Diseases of Cattle in Australasia

A comprehensive textbook

TJ Parkinson, JJ Vermunt and J Malmo

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FOREWORD

"Diseases in of Cattle in Australasia" provides cattle practitioners and veterinary students with an authoritative text on cattle diseases that may be encountered in the predominantly pasture-based environments in New Zealand and Australia. The cattle industry in Australasia is the largest animal industry in the region, and includes the dairy, pasture-fed beef, feedlot, and live-export sectors. The industry operates across a wide range of environments and production systems, and more than half of the produced dairy and beef commodities are exported.

This textbook is arranged in 25 chapters, commencing with an overview of the dairy and beef industries in New Zealand and Australia and ending with a chapter on practical therapeutics, and comes with an extensive image library on CD-ROM. The text has been mainly co-authored by Tim Parkinson, Jos Vermunt and Jakob Malmo, with additional contributions from fifteen other authors. The book is written from the perspective of the veterinary practitioner encountering the diseases in cattle on a farm. The reader is provided with a detailed outline of the diagnostic methodology based on clinical examination of body systems, with confirmation by ancillary tests and responses to treatment.

The principal authors are eminently qualified and experienced. Tim Parkinson is currently Professor of Farm Animal Reproduction and Health at Massey University in New Zealand, and a Diplomate of the European College of Animal Reproduction and Fellow of the Royal College of Veterinary Surgeons. Tim has extensive practical, academic and research experience with cattle in both the United Kingdom and New Zealand. Jos Vermunt is a registered veterinary specialist in cattle medicine and Fellow of the Australian College of Veterinary Scientists, and has combined cattle practice in the Netherlands, Middle East, Canada, New Zealand and Australia, with academic teaching and research. Jakob Malmo is a registered veterinary specialist in cattle medicine and Fellow of the Australian College of Veterinary Scientists, and has combined a career in private practice while running two dairy farms, with teaching cattle medicine to undergraduate veterinary science students at the University of Melbourne, and supervising postgraduate students undertaking research projects in commercial dairy herds. Together, these principal authors bring a wealth of practical, academic and research experience to this text.

This is the definitive textbook on diseases of cattle in Australasia. All of the important diseases of cattle are covered, with particular emphasis on clinical examination, diseases of the gastrointestinal tract, lameness, mastitis, and reproductive disorders. The textbook will be an essential reference for cattle practitioners throughout Australia and New Zealand, and will have application where cattle are kept under similar conditions in other countries. The chapter on practical therapeutics for the cattle veterinarian will be of great value for veterinary students, and for the young cattle veterinarian to have in the car for reference during on-farm consultations.

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PREFACE

Over the years, several major books on large animal medicine in general, and cattle in particular, have become established as comprehensive and definitive reference works. However, during the many years that the authors have worked with cattle in Australia and New Zealand, we have not been able to access a textbook on the diseases of cattle which had been specifically written for the subject in this part of the world. We have considered this to be a major deficiency and that a specific need exists for establishing such a book. Writing this particular textbook seemed a logical and fitting response to this deficiency.

This book has had a long gestation. It was conceived somewhere between 2000 and 2001, during late-night conversations at conferences of the Society of Dairy Cattle Veterinarians of the New Zealand Veterinary Association, between members of that society and the principal authors. In hindsight, as for many conceptions, what seemed a great idea on a dark night seemed less rosy when the hard graft of writing began. But, nonetheless, by somewhere around 2004, it was clear that pregnancy had become established, and scoping and drafting of the text began.

The book has been written to serve as a reference book for the subject of diseases of cattle in Australasia, and with the intention to provide an immediate source of reference and information to veterinary students and veterinary graduates working in clinical practice, in particular. It is also intended that the book should be useful to the progressive farmer, professional agricultural advisors, and those in other scientific disciplines who require access to both general and detailed knowledge on diseases of cattle in Australasia.

