

THE SUPPLY OF NON-TUBERCULOUS DAIRY STOCK.

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THE object of this paper is to draw attention to the need of a further supply of sound dairy stock. Three main arguments in favour of this proposal have occupied our minds: (1) that the loss to the dairy industry through tuberculosis in cattle amounts to a considerable sum each year, (2) that there is serious loss in human lives due to bovine tuberculosis, (3) that, owing to their dearth in the country, there should be sufficient demand for sound dairy stock to place a farm devoted to the rearing of such cattle on a sound financial basis. The last part of this paper deals with a proposal to carry out this scheme.

The annual loss to the dairy industry through tuberculosis is undoubtedly considerable, although the loss to any individual farmer is very difficult to estimate. The following table is probably a very moderate estimate of the amount of this loss:

Cows and heifers, etc., 2 years and above in England and Wales in 1913	3,415,028
2 % of these being wasters	68,300
Wasting probably due to tuberculosis in at least one- third of cases	22,766
Average loss on each waster	£12
Total annual loss	£273,192

It would be possible to give a very much more accurate estimate if a birth and death register of dairy cattle were kept. When we

remember the extreme and ever-increasing value of the Registrar General's records of births and deaths for human beings, and the extraordinary influence these have had on modern legislation in producing a nation, longer lived and healthier than has ever been known in the past, it seems incredible that no attempt has been made to establish similar records for one of the most important industries of our country. Progress in the prevention of diseases of animals must always be hampered so long as there are no true records upon which to base procedure. A small fee to the veterinary surgeon would produce a record of constantly increasing value, which would bring home to us the true extent of our losses and direct our energies to the most pressing problems of the diagnosis and prevention of animal disease.

It was hoped that the Tuberculosis Order, which deals with tuberculosis of the udder, tuberculosis with emaciation, and cows giving tuberculous milk, that is to say, advanced cases only, would give a measure of the extent of patent tuberculosis. This result cannot yet be said to have been attained. Professor McFadyean has recently pointed out that the number of cows and heifers in milk or calf in Great Britain in 1913 was 2,695,391. During the twelve months, April 1913 and April 1914, notice was given under the Order of the intended slaughter of 6738 bovine animals, or 1 in 400 of the cows and heifers in milk or in calf. These figures indicate that the provisions of the Tuberculosis Order have been evaded by the great majority of owners, and that probably not more than 25 % of the clinically tuberculous animals have been reported. It is probable that Professor McFadyean's estimate is correct.

We have ourselves made an attempt to estimate the possible number of cows supplying tuberculous milk for human consumption in England and Wales. Our calculation is based on the statistics obtained by the examination of samples of mixed milks in London and Manchester for tubercle bacilli. Of 15,008 samples, 9.3 % showed *Bacillus tuberculosis*. These results have been obtained in large cities, where the routine examination of milk for tubercle has been carried out for many years. This is known to the farmers supplying these cities. In districts where less strenuous efforts are made a very much larger proportion of tubercle bacilli is found in mixed milks, thus Mitchell, for example, found 20 % in milks bought in Edinburgh dairies. Similar results have been obtained in country districts where supervision was not stringent. If we take 10 % as an average this is certainly not too high an estimate. On an average a milk churn contains the milk of 15 cows, and therefore

at least one cow in 150 is excreting tubercle bacilli in its milk. The total number of cows and heifers in milk and in calf in England and Wales in 1913 was fully 2,250,000. Of this total 1,750,000 may be assumed to be concerned in the supply of milk and milk products for human consumption. On the basis that 1 cow in 150 produces tuberculous milk, a total of 11,666 cows and heifers in a dangerous state of tuberculosis is obtained. It is interesting to note that a similar result is obtained by a different method. It was assumed on an earlier page that 2 % of the cattle over 2 years old in England and Wales were wasters, and that one-third of this 2 % suffered from "tuberculosis." Two per cent. of the 1,750,000 dairy stock is 35,000 and one-third of this number is 11,666. We are aware that these calculations are subject to criticism, as for example, that the same cow may be infecting the milk of two dairies, that some of the samples may have contained tubercle bacilli of human origin, that some of the samples taken may have been repeat specimens, etc. It is none the less interesting that the two methods adopted give results so closely corresponding one to another, and it cannot be denied that they are appreciably lower than those usually stated, yet represent a very definite loss to the dairy industry. It must also be remembered that the Tuberculosis Order was designed to remove from herds the most extreme cases of infection, it does not affect the vast majority of the cases of tuberculosis.

