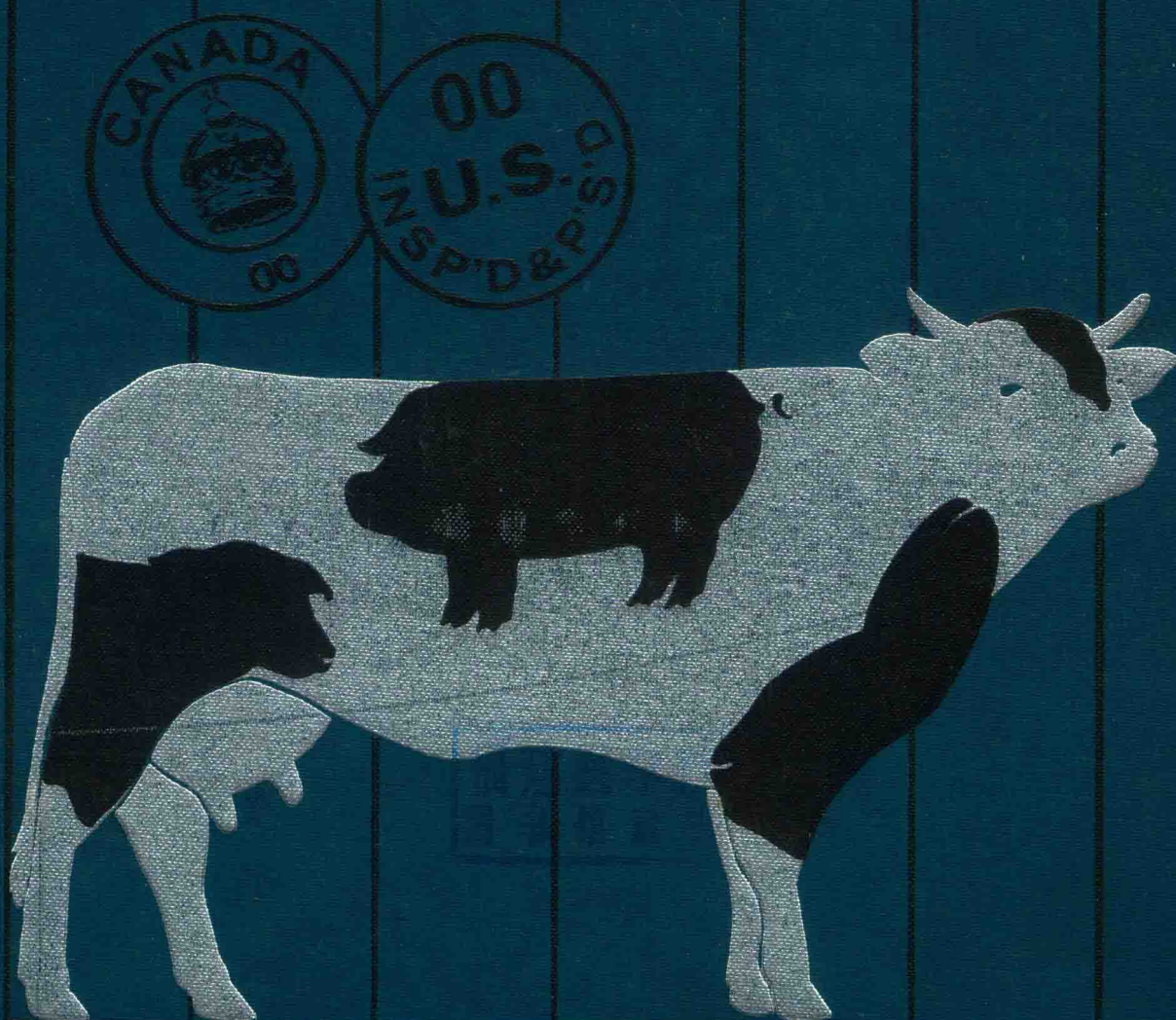


W723200

# Food Animal Pathology and Meat Hygiene



Herenda • Franco

# **Food Animal Pathology**

## **and Meat Hygiene**

**Drago Carl Herenda, D.V.M.**

Veterinary Inspector, Agriculture Canada  
Food Production and Inspection Branch  
Toronto, Ontario, Canada

**Don A. Franco,  
D.V.M., M.P.H., dipl.A.C.V.P.M.**

Director, Slaughter Operations Staff  
Inspection Management Program  
Inspection Operations  
U.S. Department of Agriculture  
Food Safety and Inspection Service  
Washington, D.C.

