

A TEXT-BOOK
ON
INDIAN AGRICULTURE.

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GENERALLY

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SUBJECT INDEX

- Abortion, infectious, 255
- Acid-base equilibria, 117-130
 - effect of heat, 125
 - references, 134
- Acid curds, 211
- Acidity, changes during growth of bacteria, 305
 - effect on churning of cream, 185
 - cream whipping, 181
 - rennet coagulation, 207
 - overrun of ice cream, 234
- Acidophilus milk, 324
- Acids, fatty, 65
- Acrostalagmus, see key, 395
- Actinomyces farcinicus, in udder, 258
 - necrophorus, in udder, 258
- Actinomycetes, see key, 395
 - characteristics, 387
 - in dairy products, 387
 - effect on milk flavor, 393
 - in udder, 258
- Aerobacter aerogenes (see also Bacillus aerogenes, Bacterium aerogenes and Bacterium lactis aerogenes)
 - fermentation of citrates, 284
 - lactic acid production, 280
 - limiting hydrogen ion concentration, 339
 - proteolysis by, 291
 - thermal death point, 367
 - cloacae (see also Bacterium cloacae)
 - fermentation of citrates, 284
- Aerobiosis, 295
- Agglutination, by heat, 188
- Agglutinins, in colostrum, 417
- Aggregation, fat globules, 160
- Aging, effect on cream whipping, 178, 180
 - viscosity of ice cream, 230
- Albumin (see also lactalbumin)
 - ice cream, effect of overrun, 234
- Alcaligenes abortus (see also Bacillus abortus and Brucella abortus)
 - in udder, 252
- albus, proteolysis by, 292
- fecalis, source, 243
- melitensis (see also Brucella melitensis)
 - in udder, 252
- Alcohol, coagulation, (see coagulation, alcohol)
 - test, 194
- Alcoholic fermentation, 283
- Alternaria, see key, 395
 - in butter, 393
- Amino acids, in casein, 44
 - lactalbumin, 60
 - nutritional value, 408, 411
 - nitrogen, in milk, 24
- Ammonia, in milk, 23
- Anaerobiosis, 295
- Anemia, relation to feeding of milk, 427
- Annatto, butter color, 100
- Anthrax, transmission to milk, 258
- Antibodies, in colostrum, 417
- Ash, of milk, 20
- Aspergilli, see key, 395
- Asses' milk, composition, 17
- Bacilli, resistance to heat, 312
- Bacillus abortus (see also Brucella abortus and Alcaligenes abortus)
 - agglutinins in blood, 419
 - acidi-lactici (see also Streptococcus lactis)
 - lactase production, 274
 - aerogenes (see also Aerobacter aerogenes, Bacterium aerogenes and Bacterium lactis aerogenes)
 - proteolysis by, 291
 - albolactis, proteolysis by, 293
 - amylobacter (see also Clostridium butyricum)
 - butyric acid production, 282
 - anthracis, source, 244
 - sporulation, 313
 - bulgaricus (see also Lactobacillus bulgaricus)
 - lactase production, 274
 - pH effect, 338
 - casein & lactic acid production, 278, 279
 - cereus, proteolysis by, 293
 - coli (see also Bacterium coli, Bacterium coli commune, Bacillus coli communis and Escherichia coli)
 - destruction by electricity, 375
 - pH effect, 338

- Bacillus coli*, protection against, by colostrum, 419
 proteolysis by, 291
communis (see also *Bacterium coli*, *Bacterium coli commune*, *Bacillus coli* and *Escherichia coli*), 360
 lactic acid production, 280
 proteolysis by, 291
 in udder, 258
diphtheriae (see also *Corynebacterium diphtheriae*)
 pH effect, 338
enteriditis sporogenes, in milk powder, 381
fluorescens, lipase secretion, 286
liquefaciens (see also *Pseudomonas fluorescens*)
 fat-splitting by, 286
indicus, lipase secretion, 286
mesentericus, fermentation of citrates, 284
 lipase secretion, 286
 proteolysis by, 294
mycoides, proteolysis by, 294
 sporulation, 315
neapolitanus, 360
paratyphosus A (see also *Salmonella paratyphi*), 266
prodigiosus (see also *Serratia marcescens*)
 lipase secretion, 286
proteus (see also *Proteus vulgaris*)
 lipase secretion, 286
 pH effect, 338
putrificus, lipase secretion, 286
pyocyaneus (see also *Bacterium pyocyaneum* and *Pseudomonas aeruginosa*)
 lipase secretion, 286
 proteolysis by, 292
ruber, lipase secretion, 286
stutzeri, lipase secretion, 286
subtilis, effect of pressure, 374
 fermentation of citrates, 284
 pH effect, 338
 proteolysis by, 290, 293
 source, 242
 spores, agglutination of, 312
tuberculosis (see also *Mycobacterium tuberculosis*)
 destruction by electricity, 374
 in milk powder, 381
 survival in acid media, 339
typhosus (see also *Eberthella typhi*)
 pH effect, 338
vulgatus, proteolysis by, 293
Bacteria, acid-forming, 350
 proteolysis by, 290
 alkali-forming, optimum temperature, 349
Bacteria, alkali-forming, proteolysis by, 291, 292
 surviving pasteurization, 362
 in butter deterioration, 327
 counts, 304
 destruction, by heat, 351
 distribution, 261-269
 references, 269
 fluorescent, proteolysis by, 292
 gas-forming, optimum temperature, 350
 growth, 271-336
 changes in acidity, 305
 curves, 302
 death phase, 310
 effect of carbon dioxide, 381
 chemical factors, 337-385
 desiccation, 380
 electricity, 374
 freezing, 341
 low temperature, 341
 nutritional level, 306
 osmotic pressure, 376
 pH, 337-340
 physical factors, 337-385
 preservatives, 382
 pressure, 373
 salts, 378
 symbiosis, 307
 surface tension, 379
 temperature, 306, 340-373
 ultraviolet light, 375
 on pH, 305, 338
 in foam, 364
 lag phase, 307
 logarithmic phase, 308
 morphological changes, 303
 optimum temperature, 343
 pasteurized milk, 365
 phases, 302-312
 physiological changes, 303
 references, 334, 383
 resting phase, 309
 thermal death point, 351
 intestinal, in milk, 247
 metabolism, 271-336
 products, 316-334
 references, 334
 nitrogen sources for, 289
 nutrition, 272
 oxygen requirements, 295-298
 pathogenic, dissemination, 261-269
 optimum temperature, 348
 source, 243
 peptonizing, surviving pasteurization, 362
 pigment formation, 322
 from plants, 244
 reducing abilities, 298
 reduction potentials, 301
 rennet-forming, proteolysis, 291

- Bacteria, from soil, 242**
sources, 241-261
references, 269
spore-forming, proteolysis by, 293
sporulation, 312-316
surviving pasteurization, 354
synthesis of fat, 286
thermophilic, 368
optimum temperature, 351
source, 243
udder, 249-261
- Bacterium acidii propionici, propionic acid production, 281**
symbiosis, 307
- aerogenes (see also Aerobacter aerogenes, Bacillus aerogenes and Bacterium lactis aerogenes), 244**
source, 244
casei, proteolysis by, 290
cloacae (see also Aerobacter cloacae) proteolysis by, 291
coli (see also Bacterium coli commune, Bacillus coli, Bacillus coli communis and Escherichia coli)
acid formation, 305
lactase production, 274
lactic acid production, 279, 280, 281
limiting pH, 308
multiplication, 306
physiological changes, 303
physiology of lag, 307
proteolysis by, 291
salt effects, 274, 378
commune (see also Bacterium coli, Bacillus coli, Bacillus coli communis and Escherichia coli)
effect of ultraviolet light, 375
lactis aerogenes (see also Aerobacter aerogenes, Bacillus aerogenes and Bacterium aerogenes)
fermentation of citrates, 284
lipolyticum, fat-splitting, 286
punctatum, fat-splitting, 286
lipase secretion, 286
pyocyaneum (see also Bacillus pyocyaneus and Pseudomonas aeruginosa)
nitrogen metabolism, 288
synthesis of alanine, 272
typhosi B, 115
- Bactridium lipolyticum, lipase secretion, 286**
- Betacoccus bovis (see also Streptococcus bovis)**
in butter making, 326
- Bitterness of milk, cause, 321**
- Blood circulation, relation to secretion, 493**
serum, 26
- Botulinus poisoning, milk-borne, 266**
- Brucella abortus (see also Alcaligenes abortus and Bacillus abortus)**
bitter milk, 321
var lipolyticus, fat-splitting, 286
source of, 243
lipolyticus, in udder, 257
melitensis (see also Alcaligenes melitensis)
in udder, 257
- Buffalo's milk, composition, 17**
- Buffer action, 118**
constituents, of milk, 118, 119
index, of milk, 122
salts, stabilizing effects, 190
- Bulgarius milk, 324**
- Butter, bacterial deterioration, 327**
catalase in, 29
cheesy, 326
churning (see cream, churning)
color, artificial, 100
composition, 34, 473
deterioration (see milk fat)
effect of water dispersion, 184
working, 184
fishy, 73, 88, 326
flavors, 325, 328
freezing point, 225
history, 15
lecithin in, 72, 73
metallic flavor, 326
moldy, 393
nutritional value, 473
"off" flavors, 327
peroxidase, 30
rancid, 326
tallowy, 326
vitamin A content, 99, 440
vitamins, 473
water distribution, 182, 185
whey, composition, 38
- Butter fat (see milk fat)**
- Buttermilk, commercial, composition, 35**
condensed, composition, 35
genuine, composition, 35
powdered, composition, 35
- Butter oil, composition, 35**
- "Buttons", in sweetened condensed milk, 377, 395**
- Butyric acid fermentation, 282**
- Calcium assimilation, 466**
caseinate (see casein)
metabolism, secretion of milk, 511
paracaseinate (see paracasein)
rennet coagulation, 208
- Camels' milk, composition, 17**
- Carbohydrate metabolism, secretion of milk, 511**
in nutrition, 406

- Carbon dioxide, growth of bacteria, 381
 metabolism, of bacteria, 274
 source, milk fat, 285
 nitrogenous compounds, 287
 Carbonates, buffering effect, 123
 Carotin, absorption bands, 96
 constitution, 94
 in feeds, 93
 milk fat, 92
 determination, 98
 properties, 94
 variation in milk and feeds, 98
 Carotinoids, isolation, 97
 Casein, amino acids, 44
 carbon disulfide, 50
 chemical characteristics, 198
 identity with paracasein, 200
 coagulation (see also coagulation, casein), 47
 colloidal character, 198
 in colostrum, 415
 combining capacity, 47
 composition, 39, 44, 63
 decomposition products, 51
 desamino-, 49
 dispersion in milk, 140
 elementary analysis, 44
 formaldehyde, 50
 glues, 54
 gold number, 139
 halogen compounds, 49
 history, 15
 homogeneity, 46
 in insecticides, 57
 medicinal preparations, 56
 methylated, 50
 molecular weight, 43
 nitro-, 50
 nitrogen distribution, 45, 63
 source for bacteria, 289
 paint, 56
 in paper industry, 54
 phosphorus in, 45
 physical characteristics in milk, 198
 plastics, 55
 preparation, commercial, 53
 for research purposes, 51
 properties, 46
 "protein poison," 50
 racemization, 48
 sulfur in, 45
 in textile manufacture, 56
 uses, 54, 57
 Castration, effect on secretion of milk, 485
 Catalase, 28
 Catalysts, effect on flavors of butter, 328
 Catenularia, see key, 395
 Cephalin, in milk, 23, 72
 Cephalosporium, see key, 395
 Cheese, abnormal fermentations, 333
 flavors, 333
 Brick, composition, 37
 Brie, flavors, 332
 mold of, 394
 Camembert, composition, 37
 flavors, 332
 mold of, 394
 catalase in, 29
 Cheddar, acidity, 215
 composition, 37
 flavors, 329
 rusty spots, 333
 classification, 210
 composition, 36
 cottage, composition, 38
 cream, composition, 38
 Edam, 323
 flavors, 329
 effects of freezing, 229
 Emmenthal (see cheese, Swiss)
 flavors, 328
 freezing point, 225
 gassy fermentations, 304
 Gorgonzola, flavors, 332
 mold of, 394
 hard, composition, 36, 211
 flavors, 329
 Italian (see cheese, Parmesan, Ricotte, Ziger)
 Limburger, composition, 38
 ripening, 331
 loaf, manufacture, 219
 manufacture, 210-221
 acidity, 214
 clarified milk, 216
 coagulation temperature, 211
 time, 212
 cutting of curd, 213
 escape of whey, 213
 homogenized milk, 216
 hydrogen ion concentration, 214, 219
 loaf, 219
 pasteurized milk, 217
 references, 221
 salts and neutralizers, 218
 scalding, 215
 mold-ripened, flavors, 332
 molds of, 394
 Mysost, composition, 38
 Neufchatel, composition, 38
 mold of, 394
 nutritional value, 473
 Parmesan, composition, 36
 flavors, 329
 pigments, 333
 Primost, composition, 38
 properties, 210
 red slime on surface, 333
 Ricotte, composition, 38
 ripening, 219
 Roquefort, composition, 37

- Cheese, Roqueforts, flavors, 332
 mold of, 394
 salting, 220
 semi-soft, composition, 37
 soft, composition, 38, 211
 Stilton, flavors, 332
 mold of, 394
 Swiss, composition, 36
 flavors, 329
 yeasts, 386
 vitamins, 440, 473
 whey, composition, 38
 Ziger, composition, 39
- Cheesy butter, 326
- Chlorine-lactose number, 23
- Cholesterol, differentiation from phyto-
 sterol, 70
 in milk, 23
 properties, 68
- Choline, in lecithin, 70
 in milk, 24
- Chromobacterium violaceum, pigment
 formation, 322
- Churning of cream (see cream, churn-
 ing)
 effect on ice cream, 239
- Chymase (see also rennin), 195
- Citrates, buffering effect, 123
- Citric acid, fermentation, 283
 in milk, 21
 source of carbon, 283
- Citromyces, see key, 395
- Cladosporium, see key, 395
 in butter, 393
 butyri, lipase secretion, 286
 in cream, 393
- Clarification, effect on cream rising, 168
- Clarified milk, in cheese manufacture,
 216
- Clostridia, resistance to heat, 312
- Clostridium botulinum, in cheese, 266
 butyricum (see also *Bacillus amylo-*
 bacter)
 butyric acid production, 282
 oxygen requirements, 295
 proteolysis by, 294
 putrificum, butyric acid production,
 282
 proteolysis by, 294
 welchii, butyric acid production, 282
 in cheese, 333
 infantile diarrhea, 267
 in the intestines
 proteolysis by, 294
 source, 242, 248
- Clotting (see also coagulation)
 casein, chemistry, 203
 indirect effect of rennin, 197
 stages, 197
- Coagulation (see also clotting)
 casein, heat, 189
 lactalbumin, heat, 188
- Coagulation, milk, 188-222
 alcohol, 194
 effect of forewarming, 191
 homogenization, 193
 heat, 188-193
 references, 221
 rennet, 195-210
 acidity, 207
 calcium, 208
 cations, 208
 chemistry, 203
 heat, 206
 homogenization, 216
 hydrogen ion concentration, 207
 Coalescence, milk fat globules, 160
- Coli-aerogenes group, gas ratio, 245
 proteolysis by, 291
 surviving pasteurization, 360
- Colloids (see specific substances, as
 casein, etc.)
 hydrophylic, effect on cream rising,
 169
 plasma, effect on cream rising, 169
 protective, effect on cream whipping,
 179
- Colostrum, agglutinins in, 417
 antibodies in, 417
 composition, 414
 euglobulin in, 417
 function, 416
 hemolysins in, 416
 immunity from, 419
 nutrition, 413
 pseudoglobulins in, 417
 transition to normal milk, 19, 415
- Composition of milk, 15-31, 119
 effect of foot and mouth disease,
 522
 pathological conditions, 518
 major constituents, 16-22
 and milk products, references, 41
 minor constituents, 20-31
 milk products, 31-41
- Condensed buttermilk, composition, 35
 milk (see sweetened condensed milk)
 soured pasteurized skim milk, com-
 position, 34
 whey, composition, 39
- Conductivity, of milk, 25, 153
- Cooling, effect on bacteria in milk, 343
- Copper, in milk, 21
- Corpus luteum, effect on mammary
 gland, 481
- Corynebacterium diphtheriae (see also
 Bacillus diphtheriae)
 in milk, 264
 effect of surface tension, 379
- Cream, churning, 181
 effect of acidity, 185
 advance in lactation period, 185
 globule size, 185
 milk fat, 185

- Cream, effect of, temperature, 184
 theories, 183
 composition, 32
 dried, composition, 33
 effects of freezing, 228
 foaming, 171-174
 freezing point, 224
 homogenization, 161
 lecithin in, 73
 moldy, 392
 nutritional value, 471
 rising, 166
 effect of clarification, 168
 globulins, 169
 hydrophylic colloids, 169
 pasteurization, 168
 plasma colloids, 169
 temperature, 168
 viscosity, 169
 recreaming, 168
 viscosity, 149
 vitamins, 472
 whipping, 174
 effect of acidity, 181
 aging, 178, 180
 fat content, 176
 homogenization, 177, 179
 pasteurization, 176
 powdering, 181
 protective colloids, 178, 180
 size of fat globules, 177
 temperature, 176
 viscogen, 179
 yeasty, 392
- Creatin, in milk, 24
- Creatinin, in milk, 24
- Denaturation, by heat, 188
 of lactalbumin, 138
 proteins, 62
- Density of milk, 150
 of milk fat, 80, 151
- Desaminocasein, 49
- Desiccation, effect on bacteria, 380
- Deterioration, butter, effect of bacteria, 327
 milk fat, 80-89, 327
 milk products (see specific product, also milk fat)
- Diarrhea, infantile, milk-borne, 266
- Diastase, in milk, 28
- Diet, secretion of milk, 493
- Digestibility, of corn protein, 453
 proteins, coefficient, 452
- Digestion of food, secretion of milk, 492
 milk, effect of hydrogen ion concentration, 128
- Diphtheria, milk-borne, 264
- Dispersion of milk constituents, 136
- Distribution of bacteria by milk, 261-270
 references, 269
- Dried buttermilk, composition, 35
 cream, composition, 33
 skim milk, composition, 34
 whey, composition, 39
- Drugs, effects on secretion of milk, 517
 transmission to milk, 514
- Drying, effect on bacteria, 380
- Eberthella typhi (see also Bacillus typhosus)
 occurrence, 265, 266
 persistence in ice cream, 261
- Electricity, effect on bacteria, 374
- Emulsification, effect on viscosity of ice cream, 230
- Energy, nutritional, requirements of mammals, 402
- Enzymes, action on fats, 68
 bacterial, proteolytic, 288
 history, 16
 in milk, 27-31
 rancidity of fat, 81
- Epicoccus, see key, 395
- Epidemics, milk-borne, characteristics, 262
 diphtheria, 264
 infantile diarrhea, 266
 paratyphoid, 266
 preventability, 268
 scarlet fever, 264
 septic sore throat, 263
 typhoid fever, 265
- Equilibria, lactose solutions, 106
 milk, acid-base, 117-130
 physical, 136-187
 references, 185
- Escherichia coli (see also Bacterium coli, Bacterium coli commune, Bacillus coli, Bacillus coli communis)
 effect of surface tension, 379, 380
 fermentation of citrates, 284
 lactic acid production, 280
 limiting hydrogen ion concentration, 339
 optimum temperature, 351
 proteolysis by, 291
 reducing ability, 298
 survival at low temperatures, 341
 of pasteurization, 361
 in udder, 258
- Estrus, physiology, 480
 secretion of milk, 485
- Euglobulin, in colostrum, 417
- Evaporated milk, coagulation, 190
 composition, 31
 effects of freezing, 228
 freezing point, 225
 history, 16
 nutritional value, 475
 sterilization, 373
 vitamins, 475

- Evaporated milk, skim milk, composition, 33
- Extracts, animal, secretion of milk, 517
- Fat (see also milk fat)
 hydrolysis, 67
 metabolism, secretion of milk, 506
 in nutrition, 406
 phase of milk, 154
 synthesis by bacteria, 286
- Fatty acids, 65
 boiling points of esters, 75
 distribution in glycerides, 76
 estimation, 75
 physical constants, 74
 separation, 75
- Feeds, carotin in, 93
 effect on milk fat, 508
- Fermentation, alcoholic, 283
 butyric, 282
 of citric acid, 283
 lactic, 278, 317
 of lactose, 274
 propionic, 281
 theories, 275
- Fermented milks, 323
 composition, 40
- "Fishiness", butter, 73, 326
 milk fat, 73, 88
- Flavors, butter, 325
 effect of catalysts, 328
 cheese, 328
 milk, transmission from food, 515
- Fluidity (see viscosity)
- Foam, bacteria in, 364
- Foaming, milk and cream, 171-174
- Food, secretion of milk, 493
- Foot and mouth disease, effect on composition of milk, 522
 transmission through milk, 258
- Forewarming, effect on coagulation, 191
- Freezing, effect on bacteria, 341
 cheese, 229
 cream, 228
 evaporated milk, 228
 ice cream, 229
 milk, 228
 of milk, 223-240
 references, 240
 milk products, references, 240
- Freezing point, butter, 225
 cheese, 225
 cream, 224
 evaporated milk, 225
 ice cream, 226
 milk, 25, 223
 milk products, 225-228
 sweetened condensed milk, 225
- Fungi (see molds)
- Fungicides, casein in, 57
- Fusarium, see key, 395
- Gas ratio, coli-aerogenes group, 245
- Gases, of milk, 24
- Gelatin, ice cream, effect on overrun, 233
 texture, 237
- Germicidal action of milk, 250
- Germicides, effect on spores, 314
- Gestation, effect on secretion of milk, 485
- Gliocladium, see key, 395
- Globulin (see lactoglobulin)
- Globulins, effect on cream rising, 169
- Glue, casein in, 54
- Glycerides, 65
 of milk fat, distribution of fatty acids, 76
- Goats' milk, composition, 17
 hydrogen ion concentration, 118
- Gold numbers, 139
- Growth of bacteria (see Bacteria, growth)
 references, 334
 curves, bacteria, 302
- Heat (see also temperature)
 coagulation (see coagulation, heat)
 effect on acid-base equilibria, 128
 acidity of milk, 190
 rennet coagulation, 206
 viscosity of milk, 149
- Hemolysins, in colostrum, 416
- History of milk, 15
- Homodendrum, see key, 395
- Homogenization, of cream, 161
 effect on coagulation, 193
 cream whipping, 177, 179
 dispersion of fat, 163
 distribution of fat, 163
 size of fat globules, 162
 viscosity of ice cream, 230
 of milk, 161
- Homogenized milk, in cheese manufacture, 216
- Horses' milk, composition, 17
- Human milk, composition, 17
 hydrogen ion concentration, 118
 lecithin, 72
- Hydrogen ion concentration, in cheese manufacture, 214, 219
 effect of bacteria, 339
 on bacteria, 337-340
 molds and yeasts, 340
 rennet coagulation, 207
 of milk, 118
 effect on digestion, 128
 of heat, 190
 versus "titratable acidity", 129
- Hydrolysis, fat, 67
 lactose, 111
- Ice cream, churning, 239
 composition, 40, 229

