Some problems of the fox-raising industry

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SOME PROBLEMS OF THE FOX-RAISING INDUSTRY.

INTRODUCTION.

The business of fox-breeding, which in the years before the Great War was little more than a speculative adventure, is today a solid commercial enterprise, success in which depends entirely upon the number and quality of the pelts actually sold. In this character it has already attained a truly surprising magnitude. In Prince Edward Island alone there are about 275 fox farms with, it is conservatively estimated, at least 4,000 pairs of breeding foxes. During the season 1918-19 there were offered for sale, at prices ranging mostly from $250 to $1,000, approximately 5,000 skins, and the total revenue of the Island from this source must therefore have been little short of $1,000,000. When it is considered that this province is not the only one in which foxes are raised for their fur (ranches have been established also in New Brunswick, Quebec, Ontario, Manitoba, etc.), and when it is further realized that the pelts produced are practically all exported, it becomes evident that the industry may justly claim not merely a local, but a national importance, which is very far indeed from being negligible. Needless to say, it has not reached this status without encountering a variety of difficult problems. It is the purpose of the following pages to inquire into the nature of these, and to consider whether it would be profitable, and in what manner it might be possible, to attempt their solution.

I. THE AVERAGE YIELD AND THE POSSIBILITY OF ITS IMPROVEMENT.

It can hardly be doubted that under existing circumstances the returns of the industry are on the average lower than they need be. It is, to be sure, impossible to ascertain with exactness either the total number of fox pups born in a given year, or the total number raised to maturity; but the information available would suggest that the 4,000 pairs of adult foxes in Prince Edward Island raised successfully last year not much more than 5,000

pups. This would be an average yield of only 1·25 per pen. Since the number at a birth is seldom less than 3, and is often from 5 to 7, it is obvious that such a figure indicates either a large percentage of infertile matings, or very considerable losses among the growing pups. The exact importance of the first factor cannot at present be even roughly estimated, but as regards the second it would appear to be established, upon the independent testimony of many experienced breeders, that from 40 to 60 per cent of the foxes actually born never reach maturity. The losses thus indicated are largely avoidable, for there are individual ranches where the yield is very much higher than the estimated average. In many it is over 2·5, and it appears that it may sometimes even exceed 4. What can be accomplished by some ranches ought not to be impossible to any. It would be hard to say what may be the practical limit of improvement, but if the actual yield be taken as 1·5, and the generally attainable set no higher than 3, it would seem not unreasonable to hope that the revenues of the industry might, by scientific management, at least be doubled.

II. Factors Responsible for the Low Rate of Increase.

The factors responsible for the low average rate of increase are evidently very numerous, and are not always readily determinable; but most of them appear to be classifiable under one or other of the following heads:

1. Infectious Diseases.
2. Parasites.
3. Food Poisoning.
4. Imperfect Nutrition.

1. Infectious Diseases.

Several ranches are known to have been visited by distemper within the last few years, and it is suspected that others have suffered without permitting their misfortune to become public. While the loss thus caused to the industry as a whole represents probably but a small fraction of the total revenue, a single outbreak may spell at least temporary disaster for the individual.

It hardly needs to be said that the problem presented by distemper is mainly one of prevention. From this point of view the existing practice of many ranches is certainly capable of

improvement. It ought for instance to be a matter of routine, that every fox introduced from another locality should undergo before admission a regular period of quarantine. Not only so, but the foxes should be more rigidly isolated than at present from every contact, direct or indirect, with other animals. It is not definitely known what species are, and what are not, capable of harboring or transmitting the specific virus of distemper; but it would obviously be the part of wisdom to exclude every kind of animal, domesticated or wild, not only from the neighbourhood of the fox ranch, but also from the society of the keeper.

Should distemper once make its appearance in a ranch the most strenuous steps must be taken to prevent its spread. The only hope of doing so, apart from the use, as yet in its experimental stage, of protective vaccines, lies in the prompt and complete isolation of the affected animals, and the thorough disinfection of their pens. Such a procedure presupposes of course the possession by the infected ranch of a special group of pens, separated from its regular system, and capable of serving on occasion as a quarantine station, an isolation hospital, or a special nursery for backward pups. Every fox-breeder will probably admit the desirability of such an arrangement; but there are few as yet who have put it into operation.