Antemortem (history), postmortem (gross), histologic, and bacteriologic examinations of 355 selected cases (646 illustrations) of food animal pathology in Canada and the United States (calves, cattle, swine, sheep, goats, horses, and rabbits).

**M Mosby  
Year Book**

St. Louis Baltimore Boston Chicago London Philadelphia Sydney Toronto

Copyright © 1991 by Mosby-Year Book, Inc.  
A B.C. Decker imprint of Mosby-Year Book, Inc.

Mosby-Year Book, Inc.  
11830 Westline Industrial Drive  
St. Louis, MO 63146

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Printed in the United States of America.

Permission to photocopy or reproduce solely for internal or personal use is permitted for libraries or other users registered with the Copyright Clearance Center, provided that the base fee of \$4.00 per chapter plus \$.10 per page is paid directly to the Copyright Clearance Center, 27 Congress Street, Salem, MA 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collected works, or for resale.

Library of Congress catalog card number: 90-84785

**NOTICE**

Disposition was in keeping with Canadian regulations. Opinions and conclusions in this publication are those of the authors and do not necessarily represent Agriculture Canada or the United States Department of Agriculture.

**Food Animal Pathology**

**and Meat Hygiene**



Dr. Herenda joined the federal government in October of 1969 and has been with the department since that time. Prior to 1969 he worked in large animal practice in Alberta. As a federal veterinarian in Meat Hygiene Operations, he has been in charge of many Ontario abattoirs. His main responsibility has been to assure safe and high quality meat and meat products for domestic and international trade. Dr. Herenda serves as a resource person in occasional conflicts with industry regarding the disposition of animals or carcasses. For the last few years he has been cross-utilized in Animal Health Operations for supervision and certifications of animals for export at Ontario stockyards. He is responsible for the maintenance of high standards of health in Canadian livestock and the protection of the general public against certain zoonoses.

Dr. Herenda was enrolled as a special non-degree student in graduate studies in courses of Pathology and Veterinary Immunology at OVC from 1986 to 1988. His special interest is food animal pathology. He has maintained membership in many professional and voluntary organizations.



Dr. Franco joined the United States Department of Agriculture in February of 1968. He has held numerous supervisory and staff positions; all his responsibilities have been related to food hygiene/pathology. He has received numerous agency and department awards during his career, culminating in the Department's Award for Superior Service "For notable authorship which has brought national and international recognition to the United States Department of Agriculture, Food Safety and Inspection Service," June, 1990.

Dr. Franco has over 30 peer-reviewed publications, most associated with the bacterial foodborne zoonoses. He has adjunct academic professional appointments at two medical institutions. Dr. Franco is Board Certified by the American College of Veterinary Preventive Medicine, and a member of the Examination Committee of this college. Presently he is the Director, Slaughter Operations Staff, Inspection Management Program, Inspection Operations, Washington, D.C.

## Foreword

I am extremely pleased the the authors of *Food Animal Pathology and Meat Hygiene* are representatives of both the Canadian and the United States Departments of Agriculture. A book of such depth and perspective is greatly needed and has long been awaited in the area of staff training and program delivery for regulatory and field veterinarians in both countries. I wish to express my sincere gratitude to the authors for a job well done. I have known the senior author, Dr. D. Herenda, since 1969 when he practiced in Alberta. He was always motivated and result-oriented and has been a great asset to our organization. I do believe that this book will brighten the role of the regulatory veterinarian and be extremely useful in his/her work. It will also respond to the needs of technical staff as well as the public. The book contains critical information needed for diagnosing pathologic conditions and evaluating the fitness of carcasses for food consumption. The description of cases with complete antemortem (history), postmortem (gross), and histologic and bacteriologic examinations is a new and refreshing challenge for veterinarians and inspectors engaged in meat inspection as well as for veterinarians in large animal practices. The illustrations of major lesions in numerous cases at certain points of slaughter, as well as the listing of tables of condemnations with seasonal prevalences for these lesions in Canada and the United States, make this book unique in many respects. Currently, there is no other book on the market addressing this concept. I personally believe that the end user will benefit from the more readily available and improved reference material to enhance the study of food animal pathology and the principles of meat inspection. The inclusion of chapters on exotic diseases, residues, food safety, as well as HACCP makes this book international in character. I hope that all personnel engaged in food safety will read this text and ensure they have a copy available in their private libraries as a valuable reference.

