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Society for Veterinary Epidemiology
and Preventive Medicine

CONTENTS

PREFACE

The idea of holding this symposium was conceived by Roger Eddy. It was planned and organised by Peter Ellis and chaired by Professor Betts. Neil Edington acted as principal rapporteur and Nicholas Putt, Jim Scudamore, Andrew Stephens and Lindsay Tyler served as rapporteurs in the four workshops. This efficient assistance produced a final draft of the proceedings in record time with the efficient help of Mrs. Graves and Mrs. Patience of VEERU.

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INTRODUCTION

Epidemiology in Animal Health

A review of practical applications of epidemiology in the work of the Veterinarian.

A Symposium held at B.V.A. Annual Conference, Reading, Friday, 24th October 1982.

GENERAL SESSION I

Dr. A.O.Betts, Principal of The Royal Veterinary College, (University of London) opened the meeting. He drew attention to the increasing economic pressures in animal production, to the development of more sophisticated laboratory techniques, and to the advent of increased data recording at the field level, and methods of processing the data as being major factors that had influenced the development of veterinary epidemiology in the last decade.

New techniques in veterinary epidemiology - providing workable answers to complex problems

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It is not too great a distortion of the truth to say that twenty or twenty-five years ago, most diseases of interest to veterinarians had identifiable single causes, recognizable clinical signs, and in many cases a beneficial treatment. Today it is generally accepted that most diseases are the result of multiple contributing factors, that clinical signs are poor indicators of the significance of disease in livestock, and that a preventive approach to animal health and production offers much larger benefits than treatment.

In part, this change in perspective results from the fact that the diseases which were susceptible to straightforward systems of control at the farm or national level have been greatly reduced in importance over recent decades. Much of the change of perspective has however been due to improved understanding of the true causal relationship in complex diseases, so that over-simple views have evolved into more comprehensive conceptual models of disease processes, both within and among animals.

Within the animal, pathogenetic mechanisms are now far better understood because the pathways of pathological change have been mapped and quantified down to the cellular or molecular level. Among groups of animals, epidemiological patterns are becoming better understood because the causal pathways are progressively being mapped and quantified; and research workers are more willing than in the past to allow for the existence of complex interactions in the diseases they study.

For practising veterinary surgeons, State Veterinary Service administrators and field staff, and research workers alike, the simple cause-and-effect approach to disease and its control has had to be discarded, and the previously clear-cut division between "health" and "production" has become very blurred and indistinct.

These trends are now well recognized, and have led to greatly increased emphasis on an epidemiological approach to animal health issues, because by definition the epidemiologist looks systematically at all aspects of a problem, without prematurely jumping to conclusions about the nature of links between causes and apparent effects. The epidemiological approach has been of great value in breaking what might be called "the tyranny of Koch's postulates."

Everyone has his own definition of epidemiology. Mine is as follows: "Epidemiology is the systematic characterization and explanation of patterns of disease, and the use of this information in the resolution of health problems".

As Schwabe (1982) points out, 1960 marks about the turning point when what is now called "the epidemiological approach" began its rise to current prominence. At that time relatively few veterinarians called themselves epidemiologists, and those who did tended to rely heavily on the techniques of medical epidemiology.

Over the ensuing twenty years veterinary epidemiology has evolved away from medical epidemiology. The point has been reached where veterinary epidemiologists have now developed a fairly comprehensive range of techniques, many of which can be used also by field veterinarians and research workers to better deal with the particular problems they face.

Major impetus has been given to the development of new approaches has by the advent of low-cost computing, and wider availability of easy access to computers. The essence of the epidemiological approach is to obtain a large amount of data, among which any single item is of very limited value, and to distill the greatest possible practical value from it. "Distill" is an appropriate term, since the aim is to retain what is valuable and reduce it to a small volume of concentrated information, removing the irrelevant and misleading content until the product is potent and relatively pure information which can be used for action.

In principle, many of the techniques for doing this were already available by 1960, but they were so cumbersome to use and so demanding of special expertise that they found little practical application. As the cost of electronic computing has fallen dramatically and it has become easier for the users to interact with the computer programs to get precisely the information they want in the way they want it, many previously unthought-of possibilities for practical application of hitherto impracticable or little-used techniques have emerged.

In this paper I will endeavour to provide an over-view of the types of new epidemiological techniques which have been developed in recent years, and indicate their likely relevance to farm veterinary practice, the State Veterinary Service, research and teaching. With such a broad canvas, the coverage will inevitably be thin in places. The papers which follow will provide illustrative examples of the ways in which epidemiological techniques are being applied.

Performance-related diagnosis

In dealing with a clinical problem, the veterinarian compares clinical and laboratory findings with his concepts of normality, and seeks to identify a pattern which will lead unequivocally to a correct diagnosis and an accurate prognosis.

In current livestock production systems where the concern is with lower feed conversion efficiency, smaller litter size or lengthened calving to conception intervals, and there are likely to be three or four health and management factors which interact to produce the problem, the purely clinical approach breaks down since it does not lead to either a single diagnosis or a plan for corrective action.

We are therefore relying increasingly on performance-related diagnosis, in which normality and abnormality are measured in relation to selected "performance indicators", the target values of which take account of the management situation in livestock enterprises of that type, the economic implications of deviation from the targets, and other factors relevant to the goals and capacity of the farmer.

For example, the target for calving to conception interval in a herd of 150 dairy cows in southern England might be a mean of 90 days and a standard deviation of 40 days or less. Vinson and Muirhead (1981) give targets for fifteen performance indicators in a swine farrowing unit, such as 10.9 pigs born alive per farrowing.

As our thinking in this area advances, we are realising some important limitations of the first sets of performance indicators which were used during the 1970's (the approach having emerged independently in a number of countries at about the same time); and there is growing sophistication in how the indicators are measured and interpreted.

Appropriateness of the Indicators

The indicators require constant checking against reality and revision in the light of growing experience about what is feasible and economically beneficial. They must not be based on arm-chair pontification, but must be a balance between what is economically (not just biologically) optimal for the locality and what is achievable by the best managers under ideal conditions. In our work on reproductive performance in dairy herds in Australia, for example, we found that a first service pregnancy rate of 65% was not sustainable over a long period even in the best herds, although it is commonly cited as a reasonable target.

In contrast, it is commonly considered impossible to achieve a mean calving to first oestrus interval of less than 40 days in a herd because earlier heats are frequently "silent", yet we had a herdsman who reliably (and we believe genuinely) achieved a mean of approximately 25 days in a herd of over 400 cows.

Distribution or Spread of Values

Initial reliance was placed almost entirely on average data for a herd. We are now giving much greater emphasis to the distribution or spread of values for a performance indicator within a herd. At its simplest, this may be just the recognition that a measure of spread (such as standard deviation) is of almost as much importance as the mean in deciding whether or not performance is satisfactory. For example, achieving a low mean calving to conception by inappropriate means (such as very early breeding of some cows after calving) so that the standard deviation becomes much larger, can virtually eliminate the economic benefit which the owner thinks he is achieving, because the economic benefit results from most cows calving with intervals close to 365 days, and this will not be the case if the standard deviation is large. That is a relatively simple case, but we are now looking at more and more subtle differences in the frequency distribution of performance indicators, including such techniques as looking at differences in the pattern of indicators between age groups, between animals grouped by their dates of parturition, and so on. Computer analysis makes it possible to do this quickly and easily, and to display the results in charts or graphs so that they are easy to absorb. We have found, for example, that the single most informative indicator of oestrus detection efficiency in a dairy herd is to look at a frequency distribution of interoestral intervals in a herd. If we group the intervals in a biologically rational manner and examine the percentage in each group, we can form a reliable impression of the herdsman's performance, minimally confounded by other factors such as nutrition. As a first scan, we look at the ratio of cycles which are 18 to 24 days in length, to those 39 to 45 days in length. If the ratio is 7:1 or higher, oestrus detection is unlikely to be a problem. If it is 4:1 or less, detection is almost definitely a problem. Between those two limits, the situation needs to be looked at in more detail. This will involve looking at the frequency distribution more carefully and looking at other related indicators, and then undertaking clinical and laboratory investigations to identify the causal relationships precisely (as outlined by Morris, 1976b).

Identification of Patterns of Indicators

As experience grows, we are realising that the power of performance-related diagnosis is greatly increased if we look at two, three or four indicators simultaneously. The evidence from a single indicator may be equivocal, but in combination a set of marginal and clearly abnormal values may be almost pathognomonic of a particular syndrome, whether it be a nutritional infertility, a management-induced problem of poor growth rate, or a specific infectious disease.

At present the use of "pattern diagnosis" of the causes of suboptimal performance lies more in the realms of art than science, and moreover relatively few of those who practise the art have published their findings. There is a need for skilled exponents (many of whom are in the United Kingdom) to publish their views, and for research workers to work on converting the art into a sound science. The approach is undoubtedly one of the keys to rapid progress in developing better ways of handling multifactorial problems.

Use and Interpretation of Indicators

In using performance-related diagnosis, we are gradually moving towards consensus on what are appropriate indicators. I like to differentiate between "performance indicators" which are used to assess whether or not performance is adequate, and "diagnostic indicators" which are used to help identify the cause when performance is judged to be inadequate. One task for the next few years is to achieve some degree of standardisation in the indicators which are used, and especially in how they are calculated. How this could be achieved deserves attention at this meeting.

Secondly, we need to exchange information on what are regarded as targets in different places and to reach some agreement on the interpretation of values which differ from the targets. Vinson and Muirhead (1981) use the term "interference level" to designate the level at which deviation from the target is sufficient to justify investigation. Although we need to remember that on economic criteria any deviation from the target value represents a loss of gross income, it is sensible to define limits at which the deviation is unlikely to be random and is likely to be serious enough to justify the cost of investigation and correction. The traditional quality control concepts of "warning level" and "action level" would seem appropriate, but there is a need to clarify just what is meant by any terms which are adopted.

Health and Productivity Monitoring Systems

If veterinarians in practice are to use performance-related diagnosis, they need to have access to easy ways of collecting and processing the data at minimal cost. Such systems have gradually evolved over the last decade in various parts of the world, principally for dairy cattle and swine, but also to some extent for beef cattle and sheep (Cannon et al, 1978; Russell, 1980; Stephens, Esslemont and Ellis, 1980; Gibson, 1982; Kaneene and Mather, 1982; Stein et al, 1982; Morley, 1982).

Until recently such systems had to be physically remote from the herd, because they operated on large computers. With the advent of micro-computers at costs below U.S.$5,000 but with all the capabilities required for health monitoring systems, it has become practical to have such units at the level of individual veterinary practices and farms. A whole new range of possibilities then opens up, and the design features of a practice system differs in important respects from a remote one. Data entry can be fully interactive and easy to carry out. Reporting and file interrogation can be personalised to particular local circumstances and needs, and the cost of providing the service becomes almost trivial, apart from the costs of developing and maintaining the programs. Even that is now declining with the development of advanced data management programs which can obviate the need to write special-purpose programs since all the necessary features are built-in and only the structure of the specific system and the report generation process need to be defined.

Graphics capabilities of microcomputers are also becoming very advanced and it is likely that use of attractive visual methods of reporting information will supplement and in some cases replace numerical tabulation.

Work is going on at various places to develop practice data management systems which incorporate health management aspects, including the Universities of Reading, California and Minnesota, and Michigan State University.

The same general trends can be expected to occur in Government veterinary services, with growing use of computer-based systems to monitor and support official disease control activities. Centralised systems have existed in the U.K. and elsewhere for some years, and this experience led naturally to the evolution of regional systems, such as the Australian National Animal Disease Information System (ANADIS). This comprises a network of 21 minicomputers located throughout the country (Morris, 1976a; Roe, 1980). The system was initially concerned largely with the brucellosis and tuberculosis eradication campaigns, but is now moving into its next phase in which it will have the capacity to handle diagnostic laboratory data, exotic disease emergencies, a national serum bank, and other areas of activity, such as the health and productivity profile studies described below. A number of other countries are moving towards similar or more advanced systems, and there should be scope in future to bring private and official systems closer together, with mutual benefit.

At the international level, the International Office of Epizootics (OIE) in Paris plans to implement a computerized animal health databank and information exchange system. This will greatly improve the accessibility and value of such data, and will encourage countries to collect and contribute data of higher quality to the international system.

Evaluating the Animal Health Status of a Region or Country and Setting Priorities for Animal Health Programs

There are two major practical reasons for obtaining valid data about the level and significance of health problems in an area. The first is that any action to deal with such problems which requires funds is nowadays unlikely to be supported unless sound evidence (preferably including economic data) can be offered to support the proposal. The second is that the information is essential for planning and priority setting with respect to future veterinary activities, and provides standards against which practising veterinarians can measure performance in the herds with which they work.

In the past, most of the information about disease prevalence, incidence and economic significance was obtained from sample surveys conducted because a decision had already been made that the disease was important enough to justify further action. Moreover, with a few notable exceptions (such as the U.K. national disease survey) investigations were only undertaken for identifiable diseases for which a reliable diagnostic test was available, and this biased attention unduly towards infectious diseases and away from inadequately characterised disease complexes. Surveys of single diseases also eliminate the possibility of examining interactions between all the factors which may be involved in a problem.

To overcome these problems, epidemiologists have been progressively moving towards methods of undertaking field studies which will give rankings of diseases in order of economic significance within a particular species and livestock production system, and which will provide epidemiological data about the diseases at the same time.

To do this, a carefully planned set of measurements must be made in livestock production units over a period of at least a year. The measurements must deal with productivity of animals as well as with their health status.

Over the last few years, studies have been conducted which have moved progressively closer to this approach, although because they were exploratory most of them have not been as comprehensive as might be wished.

Some of the investigations have been called "sentinel studies" while others have merely been called surveys. None of the existing titles is satisfactory, and I prefer the term "health and productivity profile".

A health and productivity profile is an investigation in which regular coordinated measurements of disease occurrence, overall health status, nutrition, management, productivity and economic performance are made in animals which are kept under conditions typical of those under which livestock in the area are usually kept.

The emphasis is on coordination of the measurements, so that interrelationships between the various items can be evaluated. Where a relationship requires further definition other epidemiological techniques can be used to examine it in detail.

The approach has so far been used in developing countries more widely than in developed ones, because it has been more clearly recognized in developing countries that there is a need to evaluate disease control priorities in the context of local production systems, and there are fewer preconceptions and prejudices about which problems are most important.

The more comprehensive the nature of a profile study in the factors which are considered, the more useful will be the results in reassessing traditional priorities and defining the best way in which resources should be directed. Moreover the profile technique provides an excellent framework within which issues raised by the profile study can be subsequently investigated in detail, since most of the basic requirements for setting up a field study will be available automatically as part of the profile study. These requirements may range from animal handling facilities to an established system of obtaining market price data for animals from the study units. The profile system is also a particularly appropriate framework for economic studies.

The study unit for a profile is the natural epidemiological unit in which animals are kept; in the United Kingdom it would normally be the complete herd on an intensive livestock grazing farm, or a self-contained unit in a broiler growing poultry enterprise, or some similar grouping.

The number of study units required is not nearly as large as is commonly thought, and there are substantial benefits from the approach over single-purpose surveys.

A profile study only needs to be undertaken about every five years, and other investigational approaches can be used in between to clarify issues raised but not answered by the profile approach. A profile system can, because of the statistical validity of the sampling plan and the depth of the investigation, provide a standardising system which enables much better use to be made of other data sources such as diagnostic laboratories, abattoirs and veterinary practice records (Morris, 1982). Without such a framework, records of this type are of very limited value. A serum bank comprising geographically representative sera can also easily be incorporated into the system, and can be used retrospectively to trace the history of newly recognized agents. A number of countries are now developing such banks as epidemiological tools. By using information derived from a comprehensive national animal disease information system, tentative economic priorities for action can be decided. Pilot field studies of the effects of interventions to deal with these problems can be conducted, and the information from these studies can be used for decisions on further action. In this way, more soundly based priorities for future animal health programs and services can be developed.

Methods of Data Analysis and Synthesis

There is little point in developing efficient means of gathering data if the only outcome is to swamp the user in a mass of uninterpretable detail. All too often in the past data-gathering has been undertaken with no clear objective, in the mistaken belief that "it must be useful". Under those circumstances, it rarely is.

I always try to keep to the following precepts:

1. Only collect data if there is a clearly defined purpose for doing so.
2. The system for analysis and interpretation of the data should be worked out before data collection commences.
3. Analysis of the data should be conducted promptly after its receipt.
4. There should be effective quality control procedures in any data collection system.
5. There should be prompt feedback of some sort to the data suppliers, so that they know their efforts are making a useful contribution. If at all possible, data suppliers should receive some tangible or intangible benefit from their involvement.
6. The data gathering exercise should either have a defined end-point, or should be subject to periodic review (a "sunset provision").

If all of these requirements can be met and the data is of the highest achievable quality (which may not, in some cases, be very high), then there are ways of maximising the value which is obtained from the data. Not all of these are well known.

Design of the Investigation Procedure

There are various well-recognized epidemiological investigation procedures which can be used to give strength to investigations of health problems under the relatively uncontrolled conditions that must be used for field studies.

Although some of these (such as "cross-sectional studies" or surveys and "intervention studies" or field trials) are well known, some of the other techniques (such as case-control studies and cohort studies) have been underused in veterinary medicine. Details of the techniques can be found in sources such as Schwabe et al (1977) and Willeberg (1980). If the investigation procedure conforms to one of the accepted formats, then some of the better analytical procedures developed especially to deal with such data can be used. These increase the reliability and precision of the conclusions.

Analytical Procedures

One of the less obvious benefits which the computer has provided is access for the biologist to advanced statistical procedures, especially those which deal with a number of variables simultaneously. Previously the practical difficulties were so daunting that only the intrepid would attempt to work with the more complex procedures. The techniques should even now only be used under expert guidance, since an untutored novice can make serious blunders. Nevertheless, in careful hands they make powerful tools.

At the simplest level, partial correlation analysis is a useful and surprisingly little-used tool for separating out specific relationships between variables in a group when there are correlations between them.

The most widely used technique for investigation of complex situations is multpile regression analysis. Although findings must be interpreted with caution, it permits the user to estimate the contribution of various factors to variation in some measure of disease occurrence, weight gain, litter size and so on. A particularly useful variant of multiple regression analysis is path analysis (Burridge et al, 1977). This permits the major causal pathways in determining (say) disease prevalence to be mapped and quantified in importance, in precisely the way which is needed for sensible interpretation of complex field problems.

Other procedures which are of interest in analysing complex problems include:

1. Factor analysis (Franti et al, 1974) which simplifies a large number of correlated variables down into a predictive equation consisting of a smaller number of uncorrelated variables. It can be used to improve understanding of complex interrelationships in some circumstances.
2. Discriminant analysis (Vandegraaff, 1980), which can be used to produce an equation which will predict (on certain defined pieces of information) which of two or more categories a particular herd or animal is most likely to fall into. Discriminant analysis is a more comprehensible technique than factor analysis.
3. Cluster analysis permits the identification of natural groupings and subgroupings within a large and diverse group of individuals or herds on which measurements have been made.

Another area of development over recent years has been in "non-parametric statistical methods". These can be used to analyse data which does not adequately conform to the requirements for standard forms of statistical analysis, and will find growing application in dealing with "difficult" field data.

Computer Modelling

A totally different epidemiological technique which has found growing application is computer simulation or modelling. In essence, this involves the development of a computer program which mimics all relevant aspects of a disease complex within the computer. This is not nearly as difficult as it sounds, and models can be constructed which represent the epidemiology of a disease, its effect on productivity, and the economic benefit which can be expected from various types of control programs (Morris, 1972; Hugh-Jones et al 1975; Morris and Roe, 1976; Roe and Morris, 1976; Meek and Morris,1981; Stein et al, 1982). This takes some millions of calculations, but the result can be produced by the computer as little as 10 seconds after the control measures have been chosen and the model has commenced to run.

As modelling is progressively integrated with field research techniques, the combination is proving to be very powerful as a way of leading to improved disease control planning (Elder et al,1982).

Optimisation Techniques

In evaluating disease control programs by economic methods, techniques such as benefit-cost analysis, budgeting and modelling have the limitation that they only assess what the user thinks are likely to be desirable approaches. A series of techniques, which go under the generic term of mathematical programming, is available and can be used to automatically find an economically optimal solution to any decision problem. The methods can also be used for certain other types of investigation, which do not directly involve optimisation. There is a growing number of examples of the veterinary use of the simplest of the techniques, linear programming (see, for example, Carpenter and Howitt, 1980; Johnston and Berman, 1980). The more advanced techniques in the group are more powerful, but also more difficult to use.

The main difficulty with these techniques is to ensure that biological realism is maintained, but experience in achieving this is growing.

Decision Making

This issue, which brings together all the points discussed earlier in this paper, will be taken up in more detail in the following paper (Ellis, 1982). Suffice to say here that as decisions become more complex, so there gets to be value in developing aids which demonstrate the implications which can be expected to follow from particular choices. We are using computer models in this role (Stein et al, 1982), and plan to provide veterinarians in practice with easily-used computer programs which enable them to evaluate and demonstrate the expected effects of using (or not using) particular control procedures for problems such as mastitis or poor reproductive performance.

The Integrative Role of the Epidemiological Approach

Using the techniques described here and others still under development, it is becoming increasingly possible to draw together the various strands of veterinary activity to increase their value to livestock owners.

It is becoming possible to foresee future developments in which the practising veterinarian will provide almost all the primary contact with livestock producers, and will provide a service of greater breadth and depth than has been the case in the past. Government veterinary services will play a growing role in the provision of specialised support for practitioners. At field level, this will come through assistance in detailed investigation of difficult or emerging field health problems, and in integrating health and production support services. Government diagnostic laboratories will shift some of their effort from handling voluntary accessions towards being closely involved in structured epidemiological studies which provide a sound foundation for assessing the importance of specific diseases and disease complexes.

Research and investigation will move more into realistic farming situations, as techniques for conducting investigations under such circumstances are further refined.

The epidemiologist will provide the link between these various groups - or perhaps the term will simply fade away as all the other groups adopt the epidemiological approach and it ceases to be a specialty.

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Epidemiology, Economics and Decision Making

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Although this session is primarily concerned with the applications of epidemiology in the different roles of the veterinarian, we must also consider the implications of the economics. Epidemiology almost invariably involves decision making. Findings lead on to further investigation, to an assessment of the significance of the problem and a decision whether or not to take action.

Obviously, financial implications play a major part in the decision that the farmer takes on the advice of his veterinarian, and at the national level the governments have to weigh the costs and benefits of all the many schemes among which scarce resources have to be shared. What is not quite so obvious is that economic and social constraints can make major contributions to changing patterns of disease, even of major epidemics. When we extend such wider considerations we begin to realise that national and international economic trends are likely to bring changes to the role of the veterinarian, at least in relation to food animals. It is important therefore, that this introductory paper should elaborate a little on each of these links to epidemiology and, for simplicity of presentation, effects of disease patterns will be considered first, methods of using economic techniques will be taken second and implications for the future of the veterinary profession will be the final theme.

Economics as a Determinant of Disease Patterns

Mastitis: Those of you who have followed the mastitis literature and debates over the past few years will easily agree that facilities and management of the dairy herd have great influence over mastitis prevalence and incidence. A careful cowman, exercising a disciplined hygiene programme, can reduce many types of infection to very low levels and maintain it there (Dodd and Neave 1970, Asby et al 1975). However, economic trends and policies have forced farmers to reduce the amount of labour that could be allowed for each cow so the capability of providing such care has been under increasing pressure. If the government had subsidised labour rather than housing in its efforts to encourage overall milk production the mastitis picture and the balance between the various bacterial agents involved would have been quite different. Parlour, milking machine and housing design to minimise labour requirements brought the risk of greater stress to the animal and potential damage to the udder. The loose-housing system has brought an upsurge of E.Coli infections. Similarly, pricing of different commodities can also be said to have had effects. High milk prices coupled with low feed prices made selection for higher yield the primary goal and with this came high stress on the animal's metabolism, de-emphasis of grazing and exercise and greater concentration of animals in buildings. The significance of these economic pressures on mastitis is clearly recognisable when the results are contrasted with those of grazing based and efficient hand milked dairy systems.

Brucellosis: The same economic influences became apparent when the intensification of brucellosis control was studied in England and Wales (Hugh-Jones et al 1975). Certain management systems, particularly the "Flying Herd" with rapid turnover of cows and replacements bought in, resulted in higher reactor prevalence rates than were found in closed herds. High land values and local market demand were underlying causes. Larger herds and herds with concentrated breeding seasons were also more vulnerable to internal spread once infection was introduced. Control costs were higher in these latter types of herd and made voluntary schemes uneconomic from the farmer's point of view. The use of housing had a marked effect on reactor prevalence too - a difference which became more apparent when the potential for brucellosis eradication in France and Italy was examined. Herds that had little or no need for housing were less frequently affected and had lower reactor prevalence rates (Ellis and James 1976). Perhaps the best illustrations of how dramatic such economically motivated differences can be were the near impossibility of securing very large zero-grazed herds against infection, without vaccination (P.Nicoletti, USDA, personal communication) and recent findings from a sample survey of village cattle holdings in Java, Indonesia, which suggests that the disease has failed to spread despite the absence of a control scheme (Supriatna 1982).

Clearly, ecological, sociological and economic factors determine the nature of the brucellosis problem when it affects cattle populations.

Consequently, plans for control and eradication must vary according to local circumstances and animal health planners need a wide range of data and means of analysing it if optimal strategies are to be defined. Comprehensive data must be brought together if the problem is to be fully understood and rational decisions taken.

In 1975 such evidence gave our Government confidence that brucellosis could be eradicated with acceptable costs and benefits in the period 1980-82. In fact, we calculated that the optimum ratio of costs and benefits could be obtained by eradication in 1981. Eradication was achieved in 1981.

Swine Fever: Studies on classical swine fever in the E.E.C. (Ellis et al 1977) further strengthened our conviction that industry structures could influence disease prevalence and spread. In Figure 1 are shown areas where the disease was most commonly found. All are predominantly breeding areas and such limited serological evidence as could be gathered suggested that the systems of introducing and managing young females favoured the persistence of carrier sow infection. Seasonal patterns of swine fever in four countries over five years can be summarised in a graph (Figure 2) which shows that over the years 1970-75 a high proportion of outbreaks in March and April and lesser peak in the autumn. These peaks tended to coincide with an upsurge in movements of breeding stock in the spring and weaners in the autumn. Epidemic cycles tended to involve a higher proportion of fattening units and show a periodicity which could be related to producer expectations associated with rising pig prices.

The evidence was very slender but no alternative hypothesis could be as well sustained. In essence it appeared that a few carrier herds in limited areas were helping swine fever to moulder continuously, to produce sporadic outbreaks through immune-tolerant piglets and in periods of pig industry expansion sufficient movement occurred to spark epidemics. Numbers, densities, prices and probabilities began to emerge as measurable quantities which could explain the course of events. By simply calculating the flow of piglets born into a given population and relating this to the timing and efficiency of vaccination it became clear that a vaccination policy was unlikely to break the sequence of the carrier cycle.

These illustrations are just a few among many investigational exercises which have revealed the complexity of disease problems.

Change in production systems, for any of a wide variety of reasons, will bring change in the variety and character of health constraints on animal productivity. This concept was discussed at length by Brander and Ellis (1976) and Morris, Roe, Macallon, Meek,Macauley, and Powers are among the expanding list of people who have brought economics together with epidemiology in order to provide clearer understanding of disease prevention and control needs. For those who want to read more, the reports of the three International Symposiums on Veterinary Epidemiology and Economics contain much of this work (1976, 1979 and 1982).

Economics in Decision Making

What kinds of economic technique do we need to bring into veterinary decision-making?

For the Herd: For the farmer the partial budgeting technique serves many needs. The kind of calculation which is shown in table (Ellis and Esslemont 1979) has convinced many farmers that fertility control is an extremely valuable activity. Changes in inputs which result from an intervention, are simply compared with changes in outputs. The net figure of £60. per cow would be far greater at today's values. This type of calculation can be repeated for any problem and is represented schematically in Figure

The 'normal' herd structure and pattern of production are determined by feeding, management, climate, housing, replacement policy and a background series of health problems such as mastitis and parasitism in some of its many forms. If a new disease problem is added or an existing one is to be reduced or eliminated, changed birth rates, growth, output and mortality or culling will affect the herd size and structure. Thus, by recording or measuring certain key parameters in the normal and the affected herd and calculating all the other relationships it becomes possible to demonstrate in financial terms the changes in costs and income for each representative unit. Such changes can be summed under four headings which make up a convenient equation :-

$$\begin{matrix}\text{Costs saved} \\ + \\ \text{Income gained}\end{matrix} \; - \; \begin{matrix}\text{Costs added} \\ + \\ \text{Income lost}\end{matrix} \; = \; \begin{matrix}\text{Net financial} \\ \text{effect for the} \\ \text{unit}\end{matrix}$$

Once this series of calculations is set up for the representative or flock, a model is available for estimating a variety of effects and the costs and benefits of new control measures can be assessed.

For the Industry: The economic assessment of health problems and schemes on a larger scale is obviously more complex. However, if the problem is thoroughly defined by epidemiological analysis, treatment and control measures can be grouped into a series of "strategies" which should induce improvements, at different rates, according to the intensity and efficiency of each strategy. There are always at least two strategies to examine - to do nothing or to intervene - but for most problems several alternative types of intervention can be devised. Professional judgement, combined with factual evidence of the responses to the measures combined in each strategy, make possible projections of the rate of progress that could be expected. On this basis, the rates at which benefits - both economic and social - are gained can also be projected and a value summed for each strategy.

In Figure 1 the sequences of steps in this problem are shown. This chart was first developed by a WHO Study Group on the Economics of Zoonoses (WHO 1972) but applies equally well to the generality of animal disease. It will be noted that quantitative calculations are based on a "Unit". The behaviour of most diseases varies significantly with the size and type of animal group. The effects of each disease vary accordingly so if the socio-economic implications of the disease are to be assessed for a whole country or region they must be measured or estimated in representative groups of animals. Rarely, there is a stable population of herds of a similar size, managed in a similar fashion. This whole population can be treated as a single Unit and losses averaged for many thousands of animals. More commonly, the population needs to be grouped or stratified according to size and type of holding, and then for each group a typical unit can be "modelled" as suggested for decision making at the herd level. Many such models now exist and are adapted to different sets of circumstances. They can represent the technical performance of each "Unit" and convert inputs and outputs to financial values. The sequence of changes over at least five years must be covered in the case of cattle, and three years in the case of sheep and pigs, in order to encompass the long term repercussions of disease problems or control schemes. Since benefits tend to be cumulative the models are usually required to present the results over at least ten years and usually twenty years. Banking organizations now use such models regularly to evaluate credit requests from livestock farmers. The U.S. Department of Agriculture uses one in the planning and appraisal of all new animal health schemes (Beal, 1982).

