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THE CARE, SANITATION AND FEEDING
OF FOXES IN CAPTIVITY

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PLANT INDUSTRY

THE USE OF SYNTHETIC AND FIBROUS
PAPER IN THE PULP

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THE CARE, SANITATION AND FEEDING OF FOXES IN CAPTIVITY.

INTRODUCTION.

Within a very few years the rearing of foxes in captivity has attracted more than ordinary attention. The very high value attached to pelts of exceptional quality naturally resulted in those who had been supplying the higher grades attempting to rear those wily animals under artificial conditions. For some years this was practically a secret industry, but the ever-increasing price of pelts led to offers being made for live animals with a view to using them for breeding purposes. From a very moderate figure the price has gradually increased, and now many of the choicest animals are capitalized at from fifteen to thirty thousand dollars per pair, with very few available.

It is natural that the maintenance of such valuable animals in captivity has, as in other lines of endeavour, presented its problems of care, sanitation, and feeding, which, in some instances at least, have been disastrous. Breeders are alive to the fact that there is no royal road to wealth in this industry; nevertheless, the returns have been great and progress has been made as new facts have been secured to reduce the hazard.

The purpose of this compilation is not to supply information which will prevent all future losses, but to point out some of the fundamental principles, the observance of which will, in a measure at least, assist in a fuller understanding regarding the problems confronting those now engaged in, or about to engage in, the business.

As a general consideration it is taken for granted that the keeper has had experience in the care of foxes under artificial conditions, is a keen observer and is possessed of sound judgment in their handling and management. He should be a person of unimpeachable integrity, for otherwise there will be difficulty in learning of leaks should such unfortunately occur. The utmost care should consequently be exercised in his selection, or serious failure may be anticipated at the outset.

While many consider that luck plays an important part in the financial success of fox farming, I believe that it is but a minor factor, and that a thorough knowledge of the animal, its vagaries at various seasons of the year, coupled with an understanding of methods of feeding and sanitation are the factors which will with greater surety lead to success.

In discussing the whole subject, I will endeavour to take up the various features under different headings in order that those desiring to consult this small treatise may do so with the least possible difficulty.

I may here acknowledge my indebtedness to the Veterinary Director General, Dr. Fred. Torrance, my chief, who detailed me to the investigation of this industry, to Premier Mathieson, through whose instrumentality I was permitted to visit Prince Edward Island, to Mr. Fred. L. Rogers, president of the Fox Breeder's Association, to Dr. W. H. Pethick, the inspector in charge of the Health of Animals Branch for Prince Edward Island, and to the many breeders, keepers, and investors who in every instance afforded me the opportunity to learn of their methods, their successes, and their failures. Without this assistance my mission would have been fruitless and the data for this compilation could not have been secured.

II.—SELECTION OF STOCK.

In the selection of stock for the breeding of any species of animals, the greatest care must be exercised, or serious financial loss and disappointment will follow. This is probably of greater import in the farming of foxes for profit than in the rearing of any other class of live stock. Many reasons exist for this, the principal being that the fur of the silver fox has from time immemorial been the fur of Royalty. The exploration and sentiment of those remote corners of the earth inhabited by the fur-bearing animals has progressed, till now the securing of fox pelts is presenting greater difficulties each year, and, furthermore, the difficulty of rearing these animals in captivity has presented insurmountable barriers.

The animals mature rapidly, and the returns have reached a figure which in many instances has placed poor farmers in affluent circumstances within a very short period.

If possible it is preferable to secure breeders from what is termed pure-bred stock, or stock that is known to be capable of reproducing its kind without a reversion of type. At the same time it must be borne in mind that the pelt value is the ultimate basis upon which the industry rests, and the only one to be considered when selecting the stock. In judging of the pelt value in breeding stock, another consideration enters, namely, the conformation and stamina of the individual, for without perfect conformation, deformities will be encountered in the progeny, and without a very high stamina, the progeny will be weaklings and succumb early in life, losing to their owner not only the pelt value and the individual but the profits which would otherwise accrue from such as future breeders. These considerations are paramount and will save much subsequent annoyance if thoroughly weighed at the outset.

Having borne in mind the foregoing considerations, the breeding of the progenitors of the stock selected should, in so far as it is practicable, be known as far back as it is possible to go. This ensures the fixity of the type and thus eliminates the danger of a recessive or sport* appearing in the progeny. Such recession not only has a tendency to depreciate the value of a given litter but the possibility of its recurrence in such a breeder's progeny is ever present. It is thus apparent that where the type is fixed, and it is known that the chances of a recessive or sport occurring are remote, the value of the pair and the progeny as breeders is greatly enhanced.

This also brings in for serious consideration the probabilities that may be expected from the introduction of silver, black, patch, or cross foxes for breeders. At the present time little or nothing is definitely known concerning this. Many hold that a fox is a fox regardless of colour or place of origin and that it may be mated in any manner without danger. Others, again, hold that nature has bred foxes of different varieties, each true to type, such as the Alaska blue, the Northwest black, the cross, the red, and the grey; that these types are fixed, and while in the first generation they may freely interbreed, this progeny being hybrids will be sterile or very nearly so. We get hybrids among equines by crossing the Jack and the mare or the stallion and the Jennet, yet these cannot be bred further. Among birds we know that domestic and wild geese cross, and while this cross results in the finest table bird known it does not go further, as the hybrids are sterile. Upon this basis it is argued that the various breeds of foxes have been fixed by some fundamental law of nature, and that these laws cannot be controverted by man's desire to secure valuable fox pelts, excepting along certain given lines which future experience alone will determine.

These considerations possess a definite cash value in any breeding proposition, and must be considered in the organization and development of strains of breeding

* A recessive or sport in breeding is the offspring of an animal whose characteristics, either colour makings or conformation, revert to some ancestor, male or female. This recessive characteristic may skip a number of generations before presenting itself.

stock. Experience and experiments will doubtless determine the value of the considerations outlined, and therefore every breeder of foxes should keep an accurate record of all his stock from the first start in order that the whole may be compiled for the collective benefit of the industry. Such accurate facts will ensure the confidence of the investors, and will also prove of value in pre-determining the price which can safely be paid for a male or female with certain breeding.

III.—LOCATION OF A FOX RANCH.

Many ideas prevail as to the best location of a ranch. It is, however, conceded that it should be on high, dry ground. The soil should be sandy and free from alkali if the best pelts are to be secured. Sales have shown that the most valuable pelts have been supplied from Prince Edward Island, and it is fair to assume that the climate and the soil are here eminently suited for the exploitation of the industry.

Various experienced breeders have considered it necessary to provide shade, and consequently the majority have located their ranches in a bush composed of spruce, birch, and poplar. One of the main arguments for such a location is, that foxes in the wild select a similar breeding place. It is said to be detrimental to the fur if too much sun is permitted in the ranch, thereby causing a fading of the gloss, sheen, and other fine points which are factors in judging the value of a given pelt. Observation, however, shows that both the old and young foxes differ in regard to their desire to sun themselves. Some will lie for hours in the sun, moving every time they become shaded, while others will act just the opposite. These habits will doubtless vary greatly with the different seasons, but from these considerations it would seem desirable to supply both shade and sunlight in every pen of the ranch in order that each individual fox may satisfy his own desires in this regard. It having been pre-determined what animals are to be used for pelt production, these individuals can be shaded or otherwise treated with this end in view.

