in length. The parasites inhabit the trachae, bronchi and lungs whence the worm eggs are coughed up and swallowed. In the intestine the eggs hatch and young larvae are passed out in the faeces. Under favourable conditions of moisture and temperature these larvae survive and are swallowed by other animals along with the grass and reach the lungs *via.* the blood stream. The common symptoms are nasal discharge, paroxysms of cough with expulsion of mucus which is sometimes mixed with blood and always contains worms and their eggs. The coughed-up mucus may be swallowed and passed out with the faeces, thereby spreading the infection on the pastures and farm premises. The animal gradually loses condition and becomes anaemic and its respiration becomes accelerated. Swellings may appear on the dependent parts of the body. The affected lung shows patches of consolidation with the worms and their eggs in the air passages. The condition can be diagnosed by observing the symptoms and confirmed by a Veterinary Assistant Surgeon by examining the parasite and the eggs, under the microscope, in the coughed-up mucus and nasal discharge.
2	Hump sore ..	It is a skin disease caused by a white thread like round worm (*Stephanofilaria assamensis*) and appears in the form of a sore generally localised in or about the region of the hump. In rare cases the lesions are found situated at the yoke place, flat of the neck, etc. No acute systematic disturbances are generally observed in the affected animal but the condition assumes most distressing features at times, due to continuous attacks of flies which deposit their eggs on the sores resulting in maggots. The lesion generally arises in the form of slight elevation on the skin of the hump during the monsoon season, which cause pruritis (itchiness), the animal rubs the part vehemently against a tree trunk or a wall with the result that they break up and coalesce to involve a bigger area of the skin. The lesion becomes ulcerative by repeated acts of rubbing and appears to consist of an exuberant granulation tissue which gives it a cauliflower-like appearance. During winter the lesion dries up and remains quiescent till the next rainy season when it again assumes activity. The condition may persist throughout the life of an animal. This condition is peculiar to plains cattle, more especially in the humid areas and it generally does not occur on the hills. When affected cattle are taken to the hills the disease disappears without any treatment The mode of its transmission is not yet determined. Diagnosis can be confirmed by a Veterinary Assistant Surgeon by examining the scrappings from the lesion under the microscope for the detection of microfilaria. Adult worms may also be found in the lesions.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *Lung worms.*	(*b*) For the control of this parasitic infestation, the affected animals should be isolated and the infected premises vacated. Low-lying places and ditches should be avoided. The animals should be fed liberally on nourishing diet and provided with clean drinking water and should not be overcrowded. Regular drenching of the whole stock with a suitable vermicide mixture as recommended earlier under parasitic gastritis is likely to prove useful. Those vermicides which are excreted by the lungs and act as polmonary and bronchial disinfectants are especially useful, e.g., turpentine oil (1-3 drachms) or carbolic acid (5-15 minims) or lysol (5-15 minims) given in milk. This method has the additional advantage of destroying stomach parasites which are so often simultaneously present. Generally the treatment of individual cases is difficult on account of the peculiar location of these worms. However, they may be treated by a Veterinary Assistant Surgeon by pouring about ½ to 1 drachm of chloroform into the nostrils or better 3 to 4 drachms of the following iodine mixture may be given slowly by means of an intratracheal injections : Iodine 1 part. Potassium iodide 10 parts. Distilled water 100 parts. The general measures recommended for the prevention of parasitic diseases should also be adopted.
 *Hump sore.*	It has been found that six injections of Antimosan (dose being 10—20 c.c. daily according to the size of the animal) by the subcutaneous routes for six successive days and local application of Tartar-emetic ointment (1 in 25) for a period 10—15 days effect a definite cure. Instead of Antimosans ome workers have given sodium antimony tartrate injections (dose being 1 gr. per 100 lb. body weight in 2 per cent. solution) by the intravenous route at 3-4 days' intervals, along with the local application of Tartar-emetic ointment, and have claimed good results.

Serial no.	Name of disease	Characteristic features
1	2	3
3	Tapeworms	.. These are very long flat, whitish, ribbon-like worms. The worm possesses a glolular head, a narrow neck and a segmented body in which each segment is a sexually complete individual possessing both male and female genital organs. The head is armed with four suckers which enable the worm to attach itself to the intestine of their hosts. Cattle especially the calves, harbour adult tapeworms in their small intestine, viz. the broad tapeworms (*Moniezia expansa*) which is about 3 to 20 feet long and about ½" broad and a narrow tapeworm (*Avitellina centripunctata*) which is about 3 to 15 feet long and about 1/12" to ½" broad. They may also harbour young or larval forms of tapeworms almost in any part of their body, e.g. cystricareus bovis (cause of " measly" beef) and Echinococcus cyst (or Hydatid cyst) which are larval forms of *Taenia saginata* and *Echinococcus granulosus*, the adult inhabiting the intestine of human beings and dogs respectively. The measles are about the size of a pea and are greyish white in colour. The hydatid cyst consists of a large cyst in which are found several daughter cysts each of which contain numerous tapeworm heads. All the cysts and daughter cysts are tensely filled with watery fluid. The cyst vary in size from a pin head to that of a small football according to age. When the parasites are present in small numbers no marked symptoms may be observed but when they are in large numbers the animal appears dull, the visible mucous membranes are pale and digestive disturbances set in. Rumination becomes irregular. At first there is constipation but it is soon followed by diarrhoea and mature segments of the parasites containing the eggs are passed out in the faeces. There are indications of colic and the worst affected animals will follow the herd with difficulty. There is progressive weakness and exhaustion and the affected animals remain stunted in their growth. The larval forms give rise practically to no symptoms and the cases are detected mostly when they are slaughtered. Infestation with intestinal tapeworms may be confirmed by a Veterinary Assistant Surgeon by examining the faeces for worm segments or eggs under the microscope.

