Table of contents

Acknowledgements xiii

Preface to the Third Edition xiv

About the Companion Website xvi

Part I How the Cow Works 1

1 Introduction - The Dairy Cow of Today 3

Milk as Food 6

Nutrient Supply 7

Healthy Digestion 8

Taste and Appetite 9

Do no Harm 9

Biological Efficiency of Milk Production 10

Milk Production: Species and Breed Comparisons 11

Efficiency of Feed Conversion to Milk, Eggs and Meat: Competitive and Complementary Feeds 12

Behaviour and Welfare 14

2 Digestion and Metabolism 18

Structure of the Digestive Tract 18

Eating and Rumination 22

Grazing 22

Salivation 23

Rumen Movements 23

Rumination 25

Digestion 26

Fermentation of Carbohydrates in the Rumen 28

Utilization of Metabolizable Energy for Maintenance and Production 31 Digestion of Crude Protein 32 Microbial Protein Synthesis 35 Truly Absorbed Amino Nitrogen 37 Urea Recycling 38 Digestion of Lipids 38 Absorption and Secretion of Minerals 39 Calcium Exchange 41 Appetite and Food Intake 42 3 Reproduction and Lactation 45 Anatomy of the Female Reproductive Tract 45 Follicle Development and Ovulation 45 The Oestrus Cycle 49 Puberty 49 Fertilisation 50 Pregnancy 51 Placental Transfer and Foetal Nutrition 53 Parturition 53 Dystocia 55 Lactation 56 Anatomy of the Udder 56 Milk Yield 58 Extended Lactations 59

Hormonal Control of Lactation 60

Reproduction in the Male 61

4 Environment, Behaviour and Welfare 64

Environmental Needs 64

Behaviour 65

Physical Comfort 66

Thermal Comfort 68

Sensible Heat Loss 68

Evaporative Heat Loss 69

Metabolic Heat Production 71

Climate, Production and Welfare 73

Tropical Climates 73

Cold Climates 74

Security and Social Behaviour 74

Sexual and Maternal Behaviour 75

Behaviour as an Indicator of Welfare 76

Part II Feeding the Dairy Cow 77

5 Nutrition: Supply and Demand 79

Nutrient Requirements and Responses 81

Nutrient Allowances for the Lactating Cow 84

Mineral Requirements 88

Nutritive Value of Feeds 90

Ration Formulation 93

Prediction of Food Intake 93

Assessment of an Existing Ration 94

Feeding Plans for Dairy Cows 95

Inputs 95

Outputs 96

Allowances for Growing Heifers 97

6 Feeds and Feeding Strategies 99

Pasture 100

Grazing Strategies 102

Legumes 104

Grass Silage 104

Dry Matter 105

Metabolisable Energy 106

Protein 106

Silage Additives 107

Hay 107

Straw 108

Ensiled Whole-crop Cereals 108

Other Green Feeds 109

Root Crops 109

Cereals 109

By-products 111

Oilseed Cakes and Meals 111

Miscellaneous By-products 113

Sugar Beet Pulp 113

Maize Gluten 113

Brewers' and Distillers' Grains 114

Wheat Bran 114

Balancing Forages and Concentrates 114

Feeding Strategies 117 Feeding to Yield 117 Total Mixed Rations and Flat Rate Feeding 119 7 Feeding Problems and Metabolic Diseases 121 Feeding Problems 123 Rumen Acidosis 123 Abomasal Disorders 125 Bloat 126 Metabolic Disorders 127 Ketosis 127 Prevention and Treatment 129 Parturient Hypocalcaemia ('Milk Fever') 130 Prevention and Treatment 131 The Downer Cow 132 Hypomagnesaemic Tetany (Grass Staggers) 133 Prevention and Treatment 135 Other Mineral Deficiencies 136 Phosphorus 136 Copper and Molybdenum 137 Cobalt 138 Selenium 138 Vitamin Deficiencies 139 Vitamin A 139

Vitamin D 140

Vitamin E 140

Last Words on Minerals and Vitamins 141

Part III Housing Health and Management 143

8 Healthy and Humane Housing and Handling 145

Accommodation 145

The Cow House 146

Cubicle Design 150

The Cubicle Bed 153

Passageways 154

Calving and Isolation Boxes 154

Heifer Yards 156

Handling Facilities 156

Lameness 157

Conditions that Cause Lameness 159

Sole Haemorrhage and Sole Ulcers 159

White Line Disease 161

Digital Dermatitis 161

Interdigital Necrobacillosis 'Foul' 162

Aseptic Laminitis, 'Founder' 162

Risk Factors for Lameness 162

Transport and Slaughter 164

Loading and Unloading 164

The Journey 165

A Gentle Death 166

9 Milking and Mastitis 168

The Milking Machine 171

The Milking Parlour 174

Hygiene in the Milking Parlour 174

Mastitis 175

Indicators of Mastitis 176

Contagious Mastitis 177

Environmental Mastitis 178

Summer Mastitis 180

Dry Cow Therapy 181

10 Miscellaneous Maladies 182

Signs of Disease 183

Sudden Death 183

Drooling 185

Abdominal Symptoms 186

Nervous Symptoms 187

Fever 187

Inappetence and Anorexia 188

Notifiable Diseases 189

Bovine Tuberculosis 191

Foot and Mouth Disease 192

Other Infectious Diseases 193

Bovine Viral Diarrhoea (BVD) 193

Johne's Disease 194

Salmonellosis 194

Leptospirosis 195

Parasitic Diseases 195

Part IV Breeding and Fertility 197

11 Breeding 199

Selection Criteria 202

Genomic Selection 206

Sexed Semen 206

Cow Selection 207

Beef Bulls 209

12 Fertility 211

Fertility Management 212

Behaviour at Oestrus 212

Aids to Oestrus Detection 213

Synchronisation of Oestrus 216

Time of Insemination 217

Pregnancy Diagnosis 217

Rebreeding 219

Infertility 219

Ovarian Dysfunction 220

Uterine Disorders 221

Retained Placenta 221

Endometritis 222

Early Foetal Death 222

Abortion 223

Nutrition and Infertility 223

Condition Score at Calving? 225

Condition Score at the Time for Rebreeding? 225

Milk Yields in Early and Mid-lactation? 225

How Well Does Nutrient Supply Match Requirements? 226

Transition Management 226

Part V Cows, People and the Environment 229

13 Cows, People and the Living Environment 231

Most of Those who can Consume Too Much Meat and Milk 232

Food We Could Eat is Fed to Animals While the Poor Grow Hungry 233

Intensive Livestock Production is Incompatible with Animal Welfare 233

Livestock's Long Shadow is Destroying the Planet 235

Methane Production and Climate Change 237

Pollution from Dairy Units 238

Alternative Husbandry Systems 240

Organic Dairy Farming 240

Traditional and Village Systems 241

Fair Play for Cows, People and the Planet 242

Herd Health and Welfare 242

Herd Health Management 243

Animal Welfare: Quality Assurance and Quality Control 243

Further Reading 247

Index 252