Dr. Gordon E. Dittberner  
Inspector General  
Operations Directorate  
Agriculture Canada

## Foreword

An enigma of the efficiency of advanced production and processing technology appears to be that meat and poultry inspection must now assume an increasing responsibility to control the pathogens that cause foodborne diseases. One would think that the microbiologic knowledge gained over the past several decades would have caused effective controls that would have significantly lowered the incidence of food transmitted infectious diseases. Instead the reverse seems to be true.

One should not take meat inspection for granted.

One should not take for granted the efforts required of the professionals who inspect.

One dare not take for granted the need for updating the medical knowledge and skills of inspection personnel if they are to fulfill their public health mission.

For decades there has been a desperate void in meaningful continuing medical education and in the availability of scientifically current textbooks that attempt to present new information or to refresh the medical knowledge of the valiant men and women who strive to keep the abundant supply of meat and poultry safe and wholesome.

With the publication of this textbook a void has been filled. The scope of this text is unparalleled in variety and number of pathologic conditions shown and discussed. Furthermore, its inclusion of discussions on microbiologic, environmental, and residue hazards as well as HACCP truly makes it up to date.

The authors must be highly commended for recognizing the need and then for providing the time and expertise required by this effort.

I sincerely hope that every veterinarian in the meat inspection field reads and digests this text.

Furthermore, I hope that agencies with meat inspection missions provide copies of *Food Animal Pathology and Meat Hygiene* to veterinarians. This is a critical need, and the results might prove to be extremely cost effective.

Edward L. Menning, D.V.M., M.P.H.  
Executive Vice President  
The National Association of  
Federal Veterinarians  
Washington, D.C.

## Preface

*Food Animal Pathology and Meat Hygiene* describes significant pathologic conditions of different species of food animals. Illustrated photographs of pathologic lesions are included to visually enhance details of food animal pathology observed during antemortem and postmortem inspection of food-producing animals in Canada and the United States.

In total, 355 cases with primary and systemic pathology are represented with 646 illustrations. The chapters are grouped in systems according to the most significant lesions of these systems. Mineral deposits and pigments, neoplasia, and parasitic conditions are recorded as separate chapters owing to their significance in meat inspection.

Special efforts were made to record all the lesions in individual animals on antemortem (history) and postmortem (gross) examinations. Histologic and bacteriologic examinations and disposition of the animal are also mentioned. This type of combined clinical and gross presentation has not been previously attempted in any other such book. It is hoped that this diversity will be of interest to veterinary food hygienists and veterinarians engaged in large animal practice. The book is also intended as a resource for veterinary students in pathology, food hygiene, clinical medicine, and regulatory veterinary medicine. Students in agricultural programs, at both the undergraduate and graduate levels, will also find this book of value in animal and food science and technology.

The reader should refer to standard texts of veterinary microbiology, immunology, pathology, and parasitology for more in depth coverage of the topics highlighted.

The majority of gross pathology photographs are of specimens found in selected Ontario establishments during a 3-year (1984–1986) survey. While the primary objective of the survey was to determine the prevalence of various pathologic conditions in food producing animals slaughtered in Ontario, imported United States animals were also included (Appendix 2, Table 8).

A total of 478 histologic and 66 microbiologic preparations on selected gross lesions were used to assist in the descriptive diagnosis on certain conditions.

The number and percentage of condemned carcasses by the CDA (Canadian Department of Agriculture) in all

Canadian establishments for the period 1984–1986 is recorded in tables in this book. The numbers of condemned portions and the percentages they represent are mentioned for some selected conditions only. Whenever possible, condemnation data from the United States Department of Agriculture (USDA) during the 3-year period (1983–1985) were presented for comparison.

