

Animal Health, Production and Pasture

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Foreword

Sir John Hammond, C.B.E., M.A., D.Sc., F.R.S.

In most countries in the world, including New Zealand, Australia, Africa and South America, the production of milk, meat and wool depends largely and sometimes entirely on the amount and quality of grassland and its products; this dependence is exemplified by the advanced methods of grassland management practised in New Zealand. During the last fifteen years the dairy, beef and sheep industries in Great Britain, Europe and the North American continent have turned to grass and grass products to supply much more of the protein requirements for cattle and sheep, largely as a sequel to the absence or severe shortage of imported feeding-stuffs during the last war. This has involved new methods of increasing the output of our grassland, new systems of management and increased stocking rates.

Each step in intensification has raised new problems to be solved before full and safe use could be made of them, and not the least of these was the effect of the changes on the health of the animal. This book will supply a long-felt want in not only giving an account of the new methods used in the intensification of grassland production but also of the hazards involved by these methods on the health of the animal and most important, methods of control for the various nutritive and parasitic diseases concerned.

In recent years a large amount of research work has been undertaken on these subjects but the literature is very scattered and is often not accessible to those who want to use it. The chapters of this book, each written by specialists in a particular field, bring all the recent knowledge together so that the book should be invaluable to all those interested in pasture and the nutrition and health of the animals fed on it.

Cambridge,
December 1962.

Editors' Preface

The suggestion that a book should be written with the object of bringing together, between one set of covers, the sum of our knowledge of the factors which influence the health and productivity of the grazing animal was first made by Sir James Scott Watson. To him we owe a special debt of gratitude. At a stage when we are passing from what may be called the 'pasture establishment era' into the 'pasture use era' it seemed appropriate to Sir James that a volume should be published which would both summarize existing knowledge on pasture use and, by doing so, indicate the gaps that remain. Such a volume, it was thought, would prove to be a useful reference for farmers, students and veterinarians, and a stimulus to agricultural and veterinary research workers and advisory officers.

Thanks to the patient co-operation of all the contributors the volume is now ready. Knowledge concerning the health and productivity of grazing animals is, of course, far from complete, and therefore we need make no apology for the fact that this book provides answers to some of the problems only. We can claim, however, that reflected in its pages is the accumulated knowledge of a group of workers, experienced in their various fields in several countries, whose efforts have been directed to achieving increased health and productivity in grazing flocks and herds. We are extremely grateful to all of them for the time and effort that they have given to this project.

Our thanks are due also to the editors and publishers of several journals and scientific publications e.g. *Australian Journal of Agricultural Research*, *Journal of Agricultural Science* (Cambridge University Press), *Journal of the British Grassland Society*, *Journal of Comparative Pathology*, *Proceedings of the 8th International Grassland Congress*, *Journal of Helminthology*, *Parasitology* (Cambridge University Press), *Journal of Physiology*, *Veterinary Record*, *Biochemical Journal*, *Empire Journal of Experimental Agriculture*, *Journal of Animal Science*, *Journal of the Chilean Iodine Educational Bureau*, *Journal of Pathology and Bacteriology*, *Journal of the Science of Food and Agriculture*, *Landwirtschaftliches Jahrbuch der Schweiz*, *Netherlands Journal of Agricultural Science*, *Plant Physiology*, *Proceedings of the Nutrition Society*, *Proceedings of the Third World Congress on Fertility and Sterility*, *United States Department of Agriculture Yearbook for 1948*, the *Welsh Journal of Agriculture*, and to George Allen & Unwin Ltd. for material from *Grassland Husbandry* by Moore and Her Majesty's Stationery Office for material from

Editors' Preface

Ministry of Agriculture, Fisheries and Food Bulletin No. 48 and Agriculture Journal, for their permission to reproduce figures or tables.

By the happy coincidence of his return to the United Kingdom, we were able, as the book reached the proof stage, to obtain the help of Mr Donald W. Jolly, M.R.C.V.S., whose knowledge of editorial matters has contributed enormously to the rapid and smooth transformation of manuscript to text. The task of editing this book has not been an easy one, and but for Mr Jolly's support and the encouragement and co-operation of Longmans, Green and Co., it would have been immeasurably more difficult.

We gratefully acknowledge the advice and assistance of Ruth Allcroft, O.B.E., Ph.D., B.Sc., whose excellent review 'The Use and Misuse of Mineral Supplements' (*Vet. Rec.* 73, 1255, 1961) provided the basis of the section on selenium. We are also grateful to the Editor of the *Veterinary Record* for allowing us to make liberal use of the review.