None of us had written a textbook of this size from 'the ground up', although all of us have written, revised, contributed to and edited other works. But we knew, from hard-won experience, the difficulty of getting manuscripts from far-flung scribes with no obligation other than a cheerfully and hastily given promise to write a chapter for a particular volume. In the present case, we have been blessed with colleagues who have been willing to make an extraordinary effort to bring their labours to fruition at the agreed time. For this we are grateful, as we are to the many colleagues who have commented on, and constructively criticised, our developing manuscript.

There has been a determined effort to prevent this book growing into an unwieldy text. In making this attempt, it has been the intention to concentrate on those aspects that will be of most assistance to the veterinary student and the veterinarian in the field. Hence, whilst not being fully referenced, the chapters include recommendations as to further reading that should assist those who wish to obtain more detailed information on that particular topic. Key references to new, controversial or pivotal discoveries have, however, been included. On the other hand, we have wanted to illustrate as many of the conditions described in the text as fully as possible. Many colleagues have contributed illustrations to the book; Keith Thompson has been especially generous in allowing us to trawl through more than 30 years of accumulated pathology slides: a unique collection that we are privileged to have had the opportunity to access.

While each of us has been responsible for the initial draft of portions of the text, the final version represents the consensus (sometimes hard-won) of our views. We like to think that there has been advantage in our having gained extensive experience in clinical cattle practice, as well as at a variety of veterinary schools. We are also grateful for other specialists who, from practice or academia, have generously contributed to this work.

In preparing this book, care has been taken to ensure accuracy of reference ranges, dose rates, normal values, etc. It is possible, however, that some errors or inconsistencies may appear. Therefore, clinicians are urged to read the manufacturer's recommendations carefully when administering medications. Similarly, reference ranges specific to the laboratory used should be consulted when interpreting laboratory results. In some situations, it may be necessary for the clinician to use his/her own clinical judgement. Likewise, we have tried to ensure that all material, illustrations or data, has been properly attributed. If there are any that we have not fully acknowledged, we apologise.

Tim Parkinson
Jos Vermunt
Jakob Malmo

November 2009

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This project was conceived in discussions between the principal authors and the Society of Dairy Cattle Veterinarians (DCV) of the New Zealand Veterinary Association (NZVA), in 2000 and 2001. Initially, Warren Webber and Peter Jolly from VetLearn® (the NZVA Foundation for Continuing Education) helped turn the project from an idea into reality, while Peter Jolly continued to manage the publication as a continual advocate and facilitator despite his many commitments.

Ansley TeHiwi and the staff of VetLearn have undertaken a great deal of detailed work in the production of the book, which we gratefully acknowledge. Likewise, the input of Gina deNicolo has been invaluable as an editorial assistant, especially for the coordination of contributions from authors and all the myriad 'chasings-up' that a book of this nature requires. The graphic art and original artwork was created by Peter Parkinson, who also completed the initial graphic design and layout. Final editing and prepress was completed by Carolyn Lagahetau, Cheryl Rowe and Murray Lock, and the indexing completed by Robin Briggs. William Hickson, Aaron Fulton and Sam Spencer from VetLearn created the extended image library on CD-Rom.

The contribution of Richard Laven in his critical comments upon early drafts of several of the chapters is also gratefully acknowledged. Thanks also to Peter deGaris for his comments on the chapter on metabolic disorders. We are particularly grateful to Keith Thompson and Rob Fairley for giving us unlimited access to their collection of pathology images which have been used extensively throughout the text.

Financial support has been provided by VetLearn, the DCV and the NZVA Society of Sheep and Beef Cattle Veterinarians. Generous sponsorship and support has been granted by Intervet Schering-Plough Animal Health in both Australia and New Zealand, and Merial Ancare in New Zealand, facilitating access and affordability of this text by veterinary students and practitioners. Particular thanks go to Mike Stephens and Craig Stevenson from Intervet Schering-Plough Animal Health, and Justin Hurst from Merial Ancare.