- Ice cream, "dead whip,"** 232
effects of freezing, 229
freezing point, 226
history, 16
nutritional value, 474
overrun, 231
 effect of acidity, 234
 albumin, 234
 gelatin, 233
 "improvers," 234
 milk fat, 232
 milk-solids-not-fat, 233
 sugar, 232
 surface tension, 232
 viscosity, 232
 purpose, 231
 plasticity of ripened mix, 234
 properties, 229-239
 references, 240
 "sandiness," 108, 239
 smoothness, 235
 texture, 234
 effect of fat, 235
 gelatin, 237
 hardening temperature, 239
 "improvers," 237
 mechanical treatment, 238
 milk-solids not-fat, 236
 sugar, 237
 whipping, 238
 viscosity, 229
 basic, 234
 effect of aging, 230
 emulsification, 230
 homogenization, 230
 "improvers," 230
 pasteurization, 230
 vitamins, 475
- Ice cream powder, composition,** 40
- Immunity, from colostrum,** 419
- "Improvers", ice cream, effect on over-**
run, 234
 texture, 237
 viscosity, 230
- Index of refraction (see refractive in-**
dex, refractivity)
- Indicators, reduction,** 131
- Infection from milk (see epidemics,**
milk-borne)
- Insecticides, casein in,** 57
- Intestinal bacteria, in milk,** 247
- Irradiation, effect on vitamin D,** 446,
447
- Kumys,** 323
- Lactalbumin, amino acids,** 60
coagulation by heat, 188
in colostrum, 415
denaturation, 138
dispersion, 136
elementary analysis, 63
- Lactalbumin, gold number,** 139
 history, 16
 isoelectric point, 140
 nitrogen distribution, 63
 preparation, 59
 properties, 60
 source of nitrogen for bacteria, 295
- Lactase,** 28, 111, 274
- Lactation curve (see also secretion of**
milk), 486
 period, churning of cream, 185
 milk yield, 483
- Lactic acid bacteria,** 278, 317
 proteolysis by, 290
 fermentation, 278, 317
 production by bacteria, 317
- Lactobacillus acidophilus, effect of sur-**
face tension, 380
 fermentation of citrates, 284
 implantation, 324
 peroxide formation, 310
 bulgaricus (see also *Bacillus bulgari-*
 cus)
 effect of surface tension, 380
 in fermented milk, 324
 lactic acid production, 279
 limiting pH, 309
 peroxide formation, 310
 proteolysis, 290
 retarded, 291
 source, 242
 in souring milk, 318
 symbiosis with *Streptococcus lactis*,
 307
- casei, fermentation of citrates,** 284
 in fermented milk, 323
 source, 245
 in Swiss cheese, 331
 symbiosis, 307
- delbrucki, source,** 245
- pentoaceticus, source,** 245
- thermophilus, characteristics,** 372
 source, 370
 temperature relations, 351
- Lactochrome, constitution,** 102
 isolation, 101
 in milk, 100
 preparation, 101
 properties, 102
 source, 103
- Lactoglobulin, in colostrum,** 415
 dispersion, 136
 elementary analysis, 63
 history, 16
 isolation, 61
 in milk, 58
 nitrogen distribution, 63
 source for bacteria, 295
 properties, 61
- Lactomucin, membrane of fat globules,**
141
 in milk, 58

- Lactose, 25, 105-116, 520
 commercial, composition, 40
 constitution, 105
 crystallization, 108
 effect of heat, 112
 equilibrium relations, 106
 fermentation, 274
 food value, 115
 history, 15
 hydrolysis, 111
 manufacture, 113
 occurrence, 105
 oxidation, 111
 phenylosazone, 113
 physical constants, 110
 reduction, 112
 references, 116
 solubility, 108
 source of carbon, 274
 specifications, 115
 therapeutic value, 116
 uses, 116
- Lag phase, growth of bacteria, 307
- Leben, 323
- Lecithin, in butter, 72, 73
 cream, 73
 destruction by heat, 71
 hydrolysis in fishy butter, 88
 in milk, 23
 milk fat, 70
 separator slime, 72
 skim milk, 73
- Lipase, action on fat, 81
 bacterial, 285
 in milk, 29
- Macrosporium, see key, 395
- Maintenance requirements, of milking
 animals, 496
- Malted milk, composition, 40
- Mammary gland, atrophy, 481
 development during pregnancy, 481
 prior to parturition, 479
 effect of fetal and placental ex-
 tracts, 481
 hormones, 480
 hypertrophy, 481
 physiological relations, 490
 structure, 490
- Manure, bacterial content, 247
- Mastitis, 253
- Matzoon, 323
- Metabolism (see also protein, calcium,
 etc.)
 bacteria, 271-336
 abnormal flavors, 321
 bitter flavors, 321
 carbon, 274
 fermented milks, 323
 lactic acid, 317
 nitrogen, 287
 pigments, 322
- Metabolism, bacteria, products, 316-334
 references, 334
 ropiness, 319
 sliminess, 319
- Metallic flavor, butter, 326
- Methyl guanidine, in milk, 24
- Methylene blue test, 298
- Micrococcus casei liquefaciens, pro-
 teolysis, 292
- cereus, proteolysis, 292
- citreus, proteolysis, 292
- conglomeratus, proteolysis, 292
- freudenreichii, proteolysis, 292
- perflavus, proteolysis, 292
- subflorescens, proteolysis, 292
- tetragenus, lipase secretion, 286
- varians, proteolysis, 292
- Milk (see also composition, nutritive
 properties, etc.)
 abnormal flavors, 321
 acid-base equilibria, 117-130
 effect of heat, 125
 acidity, effect of heat, 190
 aeration, 24, 516
 antibodies, 250
 bacteria, sources, 241-261
 bitter, 321
 buffer action, 118
 buffer constituents, 118, 119
 buffer index, 122
 carotin in, 91
 cephalin in, 72
 clarified, in cheese manufacture, 216
 coagulation by alcohol, 194
 heat, 188-193
 rennet, 195-210
 colloidal system, 136
 color, 91, 100
 composition, 15-31, 119, 120
 different animals, 16
 effect of disease, 518-526
 minor constituents, 20-31
 prior to first parturition, 482
 variations, 17
 condensed (see sweetened condensed
 milk)
 condensed soured (see condensed
 soured pasteurized skim
 milk)
 conductivity, 25, 153
 constituents, dispersion, 136
 culture medium, 273
 density, 150
 digestion, effect of hydrogen ion con-
 centration, 128
 enzymes, 27-31
 evaporated (see evaporated milk)
 fat phase, 154
 fermented, 323
 composition, 40
 flavors from feeds, 515
 fluidity, 146

- Milk, foaming, 171-174
 freezing, effects of, 228
 freezing point, 25, 223, 521
 germicidal action, 250
 homogenization, 161
 homogenized, in cheese manufacture, 216
 human, lecithin, 72
 phospholipids in, 72
 hydrogen ion concentration, 118
 lactic fermentation, 317
 lactochrome in, 100
 lactose in, 105
 lecithin, 72
 malted (see malted milk)
 moldy, 392
 nitrogen metabolism of bacteria, 287
 nutritional value, 402-469
 osmotic pressure, 25
 oxidation-reduction equilibria, 130-134
 pasteurized, in cheese, manufacture, 217
 counts, 366
 growth of bacteria, 365
 souring, 362
 phospholipids in, 72
 pigments in, 91
 production, economy, 495
 refractivity, 151
 ropy fermentation, 319
 salt combinations, 22
 secretion (see secretion of milk), 479-528
 skim (see skim milk)
 surface tension, 143, 173
 titration, 126
 viscosity, 146
 effect of temperature, 149
 vitamins, 31, 438-451
 watering, detection, 224
 yeasty, 392
- Milk fat, 65-90
 acetyl number, 79, 80
 acid value, 78, 80
 acidity, 81
 Baudouin test, 79
 cadmium value, 79
 clumping, 167
 composition, 65
 density, 80, 151
 deterioration, 80-89, 327
 dispersion, 154
 effect of homogenization, 163
 distribution, 155, 163
 effect on churning, 185
 cream whipping, 176
 foaming, 172, 174
 feeds, 508
 phosphorus in feeds, 508
 fatty acids, distribution, 76
 "fishiness", 88
- Milk fat, globules, aggregation, 160
 coalescence, 160
 number, 143, 154-162
 protein membrane, 141
 rates of rise, 165
 size, 136, 143, 154-185
 glycerides, 65
 distribution, 67
 Halphen test, 79
 Hehner number, 78, 80
 history, 15
 ice cream, effect on overrun, 232
 texture, 235
 insoluble acids, 78
 iodine value, 79, 80
 Jensen-Kirschner value, 78, 80
 Koeststorfer number, 78
 Kreis test, 79
 lecithin in, 70
 loss in cheese whey, 213
 melting point, 77
 methods of examination, 76
 microscopic examination, 78
 molecular weight, 80
 oxidation, 82
 phospholipids in, 70
 pigments, 92
 secretion by mammals, 92
 synthesis, 92
 Polenske value, 78, 80
 rancidity, 81
 references, 89
 refractive index, 77
 Reichert-Meissl value, 78, 80
 saponification value, 78, 80
 separation, mechanical, 169
 spontaneous, 164
 solidifying point, 77
 soluble acids, 78
 source of carbon, 285
 specific gravity, 80
 "tallowiness", 82
 turbidity test, 77
 unsaponifiable matter, 79
- Milk powder, composition, 32
 deterioration (see milk fat)
 history, 16
 molds in, 395
 nutritional value, 433, 476
 vitamins, 476
- Milk products, composition (see also butter, cheese, etc.), 31-41
 nutritional value, 469-478
- Milk proteins (see also proteins, casein, lactalbumin, lactoglobulin, lactomucin), 43-64
- Milk serum, 25
- Milk-solids-not-fat, ice cream, effect on overrun, 233
 texture, 236
- Milk sugar (see lactose)

- Mineral content of milk, effect on nutritional value, 465
 - metabolism, secretion of milk, 511
 - requirements of bacteria, 274
 - mammals, 409
- Molds, of butter, 393
 - characteristics, 388, 390
 - of cheese, 394
 - cream
 - dairy products, key to identification, 395
 - effect of hydrogen ion concentration, 340
 - moisture, 391
 - oxygen, 390
 - temperature, 392
 - factors influencing, 390
 - of milk, 386-401
 - references, 401
 - milk powder, 395
 - milk products, 386-401
 - references, 401
 - prevention, 392
 - significant species, 389
 - sources, 389
 - in sweetened condensed milk, 377, 395
- Monilia, see key, 395
- Morphological changes in bacteria, 303
- Mucins (see also lactomucin)
 - in slimy milk, 319
- Mucors, see key, 395
 - characteristics, 388
 - in cheese, 394
 - cream, 393
- Multiplication of bacteria (see bacteria, growth)
- Mycobacterium tuberculosis (see also Bacillus tuberculosis), 259
- Neutralizers, in cheese manufacture, 219
- Nitrocasein, 50
- Nitrogen distribution, casein, 45, 63
 - lactalbumin, 63
 - lactoglobulin, 63
 - metabolism in milk, 287
 - source for bacteria, casein, 289
 - lactalbumin, 295
 - lactoglobulin, 295
 - simple nitrogenous compounds, 289
- Nitrogenous compounds, source of carbon for bacteria, 287
- Nutrition, of bacteria, 272
 - elements required, 405
- Nutritional energy, of food, secretion of milk, 495
 - required by mammals, 402
 - man, 403
 - level, effect on bacteria, 306
 - properties of milk, biological experiments, 422
- Nutritional requirements, factors, 405
 - of mammals, 402, 410
 - value, amino acids, 408, 411
 - butter, 473
 - cheese, 473
 - cream, 471
 - evaporated milk, 475
 - ice cream, 474
 - milk, 402-469
 - references, 476
 - milk powder, 476
 - milk products, 469-478
 - references, 476
 - proteins, 406, 407, 411, 451-464
 - skim milk, 471
 - sweetened condensed milk, 475
- Odors of milk, from food, 515
- Oidium lactis, see key, 395
 - in butter, 393
 - cheese, inhibition, 220
 - cottage cheese, 394
 - cream, 393
 - Neufchatel cheese, 391
- Oöspora, see key, 395
- Osmotic pressure, effect on spores, 316
 - bacteria, 376
 - of milk, 25
- Overrun, ice cream (see ice cream, overrun)
- Oxidation-reduction equilibria, 130-134
 - references, 134
- Oxygen, effect on spores, 315
 - yeasts and molds, 390
 - requirements of bacteria, 295-298
- Paints, casein in, 56
- Paper making, casein in, 54
- Paracasein, 49, 199
 - identity with casein, 200
- Paratyphoid, milk-borne, 266
- Pasteurization, bacteria surviving, 354
 - cooling, 354
 - development, 352
 - effect on cream rising, 168
 - whipping, 176
 - growth ratios of bacteria, 362
 - number of bacteria, 365
 - nutritional value, 469
 - viscosity of ice cream, 230
 - vitamins, 470
 - efficiency of, 304
 - growth of bacteria in foam, 364
 - methods, 353
 - survival of bacteria, 357, 360, 362
- Pasteurized milk, bacteria, hypothetical grouping, 362
 - bacterial counts, 366
 - in cheese manufacture, 217
 - growth of bacteria, 365
 - souring, 362

- Pathological conditions, effect on composition, 518
secretion, 518-524
- Penicillia, see key, 395
in butter, 393
- Penicillium aromaticum, 394
brevicaule, in cheese, 394
camemberti, in cheese ripening, 332, 394
var rogeri, in cheese ripening, 394
glaucum, 394
roqueforti, in cheese ripening, 332, 394
- Pepsinase, bacterial, 288
- Peptonizing bacteria, optimum temperature, 348
- Peroxidase, in milk, 30
- pH (see hydrogen-ion concentration)
- Phases of bacterial growth, 302-312
- Phosphates, buffer effect, 123
colloidal, 142
precipitation by heat, 189
- Phospholipids, in milk constituents, 72
milk fat, 70
- Phosphorus, assimilation, 466
in feeds, 508
metabolism, secretion of milk, 511
- Physical equilibria of milk, 136-187
references, 185
- Physiological changes in bacteria, 303
- Physiology of estrus, 480
the mammary gland, 490
milk secretion, 479-528
references, 526
summary, 524
- Phytosterol, differentiation from cholesterol, 70
- Pigments, bacterial, 322
cheese, 333
milk, 91-104
references, 103
milk fat, secretion by mammals, 92
synthesis, 92
- Pin point colonies, 359, 368
causes, 370, 372
significance, 371
- Pituitrin, effect on secretion, 518
- Plasticity of ripened ice cream mix, 234
- Pneumococcus, 338
- Poisons, transmission to milk, 514
- Potential, reduction, bacterial, 301
- Powdered buttermilk, composition, 35
cream, composition, 33
whipping, 181
milk (see milk powder)
skim milk, composition, 34
whey, composition, 39
whole milk, composition, 32
- Pregnancy, effect on the mammary gland, 481
secretion, 485
- Preservatives, effect on bacteria, 382
- Pressure, effect on bacteria, 373
- Propionic acid fermentation, 281
- Protease, bacterial, 288
in milk, 27
- Proteins, denaturation, 62
digestibility, 452
effect on secretion of milk, 500
of milk (see proteins, casein, lactalbumin, lactoglobulin)
effect on digestibility of other proteins, 463
references, 63
nutritional value, 406, 407, 411, 451-464
utilization by milking cows, 501
- Proteolysis, bacterial, 290
in milk, 288
- Proteoses, in milk, 58
- Proteus group, proteolysis, 292
vulgaris (see also *Bacillus proteus*)
fermentation of citrates, 284
physiological changes, 303
proteolysis, 292
- Pseudoglobulins in colostrum, 417
- Pseudomonas aeruginosa (see also *Bacterium pyocyaneum* and *Bacillus pyocyaneus*)
pigment formation, 322
proteolysis, 292
fluorescens (see also *Bacillus fluorescens liquefaciens*)
proteolysis, 290, 293
source, 243
- Puberty, development of the mammary gland, 480
- Quinhydrone electrode, 133
- Rancidity in butter, 326
- Recreaming, cream rising, 168
- Reducing abilities of bacteria, 298
- Reductase in milk, 30
test (see methylene blue test)
- Reduction by bacteria, 298
indicators, 131
intensity, due to bacteria, 299
potential, 130
due to bacteria, 301
- Refractive index of milk, 151
- Reindeer milk, composition, 17
- Rennet coagulation (see coagulation, rennet; rennin)
curds, 211
- Rennin, changes produced, 196, 199
factors influencing action, 205
nature, 196
potency, 196
rate of action, 196
versus pepsin, 195
- Rhizopus, see key, 395
- Ripening of cheese, 219
- Ropiness in milk, cause, 319

PREFACE.

This volume deals with the principles of breeding farm animals, with the food of farm animals and economy in feeding, and with the management of farm animals generally. The various breeds of cattle of the Presidency are illustrated and described. I hope to be able in time to add largely to this section with illustrated descriptions of the numerous breeds of cattle found in other parts of India.

I am indebted to Dr. Leather for the numerous analyses of Indian foods and fodder, and to him, Veterinary Major Mills, and Mr. Baldrey for some of the photographs which are illustrated. The blocks for illustrations were prepared by Mr. F. B. Stewart, Photo Artist, Poona. Mr. Yashvant Nilkanth, the Superintendent of the office of Director of Land Records and Agriculture, kindly corrected the proofs.

J. M.

Poona, January, 1901.

CONTENTS.

PAGE.

The Principles of Breeding Farm Animals:—

More particularly in reference to Cattle	1
The Food of Farm Animals and Economy in Feeding	11
Ensilage	34
The Harvesting, Curing and Stacking of Fodder Crops	38
Management of Brood Mares and Foals in India	41
The Rearing and Management of Young Horse Stock in India ...	46
Management of Dairy Cattle and Young Stock in India	48
A few points on Sheep and Goat Breeding in India	59

The Breeds of Indigenous Cattle of the Bombay Presidency:—

Gir Cattle	63
Gujarát Cattle	72
Krishna Valley Cattle	84
Nellore Cattle	88
Lower Sind Cattle	94
Deccani Cattle	102
Khillári Cattle	109
Málvi Cattle	118
Aden Cattle	123
Singalese or Ceylon Cattle	131
Nimár Cattle	137
Buffaloes	140
Jáfferabadi Buffaloes	142
Delhi Buffaloes	148
Surat or Deccani Buffaloes	152

THE PRINCIPLES OF BREEDING FARM ANIMALS.

MORE PARTICULARLY IN REFERENCE TO CATTLE.

Cattle form the backbone of India's agricultural enterprise. Numerous indigenous breeds exist which vary from each other in a remarkable degree in size, type and in other respects. The variations referred to are in a great measure due to natural conditions over which the breeders have little or no control. If the natural conditions of a district are suitable, an expert stock owner can in time breed up to an improved standard, but if they are unfavourable or incapable of artificial improvement, efforts to improve the characteristics of indigenous breeds will probably fail.

The character of each indigenous breed is greatly influenced by natural conditions.

It should be noted in contrasting the favourable and unfavourable natural conditions as they exist in India, that in the Bombay Presidency the districts where the best cattle are bred have extensive ranges of good grass-land with abundant or fairly abundant pasturage at all seasons. Such lands are ordinarily upland hilly tracts naturally well drained, freely shaded with trees and having an ample water-supply in perennial springs or streams. The soil is best if of fair depth and quality and with the subsoil fairly pervious to rain as it falls. The rainfall should not exceed 35" per annum. The breeding grounds of the Gir cattle in Káthiáwár and of Khillári and Málví cattle in the Sátpuras and in Holkar's territory exhibit such favourable natural conditions as those referred to; moreover, on the more fertile lands, which lie as arable plains at lower levels, a considerable variety of cultivated crops are grown, and it is possible to arrange in almost any season that a full supply of nutritive fodder is held in reserve to supplement the natural supply when it gets scant. The finest cattle of the Bombay Presidency are bred in Northern Gujarát in tracts of grass-land which extend round the Rann of Cutch and northwards through Rádhanpur, Wadhíál, Kánkrej, Pálanpur into Rájputána. The deep alluvial loamy plains of Gujarát are very suitable for rearing young stock. The district like other suitable cattle-breeding districts is safe from famine except, perhaps, once in a century. The young male stock are sold as yearlings to occupants of arable lands in Baroda, Kaira, Ahmedabad, &c. These arable districts are probably more fertile than any other districts in India. A great variety of crops are grown. Pulse crops are extensively cultivated, and these produce most

Natural and other conditions which are favourable for cattle breeding.

nutritious fodder. The cattle are very fine and it would be indeed curious if a district so favourably circumstanced did not produce fine cattle. In the cattle breeding districts proper, the owners are chiefly professional herdsmen owning comparatively large herds and leading with their families more or less wandering lives. It is usual to keep only bulls specially suitable for stud purposes. Such young bulls as are not required are either castrated early or sold young. Young stock are rarely housed or tied, and with the older stock get a healthful amount of freedom in the grazing grounds.

Natural and other conditions which are not favourable for cattle breeding.

Throughout the Deccan where the arable cultivation is extensive and grazing areas are restricted some breeding animals are kept in every village, but only a few by each individual owner. He cannot afford to herd them separately. The village cattle run together herded by one or two children and early castration is not practised, consequently the mating of animals is altogether uncontrolled. This system of breeding, if system it can be called, has resulted in producing cattle of very mixed breeding and generally of inferior class. The breeding of cattle in Deccan villages would not in any case be profitable, because the natural conditions are unfavourable, and the best cattle that could be bred would not be saleable at high prices. The district is subject to deficient rainfall, scarcity of fodder and periodic famines. Only small active hardy cattle could exist under such trying conditions; therefore it would be risky and unwise to attempt to increase the size of the cattle by crossing or materially change the natural characteristics of the breed by any other means. In the Konkan or below the Gháts, north or south of Bombay the rainfall is too heavy for successful stock breeding. Buffaloes thrive fairly well there, but though they are by nature water animals, still they can be most successfully reared in a comparatively dry district. A damp malarious situation would not be selected as a village site, neither is it suited for breeding healthy, vigorous animals. A deep moisture holding soil which gets sodden during rain is unsuitable for a stock farm. Such lands as the deep retentive cotton soils of Surat, Broach, &c. are very unsuitable for the purpose.

A decided degree of cold in the winter season is a favourable influence.

The finest cattle in India are bred in districts where there is a decided degree of cold in the winter season. This seems to have an invigorating influence. In fact, it may generally be said that in the southern and warmer parts of India the breeds of cattle, horses, sheep and goats are smaller and altogether less valuable than those found in colder and more northern districts.