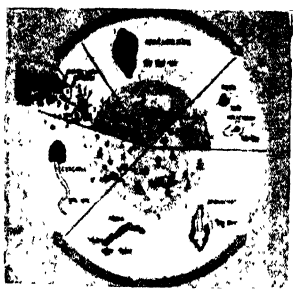
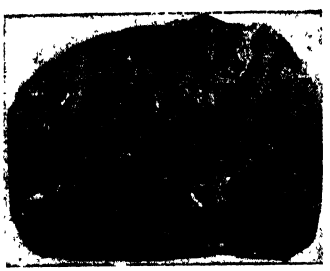
Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5

A. Broad tapeworm.
B. Narrow tapeworm.

A. Hydatid cyst of liver.
B. Heart muscle affected with measles.

For treatment the Veterinary Assistant Surgeon should be consulted. In the case of intestinal tapeworms a drug should be considered to have produced the desired effect only when the heads of the parasites are passed out in the faeces and one should look for these after a vermicide drench has been given. One per cent. solution of copper sulphate, as recommended in parasitic gastritis due to round worms, also proves effective against tapeworms provided one per cent. by weight of tobacco dust is added. The tobacco dust should be steeped overnight in a little cold copper sulphate solution and then added to the rest of the solution. It is not necessary to follow up with a purgative. Another method of treatment is to give the calf two doses of Kamala (1 to 1½ drachms) in about 4 oz. of castor oil the same day. For the prevention of infection with the larval forms care must be taken to prevent contamination of cattle food and drinking water with the excreta of human beings or of the dog. Measly beef is unfit for human consumption and where facilities for beef inspection do not exist the beef must be properly cooked before it is consumed. It is better not to allow dogs on grazing areas nor in slaughter houses.

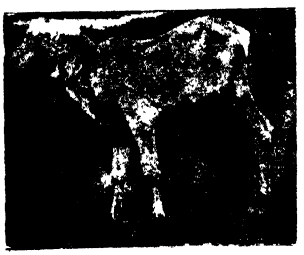
Serial no.	Name of disease	Characteristic features
2		3
4	Liver flukes ..	There are six species of liver fluke found parasitic in cattle and buffaloes in this country, viz. two large flat (leaf-like) flukes (*Fasciola gigantica* and *Fasciola hepatica*), two small flat flukes (*Dicrocoelium dendritieum* and *Eurytrema*) and two conical thick flesky flukes, (*Paramphistomum cervi* and *Paramphistomum explanatum*). The life-cycle of all the liver flukes mentioned is similar and very interesting. The eggs are laid by the adult worm in the bile ducts and passed out in the faeces. The larvae are hatched out from the eggs, on the latter coming in contact with water. If within 24 hours they do not come in contact with a snail of appropriate denomination they die. If they meet the right kind of snails they penetrate their body and multiply. Cercariae, the last larval form, come out of the body of the snail and swim about actively in water, by the movements of their tail. After a while they sink down in water and crawl up on the grass and secrete a protective shell or cyst about them. In this process of encystment, the tail which is no longer a necessity, is cast off. The encysted larvae can remain alive on grass blades for several months. The cattle acquire infection by swallowing such infected grass. When any kind of these flukes are present in sufficiently large numbers the animals become dull, anaemic, emaciated and weak with disinclination to take food, slow and irregular remination, laboured respiration, oedematus swellings of the eyelids and reduction in milk yield. Infected pregnant animals produce inferior calves. Finally diarrhoea sets in and the affected animal succumbs.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
4	5
 *Liver flukes.*  *Snail.*	In very weak and debilitated animals and those in an advanced stage of the disease treatment is not likely to be of much avail and may even precipitate death. In the case of others extract of male fern or its proprietary preparation (Danistol) may be used for valuable cattle and carbon tetrachloride for ordinary cattle. Preventive measures are likely to yield better results and in addition to those already mentioned previously, the animals should be kept away from marshy places which should be drained or fenced off and the snails should be exterminated by mechanical removal and destruction, introduction of domestic ducks and geese in ponds or by the use of a weak solution of blue vitriol (copper sulphate), one lb. of copper sulphate should be added for every 200,000 gallons of water. This should be done at the beginning of the monsoon and should be repeated soon after the rain are over in order to kill all the snails and their young ones. Stronger solutionl should not be used as it will prove fatal to many usefuanimal lives and plants in the water and even to live stock.
 *Showing life-cycle of liver fluke.*	
 *An affected liver showing thickened bile ducts with flukes.*  *Collection and destruction of snails.*	

Serial no.	Name of disease	Characteristic features
2		3
5	Nasal granuloma ..	It is caused by a species of blood flukes (*Schistosoma nasalis*) the adults of which, both male and female are found together in the blood vessels causing very little injury, but their eggs which possess sharp points at one of their ends cause rupture of the blood capillaries, haemorrhage and inflammation giving rise to nasal granuloma or snoring disease. The outgrowths in the nasal chambers interferes with respiration resulting in snoring and reducing the working efficiency of the animal. Aggravation of the symptoms occurs during the rainy season. Cattle of all ages above one year and of all breeds and sexes are found affected with the disease. Buffaloes are rarely affected while bullocks are most susceptible probably due to the presence of wounds on the nasal mucous membranes caused by the nose string. The eggs are voided by the animals through the nasal discharge. The disease may be confirmed by a Veterinary Assistant Surgeon by the detection of eggs in the nasal discharge under the microscope. Larval stages occur in snails from which cercaria emanate and attack the cattle by penetration either through the lining membrane of the nose, or when they are swallowed, through walls of the digestive tract. In any case they enter the blood stream and then reach their destination in the body of the animal.
		(ii) Diseases caused by external parasites
1	Ticks	The common ticks found on our cattle and the extent of damage caused by them to the hide industry have been dealt with later under chapter on 'Improvement of hides.' They also cause harm by sucking the blood of their hosts which becomes anaemic and by inoculating into the host's body a poisoning saliva which creates uneasiness, emaciation and stunted growth. The milk yield as well as the working efficiency of heavily infested animals are considerably reduced. They also transmit blood protozoan disease, e.g. red water (piroplasmosis) and theileriasis.
2	Mange mites	There are three different mites which produce mange in cattle, namely *Sarcoptes scabie* which cause the so-called sarcoptic mange and particularly attacks areas around the eyes, cheeks and neck, *Psoroptes communis* which causes the so-called psoroptic mange and attacks the sides of the neck, shoulders, base of the horns, root of the tail and back, and *Symbiotes* (*Chorioptes*) *bovis* which causes a type of mange noticeable at the base of the tail but which may extend towards the anus and inside the thigh. The lesions produced in all the three types and their treatment are very similar. Sarcoptic mange is the worst type of mange as its parasite burrows under the suface of the skin and remains embedded, especially during winter, and is therefore not easily affected by medicinal dressings. The disease spreads by direct contact or through contaminated yards and houses, grooming utensils, clothing, etc. After infection it may take about a month for noticeable symptoms to develop. It develops more readily in unthrifty animals during the winter months. The parasites are specific for cattle and do not thrive on other species of animals and man. The first noticeable symptoms in mange is constant rubbing and scratching of the skin. The skin is first covered with small pimples and scab, and after the hairs are rubbed off, bare patches appear on the affected parts. Later the skin becomes thickened, wrinked into folds and cracked. There is marked loss of condition and even emaciation. During the warm weather, when pastures are also luxuriant, the condition may temporarily improve and remain undetected. All the three types of mange may be readily diagnosed by the detection of the parasites in scrappings from the lesions, when these are examined on a dark-background with a hand lens or under a low power of microscope.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necessary
 *Nasal Schistosomes.*  *A Case of nasal granuloma.*	About 4 to 6 intraenous injections of sodium antimony tartrate (1 gr. per 100 lb. body-weight in 2 per cent. solution) given at 4 days intervals are very useful as a curative measure. Besides avoiding marshy places and extermination of snails as recommended for the control of liver flukes, the animals should not be allowed to wade through infected water as the infection may be acquired through skin or the mouth. The water from the infected streams should be avoided for drinking purposes but if this cannot be done it should be stored for full two days, after which period it may be used with impunity as during this interval of 48 hours all the carcaria in the water will have perished.
SEE PLATE XXVIII Fig. 8—12	The measures to be adopted for their control have been described later. The type of cattle dipping tank used in the Bombay Province should be copied elsewhere.
 *Sarcoptic mange-mite.*  *A calf affected with sarcroptic mange.*	All the affected animals should be strictly isolated till cured and the infected premises, utensils and clothing should be thoroughly disinfected. The bedding and litter of the infected animals should be burnt. In the treatment of individual cases the hair should be clipped, if the affected area is not too large and the weather is warm. The clipped hair should be completely burnt, wash the surface with soap and warm water, clean it allow it, to dry and then apply the following dressing by means of a suitable brush : Sulphur .. .. .. 2 parts. Oil of tar .. .. .. 1 part. Potassium bicarb .. .. 1 part. Raw linsied oil .. .. 8 parts. (Gradually heat the ingredients together and stir till thoroughly mixed.) This dressing may be applied warm at a temperature that is slightly higher than the body temperature (105°—110°F.) so that its consistency remains thin and it may be applied more easily. The application should be left on for about 10 days and the surface of the body should then be washed and a second application given as before. Ordinarily two applications are sufficient to effect a cure but in obstinate cases another application may be given. When the number of animals to be treated is large they may be dipped and the dip recommended in the case of ticks will also hold good against the mange-mites.