For each of us, the most rewarding function of the acknowledgements is the opportunity it affords us of thanking those who have deeply assisted us in our work. Our wives have been especially generous in their encouragement over the past years, and their support of absentee husbands who have spent myriad evenings crouched over a glowing computer screen. To Jennie, Ans and Jay we are undyingly grateful, for your encouragement and sustained patience in this endeavour, especially when we were despairing. During the many years of writing, you have continuously reminded us that, after all, there is life beyond this book.

Tim Parkinson
Jos Vermunt
Jakob Malmo

About the principal authors

Tim Parkinson

Devonshire, in the 1960s, was still a deeply rural part of Britain that was dominated by the farming of dairy cattle, beef cattle and sheep. Growing up in rural Devon and rural Sussex meant that cattle and sheep were an inevitable, formative, part of one's life. Studying veterinary science at Bristol University progressively confirmed that my core interests were in these species, and working in practice in Dorset confirmed that livestock farming was my absorbing passion (and that dogs and cats were not!). Time spent working in the cattle AI industry, in Nottingham University's agriculture faculty and, later, in a lectureship in Veterinary Reproduction and Obstetrics at Bristol University, developed my interests in these areas: interests that I was later able to bring to a new focus in leading the Dairy Systems academic group in New Zealand at Massey University. In the decade or so that I have spent in New Zealand, two things have emerged as being of paramount importance to me: namely, the breeding health and welfare of cattle, and the well-being of the rural veterinary industries of that country and its western neighbour. It is my hope that this text will be of benefit to both.

Jos Vermunt

My initial interest in cattle was stimulated as a boy by the many summer holidays that I spent with my grandfather and uncle on their dairy farm in the Netherlands. It was further nursed by the excellent teaching of the various aspects of cattle medicine at the Faculty of Veterinary Medicine in Utrecht, and during the annual foot-and-mouth disease vaccination campaign that was in place at that time in the Netherlands, and in which I was intimately involved as a veterinary student. It provided me not only with a great source of student income support but also ample opportunity to see cattle practice when accompanying practicing veterinarians on their evening and night calls. Their continual interest and devotion to cattle medicine served as an example to me, and I have learnt a great deal from them indeed. My interest in cattle medicine and management continued to grow while I was working in clinical practice in the Netherlands, the Middle East and ultimately New Zealand. After working for more than 25 years in cattle practice in Australasia, interspersed with short stints in academia in Canada and New Zealand, the physical demands of this profession forced me to make a career change. I endeavour nevertheless to stay up to date and continue to maintain a keen interest in the animal welfare and health issues associated with both dairy and beef cattle farming in this part of the world. Nowadays, cattle farmers are more informed about the health and care of their animals, and are asking and prepared to pay for quality veterinary services. My contribution to this book will prove worthwhile if it assists in the development of a better understanding and appreciation of the issues involved in providing such quality service by veterinary students and cattle practitioners alike.

Jakob Malmo

As the son of a large animal veterinarian I spent a considerable amount of time seeing cattle practice with my father and this inspired me to undertake a career in veterinary science. Upon graduation from the University of Sydney I settled into mixed (primarily cattle) practice in the Macalister Irrigation District of Victoria. In the late 70s I was approached by Prof. Douglas Blood to work with him in the development of the University of Melbourne Rural Veterinary Unit at Maffra. This facility, located in our veterinary practice, was developed with a view to exposing final year veterinary students to various aspects of cattle medicine and production. Since its inception I estimate that we have had over 1500 undergraduates spent time at the unit. While very many members of the veterinary profession have supported me during my career, four stand out as being particular sources of inspiration to me. These were my father, Sigurd, who was very highly regarded throughout Gippsland, Dr. Neville Beasley, a very dedicated and enthusiastic beef cattle veterinarian in my neighbouring practice, Prof. Douglas Blood, a world-renowned veterinarian, and Prof. Ivan Caple, the recently retired Dean of the Faculty of Veterinary Science at the University of Melbourne. To them, and to the many members of the veterinary profession who have supported me during my career, my very sincere thanks. I have been privileged to witness the development of large animal practice, and of the beef and dairy industries in Australia, over the last 45 years. In the words of the late Otto Radostits, I have had the opportunity to work in the golden age of cattle practice. I am very grateful for the opportunities that both the veterinary profession and the cattle industries have given to me. I hope that this text will be of benefit to cattle veterinarians, and the industries that they serve, both in Australia and New Zealand.