"Like begets like" is only true in a certain sense.

The pure breeds of cattle as we find them in India and as bred by professional herdsmen, exhibit certain characteristics which indicate that they have been maintained pure for many generations. We know little or nothing of the original stock from which each breed sprang. The saying "like begets

like" is as true in India as in other countries. It is, however, only true in a certain sense. The Indian breeds of to-day probably differ materially from original stocks. The present-day characteristics of improved breeds in other countries have chiefly been brought about by the breeder's art, but the successful breeder in India or elsewhere must always subordinate his aims to natural conditions. If such conditions are suitable, then he can breed up to an improved standard, but if unsuitable or incapable of artificial improvement he will probably fail in his effort. It would be very unwise to attempt to eliminate characteristics and qualities which are inherently caused by natural conditions which are unchangeable.

The influences of the breeder's art assisted by natural conditions have been to some extent the means of giving to every improved breed certain distinctive characteristics, but independent of these influences there are others which will directly refer to, as the various principles attending the breeding of farm animals are described.

Skill in breeding.

When domesticated animals are left more or less to themselves and are allowed to breed more or less indiscriminately, certain peculiarities are thereby induced. Variety in colour and broken colours thus become common. The cattle found throughout the Deccan furnish an excellent example. Cattle that are reared in herds by professional herdsmen away from villages acquire the instincts and habits to some extent of wild animals. They are easily startled by strangers or by any unusual object and are fleet of foot when so startled, or they may become dangerously hostile. Gir cattle in the Gir hills are quite tame with their owners or attendants and are easily handled, but it is dangerous for a stranger, and particularly a European, to incautiously approach them. The same may be said of Khillári cattle. The cows of both breeds have great maternal instinct, resembling in this respect other cattle that are reared in a purely wild or semi-wild state, for instance the Kyloe cattle of Scotland. These cattle during winter and summer are never sheltered nor tied in buildings. They graze amongst the heather of the Highland hills. The calves are rarely seen until they are some days old. The dam hides her offspring in long grass or rushes visiting the spot periodically to suckle the little one. If anyone approaches the place unwarily the cow comes at a hard trot with intentions too manifest to be misunderstood. Through haphazard breeding other characteristics, besides these referred to, are caused particularly in horses. In the Káthiáwár breed we not only find great variety of colour but very unusual colours such as duns, skew-balds, pale creams, in the latter case with skin much the same colour as the hair. Wall eyes and flesh coloured muzzles are very common. An evil temper, a mean disposition and extraordinary capacity for continued endurance are also common characteristics. Precisely similar characteristics and qualities

Peculiarities induced by indiscriminate breeding.

have been induced by similar causes in the mustang or semi-wild horse of the western prairies of America and Canada. These horses are owned by Indian tribes and run half-wild in "bands" or droves.

Effects of domestication.

Domestication and careful breeding in any breed tend to tame and produce a docile temper. Earlier maturity and increased fecundity are also induced by the same conditions.

Close breeding or "in-and-in" breeding and characteristics induced thereby.

Horses and cattle allowed to breed indiscriminately as described above are often closely bred. "Close breeding" or "in-and-in" breeding results from the mating of near relations; generally this is not advisable. It leads to weakening of constitution and diminution of size, sometimes also it impairs fecundity. It has been resorted to by skilful breeders as a means of stamping in a marked degree some special excellence in a particular family. If the practice is pursued to a limited extent the result may be that desired, if practised to excess harm will follow. The effect of close breeding is well exemplified in the more or less dwarfed cattle found in the islands at the head of the Persian Gulf. These Bahrein cattle resemble ordinary Indian cattle in having a hump, but differ from them in every other particular. They are useless for draft purposes because they are so small, and valuable because their milking properties have alone been developed, and in this connection, it may be stated with assurance that close breeding does not deteriorate milk yielding capabilities. It is notorious that Channel Island cattle and Jerseys in particular are very much inbred; yet for their size, probably, no breed in the world can furnish a better milk record, if quality and quantity of milk be together considered. Jersey and Guernsey cattle must of necessity be inbred because until comparatively recent times it was held penal either to import cattle or export the indigenous breed and these islands are very small. We can only conjecture what Bahrein cattle referred to above were originally like. It is certain that they have become dwarfed in size because they have been bred in-and-in. Their conformation indicates milking properties. The hindquarters look the more massive because there is no droop behind the loins. The limbs and feet resemble those of deer. The head is small and neat, the muzzle very fine and often flesh-coloured or mottled. The eyes are very prominent and have a docile appearance. The ears are short and alert, the neck thin and long, the frame well formed and the tail exceptionally long and thin, the udder capacious and well formed. These cattle are thoroughly domesticated and particularly docile, and are not afraid of strangers or Europeans like ordinary Indian cattle. They are fed on fish, bran, dates and hay when in full milk. The fish given is not necessarily fresh. I am not prepared to say that this diet unfavourably affects the flavour of the milk, but I imagine it probably does in no uncertain degree. It is noteworthy that the climate at the head of the Persian Gulf is exceptionally trying. At certain

seasons a considerable degree of cold is experienced, whilst at others the heat is excessive. The Bahrein cattle on a diminutive scale resemble in some ways Aden and Singalese cattle, and there is no doubt that both Aden cattle and Ceylon cattle are also inbred to a very considerable extent. In these breeds, we have again general smallness of size, deer-like appearance in the colour, head and limbs, remarkable docility of temper, and in the Aden breed milking capacity fairly developed. Another instance of peculiarities induced by close breeding is found in the sheep of the islands more or less remote from the west of Scotland. These sheep were generations back identically the same breed as the horned or hill sheep of the Highlands of Scotland. Those now found in the smaller outer islands with which there is rarely any communication from the mainland, differ from the original stock, because they have been bred in-and-in. The effect of in-and-in breeding has been to diminish the size, to change the character of the fleece from a coarse long wool to something resembling hair, and now instead of having two strong horns many have four or six of these excrescences which, however, are small.

It has been stated that one of the general effects of close breeding is to diminish size. Judicious change of blood from time to time would have an opposite effect and tend to increase the general size of the young stock in the breeding herd and also strengthen them in hardiness and general robustness.

Value of change of blood.

When the owner of cattle or of other farm animals undertakes to improve his stock he has set himself a task which demands close and persistent attention and an intimate knowledge of the principles which underlie his profession. The history of any improved breed shows that the men who effected the improvement began with a definite ideal object or objects in view. The aim of successful breeders has been to breed up to the ideal by perpetuating the good points of the parents in the offspring and eradicating the weak or bad points. The latter object can only be attained by rejecting all for breeding purposes that do not come up to a desired standard. It is not difficult to eradicate a defect in a single generation. This is accomplished by mating an animal particularly good in a certain point with one that may be deficient therein. It, however, requires the greatest care to prevent a relapse to the same fault or deformity in future generations. Breeding from "weeds," that is from animals inferior in appearance or otherwise, no matter how good the pedigree may be, is a fruitful cause of permanent mischief. If either parent is defective the defect will probably appear and often be perpetuated in the offspring. Faults of one parent may be overcome by special excellence in the other. In cattle, horse and sheep breeding, the bull, the stallion or the ram often represents half the influence in improving the herd, the stud or the flock. Hence, the selection of the male is of special importance. This does not mean that special care should not be taken in selecting the female.

The successful stock breeder must necessarily have an intimate knowledge of the principles which underlie his profession.

The selection of the male is of great importance.

It simply means that a stock breeder can materially improve his stock through the influence of high class sires, even though the females are only moderately good.

Violent crossing is highly objectionable.

Violent crossing must be sedulously avoided. Males and females widely divergent in type and breed should not be mated. The offspring of such a union is at the best a half-caste and is often a mongrel. Many of the Indian breeds are very unlike in characteristic appearances and the crossing of breeds divergent in type cannot, by an experienced breeder, receive any commendation, whatever the objects aimed at may be. English bred bulls have been now and again imported into India with the object of improving the indigenous breeds. Fortunately the indigenous cattle have only been sparingly tainted by the exotic blood. The two types are so different and the purposes for which they are bred so divergent that it is impossible that English and Indian cattle can be crossed with advantage.

The numerous pure Indian breeds are the result of careful breeding through many generations.

The numerous breeds of cattle found throughout India are commonly presumed to be the result of haphazard breeding. This is not so, for, every pure breed has a distinctive type and family likeness which could only have been produced by careful breeding and by maintaining the pristine purity of the breed through many generations. Distinctive characteristics such as those referred to above may have been induced by accident or otherwise in the first instance, but have undoubtedly been perpetuated in some degree by careful breeding for a very long time. It is not likely that in India even in the best breeding districts careful mating can be absolutely controlled, because the breeding herds are grazed in large droves; whilst in cultivated districts the cattle of each village are so mixed up on the common grazing ground that there necessarily must be indiscriminate breeding. Therefore in India desired results cannot be attained to the same extent, as in Western countries where every breeder's stock is absolutely under his own control.

The adaptiveness of cattle as milk and meat producers and as beasts of burden has been controlled by the breeder's skill.

In these Western countries cattle breeders have been able to induce very remarkable differences in the characteristics which distinguish different breeds and this is not altogether strange, because bovines are useful to man as milk and meat producers and also as beasts of burden. It is only natural that efforts have been made to improve their adaptiveness for each purpose. I will endeavour to show that the appearances which indicate milk and meat production are somewhat dissimilar; also that the conformation, of a good work bullock is very different from that of a fat steer intended for the butcher. There is no doubt that the work cattle form the backbone of India's agricultural prosperity, and in consequence cattle in India have been bred chiefly for draught purposes. Buffaloes are essentially the milk breed of this country. Consequently the milk yielding capacity of the cow has

been somewhat neglected, except in some districts. It does not at all follow, however, that a cow is incapable of milking well and at the same time of producing a bull calf which will grow into a good draught animal.

As regards milch cattle mildness of temper is of special importance. Nothing tends so much to full and free milk secretion, but there are other characteristics which also are indicative of deep milking qualities. A qualified judge will unerringly say that one cow will milk well whilst another will hardly be worth her food. He is guided to some extent by experience which is almost instinct and which is only acquired by few. Special breeds have been bred specially for dairy purposes. Well bred specimens of a purely milch breed have light forequarters in comparison with the hind-quarters which are massive and heavy. The lightness of the forequarters must not contract the chest so that there is insufficient lung and heart room. A good milch cow will have wide loins, massive square quarters, deep well-packed thighs with back ribs long and well sprung. This conformation gives ample accommodation for the bowels and intestines, a point of particular value, because a deep milker has invariably a large paunch and a full flank. A lean and clean cut head, a thin, long neck, a thin, long tail, a skin which when handled is soft and pliant are all points observable in a good milker. The truest indication of milking properties is to be found in the appearance of the udder and milk vein. The latter should be prominent, *i. e.*, easily seen all along the abdomen until it disappears near the brisket. The udder should be of large capacity, the larger the better, provided it is not fleshy. If fleshy, it retains its shape after milking, whereas a good udder collapses into a wrinkled bag when the milk is drawn. The udder should not be too pendulous but should extend well forward on the abdomen and should come up well behind between the thighs. The teats should be large enough to permit the milker taking hold of them. They should be squarely set on the udder, be of equal size, and not be grouped in a cluster, but be wide apart. The heifer from a good milking dam also usually milks well; but the effect of the bull is just as potent as that of the cow. The sire must also come of a good milking strain.

Characteristics indicative of deep milking qualities.

Draught cattle especially those adopted for quick draught are all the better of fierce and fiery tempers which give them spirit. The Amrit Mahál Mysore cattle are essentially a draught breed much better suited for the road than for the field. They are quick moving, hardy cattle capable of travelling long distances in a very short time. Unlike some other indigenous breeds the dewlap is not pendulous and does not interfere with their trotting action. They are medium sized cattle, squarely built and stand well on their legs, which are powerful and well shaped. They have hard flinty feet. The quarters droop behind the loins as in all Indian breeds, but I am not at all sure that even this characteristic has not something to do with

The characteristic appearances found in good draught cattle.

the activity of the Mysore and of all Indian cattle. The Amrit Mahál takes the place amongst Indian work cattle, that the thorough-bred takes among horses. For heavy haulage and slow work, a work bullock of very different conformation is required. The Krishna Valley breed is perhaps typical for this purpose. They are large ponderous cattle with frames wide and deep, and stand on short legs. The leg bones are coarse and the feet large. The dewlap and loose skin on the sheath are unusually developed, significant indications that the cattle are slow. The ears droop. The eye though prominent indicates that the temper is docile. The head is short and wide; the neck is short and thick. The back level with little or no tendency to droop behind the loins. The quarters are massive and square, the thighs far better developed than usual.

Characteristic appearances found in beef breeds.

The beef breeds of cattle, *i. e.*, those bred specially for their value to the butcher differ as much in conformation from a purely milk breed as they do from the draught breeds of India.

In Western countries the ox is occasionally a beast of burden, but in England he is mainly useful as a beef producer, and the conformation best adapted for this purpose will ill-adapt him for a hard day's toil. Early maturity and adaptiveness to fatten quickly are essential characteristics; small bones and lightness of offal tend to increase the percentage of beef. A good specimen of a fat ox is square all over, a result clearly due to breeding.

Impressiveness.

A sire is said to be impressive when the most of his offspring inherit from him certain particular valuable characteristics. This power would be shown as effectively with females of his own breed as with those less well bred. Impressiveness is not due entirely to characteristics and appearances noticeable in a particular animal. It may, to some extent, be hereditary, consequently some value should be attached to pedigree and an enquiry made regarding the good points as well as the more pronounced faults of ancestors for several back generations. The breeder will be guided by this enquiry as well as by the appearance and other noticeable qualities of the males and females which he mates. The males of those breeds which have been maintained pure for many generations are much more impressive than the males of such breeds as have been improved by recent crossing. But even in pure breeds the males of some are more impressive than those of others. Thus in India a cross between an Aden bull and Gir cow inherits the characteristics of the Aden to a very great extent. Again, if an Amrit Mahál bull is used for cows of almost any indigenous breed the offspring partakes very largely of the Mysore type. The cross between an Aden bull and a Gir cow is characteristically different from that between a Gir bull and an Aden cow. In each case the offspring resembles in a marked degree the male in outward

appearance. The superior impressive power of the Aden is demonstrated, however, by the offspring in each case almost invariably inheriting the Aden colour; also by the almost total disappearance in the Gir-Aden or Aden-Gir cross of the loose skin on the sheath and on the dewlap which is so characteristic of the Gir breed, but entirely wanting in the Aden. Gir and Aden cattle are so different in type that a cross between them must be regarded as a violent one, and therefore not to be recommended. It has, however, been often noted that in crossing two breeds more closely resembling each other in character the results noted above were obtained and the cross between "A" bull and "B" cow was a much more satisfactory one than between "B" bull and "A" cow.

Hereditary defects require special care in stamping them out. Any constitutional weakness or unsoundness may be transmitted to offspring freely by either parent. Tuberculosis in cattle and wind diseases in horses are, perhaps, more particularly transmissible than other constitutional diseases. The effect of breeding from unsound parents may give disappointing results in other ways. I have known of a bull with tubercular taint being the direct cause of numerous abortions in the cows which he covered. It has been stated with the conviction of authority and experience that the outward conformation is mainly imparted by the male and the character of the vital and digestive organs by the female. This statement must be accepted with some caution. There is no doubt that any pronounced fault is apt to be inherited alike readily from either parent.

Hereditv.

Breeding back is known as atavism. There have been numerous examples of this peculiarity in breeds characterized by a particular colour or by some other distinguishing feature. It is not uncommon to find occasionally one of the offspring varying from the recognized type. The variation may be traced to a particular more or less remote ancestor.

Atavism.

Imagination may prove a disturbing cause particularly in regulating the colour of the offspring. A cow in heat is highly sensitive and a steer or even another cow of peculiar colour jumping on the cow during æstrum may be the means of imparting to the offspring the particular peculiarity of color even though the bull used for service has the ordinary color of his breed. Many cases are on record which prove that the imagination of a female can be so excited whilst she is in heat or whilst being impregnated that the colour of the offspring is thereby controlled. Some authorities go to the length of saying that the shape of the offspring is also influenced. I know a successful breeder of horses in Canada whose invariable practice is to walk the stallion in front of the mare immediately after service in order that the mare may admire the fine proportions of the horse and the owner believes that the shape of the foal may be thereby influenced.

Imagination.

The age at which
farm animals should
be bred from.

It is a common saying that a young bull and an old stallion are sure stock getters. Stallions are not usually used for stud purposes until they are mature or nearly so. On the other hand bulls or rams of the early maturing breeds are put to service long before they have reached maturity. It is not uncommon to find bulls of all the early maturing European breeds used as sires as yearlings, whilst rams under a year old are similarly employed. In the face of popular practice, I should say that only mature and fully developed animals should be bred from. Indian cattle and sheep mature slowly, and ordinarily an Indian bred bull will not attempt to cover a cow until he is two or three years of age. In respect of females if they are bred from, whilst too young, they are weakened in constitution and dwarfed in size. A filly bred in India should not be put to the stallion before she is $3\frac{1}{2}$ or 4 years old and heifers are usually mature enough for breeding at the same age.

Abortion.

A female that has once aborted is liable to abort again. There are various causes of abortion. Excitement or fright is a common cause. Over exertion or fatigue, any sudden change in the weather, exposure to cold or storm, injury, weakness due to insufficient food are all exciting causes. "Ergot of rye" a fungoid growth found on many grasses is an undoubted cause of abortion and all fodder affected with any kind of fungoid growth should be viewed with suspicion. Recent research in the veterinary profession has proved that like other more malignant diseases abortion is contagious or infectious. The exciting cause or causes may not readily be detected even when such are preventable. An animal that has actually aborted or shows signs of abortion should be at once isolated and every precaution taken to prevent other cases by disinfection or by other means.

In horses certain
appearances indicate
certain qualities
which are sometimes
valuable and some-
times not.

Horses are bred for various purposes. The conformation naturally varies with the purpose for which the animal is bred. All good specimens have certain points in common. The experienced horse breeder in selecting a brood mare or stallion takes count of certain appearances which are indicative of certain qualities which qualities are not quite apparent to the eye. Thus, docility of temper is indicated by a wide forehead immediately above the eyes, by a full prominent eye the white of which is not conspicuous but is flecked with brown spots or blotches. A sleepy eye, drooping ears and pendulous lips, each indicates want of endurance, activity and courage. A light chestnut with white legs and face and with the white of the eye prominent, has usually a treacherous, vicious temper, but on the other hand is often full of spirit and quality. The latter characteristics are indicated by wide nostrils, alert, well set and well shaped ears, by a thin skin on which the veins show prominently, by a silky coat and by a general high bred appearance. The best test of spirit, courage, temper and quality is a fair trial. Endurance and hardiness are sometimes denoted by colour. A very

dark brown with black points and a dun with a black strip along the back are usually good for long endurance and can keep in thrifty condition on comparatively poor fare. A good judge can often with conviction declare that a particular animal is a bad doer. He arrives at this conclusion by noting peculiarities of conformation and sometimes of colour which would certainly not catch the eye of an ordinary or casual observer.

In India, the males of indigenous breeds whether stallions, bulls, or rams are more certain stock getters at stud than imported sires and are capable of successfully covering in a year or season a larger number of females of their particular class.

Males of indigenous breeds are more certain stock getters than imported sires.

THE FOOD OF FARM ANIMALS AND ECONOMY IN FEEDING.

Food can be used economically under certain conditions ; under other conditions it is more or less wasted. If too rich, that portion which is not assimilated by the organs of digestion is passed away in the solid excreta. This occasions loss in a certain sense. The urine only carries away waste products, this waste being occasioned by the wear and tear of tissues caused by exertion, by animal energy and by other causes inseparably connected with animal life. Exposure to inclement weather demands an extra supply of heat producing food to maintain the natural warmth of the body, therefore food can be economized if comfortable shelter is provided during wet or cold weather. The counterpart of protection against cold is found in the value of shade as a protection against heat. Animals under exercise or exertion require a larger supply of digestible food than those at rest, but this extra requirement cannot be termed loss, because animals under exertion are working for their keep and all young animals require exercise to promote growth and essentially to influence good health. Fattening animals increase in weight most rapidly with little or no exercise, but the artificially fattening process is by no means a natural process. Accumulated fat in the animal frame is used to help to maintain warmth and vitality in the body, when during a period of scarcity an insufficient ration is given. In cold countries a wild animal gets fat during the summer and the fatty tissues then formed undoubtedly furnish much of the material used to keep the body warm and provide other energy during the winter months when food is scant.

Food can be economized in various ways.

Food can be made more digestible and often more palatable and useful in many ways. Much of the food given to domesticated animals is not procurable by wild animals and is not therefore natural food. It may

Food can be made more palatable, digestible and useful in many ways.

therefore be necessary to use artificial means whereby it can be economized as well as made more digestible. The digestive power of young animals and of healthy adult animals is greater than that of old animals. The former classes may (although they often do not) extract nearly all that is nutritive from grain with coarse fibrous husks; not so in the case of animals of advanced age; but, irrespective of age, those grains which have a hard undigestible outer integument, if fed to farm animals, often pass through the alimentary canal with the full germinating power left intact. The digestive agents have been unable to penetrate the outer husk and extract nutriment from the richer inner tissues. An old horse inclined to greedily bolt his food without properly masticating it cannot possibly by any digestive process which subsequently takes place, get full benefit from his food. A ruminant may swallow a large amount of food with but little preliminary mastication, and unless fermentation and tympanites ensue, be none the worse, because when the cud is chewed, the food is returned from the stomach to the mouth to be further masticated, and this is done in such a placid methodical manner that there is a good opportunity of thorough digestion; yet even in the case of a ruminant we find a good deal of the food passing out in the excreta and practically unchanged. It is therefore easily understood why the gram supplied to a horse is all the more nutritious if it is crushed, but it is not quite so clear why the food of the ruminants should be artificially prepared with just as much care. That there is economy in doing so will be made clear from the following which is an everyday instance of imperfect digestion. The best of our grass *kurans* are shaded by *bábhul* trees. *Bábhul* pods are eagerly eaten by cattle, sheep and goats. The *bábhul* seed passes with the excreta of even half-starved animals with its full germinating power unchanged. The solid excreta is, of course, a good medium in which the *bábhul* seed can germinate and because the seedling is surrounded by a fertilizing substance, it thus grows with great vigour, and for this reason young *bábhuls* spring up in every cultivated field, the seed being conveyed there in the droppings of work cattle, goats, &c.

The necessity of preparing artificially in many ways the food for farm animals.

The necessity of crushing concentrated food into a fine granular condition is unquestioned. Even oil-cake is all the better for being broken fine. The expression of the oil from the oil-seed has crushed the latter, yet the pressure necessary for this purpose has consolidated the particles to such an extent, that it is necessary that the cake should be broken fine to permit of easy mastication and digestion. Straw or hay can, with every advantage, be chaffed. In India straw is practically chaffed under the feet of bullocks, whilst the grain is being threshed and is thereby made softer and more digestible; moreover the practice admits of the fodder of cereals and pulses being mixed together with great advantage. The mixed *bhusa* thus produced is superior to either of the ingredients alone for feeding purposes.