Serial no.	Name of disease	Characteristic features
1	2	3
3	Lice	Three kinds of lice, namely *Haematopinus eurysternus*, the short-nosed cattle louse, *Linognathus vituli*, the long-nosed cattle louse and *Trichodectes scalaris*, the biting louse of cattle are commonly met with on our cattle, particularly the young stock. Neglected and poorly-nourished cattle kept under insanitary conditions are more predisposed to infestation with lice. These parasites are specific for cattle and do not show any tendency to leave the host. Once the parasites and eggs become dislodged from the animal, they die within 7 or 8 days under most favourable conditions. The first two species of lice are shown as the sucking lice because they puncture the skin and suck blood. They are about 2-3 mm. long. The biting louse, which is smaller and more common than the sucking lice, is commonly met with on the withers and around the root of the tail. The sucking lice, being more irritating, usually select such parts of the body where efforts of the animals to dislodge them cannot be successful, e.g. sides of the neck, brisket, back, inner surface of the thighs, on the head, and around the nose, eyes and ears. When the infestation is heavy they may be found on any part of the body. All the three species of lice feed on the tissues of their host and cause a great of irritation, evidenced by rubbing and scratching. In the infested parts scurf and even crusts of dried blood may be found and the hair may look coarse and erect. Heavy infestation results in emaciation and anaemia. On careful examination one can find the parasite and its eggs (nits), the latter attached to the hairs.
4	Ringworm ..	This is a contagious skin disease caused by a parasitic fungs (*Trichophyton tonsurans*) and characterised by the formation of circular patches covered with scales, scabs and short and uneven hair stumps. It occurs most frequently among calves, especially during the winter months, and when they are kept undernourished and overcrowded in insanitary buildings. The vitality of the parasite is very great and it may live in a dormant state for several months in damp stables and may be carried from year to year, resulting in annual outbreaks of the disease. It spreads from one animal to another by direct contact and indirectly by posts and other fittings in the caf pens, against which the infected calves may have rubbed their bodies or which may be contaminated by clothing or grooming utensils used on infected calves.

Specific lesions, etc. (Illustrations)	Specific control measures (In addition to general measures described previously) for which the help of a Veterinary Surgeon is absolutely necesary
4	5
 *Short-nosed cattle louse*	For all the three species of lice the same method of treatment and control proves effective. This consists in isolating the affected animals and applying some parasiticide dressing. The dressing should be applied thoroughly and repeated twice or thrice with 15 or 16 days' interval, as some of the eggs may survive the first dressing and hatch in about 10—14 days, thus giving rise to a new generation of lice. When the number of animals to be treated is small, equal parts of cotton-seed oil and kerosene may be applied with a brush or two parts of kerosene emulsified with one part of milk and added to 8 parts of water may be applied by means of a spray pump all over the body, taking special care of the brisket, inside the thighs, ears, etc. If the weather is not cold the hair may be clipped before applying the dressing and burnt. When the number of animals to be treated is large, dipping is the best method of treatment, the lime and sulphur dip, as recommended for mange, may be used against lice, observing all the necessary precautions mentioned there. Attention should be paid to the proper cleanliness of the animals and the premises.
  *Long-nosed cattle louse* *Biting louse of cattle*	
 *A calf affected with ringworm.*	The affected animals should be segregated and the premises as well as all the fittings should be thoroughly cleaned and disinfected. The best way of treating the lesions is to remove hair from round about them, soften the scabs with warm water and soap and remove all the debris, which should be burnt. Allow the parts to dry and then apply tincture of iodine and vaseline or 1 to 40 ointment of biniodide of mercury. For widespread lesions one part of sulphur, one part of pottasium carbonate, one part of oil of tar with 8 parts of lard or oil is quite good. A case should be considered as cured only when there is no longer a scabby condition of the skin and a good smooth crop of new hair grows.