Significant differences exist between Canadian and United States condemnation rates for certain diseases. The difference might not be solely due to disease incidence, but also in the veterinary approach and judgment criteria for certain diseases.

The disposition of carcasses and portions were made according to Canadian disposition criteria found in *Canadian*

*Meat Inspection Regulations (CMIR)* and *Canadian Meat Hygiene Manual of Procedures (MHMP)*. Other references included the *United States Meat Inspection Regulations (USMIR)* and the *Manual of Veterinary Meat Inspection Disposition Guideline (VMIDG)*, and “Draft International Code of Practice for Ante-mortem and Post-mortem Judgement of Slaughter Animal and Meat,” published in 1976 by the Codex Alimentarius Commission (CA) of the Joint FAO/WHO Food Standard Programme.

The animals referred to as “suspect” throughout the book were held on antemortem examination. Complete clinical examination were performed and temperatures were taken. Animals were slaughtered at the end of the killing operation of the abattoir and also thoroughly examined on postmortem.

## Acknowledgments

The authors wish to acknowledge many colleagues and friends who have assisted in the preparation of this book.

We are particularly thankful to Dr. Patrick C. Mc Caskey, Director, Pathology and Serology Division, USDA, FSIS, Science, for his critical review of all chapters and his expert preparation of the photomicrographs.

We are also especially grateful to Dr. T.W. Dukes, Animal Disease Research Institute, Nepean, Ontario, for his professional and technical assistance in the preparation of the chapters. His willingness to discuss various aspects of this textbook and to share his knowledge were most helpful.

The staff of the Animal Diseases Research Institute for technical and bacteriologic assistance. Our grateful thanks are further extended to Dr. Tom Feltmate, Chief, Epidemiology, Meat Hygiene Division, for his fine comments in reviewing the manuscript and interpretation of statistical data.

Dr. R. M. Elias, Department of Pathology and Surgery, Medical Sciences Building, University of Toronto, was kind enough to assist us in the preparation of Chapter 3 as well as graphs for the seasonal condemnation of carcasses.

Our special thanks to Dr. R. Thomson, Dean, Atlantic Veterinary College, for his encouragement and for his professional comments on chapters in the early part of this book.

Our gratitude is also extended to Dr. R. Miller, Chair of the Department of Pathology, Ontario Veterinary College and members of his staff for their willingness to discuss various topics of food animal pathology and for the permission to use a number of their Departmental slides.

Dr. P.B. Little of Ontario Veterinary College was most helpful with his comments regarding the nervous system and Dr. R. Foster, also of Ontario Veterinary College, assisted in reviewing pathologic conditions of mutual interest.

Thanks to Dr. R.M. Tremblay, Department of Clinical Studies, Ontario Veterinary College, for his comments regarding antemortem (history) of some selected cases.

Particular thanks go to Dr. A. Muallim of Agriculture Canada for his enthusiasm and encouragement from the very beginning of this project.

The authors acknowledge appreciation to Drs. G.E. Dittberner, Inspector General, Operations Directorate, Agriculture Canada and E.L. Menning, Executive Vice-President of the United States National Association of Federal Veterinarians for their encouragement. Credit is extended to meat inspection personnel for their assistance in the collection of specimens and to the management of many meat packing companies for providing facilities in which the examination of pathologic material was made possible.

Dr. P. Masztis, Weston Veterinary Clinic, kindly permitted us the use of a selected number of his slides (3-23A, 8-17, 15-32A, 15-32B, 15-32C, and 15-32D).

We further acknowledge the *Codex Alimentarius Commission*, FAO/WHO, Draft International Code of Practice for Ante-mortem and Post-mortem Judgement of Slaughter Animal and Meat, Alinorm 83/32 Add. 1. (Rev. 1); the United States Department of Agriculture for the following illustrations: 1-5C, 2-5C, 2-8B, 2-11C, 3-2B, 3-7B, 3-14B, 3-21B, 4-6B, 7-1C, 7-9C, 8-1C, 9-1C, 11-28C, 11-29A, 13-4C, 14-2B, 15-8C, 15-9E, 15-10D, 15-15B, 15-31H, 16-3C, 16-7B, 16-32H, 17-1A, 17-4B, 17-6A, 17-9A, 17-18B, 18-

1A, 18-2A, 18-2B, 18-3A, 18-3B, 18-3C, 18-4B, 18-4C, 18-4D, 18-5A, 18-5B, 18-6A, 18-6B, 18-7A, 18-7B, 19-18A; and the Canadian Department of Agriculture for the following illustrations: 11-23A, 11-23B; and the *Canadian Veterinary Journal* for the following illustrations 3-9,A; 3-16,A; 4-3,A; 8-21,A; 8-32,A; 16-11,A; 19-14,A; and 19-14,B.