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List of acronyms and abbreviations

1,25DHD	1,25-dihydroxyvitamin D
AA	anovulatory anoestrus
AB	artificial breeding
ABARE	The Australian Bureau of Agriculture and Resource Economics
ABLD	acute bovine liver disease
ABPEE	acute bovine pulmonary oedema and emphysema
ABV	Australian Breeding Values
AcAc	acetoacetate
ACAN	aggrecan
ACV	Australian Cattle Veterinarians
ADH	anti-diuretic hormone
ADHIS	The Australian Dairy Herd Improvement Scheme
AGID	agar-gel immunodiffusion test
AHB	New Zealand Animal Health Board
AI	artificial insemination
AIOD	artificial insemination on detection of heat
AIP	atypical interstitial pneumonia
δ-ALAD	delta-aminolevulinate dehydratase
ALP	alkaline phosphatase
ARGT	annual ryegrass toxicity/staggers
ASS	argininosuccinate synthetase
AST	aspartate aminotransferase
AV	artificial vagina
BAL	British Anti-Lewisite, or bronchoalveolar lavage
BCG	Bacillus Calmette Guèrin
BCS	body condition score
BDV	Borna disease virus
BEF	bovine ephemeral fever
BEFV	bovine ephemeral fever virus
BEH	bovine enzootic haematuria
BHM	bovine herpes mammillitis
BIV	bovine immunodeficiency-like virus
BLAD	bovine leukocyte adhesion deficiency disease
BLUP	Best Linear Unbiased Prediction
BLV	bovine leukaemia virus
BMD	bovine mucosal disease
BMSCC	bulk milk (somatic) cell counts
βOHB	beta-hydroxybutyrate
BoHV	bovine herpesvirus
BPS	bovine papular stomatitis
BPV	bovine papillomavirus
BRD	bovine respiratory disease
BSV, BRSV	bovine respiratory syncytial virus
BSE	bovine spongiform encephalopathy
BSP	bromsulphalein
BTEC	Brucellosis and Tuberculosis Eradication Campaign
BTM	bulk tank milk
BTV	bluetongue virus
BV	breeding values
BVD	bovine viral diarrhoea
BVDV	bovine viral diarrhoea virus
BVLWt	breeding value for liveweight
BW	Breeding Worth
Ca-EDTA	calcium disodium ethylenediamine tetra-acetate
CBC	complete blood count
CBPP	contagious bovine pleuropneumonia
CCN	cerebrocortical necrosis
CCP	corpus cavernosum penis
CCT	comparative cervical test
CFA	colonisation factor antigens
CFF	*Campylobacter fetus* subsp. *fetus*
CFT	caudal fold test
CFT	complement fixation test
CFU	colony forming units
CFV	*Campylobacter fetus* subsp. *venerealis*
CHF	congestive heart failure
CIDR	controlled internal drug release
CJD	Creutzfeldt-Jakob Disease
CK	creatinine kinase
CL	corpus luteum
C_{max}	concentration maximum
CMI	cell-mediated immune response
CMR	commercial milk replacer
CMT	California Mastitis Test
CN	cranial nerves
CNS	central nervous system
CNS	coagulase-negative *Staphylococcus* spp.
COD	cystic ovarian disease
COWP	copper oxide wire products
COX	cyclo-oxygenase
CP	crude protein
CR	conception rate
CSF	cerebrospinal fluid
CUM	creatinine-corrected urinary Mg concentration
CVCT	caudal or posterior vena cava thrombosis
DCAD	dietary cation-anion difference
DCT	dry cow treatment
DD	digital dermatitis
DDBSA	dodecyl benzene sulfonic acid
DFA	d-hydrofolic acid
DIC	disseminated intravascular coagulopathy
DIM	days-in-milk
DJD	degenerative joint disease
DM	dry matter
DMI	dry matter intake
DMSA	meso-2,3-dimercaptosuccinic acid
DUMP	deficiency of uridine monophosphate synthetase