We are also indebted to Mr K. N. Burns, B.Sc., M.R.C.V.S., of the Central Veterinary Laboratory, Ministry of Agriculture, Fisheries and Food, Weybridge, Surrey, for the section on the industrial contamination of pasture.

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CHAPTER ONE

Introduction

A. N. WORDEN, K. C. SELLERS AND D. E. TRIBE

General Introduction—Disorders of the foot in grazing animals; foot-rot, strawberry foot-rot, red foot, foot-abscess, foul of the foot—Recent findings of potential importance, facial eczema, silica, selenium—Industrial contamination of pasture; fluorosis, other contaminants—Ecology of the grazing animal—General observations.

It is appropriate that a book concerned with agricultural production should start by reminding the reader of the critical situation which now faces mankind—a situation which has been aptly summarized in the phrase 'population explosion'. It is against the stark background of over-population and food shortage that man's endeavours must now be viewed, and if society is to find a solution to this overwhelmingly important problem there is no doubt that the farmer, and the body of scientists that now support him, must together play a key role. Also there are still vast areas of the world, even in the so-called well-developed countries, where the application of new techniques can increase greatly the output of food. In view of the fact that the world's most important crop by far is 'grass' (by which we mean the plant communities used by grazing animals), and the world's most important food-producing animals are ruminants, which depend largely, and frequently exclusively, on grass for their lifetime nutrition, any techniques for improving the production or utilization of grass are likely to bring about the most rewarding increases in the supply of food for the human population. The exciting and tremendous potential of the world's grasslands was well illustrated in the group of plenary papers which were read at the Eighth International Grassland Congress in 1960.

McMeekan (1952, 1956, 1960) and many others have pointed out that in the past too little attention was paid to the problem of pasture use but now it is becoming generally accepted that 'The productivity of grassland in terms of meat, milk, wool or hides as sale crops, must be viewed as an integral part of a pastoral enterprise, in which the nutritional demands of the ruminant animals are met for 365 days in the year and for the whole duration of its productive life' (Davies, 1960). It remains theoretically true that the most important single advance in the economy of pasture use would be the replacement of the grazing animal altogether by chemical methods of processing grass into food for humans. However, 'the grilled grass steak is a very long way from achievement' (Melville, 1960) and there is no doubt that, during the foreseeable future, grass will have to be processed through the ruminant animal before the human population can derive much benefit from it.

Although grass is the world's most important crop, it is paradoxically of almost no direct use to man as a source of food. In fact, the only sections of the animal kingdom that can derive much nutritional benefit from grass are those which have undergone a marked evolutionary change in the structure and function of some part of their alimentary tract, and which, in consequence, can accommodate a large intestinal population of bacteria and protozoa. It is this large and varied microbial population that converts the many refractory constituents of grass, which would otherwise remain indigested, into readily available sources of energy, protein, or vitamins. Herbivores such as the horse and the rabbit accommodate their microbial populations towards the dorsal end of their alimentary tracts, but the ruminant, which appears to exhibit the most advanced evolutionary adaptation to cope efficiently with a bulky, coarse grass diet, accommodates its populations in the large diverticulum of the foregut, the reticulo-rumen. The complex symbiotic relations between the micro-organisms and the host ruminant have been well summarized by Annison and Lewis (1959).

In view of the ruminant's dependence upon the processes of microbial breakdown and synthesis it is permissible, although of course it is an over-simplification, to regard grass primarily as a substrate for micro-organisms rather than as a food for cattle and sheep. Many of the nutritional deficiencies of grass then become immediately obvious. The substrate in any successful industrial bacterial fermentation process needs to be constant in quantity and quality. These requirements are

far from being met by the diet of the grazing animal. The quality of pasture is constantly changing, and, in most pastoral areas of the world, it changes over a very wide range. The intake of herbage similarly alters and is affected by a large and varied number of independent and interacting factors. Moreover in an industrial fermentation process the environment within the fermentation chamber must be maintained at a constant equilibrium, not only by controlling the quantity and quality of the substrate, but also by controlling the rate of removal of the bacterial metabolites, by maintaining constant and uniform mixing of the fermenting mass, by diluting the mass to a constant dry-matter content, and by controlling the range of micro-organisms that are active in the fermentation process and eliminating undesirable types. The analogy with the rumen is clear, and serves to illustrate the importance in this situation of the processes of absorption and rate of passage of food from the reticulo-rumen, of rumen motility and rumination, of salivation and of the factors which regulate the type and size of microbial population in the rumen and determine its variation. The precise control of these factors by the farmer or grazier is clearly impossible, but it is towards this ideal that those who manage the grazing animals must work. However, 'a fuller knowledge leads to a fuller control' and the range of research, and the diversity of specialized interests required to make our knowledge of pasture utilization more complete is exceptionally wide.