It may prove of advantage to locate the ranch at the edge of a bush, so arranging the individual pens that each may have a shaded and a clear space.

A ranch should not be too close to a settlement, for various considerations. First, the foxes should be kept free from unnecessary disturbance; and second, the foxes themselves are at times quite noisy. Furthermore, a peculiar odour is given off at all times, this being more particularly noticeable during the breeding season. With a ranch near a settlement, not only would there be many visitors, but the dangers of introducing disease through the agency of stray dogs, which cannot be controlled, is greater than would be the case when isolation is a feature.

It is possible that circumstances will necessitate a certain location being decided upon, in which event every care should be exercised to make the location satisfactory from every point of view.

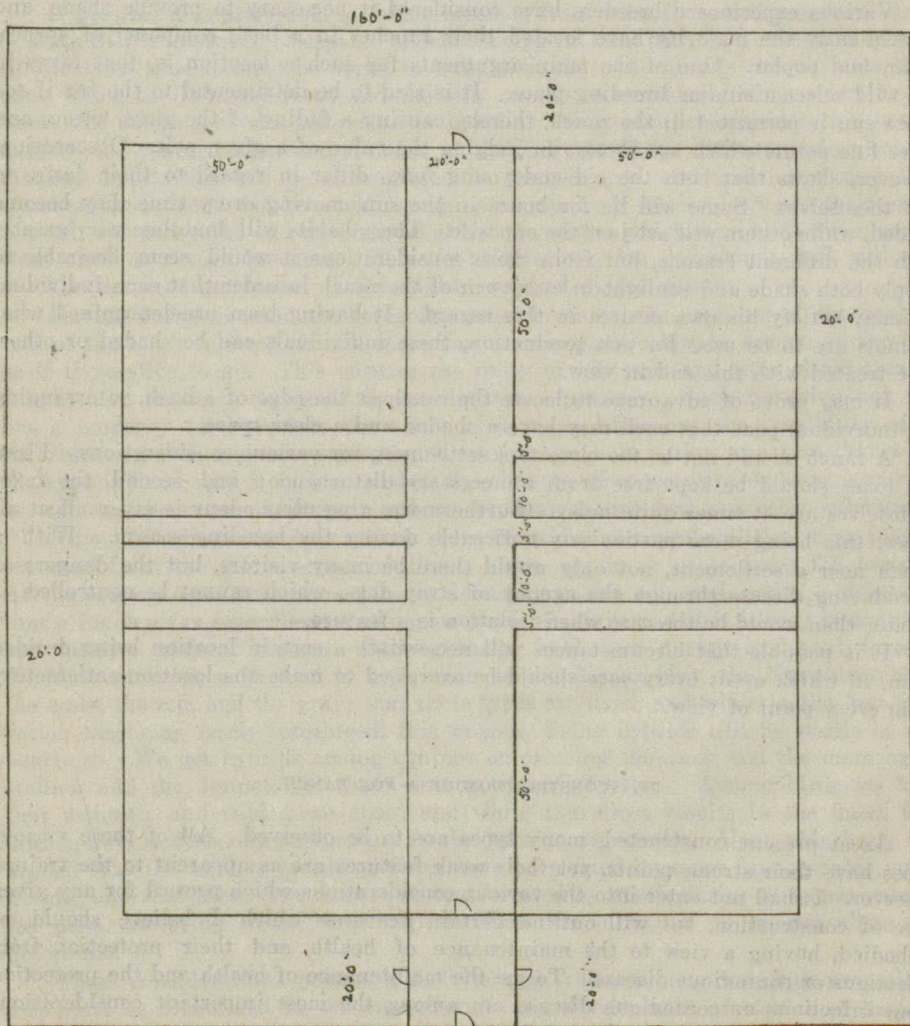
IV.—CONSTRUCTION OF A FOX RANCH.

As at present constructed, many types are to be observed. All of these various types have their strong points, yet their weak features are as apparent to the trained observer. I shall not enter into the various considerations which prevail for any given type of construction, but will outline certain features which I believe should be embodied, having a view to the maintenance of health and their protection from infectious or contagious disease. To me the maintenance of health and the protection from infectious or contagious disease are among the most important considerations affecting the fox industry to-day.

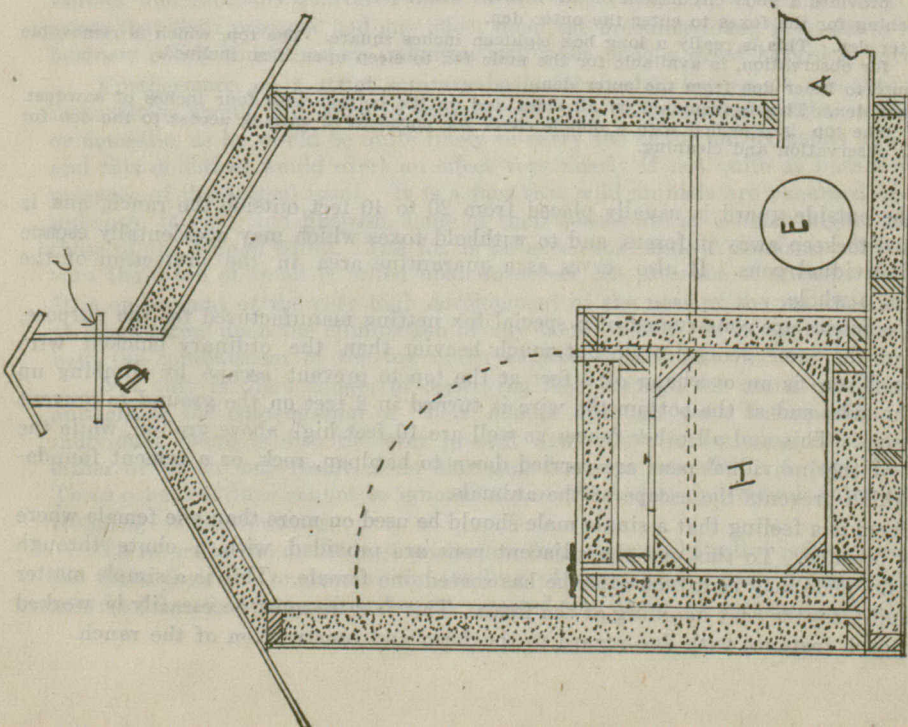
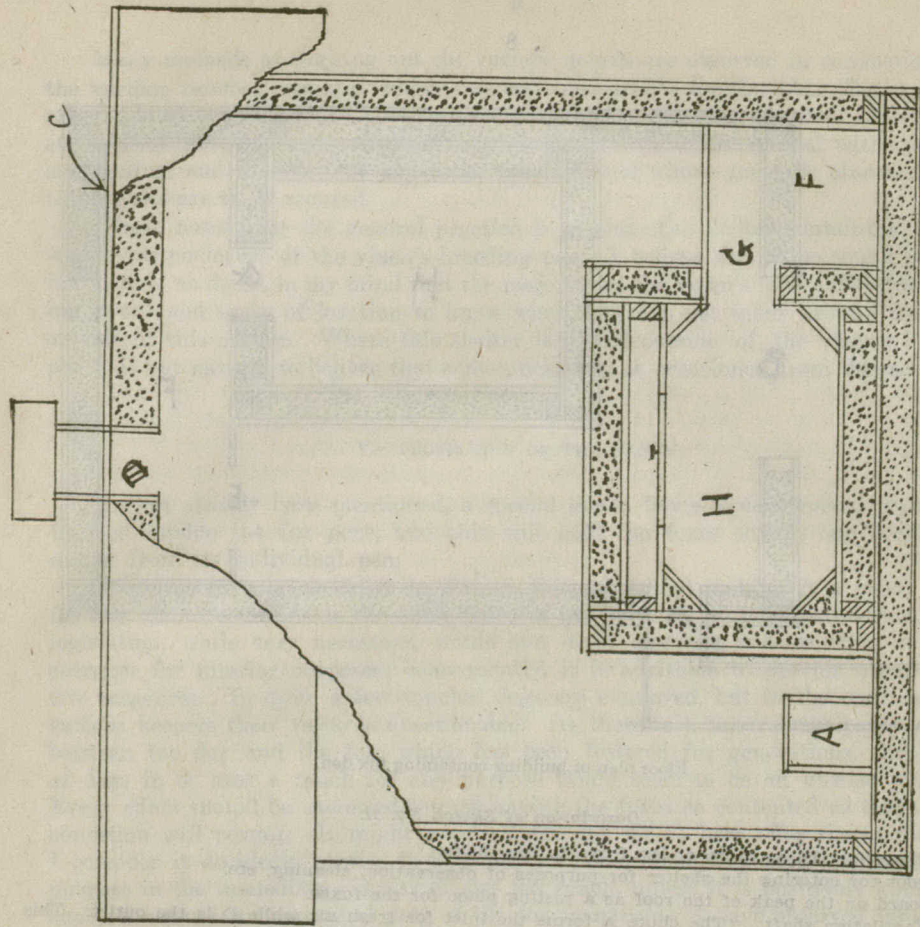
From an examination of some of the best fox ranches, and discussing the matter with the best breeders, it seems highly desirable to provide an area of approximately