Rice, barley or wheat straws are alone neither very nutritious nor palatable. A mixture of the cereal *bhusa* with the straw, pods and leaves of the pulse is eagerly eaten by all kinds of stock. Gram (*Cicer arietinum*) fodder on account of the slightly acid taste, which it imparts, is specially valuable for mixing. It is not practicable to utilize the coarse stalks of the large millets in this manner. The heads of grain only are trampled out under the feet of bullocks. The stalks furnish the ordinary *kadbi* or *karbi*, commonly used as dry fodder for milch cattle and work oxen. An axe is the usual tool used to cut these coarse stalks up into short lengths and unless the cattle are unusually hungry the coarser part of the stalks are rejected. All ruminants require a bulky food, and it is certain that even the coarser parts of the stalks of millets would, if fed to cattle, as part of a ration, prove useful as food. These stalks would at least add bulk to food. Any fodder can by means of a chaff cutter be cut into lengths of half an inch or less. The advantage would be that the coarse parts of the fodder would be cut up into such short pieces that these would be inseparably mixed with the finer and more nutritive portions and all would be eaten. It is a common practice to mix with chaffed hay or straw more concentrated food, in the form of crushed grain, meal, ground oil-cake, &c., and moisten the whole with water or with treacle and water. The whole should be allowed to ferment for 24 hours or sufficiently long to generate fermentation and heat. Care, however, should be taken that the fermentation does not proceed too far, otherwise too great acidity will be produced. The heat and fermentation soften the chaff and make it more easily digested. Another method which can in India be confidently recommended is to chaff coarse fodder such as dry *jowári* stalks along with a certain proportion of green guinea grass, green lucerne or green fodder *jowári*. The moisture of the green fodder causes a certain amount of fermentation which has a softening effect upon the dry material and during the process of fermentation the mixed chaff develops an agreeable flavour and smell which all animals like. This kind of food is improved by the addition of a little salt, about an ounce in the daily ration for full grown cattle. Carrots are an excellent addition to the chaff and grain ration for horses, but are best given fresh and cut into thin long slices.

The value of crushing grain or oil-cake, chaffing straw or other fodder and of fermentation.

It is a common practice in India to steep gram and other grain for horses. The gram is thus softened and is easily masticated and digested, but it is very questionable, whether the practice is to be generally commended. The objection is that a horse does not masticate soft sloppy food to the same extent as he would dry food, and it probably would be objectionable to give steeped soft gram to a horse inclined to greedily bolt his food. On the other hand there is no doubt that under certain circumstances, certain cereals and pulse grains and oil-seeds can with every advantage be steeped in hot water or slowly boiled.

The economy of steeping food in water and of cooking food.

Bajri or *jowdri* if ground into meal and boiled is excellent for milch cows immediately after calving. Linseed or *til* seed (sesamum) and rice meal if made into gruel are recommended for sick animals. Barley and pulses, if parched, are considered safer as food for horses than if not so treated. Cooked food is certainly easier to digest than uncooked food, but for ordinary feeding the cost is prohibitive. Cooked food has an undoubted effect upon milk yield. It stimulates and increases the flow of milk, and in the case of cows and irrespective of cost should always be given for a week or ten days after calving. The practice is, however, ordinarily only economical when waste steam from an engine boiler or other source can be utilized for cooking purposes. Steam and especially super-heated steam if passed through food will cook it more expeditiously and more thoroughly than boiling water. Horses at hard slow work may, with every advantage, be given a mash of cooked food once or twice a week. It is excellent for horses at any description of work as an occasional change. A good mash would consist of barley and bran boiled with turnips or carrots with a small proportion of linseed or sesamum seed; a pinch of nitre and an ounce of salt should be added for each full grown animal.

Malt.

Malt and malt combs are obtained by malting barley. The malting process causes loss of feeding material, a portion of the carbonaceous part of the food being converted into carbon dioxide and lost. But the diminished weight of malt and malt combs is considered quite equivalent for feeding purposes to the original weight of barley. The explanation is that through the agency of diastase—a digestive principle—the starch of the barley has been converted into sugar and dextrine, each much more easily digested than the starch whilst the sweet agreeable taste of the malt is liked by all kinds of stock.

Variety in food recommended.

A ration can very often be improved if the palate of the animal is studied. Animals like human beings have likes and dislikes in regard to their food. Variety in food and a complete occasional change is always relished. The appetite may be stimulated by the use of certain condiments. Cattle or horses are prepared for exhibition at shows in this way, *ghee* and *gul* being used in India, treacle, sugar, spices such as fenugreek, locust beans, &c. in other countries. Food rich in sugar is good for fattening purposes, but unsuitable except in small quantities for breeding animals, because in quantity it has the reputation of injuriously affecting the breeding powers particularly of males.

The constituents of vegetable foods.

Vegetable food usually consists of the following constituents :—

- (1.) Water.
- (2.) Salts or mineral matter.
- (3.) Albuminoids or proteids.
- (4.) Carbo-hydrates.
- (5.) Oils or fats.
- (6.) Crude fibre or lignose.

The food of all animals contains water. The percentage of water in air-dried grain varies in India from 6 to 11 per cent. Generally except in the case of horses at hard fast work at least four-fifths of the food should consist of water and under special conditions more. All animals will drink more in hot weather and under exertion than when cool and idle. A cow that secretes milk freely, necessarily needs more than a cow that is dry. Less water is required as drinking water when the food is succulent than when it is fibrous and dry. The natural food of cattle, horses and sheep is the grazing obtainable on green pasture. Pasture herbage is essentially a succulent food containing at least 75 per cent. of water. Milk which is the natural food of young animals contains from 81 to 88 per cent. of water. In the animal body water supplies an essential constituent of blood and of all tissues and acts as the carrier which conveys the waste from the body. This waste may be removed either through the pores of the skin in the form of perspiration or through the kidneys and bladder as urine.

Water in food.

All animal tissues contain some mineral matter. The bones and teeth contain a good deal; hoofs and horns a certain amount. In all tissues phosphates, chlorides, carbonates and sulphates of lime, magnesia, soda and potash are common. The mineral matter in any food which is ordinarily nutritive supplies all that is necessary to build up the animal frame. Usually vegetable food contains all the essential mineral matter except common salt. At any distance away from the sea-board common salt should always be added to food. Near the sea the rainfall brings appreciable quantities to the soil and at pasture in coast districts grazing animals may get sufficient to supply their full requirements. The owner of a camel is usually put to little or no cost for food for his beast of burden except in purchasing salt.

Mineral matter in food.

Albuminoids or proteids are called flesh formers. They are called so because by assimilation they produce muscle. Nitrogen is an invariable and pretty constant constituent in albuminoids. In the whole group the percentage varies somewhat. Albuminoids, although they vary, are held to contain 16 per cent. of nitrogen and in the past analysts usually determined the percentage of albuminoids in food by estimating the whole of the nitrogen. The product multiplied by 6.25 gives approximately the percentage of albuminoids. As regards some kinds of food this conclusion is wrong. Nitrogen is present in the form of amides, &c.; consequently the chemist now determines the albuminoids separately from the amides.

Albuminoids or proteids in food.

Church in his "Food Grains of India" gives the following figures as the range in percentage composition of the whole group of albuminoids :—

Carbon	...	...	...	...	50.6	to	54.8
Hydrogen	...	...	...	...	6.7	to	7.8
Nitrogen	...	...	...	...	12.8	to	18.5
Sulphur	...	...	...	...	0.4	to	1.7
Oxygen	...	...	...	...	20.6	to	27.0

In the mature plants the albuminoids are usually collected in the fruit or seed.

Carbo-hydrates,
starch, sugar, &c. in
food.

The greater part of the dry substance of the several parts of a plant consist of a class of bodies termed carbo-hydrates. In the stems of mature plants cellulose is the predominating carbo-hydrate accompanied by sugar, the latter being present in considerable amount in immature stems. In the seeds there is usually little cellulose, the greater part of them consisting of starch or mucilage. In some cases, as in oil-seeds, oils replace the carbo-hydrates to a great extent. Starch occurs in granules which differ in size as well as in digestibility. The starch of maize is much easier changed by the saliva than the starch of wheat. The digestion induced by saliva and pancreatic secretions changes starch into dextrine, maltose and a little cane sugar. Sugar varies in analysis according to kind. All kinds when supplied in moderate amount are the most easily digested of all carbo-hydrates and are soluble in water. Sugar gives, moreover, a pleasant taste to food, but in mixed foods should be less than 1 per cent.

Gums, mucilage and
pectose in foods.

These gummy and mucilaginous substances are either soluble in water or swell up when mixed therewith. They leave when burnt a small amount of mineral ash which consists of lime, potash and magnesia salts. Mucilage and pectose are considered to be easily digestible and have probably an equivalent nutritive value with starch. Mucilage swells up in a peculiar manner when heated with water, and boiled linseed for this reason forms a soft gelatinous mass which in moderate quantity for animals with weak digestion or in delicate health is considered specially suitable. Pectose is found in many fruits and is the principle which causes fruit to form a jelly when preserved by boiling with sugar.

Cellulose, fibre lig-
nose in foods.

Cellulose is a carbo-hydrate which constitutes a considerable portion of the cellular tissues of plants. When plants are young the cellulose is digestible and to some extent nutritive. As plants mature it is converted into crude fibre or lignose which is indigestible. Crude fibre has a specific value in the food of ruminants in as much as it gives bulk to it. Animals which ruminates require more bulky food than those which do not.

These are not carbo-hydrates. They contain higher percentages of carbon and of hydrogen than starch does, and therefore when consumed in the animal body, they give out more heat and energy than carbo-hydrates. The higher the percentage of carbon and hydrogen the greater the heat evolved by combustion. The heat givers of food are in a sense burnt in the animal body. These are called respiratory foods. During respiration the animal heat is maintained, because carbon and hydrogen indirectly obtained from the food unite with the oxygen of the air inhaled by the lungs, and CO_2 and water moisture are exhaled. Vegetable oils are considered to have 2.3 times the feeding value of carbo-hydrates.

Vegetable oils, and fats in foods.

The feeding value of any food is gauged by the proportion in which the flesh formers and heat producers exist, taken in conjunction with the proportion of indigestible crude fibre and other material present. Food containing a high percentage of albuminoids is known as a highly concentrated or nitrogenous food. A high percentage of oil, of starch or of water would respectively class a food as oily, starchy or succulent. The digestibility of oil, of albuminoids, of carbo-hydrates and of fibre varies in various feeding stuffs and fodders. Fodder got from stalks and leaves yet green is much more nutritious than that from a crop which has been allowed to fully ripen because as the plant ripens the carbo-hydrates and albuminoids are largely transferred from the stem and leaves to the fruit. The best fodder is got from a crop when in flower. At this stage the fodder has nearly attained its maximum bulk and the albuminoids, oil and carbo-hydrates are distributed more or less through the substance of stalks and leaves, whereas when the crop is ripe they collect for the most part in the fruit or seed. Meantime the cellulose becomes less digestible or is converted into indigestible crude fibre.

The economic values and the digestibility of the various constituents of foods.

The fodder of some crops has a much higher feeding value than that of others. The fodder of pulse crops furnishes more concentrated food than the fodder of cereal crops. The seeds of all the pulse crops provide a far more concentrated food than the grain of wheat, *jowári*, maize or other cereal. The oil-seeds are as to richness in albuminoids intermediate between pulses and the grains of cereal. Oil-cakes are the residues left when oil is expressed from oil-seed and there is a relatively higher percentage of albuminoids in oil-cake than in oil-seed. Oil-cakes are generally more concentrated than any other kinds of food.

The comparative feeding values of various kinds of food

During the process of digestion, proteids are converted into peptones; carbo-hydrates into sugar, and oil is emulsified and absorbed as such. The parts digested per 100 parts of the various ingredients of the

The changes which occur during digestion and the proportions digested.

food vary more or less as shown in the accompanying table being Wolff's average figures :—

Kind of Food.	Oil,	Albuminoids or Proteids.	Carbo- hydrates.	Fibre.
	Per cent.	Per cent.	Per cent.	Per cent.
Cereal grains... ..	83-88	60-80	85-90	30-50
Cereal straw or inferior dead ripe hay. ... }	30-40	25-35	40-60	50-60
Pulse grains	75-80	90	92	65-75
Pulse fodder	50-60	50-70	60-70	40-50
Oil-cakes	90-95	75-85	50-80	varies.

Nutrient ratio.

The relative proportion between the albuminoids and carbo-hydrates *plus* oil (reckoned as 2·3 times the value of starch) is called nutrient ratio. In calculating the nutrient ratio count should, of course, be taken of the variation of digestibility of the digestible constituents in different foods and straw in the above table.

The food of domesticated animals should under varying conditions be more or less concentrated.

The food of domesticated animals should under varying conditions be more or less concentrated. Bullocks at hard work require more concentrated nitrogenous food than fattening steers or oxen at complete rest. Growing animals especially when quite young require an essentially nitrogenous food to produce bone muscle and other nitrogenous tissues. Horses require more concentrated food than cattle or sheep and full grown animals in milk, or with young, need richer food than such as are barren. These requirements can be economically met by adjusting the nutrient ratio. This is easily accomplished if the farmer has a comprehensive knowledge of the chemical composition of the food grains and fodders he grows on the farm and of those he buys. The ratio of flesh formers to heat givers should range ordinarily between the two extremes 1 : 5 and 1 : 10. For milch cattle and hard worked bullocks the food will be sufficiently concentrated if the ratio is 1:6. To show how the nutrient ratio may vary in different foods, I will take for illustration ground-nut cake (probably the most concentrated food known) and maize a less concentrated food which is found suitable for fattening animals like pigs and poultry. In the calculations below no count is taken of the variation in the digestibility of the albuminoids, oil and carbo-hydrates as found in ground-nut and that of the same ingredients as found in maize.

In 100 lbs. ground-nut cake there would be approximately :—

How the nutrient ratio is calculated.

	lbs.	lbs.
Albuminoids	49.5	...
Digestible carbo-hydrates	...	22.5
Oil $13.5 \times 2.3 =$ equivalent as carbo-hydrates	...	31.
		53.5
The nutrient ratio is 49.5 :		53.5
or 1 :		1.08

Therefore ground-nut cake is much too concentrated to be used alone.

In 100lbs. maize meal there would be approximately :—

	lbs.	lbs.
Albuminoids	9.5	...
Starch and digestible carbo-hydrates	...	70.7
Oil $3.6 \times 2.3 =$ equivalent as carbo-hydrates	...	8.28
		79.
Therefore nutrient ratio is 9.5 :		79.
or 1 :		8.3

which for ordinary feeding or fattening purposes is probably about a right proportion for such animals as do not require a bulky food.

The residues left when oil is expressed from oil-seed are of two distinct classes. (a) Hard pressed oil-cakes such as those made in the hydraulic press mills of Bombay. The seed is roughly crushed, steamed or cooked. The oil cells thus burst and the oil freely escapes under pressure. The component particles in these cakes are coarse and the cakes for*this and other reasons are not particularly digestible. (b) Cakes as made in the country *ghāni*. The seed as it is pressed is ground to an impalpable powder by a pestle working in a mortar both rudely fashioned. The seed may or may not have been previously heated or cooked. The cake thus made generally contains more oil and when fresh more moisture than hydraulic pressed cake. The component particles are fine and a cake of almost any description is fairly, easily digested.

Oil-cakes.

Two classes of oil-cakes, i.e., hydraulic pressed and *ghāni* pressed cakes.

Hard pressed cake is more nitrogenous than the same kind of cake with a higher percentage of oil; therefore the former is best adapted for hard worked cattle and other stock requiring concentrated food provided the seed

Hydraulic pressed oil-cakes are more nitrogenous than *ghāni* oil-cakes.

from which the cake was made had no unduly high percentage of crude fibre. With much fibre present, oil in considerable quantity is beneficial not only on account of its own feeding value but because it has a softening effect which causes the digestible material in the cake to be more easily digested. Oil is itself very easily digested and is particularly suitable for maintaining soft fat condition.

Some oil-cakes have
irrespective of com-
position a higher feed-
ing value than others.

Irrespective of actual composition as determined by analysis, there is no doubt that some oil-cakes have a higher feeding value and should therefore have a higher commercial value than others. Linseed cake and sesamum cake are recognised as two of the very best feeding cakes and are very easily digested. In both oil-seeds the heat producer present is mucilage, a substance which when boiled or steamed swells up into a jelly-like mass. There can be little doubt that this property gives mucilage a special feeding value especially in the case of old, feeble and invalid animals. Then again, although analysis would indicate that rape and to a less extent mustard seed oil-cakes are concentrated cattle foods, such cakes are viewed always with a certain amount of suspicion. In England oil-cakes made from Indian mustard or rape-seed are considered dangerous or risky foods for cattle on account of the impurities generally contained, and are liable to cause violent disorders in the bowels and intestines.

Linseed-cake.

Linseed cake is made usually from brown or ordinary seed, but a variety of linseed grown in the Central Provinces produces white seed. Lineseed cake is manufactured to a considerable extent in the hydraulic press mills of Bombay, and is one of the very best feeding cakes obtainable, but dearer than other cakes, because specially suited for export. It is worth about Rs. 70, sometimes Rs. 80, per ton in Bombay. In the famine year it was found to have been an excellent and cheap food for remount horses and young horse stock at Ahmednagar as part of the daily ration, about 4 lbs. per animal having been given daily.

Til or sesamum
cake.

Til or sesamum or gingelly cake is made from three varieties of seed, red, white and black. All have low percentages of husk or crude fibre. Til is a first-class feeding cake easily digested.

Analysis by Dr. Leather :—

					Approximate Average.
Oil...	...	...	...	...	10 to 12 per cent.
Albuminoids about	...	...	...	...	30 "
Digestible carbo-hydrates	...	...	...	...	30 "
Woody fibre	...	...	...	...	4.5 "

This cake varies in price from 35 lbs. to 45 lbs. per rupee.

Niger-seed cake is made from the seed of *khurdani* (sometimes called erroneously *kdla til* in the Deccan). The seed contains rather a high percentage of woody fibre, and if the cake is hard pressed and in consequence contains a low percentage of oil, it is somewhat indigestible. The following analysis by Dr. Leather refers to niger cake made in a country *ghani*.

Niger-seed cake.

Oil	...	...	...	...	...	13.86
Albuminoids	...	...	...	...	...	27.81
Carbo-hydrates	...	...	...	...	...	20.03
Woody fibre	...	...	...	...	...	19.50

This cake also sells at 35 lbs. to 45 lbs. per rupee, but as a feeding cake is inferior to sesamum, and should not cost so much.

Safflower cake is made from safflower seed called *kardai* in Deccan, *kusumba* in Gujarát. The seed of safflower contains about 26 per cent. of husk, but the husk is fibrous and easily removed by half crushing the seed and sifting. Safflower cake is generally made from the kernels, the greater portion of the husk being previously removed. The presence of much husk can readily be detected, being pure white and glossy. The kernel is dull yellow green. Pure safflower cake is seldom made. Safflower kernels are mixed with certain proportions of sesamum and husked ground-nut seeds. The mixed cake thus obtained has a higher feeding value than the cake made from safflower kernels. In the hydraulic press mills of Bombay two mixed cakes are made—the one safflower and ground-nut, the other safflower and niger-seed. The safflower cake of the bazar is a very good feeding cake if there is no undue percentage of husk. It has the advantage of keeping well if stored in a dry condition. It has no great tendency like other cakes to mould, or become rancid; therefore can be bought in quantity at seasons when cheap. Sometimes this cake considering its feeding value, is very cheap. I have bought it at Ahmednagar at 80 lbs. per rupee.

Safflower cake.

The analysis of an ordinary bazar sample gave results as follows :—

Oil	...	...	...	...	...	9.80
Albuminoids	...	...	...	...	...	37.75
Carbo-hydrates	...	...	...	...	...	21.19
Woody fibre	...	...	...	...	...	20.17

The above sample for hard worked cattle would have about equal feeding value with niger-seed cake.

Earth-nut or ground-nut cake (*bhuimug*) is made from kernels and is perhaps the most concentrated cattle food known. It is too concentrated to be fed alone unless the fodder (hay, straw, &c.) given to make up the ration is of a very inferior quality and even in that case the quantity of oil-cake given should not be large. Ground-nut cake in conjunction with ground barley, ground maize

Ground-nut cake.

or any other starchy grain would form a useful concentrated mixed food for hard worked animals.

The following is an analysis of pure ground-nut kernel cake not hard pressed :—

Oil	...	...	...	...	...	13.41
Albuminoids	...	...	...	...	...	49.48
Carbo-hydrates	...	...	...	...	...	22.52
Woody fibre	...	...	...	...	...	2.75

Cocconut cake.

Cocconut cake is made from dried cocconut kernels (*copra*), which are shipped from the Malabar Coast extensively to Bombay. The cake soon turns rancid and should therefore be used as soon as possible after being made. It is considered a specially good food for milk buffaloes and therefore commands rather a high price in the Bombay market. It is also exported to some extent, in open boats to Káthiáwár. When there is a keen European demand the price rises to a high pitch, sometimes as high as Rs. 70 per ton. At this rate other oil-cakes will in India be found of much better value. If European cattle feeders knew with certainty the feeding value of other Indian oil-cakes, no doubt the price of all would rise owing to keenness in export demand, particularly if a sufficient guarantee could be given as to purity. Cocconut cake is not nearly so concentrated a food as other oil-cakes and therefore if used alone is for ordinary feeding probably more suitable than any of them. The kernels are extremely rich in a clear limpid oil so rich in fact that usually a high percentage is left unexpressed in the cake.

Analysis by Mr. S. H. Collins :—

Oil	...	...	...	...	...	16.53
Albuminoids	...	...	...	...	...	13.62
Carbo-hydrates	...	...	...	...	...	44.57
Woody fibre	...	...	...	...	...	12.45

Cotton seed and cotton seed cake.

The foregoing are about the only oil-cakes available as cattle food in India. A factory was started in Bombay to express oil from cotton seed but resulted in failure. This might have been anticipated. The seed of Indian cotton seed has a totally different composition to the seed of Egyptian or American cotton seed, the percentage of oil in Indian cotton seed being comparatively low. Indian cotton seed beyond a very moderate quantity is, I believe, a dangerous food for cattle of any kind, on account of the high percentage of fibre and adhering lint. The softening effects of the oil present makes this oil-seed less dangerous, but even with this ameliorating influence, I do not think that any quantity beyond perhaps 4lbs. per day can safely be continuously fed to hard worked cattle or cattle of other description, and in particular, it is not by any means a suitable food in quantity for young growing animals. Cake made from undecorticated Indian cotton seed would

be still more dangerous; because with the removal of oil the indigestible fibre would be present in excessive and injurious amount.

