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Analysis of Post-Mortem Data on Tuberculin Reactor Cattle (1970-90)

D. Byrne

Introduction
Little detailed analysis has been undertaken of the extensive database on the post mortem findings on tuberculin reactor cattle slaughtered over the past twenty years.

Over 700,000 reactors were slaughtered in the period from 1970 to 1990. In most years the figure was around 30,000. Since 1988, data have been accumulated at individual animal level on over 125,000 reactors.

For the purpose of this study reactor cattle were divided into three categories, namely, light stores (under 200kgs deadweight), heavy stores (over 200kgs deadweight) and cows.

Data were compiled nationally and for each of the four ERAD regions, viz. the North West, North East, South West and South East.

Results
The percentage of reactor cattle showing visible Tb lesions at slaughter increased steadily for most of the twenty years from 1970 to 1990, rising from an average of less than 20% in the early 1970's to over 30% in the late 1980's (Figure 1). This upward trend, which was evident in all four regions, was most pronounced in the two northern regions (Figure 2).

Figure 1. Percentage of tuberculin reactor animals showing visible lesions at slaughter, 1970 - 1990. Trend line.

It will be seen from Figure 3 that the year to year changes in lesion rates also showed a cyclical pattern. The cyclical pattern was also observed in each of the four regions (Figure 4). While the lesion rates showed an upward trend for most of the 20-year period, reactor numbers fluctuated within a narrow range from year to year but showed little or no increase until 1989 when the number rose sharply to over 40,000. Moreover, little or no correlation was evident between year to year variations in lesion rates and reactor numbers.

Figure 3. Percentage of tuberculin reactor animals showing visible lesions at slaughter, 1970-1990. Cyclical pattern.

Figure 2. Percentage of tuberculin reactor animals showing visible lesions at slaughter, 1970 - 1990. Trend lines, regional distribution.
The highest reactor lesion rates (40%) were detected in light stores followed by heavy stores (30%) and cows (26%). Similar differences in the lesion rates for the three categories of cattle were apparent in each of the four regions. However, in the two northern regions, the lesion rates for all the three categories were consistently higher than those for the two southern regions. In addition, the pattern of year to year changes were common to all categories of cattle and ERAD regions, viz. when the lesion rates rose, or fell, for one category, corresponding changes occurred in all three categories, and all four regions, simultaneously.

Discussion
A substantial and progressive improvement in the efficiency of meat inspection could account for some of the upward trend in lesion rates observed (Figure 1). However, most factories were considerably better staffed with permanent veterinary inspectors in the 1970s, when USDA inspections were carried out on a regular basis. Moreover, the extent of the increase in lesion rates over the period is more than would be expected on the basis of any progressive improvement in factory inspection. This is especially true in the northern regions where the lesion detection rates increased three-fold during the 20 year period. Some would hold that the reactor collection service, introduced in 1989, improved lesion detection rates by restricting reactor slaughterings to specified days. In actual fact, however, the lesion rates dropped in that year. It is concluded, therefore, that improvements in the efficiency of meat inspection, per se, were not fully responsible for the observed upward trend in lesion rates.

Other factors which could have influenced lesion rates in reactor cattle were the frequency of testing and severity of interpretation. Successive programmes over the years, especially the past 12 years, have progressively increased the frequency of testing and introduced more severe levels of interpretation. Both of these measures would have been expected to result in a reduction in lesion rates - yet in actual fact an increase was observed.

In noting the upward trend in lesion rates in reactor cattle from 1971 to 1985, the ESRI Report (entitled "A Study of the Bovine Tuberculosis Eradication Scheme") published in 1986, commented "that the incidence of the disease in cattle is, if anything, tending to increase". Whether, however, the observed increase in lesion rates in reactor cattle depicted in Figure 1 was due to an underlying increase in actual disease levels which was not reflected in the annual number of reactors removed, is uncertain.

The fact that the lesion rates in reactor cattle increased for most of the period while the annual number of reactors remained fairly steady, could indicate the presence in the national herd of a growing number of infected cattle that (a) fail to respond to the test or (b) are not detected until the disease is well advanced.

Any sizeable increase in the number of infected cattle that fail to respond to the tuberculin test should have given rise to an increase in the lesion rate detected in attested cattle. Such an increase did not occur. As with the annual number of reactors removed, there was no discernable increase in the lesion rates in attested cattle slaughtered during the period. The lower lesion rates in both cows (26%) and heavy stores (30%) compared to those reported for light stores (40%) are not consistent with the proposition (b above) that a growing number of infected cattle were not being detected by the tuberculin test until the disease was well advanced. Rather, the higher lesion rates in 36
younger cattle points to a more rapid progression of the disease in these animals. Indeed, the upward trend in lesion rates overall, in the absence of any discernable increase in reactor numbers, may indicate an acceleration over the period in the progression of the disease in infected cattle, rather than any underlying increase in actual disease levels nationally. Whether this could have resulted from an increase in the virulence of *Mycobacterium bovis* over the period or, perhaps more likely, from a reduced resistance in the cattle population, is open to debate.

The fact that lesion rates in reactor cattle increased over the period while the annual number of reactors removed remained fairly steady draws attention to the fact that these two conventional indices of bovine Tb are monitoring two related, but different, dimensions of the disease. While the annual number of reactors removed provides a measure of the prevailing disease level in the national herd, lesion rates in reactor cattle are a measure of the progression of the disease in infected cattle. Also, the fact that reactor numbers remained relatively steady while the lesion rates increased over the period, is an indication that the factor(s) which determine the rate of change in disease levels (as measured by reactor numbers) may not be the same as those that determine the rate of progression of the disease in infected cattle (as measured by lesion rates). While infected cattle and/or infected wildlife are important determinants of reactor numbers, some other factor(s) may be a central determinant(s) of the rate of progression of the disease in infected cattle.

A number of important questions in relation to the rate of development of bovine Tb in infected cattle, as measured by the percentage of reactors with visible lesions at slaughter, arise from this study, viz.

1. Why has the rate of development of the disease in infected cattle increased over the period?

2. Why has the increased rate of development of the disease in infected cattle not been reflected in a concurrent increase in the annual number of reactors removed?

3. Why does the increase in the rate of development of the disease in infected cattle show a distinct cyclical pattern?

4. Why has the cyclical pattern in the rate of development of the disease in infected cattle not been reflected in a similar pattern in the annual number of reactors removed?

5. Why has the rate of development of the disease been more rapid in younger rather than older cattle?

6. Why did the annual number of reactors removed rise sharply in 1989 and apparently again in 1991?

The diversity of issues raised by this study indicates that the scheme may be operating beyond the present limits of the understanding of the dynamics of the bovine Tb as it may now be operating in Ireland. In particular, the fact that the increased rate of development of the disease in infected cattle was not attended by a concurrent increase in reactor numbers is contrary to what would be expected from the conventional understanding of the mode of transmission of infection from cattle to cattle. This is further indicated by the sharp increase in reactor numbers seen in recent years. Overall, it would appear that some additional factor(s), operating outside the scope of the test and slaughter scheme, may be contributing to the continued failure to eradicate bovine Tb in Ireland. Whether this indicates a greater involvement of badgers and other wildlife than was allowed for in recent reports on the scheme, or whether some additional factor(s) may be responsible, is open to conjecture.