From all the evidence at present available, it may be taken that about 30 % of the cattle in this country are affected with tuberculosis and that of the total cattle not more than 2 % will be in such an advanced state of the disease as to be affected by the Tuberculosis Order. What then is to become of the remaining 28 %? Some will pass on to advanced tuberculosis and eventually come under the Order, having in the interval infected other animals in the herd. Some, exactly what proportion it is impossible to say, will remain chronic sources of infection; since the work of Griffith, Klose, Rosenberger, Phillip and Porter, Moore Alexander, etc., has shown quite clearly that, whatever the situation of the tubercle bacilli in the body may be, they may escape from the animal in the various excrements.

Schroeder writes: "Tuberculosis of cattle, as of persons, may be acute or rapidly progressive and run its ordinary course quickly from infection to death. This is rare. As a rule it is insidious, chronic and slowly progressive, and the bodies of its victims are able to adapt or adjust themselves to the gradually increasing, destructive changes it causes until quite extensive harm has been done or vitally important

organs have been seriously involved. The result is that the disease may be present in the body for a long time without external manifestations of its existence. It may attack any part of the body singly and remain confined to it or it may attack several or many parts simultaneously or successively. Its favourite location in the bodies of cattle, as in those of persons, is the lung... Tuberculosis is more effectually concealed in the bodies of cattle than in those of persons, and we all know how long a diagnosis with persons may remain in doubt...." Schroeder then proceeds to show that excessive coughing is very rare in cattle and occurs only during the last stage of pulmonary tuberculosis, that when cattle cough, they do not expectorate, but only raise the material which has accumulated in their air passages far enough into their mouths to be swallowed. "The tubercle bacilli that are expelled with the faeces per rectum have their origin in the lung more commonly than elsewhere. They are raised into the mouth and then swallowed and on their way through the intestinal tract become evenly mixed with the material that is ejected as faeces from the bowels; the result is that the large amount of faeces passed by cows, about 30 lbs. per day by a cow of average size, introduces an enormous amount of infectious material into their environment when they are affected with tuberculosis." Further, after giving numerous illustrations of cattle which were apparently in good health, yet were shedding tubercle bacilli in their excreta, he concludes that, "with few exceptions, the character of tuberculosis among cattle is that of an effectually concealed disease, the detection of which before it is well advanced and has done great harm is impossible through the agency of our own unaided powers of observation. Fortunately we have in tuberculin an excellent agent for detecting tuberculosis in cattle when all other means of diagnosis fail." It is impossible to say what will be the ultimate fate of an animal which reacts to tuberculin; the certain fact is that among these animals there are those which do not come under the provisions of the Tuberculosis Order, yet are a constant source of infection in the herds in which they exist, and are the cause of very considerable loss to the farmer.

We have shown that the loss to the dairy industry through bovine tuberculosis is considerable, we feel that we ought also to give some measure of the loss in human life, especially as lately some very thorough and interesting work has been published on this subject, and the longer the work continues, and the more carefully it is done, the greater is the conviction that, if tuberculosis is to be eradicated in man, bovine

tuberculosis cannot be neglected, especially as a disease of children. Twelve months ago we published a paper, in which we estimated that at least 4000 children a year died of this disease, and that there are always 40,000 children suffering from it. The annual loss to the country in extra expense due to this illness must be, therefore, not less than about £400,000. About the same time, Délépine published a paper in which he showed that in Manchester, where very special efforts have been made to secure a tubercle-free milk supply, the death rate from those forms of tuberculosis due to bovine infection had decreased more rapidly than those forms due to human infection. The results of recent investigations confirm these statements. Thus Eastwood, F. Griffith and A. Stanley Griffith investigated the incidence of tuberculous infection in a series of children (hospital cases), dying from *all causes* between the ages of 2 and 10 years, with the following results :

Cases investigated	195
Cases showing tubercle bacilli	118
Cases in which tubercle bacilli could not be grown, their nature (human or bovine) could therefore not be determined ..	20
Cases in which the bacilli could be grown	98
Cases of bovine tuberculosis	17
Cases of human tuberculosis	80
Case showing both bovine and human types of bacilli	1

These figures are of great interest. They show, in the first place, that of a very large proportion of these children dying from *all causes* about 60 % suffered from tuberculous infection, and that in those cases in which it was possible to obtain growths of the bacillus, rather more than 17 % were of the bovine type.