I give below a tabulated statement showing the analyses of the various pulses grown in India. Of these, the Bengal or ordinary gram, *kulthi*, *guvâr* and *láng* are those most usually given as food to horses and cattle. The other pulses are too valuable as food for the people to be used as food for animals, but in preparing *dál*, *i.e.*, split pulse or pulse meal from these grains the outer integument is removed more or less and with it a certain varying amount of the inner more nutritious parts. This by-product known under the name of *chuni* in the Deccan varies much in feeding value. There may and generally is a very large proportion of husk present. If there is a fair proportion of meal present with the husk then the *chuni* has a fair nutritive value. But it is very difficult to determine casually what the relative proportions are, and any ordinary purchaser is almost certain to be "done" if he purchases *chuni* in the native bazar. Bengal or ordinary gram is generally dear, and although when mixed with bran, oats or barley, it is a very good food for horses or cattle at hard work, still *kulthi*, *guvâr* or *láng* can generally be bought at a much cheaper rate and at better feeding value. It is generally conceded that Bengal gram should be crushed or, perhaps, ground into coarse meal before it is fed, and perhaps, also steeped if used as food for cattle. *Guvâr* requires similar treatment and *kulthi* should be boiled. The latter is a flat grain with smooth shiny outer integument and would readily pass undigested, unless by boiling it is made soft and swollen; and in particular it would not be properly digested, if fed in its natural condition to old animals. *Láng* in some seasons is not a safe food for either man or beast. It occasionally contains a poisonous principle which has the reputation of causing paralysis, its irritating poisonous effect on the intestines causing diarrhoea. This pulse should be parched or boiled before being used as food for cattle.

In directing attention to the analyses below, it should be noticed that the pulses are all concentrated foods with a close nutrient ratio, and therefore, for ordinary feeding purposes, should be mixed with starchy or heat giving foods in proper proportion. Bengal gram contains a rather high percentage of oil and *guvâr* a fair percentage, and both pulses are all the more valuable for feeding on this account. *Guvâr*, unlike *kulthi* and Bengal gram, has an unduly high percentage of crude fibre which, of course, detracts from its feeding value. *Láng*, peas and soy bean are very concentrated foods, the percentage of albuminoids in each being higher than in any of the other pulses. The soy bean contains much oil. This plant like some other pulses yields excellent fodder which, if cut green, can be made into excellent hay. *Kulthi* on light land, and *chola*, *ulid*, *mug*, *vál*, and *láng* on heavier land yield each a fair weight per acre of excellent green fodder. The amount of fodder got from *math*, *masur*, Bengal gram, and *tur* is trivial as compared with that from other pulses named.

The various pulses grown in India—
Their comparative food values.

Preparing the various pulses for food.

Pulses are all concentrated foods and should be mixed with starchy foods in proper proportion.

The fodder from pulses.

Analyses by Dr. Leather.

Composition.	Bengal gram (Oleraceum).	Guér Common variety used for cattle food, (Cyanopis psoraleoides).	Vatana white Indian peas, (Pisum sativum).	Vatana Black Indian Peas, (Pisum sativum).	Masur, Lentil, (Ervum lens).	Katki, or horse gram, (Dolichos uniflorum).	Ling, (Lathyrus sativus).	Chola, (Dolichos catieng).	Mug, (Phaseolus mungo).	Uddi, (Phaseolus radiatus).	Vil, (Dolichos lablab).	Meth, (Phaseolus acuminifolius).	Tur, (Cajanus indicus).	Soy bean, (Analysed from Church's "Food Grains").
Moisture	...	11.35	8.63	12.05	11.25	8.03	7.45	7.89	9.48	8.14	7.11	8.59	8.08	11
Oil	...	4.83	2.29	1.27	1.47	1.06	.89	.79	1.83	.99	.98	1.07	1.32	18.9
Albuminoids	...	18.57	18.81	24.12	24.69	23.00	20.06	24.69	23.56	18.56	23.31	22.50	19.38	35.8
Soluble Carbo-hydrates	...	56.33	55.50	54.44	52.47	61.14	60.62	57.98	56.39	59.11	56.98	58.85	61.39	26
Woody Fibre	...	6.17	10.96	5.47	6.67	2.42	4.57	4.28	4.42	4.33	6.94	4.24	5.94	4.2
Ash	...	2.75	3.81	2.65	3.45	4.35	6.41	4.37	4.32	*8.93	4.73	4.75	3.89	4.6

*Sand 4.49.

I append below analyses of various Indian oil-seeds. Except where noted the percentage of insoluble silicious matter (sand) in the samples was trifling. The cotton seed analyses show that the oil-seed is very much inferior in feeding value to the other oil-seeds. Mustard and safflower seed are also comparatively poor. Ground-nut, yellow rape-seed (*sarsav*) and black sesamum are each very rich. The samples of cotton seed are, for feeding purposes, especially for hard worked animals, worth less than half as much as a good feeding cake. A fictitious and exaggerated value is generally attached to cotton seed as cattle food. It is in general use, because it is so extensively produced, but at ordinary market rates is by no means a cheap food.

Indian oil-seeds.

As already noted linseed and sesamum seed have each a special value as food for sick or delicate animals or for getting horses into condition, and for this purpose, these oil-seeds should always be boiled and used in moderate quantity, not more than 2 lbs. per day, with other food, and generally less will be found amply sufficient.

Analyses of Various Oil-seeds.

Composition.	By Dr. Leather.										By Mr. Collins.	
	Linseed.	Niger-seed, Poona.	Safflower seed, Poona.	White oil, (Sesamum.)	Black oil, (Sesamum.)	Red oil, (Sesamum.)	Ground-nut kernel.	Yellow rape-seed, Cawnpore.	Black rape-seed, Cawnpore.	Mustard seed, (oil) Cawnpore.	Cotton seed, Poona.	Cotton seed, Surat.
Moisture ...	4.97	6.15	7.49	4.87	5.42	5.36	4.70	6.15	7.15	7.50	6.98	6.88
Oil ...	37.47	41.14	31.84	48.13	46.60	46.20	49.25	41.37	33.87	23.90	14.57	16.51
Albuminoids ...	23.19	20.07	13.31	22.50	25.81	21.03	29.09	23.61	25.89	16.29	11.34	12.54
Carbo-hydrates ...	23.97	15.08	18.66	14.05	8.96	15.88	13.21	22.25	22.04	31.87	35.96	32.54
Woody Fibre ...	5.60	12.18	26.31	4.49	6.52	4.18	1.65	2.97	6.40	5.43	25.05	27.11
Ash ...	4.80	5.46	2.39	5.96	6.69	7.35	2.10	3.65	4.65	10.01	6.15	4.47
Sand ...	.....	1.09	.....	.....	.....	1.35	.....	.....	.....	3.85	1.68	.....

The tabulated statement below gives analyses of the more common Indian cereal grains. The analysis of Indian wheat bran is also included. The more common Indian cereals.

The only foods of the list which would ordinarily be used as food for horses and cattle would be barley, oats, wheat bran and maize. And in years when ordinary millets are cheap, *jowári*, *bájri*, *nágli* and *kodra* might also be used. *Nágli* and *kodra* are each rather inferior as food, the former especially being deficient in oil and albuminoids. The grain of *kodra* as well as its straw in some seasons contains a narcotic principle which is dangerously poisonous. The other millets especially *bájri*, *vári*, *sáva* and Italian millet are extremely well balanced foods with very low percentages of husk or other indigestible material, and if ground into meal, or crushed and boiled, or steamed are all of them particularly good foods for animals in delicate health or requiring nursing. These millets can often be bought at very moderate prices. Maize, if crushed, is an excellent food for horses if mixed with gram, barley, oats and bran in proper proportion, but is too heating to be used alone. Indian barley and oats are poorer in nutritive value than English samples. The percentage of crude fibre is high in the oats, but this defect is counterbalanced by a rather high percentage of oil. It may be accepted that country oats are a very safe food for horses in hard condition or hard worked cattle, and mixed with gram or other pulse or in conjunction with a good feeding oil-cake would be excellent food for all hard worked animals. The same might be said of barley and maize or wheat bran as made in India. The latter food is totally different in composition to English wheat bran. English bran has well defined laxative properties which Indian bran has not. The latter may be regarded as a capital food if fed along with the usual description of hay or other dry fodder to animals at moderate work. * It is nearly equal in feeding value to country oats or barley, and may safely be used to wholly replace the usual gram bran ration given to *gharry* horses at moderate or slow work.

Analyses of Various Cereals.

Composition.	By Dr. Leather.					By Mr. Collins.					By Dr. Leather.					Church.				
	Wheat, Sindhi.	Wheat, Buxar.	Barley, (Jae) white.	Barley, black.	Barley, chocolate.	Oats, Dehra Bazar.	Wheat bran.	Wheat bran, Poona.	Jowari (Sorghum vulgare), white fine variety.	Jowari (Sorghum vulgare), white 2nd class variety.	Jowari (Sorghum vulgare), red cheap grain.	Rice grain, Poona.	Bajra (Pennisetum typhol- denum).	Pari, (Panicum miliari).	Sera, (Panicum mili-a ceum).		Naga, rats or bato (Elea- sine coracana).	Rila or Kana (Setaria italica).	Kora or harit (Paspalum scrobiculatum).	Bari or Bari, (Panicum trumentaceum).
Moisture ..	12.21	13.93	13.74	12.55	12.79	10.17	12.93	11.88	12.04	11.55	12.08	10.98	8.87	7.95	8.57	9.38	7.75	8.01	7.12	12.5
OH ..	1.66	2.13	1.80	1.95	1.97	5.27	4.94	4.19	3.06	3.50	3.22	.90	5.08	4.11	5.09	1.38	4.54	3.96	4.39	5.6
Albuminoids ..	9.92	8.91	8.29	7.75	8.24	6.39	7.56	10.90	7.10	6.00	9.92	4.35	8.92	8.88	9.88	5.37	10.37	5.81	7.06	9.5
sol. Carbo-hydrates ..	72.68	72.70	70.32	69.71	73.23	61.57	65.78	88.68	74.45	76.70	71.47	82.43	71.75	67.19	64.21	78.46	69.19	70.06	67.56	70.7
Woody Fibre ..	1.73	1.58	3.49	5.63	1.73	11.29	5.47	9.87	1.38	.96	1.17	.80	.90	7.63	6.30	2.47	5.22	8.47	7.44	2.0
Ash ..	1.80	1.75	2.36	2.45	2.04	5.31	3.32	5.00	1.96	1.29	2.14	1.06	1.78	6.24	6.45	2.94	2.93	4.38	5.53	1.7
Sand ..	..	..	.60	1.00	..	3.42	..	.44	.32	..	.27	..	..	4.08	3.95	.47	1.49	2.95	4.13	....

The following three analyses by Dr. Leather of *bhusa* being the straw, leaves, chaff and pods of pulse crops, show that this description of fodder is very concentrated and at least equal in feeding value to any inferior description of grain. The objections are the high percentages of woody fibre and of sand. The woody fibre is necessarily present because the fodder is obtained from dead ripe crops and the sand is also necessarily present on account of the country method of reaping and threshing. All the pulse crops when threshed yield fodder which is held in high esteem by ordinary cultivators; that from Bengal gram is used extensively to mix with the *bhusa* of wheat and other cereals, and as it imparts a peculiar acid flavour the mixed *bhusa* is relished by all kinds of farm animals.

Pulse *bhusa*.

Láng (*Lathyrus sativus*) is a pulse which is harvested whilst the fodder is quite green and the crop is dried like grass in hay-making for a week or ten days. The *bhusa* from the pulse is particularly good and generally is reserved as food for work cattle at busy seasons. The *bhusa* fodder from pulses if procurable at rates charged for ordinary fodder would be very good value. But the *rayats* generally reserve such fodder for home use.

Composition.	The husks and leaves of <i>tur</i> (<i>Cajanus indicus</i>) trampled out in threshing.	<i>Bhusa</i> of gram (<i>Cicer arietinum</i>) stems, leaves and pods.	Pea <i>bhusa</i> stems, leaves and pods.
Water	6.22	10.11	9.88
Albuminoids	14.94	4.46	9.94
Soluble Carbo-hydrates.	54.45	38.84	42.83
Woody Fibre	14.35	27.63	22.27
Ash	10.04	18.94	15.08
Sand	3.92	9.30	5.75

Below I give analyses of ordinary dry Indian fodders, cereal straws and dry grass. The analysis in the fourth column is that of hay made from grass in flower. It is better than the dead ripe grass of the third column, but not so good as the Kaira hay which is made from dead ripe grass and railed in bales to the Tramway Company in Bombay. (See 2nd column). There is no

Dry Indian fodders from the straw of cereals and grass.

doubt that some grasses are superior in feeding value whether cut green or allowed to become dead ripe, and the Kaira grass which is sent to Bombay is of superior quality. Dried grass as ordinarily obtainable (it cannot be called hay) has about the same feeding value as wheat and oat straw. Indian barley straw seems to be superior to either, and rice straw though everywhere considered inferior as fodder is not so very much worse than ordinary dried grass. The inference is that Indian hay or dried grass is very poor stuff. If the analyses of the samples of *jowári kadbi* are examined they will be found superior as regards feeding value to dried grass, and wheat, barley or oat straw, and weight for weight ought for the feeding of horses or especially of cattle be more valuable. *Kadbi* is extensively used at the Remount Depot at Ahmednagar, and I believe that the results with young horse stock have always been satisfactory. The analyses given are of average samples of *kadbi*. It is curious that the *kadbi* of *bājri* in Gujarát is considered of fairly good nutritive value, whereas in the Deccan it is held in poor esteem. In the former province *bājri kadbi* is ordinarily given to highly fed milk buffaloes and is readily eaten by these animals, whereas in the Deccan it is rejected by all animals except such as are more or less half starved. The variety of *bājri* grown in Gujarát differs from that grown in the Deccan, and the Gujarát soil being very fertile may possibly produce fodder of superior class. As regards other cereals in common cultivation some produce straw which is generally admitted to be of inferior quality. The straw of maize (*Zea mays*), if dead ripe, *nāgli* (*Elusine coracana*) *vāri*, (*Panicum miliare*), *sāva* (*Panicum miliaceum*) and *kodra* (*Paspalum scrobiculatum*) are all of this class. Italian millet or *rāla* grows very quickly either in the monsoon or under irrigation, and produces an excellent quality of straw, but no great outturn.

Analyses of Ordinary Cereal Fodders in Dry State.

Composition.	By Mr. Collins.		By Dr. Leather.		By Mr. Collins.		By Dr. Leather.		
	Rice straw, Poona.	Hay sent from Katra to train- way Company, out dead ripe, Bombay.	Nagpore grass cut dead ripe.	Nagpore grass cut green and in flower.	<i>Sundia Jowari</i> <i>Kadbi.</i>	<i>Jowari Kadbi</i> Poona bazar good quality.	Wheat <i>bhusa</i> , straw, &c., trodien under feet of cattle whilst grain being threshed.	Barley <i>bhusa</i> , straw, &c., trodien under feet of cattle whilst grain being threshed.	Oat <i>bhusa</i> , straw, &c., trodien under feet of cattle whilst grain being threshed.
Water ...	8.47	8.72	9.81	9.23	8.04	7.85	7.56	7.93	9.53
Oil ...	1.77	.....	.....	.....	2.19	2.11	.....	.....	.....
Albuminoids ...	1.18	2.45	1.54	2.46	3.83	2.29	2.37	4.00	1.37
Carbo-hydrates ...	47.03	45.89	39.39	44.16	47.98	46.27	43.06	41.45	43.48
Woody Fibre ...	25.71	34.48	34.58	31.75	27.90	31.38	34.68	34.82	36.09
Ash ...	15.84	8.48	14.68	12.40	10.06	10.60	12.83	11.50	9.53
Sand ...	13.97	7.38	12.01	10.66	7.15	7.15	11.77	6.25	5.81

Green fodders.

The following analyses of certain green fodders require no explanatory

* remarks :—

Analyses of certain Succulent Fodders.

Composition.	By Dr. Leather.		By Mr. Collins.		By Dr. Leather.			
	<i>Jowdri</i> nearly ripe but not sun-dried.	Sorghum nearly ripe but not sun-dried.	<i>Jowdri</i> green in flower, Madras.	<i>Jowdri</i> green in flower.	Sorghum reaped green in flower.	Silage, Nagpore.	Lucerna, Poona Farm.	Guinea grass, Poona Farm.
Water ...	67.02	57.15	80.24	69.76	70.96	12.08	77.75	63.38
Oil ...	.....	.....	.46	.....	.....	.....	.76	.84
Albuminoids ...	.64	1.22	1.21	.55	.81	2.53	3.00	1.88
Carbo-hydrates ...	16.42	19.17	9.71	14.74	12.14	40.52	11.89	19.86
Woody Fibre ...	12.78	18.13	6.15	11.90	12.57	33.95	3.74	8.79
Ash ...	3.14	4.33	2.23	3.05	3.52	10.92	2.86	5.75
Sand ...	1.62	3.04	.14	1.88	2.2	9.34	.11	3.15

When barley is malted and beer brewed there are two by-products—malt coombs and brewer's grains—both useful as food for animals.

Malt coombs.

Malt coombs consist of the dried rootlets and young shoots which are sifted after the sprouted barley is dried as malt. The malt coombs provide a very good easily digested food for milch cows and sheep. An average sample would contain

Albuminoids	...	...	...	...	22 per cent.
Heat givers	...	...	...	...	54

Brewer's grains is the spent residue left when wort is extracted from malt. This food is excellent for milch cows, largely increasing the flow of milk; but the milk is poor. In a fresh state brewer's grains contains much water. The average sample would have the following analysis :—

Brewer's grains.

Water	...	...	...	...	70 per cent.
Albuminoids	...	...	...	...	5 „
Oil	...	...	...	...	1 „
Carbo-hydrates	...	...	...	...	12.5 „

In India brewer's grains gets sour very quickly and moulds, and then gets fly-blown. They can, however, be desiccated when fresh and if quite dry will keep good for months.

Reference has already been made to the use of locust or carob beans as a condiment used to mix with the food of fattening animals. The pods contain a good deal of sugar and gums of agreeable flavour. Small hard seeds are imbedded in this.

Locust or carob beans.

Mr. Church gives the following as the analysis of locust bean :—

Water	...	...	...	...	...	14.6
Oil...	...	...	...	...	...	1.1
Albuminoids	...	...	...	...	...	7.1
Sugar	...	...	...	...	...	51.8
Other Carbo-hydrates	...	...	...	...	...	16.1
Fibre	...	...	...	...	...	6.4
Ash	...	...	...	...	...	2.9

Concentrated food for hard worked cattle would be mixed economically more or less as follows :—

Ration of concentrated food for hard worked cattle.

- $\frac{1}{6}$ th very concentrated food like ground-nut cake.
- $\frac{1}{6}$ th gram or any other pulse, or cotton seed in place of pulse.
- $\frac{3}{6}$ th wheat bran, ground barley, ground oats or ground maize.

I would give with the ration mixed as above or in lieu of a portion of the ration, a pound of boiled linseed or boiled *til* three times a week or oftener. An alternative ration would be as under :—

$\frac{1}{3}$ rd fairly concentrated cake like safflower or sesamum.

$\frac{1}{6}$ th pulse grain, or cotton seed.

$\frac{1}{2}$ wheat bran, ground barley, ground oats or ground maize.

Either of the above rations should be given with green grass, dried grass, *kadbi* or wheat, oat or barley straw, limiting the concentrated ration, according to the size of the animal and the work expected. A full allowance of fodder should be given. The actual weights of concentrated food necessary for different animals under varying conditions are dealt with in another chapter. If the *bhusa* of pulses is available in part as fodder, the concentrated cake and grain ration should be made less concentrated.

Ingredients of concentrated rations should be regulated by market rates for different foods.

The particular ingredients of rations may depend more or less on market prices. The cheapest foods obtainable should be used provided that the nutrient ratio does not fall below that required by various animals under particular conditions of feeding. It should also be borne in mind that the horse and the ox have each a palate, and an occasional change in the daily ration is relished. An occasional mash for this purpose consisting of boiled barley, linseed, a few boiled carrots or turnips with a full allowance of salt not only serves as a change, but also exercises a healthful influence, and similarly carrots or lucerne or guinea grass given occasionally or regularly have also beneficial effects, apart altogether from the feeding value of such food.

ENSILAGE.

The terms ensilage, silo, silage explained.

Ensilage is the process of preserving fodder in its green succulent condition. The structure on which the fodder is preserved is called a *silo*, and the fodder preserved is called *silage*.

The ancient practice of preserving grain in pits.

The process probably owes its origin to an ancient practice of preserving grain in underground pits against periods of scarcity and likewise to prevent marauding enemies from obtaining possession of the stored grain. This practice was common in Spain and Egypt in ancient times. In the Deccan and other parts of India, food grains are pitted in years of plenty; but the practice does not prevail to the same extent as formerly, because the construction of railways and maccadamized roads has equalized prices everywhere. The pit is formed where the subsoil consists of grey

impervious clay (*mānd*). A hole is dug 2 feet square and 6 feet deep, gradually becoming narrower towards the bottom. This forms a funnel-like entrance to the pit. When a depth of six feet is reached the process of scooping out the pit or *pev* commences. Its size is regulated by the quantity of grain to be stored which may be as much as 15 tons. When the excavation is complete, bamboo matting is spread on the floor and the grain is poured in. Several men arrange a thick layer of straw at the sides of the *pev* as it is being filled. When it is completely filled, a big stone is placed on its mouth, and the funnel-shaped entrance is filled up with earth which is well rammed down. The *pev* is filled as soon as the grain is threshed and before weevils make their appearance. The grain when taken out after 5, 10 or more years, looks to the eye as good as when it was pitted. No kind of preserving agent is used and the grain remains free from insects and other pests. A small quantity of grain by the sides of the *pev* is, however, spoilt in colour but is saleable. Grain, which has been stored in a *pev* has a strong earthy smell and a slightly bitter taste and nowadays sells at $\frac{2}{3}$ of the highest market rate. It will not keep any time after being removed from the pit and is therefore sold for immediate consumption. When the *pev* is opened, it is left exposed for at least 24 hours; because owing probably to the presence of carbonic acid gas people have been suffocated by attempting to remove the grain without its due exposure.

The manner in which grain is pitted in the Deccan.

Filling the pit.

Pitted grain only slightly damaged by storage for many years but will not keep when taken out.

There is danger in entering the *pev* when first opened.

An airtight compartment was at one time considered essential for the proper preservation of silage. More recently it has been proved that green fodder can be successfully ensiled in a stack or heap provided sufficient pressure is applied to exclude air. There is, however, always considerably more wastage in a stack silo than in a well constructed masonry silo.

An airtight silo is not necessary to preserve silage.

Chemical changes in succulent vegetable matter are induced by access of air. If air is absolutely excluded, no change can occur. Under ordinary circumstances, a certain amount of air must find access, and this causes fermentative changes which are difficult to control. The provender ensiled may undergo different kinds of fermentation, each kind depending upon the active growth of microbes, the germs of which are abundantly present in the atmosphere.