The completion of this book would not have been possible without the support, encouragement, and understanding of my wife Olga F. Herenda and my two wonderful children Allan and Vanessa.

My wife's proofreading ability, her assistance in organizing the chapters, and her background in the teaching of nursing have been valid contributions to this book. My son Allan has helped me in mastering computer skills. Vanessa's spirit has brightened many a dull, exasperating moment.

Finally, Mr. Walter S. Bailey of B.C. Decker Inc. is to be commended for his initiative in combining efforts to have this long, overdue North American book represented by authors of both Canadian and United States Departments of Agriculture. Thanks are also due to the staff of B.C. Decker Inc., particularly the Editor, Gillian Beechey.

## Contents

### 1 Cardiovascular system

- Traumatic pericarditis, 3
- Porcine chronic pericarditis, 4
- Bacterial septicemia secondary to endocarditis, 5
- Valvular endocarditis, 7
- Mycotic valvular endocarditis, 8
- Epicardial fibrosis, 8

### 2 Respiratory system

- Suppurative frontal sinusitis, 14
- Acute hemorrhagic tracheitis, 14
- Bronchopneumonia, 15
- Chronic diffuse pneumonia with marked lymph node hyperplasia, 16
- Fibrinous pneumonia in a steer, 17
- Pneumonia with emphysema, 18
- Enzootic (mycoplasmal) pneumonia in a pig, 18
- Chronic purulent pneumonia with abscessation, 19
- Porcine pleuropneumonia, 20
- Chronic mycotic pneumonia, 20
- Bronchopneumonia with abscessation, 21
- Pulmonary abscessation, 22
- Chronic pneumonia with abscessation in a rabbit, 23
- Ovine progressive (interstitial) pneumonia (maedi, maedi-visna), 23
- Chronic obstructive pulmonary disease (COPD) in a horse, 24
- Aspiration pneumonia, 24
- Pulmonary emphysema, 24
- Endocardial and pulmonary hemorrhage and edema, 25
- Aspiration of scalding hot water into the lungs of swine, 25
- Acute pleuritis, 26
- Fibrinous pleuritis, 27
- Chronic suppurative pleuritis, 27

**3 Hemopoietic system**

- Moderate anemia of unknown cause, 34
- Lymphadenitis and lymphoid hyperplasia, 34
- Focal granulomatous lymphadenitis, 35
- Granulomatous lymphadenitis, 35
- Mycotic lymphadenitis, 35
- Focal mycotic lymphadenitis, 36
- Eosinophilic lymphadenitis with abscessation, 36
- Lymph node abscess, 37
- Chronic abscessation of lymph node, 37
- Lymphadenitis, muscular fibrosis, and arthritis, 38
- Lymphedema and muscular degeneration, 39
- Hemorrhage and vascular thrombosis of lymph nodes, 40
- Lymphoid hyperplasia, 40
- Chronic lymph node hyperplasia and associated nephritis, 41
- Hyperplasia of hemal lymph nodes, 41
- Lymphangiectasia, 42
- Mesenteric lymph node emphysema and simple indigestion, 42
- Tattoo pigment in a lymph node, 43
- Partial duplication of retropharyngeal lymph nodes, 43
- Splenic abscesses, 44
- Splenic abscessation, 44
- Splenic anomaly, 45

**4 Endocrine system**

- Adrenal gland hemorrhage associated with ketosis, 48
- Adrenal cortical hyperplasia, 48
- Hyperplastic goiter, 49
- Melanosis of the adrenal gland, 49
- Adrenal hypertrophy, 50
- Adrenal amyloidosis, 50