2,500 square feet for each pair of foxes. Much less is observed in some of the successful ranches, while very few have a greater area.

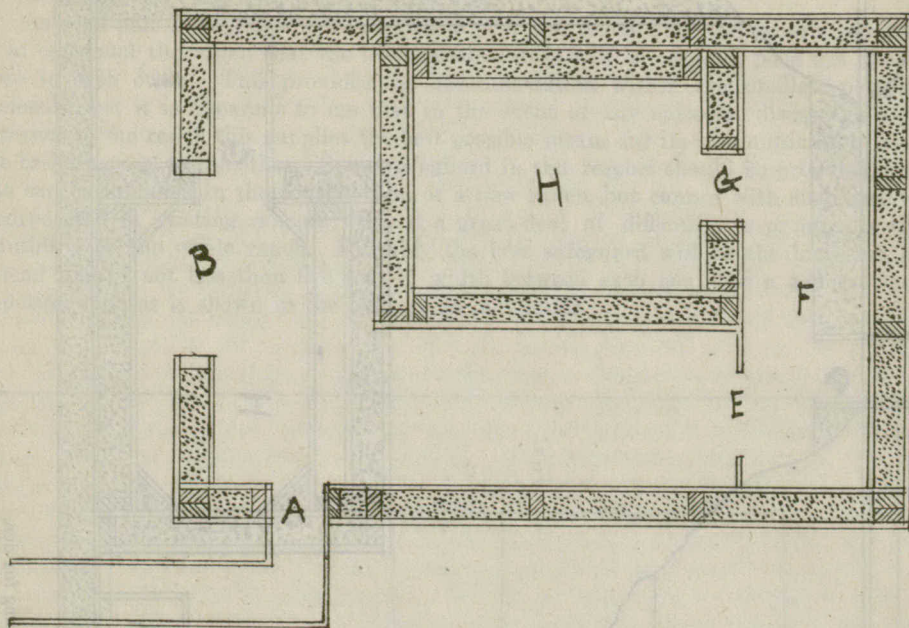
As each pair is provided with a separate pen, and it has been the general practice to so construct the ranch that the least possible area will be covered, pens are placed close to each other. This provides the accommodation within the smallest possible enclosure, yet it is apparent to me that in the event of any epizootic disease gaining entrance to the ranch this supplies the best possible means for its communication from one breeding pen to the other. Some safeguard in this respect should be provided, and this can be included in the construction of a new ranch, but cannot with such ease be incorporated in existing ranches without a great deal of difficulty, or practically the rebuilding of the whole ranch. Probably the best safeguard will be the inclusion of a dead line of not less than five feet in width between each pen, and a general construction such as is shown in the plan given hereunder.



Ground floor plan of fox ranch, showing arrangement of pens.



Cross section drawing of building containing fox den.



Floor plan of building containing fox den.

Description of Sketch No. 11.

- A. Chute for the entrance of the foxes to the shelter.
- B. Door for entering the shelter for purposes of observation, cleaning, etc.
- C. Board on the peak of the roof as a resting place for the foxes.
- D. Ventilation shaft. (The chute A forms the inlet for fresh air while D is the outlet. This provides a good circulation of air without a draft on the foxes).
- E. Opening for the foxes to enter the outer den.
- F. Outer den. This is really a long box eighteen inches square. The top, which is removable for observation, is available for the male fox to sleep upon if so inclined.
- G. Chute to inner den from the outer den.
- H. Inner den. This is insulated on all sides and on the bottom with four inches of sawdust. The top is provided with a double cover for purposes of gaining access to the den for observation and cleaning.

The outside guard is usually placed from 20 to 40 feet outside the ranch, and is designed to keep away pilferers, and to withhold foxes which may accidentally escape from individual pens. It also serves as a quarantine area in the protection of the ranch as a whole.

The fences are constructed of a special fox netting manufactured for the purpose, being of the same general style but much heavier than the ordinary chicken wire netting. There is an overhang of 2 feet at the top to prevent escape by climbing up over the side, and at the bottom the wire is turned in 2 feet on the ground to prevent burrowing. This and all other fences as well are 10 feet high above ground, while the fences of the individual pens are carried down to hardpan, rock, or a cement foundation, which prevents the escape of the animals.

There is a feeling that a single male should be used on more than one female where this is possible. To this end the adjacent pens are provided with a chute through which the male may be driven after he has served one female. This is a simple matter and facilitates the easy handling of the foxes. This feature must necessarily be worked out in each instance with due regard to the form and construction of the ranch.

Many methods of working out the various details are observed in connection with the various ranches, some of which require considerable forethought. Some definite experimental work should, I believe, be undertaken in the line of ranch construction, at the same time having due regard for the peculiarities of the animal with which we are dealing, and the sanitary and other requirements which must be observed if the best results are to be secured.

