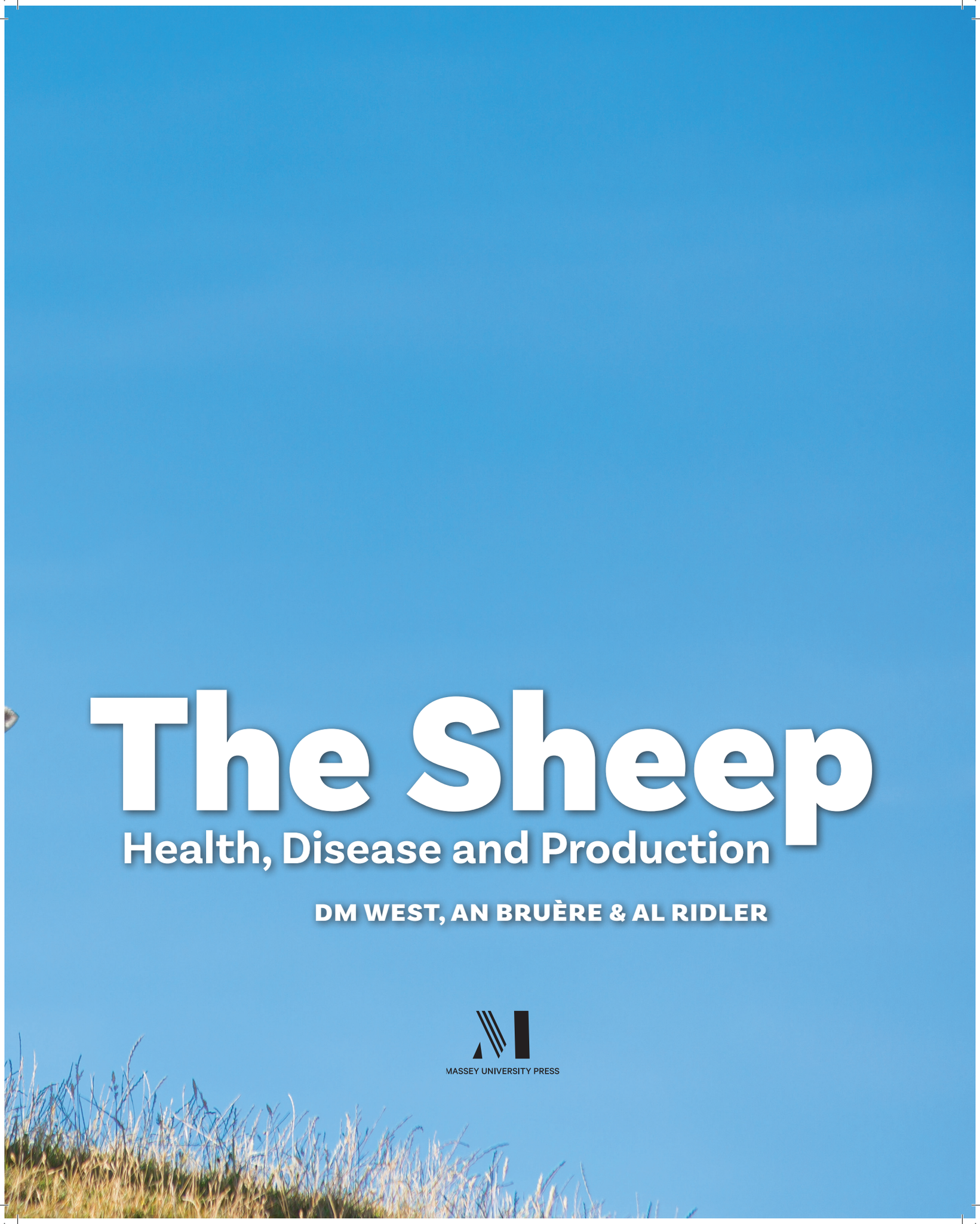
The Sheep



The Sheep

Health, Disease and Production

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MASSEY UNIVERSITY PRESS

First published in 1993 by the New Zealand Veterinary Association
This fourth revised edition published in 2018 by Massey University Press
Private Bag 102904, North Shore Mail Centre
Auckland 0745, New Zealand
www.masseypress.ac.nz