The cause of fermentation in silage.

Lactic acid fermentation occurs with almost complete exclusion of air and "sour" ensilage is produced, which keeps well when removed from the silo. When air is more or less freely admitted a high degree of heat is generated which destroys the lactic acid ferment. If the temperature rises to 120° to 150° Fah., alcoholic fermentation occurs and sweet ensilage is produced. It has a sweet agreeable odour somewhat like that of good hay, and generally the original green colour of the fodder has changed to a yellow brown. The alcoholic or "sweet" fermentation can be

Lactic acid fermentation.

Alcoholic fermentation.

arrested by applying pressure, which if sufficient will lower the temperature and arrest all further change. If, however, air gets more or less free access, acetic fermentation follows the alcoholic fermentation, and the silage becomes sour. But this description of silage is not technically known as "sour" silage.

Acetic fermentation.

The relative values of sweet and sour silage.

Silage which has undergone alcoholic or acetic fermentation will mould very quickly when removed from the silo and if exposed to the atmosphere. Sweet silage is more palatable to domesticated animals than sour silage; but during the process of ensilage there has been a greater loss of nutritive material in the former than in the latter.

Ensiled fodder loses weight for reasons given.

The fermentation is a process of oxidation, therefore the loss of solid matter falls chiefly upon the carbonaceous matter. In India the atmospheric heat is so great that it penetrates by conduction almost to the centre of any silo, however well constructed, and evaporation of moisture results. Therefore in India silage is not nearly so succulent as in Europe. The weight of silage as compared with the weight of green fodder from which it is made, indicates in India a loss of 33 to 45 per cent. In experiments conducted in England, it has been proved that under good management with well constructed silos the loss owing to the process of ensilage has varied from 5 to 15 per cent. and with bad management considerably more. The loss was found chiefly to be in digestible fibre, woody fibre and carbo-hydrates. There was also a considerable reduction in albuminoid substances.

The loss in weight in India compared with that in England.

The feeding value of ensilage and hay contrasted.

When suitable fodder of fine quality is ensiled, the silage has not in ratio the same feeding value as well made hay from the same description of herbage. The cost of making silage is greater than that of making hay. It may therefore be concluded that where hay can be made without any risk of being spoiled by weather, there is no economy in making silage, except that in cool countries (not in hot) it provides a succulent food at seasons when such food is scant. This description of food is particularly serviceable for milch cattle. But silage must be fed with a certain degree of caution. Sour silage is sometimes credited with the power to give the milk of cows fed upon it an objectionable taste. It is curious that cattle fed partly on silage drink much more water than cattle fed on other equally succulent food. This may account for the generally accepted fact that silage-fed milch cattle freely secrete milk of rather poor quality.

Silage a useful food for milch cattle; but must be cautiously fed.

Silage can be economically made in India for certain reasons.

The only sound reason why silage can be economically made in India is that the grasses come into flower and are at their best during the rains, when it is impossible to make hay. If grass is cut and ensiled early in the season

a second growth springs up which can be made into good hay during the fair season. The tall coarse grasses which are so common close to river banks, get so fibrous before the fair season arrives that they make a most inferior quality of hay, and silage could with undoubted economy be made earlier in the season from fodder of this class.

Silos may be above ground, below ground, or partly above and partly below ground. Very often an ordinary building has been converted into a serviceable silo. Specially constructed silos are generally constructed where there is a considerable surface slope and are partly above and partly beneath the surface. They can thus be filled with comparative ease and can with equal ease be emptied. The walls of a silo need only be of moderate thickness, but should be carefully plastered with cement and be quite smooth.

Silos : their construction.

A silo has a capacity of about 40 cubic feet per ton of silage. Sometimes the fodder to be ensiled is placed in the silo in its natural condition, sometimes it is previously cut into short lengths with a chaff-cutter. Chaffed fodder, particularly if succulent, bleeds under pressure and loses some of its nutritive value by drainage. Chaffing is advantageous, however, because the fodder can be packed easily in the silo and can be removed from it with less trouble than long silage.

The capacity of the silo and method of filling it.

In making sour silage the fodder should be trodden down in the silo with great care particularly round the sides. The treading should be continuous. The more perfect the treading the less artificial weighting is required. For sour silage the weights ought to be put on as soon as the silo is filled. The fodder will sink, and the silo may be again opened, filled and reweighted. 100lbs. per square foot is probably sufficient weight. The more succulent the fodder the less pressure is required. Close fitting boards should be placed over the silage and a super layer of sand or earth one foot to fifteen inches thick will afford sufficient pressure.

Filling for sour silage.

For sweet silage the fodder need not be trampled down in the silo with the same care, and when the silo is full it may be left for two or three days unweighted until the temperature rises. The silage will sink as it gets hot and more fodder may be added from time to time. It may take a week or 10 days to complete the filling of the silo. If the temperature is then as high as it ought to be, the mass may be weighted in the manner described above. Under the most careful management, a few inches of silage at the top and round the sides of the silo will mould.

Filling for sweet silage.

The quality of silage depends upon the quality of the green fodder from which it is made. The fodder which is used should not be watery and underripe or fibrous and overripe. Fodder cut when in full flower makes the best silage. Any ordinary fodder crop is suitable.

Fodder for silage.

The construction of the stack silo: its advantages and disadvantages.

The silo stack possesses the advantages of cheapness and the disadvantage of causing considerable wastage of the material ensiled. Grass is the usual fodder ensiled in a stack. It should in India be tied into sheaves in the field and thus carted to the stack. The sheaves or bundles are easily handled and can be thrown up on a stack silo of considerable height. The bundles should be untied on the stack and the stack built up with grass in the same manner as with hay. The sides and ends should be either kept quite perpendicular or inclined outward from the base and trimmed as the stack is built, so that there may be as little waste as possible. The silage should be trampled down tight as the building proceeds and the stack finished in three or four days. The silage can be weighted by building hay or other dry fodder over it. The stack can be topped in this manner and it may be thatched if necessary. There is always considerable loss of silage at the sides and therefore it is advisable to build large stacks, so that the extent of loss may be proportionately less.

Fermentation in a stack silo is not easily controlled.

The temperature of a stack silo cannot easily be controlled. Generally in a stack silo the lower layers will be seen to be greener than the upper, whilst the colour gradually gets brown towards the top. The bottom layers have been converted into green or sour silage, because the pressure of the super layers has excluded the air. Above sufficient air has found access to supply oxygen for high temperature fermentation, and sweet silage is thereby produced.

THE HARVESTING, CURING AND STACKING OF FODDER CROPS.

Hay-making.

The method of converting certain green succulent crops into dry fodder is called hay-making. When green grass is mown, sun-dried and stored in sound condition in a stack it has been made into hay. Similarly when clover, lucerne, oats, &c. are cut before maturity, cured and stacked, the produce is called, as the case may be, clover hay, lucerne hay or oat hay. *Jowári* and other sorghums are often cut green and converted into *kadbi*. This can hardly be termed hay-making, yet the process is identical.

Kadbi (dry fodder *jowári*.)

The stage at which sorghums should be harvested for fodder.

The sorghums yield the best dry fodder, when cut while in full flower. The crop has, at this stage, almost acquired its full growth. The leaves and stalks are sweet and succulent and contain a maximum proportion of nutritious matter, and a minimum percentage of indigestible material.

Method of harvesting and curing.

The sorghums are reaped with a blunt sickle. These crops feed near the surface and the plants are easily uprooted, only a few stalks here and there being cut through. As each handful is cut the roots are beaten sharply

with the back of the sickle and freed of the dry earth particles. The stalks are laid neatly in swathe and should be exposed to the sun for two days. The crop is then bundled, the stalks which were most exposed occupying the centre of each bundle. The bundles should be carefully stooked, about 10 bundles together. If rain threatens, the sheaves should be turned daily, so that they may sooner become dry. It takes a week to dry fodder *jowari* sufficiently for safe storage. It will lose about 50 per cent. in weight before it can safely be stacked. If the bundles are made small they will dry the quicker. This is a necessary precaution only during the monsoon. A Dutch barn is very valuable for storing half-dried fodder at this season, because fodder can be stacked in the barn when rain threatens and turned out to dry thoroughly in fair weather. Exposure to one day's rain does little harm, but if the rain comes in intermittent showers all fodders very quickly spoil in India.

The advantages of a Dutch barn.

The general method of cutting grass in India is also with a sickle. Cutting and bundling costs where cool labour is dear about Rs. 1-8 per 1,000 bundles of hay. The bundles when quite dry generally average about 1 lb. each. The best hay is made from grass when in full bloom. Usually in India it is difficult to cure grass into hay at this stage, because wet weather usually prevails at the time. Grass is therefore allowed to get almost dead ripe before it is cut and becomes so dry that it can be tied up into bundles at once and stacked very soon after it is cut. If it is cut green at an earlier stage, it should be exposed to the sun for a day before it is bundled, and the grass which was most exposed to the sun should occupy the centre of each sheaf. If the sheaves are stooked up for two days more in fine weather the hay will be sufficiently dried for stacking. The grass should not be allowed to get quite dry, because if a certain amount of moisture is left a slight degree of fermentation in the stack will result. This will be beneficial, in as much as it gives to the hay an agreeable aromatic odour and a pleasant taste which makes it more palatable to all kinds of stock. If the hay is stacked in too wet a condition, a considerable degree of heat will be generated at the centre of the stack, whilst near the outsides mildew or rotting may occur, and the hay becomes musty.

Grass cutting and hay-making.

Method of curing grass when cut green.

The effect of stacking hay before being properly dried.

It has been proved in England that when hay is cured with a slight degree of fermentation in the stack, the loss of weight is nearly all accounted for by the loss of water. The remaining loss which is trivial is almost entirely due to loss of woody fibre, digestible fibre and carbo-hydrates. The changes induced by fermentation, however, will make the carbonaceous substances left more digestible. No loss of the albuminoids present in the grass occurs, but a considerable proportion of the insoluble albuminoids becomes more soluble and therefore more easily digestible.

The effects of fermentation in the stack.

The quality of hay depends upon quality of grass.

There are coarse and fine grasses, and the quality and value of hay vary with the kinds of grass from which it is made.

The method of stacking hay or other dry fodder.

When hay or *kadbi* is stacked, the rick should be built on a raised bottom of stones, dry brushwood or dry inferior fodder. As the stack is built, it is imperative that the middle of the stack should be kept considerably higher than the walls and be well trampled. If this is neglected the centre of the stack sinks during the process of settling, so that each sheaf occupies an inclined position, and the but end of each at the outside of the stack occupies a higher elevation than the remainder of the sheaf; consequently when rain falls it will be conducted to the centre of the stack instead of dropping to the ground at once. There is less risk of rain entering a hay stack if the walls are inclined slightly outwards. If built in this way the stack will be longer and wider at the eaves than at the ground. Another precaution is to have the slopes of the top as steep as possible. A well built stack cannot be damaged to any extent by rain even though it is not thatched, whilst a badly built stack is certain to suffer even though well thatched. A stack should be thatched as soon as it has quite settled.

Stacking the dry fodder of sorghums.

In stacking fodder *jowári*, or any of the larger millets and sorghums the largest and longest bundles should be used to make the body of the rick and short bundles or better still hay should be used to head it out properly.

Mowing machines and rakes for hay-making.

Mowing machines and rakes have recently been introduced into India and can where cool labour is scarce and dear be economically used for hay-making on cleared grass-land. They can be used on rough ground if cleared of jungle growth and hidden obstacles. Large trees if growing sparsely will not interfere in any great degree with the working of a mowing machine. The mower and rake together cost Rs. 600. The great advantage in using these implements is that hay-making can be completed much more expeditiously than by hand labour at a season, when such labour can be fully employed otherwise. The grass can moreover be cut when comparatively green, and there may be a saving in cost of hay-making. Both mower and rake can be worked by bullock power, with the draught arranged for neck yoke in the ordinary country way. The mower requires a pair of strong quick moving bullocks. In a day of 10 hours 2 pairs in relays will be required.

The advantage of these machines.

Method of working.

A small pair of bullocks works the rake. One mower can cut on ordinary Indian grass-land 8 acres in 10 hours. One rake working 6 hours per day will gather the grass cut by one mower as quickly as it dries. The mower will cut at least 200 acres in a season, and last certainly for 5 years. Farm labourers of ordinary intelligence can manage the mower. An ordinary hay

kuran in an average year will yield 1,200 lbs. of dry grass per acre, and the cost of cutting 200 acres will be as under :—

Interest and replacement (say per annum) ...	Rs.	150	0
3 pairs of bullocks for 25 days	..	37	8
4 men for 25 days	..	25	0
Oil and repairs	..	20	0

Cost of cutting hay on 200 acres Rs. 232 8

Weight of hay $200 \times 1,200 = 240,000$ lbs. The cost of cutting is therefore Ans. 15 per 1,000 lbs. as against Rs. 1-8 per 1,000 lbs. by manual labour. In the remote grass-lands of Northern Gujarát grass-cutting and bundling in average years only cost Re. 1 per 1,300 bundles.

The mower cuts the grass and leaves it in swathe. When dry the hay is collected into "wind rows" by the rake. Thence it is carted to the stack, or if there is risk of rain built up into hay "cocks" in the field and should remain thus until the weather clears. The hay is, however, loose and more difficult to stack than hay tied neatly into bundles. This objection is, however, overcome if a hay press is used. A good hay press for manual power costs about Rs. 800. It will bale the hay so that it can easily be transported, and cartage or railway freight is thereby considerably lessened. There is small risk by fire if hay is baled, moreover, it occupies far less space in a barn than loose hay.

The economy of using a hay press.

MANAGEMENT OF BROOD MARES AND FOALS IN INDIA.

The produce from a mare by a stallion is called a colt or filly foal according to sex. We speak of yearling, two year old, three year old, colts or fillies according to age. Foals are generally classed as foals until 12 months old. Yearlings range between 12 and 24 months in age and so on. A colt becomes a gelding when castrated. The operation should generally be performed when a colt is a yearling. A filly becomes a mare when of breedable age, or when she has produced a foal.

Names of horse stock at different ages.

In India a colt may be used as a stallion when four years old. A filly should not be bred from until $3\frac{1}{2}$ years old, but if well grown and in good condition will generally come into "heat" earlier but should not be then covered in India. The space of time between periods of æstrum varies from 16 to 22 days. If a mare has produced

Age when bred from.

Æstrum and indications of heat.

a foal she will be in heat 9 to 11 days after foaling. If covered at this time she is far more likely to prove pregnant than at any subsequent period of æstrum. In the case of old mares it is usually easy to determine when they are in heat. A viscid discharge is passed at short intervals from the vagina; the animal is excitable, and inclined to playfully kick whilst being groomed in the stable, or whilst at work in harness, and in the presence of a stallion does not object to his attentions. In the case of a young mare these signs are sometimes not so apparent, and a period of æstrum may pass

Covering the mare.

unnoticed. Therefore when a mare has once been covered, especially a young mare, it is well to determine whether she is probably pregnant by bringing her to the stallion from 16 days to three weeks afterwards and subsequently when periods of æstrum may probably be expected. The mare and stallion, when the former is being "tried", should be on opposite sides of a strong wooden barred gate or a rail fence which should be a closely barred structure about $4\frac{1}{2}$ feet high and 20 feet long and so strong that the mare cannot possibly hurt the stallion. If the mare is not in heat she will show hostile feelings by screaming and kicking viciously at the stallion. The fence or gate will prevent any injury. If in heat the stallion will be very attentive, biting and "teasing" the mare in a playful manner. The mare will gradually become quiet and urinate in dribblets passing at the same time the viscid discharge referred to. When this is observed she should be hobbled to prevent her kicking and then covered. A mare generally remains in heat for several days (about 3 and 4) and is most likely to prove pregnant if covered when going off heat. During any particular period of æstrum she should only be once covered. A six year old or older stallion is generally a surer stock getter than stallions of younger age. Stallions from 10 to 15 years of age, if vigorous and in good health, are usually very sure. It is usual to throw a bucket of cold water over the quarters and loins of a mare immediately after being covered, and afterwards she ought to be kept in a quiet place away from other horses for 24 hours. It is a bad plan, although a common practice, to give the mare violent trotting exercise immediately after being covered.

Gestation.

The period of gestation varies from 320 to 350 days. In young mares the period is less than old mares. The average period is about 11 calendar months. A mare rarely produces twins. When twins are born both generally die, and one almost invariably. Mares in India foal at all seasons. Many mares, however, come into heat when the monsoon rains have produced good grass and probably a large proportion of country-bred stock are foaled in May, June and July. The age of a country-bred dates from the 1st of May. Government stallions are allowed to cover 50 mares in one year. Stallions in Europe generally cover 80 or 100 mares in one season, and often more; and country-bred stallions in India if well cared for and liberally fed, can successfully cover an equal number.

Number of mares per stallion.

The pregnant mare should not be kept in high condition; thriving condition is necessary, then the mare is likely to produce a vigorous healthy big foal, and probably will milk well. A fat mare generally produces a small, foal and also gives a poor yield of milk. If the mare is well fed and otherwise well cared for during the early period of pregnancy (say, for five months) she may be put during that time to ordinary, slow, hard work. Afterwards she must be worked with some caution. Light work up to the day she foals is beneficial. Ample exercise in any case should be given, either by natural liberty in a grass run or otherwise. As the time of parturition approaches the mare should be put at night in a roomy, well littered loose box or yard, or, if the weather is dry, into a small pasture securely enclosed with posts and rail fencing. A small loose box is dangerous, because a mare in the act of foaling may lie down close to the walls. The labour pains are very powerful and the foal is expelled with great force and may be hurt or killed if forced against the wall or partition of a small loose box. Accidents of this sort are common even if the mare is watched. The labour pains come on suddenly, and a mare is seldom seen in the act of foaling.

Treatment during pregnancy.

The risks which attend parturition in the mare are greater than in other farm animals. If there is a false presentation or other mishap inflammation is much more easily set up in the mare than in the cow or sheep and inflammation of this sort in the mare is dangerous or risky. Under certain circumstances mares are liable to abort, particularly through injury, poor condition, fright or by exposure to great fatigue and severe weather. In such cases retention of the placenta is certain to cause serious inflammation, and skilled veterinary assistance should be sought at once.

Parturition and abortion.

The near approach of parturition is more distinguishable in the mare by the appearance of the udder than in any other farm animal. It becomes, of course, enlarged. A wax-like sticky substance begins to exude from the teats several days before foaling. When this substance becomes white and milk-like the foal may be expected in less than 30 hours. Cases of protracted parturition are rare and require skilled assistance. The diet of a mare approaching parturition should be regulated. Hard heating concentrated food should not be given. Boiled barley, bran, crushed linseed (half a lb. of the latter, not more, per day) are much better as a concentrated ration for 10 days before foaling, than gram, oats, maize, &c. A liberal allowance of green grass, lucerne and sweet fresh hay should be given with the concentrated food. A mare exhausted by parturition should have stimulants—linseed, oat meal, or rice gruel with about 3 ozs. of brandy or whisky would be a good stimulant. If the after-birth does not come away at once or soon, and if the mare strains, veterinary assistance should be got at once.

Treatment of foals
immediately after
birth.

The foal may need attention almost as soon as it is born, especially in the case of young mares. Old mares should be left as much as possible alone. It is necessary, of course, to examine the foal after birth to prevent any mishap. The foal may come enveloped in a membrane covering which in the act of foaling is usually rent asunder, the umbilical cord snapping at the same time, but if the membrane covering envelopes the head and nostrils after birth, the foal may be suffocated, the remedy is obvious. If the umbilical cord snaps too near the navel bleeding may ensue. It is always well to examine the umbilical cord and tie it tightly with a ligature about an inch from the navel and cut away any longer length if necessary. Weak foals are often born with obstructed breathing and timely efforts must be made to revive them. Respiration may be induced by breathing hard in the nostrils after spunging the face and nostrils with cold water. Also by striking the sides of the chest smartly with a cloth and by rubbing the body. The foal is generally unable to get on its legs and balance itself for several hours after birth, meantime the mare licks it dry. This has an invigorating effect upon the foal. Young mares are so fond of their offspring, that in their eagerness, they may trample on the foal and hurt it. They are less likely, however, to do so if left alone. If the mare licks the foal all is generally well. If she does not, she may be induced to do so, by sprinkling salt or flour or any other substance which the mare particularly likes on the sticky matter which covers the foal at birth. A foal when it once gets on its legs, instinctly finds the udder and sucks. The foal may require assistance if it is a weakling or if the mare refuses to let it suckle, as is the case sometimes with young nervous mares.

Swollen udders.

The foal for the first few days is sometimes not able to take all the milk. Generally the milk escapes freely of its own accord or naturally from the udder of the mare, but if this is not the case, and if the udder gets hard (mares in high condition are specially liable to this) then the milk should be drawn away at least twice a day and the udder thoroughly fomented and thoroughly dried with a cloth after fomentation. The food should be of a slightly laxative character and limited in quantity.

Management of
young foals.

Foals are not so robust as calves and need much more attention. Exposure to cold or wet weather during the first few days is often fatal. They are hardier afterwards. Exposure generally causes diarrhoea and this unless checked as soon as possible is almost certain to prove fatal. Rice water and one or two drachms of laudanum after each motion is suitable medicine. A foal is generally reared for two months or more almost entirely on the mare's milk. When six weeks or two months old the foal

begins to take other food, generally beginning to nibble at the food given to the mare and along with her. It is, perhaps, best to keep mare and foal in a roomy loose box or sheltering yard for a week or ten days, after foaling, and subsequently both should run together at pasture, shelter being afforded in wet or bad weather. Good grass gives all the nourishment that a mare and foal needs. The mare may necessarily have to do light work before the foal is weaned. If the foal accompanies the mare at work it will be more or less in the way, and therefore a nuisance; moreover, it probably will be liable to accidents. It should therefore be separated from the mare and shut in a *secure* place. It will make every effort to follow the mare and may hurt itself by those efforts unless put in a *secure* place. The mare also when first separated gets very excited and usually perspires freely. The milk in a full udder becomes tainted with sweat and heated, and is bad for the foal. Such milk may cause inflammation of the bowels. The udder should therefore be partly emptied by hand before the foal is allowed to suckle. When the mare is first put to work, the foal should suckle four times a day and be with the mare over night. The mare when worked should have a liberal quantity of food of a soft laxative character, but the work must be light or fairly so at first.