Once the costs and benefits for each control strategy have been worked out for each representative "Unit" the figures can be multiplied up to give totals for a whole Region or Country. They are built into estimates for many years into the future and values for such factors as labour may have to be changed to reflect the benefit of increased employment, while the figures for each future year are brought to "present values" by a procedure known as "discounting". Results are expressed as benefit-cost ratios, internal rates of return and net present values (Gittinger 1980). To these results may be added evaluations or commentaries on social considerations such as human health effects through disease and nutrition, and on animal welfare. The decision maker can then choose more fairly between the various schemes proposed and decide more fairly between animal health and other obviously worthy uses for funds at his disposal.

Such economic appraisals are now the rule rather than the exception when disease control policy decisions are required.

Economics, Longterm trends and implications for the veterinarian

Our third main economic consideration has to be - effects on overall policy and on the provision of services to the livestock industry. The question to be answered is how much of the cost of serving the livestock industry should be borne by Society as a whole, through Government, and how much should the farmer bear, directly or indirectly.

Politics: The political scene, reflecting changes in social attitudes and policies is inextricably linked with macro-economics. According to "The Economist" there seems to be a swing away from paternalistic Government in Europe as a whole as well as in Britain. This swing seems to have been sparked by an urge among people for greater individualism and self-sufficiency and has been fuelled by the realization that Government resources can never be adequate to provide all the services that the community would like. The result is growing resistance to further Government involvement and a trend in some cases such as Britain to privatisation. Thus the political trend suggests that farmers will be asked to secure their own supporting services to an increasing extent.

Macro-economics: Major economic trends are likely to be an even more dominant factor. Europe has become self-sufficient in almost all animal produce and is generating surpluses of some, like milk and some kinds of meat. Meanwhile economic pundits have lowered projections of world population growth and increased projections for the expansion of food supplies so the prospect of significant export markets for European animal produce is fading. Indeed, the author feels that the potential for growth in world food supplies is still markedly underestimated. If these trends are realised the long standing policy of increased production will be replaced in Britain by one of containment of production. This, inevitably, implies lower prices for produce, irrespective of cost factors. The farmers' response will have to be to optimise productivity, probably at lower levels of output. They will also be motivated to compete by grouping together to establish a larger share of the market. Past standard pricing arrangements and low input costs, encouraged the individual farmer to "beat the system". Lowered Intervention Prices would seem to favour the formation of more producer-controlled marketing groups which will establish a special identity and price for quality products. Such groups will need help in providing consistent supplies and above average quality.

Government funding for new animal health activities is more likely to diminish than to increase while the need, and the demand for them from farmers, is likely to increase. Protection of the livestock industry against such catastrophic problems as Foot-and-Mouth Disease and swine fever will remain a Government-funded task. Emergency programmes of this kind can only operate efficiently if a central authority has full legal powers, immediate and unrestricted resources, an established organization and specially trained staff. Connections with world wide disease reporting systems will be needed and an increasing range of early-warning techniques like those which operated for FMD in 1981 should diminish risks. These are large commitments and Government will endeavour to limit its interventions to problems which can or might so setback animal production as to create supply shortages and/or drastic price increases.

Intervention in new problems will have to be justified in terms of their catastrophe potential: likeness to FMD swung the balance in favour of a programme against swine vesicular disease but only nominal assistance has been given for enzootic bovine leucosis and, as yet, no support has been granted for the control of Aujesky's disease. Exceptions have been made in the past and are likely to continue for problems of borderline economic catastrophe significance where there are clear human health implications, as was the case with brucellosis. Decisions of this kind are going to involve much higher levels of epidemiological and economic appraisal than in the past and farm organizations, with veterinary help, may have to fight for favourable decisions using their own supporting analyses.

Obviously, many borderline control schemes still have to be funded in some way by the livestock industry. One possibility is for one or all of the different sectors to contribute to a central fund by levies on their respective products. However, administration by central Government services would not seem to be in line with present policy and the experiences with large autonomous bodies like the MMB and MLC suggests that they are unlikely to be able to attain the necessary degrees of flexibility and farmer confidence. Never-the-less a semi-autonomous agency approach should not be discarded without careful examination because it has proved successful in Holland. A State veterinary service funds and controls measures against the major epidemic diseases but a separate "Animal Health Service" takes care of a series of less dramatic disease problems and takes new initiatives in such fields as infertility. This independent service is funded up to certain limits from State revenues and to an equal or greater extent by producer organizations. Producers also participate, along with veterinarians, in committees at headquarters and Provincial levels, which determine and adjust policies. Enzootic bovine leucosis control, for example, is proceeding very successfully under the aegis of the Animal Health Service. Veterinary Diagnostic Services are also linked to the Animal Health and are involved in a national cattle identification and movement registration scheme.

Variants of this delegation of responsibility and aggregation of resources exist in Germany, where the "Animal Health Fund" of each State is the core of locally controlled schemes and in France, where the Departmental and Commercial Animal Health groupings have considerable autonomy in implementing policy. In both cases producer and local funding is added to what the central government provides. However, Constitutional structures requires far more authority to remain with local Government in both Germany and France than is the case in Britain.

How can a comprehensive service be arranged and funded in Britain? We already have leads from the contractual arrangements that have developed in the poultry and pig industries. In dairying too regular visiting arrangements with increasing support from data management systems, are proving financially viable for both the veterinarian and the farmer. Thus the progressive medium and larger herd operator seems to be able to fund and control his own service.

Never-the-less distance and unit size are still a problem. Wider extension of such health and productivity services will probably have to depend on grouping of farmers so that costs to the individual are lowered sufficiently to allow participation of the smaller progressive unit without jeopardising the quality of the service. For this the need for producer-controlled marketing groups could provide an opening where such marketing groups or cooperatives have developed in other countries, the provision of very effective technical services from a small levy on sales has been a sequel. Involvement of advisers in group sales bonuses could provide interesting incentives.

For the longer term one could foresee the linking of producer and advisory groups to provide a structure through which exchanges of staff and perhaps even the take over of laboratory diagnosis and analysis services could be arranged.

Conclusions

This paper should not pre-empt the conclusions of the various workshops which follow but it seems appropriate to identify two themes that the workshops on food animals should take up. The first is the need to incorporate structural and economic data in the new range of information systems that will have to be built up if the required levels of productivity and health management are to be attained.

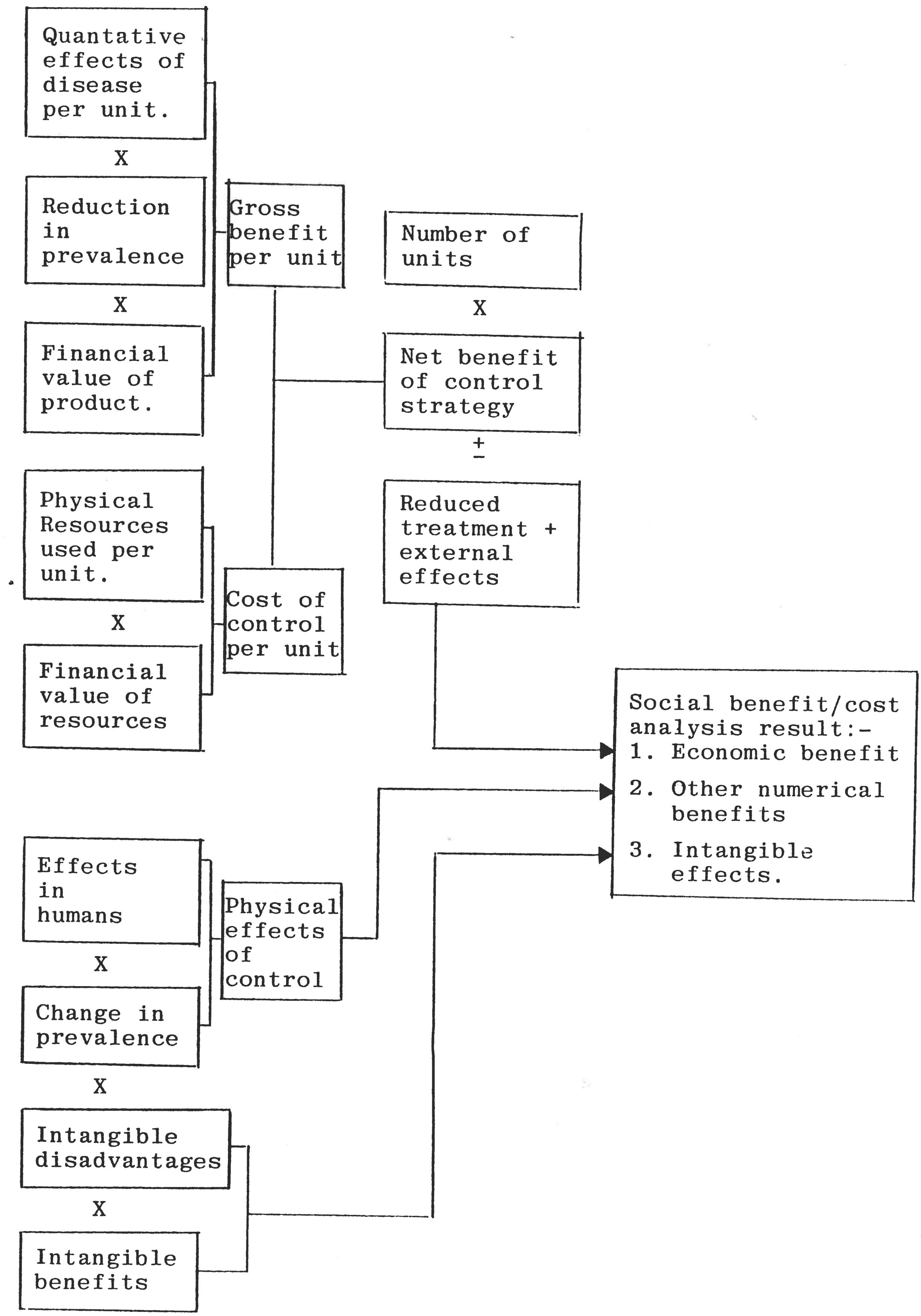
New recording and analysis schemes must be developed from the producer level upward. They can start most easily with veterinarians who are dealing with the day-to-day problems of farmers. Preventive medicine and veterinary extension activities are becoming as important as clinical care because they provide vital keys to productivity. Investigation and research should be an important but secondary aim of such schemes because, as Morris (1982) points out, the over-riding requirement is for data of high quality. Unless the generators of the data see a clear purpose for it the quality cannot be relied upon.

A second tier of recording must be built around the work of veterinary investigation laboratories and field services, marketing, abattoir systems and other livestock related activities. Ideally, findings from these sources should be linked to population data and be comparable with findings from the herd level schemes.

A second theme should be the definition of levels and types of training that are needed to enable existing graduates and undergraduates to take an economic view of what they are doing. The immediate response from veterinary educators will be that veterinary curricula are already overloaded. However, they must bear in mind that the survival of the veterinarian in the food animal field almost certainly depends upon the reorientation of courses toward preventive medicine and herd health and that similar adjustments will be needed toward other phases of veterinary work. Epidemiology and economics will be essential to successful decision making in all of them.

FIGURE 1.

SOCIAL BENEFIT-COST ANALYSIS
OF DISEASE CONTROL



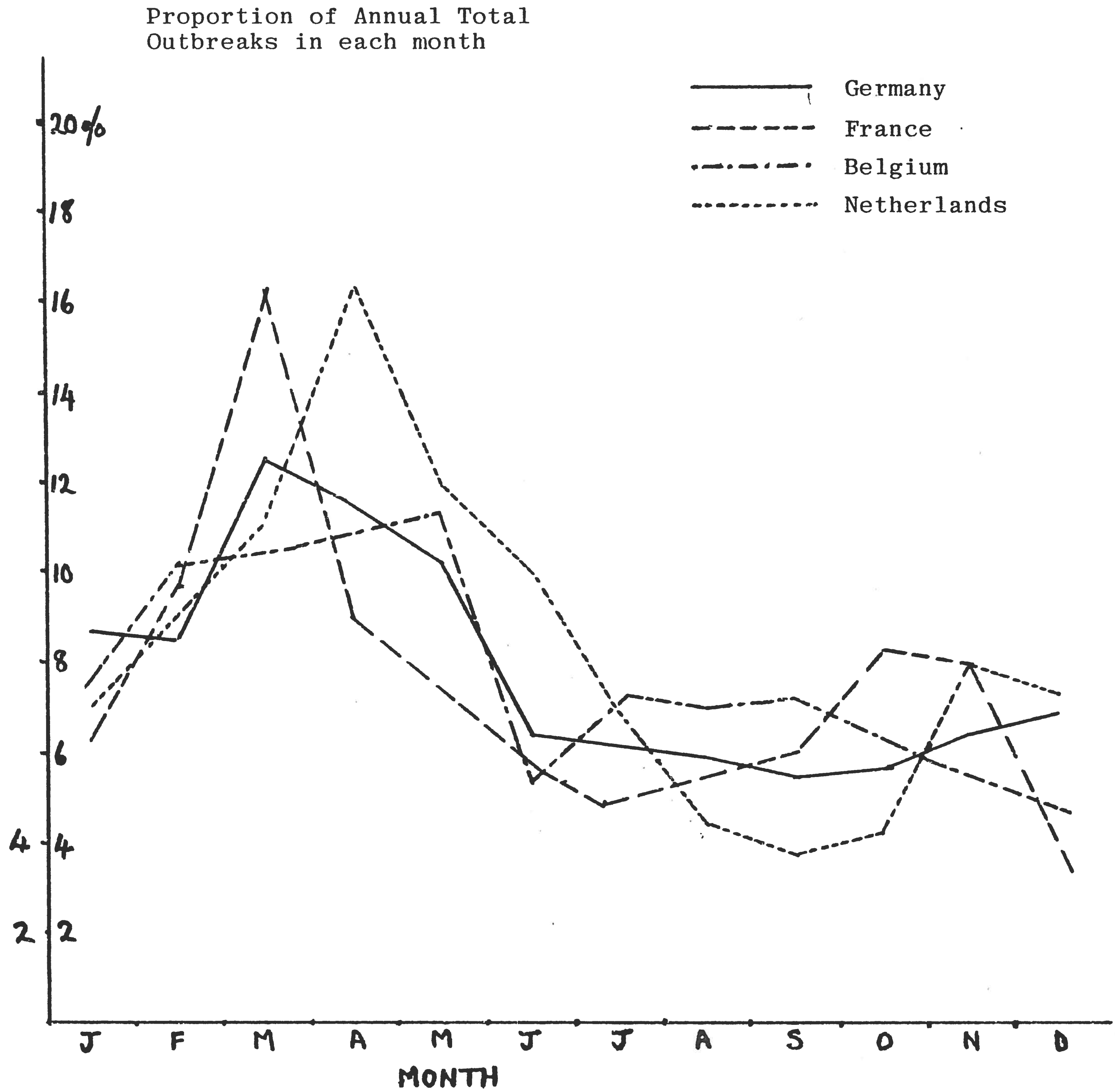


FIGURE 2: SEASONAL PATTERN OF SWINE FEVER OUTBREAKS IN THE EEC: 1970 - 1975.

TABLE 1.

THE EFFECT OF FERTILITY ON PROFITABILITY
IN A MODELLED HERD (1979)

			Difference
Calving to conception (days average)	83	107	24
Litres per cow per year	5205	4950	255
Sales per cow high 10.40 per litre, low 10.32 per litre.	£541	£510	31
Cost of Concentrates per cow @ £95. per ton.	£117 (1.23t)	£105 (1.11t)	12
	£424	£405	£19.00

The effect on Profitability in a Dairy Herd
including other variable costs

	£ per 100 cows
Margin over concentrates (MOC) lost	1,900
Extra culling 12 at (£400 - £250)	1,800
Reduced calf sales based on £50 per calf 12p. per day x 24 days per cow	288
Effect of lower age structure on yield 12 lactations at £100 MOC	1,200
Longer dry period 10 days @ 50p per cow	500
Veterinarian's time; six minutes per cow @ £16 per hour	100
Extra serves due to poor conception	210
	£5,998

Effect per cow = £60.00

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DISCUSSION

GENERAL SESSION I

It was pointed out that while the Government had decreased direct compensation it had increased its financial commitment in other fields of disease control. It was agreed that the number of "catastrophic" diseases had been reduced and that the shift in strategy might be for the Government to act more as a catalyst in dealing with contemporary problems.

The importance of epidemiology for the future of the profession was acknowledged but it was questioned whether this was sufficiently recognised in undergraduate training. It was pointed out that the teaching allocation for epidemiology was increasing, both as a subject in its own right and as an integral part of other sections of the syllabus. There were difficulties both in awakening the undergraduate mind to the relevance of epidemiology and in allowing for the inevitable lag phase in seeing effective teaching translated in to field practice.

Discussion of practical issues raised the importance of remaining flexible in the presentation of results in various forms (e.g. graphs versus tabulated data) to make easier the communication of the significance of results. The procedures for carefully selecting a stratfied random sample from the small number of premises used in in-depth systems of examination was discussed, and it was emphasised that the results from these herds should be integrated with those from existing voluntary monitoring systems. The difficult of unrecorded changes, such as changing the brand of diet, occurring while monitoring was in progress were considered. These were acknowledged and the value was recognised of building model systems for "prediction situations" which could then be used to check back and thus help to elucidate possible discrepancies.

W O R K S H O P   1.

FARM PRACTICE

The Use of Herd Records in Planned Animal Health and Productivity Services (Pahaps)

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I Introduction

It has been emphasised, on many occasions, that the veterinarian has a key role to offer in Planned Animal Health and Production Services (P.A.H.A.P.S.) yet progress in this field has been painfully slow. It could be that the practitioner has not been fully equipped to undertake this role. Advice at herd level must be based on reliable information which has been analysed in a way which can be of value for diagnosis and monitoring herd performance. It is not only essential that records be kept but that the record system should be conducive to regular and comprehensive analysis. The reluctance of many farmers to keep records is often due to the lack of analysis and therefore use of the information recorded. This has been largely the result of the veterinarian not being involved in the design and operation of recording systems. Farmers have usually been left to design and operate the system of their choosing with little or no veterinary guidance.

The availability of the Melbread system in 1972 demonstrated to the author the potential benefits of the practitioner directing a recording system for his farmer clients. These benefits were :-

1) Demonstration to the farmer an interest in HERD performance leading to an increase in the use of veterinary advice.

2) Access to instant analysis of a wide variety of fertility parameters which were available to monitor herd performance and were extremely valuable when assessing the various factors which affect fertility particularly the effect of forage quality and stockman efficiency. Advice could be offered on the basis of well analysed, reliable information.

Improved fertility was achieved in 9 out of 10 herds from 1972-1976 and the importance of records and record systems in that achievement have been reported (Eddy, 1981).

In November 1979 the practice purchased the DAISY computerised recording system to offer, on a commercial basis, to local dairy farmers a recording service which would include health, fertility and milk yields. Options were offered of health and fertility only every 1, 2 or 4 weeks or health and fertility plus milk recording every 1, 2 or 4 weeks. Data is brought to the office by the herdsman, his messenger, by post or telephone. Some herdsmen wait while the records are processed. The turnround of reports can be as little as 30 minutes but is always on the day or receipt of the raw data. Details of the Daisy system and the report options can be seen in the appendix. The principal advantages of the Daisy system to dairy farmers are :-

1) Integration of recording systems. On farm evolution of specialised recording systems has led to increased work in on-farm recording. Individual cow health cards, rotary boards and wall charts for fertility management, official milk recording schemes and brinkmanship books can all be in existence simultaneously so that when a cow calves that event has to be recorded in up to five separate places. The Daisy system considerably reduces the time spent in on farm recording providing the existing recording systems are abandoned.

2) Brinkmanship as a management system monitoring milk production weekly and allocating concentrates is now widely practised by leading dairy farmers but entails two hours per 100 cows per week in herdsman's time. Computerisation of brinkmanship has proven a valuable attraction of Daisy. The system also allows the practitioner to regularly assess milk production and to be in a position to offer advice on production and feed levels.

3) The fast turnround of reports allows the farmer to monitor performance and take the necessary management action based on up to date information. Milk recording schemes based on monthly recording and 10-15 day turnround of reports are of little or no value as a management aid.

4) Fertility recording. The cost of fertility has been well documented and the importance of oestrus detection cannot be over emphasised (Esslemont, 1972). The Action lists perform a similar function to the rotary boards by indicating dates for drying off, calving dates due, cows due for service and pregnancy diagnosis. The mean interval from calving to first service must be maintained at 65 days to achieve a calving to conception of 85 days and it is essential therefore that all cows are served at the first observed

oestrus after 50 days post partum. The action list, cows calved but not yet served, helps to prevent too early service and to maintain vigilance for oestrus detection by the herdsmen. Cows not served by 70 days post partum can be examined at the subsequent veterinary visit.

Fertility analyses

A) Cu sums for conception rate have been described elsewhere (Eddy, 1980) and have proven valuable in explaining changes in conception rate which often occur during the course of a breeding season. Changes in management or feeding are frequently associated with changes in conception rate e.g. housing cattle during November, changing from Autumn grass to silage or the change of silage clamps during the winter. A further benefit of the integrated nature of Daisy is that these changes in feeding will also affect milk yields so it becomes possible to link the effect of nutrition to both milk production and fertility. Fig.1 demonstrates a sudden drop in conception rate from 60 per cent to 33 per cent on or around 22nd of February, 1980. A change in silage clamp took place on 21st February from one of M/D 10.4 to M/D 9.4. Further examples of conception rate changes within season can be seen in Figs. 2,3 and 4.

B) Effect of interval to 1st Service.

Fig. 5 which represents cows calving from 1st January 1979 to 31st December 1981 in a large dairy herd, demonstrates the effect of calving to 1st service interval on conception rate, calving to conception and milk yield. In total 1244 first services took place. It would appear in this herd that calving to 1st service interval of less than 49 days had no effect on lowering calving to conception interval but did considerably reduce conception rate and the annual milk yield equivalent. Intervals to 1st service greater than 76 days also reduced the Annual milk yield and increased calving to conception interval.

C) Analysis of interval between services.

Figs. 6, 7 and 8 are histograms of return to service intervals (in days) for 3 different farms. Farm A showed exemplary oestrust detection where 68 per cent of return intervals are between 18 and 25 days and a further 9 per cent at 6 weeks. Farm B (Fig.7) recorded only 26 per cent returns at 3 weeks with 17 and 16 per cent occurring at 6 and 9 weeks respectively. This being an example of extremely poor oestrus detection. Farm C (Fig.8) demonstrates a herd where 32 per cent of return services are less than 18 days which is indicative of inaccurate oestrus detection. This will, of course, result in a depressed conception rate. The effect of percentage of inter service intervals $<$ 18 days on conception rate can be seen in Fig. 9.

Treatment analyses

The accumulation of a large data base also provides an opportunity to assess the effects of fertility treatments. One such example is an analysis of three code uses for prostaglandin (P.G.) :-

Code 39	=	P.G. at negative pregnancy diagnosis (P.D.-ve) Corpus luteum present.
Code 49	=	P.G. at N.V.O. examination. Corpus luteum present.
Code 79	=	P.G. given without rectal examination, usually for groups of cows.

All cows were fitted with Kamar Heat mount detectors and inseminated at the 1st observed oestrus. Those not responding would be re-examined at 14 days and injected again.

The results were extracted from 7 herds in the period 20th November 1980 to 31st March 1981. The results can be seen in table 1. It can be seen that of 41 cows treated for P.D.-ve 32 (78%) were served within 6 days and 21 (51%) conceived whereas of the 99 treated for N.V.O. 58 (58.6%) were served and only 26 (26%) conceived. More cows (33 out of 90) conceived when no examination was performed. Further analysis is in progress on a larger number of herds to examine the situation further but it is likely that the better results obtained for treating PD-ve cows is due to the longer interval from calving to treatment in these cows.

Further analysis of the use of PRID and GNRH for anoestrus treatment is currently being carried out.

Other health analyses.

a) Calf mortality can be analysed monthly and related to parity. On one farm this analysis revealed a calf mortality of 15% and the farmer wasn't aware he had a problem.

b) Milk fever incidence related to parity and month of calving often reveals distinct seasonal variations (both within and between seasons).

c) Hereditary aspects of lameness and mastitis can now be examined and the incidence of both conditions can be analysed relative to sire and may prove advantageous in future advice on bull selection.

Table 1. Effect of three treatment regimes for prostaglandin; PD-ve, NVO with C.L. palpated and NVO without rectal examination.

	39	49	79
		NVO	NVO
	P.D.-ve	CL palpated	No rectal examination
Number treated	41	99	90
Number served 0 - 6 days	32	58	55
Number conceived	21	26	33
Per cent served of those treated	78%	58.6%	61%
Per cent conceived of those served	66%	45%	60%
Per cent conceived of those treated	51%	26%	37%

Summary

An integrated recording system such as Daisy can be invaluable in improving herd productivity. For a minimum of data recording on the farm the system can be used to regularly monitor yield and fertility performance, it is a valuable management aid and should be able to analyse the data to help provide accurate diagnosis to current problems, highlight weak areas of performance and also provide valuable epidemiological information for general advisory use.

The question arises as to whether computerised recording schemes should be situated on the farm, a local bureau or a central bureau. Inevitably a large number of in farm systems will be installed over the next decade. It is, however, our experience that clients would prefer a local bureau because of the interactive nature of the advice it generates. The veterinary practice is ideally situated to provide this service but also veterinary involvement in such schemes demonstrates the willingness of the veterinarian to become involved in production advice, provides him with the information required to make decisions and is therefore essential for the future of PAHAPS.

References

EDDY, R.G. (1981) The application and some economic implications of fertility control programmes in large dairy herds. F.R.C.V.S. Thesis.

EDDY, R.G. (1980) Analysing dairy herd fertility. In Practice. May 1980.

ESSLEMONT, R.J. (1973) A study of the economic and husbandry aspects of the manifestation and detection of oestrus in large dairy herds. Ph.D. Thesis Reading University.

DAISY RECORDING SYSTEM

On Farm Recording

1) Health and Fertility

ALL EVENTS for each cow to be recorded in duplicate books as the events occur. These books can also serve as a diary of events for the dairy herd. It is only necessary to record each event ONCE. These should be updated at least twice daily and can be coded at the same time from the code list supplied.

e.g.

Cow	Code	Date	Event
364	02	2.6.80	Calved dead calf
436	67	2.6.80	Mastitis L.F.qtr. - treated S.T.P.
34	8	2.6.80	Dried off with tubes
16	14	2.6.80	A.I. Bull ATME
44	76	3.6.80	Vet.treated lame ulcer R.H.
42	01	3.6.80	Calved. Live hereford bull
42	64	3.6.80	Milk fever. 1 bottle Calc.

The top copy is sent to the computer and the carbon copy kept on the farm for future reference.

The following events should be recorded:-

- Calvings - live, dead or twins and if aided.
- Milk fever and grass staggers
- Lameness - vet. or home treated.
- ALL mastitis outbreaks - only record each course of treatment once.
- Retained afterbirth
- Service dates and bull code
- Group changes
- Drying off dates
- Veterinary treatments and all other farmer treatments.

2) Milk Yield

Milk yield records can be accepted weekly, fortnightly or monthly.

Yields in Kgs. can be recorded on sheets provided by the Computer which lists all cows currently in milk, approximately 100 cows per page. There is no need to add the AM and PM recordings. Alternatively, yields can be recorded on your own sheets or "Stayclean" sheets which, being waterproof, are useful for in parlour use.

The milk records can be brought to the office by messenger or herdsman who can wait for the records to be processed and take home the reports. - Approximately three quarters of an hour is required to process 150 milk records, produce the weekly management report and the necessary action lists. If distance is a problem, milk records can be accepted by telephone. 15 minutes on the telephone is required to transmit 150 cow milk yields and the reports can be returned by post.

ACTION LISTS

		Suggested frequency of report
A.1	COWS DUE TO BE DRIED OFF Please specify length of dry period and period (in days)to be covered by the report. Available as pocket list or full table.	Monthly
A.2	COWS DUE TO CALVE Specify period to be covered by report. Available as pocket list or full table. Can include a table of numbers of cows calving each month for the next 9 months.	Monthly
A.3	COWS NOT SERVED SINCE CALVING Available as pocket list or full table.	Fortnightly
A.4	COWS FOUND NOT IN CALF AND NOT SERVED SINCE	Monthly
A.5	COWS SERVED BUT NOT YET CONFIRMED IN CALF CAN BE TIMED TO ROUTINE VISIT and used as a list of cows for pregnancy diagnosis.	Fortnightly
A.7	COWS FOR THE VET TO SEE	

RECENT EVENTS REPORTS

AVAILABLE IF AND WHEN REQUIRED

R.1 COWS LEAVING THE HERD

Cows dried or sold between any two dates specified by farmer.

Lists reasons for disposal, date, lactation length, ages etc.

R.2 COWS DRIED OFF BETWEEN 2 DATES

Lists number of lactations, dry date, calving to conception interval, length of lactation, yield, estimated date of and days to next calving, estimated calving interval, estimated length of dry period.

R.3 COWS THAT CALVED BETWEEN TWO DATES

Lists of calf status, details of previous reproductive cycle, suggested earliest date of service, problems occurring between calving and current date (aided birth, milk fever, retained afterbirth, mastitis, metritis).

R.4 PREGNANCY EXAMINATIONS CARRIED OUT BETWEEN 2 DATES

Lists date and result of pregnancy examination, service to pregnancy interval, calving to 1st service interval, Number of serves.
For cows pregnant, calving to conception interval, bull code, date of next calving, estimated calving interval.

R.5 REPRODUCTIVE EXAMINATIONS CARRIED OUT BETWEEN 2 DATES

Retained foetal membranes, post natal check, pre-breeding examination, endometritis, oestrus not observed, failure to conceive.