Fraser and Mitchell in Edinburgh have investigated this question from another point of view. Fraser examined tuberculous material from 40 children, aged 0 to 5 years who were suffering from tuberculosis of the bones and joints, and found the infection to be bovine in 28 cases, 12 being infected by the human type of bacillus. He also examined tuberculous material from 23 children aged 5 to 16. In this series the bovine type of bacillus was the cause of infection in 9 cases. Mitchell showed that, of 80 cases of tuberculous infection of the glands of the neck in children, 71 were caused by the bovine type of bacillus. In America similar results have been obtained. Of 95 cases of tuberculous infection of the glands of the neck, 51 were due to the human type and 44 to the bovine. Again, in cases in which the infection was in the abdomen, it was found that of 86 cases 34 were infected by the

human type, 52 by the bovine type of bacillus. All these statistics concern children under 16, that is to say, the chief milk drinkers. It is not claimed that bovine tuberculosis causes more than a fraction of the total death rate from tuberculosis, but it is a fraction, a very definite fraction, which causes the loss of valuable lives and is a constant source of expense to the country.

Since the loss to the dairy industry is considerable, and the loss in human lives is not to be neglected, an increase in the supply of sound cattle should appeal, both to the Agricultural and Public Health Authorities. It should also appeal to the financier, for there is no doubt, that at the present time, there is a dearth of dairy stock. The Board of Agriculture and Fisheries reports (Cd. 7325) that for the year 1913 "the number of cattle of all classes was 5,716,944, being 124,776 (2·1 %) fewer than in 1912, and 197,303 fewer than in 1911, when the stock of cattle was the largest yet returned. The total in 1913 was the lowest returned since 1904.

The net reduction of 124,776 cattle was made up as follows: cows and heifers in milk, decrease 141,458; cows and heifers in calf, but not in milk, increase of 57,942; other cattle, 2 years and above, increase of 38,430; other cattle, 1 year and under 2, decrease of 78,882; and other cattle under 1 year, decrease of 808." This decrease in the dairy stock of the country together with the facts previously stated showing the loss from Tuberculosis both in cattle and man makes it evident that it is highly desirable to take further steps to lessen the prevalence of this disease. The question therefore is, how can this best be done so far as cattle are concerned? To answer this question three propositions must be considered:

- A. The method of diagnosis must be as accurate as possible.
- B. There must be complete separation of infected from non-infected animals, and the thorough disinfection of cow byres, etc.
- C. Possible fresh sources of infection must never be re-introduced into a tubercle free herd.

A. No one will deny that it is quite impossible to diagnose tuberculosis in its early stages by clinical methods alone. There remain, however, other methods of diagnosis, of which the tuberculin test, when properly carried out, gives results the accuracy of which is not obtained in any other way, *e.g.* the Royal Commission on Tuberculosis tested 1000 healthy Jersey calves and obtained a reaction on four occasions, an error of 0·4 %. Délépine, in the Ford Bank experiment, in which

comparatively few cattle were tested, found that "tuberculin applied to cattle not exceeding 8 or 9 years of age may give absolutely reliable indications at the first application of the test in 98 % of the animals tested, and that by repeating the test after an interval of 2 or 3 months the margin of error may be reduced to nil by careful consideration of the state of the animal." Nocard says that "everyone admits the exactitude and wonderful accuracy of tuberculin as a means of diagnosis." Unfortunately everybody has not yet admitted it, and therefore it is necessary to lay some stress upon this point. Where the accuracy of the test is accepted and the farmer has had it applied to his cattle, it is most essential that he should carry out *B*, the separation of the reactors from the non-reactors, and the disinfection of all cow byres, etc. It is possible for an enlightened farmer possessing the necessary buildings to carry out these conditions, fattening and killing his reactors, and cleansing and disinfecting his buildings, and many would be prepared to do it, in spite of the fact that there must be loss upon the animals which are discarded and some dislocation of their milk contracts, if they could only be certain that it was possible to replace their discarded cattle by thoroughly sound stock. At the present time there are only two ways by which a farmer can replace his stock: (1) he must purchase in the open market without any reference to the tuberculin test, or (2) purchase them subject to the test. These methods are unsatisfactory. One very large dairy farmer informed us that 50 % of the cattle purchased by him under the second method reacted after being three months on the farm, while the purchase of cattle by the first method with subsequent testing is almost certain to involve serious financial loss.