Design by Sarah Elworthy

A catalogue record for this book is available from the National Library of New Zealand

Printed and bound in China by Everbest Ltd

ISBN: 978-0-9951001-1-4

Contents

Acknowledgements

From its first publication in 1993, *The Sheep: Health, Disease and Production* has proven a valuable and popular reference for New Zealand veterinarians, veterinary students and farmers. Its publication has been made possible because of the expert and readily given advice of a number of colleagues and the invaluable skill and experience of Dr Peter Jolly and the staff at the New Zealand Veterinary Association.

We gratefully acknowledge the advice given by Professors Keith Thompson, Bill Pomroy, Kevin Stafford and Steve Morris of Massey University and Professor Gareth Bath of the Republic of South Africa on both the initial publication and subsequent editions.

We also thank all those colleagues who have provided photographs and personal descriptions of diseases, which add realism to the text. In this respect, special mention is made of the professional artwork of Peter Parkinson, which has so effectively embellished the text, which would have otherwise been less easy to understand. Also, the assistance given by Stefan Smith with photograph selection is acknowledged.

A special thanks is given to all the many loyal farmers who, over many years, have given us unstinting friendship, time and access to their flocks and properties for both student teaching and research. Without their generosity much of the knowledge and experience reported in this book would not have been gained.

Preface

This book is about sheep health and the diagnosis of sheep diseases, with a specific emphasis on commercially farmed sheep in New Zealand. It describes the common to less-common diseases seen in New Zealand; where necessary, reference is made to diseases of other countries. The final section of the book deals with exotic sheep diseases in detail, so that New Zealand-trained veterinarians and farmers can appreciate their potential threat to the livestock industries of this country.

Where considered appropriate, reference is made to historical events in the discovery of new diseases in this country. We can all profit by researching the experiences of these earlier authors who, by today's standards, worked with very limited and basic diagnostic facilities. They were keen clinical observers, and we are indebted to them for their detailed and accurate reports of the many diseases recorded for the first time in New Zealand.

Present-day veterinarians now have an extensive knowledge of most sheep diseases and how these can be diagnosed and controlled. In addition, a highly effective range of animal health products is available for both treatment and prevention of disease, with particular emphasis on the latter. Thus, sheep farmers are better able than ever to farm for maximum production through the maintenance of good animal health. New diseases and problems will arise, but with advancing technology their solution is ever more likely.