I have noted that the general practice is to place the shelter containing the den within the enclosure of the vixen's breeding pen. I believe this to be sound practice, for there is no doubt in my mind that the majority of the vixen's have sufficient reasoning power and sense of location to know when they can get easily around the entire outside of this shelter. Where this shelter is placed outside of the vixen's breeding pen it is but natural to believe that some uneasiness is occasioned from this source.

V.—PROTECTION OF THE RANCH.

As has already been mentioned, a special guard fence is constructed from 20 to 40 feet outside the fox pens, and this will hold the foxes should one accidentally escape from its individual pen.

A provincial statute exists in Prince Edward Island making it a penal offence for any one to come inside the outer fence of the premises without permission. Such legislation, while very necessary, would not deter any one endeavouring to secure entrance for ulterior purposes; consequently, it is advisable to provide other protective measures. In quite a few ranches dogs are employed, but in the opinion of the various keepers their value is questionable. As there is a natural antipathy existing between the dog and the fox, which has been fostered for generations, the holding of dogs in or near a ranch for any purpose would seem to be an unwise procedure. Every effort should be exercised toward having the foxes as contented as their captive condition will permit. It might not be amiss for me to here offer the opinion that I consider it decidedly unwise to hold any animals other than foxes captive for any purpose in the immediate vicinity of any fox ranch, unless it is positively known that such an animal is the natural prey of the fox in nature. I have observed tame bears, skunks, and raccoons quartered close to breeding pens, and while no direct evidence exists that their presence had any effect upon the breeding foxes, it seems to me a bad business policy to assume an unknown risk when such a great hazard is involved.

Furthermore, on a strict sanitary basis the feeder, keeper, or manager of foxes in captivity should not come in contact with any other animals, either wild, captive, or domestic, as he would be quite likely to carry the odour on his hands and clothing, and this doubtless would exert an effect very nearly if not quite as hazardous as the presence of the animal itself. It is a fact that wild animals are possessed of instincts unknown to men, and likewise, some of their senses are of a much higher order than those of the human being. The fox is no exception, and, in common with the carnivora the sense of smell is relied upon to detect the presence of enemies and friends. It is on account of the very high development of the nose of the fox that I have laid so much stress upon the elimination of any factor which will in any manner interfere with the contentment of the fox under captive conditions.

Not only is there danger of conveying fear through the actual presence of wild animals or the transmission of their odours through some intermediate article or individual, there is also the ever present danger of transmitting epizootic disease; either of which may result in an alarming financial loss within a very short period. These considerations cannot be ignored nor overlooked by individuals interested in the fostering of the industry.

To revert to the methods of protection from the purely police point of view, where the main desire is to prevent the stealing of animals, ordinary precautions such as may be taken in other industries are resorted to. Locks of various sorts and descrip-

tions have from time immemorial provided a means of safeguarding private and public property. They likewise provide a means of detaining the curious and any but the maliciously inclined. The use of dogs for the purpose has already been commented upon, and these animals should be eliminated for sanitary and other reasons.

The use of watchmen for the patrolling of the premises is a necessity that cannot be dispensed with. A single watchman, however, does not fulfil the entire requirements demanded for perfect safety, and various devices will suggest themselves as time progresses, the result being that constant evolutionary changes will occur as the knowledge of the fox increases.

I have suggested to a number of ranchers that goats, while performing certain police duties, would also provide the best nutriment with which the young foxes could be supplied, namely, goats' milk properly modified. I do not believe that the male goat would offer a hazard, yet I know that he would successfully cope with intruders. It may be feasible to allow a few goats to roam at will outside the ranch, but within the guard fence. They would keep down the grass and underbrush, thus materially reducing the fire hazard, which in some instances is a very serious menace, and, at the same time perform a valuable police duty. Furthermore, they would, providing the proper breed is selected, give a fair revenue on the money invested.

VI.—MATING OF FOXES.

The proper mating of foxes is probably one of the most vital considerations connected with the ultimate status of the industry. Some of the breeders with the largest experience have so mated their foxes that pelts of an exceedingly high value have been secured. With those who have had less experience the mating seems to be a matter of greater or less chance.

There is no doubt in my mind but that the ranching of foxes in captivity will ultimately be placed upon a pelt-value basis, and will not remain for any extended period upon its present breeding-stock basis. The pelt value being the one upon which it must ultimately rest, demands that such steps as are necessary be taken to arrive at this point with the least possible delay. In the breeding of other animals, either wild or domestic, certain points have ever been uppermost and necessary to attain. So in the ranching of foxes for their fur, the quality and texture must necessarily be the basis upon which the business is to be continued. With this end in view, matings must be made to produce the quality and texture demanded by expert furriers who are in direct touch with the sales end of the fur business. This will doubtless vary from time to time, but until the basic factors underlying the business are determined they cannot with certainty be secured.

Probably the most effective method of arranging for the matings would be through the assistance of an expert furrier, who could at the proper season of the year examine the fur on the live animal and thus grade it according to its valuation. With this factor as a known quantity and the assistance of the accepted laws of heredity in breeding, a few years would establish the method that must be followed to arrive at a given result.

As new blood is being introduced through the mating with cross and patch foxes of local origin and the importation of foxes from other localities, factors naturally enter which cannot be ignored. Should such foxes have the texture, lustre, quality, and length of fur required, the following of nature's laws, in so far as they are known, require to be observed to their fullest extent. At the present time it would be very unwise for me to suggest that certain matings may be made with the assurance that certain positive results may be secured. Too many factors enter here, any one of which may upset the most profound calculations. Certain it is, however, that definite laws are laid down which cannot be controverted, and these laws are involved in the production of a given result. These were first outlined by Mendel. It is not my pur-

pose to enter into a detailed amplification of his views. It will suffice for me to state that Mendel found that by crossing certain varieties of plants he could secure certain results, and consequently evolved definite hypotheses which have since proved to be founded on principles which nature observes with but slight variations.

If experience should prove that some of the foxes introduced are subspecies of the same genus, then we may have excellent results from the fur-bearing viewpoint, but secure hybrid animals which nature has deprived of those reproductive powers by which the species is perpetuated. Should such an hybridizing effect follow with an improvement of the quality of the fur, then one of nature's secrets of producing a requirement of dame fashion will have been unfolded.

In the event of hybridization not occurring, then the goal ahead is the elimination of undesirable qualities and the retention in the animal of those attributes which increase the stamina and reproductive powers of the species, with the concurrent increase in the value of the fur.

The foregoing gives very briefly the more important factors which underly the actual mating process. It is in their final carrying out that the best skill and judgment will be required. As each mating will have to be determined after the careful weighing of all the considerations, no rules are to be laid down, nor can any system be evolved as a result of our present knowledge.

VII.—THE FEEDING OF ADULT FOXES.

The main purpose of food is to sustain life. In the wild, the food of the fox will be found to vary considerably from that provided under artificial conditions. The circumstances under which foxes exist in nature are very different from those obtaining in the artificial environment of the present-day fox ranch. In nature there is the constant fear of molestation, and instinct teaches the fox to bury such food as is not needed for immediate requirements. A similar instinct is observed among foxes in captivity which renders it very difficult to determine the actual amount of food required at varying intervals. In nature, forced exercise is secured in the search for food, while in captivity exercise is largely a matter of individual taste, usually the less-contented foxes securing the greater amount of exercise as a result of its constant movements in an endeavour to secure an avenue of escape. Animals which have become fairly well contented with their surroundings do not worry to such a marked extent and, therefore, do not secure sufficient exercise for their ordinary requirements. It is thus apparent that the amount of food required by each individual animal will vary within certain limits, and these limits cannot well be predetermined.