HERD DATA REVIEW REPORTS

		Suggested frequency of reports
H.1	LACTATION CURVES FOR ONE OR MORE COWS	When required
H.2	COMPLETED LACTATION PERFORMANCE SUMMARY Analysis of completed lactations - yield and quality for cows calving over any selected period - please select periods required. Can also be used for cows dried off over any selected period. Information produced :- Peak yield, persistency, 90 day yield, 305 day yield, total lactation yield, lactation length. Butterfat and protein production in Kgs. can also be included. Reports include a list of individual cows and analysis of the group.	When required
H.3	HERD FERTILITY SUMMARY Analyses herd fertility on a month of calving basis. Select months of calving required. Useful for end of season fertility assessment or every 3 months to review herd fertility progress.	Every 3 months
H.4	HERD HEALTH & FERTILITY DATA LIST Useful in place of individual cow cards, can include current only or all recorded lactations. Lists all health and fertility events recorded The list is available for whole herd or individual lists of following groups can be produced :- Pregnant, served, unserved, not to be served, culled, milking, dry.	Fortnightly
H.5	INDIVIDUAL COW DATA LIST Produced at drying off and filed for future reference. One sheet per cow. Includes the following information:- a) Ear number, pedigree for cow. Sire & Dam. b) Previous lactation summaries. i) total yield of milk, butterfat and protein ii) number of services, mastitis, lameness, fertility and health codes.	As cows are dried off

c) Current lactation in detail
  i) Health and fertility data
  ii) Yield, butterfat and protein
  iii) Weight and condition score data
  iv) Feeding group changes

H.7	CU SUM AND CONCEPTION RATE Produces a Cu-sum of conception rate for service between two dates. Useful to monitor the effect of feed and management changes on conception rate. Also conception rate analysed by service number, by bull by week of service, by month of service, by group number by day of week.	3 month intervals & at end of breeding season
H.8	HERD GROUP LIST Lists cows in one or more groups	When required
H.9	COWS HELD ON DUMP DISC	
H.10	HEAT DETECTION EFFICIENCY 1) Effect of interval to 1st service 2) Cu sum of return heat or service intervals 3) Histogram of inter service intervals 4) Early season heat detection rate (submission rate)	
H.11	STOCK CHECK - PHYSICAL Information shown for last month, 1 and 2 months ago and rolling 12 month average. This report gives numbers of cows and heifers in the herd, % dry, average age, calf mortality, estimated 305 day yield.	Monthly
H.12	FERTILITY TREATMENTS ANALYSIS Analysis of a number of fertility treatments and the resulting effect on intervals to service and conception.	When required
H.14	INDIVIDUAL COW LACTATION CURVES	When required
C.1	CULL SORTER Identifies cows to be considered for culling by yield and/or other factors which include No. of services, No.mastitis, No.of lameness,days open, lactation number. Please state parameters required.	When required

C. 2 COW SORTER When required

Can identify good or poor performers, or cows with specified numbers of services, mastitis, lameness, can be used to identify effect of sires on lameness and mastitis.

BRINKMANSHIP + MILK YIELD REPORTS AND ANALYSES

THESE ARE AVAILABLE FOLLOWING MILK RECORDING

B.1 HERD MILK PRODUCTION SUMMARY (Averages Table)

Analysis of milk production for cows still milking on months of calving for cows and heifers separately. Last three recordings + percentage change between last 2 recordings. This table is useful for other systems of rationing.

B.2 WEEKLY MANAGEMENT REPORT

A whole herd listing showing reproductive performance and milk production performance of each cow currently in the herd and the concentrate allocation for each cow in milk.

Produced following each milk recording (weekly, fortnightly or monthly). This is the main management report produced by the DAISY system but need not involve the Brinkmanship approach as other rationing systems are used.

B.3 PARLOUR FEED LISTS

Lists parlour concentrate requirement for each cow allowing for concentrate being fed outside the parlour. Also calculates total daily concentrates required, which proves useful as a check against actual usage.

B.4 AVERAGES BY LACTATION AND/OR GROUP

Useful to monitor milk production when cows are housed in separate feed groups.

B.5 AVERAGES BY MONTH OF CALVING

Similar to B.1 but excludes cows which have marked changes in milk yield

Appendix

DAISY RECORDING SYSTEM

DAISY is an integrated recording scheme which provides essential information for establishing and maintaining a fertile, productive and profitable dairy herd.

The system, if used, need be the only recording system operating on the farm. There will be no need for separate systems for milk yields, health, service dates.

The system analyses data, as it is recorded in the herdsman's note-book, into valuable information for the herd manager, the herdsman, veterinary surgeon and adviser in a format which is easily inter-preted. Undesirable trends in herd health, fertility and production can be quickly detected and corrective action taken before they become a serious problem.

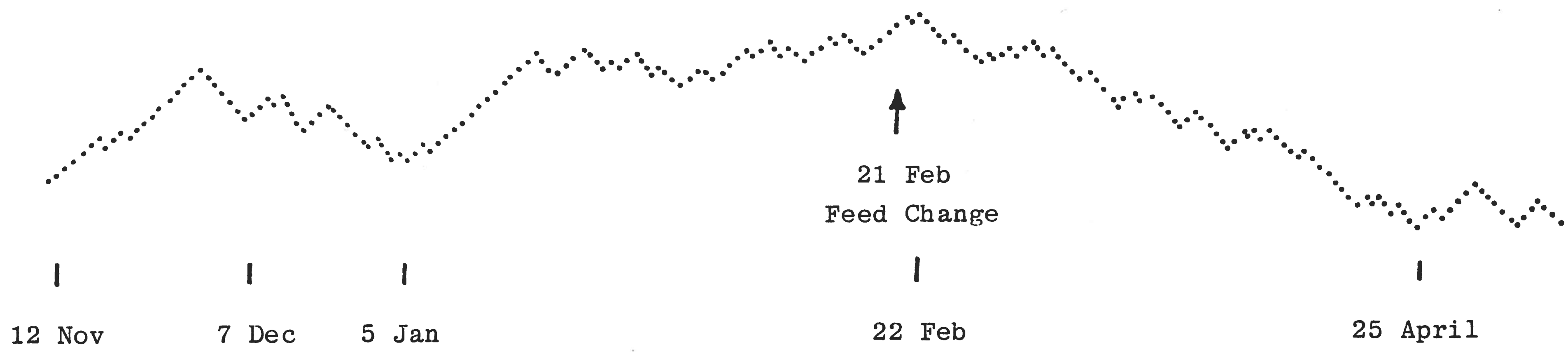
There are inbuilt programmes in the system to ensure accuracy of data and security of the information stored.

The flexibility of the system allows the user to select which of the many reports and action lists he requires to suit his management system.

Milk records can be accepted weekly, fortnightly or monthly, and processed to the Brinkmanship system of concentrate allocation devised by Ken Slater or by the Flat rate feeding system.

Reports can be available on the day of recording so that progress can be assessed without delay.

The following pages list the various reports and action lists that are available in the DAISY system.



Cu Sum of conception rate Herd 204 1979/80

$$\frac{75}{125} = 60\% >< \frac{32}{95} = 33\%$$

Fig 1

Fig. 2 Conception Rate Changes:
Herd 11 1973/4

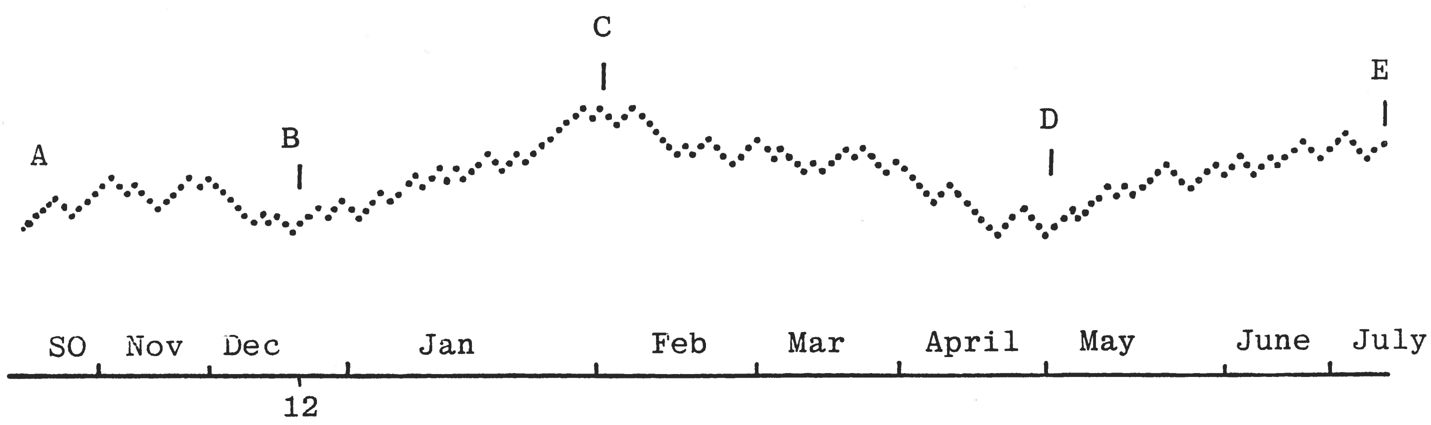


Fig. 3 Conception Rate Changes:
Herd 09 1974/5

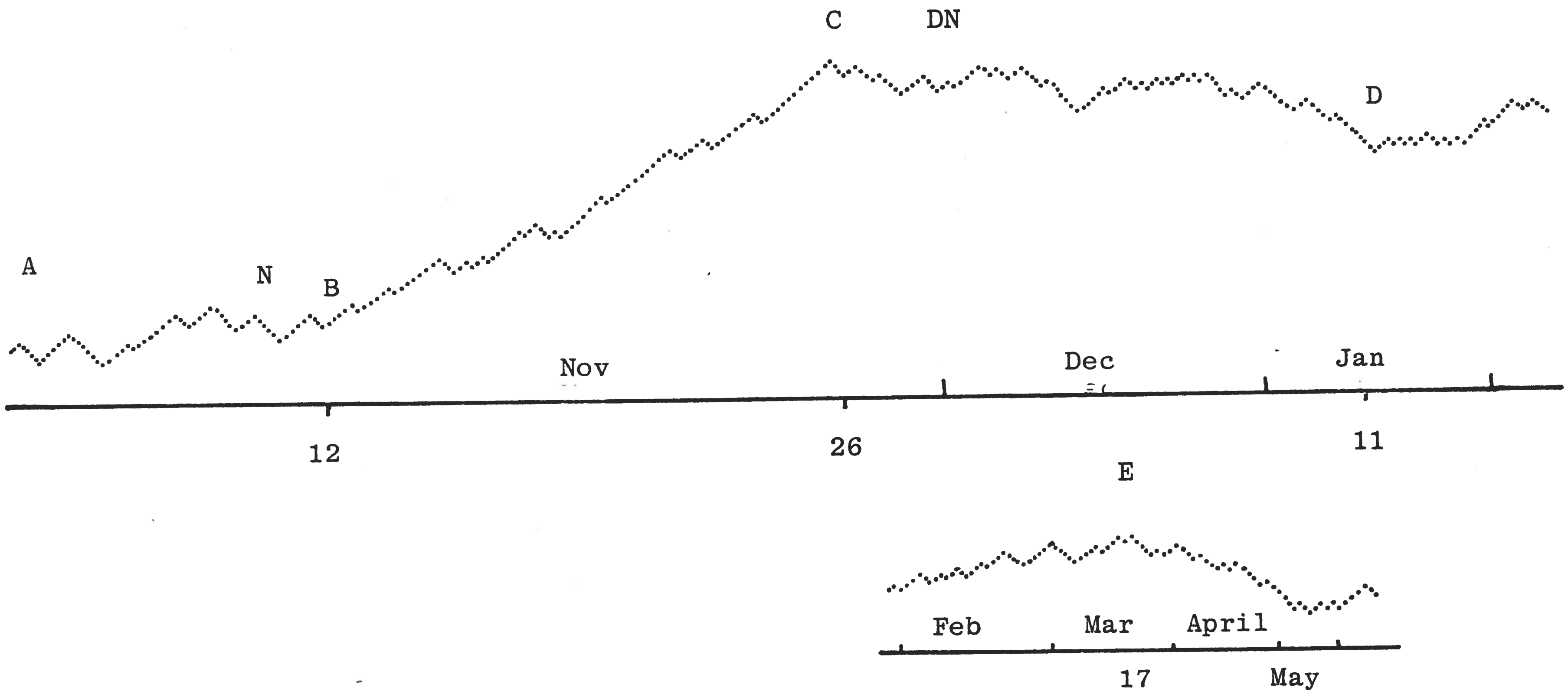
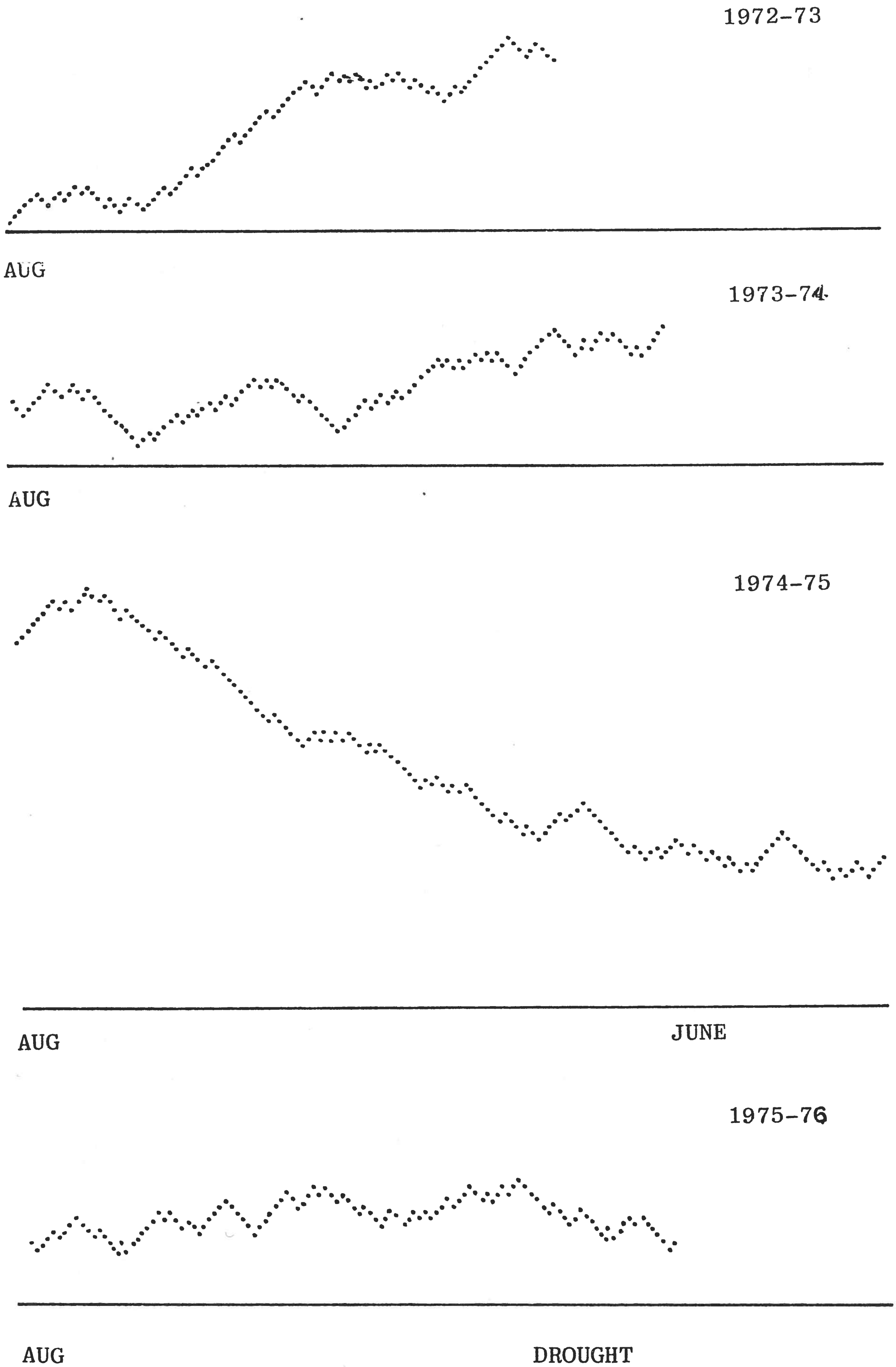


Fig. 4 Conception Rate Changes: Herd 12



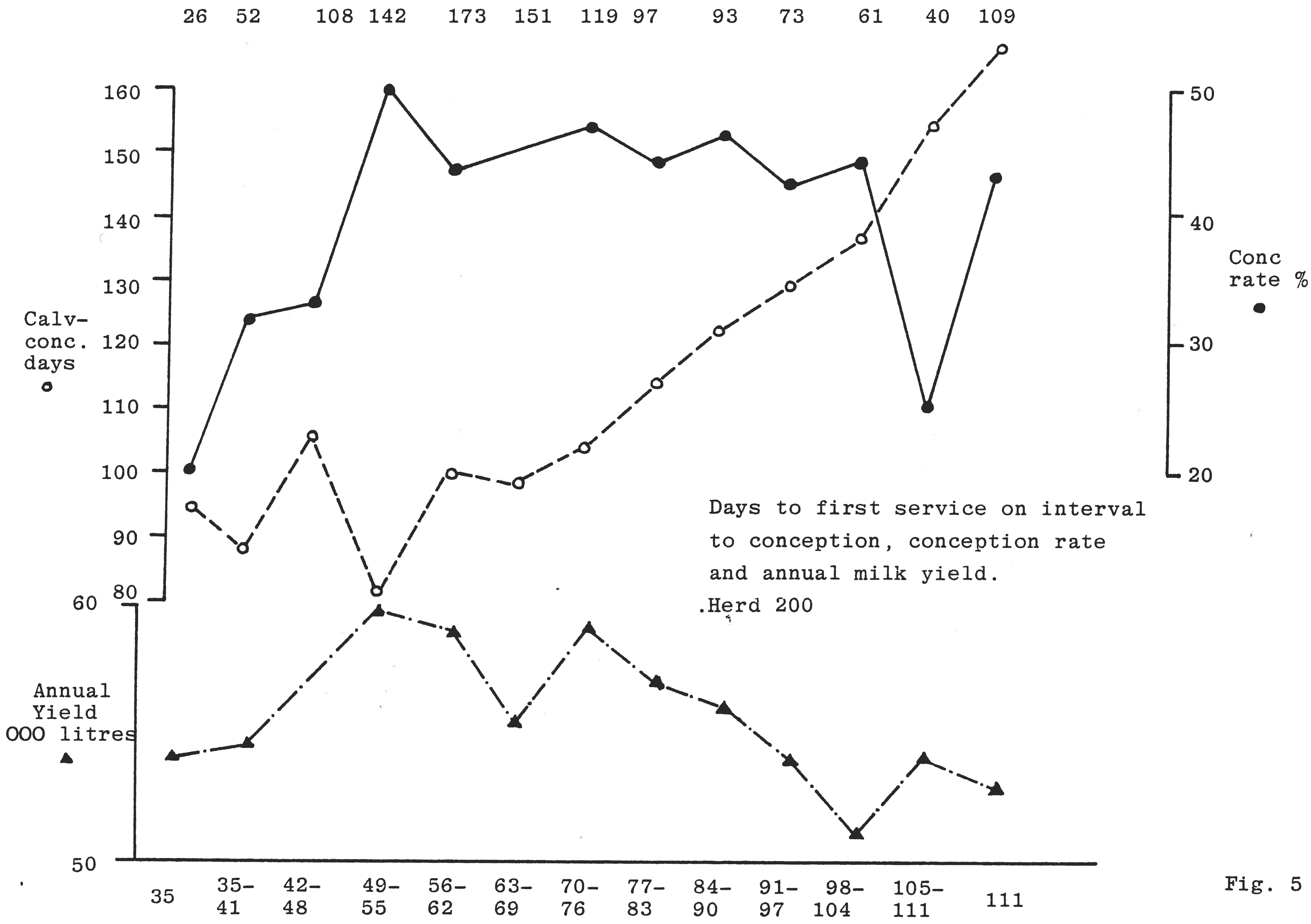

26 52 108 142 173 151 119 97 93 73 61 40 109
160
150
140
130
120
110
100
90
80
Calv-
conc.
days
50
40
30
20
Conc
rate %
60
50
Annual
Yield
000 litres
35
35-
41
42-
48
49-
55
56-
62
63-
69
70-
76
77-
83
84-
90
91-
97
98-
104
105-
111
111
Days to first service on interval
to conception, conception rate
and annual milk yield.
.Herd 200

Fig. 5

HEAT DETECTION ANALYSIS BY INTERVAL BETWEEN SERVICES.

COWS CALVING BETWEEN 1AUG79 AND 30JUN80

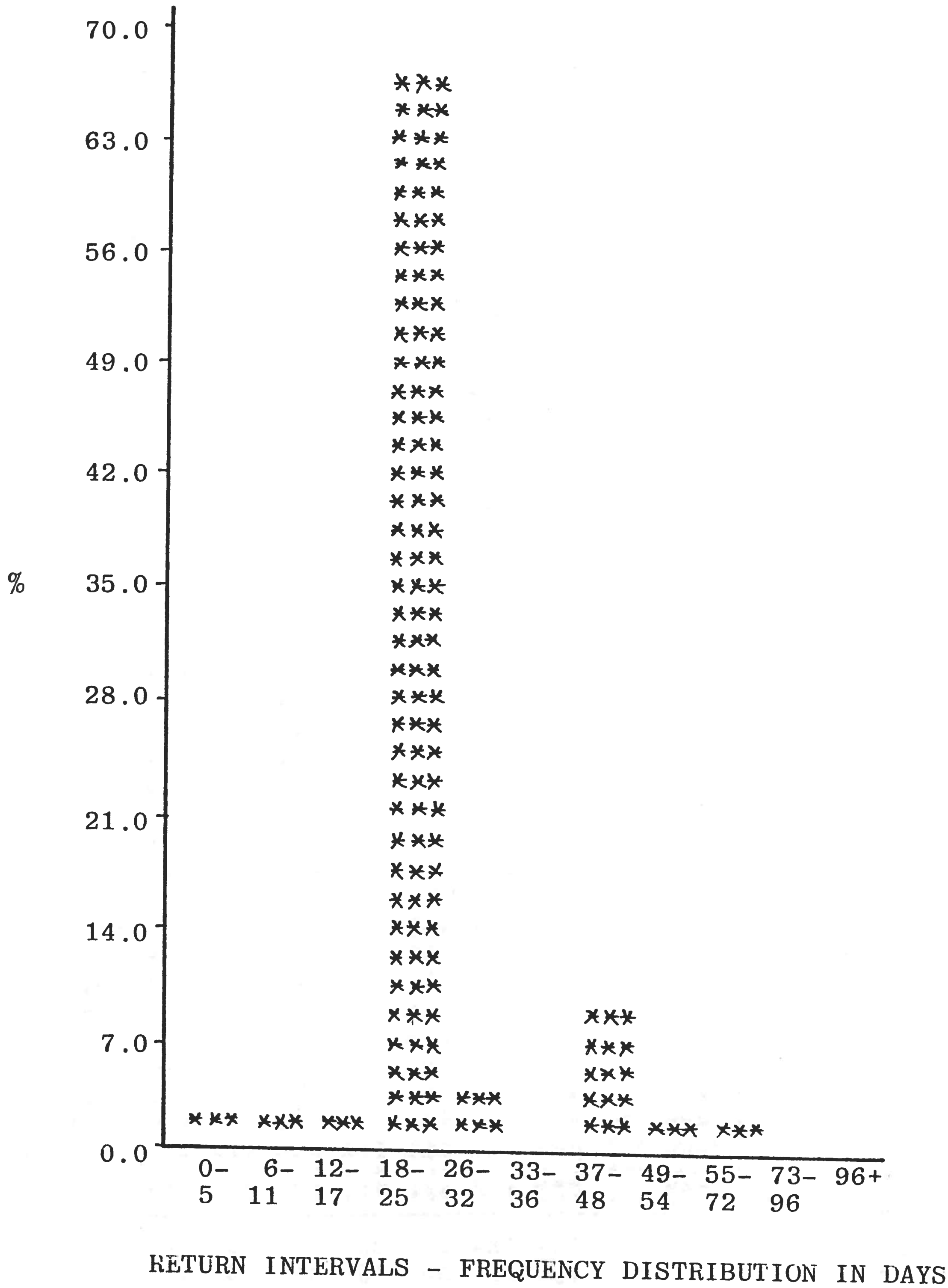


Fig. 6 Farm A

HEAT DETECTION ANALYSIS BY INTERVAL BETWEEN SERVICES.

COWS CALVING BETWEEN 1AUG79 AND 1AUG80

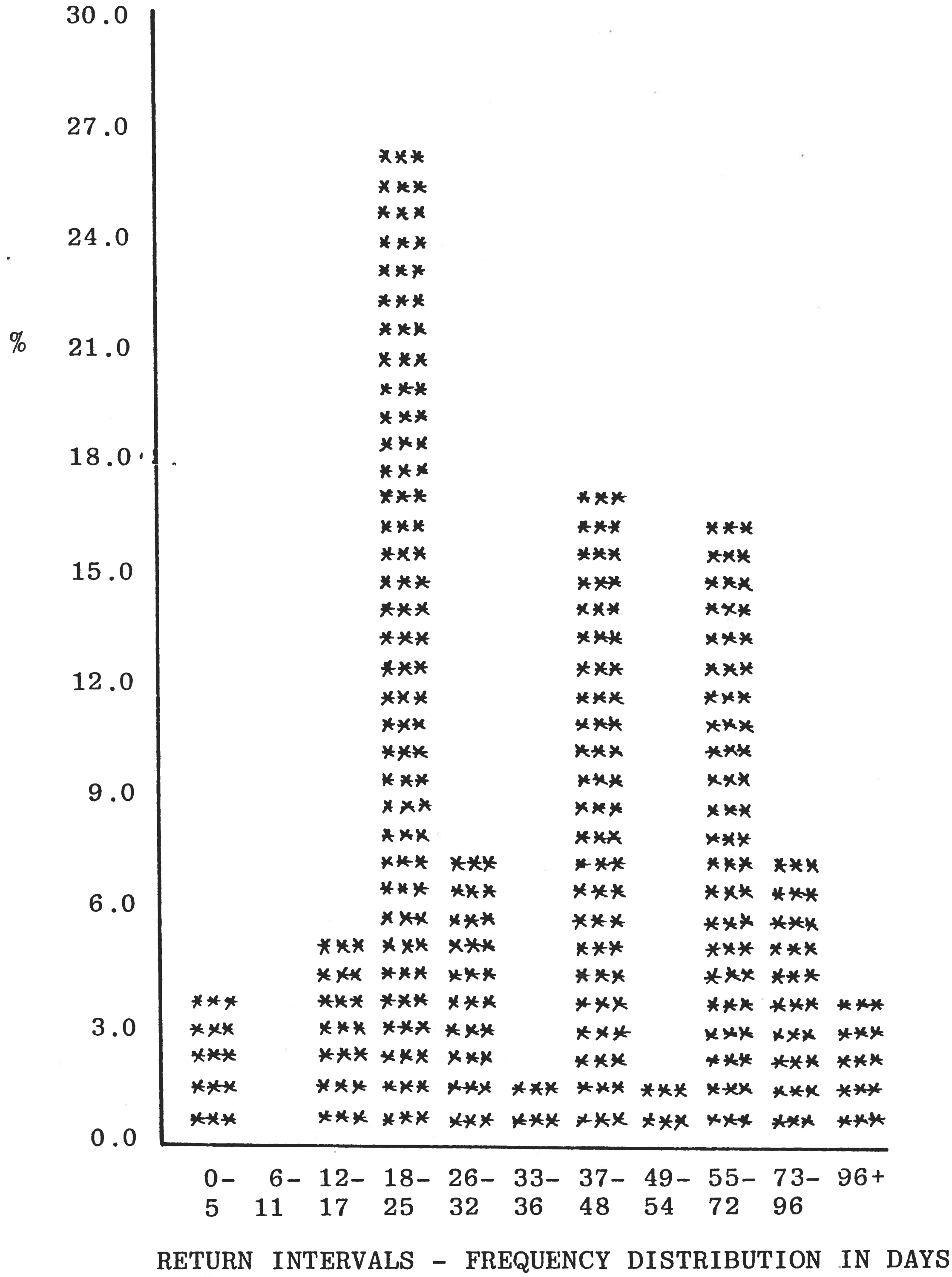


Fig. 7 Farm B

HEAT DETECTION ANALYSIS BY INTERVAL BETWEEN SERVICES.

COWS CALVING BETWEEN 1JUL79 AND 1JUL80

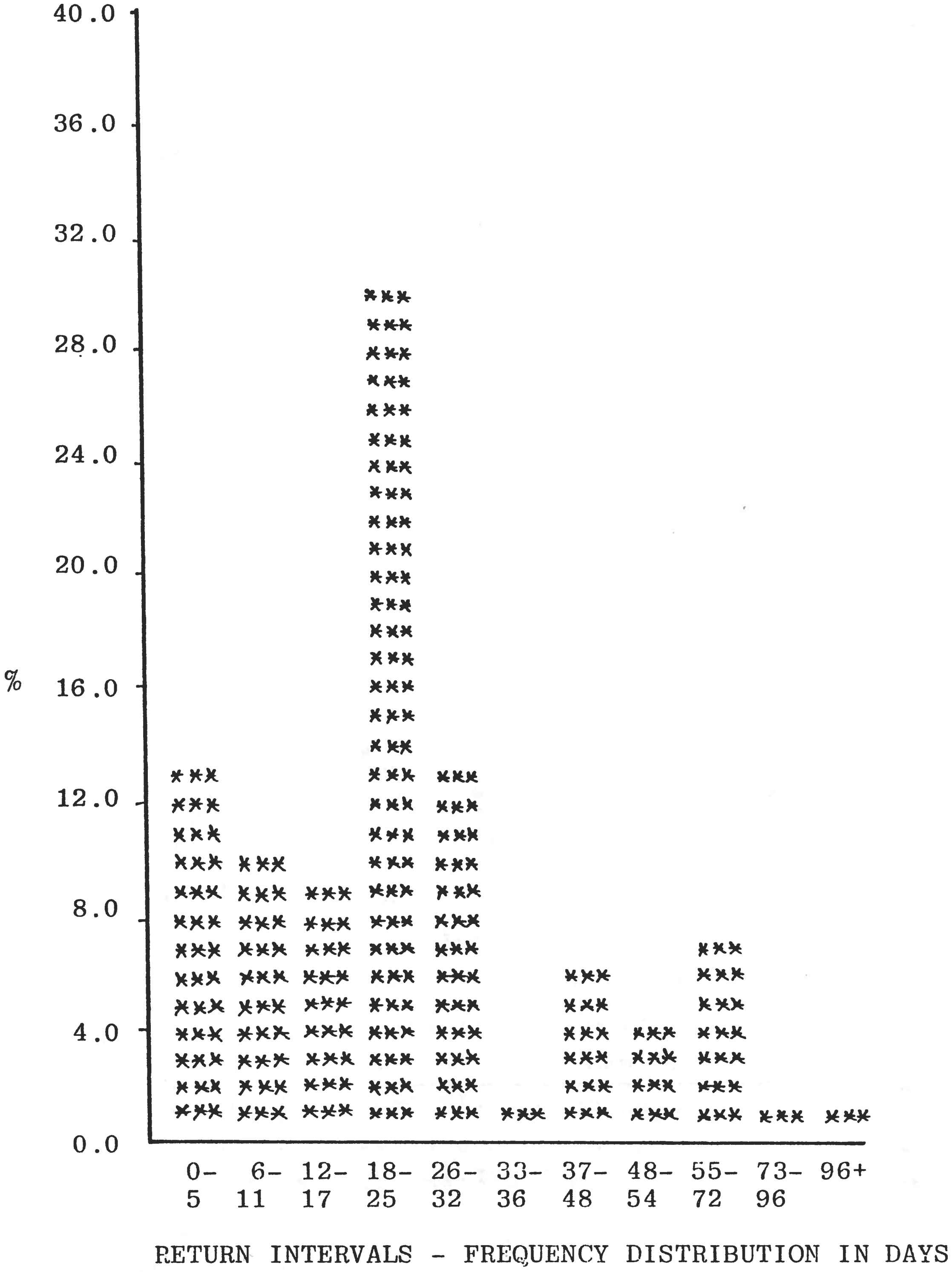


Fig. 8 Farm C

Effect of the per cent of interservice intervals < 17 days on conception rate.