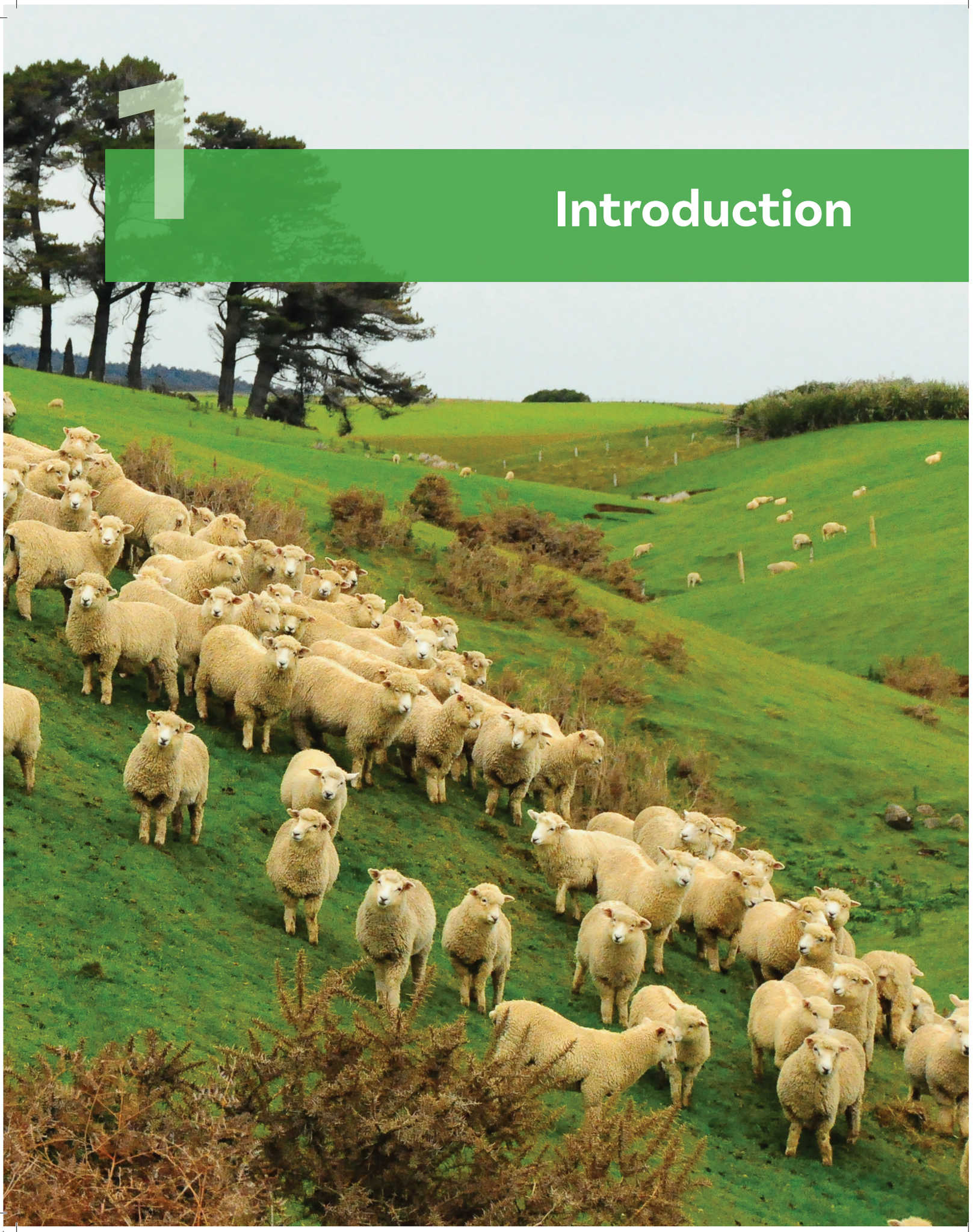
In the second edition of this book, published in 2002, new sections on *Salmonella* Brandenburg and foot and mouth disease were added and there was considerable extension of the section on transmissible spongiform encephalopathies (scrapie, bovine spongiform encephalopathy and human infection).

In the third and fourth editions of this book, many new references were added and the new data they describe has been written into the text. In addition, a wider range of illustrations and colour photographs has been used to enhance the text descriptions and there is increased use of tables.

This book is written and intended to be used as a reference for veterinary students, veterinarians and livestock farmers. The authors recommend its use by farmers, both to help them to understand the health problems that may affect sheep production and also to encourage a more informed relationship with their veterinarian.

Some commercial products available in New Zealand are mentioned in the text to assist local readers. Mention or exclusion of any particular product carries with it no endorsement or otherwise by the authors or the publisher.

1 Introduction



Despite a large reduction in sheep numbers in the past 30 years, New Zealand is still more heavily stocked with sheep than most other important sheep-producing countries, and from European colonisation in the early 19th century onwards sheep have played a significant role in our country's economy. The flock of 200 Merinos established on Mana Island in 1832 by John Wright is believed to be our first commercial sheep farm. For the rest of the 19th century, with the influx of European colonists came also large numbers of sheep; mainly from Britain, but, from 1850 onwards, many shipments of Merino sheep also came from Australia. The first million was reached by 1857, and by 1880 the sheep population had reached 13 million, which were mainly of Spanish Merino derivation.