An examination of the methods in vogue at the various ranches shows that some practise almost an exclusive regimen of meat feeding, while others prefer supplementing this by bread, either ordinary stale white bread or a special bread containing a proportion of bran, crackers or soda biscuits, and milk.

From my conversations with the many breeders, it seems that the best practice is to feed early for the next season's litter, some beginning during the preceding September to build up the vitality of the stock. This appears to have a sound scientific basis, for if the vixen is not properly fed before mating, it is hardly likely that she can readily make up this deficient condition after she has become pregnant and is carrying from four to eight pups. Experience indicates that food is taken very sparingly after the new year. The period of gestation being but fifty-one days, entails a very severe strain on the animal's system, and this is a comparatively short period in which to develop a number of fully formed living animals. Nature is very profligate in its effort to perpetuate a given species, and the fox is no exception to the rule. It is known that from six to eight young in a litter are required to maintain the balance in the perpetuation of the species among the fox tribe. This is due to the chances of insufficient nourishment, the elements, natural enemies, etc. This very factor, a

prolific breeding capacity, has more than any other been responsible for the wonderful returns in the fox industry, as each individual from first-class stock possesses a value of from one to five thousand dollars.

Results indicate the desirability of full feeding from the first of September till the first of January. In this feeding the greatest care should be exercised to ensure the female receiving the required amount of food. Under natural conditions in the wild, instinct calls upon the male to feed the vixen, but in captivity it seems quite probable that a portion of this instinct is lost, with the result that the male becomes more or less greedy, reserving for himself the greater portion of the food. Being the stronger, food that he cannot eat at the time is buried for some future occasion. This being the case the female progresses toward the period when she has to bear young and is improperly nourished for the demands that will be made upon her system.

Those who have had a great deal of practical experience with these animals note a great difference in the disposition of the male with regard to food supplied the pair. With some males the main desire seems to be to see that his mate and her young are well provided with food before partaking anything himself. Instances are recorded where the male quartered in an adjacent pen will actually starve himself in his endeavour to supply his dependents with the food provided him. This instinct will doubtless be found to be very persistent, more particularly among the monogamous males (males mating with but one female) and these will require treatment as special cases. Such monogamous males make the best fathers, and will prove most contented when assisting the female in caring for the young.

Methods must be employed which will ensure the proper nourishment of the vixen. Some practise the expedient of giving the male a piece of meat and driving him away, feeding the vixen within the house and shutting the male out; or, upon occasions surfeiting the male with food which leads to a revulsion and consequent curbing of the appetite. The surfeiting of the male is the overfeeding him on a given occasion to the point of revulsion for food. After such surfeiting his appetite will be curbed in a manner similar to that of a child who had overeaten of candy or any other substance for which they have an overfondness. I make this explanation as some may consider that surfeiting means a continuous overfeeding.

Another method is to supply at all times sufficient food to meet the full demands of the vixen as well as the extraordinary demands of the male, removing such accumulations as may remain in the pen just prior to the freezing of the ground in the fall, and such subsequent accumulations periodically thereafter.

Individual experience and practice will naturally determine the factors which must be observed in the feeding of adult foxes. No definite regimen can be laid down. Variety should be a feature, as the fox is omnivorous. The trained observer who knows the vagaries of the foxes under his care should instantly be able to determine which of the animals he is feeding is gorging itself or, on the other hand, those securing insufficient nourishment.

My point may be illustrated by citing the fact that expert cattle feeders are able to note the least deviation in condition of the animals under their care, and correct this before damage has been done. This applies to cattle fed for either dairy or beef purposes.

Unless the feeder is able to observe departures from the normal, then his usefulness to that particular ranch has come to an end. While I realize the seriousness of changing hands at any season, the man who is unable to work with and for the foxes under his care is a serious hindrance to the industry, and an exceedingly expensive employee.

I believe that the feeder must have a love for his work, have a sympathy for and with the animals, be able to secure their confidence, and furthermore be strictly trustworthy. He must have a knowledge of the various digestive processes in order that he may be able to note any deranged condition, and correct such before any damage

is done. He should have a general knowledge of health and disease, both of which are desirable in the detection of any ailment. He should have such a knowledge of physiology that he can fully comprehend the changes which take place from the time of conception until the expulsion of the fully formed pups from the uterus of its mother. This knowledge, with an understanding of the composition of the food supplied by the milk of the vixen, and that which must be supplied should anything happen to her, will greatly reduce the hazards now surrounding the industry.

I cannot close the subject of feeding the adult foxes without saying a word regarding the care which should be exercised in the storage and handling of food which is designed to sustain these very valuable animals.

In some instances, not only the method of storing such food materials as are used, but the actual handling seemed to be open for a certain amount of criticism. The foxes are quartered in expensive ranches and guarded with extreme care, yet their food may be held in an inexpensive structure, easily accessible to anyone having ulterior motives. To me it would seem essential that adequate facilities be provided in this regard for the proper preservation and protection of the food supply if untoward results are to be avoided.

VIII—WHELPING.

Probably the whelping of the vixen, or the giving birth to the young, is the most serious consideration connected with the fox industry to-day. If the vixen is able to give birth to vigorous young without accident, and to properly nourish them for the first two months, the greatest dangers are passed. Any accident at this time not only reduces the anticipated profits, but unless its cause is known no remedy can be applied to prevent its recurrence. In no breeding proposition does there seem to be such mystery or fetish as to-day obtains in the fox industry. Some of this may be founded on definite facts, but it seems to me that the major portion is a direct result of superstition or lack of keen observation and experiment.

Accurate knowledge should in my opinion be the foundation stone of progress, and until this is secured very little will be known concerning the whelping and the dangers to be encountered and overcome. Progress can only come by degrees, and in all lines of endeavour is secured by intelligent observation and experiment. Observation seems to be out of the question at the present time, at least, in so far as it can be applied to the vixen at this critical period. Experiment, however, is possible, and many have been performed by various observers. I am advised on good authority that the supposition that the vixen will not under any circumstances permit an observation of the den, or her *sanctum sanctorum*, is erroneous. There are persons, keen observers, who have established such a relationship with the vixens in their care that they can open the den each day without fear of an untoward result. While I would not advise that this be undertaken in an indiscriminate manner, I believe that the feeder should be on such terms with the animals in his care that by a systematic method he will be able to learn of the exact time of whelping and know the condition of the vixen as well as that of the pups. To this end my suggestion would be that the feeder at a given time each day should examine the den and determine its exact condition. It would be far from my object to suggest that this commence only at the period when the offspring were expected, but that it should commence many months in advance of this time with a view to establishing confidence and familiarity. Having established this confidence and familiarity little danger should be anticipated at the whelping period. This, of course, must not be undertaken in an indiscriminate manner, but at the outset may be practised with a very limited number of vixens, and those most adapted for the purpose. It may be considered necessary to keep two or three pairs of red foxes for this purpose, with which the suitability of a keeper could be accurately determined.