**5 Digestive system**

- Stomatitis, 55
- Phytobezoar, 55
- Chronic ulcerative glossitis and stomatitis, 56
- Necrotic glossitis, 57
- Wart, 57
- Fibrous dysplasia, 58
- Esophageal obstruction, 59
- Chronic fibrinous peritonitis, 59
- Chronic peritonitis, 60
- Fibrinonecrotic peritonitis, 60
- Chronic purulent peritonitis, 61
- Chronic peritonitis with abscessation, 61
- Mycotic enteritis, 62
- Gastric ulcer in a sow, 62
- Hyperkeratosis of rumen, 62
- Abomasal volvulus, 63

- Omasal impaction, 64
- Abomasal impaction with sand, 64
- Abdominal hernia, 64
- Inguinal hernia and hematoma, 65
- Intestinal emphysema (pneumoenteritis), 65
- Pendulous lipoma with fat necrosis, 65
- Umbilical cysts, 66
- Prolapse of rectum, 66

**6 Pancreas**

- Pancreatic calculi, 68
- Chronic pancreatic abscess, 68
- Chronic pancreatitis with fibrosis and cyst formation, 69
- Nodular hyperplasia of pancreas, 69
- Chronic pancreatitis in an aged animal, 70

**7 Liver and biliary system**

- Fatty liver syndrome, 72
- Tension lipidosis, 73
- Hepatic necrosis (sawdust liver) in a cow, 73
- Telangiectasis, 73
- Chronic hepatic fibrosis, 74
- Hepatic nodular hyperplasia with fibrosis, 74
- Nodular hyperplasia with fibrosis, 75
- Necrobacillosis, 75
- Abscesses in the liver, myocardium, and carcass, 76
- Hepatic abscesses, 76
- Biliary hyperplasia and cholelithiasis, 77
- Choleliths, 77
- Chronic cholangitis and cholecystitis, 78
- Distention of a gallbladder, 79
- Congenital hepatic cyst, 79

**8 Urinary system**

- Chronic pyelonephritis, 84
- Chronic pyelonephritis associated with emaciation, 85
- Renal infarcts, 85
- Chronic nephritis, 86
- Chronic nephritis (white spotted kidney), 86, 87
- Chronic glomerulonephritis, 87
- Glomerulonephritis, 88
- Chronic interstitial nephritis, 88
- Interstitial nephritis, 89
- Focal interstitial nephritis, 89
- Renal infarct, 90
- Renal amyloidosis and interstitial nephritis, 90
- Renal amyloidosis, 91
- Fatty degeneration, 91
- Perirenal fat necrosis, 91
- Renal cysts, 92
- Hydronephrosis, 92, 93
- Distended urinary bladder in a "downer" cow, 94

Chronic proliferative cystitis, 94  
 Hemorrhagic and necrotic cystitis, 95  
 Cystitis, vaginitis, and metritis in an aged cow, 96  
 Uroliths, 96  
 Pyelonephritis with urolithiasis, 97  
 Chronic glomerulonephritis and urolithiasis, 97  
 Chronic cystitis, 98  
 Hemorrhagic cystitis with urolithiasis and nephritis, 98  
 Chronic cystitis with urolithiasis, 99  
 Urachal remnant, 99  
 Abscess of the bladder diverticulum, 100

## 9 Genital system

Staphylococcal mastitis, 104  
 Coliform mastitis, 104  
 Chronic purulent mastitis, 105  
 Chronic mastitis, 105  
 Traumatic mastitis, 106  
 Chronic necrotic mastitis, 107  
 Endometritis, 107  
 Severe subacute endometritis, 108  
 Pyometra, 108  
 Pyometra and salpingitis, 109  
 Chronic endometritis and edema, 110  
 Gangrene of the uterus with fetal maceration, 110  
 Maceration of the fetus and chronic endometritis, 111  
 Fetal mummification, 111  
 Prolapsed uterus, 111  
 Luteal cyst, 112  
 Hydrosalpinx and paraovarian cyst, 112  
 Duplication of the cervix (uterus didelphys), 112  
 Congenital segmental aplasia of female genitalia, 113  
 Congenital uterine anomaly and mucometra, 113  
 Hermaphrodite, 113  
 Scrotal abscess in a bull, 114  
 Penile hematoma, 114  
 Seminal vesiculitis in a pig, 114  
 Posthitis in a pig, 115  
 Placentitis in a heifer, 115