A number of British breeds, such as the Southdown, English Leicester, Cheviot, Border Leicester, Lincoln and Romney Marsh, were also imported but in smaller numbers. The Romney Marsh, first imported in 1853, was gradually modified by New Zealand breeders; it was eventually renamed the New Zealand Romney and became the foundation breed of the country's mainly dual-purpose sheep population. By the end of the century, over 2.5 million hectares of New Zealand native pasture had been replaced by English grasses and clover and around 20 million sheep were being farmed, of which only 6 million were Merinos. Cross-breeds such as the halfbred and Corriedale (Lincoln or English Leicester rams over Merino ewes) were developed, and later other popular breeds such as the Perendale and Coopworth were derived from cross-breeding Cheviot and Border Leicester rams with the Romney. Today, approximately 8% of New Zealand's sheep population consists of Merinos and other fine-wool breeds and crosses; these are mainly grazed on the drier hill country of the South Island. They still flourish as producers of fine wools suitable for clothing manufacture, and a number of Merino breeders have developed niche overseas markets for their wool, where it is used to make high-quality clothing.

More recently, as well as the predominance of the Romney and its derivatives, there has been an increased use of two-, three- and four-breed composite sheep. These have incorporated the use of 'exotics' — the Finn, East Friesian and Texel — cross-breeding with the Romney, Coopworth or Perendale. Other breeds, including the Suffolk and Poll Dorset, have become popular as terminal sires. Wool, pelts and tallow were the first main export products of the sheep industry, but, following the successful shipping of frozen carcasses to London in 1882, sheep meat exports soon became a significant part of the country's export earnings. As an example, in 2015 over 40% of the 21 million lambs slaughtered for the meat trade were exported to the European Union.

Figure 1.1 Typical Romney Marsh or Kent sheep (1920s).

In spite of depressed meat and wool prices at times, and fluctuations in sheep numbers, the sheep industry has shown some remarkable improvements in productivity. Outstanding advances include, firstly, the improvement in the national lambing percentage (lambs docked to ewes mated), which was almost static at between 95% and 103% until the early 1990s; in 2015 it reached 127%. A second advance is the faster growth rates of young sheep — and hence the higher slaughter weight of export lamb — which has gone from 14.0 kg in 1993 to 18.3 kg in 2015. Finally, the increased number of ewe hoggets being mated (estimated at about 30%) has increased the gross reproductive performance of many flocks. These improvements are largely the result of a better understanding of the role of nutrition in reproduction and in growth and development, breed improvements, cross-breeding and significant developments in the understanding and control of animal health and disease; all of which can be attributed to a combined effort by animal scientists, veterinarians and farmers.

For a thorough overview of sheep production in New Zealand, readers are directed to the 'Sheep Production' chapter of the book *Livestock Production in New Zealand*, edited by Kevin Stafford and published by Massey University Press (2017).

The role of the veterinary profession

New Zealand veterinarians have always been actively involved in taking new animal health information to the farmer, ensuring its correct application and monitoring the results.

Historically a small cadre of earlier veterinarians, mainly associated with the Department of Agriculture, diagnosed and solved many of our animal disease problems. The first government veterinarian was John Gilruth, a Scot, who arrived in New Zealand in 1893 and was put in charge of the veterinary division of the Department of Agriculture. He soon recruited staff who, like him, travelled the country assessing the disease situation of its farm animals. Gilruth published leaflets for farmers and initiated the annual reports of the Veterinary Division of the Department of Agriculture, with the first report being published in 1893. By 1899 Gilruth's veterinary staff numbered four, and by 1902 he had a staff of 24 qualified field veterinarians. He established diagnostic laboratory services which first operated from a small room in Government House. These limited facilities were abandoned in 1905 when the diagnostic station and farm at Wallaceville were opened.

With the development of the veterinary club system under Alan Leslie — another determined Scot — in the late 1940s and through the 1950s, there was a rapid infusion of young and enthusiastic veterinarians into nearly every rural district of New Zealand. Veterinary services to sheep farms as well as dairy farms began in earnest, and areas of the country with significant sheep populations soon had well-established services.