EB	epidermolysis bullosa
EBL	enzootic bovine leukosis
eCG	equine chorionic gonadotrophin
ECP	oestradiol cypionate
ED1	ectodysplasmin gene
Edn	edition
ELISA	enzyme-linked immunosorbent assay
eNDF	effective neutral detergent fibre
EPAF	enteropathic adhesive factors
epg	eggs per gram
ε toxin	epsilon toxin
ET	embryo transfer
EV	economic values
FARAD	The Food Animal Residue Avoidance Databank
FAT	fluorescent antibody test
FEC	faecal egg count
FFA	free fatty acids
FIGLU	forminoglutamic acid
FMD	foot-and-mouth disease
FPT	failure of passive transfer
FSE	focal symmetrical encephalomalacia
FSH	follicle stimulating hormone
FTAI	fixed-time artificial insemination
g/h	grams per hour
GABA	gamma-aminobutyric acid
GDH, GLDH	glutamate dehydrogenase
GGT	gamma glutamyl transferase
GH	growth hormone
GHR	growth hormone receptors
GMA	glycerol monoacetate
GnRH	gonadotrophin releasing hormone
GPG	GnRH-prostaglandin-GnRH programme
GPX	glutathione peroxidases
GREP	Global Rinderpest Eradication Programme
Hb	haemoglobin
HCN	hydrogen cyanide
HE	haematoxylin and eosin
HGP	hormonal growth promotants
HMD	heat-mount detectors
HSS	hypertonic saline solution
IAA	indole-acetic acid
IBK	infectious bovine keratoconjunctivitis
IBR	infectious bovine rhinotracheitis
ICSCC	individual cow somatic cell counts
ICT	immunochromatographic test
ID	interdigital dermatitis
IDC	Investigation and Diagnostic Centre
IDH	L-iditol dehydrogenase
IFAT	indirect fluorescent antibody text
IFN-γ	interferon–gamma
Ig	Immunoglobulin
IgA	immunoglobulin A
IgE	immunoglobulin E
IGF-1	insulin-like growth factor 1
IgG	immunoglobulin G
IH	intermediate host
IHC	immunohistochemical, immunohistochemistry
IL	ineffective length (of teat-cup liner)
IMI	intramammary infection
iP	inorganic phosphorus
IPB	infectious pustular balanoposthitis
IPV	infectious pustular vulvovaginitis
ISF	interstitial fluid
ITEME	infectious thromboembolic meningoencephalitis
IVF	*in vitro* fertilisation
IVM	*in vitro* maturation
IVRA	intravenous regional anaesthesia
JHS	jejunal haemorrhage syndrome
LC	lactating cow intramammary formulation
LDA	left displaced abomasum
LDH	lactate dehydrogenase
LH	luteinising hormone
LIC	NZ Livestock Improvement Corporation
LMN	lower motor neuron
LPA	Livestock Production Assurance
LSD	lumpy skin disease
LWt	liveweight
LYST	lysosomal trafficking regulator
MAC	MacConkey agar
MAM	methylazoxymethanol
MAT	microscopic agglutination test
MCF	malignant catarrhal fever
MCH	mean corpuscular haemoglobin
MCHC	mean corpuscular haemoglobin concentration
MCV	mean corpuscular volume
MD	mucosal disease
ME	metabolisable energy
mEq/L	milliequivalents per litre
MetHB	methaemoglobin
MIC	minimum inhibitory concentration
MJME	megajoules of metabolisable energy
ML	macrocyclic lactones
MLA	Meat and Livestock Australia
MLWt	mature liveweight
MMA	methylmalonic acid
MMACoA	methylmalonyl-CoA
MMP	metallo-proteinases
MRP	maternal recognition of pregnancy
MRSA	methicillin-resistant *Staph. aureus*
MS	milksolids
MSA	mannitol salt agar
MSD	Mating Start Date (Australia)
NAGase	N-acetyl-ß-D-glucosaminidase
NAIT	National Animal Identification and Tracing project
NDF	neutral detergent fibre
NEFA	non-esterified fatty acids
NFC	non-fibre carbohydrates
NID	national identification of cattle
NIR	near infra-red
NLIS	National Livestock Identification Scheme
NMD	nutritional muscular dystrophy
NPMS	National Pest Management Strategy
NPN	non-protein nitrogen
NPV	negative predictive value
NRG	non-regenerative
NRR	non-return rate
NSAID	non-steroidal anti-inflammatory drug
NSC	non-structural carbohydrate