Many farmers who are willing to have their cows tested and possess satisfactory buildings for isolation have hesitated because of this difficulty of replacement of stock, and under the present conditions they cannot be blamed. It appears that at least two possible ways might be found out of the difficulty; that the farmers should combine together and use one farm as an isolation station. It is very improbable that such a scheme is likely to be adopted in this country at the present time. That centres should be established for the production of warranted stock, which should be sold to farmers prepared to take the necessary steps to clear their herds and to keep them clear.

In any scheme which might be offered to fulfil this object it must be remembered that it is essential to be able to produce a sufficient supply of milch cows, and therefore, it does not seem advisable to adopt

a method which involves a breeding herd, as there would be danger of excess of bull calves in some years. The plan proposed is that calves (mostly heifers) should be purchased within a very short period of birth, and should be reared under the best conditions, all those which reacted to tuberculin being eliminated and the remainder sold as down-calving heifers.

This plan offers a very excellent chance of success, especially if the precautions mentioned in the later part of this paper are adopted, since tuberculosis is extremely rare among young calves. The following statistics are sufficient to establish this fact:

	Slaughtered	Tuberculous
Saxony 1895		
Cows	39,495	32.49 %
Bulls	18,149	20.99 %
Calves	201,643	0.24 %
Kiel 1895-1898		
Calves less than one week old ..	21,858	0.63 %
Flensburg 1899-1906		
Calves	24,828	0.72 %
Schwerin 1893-1903		
Calves	43,449	0.21 %

The idea of a farm specially adapted and used for the rearing of calves is therefore most likely to meet the requirements of the situation, and the large number of progressive farmers who are at present considering the advisability of having their cows tested, with a view to obtaining a "free" herd, makes it abundantly clear that were heifers from such a farm available there would be no lack of purchasers. The most important points of such a scheme are discussed below.

Type of farm required. The farm on which the calves were to be reared would be required to be carefully selected and would necessarily be one naturally well fitted for the purpose, *i.e.* one with a fair acreage of grass land of moderate quality, fields with a certain amount of shelter and fairly dry buildings on a healthy site, and a plentiful supply of good water. A small acreage of arable land (say one-fifth to one-quarter of the whole) would be desirable in order to grow a supply of roots and hay for home consumption, while of the grain crops oats would be generally preferable, as both the straw and the grain would be useful, the value of crushed oats as a food for young calves having recently been convincingly proved by the Royal Agricultural Society's experiments at Woburn.

Management of the calves. The calves would be taken from their

dams when three days to a week old and transported to the farm, there to be housed and fed with all possible care. When old enough they would be tested, and all reacting to the test would be slaughtered. It is obviously much cheaper to slaughter calves a few weeks old than to rear them to maturity and then test, isolate and dispose of them with all the associated risk of infection and death.

Non-reacting calves would be kept by themselves and fed most carefully, using either milk which was known to be free from tubercle, pasteurized milk, or some of the numerous milk equivalents which have been tested and proved satisfactory. They would be reared generally under perfectly hygienic conditions, the object being to produce heifers which have not been in any way pampered or made too fat, and which are likely to turn out satisfactory dairy cows with thoroughly sound constitutions. Any animals showing signs of illness would be at once isolated. The second tuberculin test would be carried out when the animals were 12 months old, and finally before being put to service, the reactors, if any, being isolated and fattened.

Those showing no reaction at this time would be served by a non-reacting bull and would be ready for sale as down-calving heifers when $2\frac{1}{2}$ to 3 years old. The bull used should be a pedigree or half-pedigreed bull and descended from a milking family with good milk records.