The rapid expansion of field veterinary services to sheep farmers has been assisted greatly by the pharmaceutical industry, which has produced an increasing range of sheep vaccines, anthelmintics, antibiotics and endocrine products. Notable among the vaccines were the clostridial vaccines (which were vastly improved and dispensed in combination), Salmonella vaccine and the abortion-preventing vaccines for toxoplasmosis and campylobacteriosis. The improved anthelmintics have included fine-particle phenothiazine, methyridine and later the benzimidazoles, macrocyclic lactones and amino acetonitrile derivatives. With parasite control being an established part of grassland farming, the development and correct use of these latter products has been vital to the maintenance of stock health (see Chapter 8). There have also been outstanding developments in external parasite control (see Chapter 19).

The discovery of trace-element diseases caused by dietary deficiencies of copper, cobalt, iodine and selenium were of great significance to animal health. More recently, the extent of the 'subclinical' effects of selenium and cobalt has been appreciated, and widespread preventive procedures are now undertaken regularly on many New Zealand farms. This extension in use of trace elements has largely resulted from the development of very effective and readily available diagnostic tests with which they can be monitored. Their concentrations can be measured in a variety of animal tissues, animal fodder and soil, if necessary, so that an investigation can be completed within one or two days. Previously it took weeks for some test results to be obtained.

The 1950s and onwards were notable for many

improvements to veterinary services to farmers. New government diagnostic services were established at Whangarei, Ruakura, Palmerston North, Lincoln and Invermay in addition to the Central Animal Health Laboratory at Wallaceville. These are now all privately operated enterprises, except for the Investigation and Diagnostic Centre at Wallaceville. The highly sophisticated services offered by these laboratories are essential to most veterinary investigations, and the costs are now accepted by farmers as a normal part of farm expenditure. Previously such services were given to farming at no cost.

In 1963, New Zealand began training its own veterinarians. The veterinary science degree at Massey University has always had a large sheep-health component, commensurate with the size of the sheep industry and its significance to the New Zealand economy. As training for young veterinarians, the course has emphasised the application of knowledge in a preventative manner. As well as the undergraduate course, many doctoral and masterate studies on sheep health and disease have been completed. Some of the important subjects relating to sheep researched by postgraduates include: brucellosis control, anthelmintic resistance, trace-element studies, foot diseases, chorioptic mange, abortion, tooth abnormalities, pneumonia, Johne's disease, chromosome studies, leptospirosis, hogget lambing, neosporosis and ewe longevity.

In 1998, animal production scientists from the previous Faculty of Agriculture at Massey University were amalgamated with members of the previously named Faculty of Veterinary Science to form the Institute of Veterinary, Animal and Biomedical Sciences (IVABS). This proved a progressive move, particularly in the production animal area, where it brought two closely related disciplines together and advanced research and teaching of the many subjects where animal production and animal health are inextricably related.

The Sheep Society of the New Zealand Veterinary Association (now the Society of Sheep and Beef Cattle Veterinarians, NZVA) was the first specialised branch of the Veterinary Association and was formed in 1970. Since then it has brought interested veterinarians together at its annual conference and published regular proceedings. It has also contributed to and hosted International Sheep Veterinary Congresses.

In addition, the Australian and New Zealand College of Veterinary Scientists (ANZCVSc) gives formal opportunity to veterinarians who wish to establish their expertise in sheep health, to study for and pass examinations for either membership or fellowship of the College. The New Zealand Veterinary Association through VetLearn provides online courses and VetScholar programmes, which enable veterinarians to update their knowledge in their own time. The SciQuest resource includes tens of thousands of references from New Zealand journals on animal health and disease and is vital for research in these areas.

This summary of developments in sheep health and disease in New Zealand demonstrates that the profession is able to provide a high-quality, expert animal health service to New Zealand sheep farmers. In spite of economic fluctuations that have affected the incomes of sheep farmers from time to time, the application of sound veterinary advice is always vital if animals are to be healthy and produce their best.