NVL	no visible lesion
NZVA	New Zealand Veterinary Association
OA	ocular albinism
OAA	oxaloacetic acid
OAD	once-a-day (milking)
OCA	oculocutaneous albinism
OCD	osteochondrosis dissecans
ODB	oestradiol benzoate
OIE	World Organisation for Animal Health
OR	odds ratio
OSCC	ocular squamous cell carcinoma
PABA	para-aminobenzoic acid
PAE	post-antibiotic effect
PBP	penicillin-binding protein
PCR	polymerase chain reaction
PCV	packed cell volume
PEM	polioencephalomalacia
PFGE	pulsed-field gel electrophoresis
$PGF_{2\alpha}$	prostaglandin $F_{2\alpha}$
PI	persistently infected
PI3	parainfluenza virus 3
P-insert	progesterone releasing insert
PMN	polymorphonuclear neutrophils
PPD	purified protein derivative
PPH	postparturient haemoglobinuria
PPV	positive predictive value
PRID	progesterone releasing intravaginal device
PrP	prion proteins
PSC	planned start of calving
PSDP	premature spiral deviation of the penis
PSM	Planned Start of Mating (New Zealand)
PSP	phenosulphophthalein
PTH	parathyroid hormone
PUFA	polyunsaturated fatty acids
QC	quality control
RAFGAR	Reference Advisory Group of Fermentative Acidosis of Ruminants
RAPD	random amplified polymorphic DNA
RBC	red blood cell
RDA	right displaced abomasum
RDF	rumen degradable fibre
RFID	radio frequency identification
RFM	retained fetal membranes
RG	regenerative
RGS	ryegrass staggers
RMT	Rapid Mastitis Test
RVF	Rift Valley fever
S/P	sample-to-positive ratio
SAMM	Seasonal Approach to Managing Mastitis
SARA	subacute rumen acidosis
SBE	sporadic bovine encephalomyelitis
SC	subcutaneously
SCC	somatic cell count
SDH	sorbitol dehydrogenase
SID	strong ion difference
SM	staphylococcal medium 110
SMCO	S-methyl L-cysteine sulphoxide
SOD	super-oxide dismutases
SPC	standard plate counts
SR	stocking rate
SR	submission rate
SWF	screw-worm fly
Tb	bovine tuberculosis
TBA	tryptose blood agar
TCA	tricarboxylic acid
TEC	teat-end callosity
TEME	thromboembolic meningoencephalitis
TeNT	tetanus neurotoxin, tetanospasmin
TG	triglyceride
THI	temperature heat index
TMA	trimethylamine
T_{max}	time at which concentration is reached
TME	thrombotic meningoencephalitis
TMR	total mixed rations
TPP	total plasma protein
TSE	transmissible spongiform encephalopathies
UMN	upper motor neuron
vCJD	variant Creutzfeldt-Jakob Disease
Vd	volume of distribution
VFA	volatile fatty acids
VLDL	very low density lipoprotein
VNT	virus neutralisation test
VRE	vancomycin-resistant enterococci
VS	vesicular stomatitis
w/v	weight per volume
WBC	white blood cell
WBCC	white blood cell count
WD	winter dysentery
WMD	white muscle disease