## 10 Nervous system

Hydrocephalus, 122  
 Traumatic brain injury, 123  
 Brain abscess, 124, 125  
 Acute purulent meningoencephalitis, 125  
 Thromboembolic meningoencephalitis and spinal meningitis, 126

## 11 Musculoskeletal system

Fibrinopurulent arthritis, 132

Chronic arthritis, 133  
 Arthropathy (osteoarthritis), 133  
 Fibrinous arthritis, 134  
 Chronic arthritis, 135  
 Hip dysplasia in a market pig, 136  
 Chronic arthritis, 137  
 Cartilage degeneration, 137  
 Ankylosing spondylitis, 138  
 Fractured callus, 138  
 Chronic arthritis, 139  
 Arthrogryposis (curly calves, bow legged calves, crooked calf disease, acorn calf), 140  
 Hygroma of tarsal joints, 141  
 Polydactylia, 141  
 Cleft palate and brachygnathia, 142  
 Muscular necrosis with cellulitis, 142  
 Extensive bruises, 143  
 Extensive subcutaneous hemorrhage due to trauma, 143  
 Fractured spine, 144  
 Fractured tibia, 144  
 Porcine stress syndrome (PSS), 145  
 Pale soft exudative pork (PSE), 145, 146  
 Steatosis in a steer (lipomatous muscular dystrophy), 147  
 Nutritional myopathy (muscular dystrophy), 147  
 Ischemic skeletal muscle necrosis, 148  
 Eosinophilic myositis, 149  
 "Aspergillus" in the bovine diaphragm, 150

## 12 Mineral deposits and pigments

Melanism, 155  
 Traumatic hemorrhage versus melanosis, 156  
 Pulmonary and esophageal melanosis, 156  
 Hepatic melanosis, 157  
 Melanism of ligamentum nuchae, 157  
 Melanism of the mammary tissue (seedy belly), 157  
 Myocardial lipofuscinosis (brown atrophy of the heart, xanthosis), 158  
 Hepatic lipofuscinosis, 158  
 Renal lipofuscinosis, 158  
 Congenital porphyria (osteohemochromatosis, pink tooth), 159  
 Jaundice (icterus) in a ewe, 160  
 Icterus (jaundice) in a market hog, 161  
 Icterus (jaundice) in a cow, 162  
 Endocardial mineralization, 163  
 Arteriosclerosis, 163  
 Presternal calcification, 163  
 Ossification of the peritoneal scar in a pig, 164

## 13 Organs of special sense

Perforated corneal ulcer with protrusion of the iris, 166  
 Infectious keratoconjunctivitis (pinkeye), 167