This text, which is largely based on the undergraduate course that has evolved at Massey since 1967, has been produced to emphasise the clinical aspects of sheep health that the veterinarian can apply in the field. Knowledge and experience are essential for the specialist veterinarian before regular animal health programmes can be effectively developed. The operator must have both of these attributes. He/she must be thoroughly conversant with the sheep industry and target performance data. With this in mind, the authors have gone to considerable trouble to emphasise the different disease areas and give examples, where possible, of typical disease problems and how these may be dealt with.

The general principles of flock and herd investigation

Definition of 'disease'

For production animals, the term 'disease' refers not only to animals that are clinically ill but also to those animals or groups of animals that do not reach target performance. Thus, as well as being able to recognise animals affected with a particular disease, it is also necessary to investigate conditions such as hogget ill thrift, in which young sheep fail to achieve a satisfactory growth rate. In some instances

the farmer may not recognise any abnormality unless the productivity of the animals is monitored closely and a comparison made with both local and national data, for example average weaning weights, lambing performance, numbers of dry ewes and wool weights.

The importance of the clinical procedure

Most animal health programmes stem from an initial clinical investigation during which the observant veterinarian identifies a need for further investigation or monitoring of the flock, and with this the farmer will gain confidence in the veterinarian's ability as an animal health professional adviser. Thus it is imperative that the first job is done well!

The diagnosis, treatment and control of production animal diseases are very dependent on the results of the clinical investigation of the animals on the farm, their management and the environment. The principles of this basic but vital procedure may be applied, with modification, to nearly every veterinary investigation. Therefore it is essential that newly qualified veterinarians develop these skills and continually hone them as new knowledge and technology become available.

The procedure

Flock and herd investigations can be described under the following headings:

1. History
2. Examination of the environment
3. Examination of the animals
4. Use of ancillary aids
5. Data analysis and decision making
6. Reporting back and further monitoring.

1. History

In flock and herd problems a two-phase approach is commonly used. Firstly, dealing with the problem at hand; and secondly, as appropriate, expanding this into a whole-farm approach. In either case it is essential to keep a permanent record for future use. The initial data include the following items:

A clear definition of the problem

- Concentrate on the problem at hand, as this is what the farmer expects.
- Be tactful. You may be appalled by the poor condition of the animals or the state of their environment, but be careful not to offend your client. Be understanding — your client may have personal problems of which you are unaware (e.g. financial problems, family illness, etc.).
- Separate the owner's observations from his/her interpretations.
- Obtain a clear time sequence of events leading to the problem. Obtain dates if possible from the farm diary.
- Avoid using slang terms like 'crook' animals. Show concern.
- Determine the losses to date:
    - Morbidity rate — % affected animals
    - Case mortality rate — % affected animals that have died as a result of the condition
    - Population mortality rate — % exposed animals that die due to the condition.
- Determine prior treatment and control procedures, if any.
- Obtain a history of the management of the animals, in relation to nutrition, feeding and reproduction (if mature animals).
- Without prejudice, assess the ability and experience of the farmer. Remember, farmers are very intelligent people. Many have tertiary qualifications and are very experienced in business matters.
- In most investigations the history taking occurs throughout the visit and is often ongoing. With time, a good client–veterinarian relationship will develop. An experienced veterinarian with long-term knowledge of his/her client's property and its animals is an invaluable asset to the farmer. A 'local' veterinarian with experience and accumulated knowledge is a unique expert among farm advisers.

Property profile

When investigating flock and herd problems it is important for the veterinarian to have a sound understanding of the overall farm enterprise, the level of production and the financial performance. It is not always possible to collect a full range of data on the initial visit, and usually several visits are necessary for completion of the profile. The following and rather full format lists the data that need to be gathered for a full farm profile, and will greatly assist animal health investigations on that property. It can also

be readily computerised for a permanent record.