The foal is generally weaned when five or six months old. Previously it naturally has learned to eat such concentrated food as was given to the mare. The foal before weaning time should be trained to eat ground oats, parched barley, crushed gram and bran, or such other suitable concentrated food as the owner can conveniently give. Those foods named are the best; also guinea grass, lucerne or other green food. The weaning time is a critical period and the foal, if not properly attended to, may get a check in growth, which will not soon be recovered. For some weeks before weaning the foal should be kept away from the mare for comparatively long periods daily, and during the period of weaning it should have access to the mare only twice in 24 hours and should not be allowed to suckle all the milk at either time. This practice should be continued for a week or 10 days; then the foal may be completely separated. Subsequently the mare should be hand milked as often as the udder gets quite distended. It will usually be sufficient to milk the mare every second day for a week and at longer intervals afterwards, but on no occasion should the udder be thoroughly emptied. If the mare is a good milker, it may, during the weaning period, be necessary to give a light purgative. This tends to stop milk secretion. Moderate work, food of a dry description, and a restricted allowance of drinking water have similar tendencies. The foal ought to be out of sight and hearing of the mare, whilst being weaned. Its food should be liberal but not excessive, and no more should be given

Weaning.

at a time than is greedily eaten. It should be of an easily digested nutritious character. Good fresh hay with guinea grass or lucerne should be given in small quantities repeatedly and a concentrated ration in three meals consisting of

per day	{	2 lbs.	crushed oats.
		1 lb.	crushed gram.
		$\frac{1}{4}$ lb.	crushed linseed or crushed oil-cake.
or			
per day	{	2 lbs.	parched crushed barley.
		1 lb.	boiled <i>kulthi</i> .
		$\frac{1}{4}$ lb.	boiled linseed or boiled <i>til</i> (sesamum)

THE REARING AND MANAGEMENT OF YOUNG HORSE STOCK IN INDIA.

Grazing and concentrated food.

If two or more foals are weaned together, they may, after a few days, be turned into a well fenced grass run, and if there is a shed for shelter in rough weather and big trees for shade in hot weather, they may remain in the pasture day and night at all seasons. In India, as long as grass is fairly abundant and good, young horse stock will not require much auxiliary concentrated food. The concentrated ration should be increased as the colt grows, and when 2 year old should be 4 or 5 lbs. per day. A two year old, because he should grow quickly, needs as large a ration as an older animal. Linseed cake or sesamum cake in moderate quantity are excellent additions to the ordinary grain ration. The following would be a good ration for 2, 3 or 4 year olds :—

Given in two meals morning and evening.	{	2 lbs. boiled <i>kulthi</i> .	} Added to the <i>kulthi</i> whilst hot.
		2 lbs. bran	
		or	
		2 lbs. parched crushed barley.	
		1 lb. oil-cake broken in pieces 1" or less in diameter.	

Salt.

All horses need salt. Rock salt is best. A hole should be bored through each lump. By means of a string the lump can be suspended to the branch of a tree or in any other convenient way. Lumps thus suspended will be licked several times a day without any waste by each of the young stock.

Preparing chaffed fodder. Method of feeding.

During the early rains when the grass is watery and innutritious, the concentrated food can, with every advantage, be mixed with an equal weight of chaffed dry fodder either good, fresh hay or *jowāri kadbi* of good quality. When grass begins to fail extra dry fodder must be given. In order to economize it as much as possible it may be chaffed. Mixed chaff consisting of the *bhusa* of pulse crops, of chaffed *jowār kadbi*, wheat

straw, hay and green lucerne or guinea grass is very suitable, and when there is no grazing should be given three times a day, 5 lbs. at each time with 2 or 3 lbs. of hay at night. This practice is successfully followed at the Remount rearing depôt at Ahmednagar. The chaffed feed should be given in strong wooden wide troughs, raised at the bottom $2\frac{1}{2}$ feet from the ground; the hay in a net with three inch mesh stretched like a hammock between two trees and hung about 5 feet clear of the ground. The young stock can easily reach the fodder in such nets, draw it through the meshes and none is wasted. This plan is adopted at Ahmednagar. The fodder and concentrated ration referred to will keep 2, 3 and 4 year old horse stock in excellent condition.

It is customary in India to get a colt into good condition by giving *ghee*, *gul* and sometimes milk. The two former cannot help muscular development. They only help to fatten, and give an attractive appearance. Cows or buffaloes' milk is suitable for young stock if fresh and untainted, but equally nutritious food can be given at much less cost. Young stock if partly fed on *ghee* (clarified butter) and *gul* (crude sugar) invariably go back in condition when put on more substantial and more suitable food, and take some time to recover.

Native methods of feeding colts not recommended.

Young stock when changing their teeth may require special treatment and, if possible, should get soft easily digestible food. They must have free access to pure drinking water at all times. The grazing ground for young horses should be shaded with well grown trees that afford good shade during the hot hours of the day. The soil should be of such a character that it does not readily puddle during wet weather. An undulating, even a broken, surface is preferable to land which is nearly level. Freedom and exercise is indispensable. Fillies in India are by native owners usually allowed more freedom than colts and in consequence have straighter limbs and are usually better grown and more shapely. Colts, if castrated as yearlings, can run at pasture with fillies, whereas, if left uncastrated must necessarily be kept more or less in confinement. If tied up by head and heels as is the common practice in India, they cannot possibly grow into shapely animals with straight sound limbs.

The necessity of a good grass run and freedom for young horse stock in India.

All young horse stock should be early broken to lead in a halter. This is easily taught by gentle, firm handling. A bridle and bit should not be used until the colt is being broken to work. He should be early taught to stand quietly tied up. When first tied up a stout hemp rope should be fastened rather tightly round the neck in such a manner that the noose does not run tight. The free end of the rope should be tied rather short to something that neither will give nor break. He will probably try once or oftener to break

The colt should be early broken to lead in a halter.

away, but if the rope is sufficiently strong and tied securely he cannot possibly do so. He will soon understand that the intention is to tie him up, and will likewise learn that it is useless to try to break away.

Precautions against accidents.

If a colt is injured particularly about the legs, his commercial value may be very considerably lowered. All young horses are playful and mischievous, and the careful breeder should see that risks of injury from preventable causes are as far as possible avoided. The fences should be of a kind which are secure but are not likely to cause hurt. Wire fences are dangerous; more especially if the wire is barbed. Any strongly constructed wooden fence is generally safe and is improved if strengthened by a live hedge. *Inga dulcis* makes a good hedge. It needs no irrigation after the second year. The careful breeder will remove from the pasture anything that is likely to cause injury in any way. Young horse stock rarely do well in the same pasture as other farm animals, particularly if the pasture is of small extent. Sheep are more objectionable than cattle.

Ordinary ailments should be watched for.

Ordinary ailments should be watched for. Loss of condition, a staring coat and other signs of ill health will at once catch the eye of an experienced breeder. The skin requires no such attention as is required for horses at work. Skin diseases and skin parasites must be watched for and, if discovered, remedies should be applied without any delay. Young horses are subject to worms, and a colt so affected cannot possibly thrive. Remedies are, of course, necessary. Colds and strangles are common and young stock suffering from these ailments should at once be segregated, kept in warm shelter and put under treatment. The feet of young horses, particularly if the soil of the pasture is deep and soft, may require occasional attention. Overgrown hoof should be cut away. This must be done with caution. The feet of young horses cannot well be too big if they do not get out of shape.

MANAGEMENT OF DAIRY CATTLE AND YOUNG STOCK IN INDIA.

Treatment of milch cattle.

The constitutions of milch kine at time of parturition are delicate. Indian cows and buffaloes, although in a sense hardier than other milk breeds, are no exception to the general rule. Special care should at this time be exercised in providing suitable food and other comforts. If a cow or buffalo gives birth either during the monsoon or in the cold season, the animal must be protected from inclemency of weather. Experienced breeders will provide comfortable shelter during the wet days of the rainy season or the chill nights of the cold weather. A cool shady place will also be found for a newly calved cow in the hot season. A recently calved cow should not

be turned out to pasture in the blazing sun and high-day temperature of March, April and May. This practice must be deprecated even in the cooler parts of India. During the time a pregnant milch animal is "dry" which unfortunately (especially as regards the buffalo) is rather a lengthy period, the cow should be kept in good, but not high, condition. A good pasture, well supplied with pure drinking water and shady trees, will ordinarily maintain in-calf cows in good condition. But when the natural pasturage fails, supplementary food of nutritive quality must be given. A full yield of milk during the next period of lactation need not be expected if the precaution referred to has been neglected. Beyond this a fairly liberal allowance of concentrated food must be allowed for at least six weeks just before calving.

There is a very great variety of foods suitable and available for Indian milk cows. In the Deccan, *kadbi* (straw of *jowári*, Sorghum vulgare) or hay of fair nutritive value, are the usual dry fodders; whilst various oil-cakes, cotton seed, *dál chuni* (husk of *Cajanus indicus*) and wheat bran are the more common concentrated foods. Sesamum cake is perhaps the best procurable oil-cake. *Khurásni* or niger-seed cake, though rather objectionable in appearance, is considered a safe and nutritive food. Safflower or *kusumbi* cake, although rather indigestible owing to the presence of a considerable percentage of fibrous husk, has an advantage over other cakes, in that it can be bought at a season when it is cheap and thereafter safely stored. It neither moulds nor turns rancid on keeping. Cattle have to get accustomed to it, however, before they eat it greedily. Four to six lbs. per day of equal weights of oil-cake and bran, in addition to a fair allowance of dry fodder for the six weeks before calving, will keep a dry buffalo thriving. Less will suffice for a cow. A fortnight before calving, the quantity of concentrated food may, with advantage, be increased to 8 lbs. per day. The object is to supply the pregnant animal with concentrated food of a character which will not only exercise a slight laxative effect but will also improve the condition, so that free lactation may be expected soon after parturition. If in good condition, a full yield of milk forced by extra feeding will not debilitate the animal as would be the case if lean, when due to calve. For a week after calving, the feeding of the cow should receive close attention. The food should be of a laxative character and should not be too rich. Cotton seed, oil-cake and *chuni* (husk of *Cajanus indicus*) should be at this time eschewed. There is no better food for a newly calved buffalo cow than a mash consisting of boiled *bājri* (*Pennisetum typhoideum*) to which has been added an equivalent weight of bran whilst the cooked *bājri* was still hot. Five pounds each of *bājri* and bran will, with the ordinary allowance of dry fodder, provide sufficient ration for a day. Two ozs. of salt added to the mash will make it

Food for milk cattle and rations before and immediately after parturition.

Food of milch cattle.

all the more palatable. Good fresh green hay is at this time preferable to *kadbi* (straw of *jowári*, *Sorghum vulgare*) and if a limited allowance of green fodder, say, 15 lbs. per day, can be given, the ration will be improved. Thus the ration for a day of a newly calved buffalo would consist of—

- 8 to 12 lbs. of good hay.
- 15 lbs. of green grass or other green fodder.
- 5 lbs. bran
- 5 lbs. *bájrí* (*Pennisetum typhoideum*) } as a hot mash.
- 2 oz. salt

A cow should receive about $\frac{2}{3}$ of this ration.

Immediately after calving, a hot drink made up of a thin gruel; or *kánji* of ground *bájrí* and bran with a good handful of salt tends to cause the after-birth to come away quickly.

Milk fever.

In Europe, deep milking cows are liable to milk fever which is most prevalent among heavy milking cows producing their 2nd or 3rd calf. As a preventive, should there be any risk of milk fever, the cow is drenched with linseed oil and epsom salts repeatedly during the week before calving. The practice, which does not seem to be necessary with Indian cattle, simply because they are generally poor milkers, is effective, because the laxative medicine keeps the bowels open and prevents any undue secretion of milk.

Quantity of food required for different breeds.

Under the most favourable conditions an Indian cow or buffalo will not yield the full quantity of milk for a week or 10 days after giving birth. Then the full yield may be expected and ordinary food may be given. A buffalo in full yield requires to be specially well fed. I do not think, however, that any quantity beyond 18 lbs. per day of concentrated food will increase the milk yield appreciably. A moderate sized buffalo giving over 30 lbs. of milk per day (a quantity sufficient to make 3 lbs. of butter) need not get a larger ration. Any extra quantity of food would be wasted. A large framed Jáfferabad buffalo requires a larger ration than the smaller sized Surat buffalo; and moreover the former in the Deccan are less profitable, because they require a greater quantity of concentrated food and fodder to produce a given quantity of milk. Similarly a Gir cow, because usually of large size, requires to be more liberally fed than the smaller sized Áúen. The latter I have found to give an equal yield of milk to larger breeds on much less food. It is clear that no hard and fast lines can be laid down regarding the feeding of cows and buffaloes in milk. An experienced stock owner will very soon determine the quantity of food that can advantageously be given to any one of his cows or buffaloes. With good manage-

ment either a good cow or a good buffalo will, in India, milk up to the full capacity for four or five months after calving, and during this period there should be little or no change in the daily ration. A milch animal has a palate, however, and occasional variety in the food is often desirable. If milk cows are fed from month to month with precisely the same food they sooner or later may reject it altogether or eat it with less greed and relish. An occasional change in the ration is, therefore, expedient. For this purpose *dál chuni* (husk of *Cajanus indicus*) if not regularly given, can with advantage be substituted twice a week for part of the other food and occasionally crushed linseed $\frac{3}{4}$ lb. per animal, per day, may be similarly given.

Occasional variation in ration recommended.

A milk register will, if carefully kept, show at once when the milk yield begins to diminish. A daily record of the milk yield of each animal furnishes useful data. A glance at the figures will show when there has been any irregularity or disturbing cause to re-act on the milk yield. Moreover, if carefully kept, it is a true guide as to the value of different animals. One cow may milk well to begin with but the yield may rapidly diminish. Another cow may yield steadily for a long time and be much the more valuable and profitable animal of the two, although producing at no time an abnormally high yield. The milk register will also indicate whether the management of the cows has been good and, moreover, furnish data which will enable the farmer to discard one cow whilst he retains another because the latter has been proved to be the more profitable.

The milk register.

When the period of lactation has somewhat advanced and there is evidence of a lessening milk yield, the ration should also be diminished. It may be necessary to change the food at least once a month. The change will be regulated to some extent by the size and condition of the animal, but the main consideration is how much milk did the cow give during the previous month. An average buffalo giving 18 lbs. of milk per day and suckling her calf should have the ration noted below. I have found it both good and liberal :—

The feeding during the more advanced periods of lactation.

				lbs. per day.	Chaffed together if possible.
Green fodder	...	...	...	10 to 15	}
Dry fodder...	...	...	...	10 to 15	
Cotton seed	...	...	...	3	
Bran	...	...	...	3	
Sesamum oil-cake	...	...	...	3	
<i>Chuni</i> (husk of <i>Cajanus indicus</i>)	...	...	...	2	
Salt...	...	...	...	1 to 2 oz.	

The cotton seed, *chuni* (husk of *Cajanus indicus*) and bran with salt added should be moistened. The oil-cake, broken into pieces, at most an inch in diameter, may be placed on the top of the moistened mass but not mixed

Feeding.

through it. The concentrated food should be given in two meals and at milking times. This is perhaps a bad practice which, however, cannot well be avoided. Indian buffaloes and cows have been so accustomed to get their concentrated food whilst being milked that without it they refuse to let the milk down. The enjoyment of eating doubtless induces a placidity of disposition at the time which permits the *gavli* (milkman) to milk rapidly and extract more milk than he otherwise would, especially from those animals which are unusually irritable and fractious. Two-fifths of the mixed dry and green fodder should be given in the forenoon from 10 to 11 o'clock; three-fifths in the evening about 6 or 7 o'clock, *i.e.*, some time after the second milking. The cows should be milked at regular stated hours, and there should be no deviation therefrom under any circumstances: 6 A.M. and 5 P.M. are suitable hours. The concentrated food is usually given in two equal meals at these times. The cows should have free access to pure water three times a day. Buffaloes should be bathed or washed at least once a day. During the period that good grazing is available the dry fodder may be reduced to 6 to 8 lbs. given at night and the concentrated food reduced by one-third. A large buffalo may be allowed up to 40 lbs. per day of green food, and 6 or 8 lbs. of hay in addition, together with the concentrated food ration already noted. Usually 15 or 20 lbs. of green fodder per day is all that can be allowed.

Quality of milk
affected by food.

Drinking water or succulent food given immediately before the animal is milked is believed by the *gavli* (milkman) to increase the yield of milk. The quality necessarily must be lowered in a corresponding degree. A native will, when he sells a buffalo guaranteeing a certain milk yield, invariably allow the animal to drink freely before proceeding to milk. It is possible that the milk yield may be affected in this way, for succulent food undoubtedly lowers the percentage of total solids in milk by making it more watery. In 1892, at the Poona Government Farm, during the hot season 10 lbs. buffalo milk on an average yielded a lb. of butter, whilst during the following rains when a good deal of the food was succulent, the average was 1 lb. butter from 12 lbs. milk. During 1893 it was found possible to feed during the whole year a limited quantity of green fodder, and the difference previously marked was not so noticeable although still appreciable. The actual figures were: during February, March, April and May, the average quantity of milk required to produce 1 lb. of butter was 11 lbs. 7 oz.; similarly for June, July and August, the average weight was 12 lbs. 8 oz.

The quality of the milk is in other respects influenced by food. Thus cream from milk of buffaloes, largely fed on oil-cake, will churn into greasy butter even if the temperature of the cream in the churn is lowered artificially to the most favourable point. Cotton seed tends to produce fine firm butter,

and the cream can be churned at a comparatively high temperature. The cream from cows fed largely on *chuni* (husk of *Cajanus indicus*) gives butter which has a nice flavour and a better colour than usual.

When green fodder is given in fair quantity cotton seed and *chuni* (husk of *Cajanus indicus*) can be fed to any reasonable extent. If otherwise, the allowance of each should not exceed 4 lbs. per day. Lucerne is not a good fodder for milk cattle in any quantity beyond 10 lbs. per day. *Jowari* (*Sorghum vulgare*) should be well in flower before it is cut as green fodder, otherwise like lucerne it has a tendency to cause tympanites.

Precautions to be observed in feeding.

It is quite possible to over-do the feeding of milch cattle. A cow in milk should not be in high condition. An animal in very high condition will give very little milk, and this probably accounts for a common practice with *garkis* (milkmen), viz., to give a less quantity of food to fat animals so that the milk yield may increase.

Feeding may be overdone.

Indian cows and buffaloes are so excitable and irritable that a very trivial circumstance often affects the milk yield. Its secretion is influenced to a very great extent by good management. If the calf dies, the milk yield may be diminished permanently. There is an Indian proverb, the English rendering of which is "soil without manure is like a cow without her calf." Any sudden change in the food, a short journey by road or rail, a strange milker, a cold or wet day, any irregularity in feeding and especially any irregularity in milking at once re-act on the milk yield. Indian cows and more especially buffaloes get attached often in a striking manner to the man that feeds and milks them, also to the companion animals occupying the adjoining stalls; at pasture they clique together in a curious way, and it will be easily understood that any disturbance of these friendly relations will have a distinctly unfavourable effect on milk secretion. Aden and Sind cattle are different. They have docile tempers and their milk yield is not easily affected by any irregularity. Moreover, their calves can be weaned and hand-fed, whilst it is imperative that the calves of most Indian breeds should suckle. At any rate such is the case unless the practice is begun when the cow has her first calf. The maternal instincts are very strong and neither cows nor buffaloes will yield their milk unless the calf is suckling or is tied close by. When the calf dies it is common to stuff the skin and make a dummy calf which answers the purpose admirably. Where milk is dear it does not pay to rear calves, especially bull buffalo calves, and in many instances buffalo calves are quietly knocked on the head and the dummy substituted. Whether it is intended that the calf should suckle or be raised by hand it should be left with the mother until it is licked dry and clean. This has a salutary effect on the cow as well as on the calf. The viscous slimy

Mismanagement and effects thereof.

Treatment of cow and calf at parturition.

matter which covers the calf has a beneficial laxative effect on the cow. When removed from the cow the calf should be kept out of sight and out of hearing.

The signs of approaching parturition.

The most noticeable signs of approaching parturition are :—

- (1) Full distention of the udder.
- (2) Loosening and enlargement of the external portions of the vagina.
- (3) Relaxation of the pelvic ligaments.
- (4) Restlessness a few hours before calving. The cow rises and lies down frequently in her stall and whisks her tail as if in pain.
- (5) Labour pains and the water bag. The membranes of the latter when broken allow a slimy fluid to escape which lubricates the passage and facilitates the expulsion of the calf.

Parturition.

The cow, when nearly due to calf, should, when not grazing, occupy a roomy stall in a comfortable part of the byre. The stall should have a dry floor and if possible should be littered with dry litter. This obviates the risk of an inflamed udder. If the udder appears swollen and feels hard, the milk should be drawn once a day even before calving. In normal parturition the calf presents itself in the pelvic passage with the head resting on the forelegs. The cow generally requires no assistance, and none should be offered unless labour is protracted. The owner should, however, satisfy himself early that the presentation of the calf is right. Assistance is sometimes necessary, specially with a heifer having her first calf. When given, the hands and arm of the operator should be clean and well rubbed with carbolic liniment. Assistance is most effective when the cow lies on her side and the calf's legs are pulled slightly downwards towards the hocks of the cow. The operator should only assist each labour pain and should not pull at any other time. The after-birth should come away at once or in the course of a few hours. If labour is protracted owing to a false presentation or from any other cause, or if the after-birth is retained, then if the stock owner has no technical knowledge as to treatment, the assistance of the nearest qualified veterinary officer should be obtained without any delay.

First milk.

The milk of a cow or a buffalo immediately after calving is of a peculiar nature. It is called "beestings" and its function appears to be to clear the intestines of any accumulated matter which of course should at once be excreted. There is no risk of costiveness provided the calf is allowed to drink a fair quantity of the first milk. Ordinarily in India the calf is started. It is allowed to suckle until the cow lets the milk down. The moment milk

fills the teats the calf is tied up near the head of the mother and all the milk which the *garli* (milkman) can extract is taken. The calf is then untied and sucks all it can afterwards. It is impossible that it can get more than 2 lbs. per day. It, however, gets the richest part of the milk. All that it usually gets is barely sufficient to support existence. The difference in butter fat between the first and last milk drawn from a buffalo is shown by the following figures, the actual results of a test at the Poona Government Farm :—

Percentage of butter fat in the first *ser* drawn 4.0.

Do. do. last do. 10.1.

Average percentage of butter fat in the whole milk of the buffalo 6.98.