2. INTESTINAL PARASITES.

(A) ROUND WORMS.—The majority of the fox pups on Prince Edward Island would appear to become infected by the round worm, several varieties of which have been encountered locally, almost as soon as they are born. How far this almost universal infection is responsible, under existing conditions, for the high percentage of loss among the youngest pups, it is not very easy to say. It has become part of the regular routine of nearly every ranch to administer to each pup, at the end of the 3rd and 4th, and again at about the eighth week of life, some one or other of the various vermicidal preparations upon the market. Many ranchers state that since this practice has been generally adopted the round worm no longer constitutes a serious problem; others regard it still as their most formidable enemy. My own impression is that the latter view is more probably the correct one, and that many of the pups found dead in their nests, or carried out

and buried by the mother, would, if the matter were investigated, be found to have been killed by round worms. This is one of many points which might well be made the subject of careful inquiry.

The pups are generally assumed, probably quite correctly, to acquire the infection during suckling, the teats of the mother fox having become contaminated with the eggs of the parasite through contact with such material as soil, feces, or the bedding of the nest. It is almost certain that the eggs of the round worm exist, and survive the winter, in the soil of every ranch where the parasite has been prevalent; and it is probably of some significance that early litters, born while the snow is yet upon the ground, are, as experienced caretakers maintain, less liable to suffer from worms than the later ones. Unfortunately many of the statements made regarding round worms in the domesticated fox have rested hitherto upon analogy rather than upon actual observation. It is desirable that they should be tested upon the ground, and that the precise mode in which the fox becomes infected, together with the details of the parasite's life history in this particular host, should be established once and for all in an authoritative manner.

Another aspect of the subject which deserves investigation is the possibility of attacking the parasite not after, but before it has gained entrance into the new born pup. If it were possible to destroy in the fall all the worms or eggs infesting the adult foxes, the dens, and the soil of the ranch, there could be no infection of pups in the following spring. This would be a more logical method of procedure than the one now prevailing; whether it is a practicable one can be determined only by experiment.

The worms and their eggs, expelled as a result of treatment, are frequently allowed to lie unmolested in the pens wherever they happen to fall. In view of the highly resistant properties of the eggs this would appear to be a very careless procedure. It should be possible to devise some way by which they could be collected in one spot, and immediately destroyed. The observance of such an elementary precaution would probably do something to diminish the probability of reinfection.

Widely as the round worm is now distributed among the Island ranches, it would probably be an error to regard it as a necessary evil. Ranches exist in which it is alleged that worms

have never been seen, and in which accordingly treatment has never been practised; in others the infection is limited apparently to two or three adjacent pens. It is possible that a rancher starting afresh could by taking proper precautions, the nature of which will readily suggest themselves, stock his pens in such a manner as to harbor not a single worm, and could maintain them indefinitely in that condition. With this problem, as with that of distemper, preventive measures should in the future assume a predominant role. It should, for instance, become a matter of routine to examine for eggs the feces of any new fox, which it is proposed to introduce into a ranch; and in case these are found, to subject the animal before admission to the most efficacious course of treatment that can be devised. Laboratory control of some sort would of course be necessary to the complete success of such a plan.

(B) HOOKWORMS.—The Health of Animals Branch of the Dominion Department of Agriculture has recently found that many domesticated foxes are infected by the hookworm. The presence of this parasite cannot fail to have deleterious effects upon the health and vitality of the animal harboring it. Just how extensive and how serious these effects may be remains to be determined. In any case it will be necessary in the future for the fox breeder to pay attention to this hitherto unsuspected enemy, and to initiate measures for effectively controlling its spread. He can hardly do so without the advice of an expert, and the assistance afforded by a readily accessible laboratory.

3. FOOD POISONING.

Acute food poisoning has on several occasions been responsible for serious losses among both young and adult foxes. This could occur only when the rancher had not taken sufficient care to ascertain the fitness for consumption of the meat he was feeding. It would obviously be to the benefit of the industry as a whole if it adopted some general co-operative system, whereby all meat intended for foxes should be first inspected, and then properly stored in cold storage plants at a sufficient number of readily available centres.