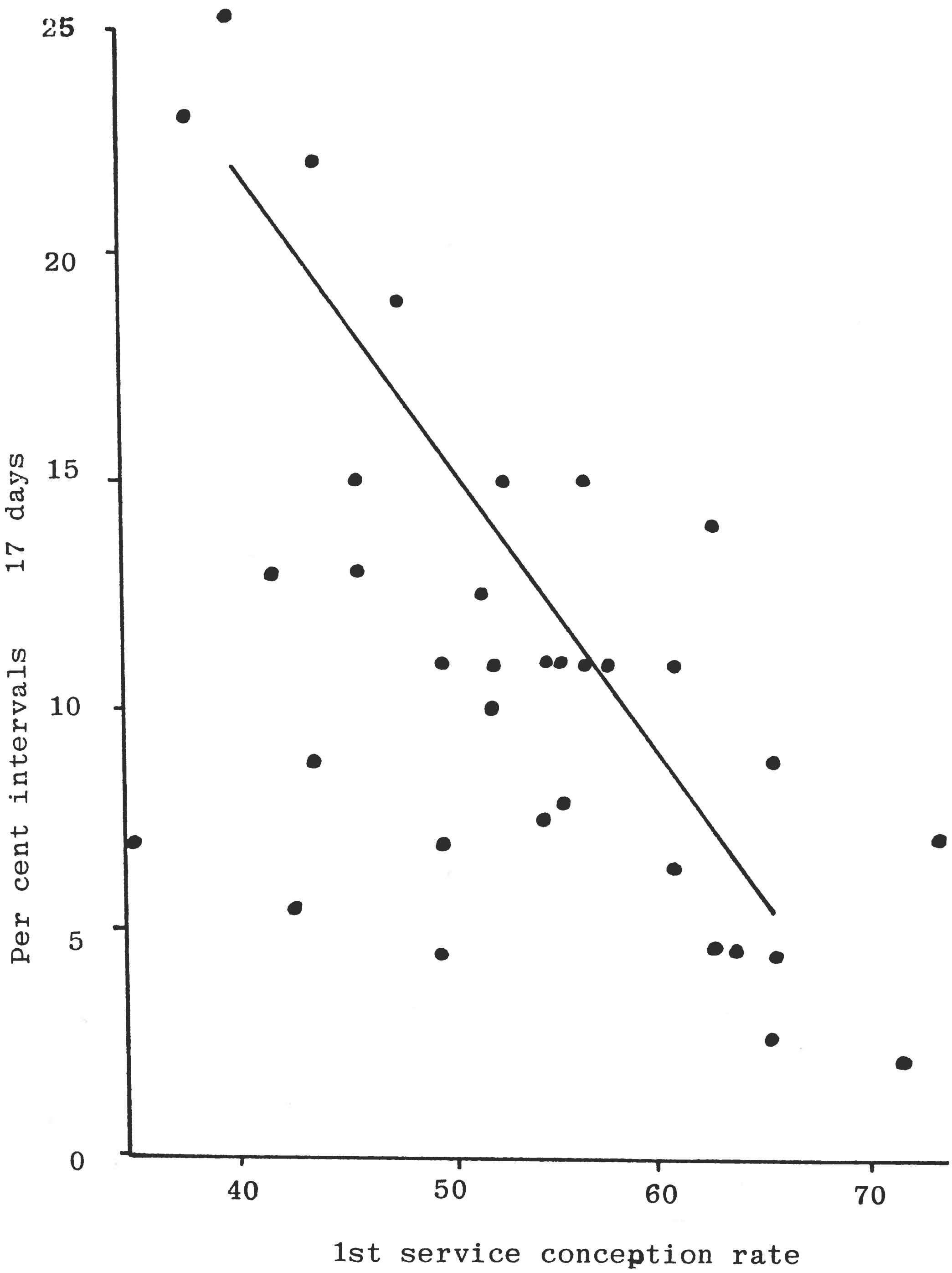


Fig. 9

Planned Animal Health and Production Services, Pig Herds

Rapporteur's summary of a verbal presentation by:-

J.G.Oldham
The White Cottage,
Halsham,
Nr.Hull
North Humberside

Health - Productivity - Welfare

In the mid sixties it was already becoming apparent, with the development of larger and more intensive (indoor and outdoor) pig units, that our most consistent problem was scarcity of information. In the absence of routine veterinary involvement on the farm, early recognition of 'dis-ease' depended on the owner or manager's powers of observation and willingness to report promptly what his eyes might see, but his intellect often refused to acknowledge. In the breeding herd at this time the only parameter quoted, usually inaccurately and over carefully chosen short periods, was 'pigs weaned per litter'. In the feeding herd only the most primitive attempts were made to assess efficiency of production; even 'age at slaughter' was an unknown quantity complicated by frequent back-mixing of pigs struggling unsuccessfully against their peers..It is a sobering thought that until 1979, with the publication of A.D.A.S. Booklet 2075 'Pig health and production recording', there were no standard definitions. Even the description 'sow' was indeterminate, making a nonsense of 'herd size' and therefore of most statistics of production produced prior to that publication.

The connection between productivity and health seems so obvious as to be hardly worth a mention. Yet in our profession we are conditioned to think in terms of 'DISEASE' and 'PREVENTION AND TREATMENT OF DISEASE'. We find it very difficult to accept that lowered PRODUCTIVITY, recognised early, can often be the most efficient indicator of 'DIS-EASE', including not only traditional Veterinary problems. WELFARE is another much abused and ill-defined word; we can at least be sure that 'DISEASE' and 'DISCOMFORT' are genuine WELFARE problems where progress can often be measured only by the use of productivity records.

Breeding records developed over the seventies tended to be based on whole-herd information. In practice it proved very difficult to manually record individual sow performance and problems in large herds, or to collect and collate over long periods analyses of pre-weaning mortality, herd parity spread and so on. Ideally we need access on demand in a 500 sow herd to all the information (and more) which the stockman carried in his head and pocket diary when the herd size was 50!

In the eighties the computer has made this a practical possibility, the necessary programmes are up and running. The two main approaches are the inward looking desk top systems and the more extrovert bureau approach allowing analysis of a much broader date base for comparative and advisory work. Certainly much of the information becoming available requires interpretation by individuals highly skilled in the field. Surely no one is better placed to fulfil this role than the Veterinarian - a challenge which he must meet now; or never. In the field of hardware we may soon be seeing such tools as sneeze/cough counters monitoring Rhinitis/pneumonia. These may even interact with computer operated heating/ventilation systems as well as informing on the need for, or progress attributable to, in-feed or other medication.

I conclude with a few examples from the 'Pigtales' system illustrating these points. The slogan is 'Down with averages, up with Histograms and Cu-sums.'

The following tables and diagrams illustrate some of the PIGTALES output. Although not selected to illustrate specific points it is possible to make useful comment on all of them.

Figure I. shows how the classification of piglet deaths is kept as simple as possible and intelligible to the stockperson responsible for data capture. Some preliminary training is required.

Figure II is a histogram of preweaning losses by cause. It is interesting how small is the contribution of scour to the overall loss. This is a general observation. 'Crushed' is the dominant finding but there may be predisposing factors, which should be further investigated. Here the information system has indicated a problem area which could have been overlooked by both producer and researcher.

Figure III shows another set of preweaning losses. Under 'optimal' has been included losses from transmissible gastro-enteritis. This is a user-defined category.

Figure IV shows a reasonable population age distribution in the sow herd. In Fig. V a very high proportion of animals are in the younger age groups which is undesirable. This may reflect severe culling in the face of a disease problem or would also be seen when a herd was expanding rapidly. Correct interpretation relies on other knowledge of the unit.

FIG.I

PIGLET DEATHS (DEFINITIONS OF CAUSES)

These are the STOCKPERSON's assessment of the Primary cause of death, for example a Runt pig which finally died because it was crushed, should be defined as a Runt, not as Crushed.

A 'non-viable' pig is one which at BIRTH is considered to have no chance of survival.

M (	SMALL NON-VIABLE	A pig so tiny and weak at birth that it had no chance of survival.
N (	OTHER NON-VIABLE	
A (	STARVED	An otherwise viable pig that didn't get any milk
C (	CHILLED	An otherwise viable pig that died of cold.
U (	BLIND ANUS	
P (	SPLAYLEG	
K (	SHAKING	Tremor
D (	OTHER DEFORMITY	
V (	SAVAGED	Deliberately attacked by the sow
L (	LAYED-ON	Crushed, stood on, or otherwise injured by the sow
I (	OTHER INJURY	Damage not caused by the sow.
S (	SCOUR	An otherwise healthy pig that got diahorrea and died
R (	RUNT	Was viable at birth but did not thrive
B (	JOINT-ILL & MENINGITIS	
T (	WHITE PIG	
O (	BLOATED but anus O.K.	
? (	UNKNOWN	

CAUSES OF PRE-WEANING LOSSES
("PIGTALES")

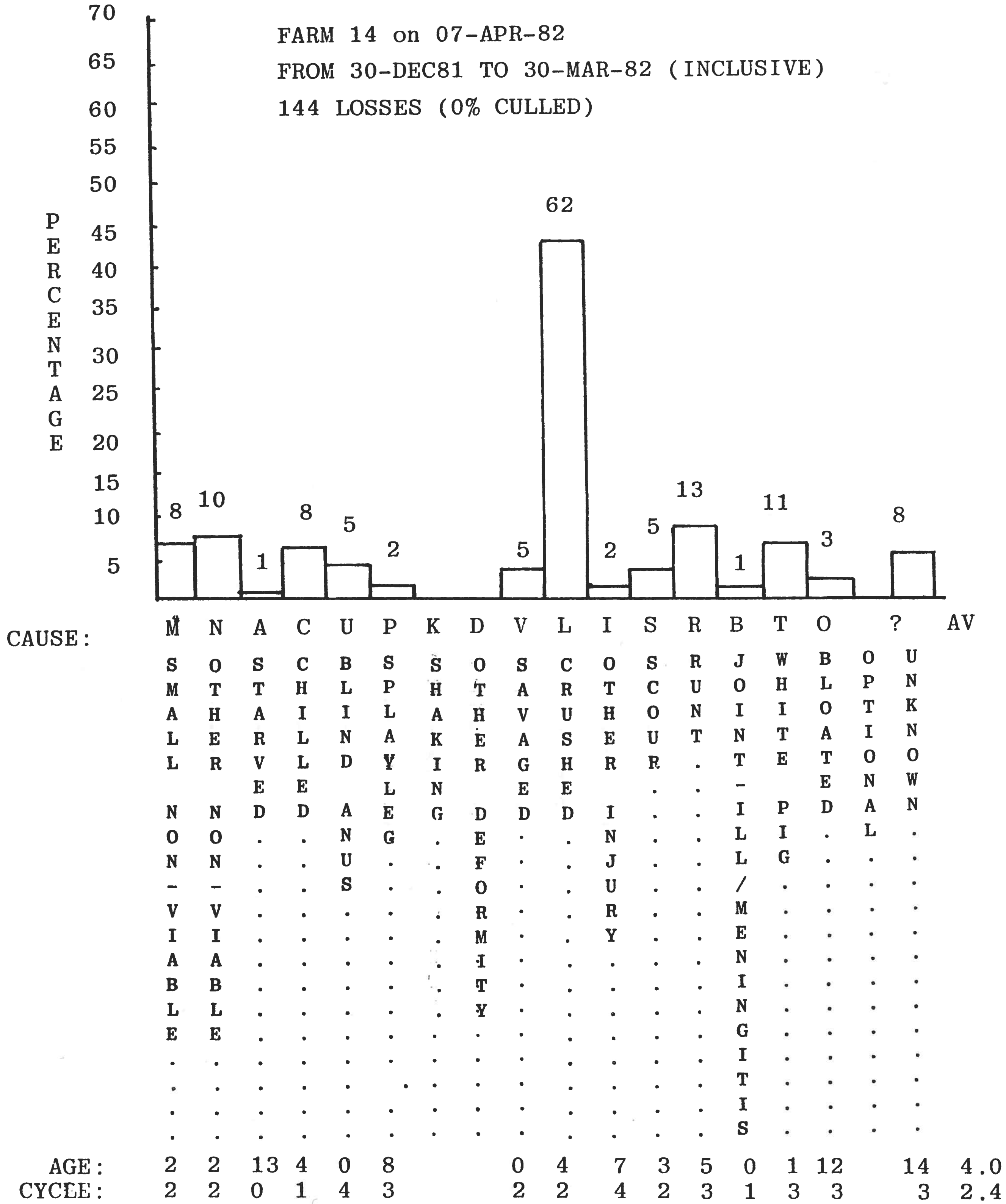


Fig. II

CAUSES OF PRE-WEANING LOSSES
("PIGTALES")

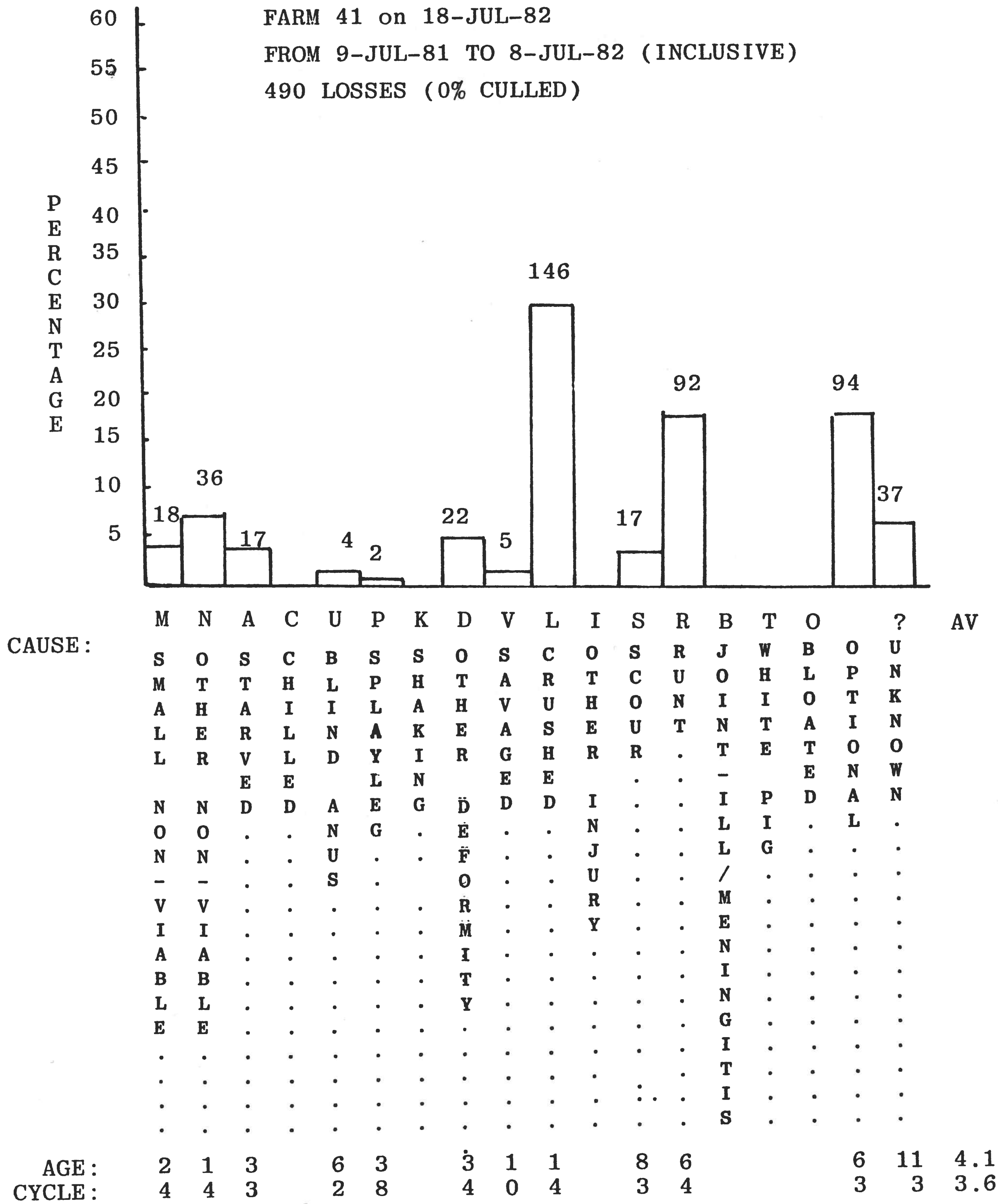


Fig. III

FARM 91 on 13-JUL-82

407 SOWS - AVERAGE AGE 2.6 CYCLES

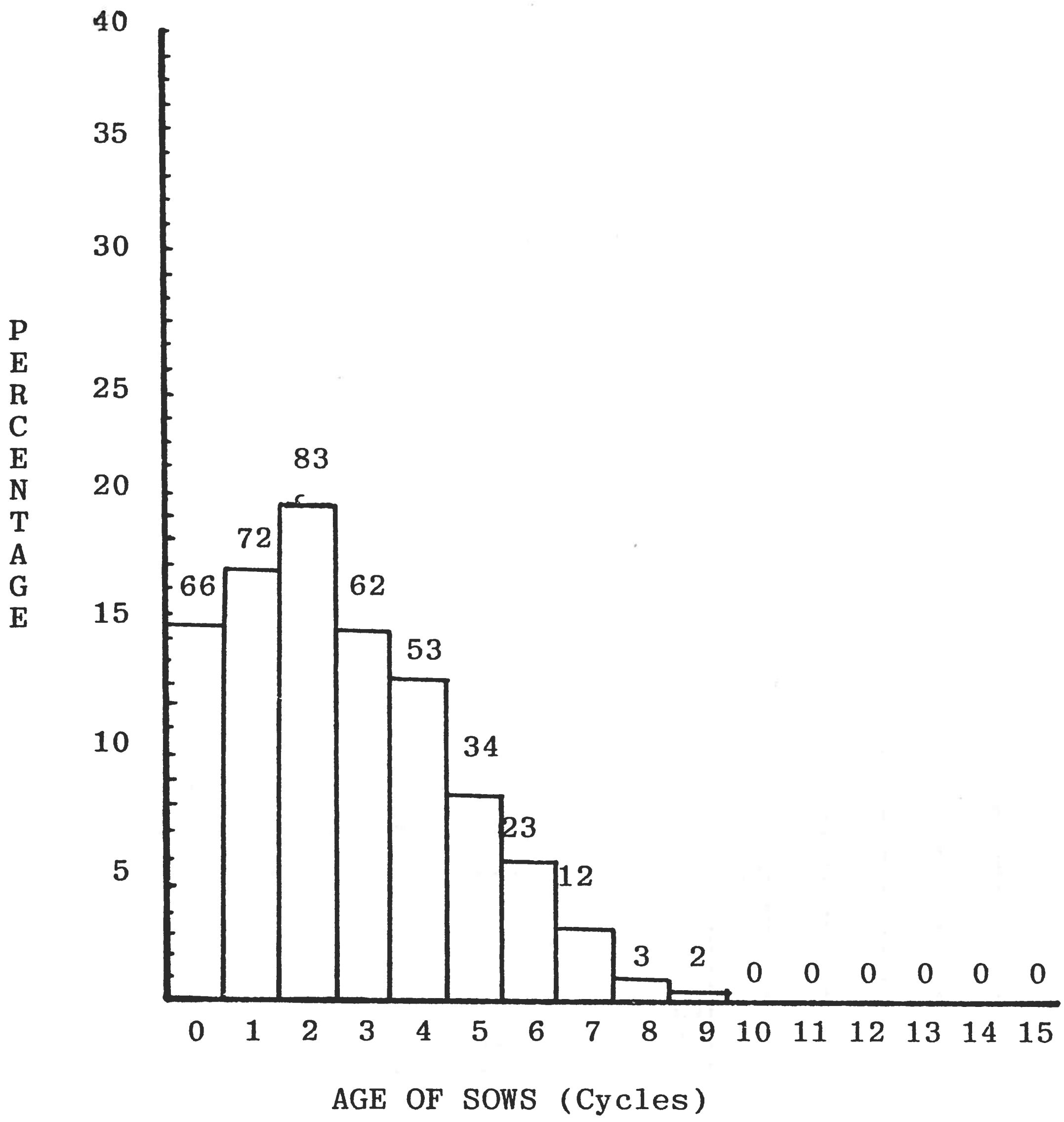


Fig IV

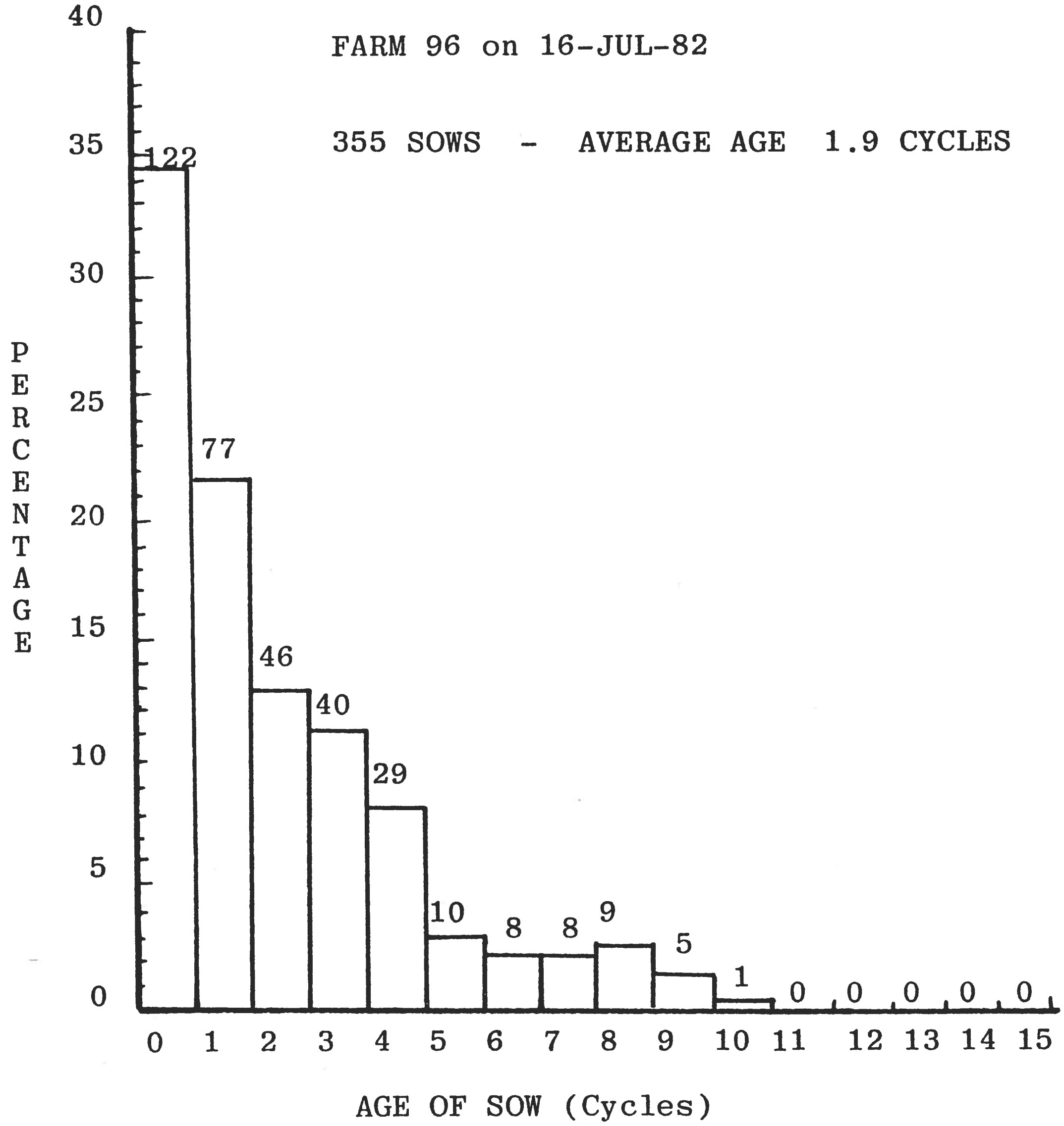

FARM 96 on 16-JUL-82
355 SOWS - AVERAGE AGE 1.9 CYCLES
PERCENTAGE
0
5
10
15
20
25
30
35
40
122
77
46
40
29
10
8
8
9
5
1
0
0
0
0
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
AGE OF SOW (Cycles)

Fig V

The use of herd health records in veterinary investigation

G.J.Rowlands, MA,DipStat.PhD.
ARC Institute for Research on Animal Diseases,
Compton, Newbury, Berks.

Summary

Many computerised livestock recording systems for dairy herds are available on microcomputers, although few have adequate coding systems for disease. On the other hand computer systems which specialise in disease recording have been designed primarily for larger computers. There is now a need to combine disease and production records into a single system in order to enable such data to be better used for veterinary investigation. It is unlikely to be possible to develop computer systems on microcomputers alone to handle the large bodies of data needed. The alternative of connecting a number of microcomputers on farms and in veterinary practices together to a centralised computer has the advantage that data collected from a number of farms and over several years could be stored in the one database and be immediately accessible for research purposes.

A livestock recording system COSREEL which combines disease and production records has been in use at this Institute for 5 years and at two outside farms for 2 years. Examples of statistical analyses being undertaken on these data are given to demonstrate the potential value of establishing a co-ordinated and extended database involving several farms and veterinary practices.

Introduction

A number of computerised livestock recording systems for dairy herds are available on microcomputers, but none of those described by Banfield and Cory (1980) (e.g. FARMPLAN, FARMFAX) make any serious attempt at disease recording. Computer systems which specialise in disease recording, for example, VIDA II, a computerised diagnostic recording system for veterinary investigation centres in Great Britain (Hall, Dawson and Davies, 1980), and a computerised system for clinical case records of small animals (Thrusfield and Hinxman, 1981), have been written for large, main-frame computers. A disadvantage of each of these disease coding systems is that they comprise lists of numbers, which cannot be remembered easily. DAISY -

dairy information system (VEERU, 19880; Esslemont, Stephens and Ellis, 1981), now operating on minicomputers at 3 'centres' in England records disease better than any of the commercial systems described by Banfield and Cory (1980) but its current version is still inadequate for detailed health recording.

Two new computerised herd health management recording systems have recently become available in this country. The first of these, VIRUS (Martin, Mainland and Green, 1982), is a dairy herd health recording system for use on a microcomputer, and is being applied to about 20 farms by the West of Scotland College of Agriculture in Ayrshire. About 70 letter codes, mostly 2 or 4 letter abbreviations, are available for disease diagnosis. Particular emphasis is placed on the type of mastitis or lameness and on genital problems associated with infertility.

The second system, COSREEL (Russell, 1980; Russell and Rowlands,1982) was originally designed for the management of cattle, sheep and pigs kept at this institute, but has since been used also by two agricultural colleges and their veterinary surgeons (Rowlands, Lucey and Russell, 1982).

COSREEL is a terminal based system using a remote main-frame computer, and has a versatile letter and number system of coding which can record medical and surgical treatment as well as diagnosis of disease. It differs from VIRUS and other systems in the method of coding. Whereas other systems classify disease into a limited number of defined conditions, COSREEL enables a wide variety of diagnoses to be defined by combining the codes for organ and abnormality. Diagnoses, for instance, begin with the symbol ? followed in brackets by 3 letters, the first to indicate the body system to which the organ belongs and the other two to indicate the organ itself. Thus, ?(ESO) refers to the sole of the foot (E=epidermal system, SO=sole) and ?(GPL) to the placenta (G=genital system, PL=placenta). Organs in other body systems: for example musculoskeletal (M), nervous (N) and respiratory (R), can be specified in the same way. Two letters follow the brackets to describe the abnormality. Thus ?(ESO)UL indicates an ulcerated (UL) sole and ?(GPL)RE a retained (RE) placenta.

The position of the organ may also be defined, for instance the foot involved in a case of lameness, and the cause of the abnormality, whether it be due to trauma,. infection, etc., also given.

The symbol # instead of ?, indicates a medical treatment, and is followed by a code for the medicament. Thus, for example #(T)AT means topical (T) administration of the Antibiotic chlorTetracycline (AT) which might be used in treating a case of solar ulcer. The symbol %, instead of ?, indicates a surgical treatment.

Examples of veterinary codes used by one of the veterinary surgeons in the field trial of COSREEL are shown in Table 1 to give an idea of the flexibility of the coding system. These codes describe diagnoses (beginning ?), medical treatments (#) and surgical treatments (%) made by the veterinary surgeon at one of his regular infertility investigation and pregnancy diagnosis visits to the farm.

The system has been in operation at this institute since 1977 and a database on the life histories of all dairy cattle that have been resident at the institute since this time has been accumulated. These data have been used for statistical analysis to demonstrate the types of research uses that such a database can be put to for veterinary investigation. Three examples are now given.

Table 1. Examples of veterinary codes used in the diagnosis and treatment of genital (G) conditions.