All are familiar with the domestic cat, and no doubt many have observed that this animal in a semi-wild state has its young in a remote place, while the same animal when fully domesticated prefers either the softest bed in the house or a point of vantage behind the kitchen stove. Should the young of the semi-wild cat be found, she will immediately secure a new hiding place and remove her young to it, while the fully domesticated cat, should the young be removed to some outbuilding, makes a strenuous effort to again secure entrance to the house with her entire family. Bearing in mind the methods which may be pursued in fully domesticating the cat, experience will soon teach the best method of procedure with foxes.

Once having ascertained the suitability of a given individual by the foregoing, or any other method, his services should and will command remuneration in accordance with his skill.

I learned of a single vixen that had, under the management of a skilled attendant, given birth to and raised twenty-four pups in four seasons. In another instance, thirteen pairs produced fifty-one pups in a given season, and these animals had during the three years immediately preceding given as satisfactory results. In each instance, the management of the feeder had been skilled and such individuals are of untold value to their employers.

To those whose prejudice will not permit them to open the den of the vixen, I would suggest the placing of a small electric bulb within its confines and having attached thereto such an arrangement (a long tube or other device) that will permit an examination of its contents when the vixen is out. Probably the most satisfactory device would be on the order of what is known in medical circles as a bronchoscope, or an instrument that may, in the hands of an expert, be passed through the mouth and down the windpipe, thus enabling an examination of the interior of this passage. At its lower end is a very small electric bulb which illuminates the entire passage. With the electric bulb a similar device in the den and a sufficiently long tube, its interior could be examined at any time. This would determine the condition of the pups and point out those needing assistance, such as artificial feeding. While suggesting this plan, my experience with complicated mechanical devices leads me to believe it to be impracticable, and in no way to be compared with the daily opening up of the den by an attendant who is on familiar terms with the vixens.

The history of breeding indicates that as progress is made in the improvement of progeny of a given species, greater hazards accompany the climax of the gestation period (parturition) or the giving birth to the young. This having been the case with other species of animals, such steps as will reduce this source of loss to the minimum should be given serious thought. The suggestions I have made are radical, but they have been followed with success by some breeders and, therefore, are worthy of serious consideration.

If my suggestions are carried out, and it is found that the vixen dies during the culmination of her effort to perpetuate the species, prompt intervention may enable the saving of at least a portion of the young. Picture post cards bear mute testimony to the fact that fox pups have been reared on cats as foster mothers. Discussions with various breeders have revealed the fact, that fearing less something was amiss, the den was opened to find the vixen dead with one or more pups living. These hazards should and can be eliminated. Almost without exception those with whom I have discussed the matter are of the same opinion; many, however, are afraid to make a move so radical as I have suggested. It would seem to me that the financial status of the industry would warrant such experiments as would put the question beyond the vale of chance and in the realm of certainty, to be condemned forthwith, or introduced as sound practice. Some modifications would doubtless suggest themselves during such experimentation, and these prove adaptable to the requirements of the business.

IX.—THE FEEDING OF THE PUPS.

There is probably no feature of the fox business that has led to so many losses as the improper feeding of the pups. Their food under natural conditions in the wild, other than the vixen's milk, is in a measure conjectural. The fact that the litters are large indicates that nature has provided for the survival of the fittest and expects the major portion to die ere they reach an age which will permit their breeding. In the ranching of animals it is desired to raise every pup born, and to this end every effort should be directed, it being generally admitted that the present losses are greater than they should be.

From the observations which I have made, the losses appear to be largely confined to the young pups and result from improper feeding or infestation with worms. At this time we are more directly interested in the feeding, but I will consider worm infestation in due course (see chapter XI). It is held that the feeding of the pups must begin some time prior to conception, and at this time naturally concerns the vixen. This feature was discussed when dealing with the feeding of the adult foxes (chapter VII), and needs no further mention at this time. After impregnation, the vixen undergoes that change common to the female of every species, and her temperament may assume a very different character from that observed at any other period. The greatest consideration at this time is to assist in the contentment of the vixen if the offspring are to be vigorous at parturition.

An exclusive meat diet cannot be expected to give the best results, as meat contains but a very small proportion of the bone-forming materials which at this time are very necessary. In my opinion, bones or some adequate substitute must be used if the proper chemical constituents are to be supplied. I believe that a bone mill for the cutting of green bones can with advantage be added to the equipment of a ranch. While offering this opinion, the fact should not be lost sight of that a mechanical advantage accompanies the gnawing of bones that cannot be supplied by any other means, consequently the chemistry of feeding will not entirely supersede other factors, but all must be considered and each given its proper attention.

The diet must be so balanced that the requisite substances will be included which are required for the development of the young, otherwise the vixen will draw from her own reserve in nature's effort to present living young of the highest vitality, even if this result in her ultimate death. As it is desired that the vixen nurse her offspring it is necessary to ever have this in view. The exact food and the method of feeding must be determined according to the supply which may be secured.

After the birth of the pups they need but little attention, as the vixen's milk will supply their wants. At this time, however, as well as during the gestation period, the vixen must be fed for the benefit of her offspring. For this reason the chemical constituents required by the growing pups must be contained in her milk, otherwise untoward results will follow, such as mal-nutrition which may ultimately develop into rickets, and from this into a permanent deformity of the legs. Experiment has proved that the feeding of other species of animals should commence early in the gestation period and be followed throughout along certain definite lines if the best results are to be secured. I believe that the same principles will apply to the fox industry, but, as has already been suggested, this of necessity must be intelligently supervised.

Meat, milk, fish, and eggs, supplemented with a small quantity of whole-wheat bread and ground bone should be used as the basis for the feeding of the vixen. The use of soda biscuits or other crackers has not been uniformly attended with satisfactory results. This may possibly be due to chemicals added during their manufacture, and to the fact that a most valuable constituent of the wheat has been removed in the bran.

When the pups have reached an age at which the vixen's milk must be supplemented, great care should be exercised in the nature of the food supplied to the mother,

as a portion of this will doubtless be offered to the pups. A good practice seems to be the placing of pieces of a coarse home-made bread in milk suitably modified, depending upon the vixen to carry portions of this within the den to the pups. Bran that has been permitted to soak up the blood of a beef carcass, and eggs may be used with advantage, as these supply the very necessary albuminous and proteid materials required by the fox. The adult foxes may be given meat at this time by fastening a bone, from which all of the flesh has not been removed, on an elevated platform. The adults can easily jump to this for their supply, whereas the pups have insufficient strength to do so at this time.

The pups should receive very little if any meat up to eight weeks of age, although some feed meat, fish, and shell fish as early as six weeks. Definite rules cannot be formulated with our present knowledge, but much can be done to overcome the difficulties now experienced if the foregoing suggestions are considered by an intelligent and careful feeder.

Digestive disorders will occur even under the most experienced guidance and their early recognition will avoid many losses. A deranged digestion either indicates a diseased condition arising from some outside cause or the supplying of an improper dietary regimen. The majority of these disorders will fall within the latter category.