4. IMPERFECT NUTRITION.

However important the factors of loss hitherto discussed, their elimination would leave the average yield of the ranches still

far below its possible maximum. The fundamental problem of the fox farmer, as of every breeder of animals, is one of nutrition; and it is the failure fully to solve this problem that occasions at present the most serious losses to the industry.

If a fox, or any other animal, is to be maintained through life in perfect nutritive condition, its diet must conform to each and all of the following requirements. (1) It must furnish **protein** (flesh-building food) in such quantity and also of such quality as will make good the wear and tear of the body tissues, and provide, in young animals, material for growth. (2) It must have an adequate fuel value or energy content (commonly measured in heat units or **calories**), a requirement best met by supplementing the necessary protein with carbohydrates (starchy foods) and fats. (3) It must contain proper amounts of certain indispensable **mineral** elements, such as phosphorus, calcium (lime), iron, and the like. (4) It must include a sufficient supply of the so-called **vitamines,** essential accessories of unknown nature, the absence of which leads to various types of disordered nutrition, and of which there are believed to exist at least three, (the "fat-soluble the "water-soluble", and the "antiscorbutic").

To what degree these requirements are met, or fallen short of, in one fox ranch or another, it is not at present possible to decide. It is of course easy enough to obtain a list of the articles that make up the foxes' menu; but to ascertain, item by item, the actual food consumption of the individual animal, (which is what really counts), is quite another matter. Such information, as it has hitherto been possible to collect, touches merely the qualitative aspect of the problem. Any attempt, therefore, here made to correlate the nutritional disorders reported with specific defects of diet is to be regarded as purely preliminary in character.

The most striking feature of feeding practice, as it has come under my observation, is its lack of uniformity. Each ranch seems to have worked out more or less independently an individual plan, and, so long as this operates with even moderate success, it fears to risk a change. Failure and success alike have been largely the result of chance. The diets in use have in short been developed largely at haphazard, and, generally speaking, with few guiding principles other than the supposed habits of the wild fox. It is assumed, rightly or wrongly, that the latter lives almost

exclusively upon flesh, and accordingly meat in one form or another forms the principal ingredient of nearly every dietary. The chief variety employed is horse-flesh, most of which is imported from Montreal or Toronto; coming, as it does, from old and exhausted animals, it is conspicuously devoid of fat. Other food materials, entering into the dietary of one ranch or another, are listed below;

Meat: (besides horse-flesh), beef, mutton, veal, pork, rabbit and chicken. Fish: smelts, salted fish (with the salt removed by washing in water). Offal: liver, tripe, the entire viscera of small animals. Cracklings. Eggs. Milk: whole or separated, raw or pasteurized, condensed or evaporated. Home-baked bread or biscuit. Flour: graham flour, whole wheat, cornmeal. Porridge: oatmeal, barley, rye, wheat, bran. Shredded wheat. Rice. Fox biscuits of various makes, especially "cod-liver-oil" biscuits. Apples.

It is difficult from a mere list of the sort given to form any judgment of the general adequacy of the diets consumed. Probably they satisfy in general the first two requirements that have been laid down; there is considerable reason to doubt whether they fully meet the third and the fourth. It is to be remarked that the majority of the articles named are drawn from two sources, namely meat and the cereal grains. A diet absolutely restricted to these would be decidedly deficient in certain mineral ingredients, for instance calcium (lime), and would moreover fail to provide a proper supply of the indispensable "vitamines". The deficiencies would be all the greater if the meat, like that chiefly fed to foxes, were practically free from fat. They might be corrected in part or in whole by the addition of fats, offal, green vegetables, eggs, or milk. **Fats** and fatty portions of meat ought to appear in the diet of foxes much more liberally than they do, not so much as vehicles for the fat soluble vitamine, in which the body fat of animals is not particularly rich, but in the general interest of a well balanced ration. **Offal,** such as liver and tripe, is a good source of the fat-soluble vitamine, and might with advantage be much more generally utilized than it is. **Greens** would supply not only vitamines but also calcium, though it is doubtful whether they could be fed to foxes in sufficient quantity to afford any important supply of the latter. In existing practice they are not

