CHAPTER - I

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Man's greatest problem has always been to secure enough food of a kind suitable to meet his nutritional needs. Well before he knew the art of cultivation, he obtained his nutritional requirement from the animals in the form of meat and milk. The cow is the foster mother of the human race. This relationship is very old, older than the art of writing. On both physiological and economical grounds the dependence on dairy animals for obtaining increased quantity of milk is a necessity.

It is understood that at the time our domesticated herbivora grazed the virgin lands, they were provided by nature with salts of the minerals either in herbages or from salt-beds or rocks. It is a known fact that wild ruminants and hoofed animals sought out salt rocks, pools and places where salt effloresces, to lick the salt. Just when the domesticated animals began to receive common salt as such in their feed, can therefore only be conjectured. It will not be out of the way, if it is assumed that the introduction of salt to man marks also the time of its introduction to animals. The habitual use of salt by man is intimately connected with the change from nomadic state to that of agricultural occupation. The rational application of common salt to the feed of the animals runs parallel to the advancement of rational scientific methods of feeding.
This will lead us to the time when the feeding standards began to appear, i.e., probably in 1810 when Thaer developed his 'hay values' as a measure of relative nutritive value (Maynard and Loosli, 1969).

Animals are utilised as converters of a wide varieties of coarse materials into palatable and nutritious food such as meat and milk. It is in this context that proper animal husbandry practice is of the greatest contribution to the well-being of human race. For dairy cattle, the controlling factor in realizing the maximum efficiency is in the average daily milk yield per cow and the reproductive performance involving its rhythmicity and raising of an improved clan of calf, with the lowest possible expenditure on it. This can be achieved only by the application of scientific methods of feeding and breeding of livestock, and thereby the socio-economic upgrading of the people in general and the peasantry in particular in an overwhelmingly agricultural country such as India is possible. It thus becomes imperative that feeding and breeding of the animals should be conditioned to a level, wherein the latest trends in the advances of the nutrition and physiology of animals' reproduction can be incorporated with maximum benefit.

All these productive and reproductive processes which are no doubt governed to some extent by inheritance, are to a great extent influenced by human factor in the modern days of improved feeding and breeding techniques, as also by general environmental conditions. Every animal in a herd that temporarily or permanently loses its conversion capacity or fertility due to
inadequate or faulty feeding or managerial imbalances, will result in a great loss to the owner. Delayed maturity, temporary sterility or low conception rate cause economic losses by making the animals unproductive or keeping them on low production level for comparatively longer time. There is a general agreement that infertility or even to some extent sterility is common among milch cows, wherever large numbers of them are brought together in an intensive programme of feeding, breeding and milk production and this failure in production and breeding is getting more prevalent. It is reported that occasionally whole herd will fail to breed in a particular period, without the apparent evidence of any disease condition. It is generally due to low or imbalanced state of nutrition. Failure to breed is very common, especially after heavy and protracted milk production, which is either due to over-drain of mineral reserves or inadequate level of some essential nutrients.

The endeavour of husbandry-men should, therefore, be to ward off the various causes, which may interfere with the normal inherent capabilities of the animal. These interference may otherwise be misunderstood as the limitations of animal system. Therefore, the feeding of animals according to their needs is important, both for effecting economy and obtaining maximum production and returns.

The ruminants are peculiarly different from other herbivorous animals because of their anatomical and physiological differences especially in the digestion of coarse and bulky fodders and that the microbial degradation of complex nutrients
and the subsequent synthesis of varieties of nutrients in their fore-stomach. The microbial break-down of complex carbohydrates yields readily available volatile fatty acids in the rumen. The feed nitrogen in the form of proteins, peptides, aminoa-

The term micro-nutrient, in general is understood to be that the substances which are essential and required by the animal in microquantities. It includes both vitamins and trace minerals. During the last decade the importance of trace minerals have been increased prominently. The history of the trace elements is as stimulating and romantic as that of the vitamins. Their economic significance is as great as or greater than vitamins and they lie equally deep at the root of normal physiological processes of the living body. All the trace elements that are found in the animal body have not yet been proved to be nutritionally essential. A very large number of elements is known to occur in the tissues of higher animals. Many of them occur in such small quantities that the early workers were unable to measure their concentrations with the
methods then available, and therefore frequently referred to
then as occurring in 'traces'. For this reason, they came to be
known as 'trace elements'. Green (1941) suggested that the
elements present up to 0.005 percent in the body may be considered
as trace elements.

Essential trace elements are those which show (i) repeated
demonstration of a significant growth response to dietary supple­
ments of the element and that element alone, (ii) development of
the deficiency state on diets otherwise adequate and satisfactory
i.e., containing all the other known dietary essential in adequate
amounts and proportions and free from toxic properties and
(iii) correlation of the deficiency state with the occurrence of
sub-normal levels of the element in the blood or tissue of
animals exhibiting the response. At present, nine trace elements
are considered as essential in animal nutrition. They are iron,
iiodine, copper, zinc, manganese, cobalt, molybdenum, selenium and
chromium. Ruminants are the only class of animals for which
cobalt can be called as essential. Other trace elements such as
fluorine, bromine, barium, strontium and cadmium are classified
as 'probably essential elements' because they have not so far
been shown to meet all the the above criteria (Underwood 1957).

Any element can be toxic to animal if consumed in large
quantities or consistently for sufficiently long period.
Fluorine, selenium, molybdenum, copper are the outstanding
examples of these. Arsenic and lead are the other trace
minerals which come under toxic elements. Further more, there
are about 25 to 30 elements found in the animal body, mostly in
minute quantities but they are not yet proved to have significant physiological function or existence in the animal. They are termed as 'accidental' or physiologically inactive trace elements, present merely or accidentally.

The value of the trace elements is often confined to the part they play in the maintenance of the health of the animals and what disease conditions normally arise when a certain trace mineral is deficient, fails to function or is present in excess. Careful examination of the ration of livestock is, therefore, essential to determine quantity and the type of minerals contained therein as compared to the actual requirements of the animals concerned, in order to take the subsequent steps to supplement the deficiency accurately. Lack of sufficient good quality forage and grass, and deficiency of trace minerals in particular regions contribute to the failure of livestock enterprises. Hence the deficiency must be adequately supplemented with particular minerals, otherwise the health and production of the animals are affected.

Many attempts have been made abroad, especially in Western countries. Australia and New Zealand to study the various aspects of the trace minerals supplementation and their requirements in case of pure-bred as well as cross-bred dairy cattle. Very little work is reported in this regard on pure-bred or cross-bred animals in southern part of India, especially on the effect and requirements of vital trace elements such as copper and cobalt, where cross-breeding programme has been taken up since last two decades.
Most of the research work with copper and cobalt in cattle has dealt with the correction of deficiencies of these elements and little information is available on the role of copper and cobalt in promoting increased feed efficiency and production. The studies reported herein were conducted to determine the effect of added dietary levels of copper and cobalt on the performance of the cross-bred cows.

These investigations are important and vital not only for the maintenance of their optimum performance in the region, but also in other parts of the country, where the number of this type of animals are coming up very rapidly for increasing the milk production. The work embodies an attempt made towards a study on some of these important trace minerals such as copper and cobalt on the cross-bred cows. It is hoped that the revelations will add materially to the existing knowledge of these trace elements and will help to those engaged in management and feeding of cross-bred herds to keep their animals at optimum level of milk production and reproductive performance.