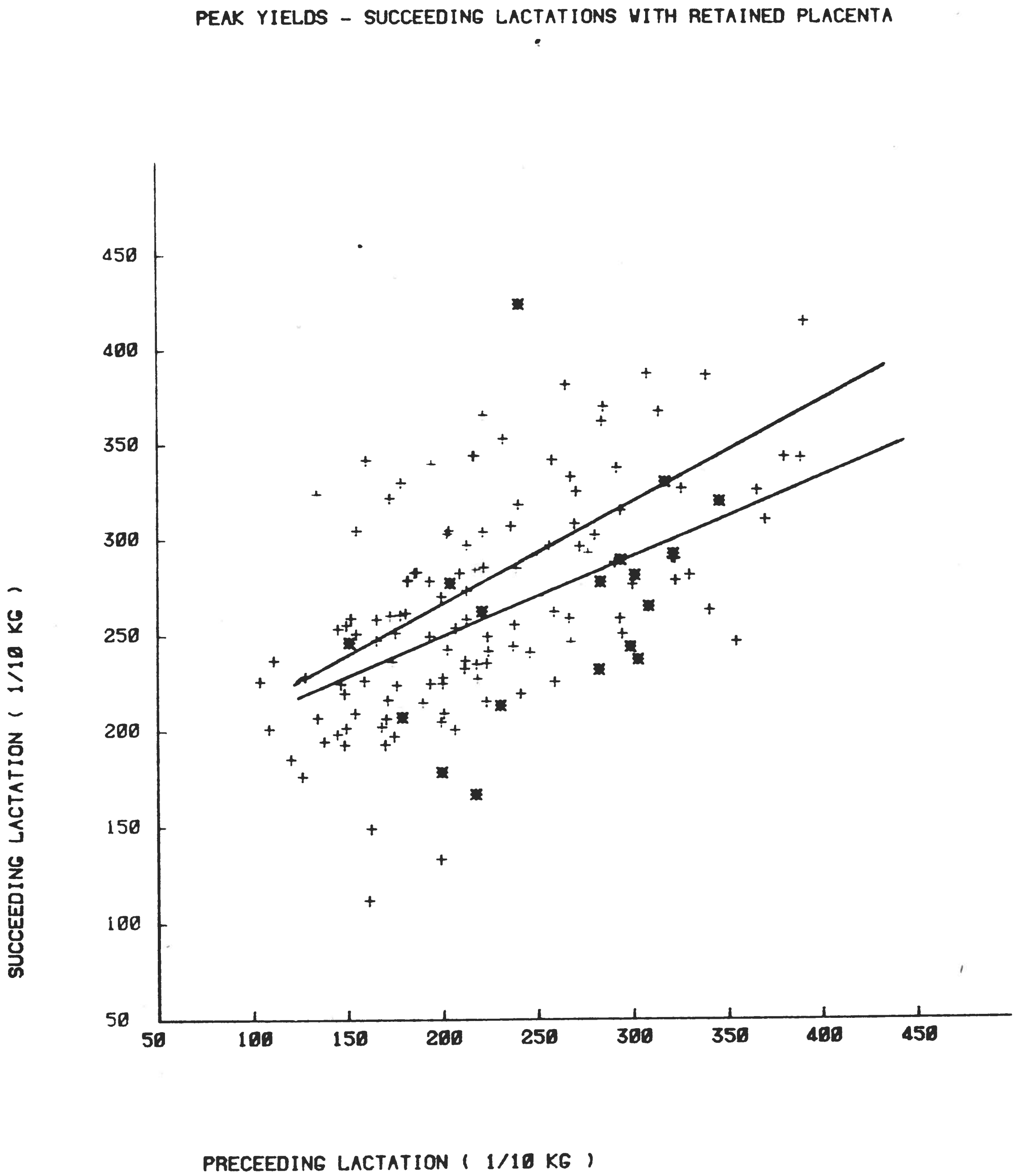
1.	?(GUT)OK	uterus (GUT) normal (OK)
2.	?(GUT)IN/PU(GCL,L)OK #(M)HG	uterine inflammation (IN) and purulent exudate (PU), left (L) corpus luteum (GCL) normal (OK); intramuscular (M) treatment with the Hormone prostaGlandin (HG)
3.	?(GOV,LR)UA #(M)HG	left and right (LR) ovaries (GOV) underactive (UA); treatment as above.
4.	?(GOV,R)AL %(GOV,R)DR	accumulation of liquid (AL) in right (R) ovary (GOV); surgically drained (DR)
5.	?(GPL)RE %(GPL)RE #(M)HS	retained (RE) placenta (GPL); surgically removed (RE); treated intramuscularly (M) with stilboestrol (HS)

Results

1. Effect of disease on lactation

Peak and 305-day milk yields were retrieved and compared for

Figure 1. Relations between peak yield in succeeding and preceding lactations in cows with no incidence of disease in either lactation (+) and in cows in which retained placenta occurred in the succeeding but not the preceding lactation (*). The lower of the two regression lines has been fitted to points marked by *, the other to the remaining points (+).



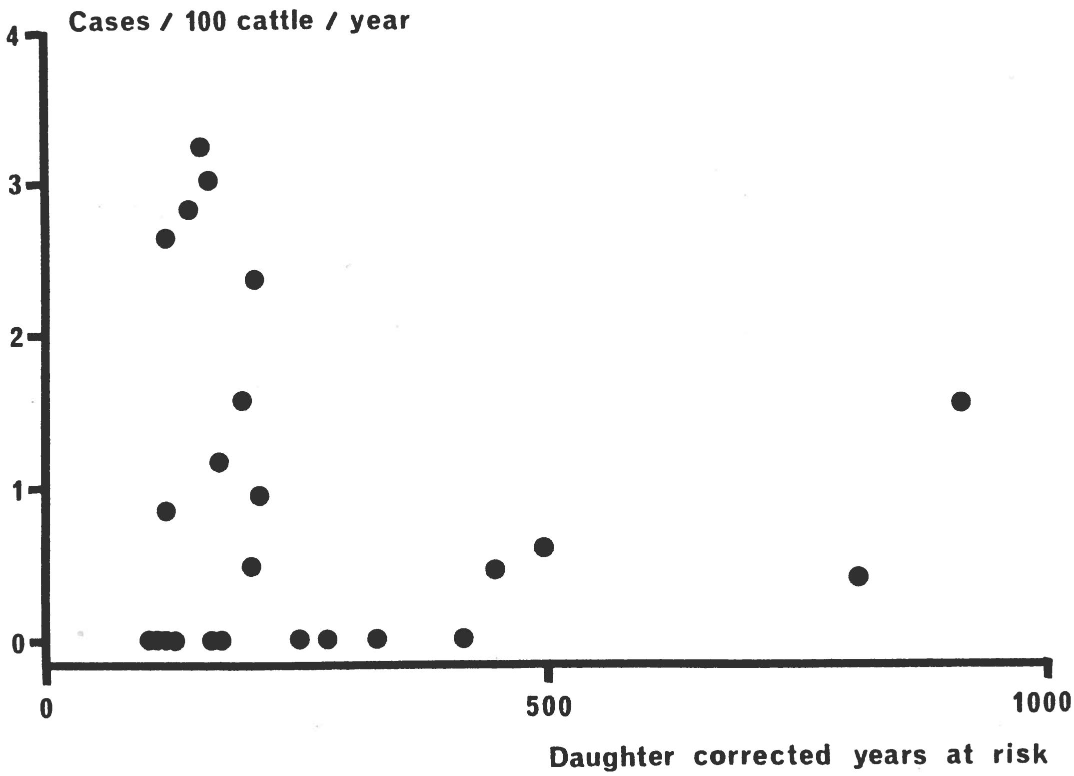
successive lactations in cows living in one of two herds. Pairs of successive lactations were divided into those in which there was no incidence of disease in either lactation (121 pairs of lactations) and into those in which disease occurred in the succeeding but not the preceding lactation. Of these 18 pairs involved occurrences of retained placenta, 17 ketosis, 29 milk fever, 7 hypomagnesaemia and 42 mastitis between calving and peak yield. Regression lines were fitted to peak and 305-day milk yields in succeeding lactations on corresponding values in preceding lactations. When the regression analysis was in turn confined to pairs of lactations with retained placenta or ketosis occurring in the succeeding one, the fitted line was below that calculated from pairs of lactations which were both free from serious disease. The results for peak yield for retained placenta are shown in Fig.1. The vertical line between any pairs of points on the two lines gives the expected reduction in peak yield associated with the particular disease. The average percentage decrease in potential milk yield in the succeeding lactation for cows yielding 25 kg at peak yield in the preceding lactation was about 10% for retained placenta and 12% for ketosis. These decreases were significant ($P<0.05$). When 305-day lactation yields were compared, the difference persisted for retained placenta (on average 12% decrease) but not for ketosis. Incidence of mastitis was similarly associated with reduced milk yields, but milk fever was not. Cases of hypomagnesaemia were too few to draw positive conclusions.

2. Coincidence of diseases

The occurrences of diseases in individual animals which calved since 1977 were retrieved and compared with each other for retained placenta, mastitis, solar ulcer, milk fever, ketosis and general uterine disorders. For each of these diseases in turn (referred to in Table 2 as disease B) the numbers of occurrences were counted, first when one of the other diseases (disease A) had already occurred during an animal's life, and second when it had not. This was done for different age groups in turn and average values calculated to compare the likelihood of a disease occurring when one of the other diseases had or had not previously occurred. The ratios (R) of these two probabilities are given in Table 2. This shows, for example, that the incidence of ketosis in cows which had already had retained placenta was 5.3 higher than that of cows which had

The range may be wide enough to suggest that genetic selection against solar ulcer is possible.

Figure 2. Percentage annual incidence rates of solar ulcer in the daughters of 24 bulls. The rates are more accurately known for bulls with larger totals of daughter years at risk.



ketosis without a previous occurrence of retained placenta. The susceptibility of cows to different diseases, in particular retained placenta and ketosis, mastitis and ketosis and solar ulcer and ketosis, that is pairs of diseases with large R values, therefore, may be linked. Retained placenta was also particularly common in cows with a history of uterine disorders (Table 2).

Table 2. Associations (R*) between retained placenta, mastitis, solar ulcer. milk fever, ketosis and uterine disorders

		Disease B					
Disease A	no of cases	retained placenta	mastitis	solar ulcer	milk fever	ketosis	Uterine disorders
retained placenta	41	-	1.7	2.9	2.4	5.3	9.7
mastitis	200	2.5	-	4.6	1.1	6.1	1.8
solar ulcer	45	2.9	2.2	-	0 **	5.8	2.6
milk fever	24	2.5	1.0	0 **	-	1.5	1.0
ketosis	32	4.2	1.8	5.1	1.5	-	1.7
uterine disorders	66	16.6	1.4	2.7	1.0	1.9	-

* The values R in the table are interpreted to mean that cows which have had disease A are R times more likely to have had disease B than cows which have not had disease A.

** No cow had both milk fever and solar ulcer.

3. Heritability of susceptibility to solar ulcer

COSREEL stores details of the identity and breed of an animal's sire and dam. These are assembled automatically to begin the life history of each live offspring of any cow already on record. These data were retrieved to study the heritability of solar ulcer. Fifty three diagnoses of solar ulcer were found to occur in 24 bulls which had most daughter years on record. Using the herd's age distribution, the susceptibility to solar ulcer of different age groups was calculated from the recorded cases. Taking into account the greater susceptibility of older cows to solar ulcer an annual percentage incidence ranging from 0 to 3.2 was calculated. Figure 2 shows this range plotted for each bull against the number of daughter years on record.

Discussion

Three examples have been given of the types of veterinary investigation that can be undertaken at a research level using herd health records. The results presented here are of limited value because they have been obtained from just one farm, and consequently need to be verified in further herds. COSREEL has already been successfully applied by two practising veterinary surgeons. Four more are starting to use COSREEL this autumn and it is planned that the 6 veterinary surgeons will have a total of 20 herds on the system in a year's time. Using this larger database the true economic importance of disease in relation to milk production, for example, could then be properly estimated.

There are many correlations and tabulations that can be explored using a database such as those being developed by COSREEL, DAISY and VIRUS. Martin, et al, (1982) mention for instance other genetic differences in sire progeny groups and cow families in their susceptibility to infertility and mastitis, and possible relationships between parentage and reasons for disposals. However, if a database is to be effectively used for veterinary investigation then it is essential that data entered into the health recording system are accurate and complete. This can only be achieved if the farmer and veterinary surgeon can make good use of the data that they enter; the quality of the data will be poor if they cannot. COSREEL for example provides users with fertility status lists, pregnancy diagnosis and infertility action lists, oestrus detection lists, post calving check lists, fertility and disease analyses and comparisons of milk production performance with expected values. The farmers and the veterinary surgeons now find these essential for herd management purposes, and they are thus motivated into keeping good records.

Veterinary investigations undertaken at a research level may not be of immediate value to the practising veterinary surgeon or farmer. However, there are many analyses that can be done at the practice or herd level, and the availability of such analyses will further encourage motivation. Analyses of fertility, disease incidence and culling rates both between herds and between years within the same herd, and the identification of individual disease resistant bulls, are all examples of data analyses that can be undertaken at this level. The flexible way in which COSREEL permits treatments to be coded (Table 1) should also enable comparisons of the efficacies of different treatments to be compared. As well as allowing herd production and health to be monitored from year to year, such analyses are also a very good way of demonstrating the benefit of a computerised health recording system to a farmer. For example, comparison of the first two years in which the two agricultural colleges have participated in the COSREEL field trial has shown reductions on average of 26 days in mean calving to conception intervals. A primary factor was improved oestrus detection (Rowlands et al, 1982). Other authors (Morris et al, 1978; Kruif and Akabwai, 1978) have shown similar effects on fertility. Mastitis incidence at both colleges has also been reduced, confirming similar findings in Australia (Williamson et al, 1978).

A major difference between COSREEL and VIRUS and DAISY is its use of a remotely sited computer via terminals both in the farm and the veterinary practice.

The two agricultural colleges and veterinary practices which have participated in the COSREEL field trial (Rowlands et al, 1982) were each provided with a typewriter terminal which could be connected by telephone to the central computer. This arrangement was expensive in telephone usage. However, the rapid reduction in costs of computer hardware should make it possible to provide farmers and veterinary surgeons with cheap micro-computers which they can use locally for data input and verification. Once the data have been stored they can then be rapidly transmitted to the central computer. Martin et al, (1982) suggested that large scale analysis of their VIRUS data would best be achieved by communications between their micro-computer and a main-frame computer. This approach is one that deserves further attention for it offers a potentially better organised and a more cohesive and reliable method of collecting data for veterinary investigation purposes than the alternative of exchanging microcomputer floppy discs which relies so much on the goodwill of the individual user. From a practical point of view too, where the farmer and veterinary surgeon have different requirements of the same data, it makes sense for the database to be stored at a place where both the veterinary surgeon and herdsman can have individual access to it. Separate computers in the veterinary practice and the farm office make it more difficult to fully exploit the use of computerisation of herd health records in preventative medicine.

In conclusion, the major requirement of a health recording system is to provide the veterinary surgeon and the farmer with an effective management tool; however, provided they are sufficiently motivated to maintain accurate and complete records their data can then be made available for veterinary research purposes. In the past this may have been viewed as a bonus, but with modern advances in computer technology and communications, it is one that can now be fully exploited.

Acknowledgements

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DISCUSSION :

WORKSHOP I ON FARM PRACTICE

Discussion centred around various aspects of PAHAPS and bureau services. The following report attempts to place remarks in some reasonable order rather than reflect chronology.

General rational of PAHAPS Both speakers had indicated the general process of obtaining through calculation of production parameters indication of areas of the production process which needed closer examination by epidemiological or clinical methods, a 'focussing-down' on problems. In discussion the difficulty of applying historical data to current problems was raised, there was always a danger of confounding factors affecting the validity of the results e.g. a farmer might introduce or remove a growth promoter. Specific questions included:

Q. Can Cu. sums be useful for conception rate analysis since the events occurred so long before?

A. With autumn calving herd one is starting to get information about halfway through the breeding season. Useful as it is it is very difficult to get this in any other way.

Although both were herd based systems neither could overlook the individual animal. Individual animal data was particularly difficult to obtain from sows but recent experience showed it could be done.

Data Capture and Quality Control

The following points were mentioned. Data collection must be kept simple where a large number of farms were involved. Software must have a considerable capacity to detect errors and the rapid entry of data on receipt assisted this. Where data was collected by several people on the farm peer group pressure was useful in bringing those with high error rates up to scratch.

Diary entry of data must take place close to the events recorded.

Physical and Financial Records

There was a need to link physical and financial records. Daisy and Pigtales did not attempt this, both speakers hoped that characterisation of the physical system would indicate where financial loss occurred. Pigtales was being expanded to include the fattening herd as well as the breeding herd. Financial information was particularly relevant in the fattening herd and this would be included.

Financial recording was also available from a range of other 'face' sources and this reduced demands for the speakers to provide it in their bureau service. Another problem was confidentiality. J.C.O. was not interested in repeating what other's had already done.

The danger of restricted financial analysis was noted e.g. a farmer could have a good margin over concentrates but inadequate profit from the enterprise.

Some financial parameters are rather crude but they are all that is available at the moment. They may still be useful in focussing down on problems.

Disease Records

What was the capability of the systems to record disease events? Daisy has a limited number of disease codes for e.g. mastitis, dystocia, lameness, milk fever etc. of these R.E. considers the recording of lameness and mastitis as very important.

It was noted that DAISY mark II would have a large number of user defined codes. Was this due to client demand? It was more to avoid the need for constant rewrites.

It was seen too that only a third of farmers recorded all cases of mastitis - there was embarrassment associated with this.

Pigtales has a limited capacity to record specific disease events. Again the approach was to identify problem areas and focus-down. The value of large disease data bases was questioned. Firstly how accurate was diagnosis? Secondly in calculating rates basic definitions were often lacking e.g. what precisely was a sow?

Predictive value of systems

Neither Daisy nor Pigtales was strictly predictive. The Sibyl programme for dairy cows simulated the herd and had predictive value but was not demanded by producers. The Brinkmanship programme came close to being 'predictive' in the narrow sense.

Both systems were more "Target orientated", whereby targets which were commercially attainable could be set and actual results compared.

Practical Aspects of Providing Services

The problem of reaching the farmer was considered. Publicity at conferences and shows was useful; once the pioneers were recruited word spread rapidly.

The lead farmers were not necessarily most likely to adopt the system - they had already workable systems. Most of the uptake was among those who had problems and wished to progress. Some had special requirements like Computerized Brinkmanship. All wanted to minimise the need for manual number crunching.

In dairying the herd with more than 100 cows was the main target.

It was important to market the advantages rather than emphasise mechanical details of the product.

Farmers did not always clearly perceive their needs; this was improving. There were two clear groups

1) Those happy with bureaux - didn't want problems of maintenance etc.
2) Those insistent on going it alone.

W O R K S H O P   II

STATE VETERINARY MEDICINE

Disease Control Policy Formulation, Including Economic Aspects

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1. The Epidemiologists Role

The investigation of disease used to be carried out by men such as the late Tom Doyle whose activities encompassed a whole range of disciplines ranging from pathology and microbiology to vaccine production and field investigation. They were complete investigators, able to present to the authorities all the evidence required for the formulation of disease control.

Those days have gone. Laboratory disciplines have become ever more complex so that it now requires a team of scientists to identify the infectious agent, to devise serological tests or to prepare vaccines. The government staff responsible for the implementation of control schemes require evidence both on the amount of disease and the practicality of controlling it and also on the economic benefit that can be expected. This has introduced epidemiologists and economists into the disease control formulation process. Their place is, as yet, by no means secure and this paper is an appraisal of the state of the developing art rather than a review of methodology.

There are a number of steps in formulating disease control policies:

1. Identification of the problem
2. Investigation of the disease
3. Identification and examination of options
4. Detailed planning of control measures
5. Monitoring the progress of control.

The epidemiologist has a contribution to make at most of these stages.

Identification of the problem

I am not at all certain that the identification of the problem is wholly the responsibility of a civil servant. Animals are afflicted by numerous diseases and it would be possible to devise any number of control schemes that resulted in interference with trade and the abrogation of the rights of the citizen. It is partly up to society in general and the agricultural industry in particular to indicate what it regards as 'a problem' that should be dealt with by Government action and it is up to their elected representatives to crystallise their feelings in a way that leads to sensible decisions.

Although the civil servant may stand back from this particular arena of public debate the epidemiologist has a major contribution to make. There can be no informed debate without facts and the crucial facts about the prevalence, distribution and trends of disease can only come from disease surveillance. In practice it is only the government service that has the country-wide resources to provide surveillance data and I see it as a responsibility of the Epidemiology Unit at Weybridge, to publish this kind of information. If it does nothing else it prevents misunderstandings in later negotiation between the industry and the Ministry.

The public and the industry do not require exact data on prevalence; they want to know the size of the problem and whether it is growing or diminishing. They want these facts in terms of disease prevalence although they are beginning to want them in terms of cost to the individual producer. The easiest and cheapest way of providing these background facts is to collate data that is already being recorded for other reasons, for example the VIDA system collates pathological data from Government investigation laboratories and the Milk Marketing Board collates cell count data from its milk testing laboratory. The Veterinary Investigation service reports and epidemiological notes in the Veterinary Record are attempts to inform the profession and the industry of changes in the disease status of the national herds and flocks.

Investigation of the disease

This used to be the exclusive province of the laboratory research worker but laboratory experiments cannot accurately reproduce conditions in the field. The identification of the causative organism and the creation of tests for infection are only tools to enable us to measure the epidemiological parameters that are the bases for devising a control scheme. More emphasis is now being placed on epidemiological investigations and these are being aided by computer recording systems. The current investigation of tuberculosis in cattle and its association with badgers is a good example of a sophisticated epidemiological enquiry.

The identification and examination of options

This is where the epidemiologist and the economist have major roles. The epidemiologist's task is to provide a reasonably exact estimate of the prevalence of infection in terms of infected herds and infected animals, together with herd size distributions, age ranges of infected stock and other data. All this is reasonably straightforward but he must then make a prediction of the likely future trend of disease in the absence of control measures and for this he needs data on the existing populations of animals and an insight on the way in which these populations may change e.g. by reductions in the number of herds and increases in herd size.

The epidemiologist also has to predict the effect of various intervention strategies and for this he must combine a knowledge of the specificity and sensitivity of serological tests with an assessment of the risk posed by infected animals and infected herds, the effect of movement controls, and survival of the infectious agent and so on. This is a very imperfect art. It was possible to construct a simple model of the effect of 45/20 vaccine on brucella infection within a herd but determining effects on whole populations of animals is difficult. There have been several attempts to model the effect of various alternative strategies (Hugh-Jones, Ellis and Felton 1975, Roe 1977) but this is a developing art. Whatever the benefit of the mathematical model as a predictive tool it is of considerable value as an aid to clear thinking about the dynamics of a disease.

The detailed planning of control measures

Once a policy option has been selected the construction of detailed procedures for the identification and elimination of infection, and the control of movement of animals can begin. At the moment this is a dialogue between veterinary administrators and the industry but where different procedures have significant epidemiological or economic effects then the epidemiologist and the economist have a part to play.

Monitoring the progress of control schemes

Monitoring has three aspects:-

1. monitoring the prevalence of disease i.e. the overall progress,
2. monitoring the cost of the programme,
3. monitoring the performance of the various tests and procedures.

The first two aspects are fairly well established; both prevalence and cost are closely monitored in the brucellosis scheme. The evaluation of tests and procedures is not so well developed and to some extent it has had to wait on computerised recording systems that allow for detailed analysis of events in the field.

Problems

The whole process of epidemiological assessment is at an early stage but already specific problems are evident. The first is the assessment of loss. Loss to individual producers in terms of diseased animals is reasonably straightforward to compute, but this is only part of the loss in sophisticated livestock production systems. An infectious disease such as enzootic bovine leukosis (EBL) may in itself cause limited losses but the long term effects on the industry can be serious. For example if infection gets into elite breeding herds it can reduce their trade and thus diminish the genetic benefit those herds provide to the industry as a whole. The assessment of these disturbance effects is difficult but is becoming crucial to a realistic measurement of benefit.

The second is the prediction of the rate of spread of infection. This is sensitive to changes in the structure of the industry. If a sector of the livestock trade becomes unprofitable it can result in a series of herd sales that are capable of dispersing infected animals far and wide. This is particularly a problem with 'new' diseases e.g. EBL and MAEDI/VISNA.

Thirdly, as the more dramatic diseases are eliminated the scope for traditional test and slaughter schemes becomes limited and we have to look at alternative methods of intervention. Penalties for milk quality may incidentally reduce the amount of mastitis; controls on livestock marketing may be the most effective way of limiting the spread of salmonella infections or I.B.R. The identification of such methods and the measurement of their effect is an embryonic art.

2. The Economist's Role

"Health is good and disease is bad" is probably as near to a statement of absolute truth as one is likely to get. Yet this apparently self-evident belief is subject to qualification. Even in the sphere of human health the maxim does not hold completely: there are diseases and ailments that could be expunged or alleviated but which are tolerated at levels far above the lower ones that could be achieved. The same applies in the animal world. Yet no one seriously contests that "health is good", so why not strive to eliminate or reduce the incidence and spread of disease and sickness to the full extent permitted by our technical ability - why acquiesce in higher incidences of illness and lower levels of disease control than are achievable? The answer provides the key to the understanding of the economist's role in disease control. The fact is that resources available for disease control (as for any other major objective) although not completely fixed (except perhaps in the short-term) are limited, while the uses to which these resources could be put, if not exactly infinite, are legion. A choice has to be made, specific objectives set and scarce resources allocated between the many alternatives. The decision involves a judgement about the relative merits of the competing uses. In general the resource allocation procedure relies heavily on the assessment of the financially measurable costs and benefits which constitute the particular concern of the economist. He is also of course, involved in the consideration of the intangible and non-measurable features of the process.

The assessment procedures which have been developed are known as social cost-benefit analysis (SCBA). SCBA provides the best available framework for the systematic consideration of all relevant factors, including the economic ones, governing decisions about disease - its planning, appraisal and monitoring. Indeed one of the, perhaps more hopeful, general conclusions of the First International Seminar on Veterinary Epidemiology and Economics was that: "The framework of SCBA has now been well established for the field of animal health and the technique is already making valuable contributions to policy decisions" (Ellis et al, 1978).

The Cost-Benefit Technique

So what is this technique ,especially as applied in evaluating projects directed at the control of animal disease? A social cost-benefit appraisal of a control strategy follows what can, conveniently, be described as the purely epidemiological appraisal. The economic appraisal generally comprises direct or implicit comparison, over time, of the costs of the control strategy (costs of implementation plus costs of any remaining lost production and other losses to the economy due to the disease) and the benefits (the saving of costs incurred in the absence of any strategy or under the prevailing strategy, or under an alternative strategy). The attached flow-chart shows the major steps to be followed in an SCBA.

Looking back at the necessary steps in formulating disease control policies which were set out at the start of this paper, the economist should be intimately involved in the last three: examination of options, planning of control measures and monitoring progress.

Examination of Options

SCBA has two main features - an absolute and a comparative aspect. The absolute aspect determines whether or not a particular control strategy is viable and worthy of consideration at all, at least in measureable economic terms. To decide this one needs to know the value <u>now</u> (i.e. net present value) of the control scheme and, since more remote costs and benefits are not on a par with more immediate ones, the estimated stream of costs and benefits over the period of operation of the control scheme have to be discounted; if the estimated present value (PV) of the benefits exceeds that of the costs so that the net present value (NPV) is positive, or the benefit/cost ratio (BCR) greater than one, then the policy is in principle acceptable. Comparison comes into play in choosing between acceptable policies. The final choice will need to take account of which among the acceptable alternatives has the largest positive NPV or better still, BCR. In some cases, however, important non-measurable factors and considerations of an intangible nature may result in the adoption of a control policy with a lower NPV or BCR than one or more of the alternatives.

It is easy, therefore, to understand the importance of having all realistic control options included in the analysis. If care is not taken to ensure this, a fully informed decision cannot be made. Frequently in SCBA the choice may rest between a particular line or action and doing nothing but in the area of animal disease control there are generally many more options to be considered. It is the Veterinary Services' responsibility to ensure that all realistic options (including 'do nothing') are considered and their related disease development profiles mapped; it is the task of the economist to estimate the measurable cost and benefit streams, both direct and indirect, associated with each separate option so that NPV's or BCR's can be calculated and compared. The epidemiologist, economist and all others associated with the exercise should be concerned with the identification and consideration of the intangibles.

Planning of Control Measures

The economist, like the epidemiologist, plays no direct part at present in the planning of control measures. This is the function of the veterinary administrators in consultation with the industry. In effect significant differences in methods of control represent different control options and should be accounted for in the identification of options process outlined already. It is more than likely however, that once a particular policy has been selected minor variations in the planned control measures could be considered in which case the economist would participate in the selection of the most cost-effective system (see Flow Chart).

Monitoring Progress

It is essential to establish whether or not the projected benefits are being realised once the selected disease control policy gets under way. In so far as they were not being realised the extent of the discrepancy and its causes would have to be identified so that decisions could be taken about the possible need for modification or scrapping of the control system. Of particular concern to the economist would be whether the poor performance was mainly due to unforeseen developments on the costs or the benefits side (or equally on both) and to what extent the potential for the policy foreseen in the SCBA was prevented from being fully realised by factors inherent in the control system itself but not fully allowed for in the analysis, or by unforeseen developments in the economy (such as relative price movements) external to the control system itself but highly relevant to its economic performance.

Major Problems

With the possible exception of discounting, none of the various steps considered in this paper raises any serious or complex conceptual issues; they all, however, raise considerable practical problems, particularly the identification of costs and benefits, the valuation of the measureable ones and the problem of risk and uncertainty.

Identifying Costs and Benefits

Whatever the nature of the control policy, its implementation will have resource effects. Without the policy the supplies of inputs and outputs to the rest of the economy would be different. But, in general, the situation in the absence of the policy will not be simply a continuation of the status quo, but rather what is expected to happen if the project were not undertaken. Thus, an accurate assessment of the situation, either with or without the project, may involve a difficult judgement: it does not normally correspond to the straightforward "before" or "after" situation.

An important distinction to be made is that between economic and financial costs and benefits. The concept of financial gain is not the same as the social equivalents of economic analysis. Financial analysis identifies the money profit or cost accruing to some party involved - say the producer or government - whereas social profit measures the policy's effect on the whole economy. For example, a money payment made by the government for, say, the wages and salaries of those implementing the policy is by definition a financial cost. But it represents an economic cost only to the extent that the use of manpower implies some sacrifice elsewhere in the economy. Conversely if the project has an economic cost in this sense that does not involve a corresponding money outflow from the government or producer - for example, because of environmental effects or subsidies - this cost is not a financial cost. Thus economic costs may be larger or smaller than financial costs. Similar comments apply to economic and financial benefits.