(*g*) *Animal Contagious Diseases Act.*—The U. P. Animal Contagious Diseases Bill (1948) is before the Provincial Legislature. The Bill when enacted will enable the veterinary staff to control the contagious diseases promptly and effectively. When enforced it will ordinarily operate only in the event of an outbreak of a scheduled disease and will be limited to the infected areas only for the duration of the outbreak. It provides for prompt reporting of outbreak, restriction on the movement of infected animals, proper disposal of carcases and other infected material, thorough disinfection of premises, compulsory vaccination of stock and the establishment of quarantine stations at suitable centres on the provincial boundaries. The following diseases have been included in the schedule :

(1) Rinderpest.
(2) Foot-and-mouth disease.
(3) Haemorrhagic Septicaemia.
(4) Blackquarter.
(5) Anthrax.
(6) Tuberculosis.
(7) Johne's disease.
(8) Rabies.
(9) Surra.
(10) Warble Fly Pest.

FIG. 1 —*Wallowing tank for buffaloes*

FIG. 2— *The best animal in the All-India Cattle Show of 1949*

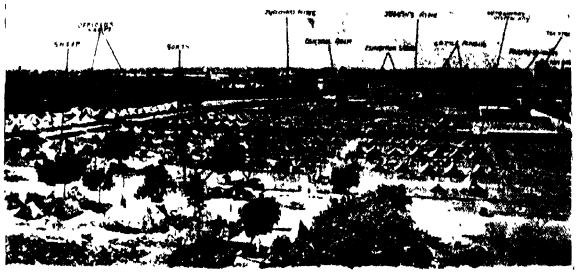


FIG. 3 —*Layout of the All-India Cattle Show at New Delhi*

FIG. 4—*The first prize-winner in the class "Hissar Cows" at the A. I. C. Show (1949) belonging to the Babugarh Cattle Breeding Farm*

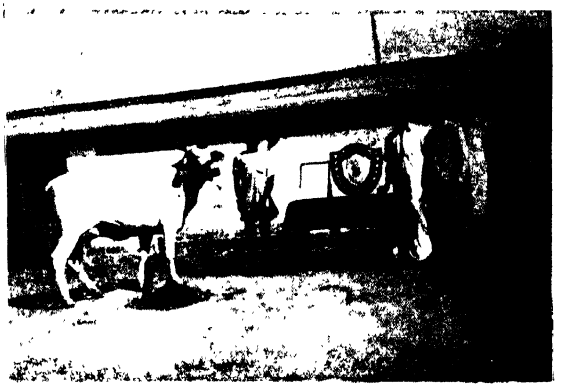


FIG. 5—*The first prize-winner in the class "Goshala Cows" at the A. I. C. Show (1949) belonging to the Hapur Goshala*

10. CARE OF BUFFALOES

What has been stated in the foregoing chapters in regard to cattle applies in the case of buffaloes as well but with the following variations :

(1) For the improvement of local non-descript type of buffaloes and their milk yield they should be graded up with buffalo bulls of the famous Murrah breed which is the best milch breed in India and is well suited to the existing environments and conditions. But, where distinct types exist, e.g. Bhadawari and Tarai buffaloes, their improvement should be effected by selective breeding. The description of these breeds and the policy of breeding to be adopted have been dealt with in detail in Chapter 3.

(2) Buffaloes are more economical producers of milk in India as compared to the cow. Male buffaloes after castration can be used for heavy transport as well as ploughing, avoiding hot part of the day. More than 50 per cent. of milk produced in India is buffalo milk [Plate XXV, Fig. 2].

(3) The percentage composition of buffalo's milk is as follows :

Water	..	..	..	82·22
Fat	..	..	..	7·66
Proteins	..	..	..	4·38
Sugar	..	..	..	4·82
Ash (minerals)		..	..	0·92

(Specific gravity—1,030).

It will appear from the composition given above that buffalo milk is richer in fat as compared to cow's milk, and therefore its utilization for the manufacture of dairy products, e.g., butter, ghee, cheese, khoa, etc., is more economical.

(4) Buffaloes being generally more massive than cattle their roughage may be increased by about 15 to 20 per cent. over that prescribed for cattle and due to the richer quality of their milk the concentrates have also to be fed at a slightly more liberal scale as given in Chapter 4.

(5) Buffaloes like to wallow in water [Plate XXV, Fig. 1]. Where possible such an opportunity should be provided to them so that they may feel comfortable especially during the summer months.

(6) Generally they take about 6 to 8 months longer to mature as compared to cattle. Their period of gestation is also slightly longer, the average being 310 days as against 285 days in the case of cows.

11. CATTLE FAIRS AND SHOWS

(*a*) *Introduction.*—It is a universally recognized fact that shows and exhibitions display a vital part in the development of any industry and the cattle breeding industry is no exception. Indeed the high level of efficiency which livestock production has reached in the various countries of the world and even in certain parts of India would not have been possible but for the knowledge, the inspiration and the encouragement provided by the show-ground and the judging-ring. The prizes generate enthusiasm and the competitive spirit which are so essential for the stimulation of production. Prize winning in a show should not be considered to be the end of an interest in the animal but it should be the beginning of it. Wherever these shows are held in India they have proved to be a means of great education to the breeders and others interested in cattle who not only carry the new ideas about their proper breeding, feeding and management for their own use but also for that of their illiterate brethren whose education and active co-operation is of paramount importance in the achievement of the desired improvement in cattle.

(*b*) *Cattle fairs.*—Cattle fairs are already a regular part of the ordinary livestock business in this country. Large numbers of animals assemble in the fairs from different places and change hands. Various livestock interests also meet there. These fairs in every province form the nucleus of sound development of raising cattle for breeding and can therefore be utilized with great advantage, for holding cattle shows simultaneously as is already being done in several places. If proper records are maintained, cattle fairs could also be utilized for collecting information regarding the different types of cattle brought to the different centres, their breeding tracts, the requirements of purchasers and fluctuation in prices. These fairs might be used for introducing such items as foot-baths, cattle dips and warble fly dressings, etc. for the better control of contagious and parasitic diseases. Cattle fairs and shows also provide ideal facilities for propaganda by Government departments, e.g., Animal Husbandry, Agriculture, Education, Co-operative, Public Health, etc., which are engaged in rural development work.