The biochemist, physiologist and microbiologist have an important part to play in revealing what may be called the 'normal' situation; in the investigation of rumen dysfunction, and, in a wider sense, the dysfunction of the grazing ruminant, veterinary knowledge must also be used. Since the research findings of all of these workers has, at some stage, to be interpreted in terms of the management of the grazing animal, the agricultural scientist has his own contribution to make. The purpose of the present volume is to bring together specialists from the various disciplines working in this broad field, in order to review the results of the enormous amount of research that has been carried out particularly in the last fifteen years, and to summarize the extent of our present knowledge in the subject.

It is recognized that our knowledge of the problems of producing grass and of managing pastures outstrips our knowledge of the problems of animal production from grass and of managing the grazing animal. Nevertheless enormous progress has been made since, during

the last war, Sir Joseph Barcroft and his colleagues at Cambridge initiated their fundamental investigations into the physiology of the rumen and about the same time, Dr C. P. McMeekan and his New Zealand colleagues intensified and extended their studies on grazing management, and since veterinary research workers in many parts of the world turned with renewed vigour to the problems of the metabolic, parasitic and nutritional diseases of grazing stock. It is the purpose of this book to review the advances that have been made, at the same time realising that this will be the first word on the subject and not the last. It is because no other volume has attempted to cover this important, but wide and complex field, that this book was required. In a rapidly developing field such as this, it is inevitable that there are gaps in the story, and that, in some instances different authors have expressed conflicting views. Indeed it has been our object not only to present what is known on the subject but also to indicate where there are deficiencies and uncertainties in our knowledge. It is hoped, therefore, that this book will stimulate further work so that future volumes will be more comprehensive. We are grateful to the eminent workers who have responded to our appeal and who have, collectively, submitted a series of chapters that cover a great deal of existing knowledge and an extremely wide range of experience.

In the selection of particular fields of work for inclusion in this book we have been guided by several considerations. Firstly, it was decided to include material only if directly relevant to the grazing animal. For this reason the fields of infertility and genetics, although both important in a general sense as factors influencing the efficiency of production of the grazing animal, are not included. Similarly although a wide range of infectious diseases, e.g. mastitis, tuberculosis, pleuropneumonia and foot-and-mouth disease, may greatly impair the productivity of grazing animals, the fact that they are grazing, or are consuming grass, does not materially affect the course of the disease, and therefore these conditions have not been considered in the present context. There is, however, one particular group of infectious conditions for which an exception can be made, the group which causes disorders of the feet. In this case the microclimate produced by the vegetation in which the animal stands, together with the type of grazing management that is practised, may exert such a profound influence upon the incidence and severity of the disorders that brief mention of them is required.

DISORDERS OF THE FOOT IN GRAZING ANIMALS

CONTAGIOUS FOOT-ROT OF SHEEP AND GOATS

There are several diseases of the foot of sheep; Beveridge (1959) believes that the term 'foot-rot' should be reserved for the specific condition which he defines as a contagious disease of the sheep's foot characterized by separation of a large portion of the hoof from the soft tissues due to a spreading infection immediately beneath the horn, and caused primarily by *Fusiformis nodosus*. The goat is recognized as the only other susceptible animal.

Foot-rot has long been established as the most prevalent cause of lameness in most of the sheep-carrying areas of the world. Beveridge (1941), in establishing that *F. nodosus* was the primary causal agent, showed that this organism does not occur naturally apart from the feet of affected animals. He regarded *Spirochaeta penortha* as an accessory causal agent and a third type of organism, a mobile fusiform, is constantly present in lesions of foot-rot but is not of established significance in the causation of the disease nor confined to affected feet. The infective agent of foot-rot does not survive for long anywhere except in the feet of sheep or goats showing some lesions, and Beveridge was able to demonstrate successful eradication procedures based upon this finding.

In view of his important contribution to the understanding of, and to the method of controlling, this disease, Beveridge's views on foot-rot may be quoted almost verbatim. Foot-rot behaves as a typical specific infectious disease in that it does not arise spontaneously. This point is of vital importance because many sheepmen and veterinarians think that the disease will make its appearance whenever conditions are favourable; in other words, that it is a non-specific infection resulting from sheep running in damp, lush pasture. This notion has arisen because in the flocks in the endemic areas the infection is constantly present and the spread and prevalence of the disease is influenced by the seasonal and pastoral conditions, for foot-rot can spread from sheep to sheep only in certain environmental circumstances.