Valuation of Costs and Benefits

Although it will probably be necessary to measure the financial implications of alternative disease control policies for the major parties involved (such as the government or the producers), SCBA is primarily concerned with the economic effects on the economy as a whole. This brings us to the important issue of valuation which may necessitate "shadow pricing". In certain circumstances it is incorrect to value at market prices the resources used in implementing a control policy. If a particular resource is very scarce relative to the demand for it then its shadow price or opportunity cost (what it could command in the best available alternative use) will tend to be high. If the resource is relatively abundant, however, the demands for it in the next best uses can be satisfied in decreasing order of importance, and its opportunity cost (or shadow price) will be relatively low. Market prices do not always reflect supply/demand conditions adequately.

Analogous considerations apply on the output side. Market prices may not reflect the value to society of using or producing a good or service, and in such instances the market price may on occasions be adjusted or replaced by a shadow value. Where there are tax and grant elements in the market prices of either the inputs or outputs used the related problem of transfer payments arises. Transfers are neither costs nor benefits to the economy as a whole since what one section of society loses (gains) another will gain (lose). The question of transfers arises over a wide front or C/B work: in animal production for instance it has to be remembered that producer's gains (losses) from a scheme may be offset in part or fully by consumers' or taxpayers' losses (gains).

Risk and Uncertainty

This is perhaps the most intractable problem of all. The epidemiologist has to predict the future incidence of the disease and its likely level and time profile. The specific effects of the disease have to be distinguished from those of other possible influences and these effects have to be costed. All this has to be done for each alternative control policy being considered and also for a policy of inaction since the estimated cost of doing nothing provide a measure of the benefits to be gained from control. At almost every step either risk or uncertainty enter in to a greater or lesser extent.

Attempts are being made to adopt the standard cost-benefit techniques to take account of risk and uncertainty but the end result has been to make the techniques even more complex and to require yet further information. The simplest approach is to present "the most probable outcome" and then to carry out a sensitivity analysis, i.e. reworking the analysis just to see what happens under different assumptions and presenting a range of alternative outcomes. The more elaborate analysis makes use of probability theory - "instead of presenting exact estimates of the relative events, an appraiser must form a judgement of likelihoods of various states of the same events" (Reutlinger 1970). One guide to project appraisal in developing countries (ODM 1977) candidly admits that the probability to be attached to each value "may be little more than a guess" but the danger of quantifying one's guesses is that they can easily acquire the status of facts and may be accepted uncritically.

However, important as the problem may be, the extended discussions of risk and uncertainty in the literature on project appraisal may divert attention from even more fundamental problems in many cases - simple ignorance of the basic facts and relationships. "The word 'ignorance' does not have pseudo-scientific cache of 'risk' and 'uncertainty' but it would seem to describe much more accurately our state of knowledge, or rather lack of it, regarding many aspects of livestock production and health" (R.J.Grindle, "Appropriate ethodology in Economic Analysis of Disease Control Projects"; Proceedings of Second International Symposium, Canberra, 1979). There follows just a few examples of the lack of knowledge in certain areas and of the wide range of estimates which may be concealed by simple averages.

1. Actual livestock numbers;
2. The state of disease prevalence;
3. The economic inpact of disease (this would be closely related to management and many other factors);
4. Relative levels of future prices.

It is the job of both the epidemiologist and economist to fill some of these gaps. Indeed one perceptive observer (Hirschman, 1967) has stressed that many cost-benefit appraisals are actually R & D projects and that they should be recognised as ".....in effect voyages of technological and administrative discovery".

FLOW CHART OF APPRAISAL PROCEDURES

The chart outlines the major steps that should be taken in appraisals of proposed expenditure.

Either sub-system (A) or (B), on the left-hand side, is to be followed, as appropriate, when a full cost/benefit analysis is to be undertaken, i.e. mainly in cases where it is a question of choosing an objective from among two or more alternatives or of allocating scarce resources between a number of objectives.

Sub-system (C) applies where cost-effectiveness procedures are required, i.e. where a formal policy decision has been taken to go ahead with a course of action and it is a question of identifying and choosing the least-cost option.

Sub-system (D) represents the minimum type of appraisal and is applicable in the case of simple decisions for which there are no realistic alternatives. In most cases these will concern expenditure of a routine or repetitive type.

The detail of analysis within each sub-system can be varied and should be appropriate to the importance and level of expenditure involved and the complexity of the decision.

The chart should be read in conjunction with the notes on the following page :-

(1) Before answering "yes" check that :-

(a) the approval has been given at an appropriate level of seniority and with whatever degree of formality is suitable;

(b) the project or on-going programme was formally approved at the outset on the basis of a suitably systematic analysis or appraisal and that this is subject to review as appropriate, for example when the objective of the expenditure is modified or its scale increased significantly;

(c) where the decision concerns expenditure which is part of a project or programme and sub-system (D) applies, guidelines are laid down and reviewed as necessary as to what is reasonable in terms of expenditure (amount, frequency, etc.) for items within that project or programme.

(2) Discounting, particularly in simple cases of the kind described in (1)(b) above may not always be necessary, for example, in the case of a cost-effectiveness study when the costs of one particular option are consistently lower than those of the alternatives.

(3) Paragraph 19 of the Treasury booklet explains how to deal with uncertainty.

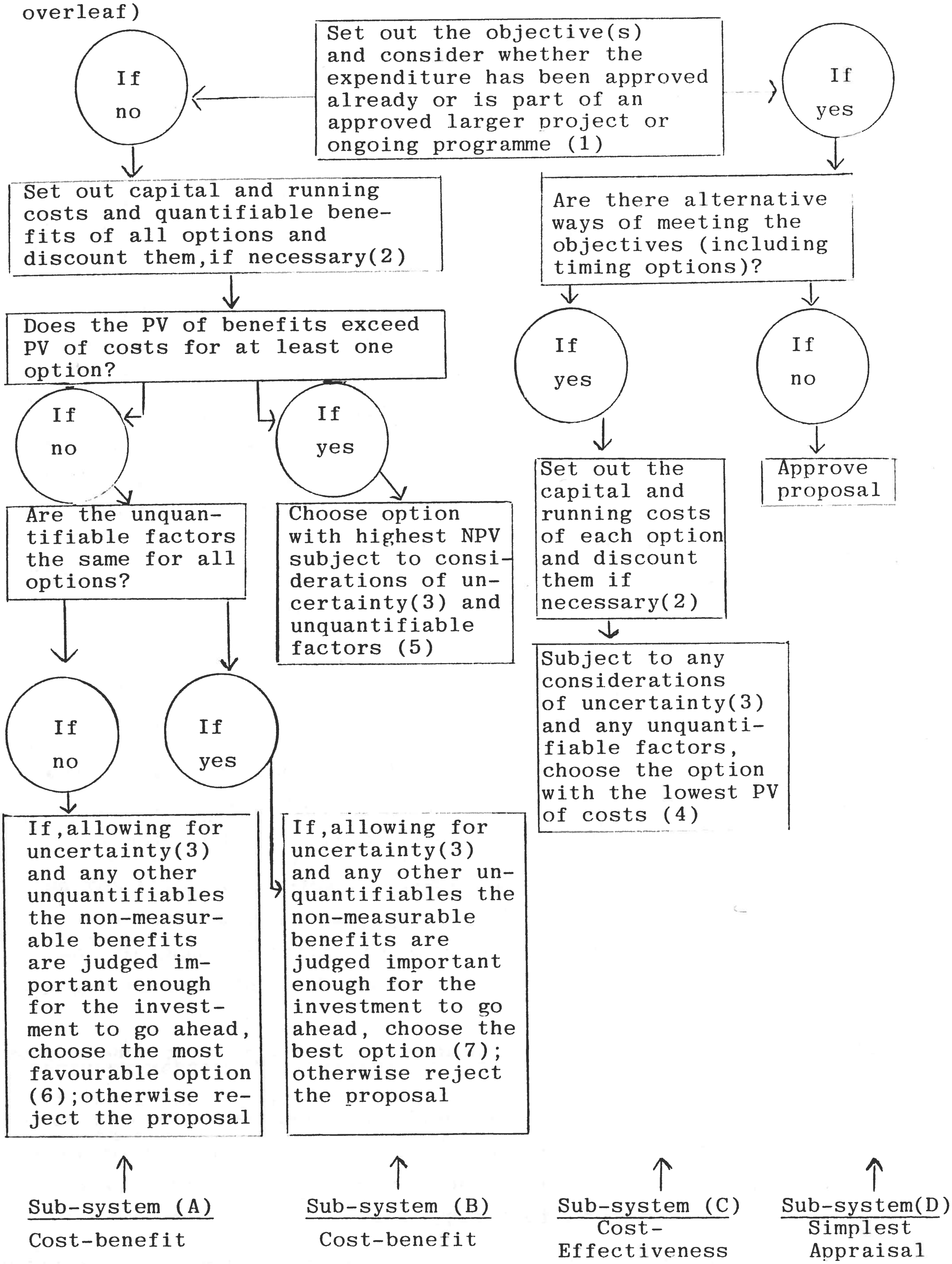
(4) If the options have different lives, use equivalent annual costs (paragraph 21 of the Treasury booklet) to compare options rather than present values (PVs).

(5) Sometimes, for example where there are 2 options with very different levels of cost, it will be better to use the ratio of net present benefit to net present cost (rather than net present value - NPV - as such) and choose the option with the highest ratio.

(6) The most favourable option will be that with the smallest (negative) difference between (discounted) quantifiable benefits and costs, unless another option has additional non-measurable benefits judged sufficient to outweigh its additional costs, in which case choose that option.

(7) The best option is that with the smallest (negative) difference between (discounted) quantifiable benefits and costs.

FLOW CHART OF APPRAISAL PROCEDURES (see notes overleaf)



National and International Reporting Services

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1. Introduction

The O.I.E. (International Office of Epizootics) is an Intergovernmental Organisation established in 1924 which, as defined in its funding Charter, has three main functions (1):

1. to collect and bring to the attention of the Governments and their sanitary services all facts and documents of general interest concerning the course of epizootic diseases and the means used to control them;
2. to promote and co-ordinate experimental or other research work concerning the pathology or prophylaxis of contagious diseases of livestock for which international collaboration is deemed desirable;
3. to examine international draft agreements regarding animal health measures and to provide signatory governments with the means of supervising their enforcement.

Indeed, the first function, information, was the reason for creating the O.I.E. and remains the major role of the Organisation.

Information is received from O.I.E. Member Countries (which now number one hundred and two) and is disseminated not only to these Countries but to practically all countries throughout the world.

The O.I.E. corresponds with Directors of Veterinary Services who are generally Delegates to the O.I.E. These Member Countries form the International Committee which is the governing body of the Organisation and meets every year during the last week in May.

II. Development of the O.I.E. Animal Disease Reporting Scheme from 1924 - 1982

The O.I.E. was the first Intergovernmental Organisation to establish a scheme for the systematic collection and dissemination of information on epizootics, following the occurrence of an outbreak of rinderpest in Belgium in 1920 (2).

The disease had been introduced into Belgium by humped cattle which were in transit in the port of Antwerp. Transit had been authorised without any prior knowledge of the animal health status in the country of origin, Pakistan.

Therefore, the reason for the creation of the O.I.E. was the necessity to keep Veterinary Authorities constantly informed of the livestock status throughout the world.

In adopting the O.I.E. Charter, the founders of our Organisation decided on two schemes :

1. a warning scheme based on notification by telegram of the first cases of rinderpest or foot and mouth disease (FMD) in a country or part of a country which until then had been free of the disease;
2. a scheme providing for the periodical dissemination of statistics on the presence and evolution of nine diseases; rinderpest, FMD, contageous bovine pleuropneumonia (CBPP), anthrax, sheep pox, rabies, glanders, dourine and swine fever.

This list corresponded to the main concern of Veterinary Administrations in Europe. The majority of the twenty-eight Countries which signed the International Agreement in 1924 were in fact European.

These diseases were basically the same as those provided for in the national legislation of European countries which had introduced the concept of notifiable diseases into the scheme for the control of epizootics in the nineteenth century.

International trade in livestock and livestock products developed considerably in the early sixties. This was possible in part due to cooperation between national Veterinary Services desirous of facilitating trade and creating a safer basis for health control in world trade. These aims necessitate a full understanding of the animal disease status in all countries and regions of the world.

In consideration of the fact that the disease reporting scheme would have to be designed to provide for the development of world trade, the International Committee established the Commission for the study of health regulations on the import and export of livestock and livestock products.

This Commission initiated significant work on the revision of the list of diseases reported to and by the O.I.E.

This revision was adopted by the International Committee in May 1964 and led to the establishment of two lists (3):

1) List A of diseases (fifteen in number) which are highly contagious, pose particularly serious problems for the national or regional economy and which comprised, in addition to the nine diseases included in Article 5 of the Internal Statutes of the O.I.E.: lumpy skin disease, bluetongue, African horse sickness, African swine fever, enzootic porcine encephalomyelitis (Teschen disease) and Newcastle disease.

2) List B of diseases (forty in number), the consequences of which have a significant effect on farming or on the animals themselves but which do not represent the same threat as List A diseases.

This nomenclature has been amended several times. List B has been reduced and a third one, List C has been created.

List A, B and C of diseases which must be reported to the O.I.E. on a bi-monthly, quarterly and annual basis respectively are shown in Appendix I.

III. Current Status

The purpose of the current O.I.E. animal disease reporting scheme is to assist Veterinary Services, responsible for veterinary legislation in their Countries, by serving as part of the necessary mechanism for preventing and controlling animal diseases.

The priority objective is to inform Chief Veterinary Officers (CVO's) of the occurrence of emergency diseases.

However, prescribed measures are infinitely more effective if they are implemented on a regional level, in collaboration with the other countries involved.

This is why the O.I.E. generally in collaboration with relevant international organisations, convenes emergency consultation meetings of Delegates from the affected or threatened countries, when necessary.

When FMD SAT 1 broke out in the Middle East in 1962, threatening countries in Europe, the O.I.E. convened an Extraordinary Conference in Vienna (Austria) on 1 and 2 October 1962 (4).

The work conducted during this Conference then served as the basis for implementing a regional control project in the Middle East and South East Europe.

A more recent example is the spread of rinderpest in West Africa in 1980: the O.I.E. convened a Meeting in November 1980, with CVO's from countries in the region as well as major donor agencies (5).

This Meeting highlighted the need to rapidly organise a vaccination campaign in nine countries. On the strength of the recommendations formulated at this meeting, funds for the campaign were contributed by the E.E.C. and F.A.O. in particular. The campaign was conducted immediately and showed signs of success within six months. The O.I.E. was responsible for managing funds accorded by the E.E.C. and actively participated in the coordination of activities of countries receiving this aid.

Besides the warning scheme, the O.I.E. also publishes monthly, quarterly and annual reports on the evolution of epizootics. These reports serve as a guide to Veterinary Services in decision making.

Since January 1981, monthly information on the evolution of List A diseases worldwide is included in the O.I.E. Bulletin. This publication also carries other sections, notably those on epizootiology and veterinary regulations.

The O.I.E. annual statistics manual summarises the status of List A diseases as well as other diseases reported by Member Countries.

The O.I.E. created a new publication in 1982 which is entitled the "Revue" (Scientific and Technical Review). This includes reports presented at General Sessions of the Committee, at Conferences of Specialists and also individual articles on epizootiology and control of animal diseases.

The second objective of the O.I.E. scheme is to provide a framework for countries to negotiate acceptable animal health conditions for trade in livestock and livestock products.

As mentioned earlier, the Committee of the O.I.E. established a permanent commission which is now called the "O.I.E. International Zoo-Sanitary Code Commission". This Commission periodically revises those notifiable diseases which are of major interest in international trade. It is also responsible for the preparation of new texts for the "Code" which must receive the approval of the International

Committee. The Code is a guideline of rules recommended for international trade in livestock and livestock products. It includes a very important section devoted to standards for the preparation and control of biological products as well as for diagnostic procedures/ techniques, disinfection methods etc.

The reporting scheme enables the O.I.E. to fulfil its second function of promoting research on the pathology or control of contagious diseases for which international cooperation is deemed desirable.

In the light of information received, priority problems are dealt with by O.I.E. Specialist Commissions at the request of the International Committee.

The first Commission was created in 1946 to examine problems arising from FMD vaccination. This Commission which held its XVIth Conference in Paris last week has played an important part in the development of effective vaccines and in defining policies which one day will help to put an end to FMD.

Even though these Commissions do not actually carry out research work, they play an encouraging role through contact with national and international bodies.

As an example, the Commission for the Study of African Swine Fever, created in 1964 and which no longer exists today, assisted in obtaining support from the E.E.C. for establishing diagnostic and control procedures against ASF in Spain.

IV. Development Prospects

During the 49th General Session in May 1981, the Committee of the O.I.E. adopted a working programme (6) aimed at improving the O.I.E. reporting scheme which should become a genuine "disease information system" as defined by P.R.Ellis, M. Hugh-Jones and R.S.Morris (7).

This programme includes in particular :

1. the improvement of quality and accuracy of disease data in general and, in particular, data on the incidence and prevalence of disease problems which may imply organised control schemes;
2. the integration into the animal disease reporting scheme of data for economic analysis;

3. the development of data bases which will allow for easier and better access to the more extensive and reliable collection of information.

An improvement in the quality and accuracy of information disseminated by the O.I.E. will greatly depend on currently used reporting schemes in O.I.E. Member Countries.

The lack of resources in developing countries for establishing efficient national surveillance and reporting schemes for animal diseases, is a major concern of the O.I.E.

This is one of the main reasons for the persistence of such problems as rinderpest, contagious bovine pleuropneumonia and foot and mouth disease which are a real handicap for the affected regions and a threat for developed countries.

The O.I.E. is therefore collaborating closely with other international bodies and governments in fostering the development of improved national disease information systems which will provide a better basis for health control.

Another factor related to the quality and accuracy of the reporting system is the nomenclature of diseases which in some cases is not always sufficiently explicit. This is a major problem with viral diseases which can no longer be regarded as a single entity, as is the case with Newcastle disease and fowl plague among others.

The question of nomenclature of notifiable diseases is being reviewed by the O.I.E. with the cooperation of specialists in this field.

Economic implications of disease problems and advantages of their control are needed by international aid agencies when they are requested to fund control infrastructures and programmes. There is a need for more and more government decision makers to avail themselves of this detailed information as they are faced with the problem of the scarcity of funds.

In order that information for epidemiological and economic analysis be used to the best possible advantage, a new design of reporting forms is under way. These forms will be more informative, they will help to ensure that adequate resources for animal health purposes are provided in Member Countries and, that measurable progress is achieved. Furthermore, they will be uniform and readily adaptable from manual to automatic processing.

It is very difficult to obtain worldwide agreement on reporting formats so initially, the formats will be used by about ten voluntary countries for a twelve-month period, in addition to the reports currently dispatched by them.

This trial will enable the necessary adjustments of report layout to be made and the establishment of a widely accepted final version.

A revision of the lists of notifiable diseases is also currently under consideration. Only two lists are anticipated, the criteria determining their inclusion in either list being as follows :

List A : Communicable diseases which have the potential for very serious and rapid spread, irrespective of national borders; which are of serious socio-economic consequence and which are of major importance in the international trade of livestock and livestock products.

List B : Communicable diseases which are considered to be economically important within countries and which are significant in the international trade of livestock and livestock products.

For List A disease reporting, the dispatch of weekly reportsfollowing the initial notification of disease presence will be the only major change made to the present system. Further information will be provided on the evolution of an incident having justified urgent notification. Reports will continue to be sent to the O.I.E. until the disease has been eradicated or until the situation has stabilised. List B diseases will only be reported annually.

Supplying more rapid services in a shorter time to Member Countries in specific fields appears a necessity to the O.I.E. These services should be increased to help Countries to formulate their animal health policies based on a modern concept of epidemiology and economics.

For this purpose, the O.I.E. will need to gather information which is already available in other agencies.

The introduction of automatic data processing, which should be facilitated by the adoption of standardised forms, will enable greater rapidity in the dissemination of more comprehensive information.

Once the information has been held on a computer file for a few years, programmes could be written for use in epidemiological and economical assessment.

The implementation of the O.I.E. programme should be facilitated by experience already gained by several countries.

This experience will then be used to the benefit of other Member Countries which could then improve their information and planning systems for the control of highly infectious diseases.

This project will then enable the establishment of information systems which will increase knowledge on all disease problems which demand intervention by Veterinary Services.

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(3) Reports by the permanent Commissions approved at the XXXIInd General Conference of the Committee of the O.I.E. (Bull. Off. int. Epiz. 62, 2, p.1603).

(4) Extraordinary Conference of the O.I.E. Member Countries in Europe and the Near East on FMD epizootic caused by SAT 1 (Bull. Off. int. Epiz. 57, 2, pp. 1212-1215).

(5) Emergency Meeting on Rinderpest in Western Africa, Paris, 27 - 28 Oct. 1980 (Bull. Off. int. Epiz 92, 11 - 12, p. 1575).

(6) Proposed Programme and Budget for the years 1981 (9 months) 1982, 1983 and 1984 - XLIX General Session of the O.I.E.

(7) Veterinary Epidemiology and Economics - F.A.O. document September 1978.

alphabetical order English

O.I.E. Disease Lists A, B and C

List A

1. African horse sickness
2. African swine fever
3. anthrax
4. blue tongue
5. classical swine fever (hog cholera)
6. contagious bovine pleuro-pneumonia
7. dourine
8. enzootic porcine encephalomyelitis (Teschen disease)
9. foot and mouth disease
10. fowl plague
11. glanders
12. lumpy skin disease
13. Newcastle disease
14. rabies
15. rinderpest
16. sheep pox and goat pox
17. swine vesicular disease
18. Rift Valley fever.

List B

1. American foul brood
2. bovine brucellosis
3. bovine tuberculosis
4. contagious pleuropneumonia of small ruminants
5. echinococcosis-hydatidosis
6. enzootic bovine leucosis
7. infection equine anaemia
8. internal acariasis pf bees
9. ovine and caprine brucellosis
10. psittacosis
11. rhabdoviral infections or haemorrhagic septicaemias of salmoids
12. swine brucellosis
13. swine trichinosis
14. tularaemia
15. varroasis
16. Venezuelan equine encephalomyelitis
17. vesicular stomatitis

List C

1. atrophic rhinitis of swine
2. avian infectious laryngotracheitis
3. avian respiratory mycoplasmosis
4. bovine vibriosis
5. contagious equine agalactia
6. contagious equine metritis
7. equine encephalomyelitis
8. equine piroplasmosis
9. equine viral rhinopneumonitis and equine viral arteritis
10. European foul brood
11. horse pox
12. infectious bovine rhinotracheitis (IBR-IPV).
13. infectious bursal disease (Gumboro disease)
14. infectious equine abortion
15. infectious pancreatic necrosis of salmonids
16. Johne's disease
17. leptodpirosis
18. mange of horses
19. Marek's disease
20. myxomatosis
21. myxosomiasis of salmonids
22. nosemosis of bees
23. pullorum disease
24. spring viraemia of carp
25. Trichomonas infection.

DISCUSSION

WORKSHOP 2 STATE VETERINARY MEDICINE

DISEASE CONTROL POLICY

In discussion the gathering of reliable data was identified as a major issue and it was emphasised that the outcome of any disease control policy was only as good as the assumptions on which the epidemiological and economic analysis was based. Models and predictions all had an important part to play but improvements in the quality of the basic data could have a more significant impact on disease control than the use of very sophisticated models based on questionable data. A number of predictive models have been successfully used including the FMD model used to predict the windborne spread of the virus. Failure of other models had resulted from using incomplete or invalid information and as a result the predictions and cost benefit analysis concerned had been of little value. The collection of reliable and relevant data is improving as more and more research workers have contact with epidemiologists. It was vital that the epidemiologists and economists should work together to evaluate the types of information that were needed for the formulation of disease control policies and discussions with universities should further attempts to get concensus views on priorities of information requirements. It is one of the responsibilities of the epidemiologists and economists to present the research worker with the basic outlines of the type of information required and to provide the stimulus necessary to improve the methods of data collection and evaluation.

Other sources of information included the Veterinary Investigation service where contacts with specific forms put them in a position to collect health related and economic information. There are many ways to collect information and although surveys no longer appeared to be as important, it was emphasised that information on specific problems or events, could be obtained by carefully prepared surveys. The concept of using sentinel farms was discussed in detail as these are not related to one particular disease but cover a range of production interests especially as many of the problems in future will relate to sub optimal production. Although the multidisciplinary approach was technically possible this could be a major undertaking resulting in the costs of the system for information collection outweighing the benefits. This problem would be overcome by a preliminary evaluation with costing to assess the potential benefits of using a sentinel farm system. It was also pointed out that there was a major conflict between the two philosophies, one of only collecting the information that was needed to solve a problem and the other of collecting all the information as proposed in the sentinel farm system in the hope that useful information on production disease would become apparent. Emphasis must be on the use of the sentinel farm system to collect essential data and to ensure that large quantities of unusable information were not accumulated. Epidemiologists must continually monitor programmes to ensure that collection of unnecessary detail is eliminated as soon as practical.

In the U.K. economists approach the problems of information collection by sampling a number of farm types and farm sizes in different sections of the farming community. Whilst this covers a wide spectrum of the industry the survey is based on a small number of farms and there are difficulties in extrapolating the results to a national level. It was pointed out that these economic surveys were undertaken by universities on behalf of the Ministry of Agriculture and Food. It appeared feasible that future sentinel farm monitoring systems could also become the responsibility of University Agriculture or Veterinary faculties. This would have a two fold advantage as students would visit farms as an important part of their training and at the same time they would be able to collect the necessary data which would otherwise be expensive to obtain. During the discussion it was mentioned that a similar system had been proposed at Guelph Vet. College and that the economic surveys in U.K. were also mainly conducted by students.

The discussion concluded leaving unanswered a number of important items which related to the funding of surveys, surveillance systems and the major question of the way in which future disease control programmes could be financed.

DISCUSSION

WORKSHOP 2 CONTINUED

NATIONAL AND INTERNATIONAL DISEASE REPORTING

During the discussions the valuable contributions by the OIE, both in the past and present, to world wide disease control were emphasised by delegates. There is a significant British contribution and the detailed information which is regularly received is of value in formulating policy for the importation of livestock. The proposed new developments in the work of the OIE would make an impact on surveillance and give valuable details of the incidence, impact and effect of disease in all member countries.

The new reporting system relating to List A diseases would be evaluated by 10 countries during the current year and after amendment would be introduced as an international disease reporting system. The proposed system would give better details of the location, population and effects of disease outbreaks eventually leading to the establishment of an international computerised data base on distribution and effects of diseases.

Problems existed when political difficulties in member countries prevented the accurate reporting of disease and other countries only give the minimum information. Although reporting was not enforceable by OIE it was hoped that member countries, by training and education, would realise the value of accurate and efficient data collection, in allowing them to assess their health status. In the case of Third World countries this would allow the preparation of accurate detailed proposals for submission to donor agencies for financial aid in their control programmes.

A further point emerging from the discussion was the importance of developing surveillance systems in Africa and Asia so that the early detection of diseases such as Rinderpest could be followed by control measures to eliminate the foci of disease before rapid spread could occur. It was emphasised that many of the diseases in these parts of the world could be spread to Europe and America and the OIE was probably best situated to assist in surveillance systems. The OIE had the expertise in information collection, analysis and dissemination of world wide disease and the future trends would result in the organisation taking a lead in information technology.

W O R K S H O P   III

LEISURE AND SMALL ANIMAL PRACTICE

The Value of Clinical Case Records in Small Animal Cases

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Case records are essential for the smooth running of a modern small animal practice. At least they provide an aide-memoire to a practitioner of an animal's age and name, with previous diagnoses and treatment. Additionally they may provide a record of the client's credit status and they can be developed to record symptoms and signs together with differential diagnoses and the clinician's intentions. Few small animal practices operate without this basic facility, and in a multi-man practice it would usually be considered indispensable, although apparently still not universal (Edwards, 1982). The use of the traditional Day Book appears almost to have ceased.

At their most simple, case records comprise small cards (minimum practical size 5" x 3"), readily stored in box files, drawers or cabinets. More sophisticated are commercially-available systems including coded or indexed retrieval for accounting or other reminders such as booster immunisations. Others may provide a facility for accounting and/or stock-keeping through built-in carbon copies of any entry. However, simple and objective information is readily stored by computer memory, and this is undoubtedly the modern approach to the problem.

Case records may further be an aid to epidemiology and to the systematic investigation and management of cases. Objectivity can be encouraged by the use of a checklist for many features of the clinical examination and by providing a fixed routine for the investigation of certain common problems (e.g. polydipsia), useful to maintain uniformity of approach in a large and busy practice, or in a teaching establishment. An ultimate development of this concept of the step-by-step analysis of cases is the Problem-Orientated Medical Record (POMR), now much favoured by veterinary schools and some practices in the U.S.A. (Osborne, 1975; Lorenz and Schall, 1977). The POMR seeks to define several steps:

1) the Data Base - the collection of information relevant to the case (client's complaint, history, laboratory date)
2) a Problem List - an index of symptoms and findings in the animal, identified as Major Problems and Minor Problems. This is reviewed and revised regularly and it includes a record of the date of resolution of the case.
3) Plans - formulated to further the diagnosis and to provide a list of differential diagnoses for items in the Problem List. Treatment, client education and follow-up are also clearly defined.
4) Progress Notes - a narrative (or flow-sheet) for each and every item in the Problem List, as defined by 'SOAP':
    a) Subjective data (the client's complaint and case history)
    b) Objective data (observations, clinical findings and laboratory results, relevant to the Problem List)
    c) Assessment of the problem (diagnosis)
    d) the Plan (procedures necessary for diagnosis, treatment and client education)

POMR is claimed to commit clinicians to making positive and rational plans, to adopting a logical, systematic approach to cases, to maintaining accurate and complete case records and to identifying clearly the relevant features of complicated histories. Above all, this should provide a thorough training in the comprehensive care of animals. A regular audit is usually built into this system, which means that records are checked for completion and follow-up. POMR requires the same approach ('Action Protocol') by all clinicians to certain well-defined types of disorder (e.g. pyometra), ('Problem-Specific Data Base'). However, POMR appears to generate voluminous case notes and it is expensive in the staff time required to maintain, process and audit this material. The exercise is successful only if all clinicians in an organisation partake enthusiastically. British experience of check-list case recording suggests lack of enthusiasm and participation.