Infectious bovine keratoconjunctivitis (pinkeye), 167

Keratoconjunctivitis in a goat (caprine contagious ophthalmia, pinkeye), 168

Keratoconjunctivitis in a ewe (ovine contagious ophthalmia, pinkeye), 169

Ocular albinism, 169

Corneal dermoid, 170

Keratoconus and corneal ulcer, 170

Purulent endophthalmitis, 171

Hyphema, 172

Cataract, 172

#### 14 Skin and appendages

Hyperkeratosis with melanosis, 174

Dermatomycosis ("ring worm") in a calf, 175

General alopecia, 175

Epidermal inclusion cysts (shotty eruption, sooty mange), 176

Dermatomycosis and shearing wounds in a ewe, 177

Pityriasis rosea, 177

Contact dermatitis, 178

Erythema, 178

Overscalded hog carcass, 179

Accidental cooking of a hog carcass, 179

#### 15 Neoplasia

Fibropapilloma, 184

Adenoma of the gallbladder, 185

Invasive transitional cell carcinoma, 185

Squamous cell carcinoma, 186-188

Bile duct carcinoma, 189, 190

Hepatic adenocarcinoma, 190

Metastatic adenocarcinoma of the uterus, 191

Adrenal cortical tumor, 191

Adrenal cortical carcinoma, 192

Fibroma in an ovary of a ewe, 192

Fibroma in the umbilicus of a cow, 193

Fibrosarcoma, 193

Fibromyxoma, 194

Adamantinoma, 194

Hemangioma, 195

Leiomyoma, 195

Rhabdomyosarcoma, 196

Mesothelioma, 196

Lymphoma in a calf, 197, 198

Thymic lymphoma, 199

Thymic lymphoma with metastasis, 200

Thymoma, 200

Lymphoma (lymphosarcoma), 200

Lymphoma in mature animal (enzootic bovine leucosis), 201, 202

Neurofibroma (schwannoma, neurilemoma, neurolemoma, nerve sheath tumor), 205

Neurofibrosarcoma, 206, 207

Pheochromocytoma, 208

Dermal melanoma, 208

Malignant melanoma, 209

Nephroblastoma (embryonal nephroma), 209

Granulosa cell tumor, 210

Renal hamartoma, 210

Cystadenoma, 211

Papillary cystadenoma, 211

#### 16 Viral, bacterial, and fungal diseases and miscellaneous conditions

Diamond skin disease (erysipelas), 222

Atrophic rhinitis, 223

Actinobacillosis, 223

Actinobacillosis with bronchopneumonia, 224

Actinomycosis, 225-227

Calcified granuloma, 227

Bovine tuberculosis, 228

Porcine mycobacteriosis, 228-230

Johne's disease, 230

Caseous lymphadenitis, 231

Caseous lymphadenitis with pneumonia, 232

Bovine viral diarrhea, 232, 233

Black leg (black quarter), 233

Emaciation, 235, 236

Edema, 236

Edema and anemia, 238

Multiple abscesses, 239-242

Scrotal abscess, 242

Multiple abscess with associated toxemia, 243

Multiple abscesses, 244

Significant findings of septicemia and toxemia, 245-247

#### 17 Parasitic diseases

*Oestrus ovis*, 249

*Hypoderma bovis*, 250

Coccidiosis in a rabbit, 251

Sarcosporidiosis, 252

*Fasciola hepatica*, 253

*Fascioloides magna*, 254, 255

*Dicrocoelium dendriticum* ("lancet fluke"), 256

*Moniezia benedeni*, 257

*Thysanosoma actinoides*, 258

*Cysticercus tenuicollis*, 259

*Cysticercus bovis*, 260

Strongylosis, 261

*Muellerius capillaris*, 262

*Oesophagostomum columbianum* ("pimply gut"), 263

*Oesophagostomum radiatum*, 263

*Ascaris suum* lesions in pig liver, 264

*Ascaris suum* infestation, 264

Onchocerciasis in a horse, 265

Parasitic cystitis, 266

#### 18 Foreign animal diseases

African swine fever (ASF), 268

Hog cholera (HC), 269  
 Foot and mouth disease (FMD), 268-269  
 Rinderpest (RP) (cattle plague), 272  
 Malignant catarrhal fever (MCF), 273  
 Sheep pox (SP), 274  
 Bluetongue (BT), catarrhal fever of sheep  
 ("soremuzzle disease"), 275

## 19 Hazards of meat

Pulmonary hemorrhage, 281  
 Agonal hemorrhage of the cardiac muscle, 281  
 Pulmonary and cardiac hemorrhage in a  
 ewe, 282  
 Meat spoilage, 283  
 Bone taint, 284  
 Meat mold, 285  
 Contamination of meat cut with grease, 285  
 Contamination of carcass with pus, 286  
 Fly larvae on cured pork meat product, 286  
 Mold on pepperoni, 287

Iridescence of corned beef (silver shine), 287  
 Postmortem meat color change, 288  
 Recent parturition, 288  
 Cystic ovarian follicle and mucometra, 289  
 Illegal implantation of an anabolic drug, 289  
 Injection site, 290  
 Tetracycline residues in meat, 291  
 Growth promotant hormonal drug, 291

## 20 Food safety: implications for public health

History of slaughter hygiene, 293  
 Slaughter hygiene, 294  
 Principles of animal and carcass disposition,  
 294  
 Animal disease surveillance, 295

## 21 Hazard analysis and critical control points

Live animal in an unhygienic state, 298  
 Head contamination, 299  
 Carcass contamination, 299