When the digestion is deranged as the result of an improper diet, the cause must be removed immediately and the animal fasted. With this fasting a gentle purgative may prove beneficial. In resuming the diet, properly modified milk (see chapter X) to which has been added a proportion of the white or yolk of egg should be fed sparingly. Should no untoward result follow this, then the full ration may gradually be resumed, but in doing so the article responsible for the trouble should be eliminated or reduced in quantity.

X.—THE ARTIFICIAL FEEDING OF FOX PUPS.

In the artificial feeding of fox pups, I particularly refer to cases where the vixen, either through death or other accident is unable to care for her offspring. With our present knowledge, this is a very difficult proposition but must be approached cautiously with the data now in our possession.

Through the kindness of Dr. A. A. Black, of Summerside, I was provided with a very small sample of fox milk, and I am indebted to Dr. F. T. Shutt, Dominion chemist, for an analysis of this. A further study of fox milk should be undertaken as the present data can only be considered as provisional until we can supplement it with other analyses. (For such an analysis at least an ounce of milk should be available.) That the single analysis which we have may be compared with other analyses I present herewith a table giving data secured from the milk of a number of species of animals.

	Human.			Dog.	Fox.	Cat.	Rabbit.	Guinea-pig.	Sow.	Elephant.	Horse.	Ass.	Cow.	Goat.	Sheep.
	I	II	III												
Casein				5.2	3.08	3.1					1.2	0.7	3.0	3.2	5.0
Albumen		0.5		1.9		6.4					0.8	1.6	0.5	1.1	1.6
Total proteid	1.7	1.7	1.5	7.1		9.5	15.5	11.2	5.9	3.1	2.0	2.2	3.5	4.3	6.5
Fat	3.1	3.8	3.3	12.5	21.92	3.3	10.5	45.8	6.9	19.6	1.2	1.6	3.7	4.8	6.9
Sugar	5.9	6.0	6.6	3.5	0.54	4.9	2.0	1.3	3.8	8.8	5.7	6.0	4.9	4.5	4.9
Ash	0.2	0.2	0.3	1.3		0.6	2.6	0.6	1.1	0.7	0.4	0.5	0.7	0.8	0.9

From this table it will be observed that the fat content in fox milk is extremely high, and I may here mention that the proteid could not be determined in the sample

at hand, while the casein and albumen could not be estimated separately. Basing my suggestions upon the analysis as given, and assuming the proteid content to be in the neighbourhood of eight per cent, or somewhere between that of the dog and the cat, a formula for the modification of goat's or cow's milk would be as follows:—

Formula for Modified Milk.

	Ounces.
Fresh unsalted butter	1½
Proteid (supplied by the use of clear beef broth free from fat or sediment)	1
Goats milk—whole	2
(In lieu of goat's milk, 1½ ounces of whole cow's milk may be used).	
Lime-water and barley-water in equal proportions, sufficient to make a total of	8

This may be fed to the pups, either with a spoon or through a nursing bottle, some of which are specially made for use with pups. For very young pups, one-half an ounce should be sufficient every three hours. Should this formula not be well tolerated, reduce its strength by increasing the amount of barley-water, making the whole up to 10 ounces. As the pup increases in size and weight, reduce both the lime- and barley-waters, and in lieu of the reduction add its equivalent in egg, beating the white and the yolk together before adding. The quantity of this modification will naturally have to be increased with the growth of the pups. The gradual increase in its strength, while reducing its liquid bulk, gives the added nourishment required without unduly distending the stomach of the small animal.

When the pups are able to lap this up, other constituents such as coarse home-made bread prepared with bran, cornmeal, milk, and beef drippings may be added, sparingly at first and gradually increasing the amount, carefully watching for any untoward result. As the fox pup becomes stronger both the lime-water and barley-water may be eliminated and the diet supplemented by eggs and later by meat and other materials such as are used for the adults.

Indigestion, manifested either by constipation or diarrhœa must be noted and the formula varied to overcome either condition. When constipation is noted this can doubtless be corrected by slightly increasing the amount of whole milk added. With diarrhœa the increasing of the lime-water and barley-water will doubtless be followed by the desired result.

It will be noted that I have given preference to goat's milk, and my reason for this is the more easy assimilation of the fat of this milk and the butter-fat in the presence of the curd of goat's milk. If cow's milk must be used it should not be from Jersey's or Guernsey's, as the milk of either breed, owing to the large size of the fat globules, forms a solid curd upon coming into contact with the acid of the stomach, and thus the digestive processes are retarded. When goat's milk coagulates in the stomach, a fine granular curd is produced which permits the digestive juices to attack it and successfully prepare it for assimilation. The milk of the Holstein and that of grade cattle have proven to be the best suited for infant feeding, next to that of the goat, and consequently it is assumed that a similar advantage will prove the rule when feeding young foxes.

It may appear that the butter-fat will exert an untoward effect, but from the fact that its natural milk has been removed I believe that but very little trouble will be experienced from this source.

At the outset, artificial feeding will present its difficulties, but a little practice and experience will indicate the pitfalls and ultimately lead to their elimination. I cannot in this very brief résumé give full details to cover the many variations that will be required in actual practice, but believe that the suggestions offered, if intelligently followed, will prevent losses that would otherwise occur.

XI.—THE DISEASES OF THE FOX.

It is not my purpose to enter into a detailed discussion of the diseases of the fox, nor do I intend to dwell upon the methods of combating specific disorders or infections. Such details must be dealt with by individuals specially trained in the diagnosis and treatment of disease who are conversant with the action and uses of drugs. From what I have been able to gather, the fox is subject to disorders peculiar to his species, and also possesses a certain susceptibility to drugs not observed in other varieties of animals. There is more to be learned in this connection, and naturally those veterinarians most intimately associated with the industry are best able to offer advice and deal with disorders at first hand. As our knowledge of their pathology increases as applied to the fox, then the advice which may be given will be of a more exact nature than is at present possible.

I have already pointed out some features worthy of more than passing interest, from the sanitary viewpoint, when dealing with the construction and protection of the ranch (chapters IV and V). As these considerations have been included as a means of preventing disease, it will be timely for me to mention some of the infectious diseases that have already occurred which will prove a constant menace to the success of the industry.

Internal Parasites.—By internal parasites I particularly refer to such as may occur in the intestines, securing the nutriment for their existence from the food that has been prepared by the digestive functions for the nourishment of its host. Probably the most serious infectious process at present confronting the industry is caused by the *Ascaris mystax*, a round worm peculiar to the fox, infesting the stomach and intestines. It has been my privilege to autopsy two fox pups twenty-six days old, and in each case death resulted from infestation with this parasite. The only means of combatting such an infection is to eliminate it before the pups are born, for to have a worm infestation in the pups we must have worms in the adults, the vixen or the male. The worms maturing within the body of the adult lay their eggs within the intestinal contents, pass out with the excreta, contaminate the mammae or teats of the vixen, to be taken into the stomach of the new-born pup with his first nourishment. These worms may attain a length of from one and a half to eight inches. The treatment of little pups is a very hazardous procedure, and may be as disastrous as the parasite it is desired to combat. Treatment, however, is indicated even in the small pups, but with such valuable animals as the silver black foxes, I believe that an examination should be made of the excreta of each adult in September, and if the eggs of this parasite are present, adequate treatment should be undertaken for their elimination, and reinfection prevented. This means some expense, but by the saving of a single pup it would prove an economical investment.