Objective data (breed, age, sex and diagnosis) can be recorded for retrieval most simply on punch cards. However, the capacity of this form of data storage is small, the system is inflexible and punch cards can become worn, causing inaccuracy. Much more sophisticated is a feature card system, e.g. Termatrex, as used at some Universities in North America and by Glasgow University Veterinary

School. A card is used for each of many hundreds of objective features recorded from a checklist (e.g. lymph node size, rectal temperature (normal, increased or decreased), colour of mucous membranes, etc.), filled in by the clinician for every case. However, although this system allows multiple correlations to be undertaken simply, the equipment for alignment and marking of cards is expensive, together with the extensive clerical time required for administration.

Check lists were found to be poorly and unethusiastically completed at the author's clinic at the University of Edinburgh, and a compromise has been reached over the storage of data from some 10,000 annual consultations. Traditional long-hand recording of case notes is employed, with summaries of diagnoses and treatment being recorded on the outside of the case envelope at the end of each course of treatment. If a diagnosis cannot readily be reached, or if it is not required, symptoms and other procedures can be recorded. This information is readily entered into a database that has been established on a mainframe computer, to which all members of staff have access at any time during normal working hours. Lay staff submit each entry, which requires approximately 15 minutes for a day's total cases. The information is readily and rapidly recalled in plain English for epidemiology or even to provide a simple summary if a record card is mislaid. Records of about 20,000 cases are now successfully stored by this system.

A compromise was reached whereby the animal's case number, breed sex and date of birth, are entered together with a summary at the end of the course of consultation and treatment which includes the date of consultation, number of consultations required for the course, up to four diagnoses (and whether investigated or not), two treatments (and whether satisfactory or not) and whether live or dead at completion. Lists or counts of cases for specified breeds, age, sex, diagnosis, treatments or combinations of these specifications can readily be made.

Despite this simplicity, the storage of case records is causing problems through lack of space and records of dead animals are now copied onto microfiche, a sample and reliable method of reducing bulky written information to an easily-handles volume.

In summary, case records aid communications between colleagues, they act as a basis of plans for patient care, they provide documentary evidence of action, reducing guesswork, and they may yield data for education and research.

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The Pooling and Use of Disease Data from Small Animals

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A considerable amount of information on disease in small animals is collected routinely. It includes primary care data collected by general practices and animal welfare societies, and more specialised material such as that from cases referred to veterinary schools. This large body of data is stored as separate accumulations of case records, in the form of longhand notes, punched cards and, more recently, computerised records. These clinical data, in common with other types of veterinary information, are frequently inaccessible (1). Much of the potential value of the data is not realised because the information cannot be studied collectively. Modern computer and communications systems offer a means of pooling and analysing data. If data are to be pooled, then consideration should be given to the methods of storing, disemminating and analysing information, and to the nature of recorded data, which is defined by the uses to which they are put. A comprehensive programme of data integration then can be devised.

1. The Nature and uses of pooled small animal disease data

Data are resources (2); they should be gathered so that they can be used. Veterinary surgeons collect data on small animals for several reasons (3) including clinical record recall and practice management. More specialised applications are epidemiological investigations, teaching and clinical research.

Clinical records are required to document diseases from which an animal suffers, and to record therapeutic and prophylactic procedures. They also frequently fulfil a managerial function, for example recording cost of treatment and indicating when revaccination is due. These data applications are reflected in the simplest case record which comprises the animal's identity (perhaps including name, age, sex and breed), a presumptive diagnosis, treatment and charge. Fuller records may include details of symptoms and comments on weight, diet, breeding history and other pertinent information. These data are of additional value to epidemiological studies and clinical research.

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Epidemiological investigations have two broad aims (4):

i) the acquisition of a greater understanding of the natural history of diseases, including information on transmission patterns, host range and vectors;

ii) the measurement of the amount of disease present in populations and the quantification of the effects of the various factors which cause disease.

A knowledge of disease morbidity and mortality rates can indicate the importance of diseases. Assessment of the strength of association between a disease and a factor - for example diet - enables the clinician to advise clients on the most prudent control or preventive measure.

The causes of some diseases (e.g. the 'fading puppy' syndrome) have still to be elucidated. Other diseases have a poorly understood or complex aetiology (e.g. the feline urolithiasis syndrome). Man's conception of cause has changed (5). The Victorian scientific mind, tidily searching for a single inducer of disease - epitomised by Koch's postulates - left a simplistic legacy of the nature of cause. Attitudes have again changed. Disease is now considered to be the outcome of a complex association between directly causal inducers and predisposing factors - components of a 'web of causation'(6). These associations are classified in a variety of ways (7) including division into primary and predisposing factors, and into those factors associated with host, environment and agent (8). There are many well-known examples, such as breed disposition to canine hip dysplasia and progressive retinal atrophy. Knowledge of these correlations has developed slowly, and has involved field observations, often supported by experimental evidence.

Epidemiology is not unique in inferring causal associations. Other branches of medical science are also concerned with formulating causal hypotheses, and frequently use the experimental situation to test a hypothesis. However, the way by which the epidemiologist infers the association is unique: it involves the analysis of the frequency and distribution of disease in populations - and this method requires a large body of accurate, reliable data.

Epidemiological techniques quantify the level of association between factors and disease, by comparing the prevalence of disease in the presence of a factor with disease prevalence in the absence of the factor (9), enabling risk to be quantified. These investigations have been undertaken commonly as specific surveys, for instance to determine the association between diet, breed, age, sex, level of activity and feline urolithiasis (10,11,12).

A second approach involves analysing records from established banks of data (data bases) such as the Veterinary Medical Data Program (13) which incorporates data from several veterinary schools in the United States, the Danish Swine Slaughter Inspection Data Bank (14) and the veterinary data programme for captive wild animals (15). These analyses have identified associations which may otherwise have gone undetected, such as breed predisposition to canine transitional cell carcinoma (16) and elbow dysplasia (17).

Studies using existing data can reveal this type of information with an economy of effort and finance but may be unrepresentative. Many current data bases draw their data from limited and specialised sources - veterinary schools and diagnostic laboratories - which are inherently biased (18). For example veterinary school clinics have a significant number of referred cases. This does not mean that data from these sources are invalid or useless. It means that caution must be observed when extrapolating conclusions drawn from the data to the population as a whole. It would, of course, be preferable to draw the data from a larger, more representative population. This aim could be more readily achieved if practitioners' primary care data could be collectively accessed from a common pool.

Veterinary teachers would also be able to select representative material from the pool.

Clinical research may involve the detection of sequelae and an investigation of syndromes. The latter often requires a record of symptoms rather than of presumptive diagnoses, because it frequently needs to associate symptoms with lesions.

All of these applications of veterinary information use either one or both broad types of disease data; those relating to observations and those relating to interpretations (19). Records of symptoms, treatment, and an animal's breed, age and sex are observations. Records of diagnoses are interpretations of observations, requiring preconceived ideas of cause. The recording of 'distemper' for example, presumes a defined causal association between certain respiratory, ocular and alimentary symptoms, and a virus. General practitioners require this latter type of data. Epidemiological investigations of cause and effect need to be divorced from preconceived causal dogmas and therefore require observational data such as those relating to age, diet, weight, breed and sex.Clinical research, similarly, may use both types.

Recorded data may vary in their accuracy (sensitivity) and degree of refinement (specificity). Sensitivity depends on the disease which is being diagnosed and the method of diagnosis. The recording of a mid-shaft femoral fracture is very sensitive when based on physical examination. However, physical examination alone may be insensitive when diagnosing diabetes - auxiliary diagnostic aids (in this case, urine analysis) are required to increase the accuracy of the diagnosis.

Specificity is often increased by enlisting auxiliary diagnostic techniques. For instance, the relatively non-specific diagnosis 'otitis externa' can be converted to the more specific diagnosis 'otitis externa due to Pseudomonas spp.' by bacteriological examination. The sensitivity and specificity of a diagnostic record, therefore, often depend on the diagnostic aids which are available to the clinician.

2. Storing, diseminating and analysing information

Disease data can be stored in longhand and on punched cards (20). However, computers offer the most flexible and rapid means of storing, querying, analysing and transporting data. They are now widely available, following developments in 'hardware' (the machines) and 'software' (the computer programs) technology. The approach to computing is also changing. Furthermore, different computers can also be connected to one another using modern communications systems, thereby facilitating transfer of information.

a) Hardware technology

The first computers were large 'mainframes' using transistors and valves. They were bulky and expensive and were therefore restricted to sizeable organisations. The invention of the microprocessor 'chip' based on silicon has decreased the size and price of computers (21) and has increased their efficiency (22). Technology is continually improving, increasing the memory store and capacity of the machines (Table 1).

Even greater reductions in size may occur if other semiconductor bases such as sapphire and gallium are used.

Auxiliary storage media have also become more compact. Large magnetic tapes and punched cards are being replaced by smaller 'hard' and 'floppy' disks for many applications.

Table 1: Microcomputer capacity developments

a) Microprocessor technology

Year	Bits
1972	4
1974	8
1978	16
1981	32
1985	64

b) 'Random access memory' technology

Year	k-Bits
1971	1
1973	4
1976	16
1979	64
1980-82	256
1983-85	1000

The chip's use has fostered the development of inexpensive and powerful 'desk-top' microcomputers which are within the budget of not only large organisations but also individual veterinary practices. These have several applications in veterinary practice, including accounting, drug stock control and practical management of case records. Though the initial reason for a practitioner's acquiring a microcomputer may be managerial (23) the machine can store and query case records with great ease and simplicity.

b) Software technology

A major reason for the modern computer's ability to manipulate case records is the concomitant developments in software design. Computer systems are now becoming simpler to handle - they are becoming more 'user friendly'. Many systems are 'menu driven', prompting the user, and verifying the input in plain text.

There is a general trend towards appliance-oriented software packages covering a wide range of activities. This necessitates careful consideration of possible packages: whether they are well supported and widely available, or are limited to a particular manufacturer's hardware. If suitable packages are not available, then it is necessary to develop new ones. A wide range of programming languages is available, the choice of which to select is complex.(Table 2). A major consideration is that the language should conform to an international standard, because this facilitates conversion to different systems (i.e. there is 'portability') as and when required.

The way in which data are stored has also changed. The electronic data processors of the 1960's handled data on punched cards, frequently with one card per patient. Thus there was an orientation towards a 'single record' model of a data base. This restricted the ability to correlate the various components of a record (e.g. age, sex, breed) between records. Particular programs were required for each defined output, and if new correlations were needed then new programs would have to be written. This was the traditional systems analysis approach to data handling, in which the application (output) was considered centrally and the data were considered to be peripheral. Data base management systems have developed, which, unlike the traditional systems analysis approach, consider the data as central, and the uses to which the data are put as constantly changing. They consider the numerous components of a data base in terms of their relations (24). This allows flexible handling and correlation of data, which is ideal for epidemiological analysis.

Some of these data base management systems use special query languages such as SEQUEL, QUEL and SQUARE, which are designed to simplify querying of the data. Veterinary clinical case recording systems, using data base management systems, have been implemented on

Table 2: Summary of general criteria for choosing a language for 8-Bit microcomputers

Languages / Criteria	Assembler	Basic	Fortran	Cobol	Algol	Pascal
1. Embedded in a support environment	-	++	-	-	-	+++++
2. Portable	+	++	+++	+++	+++	++++
3. Good data structure	-	+	++	+++	++	++++
4. Support for structured code design	-	-	++	++	+++	++++
5. Flexible input/ output	-	+	++++	++++	-	+++
6. Standardisation	+	+	++++	+++++	++++	++++
7. Stable	-	-	++	++++	++++	+++
8. Easy to teach	-	+++	+++	++	+	+++++
9. Simple, easy to use and learn	-	++++	+++	+++	+++	+++++
10. Flexible storage structures	-	-	-	-	-	+++
11. Suitability for packages	+	+	++++	+	+++++	++
12. Suitable for business data processing (record handling) etc.	-	+	++	++++	+	+++
13. Flexible file handling	-	-	+++	++++	+	++
14. Suitability for systems programming	++	-	-	-	+	+
15. Compiler availability	-	+	++++	++	++	+++++
16. Implemented on mini, micro and mainframe computers	-	+	++++	+++	++	++++

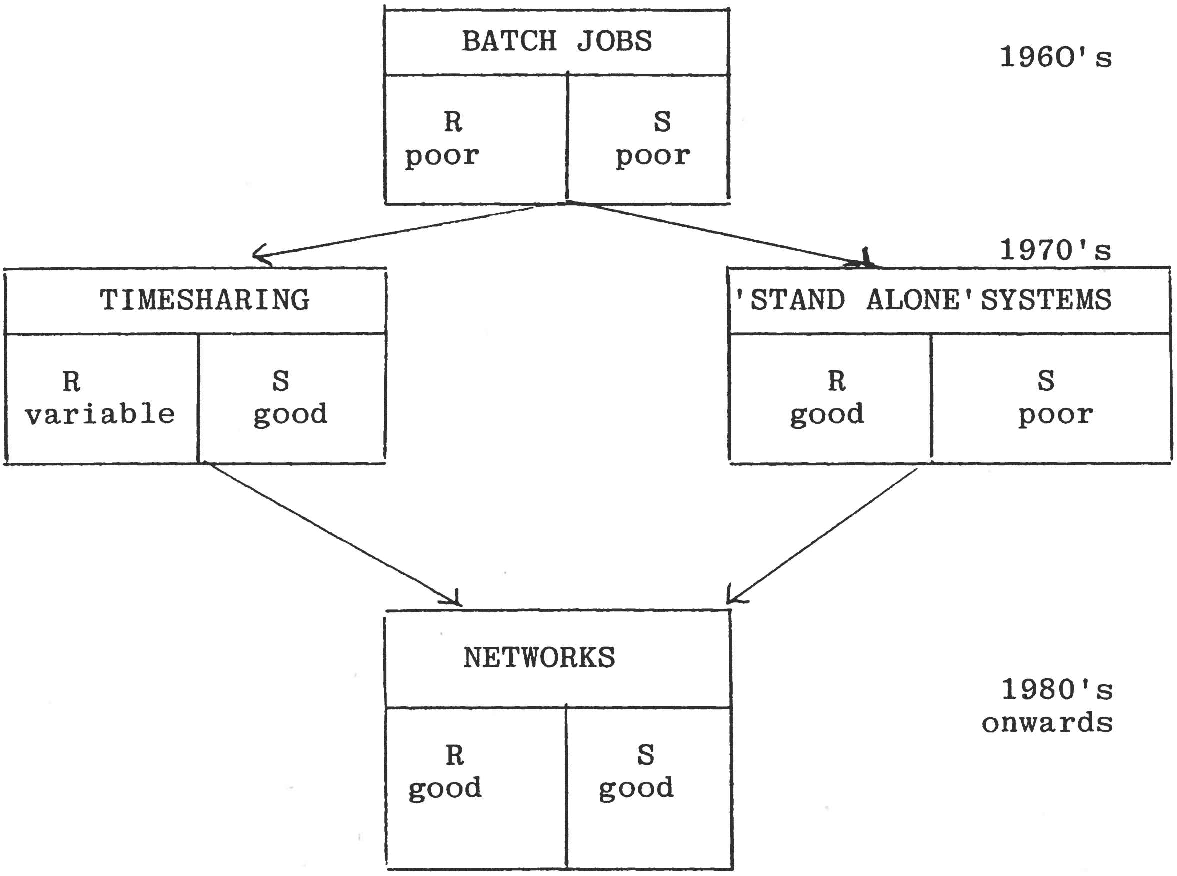
mainframe computers (25,26) and can also be mounted on micro-computers.

c) <u>The approach to computing</u>

Figure 1 illustrates how the approach to computing has developed and how it is likely to proceed in the future.

In the '60's work was run on mainframe computers, usually by inputting work on paper tapes or cards to be run overnight, as batch jobs. Response was poor, (i.e. the process was slow) and it was very difficult for users to share their data and resources.

In the 70's a division took place. Mainframe users began to share time on computers, and it was possible to share data and resources, though response varied according to the number of users and the tasks being performed at any one time. Separate 'stand-alone' microprocessor systems developed with good response but, of course, data and resources could not be shared because the systems were not linked.



R = responsiveness

S = resource and data sharing.

<u>Figure 1</u>: <u>Changing approaches to computing</u>

Future trends aim at establishing links between all users, and also speeding up response. The concept is one of a network of individual microcomputers linked by very fast communication systems; with mainframes reserved for complex calculations ('number crunching') and the processing of very large volumes of data.

d) Communications technology

Computers can be linked, using acoustic signals sent via conventional telephone handsets. However, the rate of data transfer is low. Direct fast links between computers (mainframe and microcomputers) using 'networks' are now available, such as British Telecom's 'Packet Switching System'. Data transfer will become more rapid and global with the application of satellite and laser communications. Though computer systems may be dissimilar, they can be connected readily - the protocol for linking them is becoming more 'transparent' to the user. Soon it will be possible to connect systems such as 'Viewdata' which uses television receivers, connected to a mainframe computer by a telephone link and adapter, and whose application to veterinary practice is being investigated currently (27).

3. The future approach to data pooling

The modern computer therefore offers two major facilities:

i) the ability to store large volumes of structured data;
ii) the capacity to rapidly correlate the various components of case records.

Data can also be transported, offering the prospect of pooling data from many clinical records, which will increase the scope and accuracy of epidemiological investigations.

These data will also be of value to clinical research. For example, recorded symptoms can be used to develop computerised aids to diagnosis. 'Expert systems', so-called because they include an expert opinion, have been applied to human medicine as aids to the diagnosis of pulmonary disorders, blood infections and meningitis (28), and could be adapted to veterinary problems.

If data from different sources are recorded in different ways, then it is difficult to unify them and impossible to query them with a simple software package. Programs which translate data from one format to another can be written, but this exercise is computationally inefficient and costly. A common pool of data should be constructed from 'harmonised' (29) case records, comprising 'core' data (30). Such data should include descriptive observational data (the animal's identity, breed, age and sex), observational data relating to disease (symptoms, treatment and auxiliary diagnostic aids) and interpretative data relating to disease (diagnoses). There may also need to be a plain text record of other relevant information, for example on weight and diet.

The sensitivity of the data will vary. Some practices, for example, may not have sophisticated laboratory facilities to support physical examination. A record of auxiliary tests is therefore necessary to indicate the degree of diagnostic accuracy. Similarly, the specificity of a diagnosis may be low if laboratory investigations are not undertaken. Individuals' differing requirements may also be satisfied by records of different specificity. It is therefore necessary to have a flexible system of recording data, which allows the varying specifications to be reported. The most suitable method involves coding the data to be input using hierarchically ordered letters or numbers (or both), specificity increasing from left to right (Tables 3 and 4).

Table 3: An example of a numeric hierarchical code for treatment, breed and species (from reference 31).

Code	Meaning
Treatment	
100	General Medical Therapy
110	Antibiotic
112	Oxytetracycline
120	Parasiticide
122	Thiabendazole
Breed and Species	
100	Horse
110	Pony
111	Welsh Mountain Pony
120	Warm blooded
121	English Thoroughbred
200	Dog
300	Cat
400	Ox
410	Friesian

Table 4: An example of an alphanumeric hierarchical code for clinical signs (from reference 32)

	Code	Meaning
*	D60	Signs referable to saliva
	D61	Excessive salivation
	D62	Decreased salivation
	D70	Signs of teeth
	D71	Loose tooth/teeth
	D72	Dirty teeth/dental calculi

* D refers to the digestive system.

Hierarchical numeric (33,34), alpha (35) and alphanumeric codes (32) are in current veterinary use.

A disadvantage of numeric codes is that they are not readily identifiable and remembered. Alpha codes, if designed as acronyms, are easier to remember, but may need to be longer to handle the same range of specificity as numeric codes. An eight-character acronymic alphanumeric hierarchical code should be capable of handling the full range of specificity. A case record using this coding scheme, and with an additional plain text record to include any uncoded relevant material should provide a comprehensive record with a wide range of data applications. The records would be displayed in plain text. Queries and answers would similarly be presented in words for ease of understanding (see reference 26 for examples).

This type of integrated clinical data base, using a variety of linked devices (mainframes, microcomputers and the 'Viewdata' system) would serve the daily requirements of practitioners and would supply valuable information to epidemiologists, pathologists and those involved in clinical research. However, it can be realised only if a willingness to collect and disseminate information is shown by those who have access to clinical material.

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The pooling and use of disease data from Horses

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Within the last decade the equine industry in the United Kingdom and Ireland has grown to the extent that it currently employs thousands of people and gives an interest and pleasure to many people of all ages through a variety of equestrian sports. In addition the thoroughbred horse is now an international trading commodity with bloodstock currently bought and sold for millions of pounds. As a consequence of these changes the equine population in the United Kingdom and Ireland has risen, although at the present time the size and distribution of this population is not accurately known. The population increase has resulted in a greater involvement by the veterinary profession in the specialised area of stud and racing practice, and also within general practice. The movement of horses for competition and breeding purposes has also increased significantly both nationally and internationally with the consequent risk of the spread of infectious disease. For these reasons the application of epidemiological principles including the collection, interpretation and dissemination of disease data has acquired a greater significance within what is now an extremely viable equine industry in the United Kingdom and Ireland.

Contrary perhaps to general expectation the horse, especially the thoroughbred is an excellent model upon which to apply the various epidemiological principles. The thoroughbred racing and breeding population within the United Kingdom tends to be concentrated in certain areas including Newmarket in the East, Lambourn, Epsom and Arundel in the South and Malton in the North. Consequently any veterinary problems which arise are quickly recognised, reported and thoroughly investigated. Because of the accurate means of identification through the pedigree and the passport which each thoroughbred possesses, both retrospective and prospective epidemiological studies can be undertaken. This paper provides examples of how equine disease data is at present being collated within the United Kingdom and in conjunction with information received from colleagues abroad. It includes aspects of disease investigation, health monitoring, international liaison on the incidence of infectious disease and studies to evaluate the importance to the industry of a variety of disease problems.

Disease investigation and control

There are a number of infectious and contagious conditions including respiratory and genital disease which are of considerable importance to the equine population of the United Kingdom. One of these, Contagious Equine Metritis (CEM) is an excellent example of how the industry and the profession has collaborated to control a potentially serious disease problem.

CEM was first reported during 1977 when it was diagnosed in the United Kingdom, Ireland and Australia. Its potential adverse effect on the fertility of the thoroughbred breeding population was quickly recognised and led to a ban on the importation of all breeds of horses by a number of countries including America and Canada. To control the disease a Code of Practice was developed which included recommendations for identifying carrier animals by bacteriological screening and the reporting of positive animals to a central source. The Codes which have been applied either at a voluntary or mandatory level in several countries have been extensively modified since their introduction but have been successful in reducing the incidence of Contagious Equine Metritis. Although CEM is spread primarily by venereal transmission, the causal organism has been isolated from a number of young colts and fillies out of training with no reported history of sexual contact. It has been established from field and experimental studies that the organism can persist in the genital tract for an indefinite period and a detailed retrospective epidemiological study was initiated to establish the source of infection. This study involved an examination of the breeding history of sires and dams of positive animals utilising data obtained from the General Stud Book. Within the last three years, the information contained in the General Stud Book from 1976 onwards has been placed on a Prime 750 computer using dataline technique. At the beginning of 1981, a datalink was established between the computer housed at Messrs Weatherbys, Wellingborough, and the Equine Research Station, Newmarket. The purpose of the link was to assist in the accessability of the blood typing information which now plays a fundamental part in the stud book registration procedure. Several programmes are available including one which provides details of the offspring born to a particular dam including the sire of each offspring. Utilising this programme it has been possible to obtain an accurate history of CEM positive animals born in the United Kingdom and Ireland as well as the breeding history of their dams. The conclusions drawn from this study suggest that CEM was acquired either in utero, at the time of parturition, or during the early days of life. These conclusions have considerable significance for the control of the disease for it indicates that in addition to horizontal transmission it is also possible for vertical transmission to occur. It is therefore imperative that all colts and fillies about to commence their breeding career should undergo a thorough bacteriological examination of the genital tract to ensure that they are not carriers of CEM. This also applies to horses which are to be exported so as to ensure CEM is not introduced into a breeding population within a country currently free of the disease.

Monitoring for health and fitness

Within racing practice it is now commonplace to obtain blood samples from horses in training to assist in the assessment of their health and fitness by measuring various haematological and biochemical parameters. Some of the tests routinely undertaken include haemoglobin, erythrocyte count, packed cell volume, total and differential leucocyte count, plasma viscosity, serum protein electrophoresis and a variety of serum enzymes. It is recognised however that the interpretation of these results must be undertaken with care as a variety of physiological states can exert an influence. These include the age of the animal, diurnal variation and stress due to recent exercise or transportation. Under these circumstances the value of a single sample from one animal or even a batch sample from several horses in one stable is of limited application. At the Peter Burrell laboratories of the Equine Research Station a reporting system has been developed using a Wang 2200 mini computer whereby a series of results from an individual or group of animals in one stable may be compared with the results taken from the same animals on a previous occasion.

By this means it is possible to establish a reference value for an individual or group of animals and subsequently to measure small changes which have occurred that may reflect sub-clinical abnormalities. As a result of these studies it has been possible to measure the change in the leucocyte count of the horse in response to viral infection. During the acute phase there is a high myeloid to lymphoid ratio with an associated monocytosis which is followed in the later stages by a relative lymphocytosis. The plasma viscosity may also be raised during the acute phase and some horses may show a normochromic normocytic anaemia with lowered haemoglobin and red cell levels. Should secondary bacterial infection occur then evidence of a leucocytosis will become apparent during the convalescent phase. By obtaining sequential samples from a group of affected horses and observing changes in the haematological picture it is possible to assist in prognosis and provide advice as to when affected horses may recommence their training programme.

Liaison at an international level

The reliance on air transport to move the increasing number of horses between continents for competition and breeding purposes demands that a continuous and reliable exchange of information regarding the incidence of equine infectious disease takes place between the importing and exporting countries. This is of prime importance when considering diseases like influenza which has a short incubation period, CEM in which both male and female animals can act as carriers and the abortion form of rhinopneumonitis which can occur spontaneously with no other associated symptoms. The United Kingdom is extremely fortunate in that it is free of the vector born diseases such as equine encephalitides, African horse sickness and equine infectious anaemia which can cause high mortality. These diseases are notifiable in the United Kingdom under the Infectious Diseases of Horses Order 1975 and are under the control of the Ministry of Agriculture, Fisheries and Food. The movement of horses both in and out of the United Kingdom is by licence under the control of the Ministry who may impose restrictions on the importation of horses from areas where serious outbreaks of equine disease are reported through application of the Importation of Equine Animals Order 1979. Information on the incidence of notifiable equine disease in various countries is available through the official veterinary services of each country and the regular disease bulletins published by the international agencies such as OIE and FAO.

The control of other infectious and contagious diseases such as influenza, rhinopneumonitis, strangles, CEM and Klebsiella which do occur in the United Kingdom is in the hands of the equine industry through advice provided by the profession. Until recently information on the prevalence of these and other diseases such as viral arteritis and equine piroplasmosis has been difficult to come by from countries abroad. Within the last five years however steps have been taken to improve the situation. Following discussions with the representatives of the state veterinary services and the racing authorities of several European countries it has been agreed that an exchange of information on the incidence of equine infectious disease should take place between representatives of the United Kingdom, Ireland, France, Germany, Spain and Italy. Whilst this has not occurred on a regular basis information has been exchanged on the incidence of influenza, CEM and rhinopneumonitis. These exchanges have led to control measures being implemented, an example of which is the international agreement on mandatory vaccination against influenza for horses in training. The Equine Research Station is responsible for collecting information within the United Kingdom and is in regular contact with colleagues abroad. The establishment of the Equine Virology Unit by the Animal Health Trust will be particularly useful in supplying information recording the incidence of equine viral disease including influenza and rhinopneumonitis within the United Kingdom. The movement of horses between the United Kingdom, France and Ireland has been greatly facilitated by the 'Tripartite Agreement'. This agreement was established following the recognition of the large investment in bloodstock and the interdependence of the racing calender within the three countries. For this freedom of movement to continue it is essential that a very close liaison is maintained between the state veterinary services and the equine industries of the three countries. One positive result of this liaison has been the publication in 1981 and 1982 of a combined Code of Practice to control CEM.

Establishment of disease priorities

Although demands for the greater encouragement and financial support of equine research have been voiced repeatedly, the demands have been tempered by the limitations on the amount of financial support available. The largest source of funding in the United Kingdom is the Horserace Betting Levy Board although other major contributors include the Universities, the Animal Health Trust. the Wellcome

Trust and the Thoroughbred Breeders Association as well as contributions from private sources. Increasingly these and other organisations who support equine research have been requested to spread their support over a wider area of research activity whilst at the same time accepting that the cost of conducting research has risen significantly. To ensure that the available funds are distributed in a way most likely to benefit the industry greater account is being taken of the problems that exist and the influence they exert on the efficient performance of the industry. An initial step to identify these problems was undertaken in a survey organised by the British Equine Veterinary Association Trust and published in January 1981. The survey based on the results of a questionnaire submitted to veterinary surgeons, scientists and representatives of horse and pony organisations indicated that the major limitations to health and fitness involved the respiratory, locomotor and reproductive systems which were aggravated by the parasite burden of the grazing horse. More recently Jeffcott and others (1982) reported on a study to assess wastage in the thoroughbred from conception to 4 years of age. They found that wastage among breeding stock was caused largely by failure to conceive or to carry a foal successfully to term. The most substantial reason for horses not being able to race was their lack of ability and a temporary or permanent lameness. These two studies have emphasised that problems of the respiratory, locomotor and reproductive systems are currently of prime importance and deserve the greatest research effort. They have also reiterated the point that with respect to the competing animal not all the deficiencies in performance are of a veterinary nature but are due to the innate inability of one animal to perform to the level of another within the same breed.

Future developments

Greater veterinary use could be made of the computer facilities already operating within the Thoroughbred industry. Disease tracing could be undertaken using available programmes and in discussion with the appropriate authorities further programmes could be added incorporating data such as vaccination histories. If the present trend towards an increase in stable size continues it is probable that the larger stables will install their own mini computer facilities. As well as providing the essential day to day information on costings, racing engagements, horse performance, timeform and handicap ratings veterinary data could be added. This might include vaccination histories with dates for booster injections plus the results of laboratory tests. The advent of these facilities could lead to an increase in the extent of laboratory monitoring with greater emphasis placed on haematological and biochemical parameters to evaluate fitness and the nutritional and physiological state of the horse. In addition the results of screening tests to determine evidence of viral and bacterial infections could be included as well as serological data to monitor the efficacy of vaccination programmes.