- Situation, e.g. Rongotea district, Manawatu.
- Land elevation above sea level. For comparative analysis the farm may be classed into one of the following categories:
    * Flat
    * Flat 50% hill 50%
    * Rolling hill country
    * All hill
- Effective farm area in hectares.
- Farm class or type (1–8).
- Main soil types or type (soil tests may be needed).
- Subdivision, number of paddocks; a farm plan is helpful, if available.
- Stock classes, stocking rate, sheep to cattle ratio. The stock unit (SU) conversion relates the energy requirements of various classes of stock to the requirements of one breeding ewe (55 kg) producing one lamb per annum. However, for individual properties stock units will vary depending on the mature liveweight of animals and stock performance (e.g. lambing percentage, growth rates). They are calculated for the winter tally (1 July). Stock unit measurements used in New Zealand may differ slightly between agricultural organisations, but based on the 55 kg ewe rearing one lamb equivalent, the approximate conversion factors incorporated for recording purposes are given in Table 1.1.

Stock class	Number of stock units (SU)
Ewes	1
Hoggets	0.7–1
Wethers	0.7
Rams	1
Breeding cows	6
Rising 2-year-old cattle	4–5
Rising 1-year-old cattle	3.5–4

Table 1.1
Stocking rate conversion factors based on a 55 kg ewe rearing one lamb equivalent.

Reproductive performance and mating management

In addition to the mating information, such as numbers of rams used and timing of ram introduction, the tallies of ewes and lambs at specific times of the year are recorded. From these figures, the lambing performance (lambs docked/ewes mated), ewe mortality, lamb mortality and various classes of dry ewe can be calculated. Ram examination data will be part of reproductive information and is dealt with in detail in Chapter 2. Similar data may also be collected about beef cattle on the property.

Other available animal health information

The farmer may already have considerable animal health information that may eventually prove useful in your investigations, and this may be worth collating. This will include such items as:

- Sheep or cattle disease recognised previously.
- Vaccination information — diseases vaccinated against, frequency, timing and vaccines used.
- Internal parasite control — the importance of internal parasite control in relation to the efficiency of New Zealand sheep farming is paramount (see Chapter 8). Times of drenching, anthelmintics used, classes of animals treated and the presence of special parasites such as liver fluke should be noted.
- Bodyweights and body condition scores (BCS) — one of the most useful aids in studying poor flock performance is the regular weighing and BCS of the various classes of sheep. Many farmers have this information. Bodyweight is correlated with both reproduction and wool growth (see Chapters 3 and 6).
- Trace elements — it is useful to find out what, if any, micro-element deficiencies occur on the property. Record how trace elements have been administered, products used for prevention and how frequently they have been used.
- Fertiliser usage — it may be possible to obtain information on fertiliser usage. Regular topdressing is an integral part of New Zealand grassland farming and a variety of fertilisers are used. These contain various mixes of phosphate, sulphur, calcium, nitrogen, potassium and trace elements (see Chapter 7).

2. Examination of the environment

The importance of examining the environment is often overlooked. The examination begins as you enter the property and should extend well beyond the immediate vicinity of the woolshed or dairy shed. Eventually a farm walk or motorbike ride should be undertaken to assess the topography, soil type, feed availability and water supply. This also gives you a better appreciation of how well feed supplies are being used and what are available for the future.

3. Examination of the animals

In most instances the examination of the animals (flock and individuals) begins during the history taking. Observation of the animals at a distance as well as close up is important and is often overlooked by inexperienced veterinarians. Don't be in a rush to get your hands on the animal(s) or wield the postmortem knife before you view the whole scene. Observation skills are an essential part of your investigative approach. They develop over time and eventually become second-nature to the investigation. Where appropriate, the clinical examination of individual animals must not be overlooked even though you may be investigating a flock problem.

The distance examination

The flock should be examined as a whole while in the paddock or holding pen. Specific things to observe include:

- size, approximate weight and variation in size within the flock
- fleece — look for abnormalities such as flystrike, dermatophilosis or wool derangement
- evidence of lameness
- evidence of diarrhoea (dags, faecal staining of hocks)
- photosensitivity
- listening for coughing
- whether any individuals appear abnormal (e.g. depressed, separated from flock, showing nervous signs, recumbent).