fed at all. Nevertheless the fox exhibits an appetite for a certain amount of vegetable material, and is often observed to nibble grass or the leaves of trees. This indicates in all probability a real physiological need, and the deliberate provision of some leafy materials from time to time might therefore be beneficial. Possibly some kinds of desiccated vegetable could be successfully utilized. **Eggs** are capable of supplying every requirement of a growing animal, except possibly calcium, and will of course supply this also if the shell is eaten. **Milk,** in sufficient quantity, will make good any dietary deficiency whatsoever, and the more extensive use of milk, when necessary suitably modified, would perhaps solve not a few of the nutritional problems at present confronting the fox raiser. It is true that milk already occupies a place in the diet list of practically every ranch I have visited. But it may be questioned whether the amount fed is universally sufficient to make good the defects of the meat and cereals which supply the bulk of the nutriment. There exists among breeders some difference of opinion as to the best form in which to administer milk to foxes. The proper practice would probably be to use only raw whole milk. To remove the fat is to remove an important nutrient, in which the diet as a whole is already deficient, and with it the associated fat-soluble accessory; while to heat the milk is to destroy or diminish its vitamine content in general, and therefore seriously to affect its growth-promoting and protective properties.

When cow's milk is used for the feeding of very young foxes, it ought, we may assume, to be so modified as to approximate in composition the milk supplied by the vixen. Unfortunately the exact composition of the vixen's milk is not known. There is on record but one analysis, and that a very imperfect one, of a sample which may or may not have represented a fair average. So far as it goes it indicates a much higher fat and a much lower sugar content than cow's milk. This is quite in accord with what is known of the milk of small animals in general. It would therefore seem reasonable to use for the growing pup cow's milk of the highest obtainable fat content, and even to enrich this by the addition of a suitable amount of cream. But before the fox breeder can be furnished with authoritative guidance in the adaptation of cow's milk to the successive stages of the young animal's growth, it will be necessary to secure more comprehensive and

accurate data upon the composition of vixen's milk, not only in regard to organic but also inorganic constituents. The immediate need of such data should not be forgotten in any experimental work which may be planned in the future.

The dietary imperfections, to the probable existence of which attention has been drawn, are likely to be most conspicuous during the winter season. The reason for thinking so is that milk is never included in the diet until after the pups are born in the early spring. This situation is the more unfortunate since a diet of meat and cereals alone furnishes a particularly poor provision for the requirements of pregnancy and lactation. If the practical difficulties that have hitherto excluded milk from the diet of the pregnant female cannot be overcome, other sources of calcium and of the fat-soluble accessory become an absolute necessity. Eggs (with the shell) would provide both, bone-meal might be useful in supplying the former, and the latter could be derived from the liberal use of liver, tripe and other glandular materials. Many of the most successful ranchers have been led by experience to include one or more of these articles of diet in their winter regime. In others the situation is perhaps saved to some extent by the use of cod-liver oil biscuits.

Reference has been made to the possibility of a deficiency of calcium in the diet of the foxes. The other inorganic constituents of the food also demand attention. Many caretakers appear to be very much afraid of giving their foxes too much common salt, and it would not be surprising if this fear led occasionally to a deficiency of sodium. It might be a good plan to leave the solution of this question to the fox itself, by placing in each pen a lump of rock salt.

A human subject restricted to the articles which have been actually used in feeding foxes would stand a considerable chance of being attacked by scurvy. The only foodstuffs in the list already given, which contain the "anti-scorbutic" vitamine, are milk, which is not particularly rich in it, and probably apples. Scurvy is a disease from which flesh-eating animals are not positively known to suffer; it is none the less possible and indeed likely that they require for the maintenance of perfect nutrition a supply of the antiscorbutic element present in green vegetables, fruits, and many tubers. If such a requirement does actually exist, it is

in most ranches rather imperfectly met. Although apples are fed liberally in certain of the more successful ones, in the majority they are used very sparingly if at all. There is much to be said for their regular inclusion in the diet.

After this general discussion of feeding practice in the fox industry it remains to consider which, if any, among the actually prevalent sources of damage or loss may be in whole or in part the consequence of imperfect nutrition. The list of reported complaints in which a nutritive defect of some sort may with reason be suspected to be a factor is, as a matter of fact, quite large. It would include, e.g., rickets, convulsions, sore eyes, still births, the abandoning or even the killing and eating by the mother of her young, premature cessation of milk supply, early death of the young, failure to grow, failure to reproduce, and imperfect development of fur.