Besides the numerous one-day village cattle shows the important cattle fairs and shows in the Uttar Pradesh are held at the following places during the period noted against them :

List of Important Cattle and Horse Fairs and

Serial no.	District	Names of fairs and shows	Kind of fair or show
1	Pratapgarh	Babuganj Fair	Cattle and horse ..
2	Ajaigarh State	Ajaigarh Show	Kenkatha cattle ..
3	Bara Banki	Dewa Fair and Exhibition	Cattle and horse ..
4	Agra	Batesar Fair	Ditto ..
5	Meerut	Garhmukteshwar Fair	Cattle ..
6	Shahjahanpur	Kartiki Dhaighat Ganges Fair.. ..	Do. ..
7	Budaun	Kakora Fair	Cattle and horse ..
8	Ballia	Dadri Fair	Ditto ..
9	Bareilly	Chaubari Fair	Cattle ..
10	Budaun	Qasimpur Fair	Do. ..
11	Faizabad	Govind Sahib Fair	Cattle and horse ..
12	Unnao	Takia Mohabat Shah Fair	Ditto ..
13	Do.	Sri Gobardhan Devi	Ditto ..
14	Aligarh	Government Horse Show and District Fair and Exhibition.	Ditto ..
15	Kanpur	Makanpur Fair	Ditto ..
16	Etawah	Chakarnagar Show	Jamunapari goat show
17	Rae Bareli	Annapurna Fair	Cattle ..
18	Do.	Bhawaneshwar Fair	Cattle and horse ..
19	Lakhimpur-Kheri ..	Singhai Show	Kherigarh cattle ..
20	Bulandshahr	District Exhibition and Horse Show ..	Cattle and horse ..
21	Pilibhit	Puranpur Show	Ponwar cattle ..
22	Mirzapur	Ram Sarowar Fair..	Cattle and horse ..
23	Deoria	Kulkula Asthan Fair	Cattle ..
24	Meerut	Nauchandi Show	Cattle and horse ..
25	Gonda	Debi Patan Fair	Ditto ..

Shows held in the Uttar Pradesh during the year 1948-49

Name of places where fairs and shows will be held	Date of fairs and shows	Name of the nearest Railway Station and the distance from the show-ground
Babuganj—Majhilgaon ..	October 3 to 17, 1948	Quite close to Bhadri Railway Station.
Ajaigarh State ..		58 miles from Banda, Great Indian Peninsula Railway.
Dewa	October 20 to 27, 1948	8 miles from Bara Banki Railway Station.
Bateswar	November 7 to 21, 1948	13 miles from Shikohabad Railway Station.
Garhmukteshwar ..	November 9 to 17, 1948	4 miles from Garhmukteshwar Railway Station.
Dhaighat	November 12 to 20 1948	Ditto Manjhan Railway Station.
Kakora	November 9 to 19, 1948	13 miles from Shaikhpur Railway Station, Oudh Tirhut Railway.
Ballia	November 12 to 26, 1948	3 miles from Ballia Railway Station, Oudh Tirhut Railway.
Chaubari	November, 1948	½ mile from Ramganga Ghat Railway Station.
Qasimpur	..	5 Budaun Railway Station.
Ahrauli Govind Sahib ..	December 11 to 18, 1948	14 Malipur Railway Station.
Takia Patan ..	December 21 to 28, 1948	½ Takia Railway Station.
Gauraya Kalan ..	January 1 to 16, 1949	10 Uga Railway Station.
Aligarh	Not yet decided but generally held in February every year.	1 Aligarh Railway Station.
Makanpur	February, 1949, on Basant Panchmi day.	3 Araul Railway Station.
Chakarnagar ..	Date not fixed	80 Etawah Railway Station.
Chandapur	March 1 to 4, 1949	15 Rae Bareli.
Kurri Sidhauli ..	Ditto .. .	4 Nigohan Railway Station.
Singhal	Not yet fixed .. .	8 ,, Bellraen Railway Station, Oudh Tirhut Railway.
Bulandshahr	Not yet decided .	About 2 miles from Bulandshahr Railway Station.
Puranpur	Not yet fixed ..	1 mile from Puranpur Railway Station, Oudh Tirhut Railway.
Dumduma (Ram Sarowar)	March, 1949 ..	½ mile from Chunar Railway Station.
Kulkula Asthan (Daleepnagar).	..	11 Kathkoena Railway Station, Oudh Tirhut Railway.
Meerut	March 27 to April 3, 1949	½ Meerut City Railway Station.
Debi Patan ..	Last week of March and first week of April, 1949.	1 Tulsipur Railway Station, Oudh Tirhut Railway.

(*c*) *All-India Cattle Show*—Our province has also been taking a prominent part in the All-India Cattle Show held annually at New Delhi [Plate XXV, fig. 3] and last year our exhibits won 14 prizes besides 20 prizes won by our poultry exhibits at the All-India Poultry Show held simultaneously at the same place. Our Hissar cow [Plate XXV, fig. 4] from the Babugarh Farm won the 1st prize and so did goshala cow [Plate XXV, fig. 5] from Hapur Goshala in their respective classes.

(*d*) *Provincial, Regional, District and Tehsil Cattle Shows*—This year the All-India Cattle Show is being held for the first time at Lucknow when the first U. P. Provincial Cattle Show is also being held simultaneously. It is necessary that a network of cattle shows should be organized in the province in order that cattle breeders in the rural areas may derive full advantage from them. It is therefore proposed that in each tehsil there should be a cattle show which should preferably be located in the proposed key villages or a suitable development block. These should be followed by a District Show in each district which should preferably be combined with the Sadar Tehsil Show and where prize-winners from the other tehsils may compete for district championship. There should be four regional shows, viz., one each for Meerut Circle (Agra and Meerut Divisions), Bareilly Circle (Bareilly and Kumaon Divisions), Lucknow Circle (Lucknow, Jhansi and Faizabad Divisions), and Allahabad Circle (Allahabad, Banaras and Gorakhpur Divisions) where the prize-winners from the District Shows may compete for breed championships. The district shows for Meerut, Bareilly, Lucknow, and Allahabad should be combined with the respective regional show. The winners of the selected breeds from the regional show may compete at the Uttar Pradesh Provincial Cattle Show at Lucknow, from where selected prize-winners may be sent to the All-India Cattle Show for supreme championship. The Provincial Show should be combined with the Lucknow Regional Show. The All-India Cattle Show is usually held in February. So if the Provincial Show is held sometime in January, Regional Shows in December, District Shows in November, and Tehsil Shows in October, this would enable the prize-winners to compete at the next bigger show conveniently.