Weighing and body condition scoring a number of sheep is another useful aid during a flock investigation (see Chapter 6).

Individual animal clinical examination

Even if a disease condition is affecting an entire flock, it is usual for variations to occur in the severity of the disease between individual animals. If individual animals appear abnormal, they should be examined in more detail as this may provide important clues about the disease process. A basic clinical examination does not take long to perform and should include the measurement of cardinal signs, examination of teeth and mucous membranes, assessment of hydration and auscultation of the lung fields and rumen. In some cases a more thorough clinical examination may be required, or a briefer version of the clinical examination tailored to the presenting problem may be performed (e.g. in a lameness investigation, the clinical examination may consist primarily of examination of the feet).

'Normal' values for sheep are as follows:

- temperature: 39.5°C +/– 0.5°C
- heart rate: 70–90/min
- respiration rate: 15–70/min
- rumination rate: 3–4/min
- mucous membranes (third eyelid or gums): pale pink
- hydration status: can be assessed by tenting the upper eyelid.

Note that during clinical examination sheep are usually stressed or anxious and so heart rate and respiration rate are frequently elevated as a result.

Postmortem examination

Postmortem examination of affected animals can be an extremely valuable part of an investigation. Not only does it allow identification of lesions that may be specific to a certain disease, but it also gives an opportunity to collect samples such as liver (e.g. for trace-element analysis), gastrointestinal tract (e.g. for worm counts) or specific samples for microbiology (e.g. gut contents for *Salmonella*) or histopathology (e.g. ileum or lymph node for Johne's disease). It is ideal to necropsy as many animals as possible/practical. Generally the animals selected are those that have already died, preferably selecting the most recently dead. If animals are severely affected and likely to die they may be euthanased for postmortem examination.

4. Use of ancillary aids

Further diagnostic tests are an important part of most flock/herd investigations. For diagnostic tests to be interpreted meaningfully it is necessary to collect the correct samples

and the appropriate number of samples for the test to be undertaken. The following are examples of diagnostic tests commonly used in herd or flock investigations:

- Assessing the trace-element status from blood, serum and liver samples (see Chapter 7).
- Assessing the parasite burden using faecal egg counts, worm burdens, faecal egg count reduction tests and larval culture (see Chapter 8).
- Serology, e.g. rams for brucellosis (see Chapter 2).
- Microbiology, e.g. intestinal contents for *Salmonella* spp, etc.
- Haematology/biochemistry, e.g. anaemia associated with haemonchosis, or elevated liver enzymes from facial eczema.
- Samples for histopathology, e.g. Johne's disease.
- Pasture and soil samples to assess the fertility level. These are often interpreted in conjunction with other consultants such as soil scientists.

5. Data analysis and decision making

As with all veterinary examinations, the veterinarian is required to make a decision. This falls into the area of tentative diagnosis, prognosis and therapy.

One of the first steps is to decide whether an abnormality is present and to define it in regard to the pattern of occurrence, the group affected and the costs of the problem. Many production-animal problems are multifactorial and a single specific aetiology cannot be defined. Nevertheless it is necessary to outline a course of action, usually involving some intervention or change in management, and to monitor the result. In some situations it may be appropriate to conduct a response trial.

6. Reporting back and further monitoring

Before leaving the farm it is essential to discuss with the owner the action recommended. Results of diagnostic tests can be reported by phone, fax or email. If these are not available, decisions should be confirmed in writing. The report is most valuable and is an essential record for future use by the farmer and veterinarian.

In addition, before leaving the farm the appropriate time for the next visit should be discussed with the farmer. Many herd or flock problems will not be solved by a single visit and will require further visits to monitor the progress of any action. For instance, the use of copper therapy in cattle — should this be repeated? As the results of your investigation become available, the advice may need to be modified. Thus, monitoring should be part of many flock or herd investigations and forms the basis for ongoing animal advisory services.

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