Not only may this worm be present, but there may also be any one of a number of varieties of similar parasites. The *Ascaris mystax* is mentioned as it is the most commonly met with. Some of the others are more difficult to combat, yet all may be eliminated providing the proper measures are followed under trained supervision.

Tapeworms have been found in Canadian foxes, and have caused the death of a number of animals. Of the tapeworms infesting the fox there are nine varieties which have been described. Each of these nine has its own characteristic life-history and a host from which the fox may become infested. A tapeworm is found as such in the intestine of its host, in this instance it is the fox, where it grows by absorbing the partially digested food contained therein. The tapeworm is always provided with suckers, and in some instances with small hooklets for attaching itself in the most favourable portion of the intestine or where the food supply is most suitable. After attaining a certain development the mature segments are fertilized, break away from the head portion and pass out with the excreta. Upon being voided by the animal the eggs contained in the segment are liberated, and if moistened for a few days become fully developed, from each of which emerge a small water parasite. This small water

parasite disports itself until ready for its new host, a species of water snail, making directly for its liver, and there securing itself. A certain further development takes place in this liver tissue and when completed the snail crawls up a blade of grass to sun itself. The parasite now emerges, attaches itself to the grass and forms a protective covering of lime about itself. Here it awaits a new host which in one instance is the rabbit. The rabbit eats the grass, the lime covering is dissolved from the parasite in the stomach and the parasite burrows through the tissues of its new host until it finds a suitable resting place, where, at the expense of this host it envelopes itself in a watery bag to await the arrival of a fox to devour the rabbit and thus gain entrance to the intestine, where havoc is again wrought. This, then, is a hurried sketch of the various stages of development which this parasite must undergo.

With a knowledge of the means by which the above types of parasites develop and infest the foxes, we are prepared to undertake such precautions as will prevent their causing trouble and financial loss to the industry.

Not only are there intestinal parasites which invade the fox, but a fluke which invades the liver has also been found. How dangerous this may prove is at present an unknown factor which future investigation alone can reveal.

External Parasites.—There are parasites which inhabit the external portions of the body, such as lice and fleas, but the most serious is the mange parasite which burrows into the skin. Mange has occurred among foxes, and great care should be exercised in preventing its introduction. Its treatment has presented extreme difficulties, and in many instances is of little avail. As the fox is so different from other animals its treatment must be undertaken by skilled direction.

Febrile Infectious Diseases.—Under this heading will be classed those disorders which are manifested by a rise in the body temperature. There is no doubt but that the fox is susceptible to many disorders of an infectious nature accompanied by fever. Their classification, however, at the present time is out of the question, and I will consider only distemper.

Distemper, similar to that occurring among dogs and cats, has occurred among foxes and is an ever-present menace. With distemper, as with the other disorders of an infectious nature, skilled treatment based upon the symptoms presented must be at hand, and each case dealt with as it occurs. My view here is, that this, as well as all of the other infectious diseases, are best dealt with before they gain access to the ranch. Once they have occurred, each instance must receive individual treatment, as so many variations from the classical type are observed.

Non-Febrile Infectious Diseases.—Very few non-febrile infectious diseases are observed in the fox, other than the parasitic infestations which have already been dealt with. One infection, rabies or hydrophobia, is common to all known animals and to man. On account of the danger of infecting man from the bite of a rabid animal, it is highly desirable that it should be here recorded as an affection which may infect the fox.

Rabies is an infection that can be passed only by the bite of a rabid animal. How much danger there is of this becoming epizootic among captive foxes is unknown, but to be transmitted one fox must be bitten by some rabid animal or a rabid fox, hence the ranch construction should be such as to provide against this contingency should a case unfortunately occur. History records that the Duke of Richmond died near Ottawa of rabies contracted from the bite of a pet fox. I have unsuccessfully endeavoured to secure information regarding the fox in question. At that time rabies was not known to be present among other animals in the locality. We have, however, the report of a case of rabies in man at Victoria, B.C., contracted in the Yukon from the bite of a tame wolf. In the Southwestern States the disease has been reported to be conveyed by skunks to men sleeping in the open.

Such data must be considered in its bearing on the industry surrounding captive foxes, and given its proper weight when dealing with protective problems.

General Considerations in the Prevention of Infectious Diseases.—It has been my effort throughout in the preparation of this report, to point out some of the underlying principles which will prevent the introduction of infectious disease, rather than to enter the field of dealing with the treatment by drugs or otherwise, of every disorder to which the fox is heir. Such descriptions, to my mind, would only increase the uncertainty concerning the disorder or the method of treatment which should be adopted.

For these reasons I have considered it wise to give a great deal of attention to the location, construction, and protection of the ranch. The dead lines will effectively prevent the spread of infectious disease from pen to pen unless the infection is carried by the keeper. I have personally observed keepers passing from a pen in which worms had been found in the deposited excreta, directly to another pen without giving any attention to the cleansing of his boots, which would carry thousands of eggs. This seems to me to be an unwarranted chance where such valuable animals are concerned and, as had already been stated, such verminous infestation should be eliminated from the adult and the ranch. The value of the animals warrants this step being taken. A simple inexpensive precaution is that of having extra rubbers for the keeper, as these can easily be cleansed and disinfected.

On account of the dangers which may attend the promiscuous visiting of ranches by curious strangers, I believe that it would prove a wise precaution to permit them to view the foxes from a point of vantage that will eliminate the danger of introducing infection. If necessary, it would, in my opinion, be an economical procedure to build a suitable observation walk that could be sprinkled with a suitable disinfectant. Visitors introduce a hazardous factor which should be provided for to the fullest extent.

Malignant Growths, Tumours, Cancer.—Such growths have been found in a number of foxes examined at the laboratory under my charge. At the moment I cannot suggest the significance which should be placed on their occurrence, or the danger that may be anticipated. The subject of cancer has, within the past few years, received a great deal of attention from various investigators. The most recent work seems to indicate that diet may play an important part in its occurrence. In a number of experiments it has been shown that the experimental cancer has failed to grow when the series of animals was given a restricted diet, while another series allowed a liberal dietary was severely affected. It has not been possible to secure full details of the cases among foxes coming to our notice in routine laboratory work. I merely mention their existence to indicate a possible danger from this source which will naturally increase with the domestication of the fox.

XII.—TREATMENT OF DISEASES.

I have already pointed out that disorders should be dealt with by some person (preferably a veterinarian) skilled in the diagnosis of disease among animals, and in the use of drugs. With foxes, as with other animals and the human being, proprietary remedies should be regarded with suspicion as they are liable, in inexperienced hands, to do more harm than good. The manufacturers of specifics are anxious to sell their goods, and it is but natural that they should consider their particular formulæ specifics for the disorders described in their literature and booklets.

In my opinion drugs should only be used when the symptoms indicate the necessity, and then only under skilled direction. In diseased conditions we know of but few specifics, and these are of such a powerful nature that the greatest care must be exercised in their administration.

All disorders should be treated from the symptomatic standpoint after a correct diagnosis, and never given a drug on a chance shot, save in extreme cases.