(*e*) *Judging* (*score cards*)—The animals should be judged not only on the basis of conformation for which the Indian Council of Agricultural Research

has published the authentic information in regard to the breed characteristics of some of the important breeds of cattle and buffaloes in India (Misc. Bulletin No. 17, 27 and 54) but also on the basis of production and capacity for draught, for which inspection of reliable milk records and milking competition in the case of cows, draught competition in bullocks and in the case of breeding bulls, examination of production records of their dams and where possible of their daughters are necessary. In addition to relying on the experience of judges the use of score cards, a sample of which is given below, is advantageous inasmuch as it introduces uniformity in judging and facilitates the work of such judges as are not very conversant with the breeds and the methods of judging. For every class the panel of judges should include an official expert and an experienced livestock breeder.

Cows		Bulls	
Points	Marks	Points	Marks
1. Heads—		1. Heads—	
Forehead	4	Forehead	5
Face and Muzzle	1	Face and Muzzle	2
Eyes	1	Eyes	1
Ears	4	Ears	4
Horns	3	Horns	3
	13		15
2. Body and Limbs—		2. Body and Limbs—	
(i) Fore-quarters—		(i) Fore-quarters—	
Neck	2	Neck	2
Dewlap	1	Dewlap	1
Chest	3	Chest	4
Legs and Shoulders ..	3	Legs and Shoulders	4
(ii) Barrel—		(ii) Barrel	11
Back	4		
Ribs	4	(iii) Hind-quarters	28
Navel	1		50
(iii) Hind-quarters—			
Loins and Hips	5	3. Skin, Hair and Escutcheon ..	10
Rump and Pinbones ..	6	4. Colour and colour markings ..	5
Flanks	2	5. General Appearance, Size, Bearing, Gait, Temperament, Character and Trueness to type	20
Thighs, Buttocks and Twist ..	4		35
Tail	2		
Hocks, Legs and Hoofs ..	5	Total marks ..	100
	42		
3. Udder, Teats and Milk Veins—			
Udder	6		
Teats	5		
Milk Veins	5		
	16		
4. Skin, Hair and Escutcheon—			
Skin	4		
Hair	2		
Escutcheon	2		
	8		
5. Colour and colour markings ..	4		
6. General Appearance, Size, Bearing, Gait, Temperament, Character and Trueness to type—			
General Appearance	4		
Size	2		
Bearing	3		
Gait	2		
Temperament	2		
Character	2		
Trueness to type	2		
	17		
Total marks ..	100		

NOTE—A cow/bull should be disqualified unless it scores at least half of the marks allotted on each point

FIG. 1 *Flaying equipment* –
(1) *Axe for breaking bones.*
(2) *A sharp-pointed straight knife for making slit in the hide.*
(3) *A 6" blunt-pointed curved knife for flaying.*
(4) *A 10" butcher's steel for sharpening knives*

FIG. 2 *Slit should be made along the dotted line shown in the carcase for maximum advantage*

FIG. 3 *Flaying the hide from either side of the carcase and from the inside of the legs*

FIG. 4 *Opening the abdominal and thoracic cavities and removal of viscera.*

FIG. 5—*Removal of hide from the back after hoisting the carcase*

FIG. 6 *Final stage in flaying*

12. IMPROVEMENT OF HIDES

(*a*) *Introduction*—The hide of a dead or slaughtered animal is a highly perishable article and decay in it occurs within an hour or two after the death of the animal. The hide should therefore be removed from the carcase without delay. It is true that a naturally poor or defective hide cannot be much improved even through expert handling or proper preparation, but through faulty flaying and processing a first class hide can be completely ruined. India produces approximately 257 lakh hides valued at about Rs.6 crores annually of which about 75 per cent. are dead or fallen hides and the rest slaughtered hides. On account of faulty flaying and defective curing the Indian hide industry suffers an annual loss of about Rs.70 lakhs by way of depreciation in value of otherwise good hides. It is therefore necessary that the village "Chamars" and the butchers are trained in the improved methods of flaying and curing of hides and are provided with improved tools [Plate XXVI, fig. 1] so that this heavy annual loss to the nation may be prevented. To achieve this objective the Government of Uttar Pradesh have launched a scheme under which properly qualified staff is appointed to train the village *Chamars* and butchers.

(*b*) *Flaying.*—In some countries pneumatic flaying machines are used by which the hide is separated from the carcase without the use of knives. In Germany mechanical flaying machines with knife-edge protected like a safety razor are used at most of the slaughter houses. In France the use of a wooden knife and a pounding hammer is now not uncommon. In India, as in several other countries, the flayers use knives only for ripping the hides and thereafter the hide is pulled off by the use of fists and elbows. In the Indian slaughter houses after the animal is killed and bled a flayer rips open the hide [Plate XXVI, figs. 2 and 3]. He should be an expert in the operation as it helps to produce a good patterned hide which is valued so much by the tanners and leather manufacturers. The hide is then detached from the belly on either side of the medial cut as well as from the legs and all the fore-legs below knee and hock joints are severed from the carcase. The thoracic and abdominal cavities are then opened along the medial line and the viscera are removed [Plate XXVI, fig. 4].

The carcase is then hoisted by its hind legs and the hide is detached from the butt portion and the back commencing with the tail [Plate XXVI, fig. 5]. Finally the hide is taken off by detaching it from the shoulders and neck [Plate XXVI, fig. 6]. In dealing with calf skins the flayers should use the knife as little as possible and remove the skin by making frequent use of fists and elbows.

(*c*) *Curing*—Various types of curing are adopted and it is estimated that before the last world war about 5 per cent. of Indian hides were prepared as " dry and cured," about 8 per cent. as " dry-salted, " about 38 per cent. as "wet-salted " and the remainder 49 per cent. just "air-dried " in the sun or shade in an unwashed and unframed condition producing very poor material called *suktis* which consist mostly of fallen hides handled by the *Chamars*. It is considered that the Java method of " dry framing " is the most suitable which will give the best results under our local conditions.

The green hides are washed thoroughly in clean water soon after flaying, in order to remove blood and adhering dirt. The washing prevents the impregnation of blood and dirt into the hide substance, which otherwise diminishes the efficacy of curing. In order to drain off the water, the washed hides are hung over for a short time, on a horizontal pole. Thereafter, notches are made all round the hide, at about 1″ from the edge, and at equal distances of about 8″. The distance may be shorter in the case of hides of irregular shape. When the holes are cut, a stick of piece of wood is held under the hide. This prevents the holes from being cut too wide [Plate XXVII, fig. 1].