Purchase of calves. For such a scheme as the above to be successful care would have to be exercised in the selection of the heifer calves. Many dairy farmers who at present do not rear any calves because of the value of their land or the lack of accommodation have cows of excellent type, but use a bull of very inferior quality. While the calves from such a bull are likely to be far from satisfactory for the purpose in view, those from the same cow by a pedigree or half-pedigreed bull would be very desirable animals, and valuable additions to the dairy stock of the country. Prices on a slightly higher scale might be paid where the calves were by a pedigree bull or where the farmer kept milk records and information on these points was obtained when the calf was bought. In the districts where Milk Record Societies are in existence it should be possible to arrange for a supply of calves from cows with known records, and in this case a few bull calves from exceptionally good cows—good in type and substance as well as in milk yields—might also be purchased and reared to be sold later as non-reacting dairy bulls of definite milking ancestry.

Now that the value of milk records in the dairy industry is being more generally recognised, there should be a keen demand for well-

grown heifers from cows with known records and in-calf to a good dairy bull.

At the beginning of any such scheme it would probably be impossible to consume all the home-grown fodder, or to make any quantity of dung with simply a stock of calves, but this difficulty could be largely overcome during the first year or two by the purchase of a number of heifers fit for service. These would be tested, all reactors isolated and fattened, and the remainder served and sold as down-calvers. If Irish heifers were bought it is probable that but a small percentage would be found to react to the test.

By the third year there should be a full complement of home-reared stock, and from that time onward it should be possible to say that all animals on the farm were free from tuberculosis.

Buildings. On most farms which would be at all suitable for the purpose of this scheme it is highly probable that there would be buildings which could be adapted to the housing of yearlings and bulls besides the necessary stables and food store, but it might be necessary to erect, or to alter materially a building which would make a satisfactory calf shed, and another which could be used as an isolation shed.

The calf shed would be for the accommodation of calves which had passed the test until they were beyond the stage for requiring liquid food. Such a shed must be warm, well ventilated and lighted, and capable of thorough disinfection; a concrete floor would be desirable with the walls of smooth concrete for three or four feet from the ground. Small pens of 20 to 25 square feet should be provided for the youngest calves to keep them from sucking each other; the partitions should be raised from the floor level and should fit into sockets in posts set in the concrete, but be capable of easy removal for thorough disinfection; also feeding would be greatly simplified if the partitions were made of open wood-work with movable spars. If it were necessary to economise space the calves could be tied by the neck in a part of the shed fitted for the purpose.

For calves which had passed the stage of liquid food, pens could be used large enough to accommodate four to six calves, with a feeding trough along one side, but such a trough should be fitted with ties or stanchions so that each calf may get its share of food. One large shed could be arranged with small pens for single calves, and larger pens for groups of calves, while if a new building had to be erected, the width, slope of floor, position of door, etc., could be so planned as to make it easily convertible into a building suitable for some other purpose.

The isolation shed would need to have a sound floor, smooth walls, and be easily capable of thorough disinfection.

A small separate compartment for the food store, convenient to the calf shed, should be reserved for the calves' food and fitted with a boiler to supply hot water for the preparation of the food, washing of pails, etc.

Supervision. It is essential to the success of any such scheme that the farm should be conducted in such a manner as to warrant implicit confidence being placed in the quality of the stock it produces, and their freedom from tuberculosis.

There are several cases on record and many others known to farmers throughout the country, where unsuccessful attempts have been made to get "free" herds, and when these cases are enquired into it is usually found that some important details have not been attended to—iso-lation has not been properly or effectively carried out, disinfection has been irregular and inefficient, quarantine periods have not been properly observed, etc. Where a disease is so widely distributed and of so insidious a nature as tuberculosis, it is of supreme importance that all these points receive careful attention. When it can be once said that a farm or herd is entirely free from the disease, no effort should be spared and no precaution neglected to prevent its re-appearance, and on such a farm as that suggested above the adoption of the most improved methods to obtain this end would need to be insisted upon. It would be equally necessary to be sure that all these methods were competently carried out.

It would be desirable that accurate records be kept of the history of all animals, so that the fullest information as regards their ancestry and health might be at the disposal, not only of the owner, but also of the prospective purchaser. The purchaser of any animal from such a farm should receive a certificate giving full particulars, with dates, etc. of the tests to which it had been subjected, while the animal itself might be tattooed in the ear, or otherwise marked in such a way as to make identification always possible. If the subsequent performance of heifers sold from the farm were recorded much information would be obtained regarding the effect of the sire in the inheritance of milk production.