With the increasing support for international racing and competition events both within and outside the United Kingdom, Ireland and France the emphasis on international veterinary control becomes a primary consideration. It is essential that competing horses are subjected to the minimum restrictions which are consistent with acceptable disease precautions. Success in this area is dependent on the free flow of disease information between countries although this can only be achieved if within each country there is an effective means of gathering the information. International collaboration at a scientific level could also be enhanced by the establishment of recognised laboratories to assist in the isolation, identification and typing of equine disease agents such as influenza, equine rhinopneumonitis and the CEM organism.

Finally it is imperative that an accurate and continuous assessment of the veterinary problems which affect the industry is undertaken to ensure that the appropriate control measures are being applied and if necessary to ensure that additional facilities are made available for their thorough investigation.

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DISCUSSION

WORKSHOP 3 ON LEISURE AND SMALL ANIMAL PRACTICE

Although this session was poorly attended there was a lively and very well informed discussion.

It was agreed that the primary value of clinical case records was as a form of communication between clinicians dealing with the case and as a record of and an aid to the management of the patient.

In private practice the same record may commonly be used to record financial details of the transaction and other non-clinical administrative details, but these aspects were outside the scope of the paper presented.

There has been a lot of work done mainly in human hospitals and university veterinary clinics to improve upon the traditional free-format index card as a clinical record. It was agreed that whilst edge-punched card systems and the sophisticated Termatrex optical alignment system aided systematic search and retrieval from a collection of clinical case records, they are expensive to set-up, relatively inflexible, and difficult to administrate consistently over many years. The resulting collection of cards is also fairly bulky. These systems do not in themselves improve the accuracy, completeness nor quality of the clinical case record.

There was considerable debate on the practicality of more structured clinical case records which have developed to address these problems. All of these structured records demand a more disciplined approach by the clinician in recording the clinical history and subsequent diagnoses, investigations and treatments. Many structured systems, particularly the Problem Oriented Medical Record (POMR), generate very bulky records which demand accurate internal organisation and constant review and update.

Experience suggests that it is only possible to maintain such sophisticated systems with the complete cooperation of all the clinicians involved either voluntarily or by administrative edict. They certainly have great educational value and can be very helpful in the management of problem cases, particularly in the hospital environment. A possible method of reducing their bulk is the use of microfiche.

There was general agreement that computerisation held the best hopes of improving the quality, value and use of small animal clinical case records. Large numbers of large records can be stored and retrieved with ease if held on computers.

A number of university-based and commercial computerised small animal case record systems are in use in an early experimental form, and a rapid development of these systems is expected.

There may well be some cross-fertilisation of ideas and systems between human and veterinary medicine as a result of the growing awareness by computer systems companies of the similar requirements of general practitioners of both professions for clinical case record systems.

Computerisation of clinical records holds out many hopes for in creasing epidemiologic studies in small animals and horses. A Central Database could be of interest to contributing small animal practices, for regional disease intelligence, for example. End-user access should be a feature of any proposed design.

Common coding for "core-data" has been proposed but this may be unrealistic as many coding systems exist both in the academic and commercial environment.

A series of code-translation programs might be more appropriate in the near future, with a view to greater harmonisation later.

The pharmaceutical industry could be a major customer of a practice-based data resource and might thereby provide a source of funds for the provision and administration of a control or network database to consolidate practice-originated clinical case records and disease and treatment data.

The closely co-ordinated and well defined administrations of the thoroughbred racing and horse breeding industries world-wide, lend themselves to the creation of sophisticated clinical databases which would support epidemiologic investigations and globally co-activated disease intelligence and control programmes.

W O R K S H O P   IV

PUBLIC HEALTH

Food Hygiene. Methods of linking Meat Inspection findings with Disease on the Farm and in Human Populations

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Summary

Consideration of recently-published descriptions of methods of linking meat inspection findings with human and animal health incidents prompts the view that the veterinary profession should seek to put meat inspection into perspective by re-emphasising the role of the veterinary surgeon as the link between the meat industry, the farmer and the public based on his unique ability to (a) diagnose in both the living and the dead animal and (b) extrapolate from the individual to the herd.

Meat Inspection Findings

Many countries, including Australia, Cyprus, Denmark, India, Luxembourg, New Zealand, Nigeria, Norway, UK and USA publish information on meat inspection findings. In some cases, for example UK (Blamire and others, 1980), this information comes from a comparatively small number of slaughterhouses which have been selected to provide data representative of the national situation; in others, for example India (Prabhakaran and others, 1981), a single abattoir has provided information.

These findings indicate the most common causes of condemnation of meat and offal during the period under report. They do not necessarily indicate that any action has been taken to link the findings in the slaughterhouse with field incidents but they are of value in indicating trends.

The purpose of meat inspection

The primary purpose of meat inspection today is the same as always - to protect those eating the meat. It is not performed in order to elucidate veterinary problems on the farm of origin or to assist the epidemiologist in unravelling the histories of food poisoning incidents. The visible success of this tradition of meat inspection is the paucity of reports of disease incidents directly traceable to the abattoir but, just as important, is the invisible influence of the inspection system in deterring the would-be vendor of sick animals. The most important diseases detected at meat inspection today in slaughterhouses in England and Wales are parasitic in nature especially fascioliasis, hydatidosis, cysticercosis and ascariasis. Bovine tuberculosis has declined dramatically from the prewar and early postwar eras when it was all-too-regularly included in the condemnation statistics; however, even after virtual eradication of bovine tuberculosis there will continue to be a need to keep a sharp eye for its appearance in the slaughterhouse and in this connection the Barbados report by Wilson and Howes (1980) makes interesting reading. In this case meat inspection findings of tuberculous lesions were the first indication of an epizootic of bovine tuberculosis.

Sources of information in the slaughterhouse

Although this paper is concerned mainly with meat inspection findings there are a number of sources of information, additional to that of meat inspection, which should not be ignored when discussing linkages with human and animal health incidents. Samples of blood, faeces, preputial and vaginal exudates, bile, placenta, tonsils, lymphnodes, lungs, spleens, udders, hearts etc. collected at time of slaughter have, in different studies, been subject to bacteriological, serological, histopathological and biochemical examinations. Most of these studies have been related only minimally to routine meat inspection and, sad to say, many of them failed to explore possible links with herds of origin.

Antemortem inspection

In some countries, especially the state-trading nations of eastern Europe, antemortem inspection begins at the farm of origin where a veterinarian is obliged to carry out a clinical examination of the animals to be slaughtered, and to issue a movement permit, within 24 hours before the animals are transported to the slaughterhouse. In nearly all countries, national legislation requires that veterinary antemortem inspection shall be carried out in the lairage but wide variations are seen in the manner in which these inspections are performed. For example, the inspecting veterinarian seldom notes the condition of arrival of the animals. An interesting exception to this finding is the work done by Mickwitz and Wähaus (1980) at a West German abattoir where an analysis of data on slaughter pigs which were dead on arrival at the lairage revealed a pattern, there being significantly more deaths on a Wednesday and significantly fewer on a Monday. In addition to the contribution which antemortem inspection can make to disease control there is the opportunity to participate in the protection of animals by monitoring the methods of delivery and unloading in use at the abattoir. All of these tasks are exclusively veterinary and one wonders why the profession has not fully exploited them.

Linkages

Meat inspection findings have been linked, in different countries and in different ways, to human and animal health incidents as the following examples show :

In Australia, the National Disease Information System (ANADIS) proposed six years ago by Morris uses a decentralised mini-computer network to maintain meat inspection records and serological brucellosis testing records. In the future, it will incorporate input from diagnostic laboratories to cover a very large range of disease conditions but in a controlled manner. The aim is to provide "a comprehensive picture of diseases and disease patterns on a State and national scale while permitting the early detection of emerging disease problems or changes in disease patterns" (Roe, 1980). Also in Australia, Cross and Edwards (1981) concluded, from slaughterhouse evidence of porcine arthritis, that meat with undetected arthritis lesions (and probably containing live Erysipelothrix rhusiopathiae) reaches the consumer, while Thomas and others (1981) linked the finding of melioidosis in slaughter pigs with the isolation of Pseudomonas pseudomallei from soil samples collected close to the water supply of the piggery.

In New Zealand, bovine brucellosis, Johne's disease, ovine adenocarcinoma, leptospirosis, enzootic pneumonia and Aujeszky's disease have been the subjects of slaughterhouse surveys (Christiansen and Hellstrom (1980)) and in the case of Aujeszky's disease a survey by Durham and O'Hara (1980) of sera from culled breeding stock was related to a similar on-farm survey of A.D. virus neutralizing antibodies.

In Japan, Hara (1980) combined clinical examination of slaughter pigs with post mortem inspection and microbiological studies to determine the prevalence of abscesses and the bacterial species most commonly isolated. Kiyoshi Saida and others (1981) examined E.coli strains from pigs, pig breeders and urban residents, concluding that there is a pig reservoir of E.coli with drug resistance transferable to in-contact humans. A study of apparently tuberculous cattle and clinically healthy cattle revealed a number of mycobacterial species but none of the isolates was found to be Mycobacterium tuberculosum (Shimizu and others, 1981).

In Malaysia, Tan and others (1979) in a serum survey of slaughter pigs and a related serum survey of pig slaughterers and veterinary laboratory workers demonstrated antibodies to 5 influenza viruses. The results suggested that the pigs had not infected their human contacts.

In Singapore, mycoplasmas were isolated by Tiong and Sing (1981) from pig lungs found pneumonic at meat inspection as well as from normal lungs. Some isolations were also made from the grossly pneumonic lungs of pigs which had clinical symptoms of disease prior to slaughter.

In Africa, meat inspection findings of hyatidosis in Mozambique (Pires Ferreia, 1980) and in Nigeria (Dada, 1980; Dada and others, 1980) were linked to the existence of the conditions in other domestic and wild animals and man.

In South America, Lunghi and Cal (1980) inspected clinically normal pigs at post mortem in Argentina and found 25% to have some degree of atrophic rhinitis while in Chile, Urcelay and others (1980) found 41% of their pigs to be infected with Erysipelothrix rhusiopathiae. However, Barcellos (1979) working in Brazil went a stage further in linking isolations of E.rhusiopathiae in the slaughterhouse with herds with histories of septicaemic disease. Some faeces samples from pig farms also yielded E.rhusiopathiae. Also in Brazil a pig farm with an abortion problem was investigated by Poester (1978) who isolated Brucella suis at slaughter from spleens of pigs from the same herd.

In Canada, Polley and Mostert (1980) in two surveys of slaughtered pigs showed that every second pig was infected with Ascaris suum and every eighth liver was condemned, a significant loss of production.

Nearer home, in Sweden meat inspection findings are used by local veterinary research institutes to implement preventive schemes in pig herds affected by atrophic rhinitis, enzootic pneumonia and other disease conditions. In Denmark, meat inspection findings are incorporated in a databank which is used to survey disease among pigs and to construct disease control schemes. The Danish system was reviewed recently by Willeberg (1980). In the Netherlands, Berg and others (1981) linked preslaughter clinical findings of tail lesions with embolic pneumonia in pigs and isolated a number of bacterial species from meat inspection material.

In Belgium, careful examination by Geerts and others (1980) of bovine hearts from animals which had passed routine meat inspection confirmed that cysticercosis in cattle is much more common than condemnation statistics would suggest. Although these observations were not directly linked with farms of origin or with human cases they illustrate a common pitfall inherent in all conclusions drawn from meat inspection data. Just how reliable is such information? Detection rates of C.bovis cysts perhaps say more about the competence, diligence or persistence of the inspector than about the true prevalence of this condition on the farm. (There are other examples in the literature of the fallibility of visual detection of C.bovis cysts and this has led to renewed interest in serological testing and the adaptation, on an experimental level, in the Netherlands of the ELISA test). Another report from Belgium of a serological survey of slaughtered sows revealed that 95% of those sampled were actively immune to HEV ("vomiting and wasting"disease) and in related on-farm studies Pensaert and others (1980) chronicled the development of active immunity in younger pigs.

In West Germany, a number of workers have examined the links between the detection of such conditions as Campylobacter infection (Sticht-Groh, 1982), Clostridium perfringens infection (Hoppe,1979) and Yersinia infection (Stoll, 1981; Weber and Lembke, 1981) in the slaughterhouse and the appearance of the same infections in farm animals and in humans.

In UK, renal cysts in pork pigs were traced back to one herd and affected animals were found to be the progeny of a landrace boar (Wells and others, 1980). Liver lesions consistent with reactions to migrating Ascaris larvae were discovered in lambs grazed on land which had been treated with pig slurry (Borland and others, 1980) while Gunn (1980) also described Ascaris infection in lambs in Wales. The clinician in the slaughterhouse can often initiate linkages where he suspects the existence of a favourable cost-benefit ratio in tackling specific syndromes. Thus Madel (1981), having examined udders of culled ewes at slaughter, advocates an examination of the economic pros and cons of reducing the occurrence of ovine mastitis.

Many other examples have been published of linkages between slaughterhouse, farm and home but the strength of the "links" varies according to the researchers' objective and to the resources available to him.

Methods of linkage

Trace-back and trace-forward systems depend, above all, on reliable identification of animals. Tattoos, eartags, tailtags, etc. have the merit of being relatively inexpensive but none of them is infallible nor can human error be eliminated. Electronic methods of identification are being developed and, although comparatively expensive will surely replace existing methods in the very near future. Such gadgets will probably have additional properties (for example, the body temperature of the animal can be monitored using existing transponders) and since this interrogation is electronically controlled, human error is less likely.

So far as diagnoses are concerned there is a need to devise standard definitions for the phenomena being observed by the inspector and standard terms for recording them and here the excellent work done in developing the VIDA computerised system for analysis of Veterinary Investigation Laboratories diagnoses could serve as a model.

Assuming that the problems of identification of animals and recording of diagnoses have been overcome, the next item to be considered is that of selection of information. Irrespective of the need to record reasons for condemnation (and there are good commercial if not legalistic reasons for the fullest possible records to be made) for the purpose of linking results to disease incidents on the farm, selection pressures must operate. When the problem has been identified on a farm, or where there is a desire to prove that a specified disease does not exist in a specified herd, then the meat inspector can be encouraged to look especially for, and to record as instructed, the appearance of that disease. This is the system employed by a number of pig health schemes, including that operated by the UK Ministry of Agriculture, Fisheries and Food in cooperation with the Meat and Livestock Corporation, in which especial attention is paid to atrophic rhinitis, for example. Usually, however, the surveying, the monitoring, screening or collecting of samples has to be carried out by staff not normally employed on meat inspection duties. Should one consider the adoption of systems which would reward the meat inspector for finding lesions of tuberculosis (for example)? If the authorities paid £ 1,000 bonus to the inspector for each tuberculous animal could tuberculin testing be abandoned?

More and more the slaughterhouse is used as a collecting point for blood sampling. In UK the detection rate and therefore the process of "stamping-out", of swine vesicular disease is greatly enhanced by serum surveys at pig abattoirs. Some other countries rely on slaughterhouse serology to control bovine brucellosis. Is the time coming in the larger slaughterhouses when blood will be collected automatically at the commencement of the slaughter line to be tested for a number of diseases, residues, etc. in an automated laboratory alongside the carcass-dressing operations the results appearing on a cathode ray tube at the inspectors elbow as he makes his judgement on the carcass? A print out would go back to the farmers' private veterinarian who would use the information in advising on preventive measures in the herd.

Economics of Linkage

Meat inspection costs are tolerated by the general public - on whom ultimately all such costs must fall - because meat inspection is clearly designed to protect the general public. If however meat inspection (including the ancillary diagnostic procedures now available) is expanded to provide a service to the farmer and the epidemiologist (veterinary or human) who should pay? Quite apart from the cost of obtaining and storing the information there are considerable costs - in many cases - in feeding back the information to source especially if the animal has passed through several owners on its way to the slaughterhouse.

What should the BCA do?

1. As recently as May of this year Mr.D.J.Thomas presented a short

paper to the Public Health Committee of the BVA on the feedback of information from abattoirs. In this paper, according to the report in the Veterinary Record of 26th June 1982, he said that "any feedback system was dependent upon the proper identification of animals and it was recommended that it should be BVA policy that all animals going to slaughter should be visibly identified".

2. Should BVA actively encourage schemes for collecting specific information of value to individual practising veterinarians? If so, who pays? Should the schemes be linked to existing information recording systems such as VIDA? In case of possible zoonoses should there be a link with Colindale?

3. Should BVA advocate greater use of serological etc. procedures at point of slaughter with feedback of results to the practising veterinarian? If so, is the profession aware of the effect this may have on routine Ministry-funded on-farm testing?

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Trends in Zoonosis Control

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Zoonoses are those diseases and infections which are naturally transmissible between vertebrate animals and man. There is no biologically sound reason for grouping together such a large and heterogeneous collection of diseases simply because we belong to one of the animal species affected. However, since human and animal health are the concern of separate professions and regulatory authorities, the term "Zoonoses" is useful in that it defines an area of common ground where people of various disciplines can explore the epidemiology and control of diseases in which they may have a common interest.

In this area there is opportunity for fruitful cooperation between the veterinary and medical professions. Indeed, such cooperation is essential for effective surveillance, investigation and control. Cooperation must also be seen to be effective so that people potentially at risk from infections in animals may have confidence in their professional advisers.

Today zoonoses in Great Britain are assuming increasing importance. This is partly due to our success in controlling the more important epidemic diseases specific to man or animals. Problems posed by the zoonoses are exacerbated by the relatively asymptomatic nature of many of these infections in animals, modern methods of husbandry of food animals, large scale food processing methods, the increasingly rapid and widespread distribution of food and the growing popularity of so-called health foods. We are also becoming aware of two new factors: the recognition that some infections, once thought to be confined to animals, can also affect man and the discovery of new infections common to man and animals.

Let us therefore examine the evolution of joint veterinary/medical surveillance and control of zoonoses by reference to three examples: tuberculosis, brucellosis and salmonellosis. These diseases are all subject to statutory control which facilitates their surveillance.

Tuberculosis

Notifications of human tuberculosis have declined progressively since 1915. Some important events relevant to the control of human tuberculosis were :-

1900's	-	diagnostic methods improving e.g. Xray photography
1920's	-	living conditions improving and family sizes falling
1946 onwards	-	vaccination and chemotherapy available

Some important dates in the history of the control of bovine tuberculosis were :

1913	-	the Tuberculosis Order made affection of the bovine lungs and udder notifiable
1923	-	the Milk (Special Designations) Orders were introduced
1934	-	40% of dairy cows estimated to be affected
1935	-	the voluntary Attested Herds Scheme started
1950	-	compulsory eradication started with the Area Eradication Plan
1960	-	all of Great Britain became an Attested Area.

The 1913 and 1923 orders were introduced as public health measures and did little to reduce the incidence of milk infection. It was not until animal health measures were introduced to control and eradicate disease in whole herds and to protect them from reinfection that progress was made in freeing milk from infection.

Tuberculosis has been successfully controlled in both man and cattle but it is impossible to estimate how much of the decline in human cases can be attributed to it's control in cattle. There are several reasons:

1. cattle are not the sole source of human infection,
2. human notifications make no distinction between human and bovine strains because most cases are diagnosed clinically,
3. laboratories often do not distinguish between the human and bovine strains.

<u>Brucellosis</u>

Cattle are the only significant reservoir of brucellosis in Great Britain. Control of disease in man therefore depends almost entirely on its control in cattle. Pasteurisation of milk reduces the risk of milk-borne transmission but does not protect those who are occupationally exposed or who prefer to drink raw milk. We are able to show a parallel decline in human and bovine infection.

As in tuberculosis the earliest official attempts to control brucellosis in cattle failed because controls were only applied to clinically affected animals. The Epizootic Abortion Order of 1922 made it illegal to expose in a market a cow or heifer which had aborted in the previous 2 months. Effective control began with voluntary schemes - calfhood vaccination and voluntary eradication - and was achieved by compulsory eradication measures. Reduction of infection in people was a direct result of control measures in cattle.

Salmonellosis

Salmonellosis is the most common cause of human food poisoning. Salmonellae are frequently found in apparently healthy food animals, especially poultry and pigs. Salmonellosis also causes losses to agriculture primarily in cattle through scour and ill-thrift in calves and abortion in adults.

The Zoonoses Order 1975 is a new approach to the protection of human health from infection in animals. In effect the provisions of the Order apply only to salmonellae. The Order resulted from recommendations of the Swann Committee which looked into the use of antibiotics in animal husbandry and veterinary medicine and reported in 1969. These recommendations were reinforced by an outbreak of Salmonella paratyphi B infection in dairy cattle the following year.

The Order states that where the presence of salmonellae in an animal or bird is considered a risk to human health a veterinary inspector may:

> declare an Infected Place,
> prohibit movements and isolate animals,
> require premises to be cleaned and disinfected.

The Order goes on to require that when salmonellae are isolated from certain species of animal or bird the fact must be reported to a veterinary inspector of MAFF.

In order to operate the Zoonoses Order MAFF has designated DVO's(VI) in England and Wales and DVO's in Scotland to be Nominated Officers responsible for receiving reports of animal salmonellosis from the public, copying information to the appropriate MOEH and CEHO and investigating incidents they consider to have important human or animal health implications.

The Zoonoses Order is a public health measure made under animal health legislation. It is not intended to control salmonellosis in animals since this would be economically impracticable and so disruptive of agriculture as to be resisted and fail. It has, however, led to the creation of an effective surveillance system to assist in the epidemiological investigation of outbreaks of animal salmonellosis and human food poisoning. Nominated Officers copy the information they receive under the Zoonoses Order to the appropriate MO'sEH and CEHO's so local awareness is increased and local action may be taken where appropriate. The data is also sent to the Central Veterinary Laboratory's Epidemiology Unit where a national data bank on animal salmonellosis is available for consultation and for the production of periodic tabulations. National surveillance of animal salmonellosis and of other zoonoses has been facilitated by the creation of a post in 1979 linking the Epidemiology Unit and the PHLS Communicable Disease Surveillance Centre. I occupy this post and have specific responsibility for zoonoses surveillance in England and Wales.

Local liaison has been fostered in some areas by the formation of informal zoonoses liaison groups involving veterinary, medical and environmental health services and sometimes other interested bodies e.g. water authorities. At present there are about 14 such groups in England and Wales and 12 in Scotland. The groups meet once or twice a year. At these meetings officials of various bodies, who need to cooperate in the event of a threat to public health, get to know each other and iron out problems, disagreements and sources of friction informally and without the presence of the news media. The benefits to be aimed for are improvements in the speed and efficiency with which incidents are controlled, avoidance of public disagreements between colleagues in different disciplines and increased public confidence in their professional advisers. Informal zoonoses liaison groups tend to be more active where liaison is well established and there may be an argument for linking such groups formally into the local authority health committee structure and forming new groups to cover areas where none exist at present.

A central zoonoses group was created in 1975 and has met twice yearly since then. Members comprise the Chief Veterinary Officer, the Chief Medical Officer and the Director of the Public Health Laboratory Service or their representatives. A programme of experts speaking on topical problems is arranged for each meeting. The aims of this group are to brief heads of services and to discuss interdisciplinary problems informally at a national level.

It is becoming more widely recognised that apparently healthy animals may frequently excrete organisms which, under some circumstances, may make people ill. Demands are being made to control infections in animals which may not be causing significant effects on animal health. These infections may not be susceptible to control by methods which worked in the past. Investigation and control in this unexplored field will require greater cooperation between the veterinary and medical services than ever before.

The Investigation of Zoonoses. Success and Failure in the Field

Rapporteur's summary of a verbal presentation by:-

Dr. S.R. Palmer
Communicable Disease Surveillance Centre

When a zoonosis affects animal as well as human health, investigation of the source and mode of transmission of infection is usually straightforward, and the prospect of financial loss to farmers is a major incentive in establishing the natural history of a disease. When, however, the animal suffers mild or no symptoms, cooperation in tracing sources of human infection is often limited, and resources needed to establish the natural history of the disease are difficult to find.

Historical examples of successes achieved in the investigation and control of zoonoses such as that of bovine tuberculosis in the U.K. and that of brucella melitensis, Malta Fever, in Malta illustrates the need for close cooperation between the medical and veterinary professions in zoonoses work. Additional factors responsible for the success in the investigation and control of these two diseases include:-

1. The courage to challenge existing dogma and opinions expressed, often without proper evidence, of eminent members of the two professions.
2. A sense of urgency and of responsibility with regard to the health of the general public.
3. The ability to achieve official government recognition of the problem and to receive sufficient funds and reserves necessary to instigate the appropriate investigations and control measures.
4. The adoption of a proper scientific epidemiological approach to the investigation of the problem.
5. The ability to coordinate the work of investigators of different scientific disciplines in the investigation and to fully appreciate the implications of their findings.
6. Avoidance of the non-scientific aspects of the problem, particularly with regard to the costs of proposed control measures. Such decisions as to whether the necessary resources for the control of the problem should or should not be allocated are

the responsibility of the government and ultimately the people.

7. The avoidance of any bias in favour of particular business interests or pecuniary motives of interested parties.

Examples of recent field investigations of zoonoses including ornithosis, Q fever, salmonellosis, campylobacter, listeriosis and yersiniasis illustrate the importance of these factors, the presence or absence of which contribute to the success or failure in zoonoses investigation. Experience in the conducting of investigations in the U.K. and other countries also demonstrates the importance of an ecological approach in many investigations of zoonosis outbreaks and the need to involve biologists as well as veterinary and medical epidemiologists in surveillance and investigation.

DISCUSSION

WORKSHOP 4 : PUBLIC HEALTH

FOOD HYGIENE

It was recognised that traditional systems of meat inspection based primarily on the inspection of individual animal carcases at the slaughterhouse were becoming outdated. In many instances these systems did not provide the information necessary for livestock disease control and public health purposes. Many disease organisms and chemical residues were not detectable or only poorly recognised by such methods. Although it was realised that the individual inspection of animal carcases still remained valid for the detection of certain disease conditions and for quality control purposes new sets of laboratory techniques need to be developed.

The employment of such techniques needed however to be based on a clear definition of the priorities and objectives for their use both with regard to the objectives of livestock disease control and for the protection of the health of human populations. Consideration must also be given to the organisation and supervision of the facilities necessary for the implementation of laboratory based diagnostic techniques, and to the means by which these techniques are employed.

It was stressed that the key to success lay primarily in the development of integrated and epidemiologically sound information systems linking all stages of the livestock production process. Such systems needed to be structured with regard to providing information for livestock disease control, improvements in product quality and for public health purposes. Particular emphasis needed to be placed on the generation of data with regard to disease situations at farm level and on the development of appropriate methods of identification of livestock so that the data produced at both the farm and slaughterhouse level could be more effectively integrated.

DISCUSSION

WORKSHOP 4 CONTINUED

FOOD HYGIENE CONTINUED

Two topics left over from the morning review were further explored:

1. The importance of the development of systems of animal identification necessary to rapidly and efficiently trace the movements of livestock to and from farms and slaughterhouses was emphasised. Recent advances in the development of electronic transponders which could be implanted into individual animals to produce the data required were encouraging but it was felt that research in this field had not received the resources or encouragement that its importance merited.

2. Although all were aware of the importance of receiving changes in existing policy, considerable reservations were expressed, in view of the present economic climate, as to the willingness of governments to implement such changes. It was felt that the cost effectiveness of any changes would have to be clearly demonstrated if any success was to be achieved in their implementation.

ZOONOSES

It was felt that zoonoses were increasing in relative significance with regard to the overall problem of infectious disease in human populations. Zoonoses appeared to be becoming of greater significance in these specific human population groups closely associated with livestock products when compared with the general human population. Whether this was reflective of a natural trend rather than as the result of investigations being concentrated on such roups needed to be clarified. The economic importance to particular groups of particular zoonoses affecting these groups was stressed.

The encouraging increase in the extent of cooperation between the veterinary and medical professions in the investigation of zoonotic outbreaks was proving highly productive in resolving such problems. Further efforts to increase cooperation between the two professions would be highly desirable.

More complex epidemiological patterns in the transmission of zoonoses were emerging. There was a need to clarify further the epidemiology of many zoonotic diseases and to undertake better quantitative assessments of these problems. In this area it was felt that the role of pets and wild life in the epidemiology of many zoonoses needed to be further explored and that small animal practitioners, biologists and ecologists could play a valuable role in such research. This would involve close coordination and cooperation between interested parties. Such cooperation could be achieved by the creation of small regionally based inter disciplinary teams with a central core group acting in a supervisory and advisory capacity. The establishment of such groups would not prove costly, since many of the people required were already employed in government service. However there was a need to establish zoonoses and their investigation as a clear entity in their own right involving the full time attention of individuals from the various disciplines concerned.

G E N E R A L   S E S S I O N   II

GENERAL SESSION II:

DISCUSSION

The proceedings of the individual workshops were summarised by the respective Chairmen. Emphasis was placed on the role that physicists and pure biologists might have in developing systems, particularly with the advent of CHIP technology and transponder devices. At the same time a note of caution was made concerning the danger of introducing too many changes too quickly into an established system. Allusions were made to the discrepancies between commercially and academically developed systems. The need to integrate the interests of the practitioners, the epidemiologist and research workers was emphasised. The meeting formally resolved that a Clinical Working Party should be established within the framework of the B.V.A. to further coordination between commerce and clinicians. It was recognised that this would be a useful forum in which to delineate the objectives and interests of the various parties. The Clinical Working Party would obviously have interests in common with the existing Veterinary Epidemiology and Preventive Medicine Society.

After further discussions the meeting agreed on the following recommendations:

1. That the position of epidemiology needed redefining in the undergraduate curriculum. In addition to an increase in the allocation of teaching hours there was a need for a standardisation of the content of the epidemiology syllabus. It was emphasised that the subject must be shown to be a working tool as well as a theoretical concept. The use of case studies was advocated.

2. That there was a need to familiarise veterinary graduates with modern epidemiological techniques. The training might take the form of 12-week postgraduate courses consisting of initial teaching followed by case studies, or of refresher courses, both of which might use audiovisual instruction aids.

   Some training was also necessary at a lower level for other groups such as meat inspectors and animal owners.

3. That the Data-base needed updating. It was recognised that this was most likely to occur within commercially operating systems.

4. That there was a need to encourage research and development in the field of epidemiology. It was acknowledged that this would be closely dependent on the improvement of the databases, and that this might involve a wide range of personnel.