The third stage is the fleshing of the hide which is done by spreading it over a large strong table with the flesh side up and by removing the superfluous flesh, fat and tissues, with a sharp crescent shaped fleshing knife. The operation is performed with great skill and care, so that a smooth surface is obtained without injuring or removing any of the hide substances [Plate XXVII, fig. 2]. Now the hides are ready for putting on the frames, but before this is done, they are immersed for five to ten minutes in a preservative solution [one part of commercial hide poison containing 50 to 60 per cent. As_2O_3 (arsenic) with about 90 parts of water]. They are hung for some time above the arsenic bath for draining [Plate XXVIII, fig. 3]. When the solution becomes dirty it is replenished with a freshly made one, and the tank is properly cleaned to remove any fleshing, etc., that may be in it.

FIG. 1 *Preliminary removal of extraflesh and fat after washing the blood and dirt, and the cutting of holes at the edges for fixing the hides on the drying frames later*

FIG. 2 *Fleshing of hides on the table to remove all flesh, fat and tissues. Note the crescent-shaped knife used in the work which requires special skill*

FIG. 3 *Dipping the fleshed hides in the arsenicated solution*

FIG. 4 *Fixing and stretching of hides on the rectangular frames by means of a string and "S" shaped hooks*

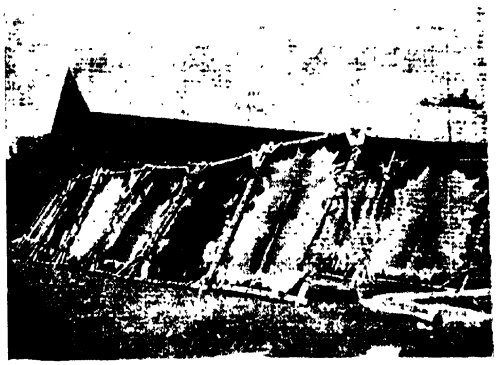


FIG. 5 *The drying of framed hides in the sun in the early stages. Note the inclined position of the frames to avoid direct rays of the sun from striking the hides*

FIG. 6—*The hides are finally dried in shade for which specially designed sheds are constructed*

When the hides are sufficiently drained, they are stretched on large wooden frames by means of "S" shaped hooks (which are made by bending long nails) in the already existing holes or notches and by fastening these hooks with a rope round the frame. The corners of the frames are strengthened by providing supports. After the hides are properly stretched, the superfluous liquid is removed from both sides with a small wooden board, which also gives a fine glossy finish, both to the hair and flesh sides [Plate XXVII, fig. 4].

The hides are next placed for drying. Here also great care is exercised. Direct or bright sunlight is avoided as there is a possibility of the hides being overheated at certain places and becoming gelatinous. In the morning or during the cooler hours of the day the frames are placed flat, but during the day the frames are put in such a way that the sun shines obliquely on the hides [Plate XXVII, fig. 5]. Further drying is effected in covered sheds, which are specially built for the purpose [Plate XXVII, fig. 6]. There is no difference between the treatment of cow and buffalo hides, except that the latter takes a few days longer to finish.

When the hides are thoroughly dry, they are removed from frames and folded in two. The hides meant for export are again immersed for 1 or 2 minutes in bundles of about 5 pieces in a larger bath containing the arsenic solution and are dried in the sun before packing. This completes the poisoning process and safeguards the hides from attacks of vermin, etc.

In Java great stress is laid on washing the hides and freeing them of all dirt, blood, etc. Fleshing is done on smooth tables and not on ground, as is often the case in India. There is a method and system even in cutting the holes in order to get a good pattern, and an evenly stretched and wrinkle-free product. In India the frames are always of bamboos which sag badly and do not serve the purpose well. In Java stout wooden frames are used, which are further reinforced at the corners. The use of hooks between the hide and the rope is unknown in India, although this greatly facilitates the stretching and saves the time and labour of passing a long rope through each hole. The drying is finished off under covered sheds and the product obtained is pliable as compared to the Indian dry-framed hides, which are dried throughout in the open and are so hard that they are often

called " flint " cured. Arsenicating the hides prior to framing and rubbing down the hair and flesh sides with a smooth board are the other noteworthy feaures of the Java cure.

(*d*) *Control of damage caused by biological factors*—The Indian hide industry also suffers a huge economic loss on account of biological factors, e.g. warble flies, ticks, mange-mites, lice, etc., which attack the living animal and damage its skin. This loss has been estimated to be about 2 crores of rupees annually. Of these warble flies and ticks are the most important and for their control expert veterinary help should be sought.

(i) *Warble fly*—The warble fly (Hypoderma lineatum) deposits its eggs usually near the knees, hocks, and on the inside of the legs, the total number of eggs laid by a single fly ranging from 200 to 500 [Plate XXVIII, fig. 1]. The cattle are usually in a state of terror when this fly is about, galloping wildly with tails erect and bellowing—called "gadding"—and are only safe and quiet if they can wade out into a pool or stream [Plate XXVIII, fig. 3]. The fly is specially active in the open during the heat of the day. The eggs are white and elongated and have at one end a brownish substance which fixes them to the hair of the host. They hatch in about 3 to 10 days and the newly hatched larvae penetrate the skin and migrate the subcutaneous tissues, oesophagus, etc., until eventually they reach the back of the animal and there each larvae forms a warble under the skin through which it pierces a hole for breathing outer air [Plate XXVIII, fig. 2]. A period of about 7 months elapses between the disappearance of the newly hatched larvae beneath the skin and the appearance of the warble which it causes in the back of its host [Plate XXVIII, figs. 4 and 5]. When the larva is full-grown, it squeezes itself through the hole, falls to the ground and pupates. A sequel to the escape of the larvae from warble tumours in this manner is that the hide of the animal concerned is riddled down with holes and in consequence becomes wholly or partially valueless for commercial purposes [Plate XXVIII, fig. 6]. *H. lineatum* has only one brood and oviposits during a period of about 3 months (March-May) in the year. The warbles themselves usually appear in " crops " on the back of the host, at intervals of about a month, during a period of 4 months (October-January) in the year. If many warbles are present they cause irritation, malnutrition and emaciation but much worse is the serious loss through damage to hides and loss