During recent years there have been conducted in different laboratories a great variety of experiments in which rats, guinea pigs, swine, or other animals have been subjected for longer or shorter periods to the influence of variously restricted diets. Among the results of these experiments one may find, singly or in various combinations, every one of the abnormal conditions just mentioned. This does not necessarily mean that these are always to be attributed to a dietary factor. The habit of killing and eating the young, for example, may be merely a vice, inherited or acquired, in which case there is nothing to be done but to destroy the animal. What the experiments referred to demonstrate is that this, and the other conditions named, may be, and doubtless often are, the consequence of improper feeding. It is probable that most of them would become much less common if the foxes could be assured a diet which supplied continuously each and all of the factors essential to perfect nutrition.

Incidentally it may be pointed out that we do not know definitely the normal duration of lactation in the fox, nor its normal growth curve. These furnish problems that should not be forgotten in any experimental study of the growing fox's nutrition.

III. Further Considerations Affecting the Returns of the Industry.

The problem of reaching and maintaining a maximum return involves more than the successful rearing to maturity of every fox that may happen to be born. It is of equal importance that the number born should be as great as the nature of the case makes possible. This implies that in any complete study of the problems of fox-raising questions of fertility and fecundity must be taken into account. These are undoubtedly in part questions of nutrition, but other factors—hereditary, psychical, climatological, etc.,—are also in varying degrees involved, and it would be desirable to have their relative importance more exactly elucidated.

A not irrelevant question is that of the proper age for the first reproductive effort of the adolescent animal. It has become the practice to mate the foxes selected for breeding purposes at the earliest possible moment, that is, in the winter following their birth, while they are yet less than a year old. It is very doubtful whether this is a practice to be recommended, and it should be considered whether it would not in the long run be more economical to postpone mating till the animals reach their second winter. A series of comparative tests might be planned to throw light upon this problem.

Again, mere numbers is not enough. The final aim of the fox-industry is the production, not so much of perfectly nourished and healthy animals, as of valuable pelts. These are by no means necessarily the same thing. A red fox may be physiologically as perfect an animal as it is possible to conceive; in the market value of its fur it may be far surpassed by a pure-bred silver fox exhibiting the worst deformities of rickets. The fox in captivity is bred in short for certain special characters, and a failure to present these in perfection is as definitely a source of loss to the owner, as early death from malnutrition. Beside the fundamental problem of nutrition we must place therefore the fundamental problem of breeding and inheritance. The more important aspects of this problem, as related to the fox industry, will be discussed in another publication of the Research Council.

IV. Recommendations.

The preceding paragraphs have indicated the existence, in connection with the fox-breeding industry, of a large variety of unsolved problems. Their final solution must await the outcome of appropriately planned experiments. The information collected is however already sufficient to suggest certain improvements in existing practice. These may for convenience be thrown together here in the form of recommendations addressed to the fox-breeder.

1. An endeavour should be made to supply in the diet more fat, a certain amount of green vegetables, and especially more milk, the fat of which ought not to be removed. A special endeavour should be made to feed milk during the winter, in which attempt the possible usefulness of whole milk powder should be remembered. The winter diet should also contain liberal amounts of tripe, liver, and eggs. Raw apples should be fed whenever it is possible to obtain them, as well as, if they prove acceptable to the foxes, raw potatoes or turnips.

2. A lump of rock salt should be placed in each pen.

3. The adult foxes should be treated for worms in the fall, and an endeavour should be made to exterminate all eggs in the pens before mating takes place.

4. All wild or domestic animals should be rigidly excluded from the neighbourhood of the pens.

5. Each ranch should maintain a small quarantine station and isolation hospital.

6. Cold storage plants should be provided for the different sections of the island, and provision should be made for the careful inspection of all meat fed to foxes.

7. It would probably be wise to abandon the practice of mating young foxes in their first year of life.

8. The fox-breeders should form an association for the registration of their valuable animals, and each should maintain a continuous record of the actual performance of its stock.