While it may readily be granted that the establishment of such a farm is desirable, or necessary, before substantial progress can be made in the eradication of tuberculosis from our non-pedigreed dairy herds, the actual launching of any such scheme will undoubtedly require

careful thought and the co-operation of the practical farmer and breeder with the veterinarian and bacteriologist.

The suggestion has already been made that the local authorities, by establishing and maintaining clean herds for the supply of milk to public institutions would supply valuable object lessons¹, and several city councils have already moved in this direction. Also in the Remkold district in Denmark an association of farmers has been formed with the intention that members shall have free herds, so that the district may become a centre for the breeding and distribution of sound stock².

In this country some progress has been made in the same direction by the farmers in Wensleydale who are members of the Wensleydale Pure Milk Society, Limited, but in this case it is specially stated that the chief disadvantage the farmers suffer from is the fact that they are continually buying and selling cattle, and thus frequently running the risk of introducing fresh sources of infection.

There are several sources from which the initiative and capital required to commence such farms might come. Where the farmers are already formed into societies dealing with stock breeding or milk records a move in the direction of the tenancy and management of a farm for the rearing of their own calves would not be impossible; it is but a step further from the co-operative societies engaged in the purchase of manures and foods, and the growing of farm seeds.

Perhaps the conditions of dairy farming which lend themselves most readily to the establishment of such a farm is where a farmer or landlord works several farms and keeps a large number of cows; one of these farms could be equipped and used as a rearing farm for the heifer calves, and the herds of cows at the other farms could be tested and brought up to the "free" standard one at a time. A farm of 150 acres should keep 100–120 stock of all ages and have 30–40 in-calf heifers per annum after the second year. Under such conditions the farms would ultimately have only home-bred "free" stock and be entirely independent of outside purchases except for occasional bulls.

A third possible method of commencement is the taking of a farm by one or more individuals and the management of it on the system outlined above, with whatever modifications might be necessary to suit local conditions. Careful calculations have been made as regards the capital required and the probable returns, and the prospects of such a

¹ Dr Eastwood's Report to the *Local Gov't. Board*, p. 26.

² *Journal of the Board of Agriculture* for July, 1913.

venture appear to be distinctly bright simply as a business proposition. Dairy farmers in the South of England will agree that for some time back the prices made by good class heifers have been more satisfactory to the seller than to the buyer, and that any change in the situation is unlikely to take place for some years to come.

As is usually the case on taking a new farm, no profit would be made in the first, and perhaps the second year, but afterwards a satisfactory return should be obtained on the capital invested, while a distinct step forward would have been made towards the complete eradication of tuberculosis.

It has already been pointed out that the Tuberculosis Order of the Board of Agriculture and Fisheries, while stamping out of our herds the most flagrant sources of infection, still leaves in those herds animals infected with tuberculosis, some of which will themselves become active agents in spreading infection both to other members of the herd and also to the milk supply. The present Order can, therefore, have no finality. The recently introduced Live Stock Scheme of the same Board gives facilities for the small farmer to improve his stock, but does not provide him with sound cattle. Could not, therefore, another scheme be evolved which would bridge the gap and supply the farmer, not only with better stock, but also with sound stock?

Rearing farms carried out on the lines here suggested would appear to accomplish this object, and if taken up by responsible authorities, would be of the greatest assistance in the improvement of the health and quality of dairy cattle. Moreover, such rearing farms could be made financially successful. The proposal seems worthy of the consideration of county and other authorities, and its value would be still further enhanced if a system of inspection and registration of rearing farms and their stock were devised. The work accomplished by the Tuberculosis Order would be thus extended, and dairy farmers would be encouraged to have their herds tested if they knew that they could replace the reactors by sound stock. It would also increase the number of calves reared and lead to a better supply of milk-cows of known breeding, good type and sound constitutions. Finally, in the course of time, small areas would arise in which all stock would be guaranteed non-tuberculous. Such areas would be models of management and centres for the breeding and distribution of healthy cattle, an advance, of incalculable advantage not only to the individual, but also to the State, with a far-reaching influence in reducing the present enormous mortality from tuberculosis.