PLATE XXVI

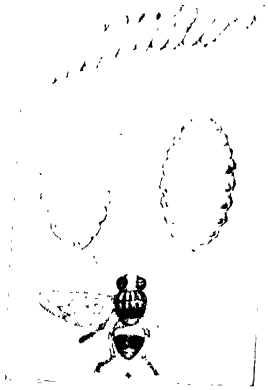


FIG. 1.—*Showing the warble fly, its eggs laid on a hair, and two warbles*

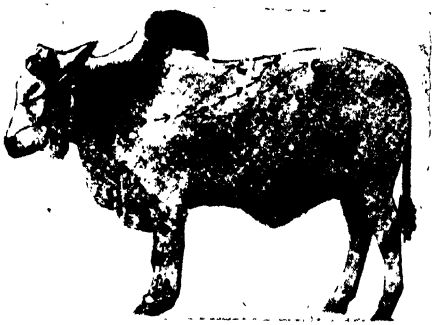


FIG. 2.—*Showing the movement of warble fly larvae inside the body from the legs to the gullet and finally to the back of cattle*

FIG. 3.—*Gadding of cattle due to the warble fly*

FIG. 4.—*A warble fly larva lying under the skin with an opening through which the larva breathes*

FIG. 5.—*Warble nodules containing the larvae on the back of cattle*

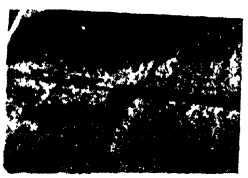


FIG. 6.—*A piece of tanned hide showing warble holes in large numbers*

FIG. 7.—*Warble dressing being applied on cattle's back*

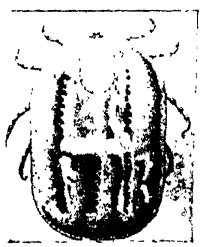


FIG. 8.—*Boophilus australis a continuous feeder tick*

FIG. 9.—*A heavily tick-infested bullock*

FIG. 10.—*Hyalomma aegyptium an interrupted feeder tick*

FIG. 11.—*A piace of tanned leather showing damage by ticks*

FIG. 12.—*A cattle dipping tank*

of milk and flesh during the " gadding " season. The damage caused by this pest can be prevented by controlling the fly by the following methods :

(1) *Singeing*—The eggs laid by the warble flies (*Hypoderma lineatum*) on the legs of cattle from about the middle of March to middle of June can be destroyed by singeing the hair on all the four legs, especially below the hocks and knees regularly at six days' interval. An iron rod about 4 ft. in length, with one end turned into handle and the other end turned into a loop, is used for this purpose. About half a yard of old khaddar is tied and wrapped round the loop and dipped in mustard oil and ignited. It is then extinguished and lightly applied in a smouldering condition to the legs killing all the eggs laid thereon. This is though laborious yet not only reduces the number of warble flies in future but also saves the animal from all the painful infestation of their body with warbles and damage to their skins.

(2) During the warble season when the warbles appear on the back, i.e., from October to January four dressings at monthly intervals, of 10 per cent. aqueous solution of Derris, should be applied with a special brush (with $2\frac{1}{2}''$ square brush space and 9" long handle) obtainable from Brushware & Co., Kanpur, on the back in the direction against the hair so that the Derris particles come in contact with the breathing apparatus (spiracles) of the warbles through the holes in the skin and kill them. Derris powder is available at Rs.5 per lb. from Mousell and Company, Calcutta, which is sufficient for four dressings on forty cattle [Plate XXVIII, fig. 7].

(ii) *Ticks, etc.*—The damage caused by tick bites consists in the formation of abrasions upon the grain of the hide, which in consequence becomes spotted and makes a poor leather [Plate XXVIII, fig. 11]. Ticks also suck the blood of the host, bring about their emaciation and transmit diseases like tick fever, etc. [Plate XXVIII, fig. 9]. There are two species of ticks commonly parasitic on cattle in this country, viz., (1) *Boophilus australis*, a continuous feeder, i.e. its entire development from the larval to the adult stage is accomplished on the same host and it drops off only for the purpose of depositing eggs [Plate XXVIII, fig. 8] and (2) *Hyalomma aegyptium*, an interrupted feeder, i.e. it drops off from the host on the completion of the larval stage, and again on the completion of the nymphal and adult stages respectively [Plate XXVIII, fig. 10]. The common method adopted for the control of ticks and tick-borne diseases is the use of cattle dips. When the number of animals to be treated is however small the tick killing

solution can be applied by means of brush or cloth or a spray pump. The following formula constitutes a satisfactory solution for this purpose:

Arsenious oxide 8 lb.

Caustic soda 5 lb.

Stockholm tar ½ gallon.

Tallow or oil (animal or vegetable) 4 lb.

Water 400 gallons.

Mix from 8 to 8½ lb. of commercial arsenic (to contain 8 lb. arsenious oxide) in its powdered dry state intimately with 2½ lb. of caustic soda and while stirring add slowly up to 4 gallons of water. Heat to boiling point if arsenic has not properly dissolved. Then boil from 50 to 100 gallons water in a 400 gallons tank and 2½ lb. of caustic soda and 4 lb. of tallow (or oil), boil for about 15 minutes, then add slowly in a thin steam half a gallon of the best Stockholm tar. When the whole of the tar has been added, boil from 30 to 40 minutes, then add the arsenical solution and fill up the tank with water. It is advisable to test the safety of arsenical dips first on a few animals. Special care must be taken with such a dip when using it in a hot and humid atmosphere and if found necessary it may be further diluted so as to render it safe but not ineffective. Strength of the dipping solution should be adjusted by a qualified person each time before use. When not in use the tank should be kept covered to prevent dust and undue evaporation, etc.

The animal should not be thirsty or hungry or overfed before dipping. Thirsty animals may drink the poisonous dip with harmful results. They may be rested, if they have travelled a long distance, prior to dipping. The animals' bodies should be free from injuries and there should not be any projecting nails or similar objects in the vat which may injure the animal's body. The dipping solution may be stirred by means of a bucket or a plunger before the dipping commences. The animals should enter or jump into the dipping tank from the one end and swim through in order that they may be completely dipped for at least 2-3 minutes, ducking their beads once or twice by means of a fork with a long handle. From the dipping tank the cattle walk into the dripping pen from where the fluid goes back to the tank. Dipping to be more effective should be repeated at 10--14 days' interval. Immediately after the dipping the animals should be protected from ex-

posure to cold. Dipping may be avoided during very cold weather. All the infected and exposed animals should be dipped. Following each dipping the yards and sheds occupied by them should be cleaned and disinfected and the animals put in clean yards, which should preferably be *pucca* with no cracks in which the female ticks can deposit her eggs. The pastures should be changed and the vegetation on infected pastures should be burnt. The dipping of cattle also destroys other skin parasites like mites and lice [Plate XXVIII, fig 12].

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