Predisposing factors necessary for the spread of foot-rot are prolonged wetness of the feet or injury to the skin between the digits by any agent such as grass seeds or larvae of the nematode, *Strongyloides* spp. Damp, lush pasture is favourable to the spread of the disease whereas free water, as in marshes, is not. Warm water is more favourable than cold. Thus outbreaks of the disease occur most commonly in spring

and autumn on rich pasture. In these circumstances the sheep may develop a condition popularly known as 'scald'. This is a non-specific superficial inflammation of the skin between the digits. The cause of 'scald' has not been established. In itself it is not serious and usually clears up spontaneously, although it may cause lameness for a few days. Scald provides an ideal portal of entry for the causal agents of foot-rot, and when some animals in the flock are carrying the infection an outbreak of foot-rot follows the 'scald'.

Sheep of all ages are infected; lambs become infected rather more readily than older animals but the disease is less severe. The Merino is more susceptible than the British breeds, although the latter are not particularly resistant.

The method of control devised by Beveridge (1941) has stood the test of time, not only in Australia itself, but also in New Zealand (Ensor, 1957), Italy (Coppino, 1951), and England (see Beveridge, 1959).

The principle to be followed is to segregate all affected animals and any suspected of carrying the infection and then place the remaining healthy sheep on a pasture that has not had infected sheep on it for at least two weeks. The infection can live in mud and on pasture for some days but not as long as two weeks. If many of the flock are affected a concerted effort should be made to cure them by repeated treatment before carrying out the final eradication procedure. This eradication procedure should be done when the incidence of the disease is low and when climatic and pastoral conditions are not conducive to the spread of the disease, that is to say, in the driest time of the year.

In order to eradicate the disease it is necessary to impress on the farmer that the object is to eliminate all trace of infection and not merely to deal with lame sheep. All sheep in the flock must be caught and their feet examined closely and if necessary trimmed. It is essential to segregate not only those showing lesions of foot-rot but also any showing moist, inflamed hairless skin between the digits. Such animals may carry the infection for months without the hoof being affected. Misshapen hoofs should be trimmed and searched for small pockets of infection. Those sheep found healthy should be passed through a foot-bath of 5 per cent formalin before being placed on the fresh pasture. The sheep with foot-rot and the suspected carriers should be either sold for slaughter or kept in isolation while undergoing treatment. When cured they should be held for a further month and re-examined before being returned to the healthy flock because relapses often occur in sheep that appear to have been cured. It has been suggested that

relapses may be less likely to occur after treatment with chloramphenicol than after formalin.

The detailed procedure to be followed in eradicating the disease from a particular farm needs to be adapted to local conditions. Reasonably good facilities are essential for success and it is unsatisfactory to work in a muddy yard. A shearing shed is the ideal place to do the work. Re-introduction of infection is, of course, always through sheep or goats, so that any new-comers should be examined carefully and, if necessary, treated and isolated before being allowed to join, or to graze upon the same land as the main flock. Littlejohn (1961) has adopted the methods of Beveridge to British farming conditions and has reported a successful eradication from 15 commercial flocks.

STRAWBERRY FOOT-ROT IN SHEEP

This condition has been reported from Scotland by Harriss (1948) and appears to be a mycosis: Thomson (1954) was able to isolate an organism now known as *Dermatophilus pedis* (Ainsworth and Austwick, 1959). Affected animals develop what may become an extensive inflammatory swelling of the foot from the coronet upwards, followed by thick crust formation. A variety of treatments has been employed but none so far has been reported as influencing favourably the natural course of the disease.

RED FOOT OF LAMBS

Red foot is a widely distributed condition of new-born lambs in southern and central Scotland and is therefore a disease manifested in the progeny of grazing animals. It has been described by Greig (1951), who believes that it is neither infectious nor hereditary in origin. It appears to have a varied incidence from flock to flock, and may disappear from a given flock for a number of years despite any known changes in management practices. The incidence in affected hirsels is said rarely to exceed 15 per cent. Red foot may be seen just after birth and is confined to young lambs. The horn of the hoof becomes detached, with the exposure of red, sensitive tissue. There are sometimes ulcerated areas in the mucous membrane of the mouth. No means of effective treatment is known, and destruction is advised, since the lamb although otherwise healthy in appearance is so crippled that it cannot follow the ewe.