If reared by hand, Indian calves which are generally small can be kept in fairly thriving condition on 4 lbs. of whole milk per day given at two meals. This if continued for 4 or 6 weeks will bring the calf to a time when it can be fed on other food. The whole milk can be replaced by separated milk, but every cow-owner cannot procure separated milk and on account of the heat in India there is no such thing as *sweet* skim milk. The young calf will soon learn to eat a little *chuni* (husk of *Cajanus indicus*) and bran, also a little good hay or green grass. A handful of mixed *chuni* and bran (about $\frac{1}{2}$ lb. per day) in two meals is all that is required at first. The quantity may gradually be increased until, when 8 months old, $1\frac{1}{2}$ lbs. per day should be allowed. On the ordinary milk ration of Indian calves, large framed English calves would literally starve. When a calf is raised by hand it has to be taught to drink. Its instinct is to suckle and this is taken advantage of in giving the first lesson. If sufficient time after birth is allowed, the calf gets hungry. It will suck one or two fingers of the right hand if introduced into its mouth. If at the same time the head is forced gently into a vessel containing the milk so that the muzzle just reaches the milk, the calf will soon learn to drink. The first milk is drawn into the mouth unconsciously and swallowed in the act of sucking the fingers. The important points to be attended to in rearing hand-fed calves are that the milk and food should be clean and fresh and of course given in a clean vessel. Sour milk or milk tainted in any way is apt to produce diarrhoea or scour. Well ventilated and well drained accommodation for calves is necessary. All excreta should be removed at least twice a day. The droppings from calves, fed on milk, soon acquire a most disagreeable smell. Any unsanitary condition tends to cause scour. Over-crowded calves never thrive. They are subject to be attacked by parasitic vermin and skin disease, especially ring-worm and itch. A piece of rock-salt should be placed so that the calves can lick it. If a hole,

Rearing calves

is bored in the lump and the lump is suspended by a string, none of the salt is wasted. A lump of lime or chalk placed within reach will also be regularly licked. The chalk is beneficial, because it has a tendency to counteract that acidity in the stomach which always accompanies scour.

Management and
feeding of young
stock.

If proper attention is given to the feeding and management of calves during the first few months of their life and if satisfactory progress has been made in growth during that period, they will continue to thrive often with much less care and with much less food than young animals which have previously been half-starved, and this remark is applicable to all animals. If young stock are to make satisfactory progress, even in India, a certain amount of shelter is necessary. The monsoon is decidedly the most trying season. Roomy yards with shelter sheds must be provided to be used during excessively heavy rain. Grazing ground gets so soft and so easily puddled that any attempt to turn young stock out to graze would be alike harmful to them and to the pasture. In India the conditions associated with the rearing of young stock are different from those found in other countries. There is in India grazing of a sort all the year round. The grazing is not equally good at all seasons. Usually there is only green grass for 5 or 6 months and the natural food must afterwards be supplemented by other food. The daily ration must be especially liberal at those seasons when the natural food is scarce. Super-abundance at one season and semi-starvation at another is a fruitful cause of loss. Particular care should be exercised when young grass begins to grow. It flushes up very suddenly in India. The first growth, although it is green, is not nutritious and being succulent is not well suited as a change from the hard dry fibrous fodder previously given. Most of the cattle which die in India die at this season. The change of feeding is so sudden that impaction of the stomach is induced. The innutritious fibrous food previously given collects in the rumen and becomes impacted, whilst the green food passes through the alimentary canal without being properly digested. The first symptom is that the animal scours. Young stock should be prepared before they are turned out to grass. Linseed cake is a useful food at this season on account of its laxative character and its softening effect on other food with which it becomes mixed during the process of digestion; but linseed cake is not usually procurable in India. A cake rich in oil and free from fibrous matter, for instance sesamum cake, should be fed to all young stock for at least a fortnight before they are turned out to grass; 2 lbs. per day along with the usual ration of dry fodder will prevent the serious consequences which would follow a sudden change from dry fodder to green grass.

Indian cows and buffaloes are at the best irregular breeders. Some breeds are more irregular than others. Gir cows are very unsatisfactory in this respect. On the other hand, Aden cattle, if well fed, will come in season for the bull six weeks or 2 months after calving. Buffaloes are less regular than cows. Green food given in moderate quantity all the year round tends to bring cows and buffaloes sooner into "season" after calving. This would be the case even although the animals are otherwise well fed. A bull turned out to pasture with the cows periodically, say, once a week, and especially a buffalo bull with buffalo cows tends to bring them into season sooner than would otherwise be the case. The following tabular figures show the average period of lactation and the average time between two successive births of the cow herd and buffalo herd on the Poona Farm in 1893 :—

Indian cows and buffaloes are irregular breeders.

		Average period of lactation. Days.		Average period between two successive births. Days.		Average periods of lactation.
Whole buffalo herd ...	...	364	...	...	524	
Whole cow herd ...	...	360	...	...	475	

The longer period between births in respect of buffaloes arises partly because buffaloes are longer pregnant than cows.

Buffaloes are in the average pregnant ...	...	315 days.
Cows " " " ...	...	282 "

Period of gestation.

An old cow will carry a calf 10 days or a fortnight longer than a heifer, and a cow bearing twins will usually go 272 to 275 days.

The period of heat or æstrum in a buffalo is of short duration, usually only a few hours. A buffalo should therefore be put to the bull at once when the symptoms of heat are observed. In the case of a buffalo they are unmistakable. At pasture a buffalo in heat will rush all over the field, and bellow or rather grunt vigorously. A cow remains longer in heat, usually about 24 or 30 hours. The cow though also excited does not make so much fuss or noise as the buffalo. The cow is most likely to hold to service if covered when going off heat.

Æstrum.

Neither cows nor buffaloes should be covered more than twice during the period of heat. A stud bull is a much more certain stock-getter if he is as regularly worked as an ordinary work bullock. He must, however, be liberally fed. One bull is sufficient for a herd of 40 cows. If a cow has been covered and does not hold to service, she will, if in thriving condition, come in season again in 21 days. Buffaloes may come in season every three weeks but often a much longer period elapses between periods of æstrum. If a cow is healthy, she will not come into heat when pregnant. The other signs of pregnancy are—the belly enlarges particularly on the right side, and about the sixth month the calf can be felt as a hard lump near the flank

Stud bulls.

Signs of pregnancy.

on the right side. The calf can be seen even earlier than this to jump especially when the cow drinks cold water.

Milking.

One attendant is required to feed, attend to and milk 8 to 10 cows. Each animal should be milked always by the same man. At milking time the stalls should be clean. The milkman should wash each udder and dry it with a cloth immediately before milking. This is specially necessary with buffaloes which when excited urinate in small dribbles, which run down the thigh on to the udder and drop from the teats. The milker's hands should also be washed clean. It is almost needless to add that the milk vessel used must also be clean. Milking should be done expeditiously and the last drop of milk extracted. The calf usually is accountable for the thoroughness of the latter operation. It is common in dairy farms, where no calves are suckled, to go over the cows a second time and draw away the last milk, which is called "strippings". This, as already noted, is the richest part of the milk and is usually set aside in farmers' households to answer the purposes of cream. Any milk left in the udder does not tend to increase the yield at next time of milking but rather to set up local inflammation.

Milk tainted by food, water and in other ways.

The milk is easily tainted by the food given to the animals. Buffaloes are indelicate feeders, and with good reason their milk is often objected to on this score. Any plant with a pungent aromatic odour is apt to taint milk. Turpentine given as medicine will taint milk secreted during the following 24 hours, so much so that the milk is quite undrinkable. The drinking water of cows, if polluted with sewage or with decaying organic matter, whether animal or vegetable, may be the cause of tainting the milk, so that it becomes dangerous as human food. Every contagious disease has its own germ, and milk at any ordinary temperature is perhaps the best medium in which these germs may be propagated. Disease in the human subject has been repeatedly traced to impure milk. How far enteric fever, cholera, diphtheria and many other diseases can be communicated through milk may be conjectured. There is no question that unsanitary conditions surrounding cow-sheds and dairy premises furnish a public danger of no common order. A simple test to determine whether organic matter is present in water, is accomplished by evaporation and by burning the residue in an open vessel if the smell peculiar to burning organic matter is given off the water is unwholesome. Nitrates or common salt present in drinking water indicate contamination by sewage, common salt being an indication that the contamination is due to human urine.

Cow sheds.

Cow sheds in India should be airy, well ventilated, have *pukka* floors and open gutters or drains to carry the urine directly to the manure pit. The byres should be situated on a high well drained situation. Cows should not stand crowded in the stalls.

A FEW POINTS ON SHEEP AND GOAT BREEDING IN INDIA.

Sheep and goats are most successfully bred in districts with moderate or light rainfall, and light naturally well drained soils. Upland thin poor soil with sparse jungle growth and considerable variety of natural herbage is good for the purpose if of sufficient range or extent. Neither sheep nor goats thrive during the monsoon in heavy soil districts except when owned in small numbers, in which case they can be comfortably sheltered at night. In the breeding districts large flocks do not thrive unless they continuously graze on clean ground. If the grazing ground is limited and becomes fouled with excreta, sheep will not thrive even though the food is fairly abundant.

Soil and climate suitable.

There is an undoubted advantage in giving sheep and goats clean ground to graze over each day. The wandering flocks of the Deccan and Gujarát thrive very well during the fair season chiefly on this account. Large flocks of sheep and goats are brought in the fair season by professional shepherds from Káthiáwár into the fertile plains of Northern Gujarát and also from the upland comparatively dry waste grazing lands, east and north of Khándesh, to the black soil tracts and arable plains of the Deccan. In the cultivated parts of Khándesh, Násik, Ahmednagar, Sholápur, Sátára, &c., very large flocks of sheep and goats are found during the fair season. These large flocks are herded in separate lots of 300 or 400 and are driven slowly during the day and probably over a distance of five to eight miles between morning and night. The arable lands are mostly clear of crop at this season, and the sheep clear them of any thing they can find to eat. The flocks are herded within range of *nálds* or running streams. The shepherds are accompanied by their families and dogs, and own usually a few donkeys which carry the camp kit, which is not extensive. The shepherds surround the flocks at night on a particular field or fields and carefully guard them from wolves, the sleeping *páls* being pitched conveniently for the purpose. The fields on which the sheep are kept at night are manured to a considerable extent, and this advantage is fully appreciated by the owner who usually gives the shepherd a stipulated quantity of grain, &c. A few of the sheep and nearly all the goats are regularly milked and the women make *ghee* each morning before striking camp.

The sheep flocks of the Presidency.—The conditions most favourable for successful management.

A few goats amongst sheep are decidedly advantageous. They are active and industrious feeders. They do not feel the midday heat to the same extent as sheep do. They lead the flock and keep the sheep moving. Sheep will continue to feed as long as they are kept moving. If grazed without goats they are difficult to drive. They lie down under the shade of trees and refuse to move during the hotter hours of the day.

A few goats among sheep advantageous.

**Management
during the monsoon.**

One flock should not usually exceed 300. If a larger number are owned by one man they should be divided and herded separately. The Deccan sheep-owner keeps his sheep at night in a pen which is usually situated on hard rocky ground and is surrounded by a strong fence of *bábhul* branches. The monsoon is by far the most trying season. Heavy rain for several days chills the sheep and causes diarrhoea or other ailments. The most effective preventive is a comfortable dry pen, at night, and a feed morning and evening of pulse *bhusa* (the pods, leaves, chaff of a pulse crop) or gram, *tur* or other pulse crushed or ground into meal, and mixed with an equal weight of bran, crushed oats, maize, barley, *jowár* or any of the cheaper cereals. Half-a-pound per day of the mixed concentrated food or $1\frac{1}{2}$ lb. of the *bhusa* will be quite sufficient.

Breeding.

The ewe is pregnant 21 to 22 weeks. The time between two periods of æstrum is 16 days. In India sheep breed at almost any season of the year and occasionally twice in 12 months, but this should not be permitted. Ewes have rarely more than one lamb at a birth. They should not be bred from until 18 months or 2 years old. Goats are very precocious. They breed when very young, often have two, sometimes three, kids at one birth, and often produce young twice a year. Ewes generally come into heat early in the monsoon if they are in thriving condition, and this is the best time to put the ram with them. One ram is sufficient for 40 or 50 ewes. The lambs should come in October, November or December and if so will thrive during the fair season, and, when the monsoon comes, will be sufficiently vigorous to resist the trying conditions of that season. Male lambs, if not intended to be sold as young fat lambs, should be castrated when three weeks old. The end of the scrotum is generally cut off and the testicles drawn and an antiseptic ointment or lotion applied. Lambs should be driven slowly and otherwise gently handled for a week after castrated, and should be protected from cold and especially from wet. A clean comfortable pen should be provided at night. Lambs and o'der shrep should be clipped before the hot weather sets in. The older sheep are clipped twice a year—about the middle of March and the middle of October.

Castration.

Fat lambs.

If the owner intends to sell young lambs in fat condition (and such are worth more than full-grown sheep) then the ewes as well as the lambs must have concentrated food. The concentrated food given to the ewes produces an increased flow of milk which helps to increase the condition of the lamb materially. Moreover, the lamb soon learns to eat anything that the ewe eats. Three-quarters of a pound per day of pulse meal and bran is sufficient for ewe and lamb. Grain (*Cicer arietinum*) is specially good food for sheep being fattened for the butcher.

In certain districts maggots are troublesome particularly towards the end of the monsoon, and more especially if the sheep are affected with diarrhoea and the fleece is dirty from this or other cause. Maggots are the larvæ of certain flies which are attracted by dirt. The maggots hatch from eggs laid by the flies and penetrate through the wool to the skin which they cut through and soon eat into the flesh. If the sheep are kept clean there is little fear of maggots in India. Their presence is indicated by an affected sheep being restless, running quickly from place to place, stamping the hind feet quickly in succession and trying to bite the affected part. Spirit of tar rubbed into the wool, is perhaps the most useful application. If there is a wound the wool should be cut off and carbolic liniment applied daily until healed.

Fly-blow.

Foot rot is common in black soil districts, especially when the soil is wet with continued rain. Foot rot is believed to be contagious to some extent, but ordinarily it is induced by the foot getting out of shape by irregular growth of hoof. The hoof may slough off if the disease is neglected. All diseased hoof and uneven growth should be pared away with a sharp knife until the seat of the foetid discharge is reached. The diseased parts should then be lightly painted with butyre of antimony and if the case is bad the foot or feet bound up in cloth with tar or carbolic liniment, or other antiseptic healing applications. The feet should be washed clean and examined daily until a cure is effected. The only preventative of foot rot is to keep the sheep on hard dry ground.

Foot rot.

Rot or liverfluke is not likely to appear amongst sheep which are kept on high dry ground but is often prevalent amongst sheep that have been grazed for some time on low-lying damp situations or along the course of *nâls* or streams. The sheep do not lose condition when first affected, but when many full grown flukes are present in the liver ducts the functions of that important organ are interrupted or deranged and the characteristic symptoms appear, *viz.*, a yellow tinge in the skin and exposed membranes, dropsical swellings under the jowls, loose, unhealthy looking wool and rapid waste of flesh with diarrhoea. If one or two sheep in a flock are seen to be affected as described, all should be moved at once to high dry ground and get a free allowance of rock or common salt.

Liverfluke.

Sheep in India are not affected with the same variety of skin diseases or skin parasites as in Europe. There, unless dipped twice a year, they would become infested with lice and ticks and probably affected with scab. Dipping also prevents "fly blow", *i.e.*, maggots. A cheap effective dip can be made from tobacco juice, pitch oil and soft soap. Ten pounds of each in 100 to 150 gallons of water are sufficient for 100 sheep. The pitch oil and soft

Skin diseases and parasites.

soap should be boiled in sufficient water and whilst hot the tobacco juice should be added. The mixture should be diluted with warm water as required. The effective constituent in pitch oil is carbolic acid. The dip may be applied directly along partings made in the wool along the back, sides and underneath, or the sheep may be immersed in the dip in a dipping trough. Sheep should be washed in a clear running stream a week or so before being clipped and should afterwards be kept in a clean place until the fleece is removed. Washing removes sand, dirt and other impurity.

Wool.

The wool of the various breeds of sheep found in India varies in colour, texture, length of staple and weight of fleece. Generally the wool is short, coarse and hairy. It may be white, red or tawny red, brown, black or grey in colour. A fleece rarely exceeds $1\frac{1}{2}$ lbs. in weight.

Deccan sheep.

The Deccan sheep are black, brown, reddish brown, white and black and white in colour. The wool is inferior in quality. The sheep are hardy and may be classed as small, compact and shapely, with short legs. The ewes are hornless. The rams are sometimes horned and sometimes not. The Native Chiefs and others own fighting rams of this breed with the frontal bone and horns developed to an unusual extent.

Gujarāt sheep.

The sheep of Gujarāt or Kāthiāwār are mostly white with black or red-brown heads and necks. The heads are large, hornless, with Roman noses and are by no means attractive. These sheep are of medium size, are squarely built, with wool of fair length and quality, but the fleece is rather loose and open. The leg bones and feet are coarse and the mutton is rather inferior.

Rajputāna sheep.

Rājputāna sheep which supply the Bombay market largely with mutton are mostly white. They have loose long wool, are leggy and flat sided, but larger than ordinary. Both the ewes and rams are hornless.

Dumba sheep.

Dumbas are chiefly bred in Sind and in Afghanistan. The enlarged tail is the conspicuous characteristic. The rams have generally large horns curled two or three times, but I have seen good pure bred specimens with small horns; also without any. The ewes are hornless. The face is generally mottled white and black; so also are the legs. The frame is long, level, wide and near the ground. This breed has been proved exceptionally suitable for crossing with the Deccanis. The half-breds are good mutton sheep and are particularly shapely and thrive well in dry situations in the Deccan. Their wool like that of the pure *dumba* is of fine quality and long. The Deccani *dumba* has no unusual development of tail. This is an advantage, because the abnormal tail is unsightly and a positive danger when the sheep are affected with diarrhoea, because certain to become affected with maggots.

THE BREEDS OF INDIGENOUS CATTLE OF THE BOMBAY PRESIDENCY.

GIR CATTLE.

This is a noted milk breed reared extensively in herds in the Gir forests and hills in the south of Káthiáwár. In a more domesticated state these cattle are extensively bred in the villages and towns of the southern half of the Province. As Káthiáwár is entered by rail from Ahmedabad pure bred Gir cattle can here and there easily be discerned amongst the village cattle which are mostly of the Gujarát type, *i. e.*, like the large white or grey breed found throughout Ahmedabad, Kaira and Baroda. In the North of Káthiáwár, many cross-bred cattle, with unmistakable Gir characteristics, can readily be recognised, and further south this cross preponderates to a very decided extent. In the south the proportion of pure or nearly pure bred Gir cattle is considerable, but there are clear indications that the breed is spreading rapidly away from its original home, and I fear the cross-bred offspring resulting from the haphazard mixing of two noted pure breeds will cause degeneration of both. In some of the Káthiáwár States, efforts are being made by the ruling Chiefs to keep the old Gir breed pure, and in the Gir hills the herdsmen take good care that the pristine purity of the breed is maintained. The herdsmen or professional cattle breeders are mostly Rabáris, Bhárváds and Chárans. The Gir forests and hills extend to about 1,000 square miles and afford excellent grazing all the year round for such cattle as are owned locally, but in years of scarcity the forest is resorted to by cattle-owners from all parts of Káthiáwár and Cutch, and sometimes from Northern Gujarát, and then the grazing grounds become overstocked and grass gets scant. The grazing grounds are well shaded with a large variety of forest trees. There is an abundant supply of water in perennial streams. The forest is penetrable for grazing in all except the more hilly parts. The right of grazing is controlled by the Junagadh State, and the charges per annum are as follows :—

The condition under which Gir cattle are bred.

				Rs.	a.
She buffalo	...	...	...	0	12
Cow	...	...	...	0	8
Calf	...	...	...	0	4
Bull	...	...	...	0	4
He buffalo	...	...	...	0	8
Bullock	...	...	...	0	8
Horse	...	...	...	0	8
Camel	...	...	...	1	0
Goat	...	...	...	1	0



25.—Typical head of Gir cow.
(The numbering of illustrations is in continuation of that given in Vol. I.)

Each local herdsman owns at least from 15 to 30 cows and buffaloes. Men in easy circumstances own from 40 to 100 each. Cattle belonging to one family are generally herded by themselves. The owners and their families lead more or less a wandering life. The huts or houses in which they live are of a temporary description constructed of rough timber, branch wood and thatched with teak leaves. When the grazing gets bare in any particular part the cattle, the herdsman's family and his habitation are moved elsewhere to "pastures new." The cattle are neither housed nor sheltered at any season. Suckling calves are kept in the huts during bad weather. No grass is cut and saved as hay. The cattle graze all the year round. Generally the grazing is superabundant, the cattle as they graze trampling through long grass. The risk of fire is considerable, and grass over large areas gets burnt occasionally. Lions and panthers destroy considerable numbers of young stock, but four or six full grown buffaloes are believed to be quite a match for a Gir lion. Cows are milked morning and evening. They are not haltered or tied by the neck for this purpose. Gir cattle though naturally wild know their owners and are trained to stand quiet at milking time. To prevent the cows kicking at milking time the hind legs are tied above the hocks in ordinary native way by a hard thin rope about 5 feet long. *Ghee* is the chief product. The *chhds* or butter milk is used for domestic purposes and also given to the milch cattle. A young healthy cow produces a calf every second year. The best cows continue in milk for 15, sometimes 18, months. The calves are mostly dropped in August-September. The calf is kept with the cow until she goes dry. Bull calves are sold as yearlings to cultivators of arable lands in *Káthiáwár*. The cultivators get them castrated by *Vághris* in the common native way. A yearling bull is only worth Rs. 6 to Rs. 8. Even at this price there must be profit in rearing them, considering the nominal cost of pasturage. Heifers breed at three years. Individual owners each keep a good bull, and care is taken that such bulls are pure bred and the offspring of cows that milk well. Contagious diseases, like rinderpest, foot and mouth and cow pox (*Variola vaccina*) sometimes cause loss.*

Pure Gir cattle are remarkably true to type and in several respects are so characteristically different from other indigenous Indian cattle that the breed must have existed for a very long period and been kept uncontaminated by any alien blood.

Gir cattle are particularly true to type.

The colour or colours are distinctly characteristic, and yet there is great variety of colour. Broken colours, *i.e.*, large distinct markings of two or more colours may be taken as decisive proof that an animal so marked is not

Characteristic colours.

* For this information I am under acknowledgment to *Sirdar Rao Bahadur Becharis Voharidas*, *Dewan of Jmāgadh*.

pure bred. At the same time, a more or less intimate mixture of two colours or different shades of two colours, the one blending into the other in a curious manner, is very common. Then again, a common colour is a more defined intimate mixture of the two colours. The English term for this mixture would be "roan"—a dark roan when the dark colour preponderates; a light roan when the light colour preponderates. A still more defined admixture of two colours (and this is perhaps more common in pure Gir cattle than any other combination) may appropriately be termed speckled. Another by no means unusual combination is a white or dirty white ground work with faint markings shaded into the dirty white over the body. Almost always the limbs, the neck and particularly the ears are much darker. I have seen a few specimens of pure bred Gir cows which were entirely red excepting a white udder. In light coloured cattle the tuft of hair at the end of the tail is usually dull red or black. On the body the dark colour may occasionally be black (not common), dull brown, dull red, red or light red and tawny red or dull yellow. The light colour can never be called pure white. It has a bluish, dingy, smoky or dirty looking tinge which can hardly be described but can readily be distinguished when once seen. The combinations of colours referred to, would, on paper, indicate that the colours seen in Gir cattle can in no way be called characteristic. Yet there is no doubt that a trained eye can readily detect a Gir animal by its colour amongst cattle of other breed at a distance without particularly noticing other characteristics.

The general and particular characteristics of the breed.

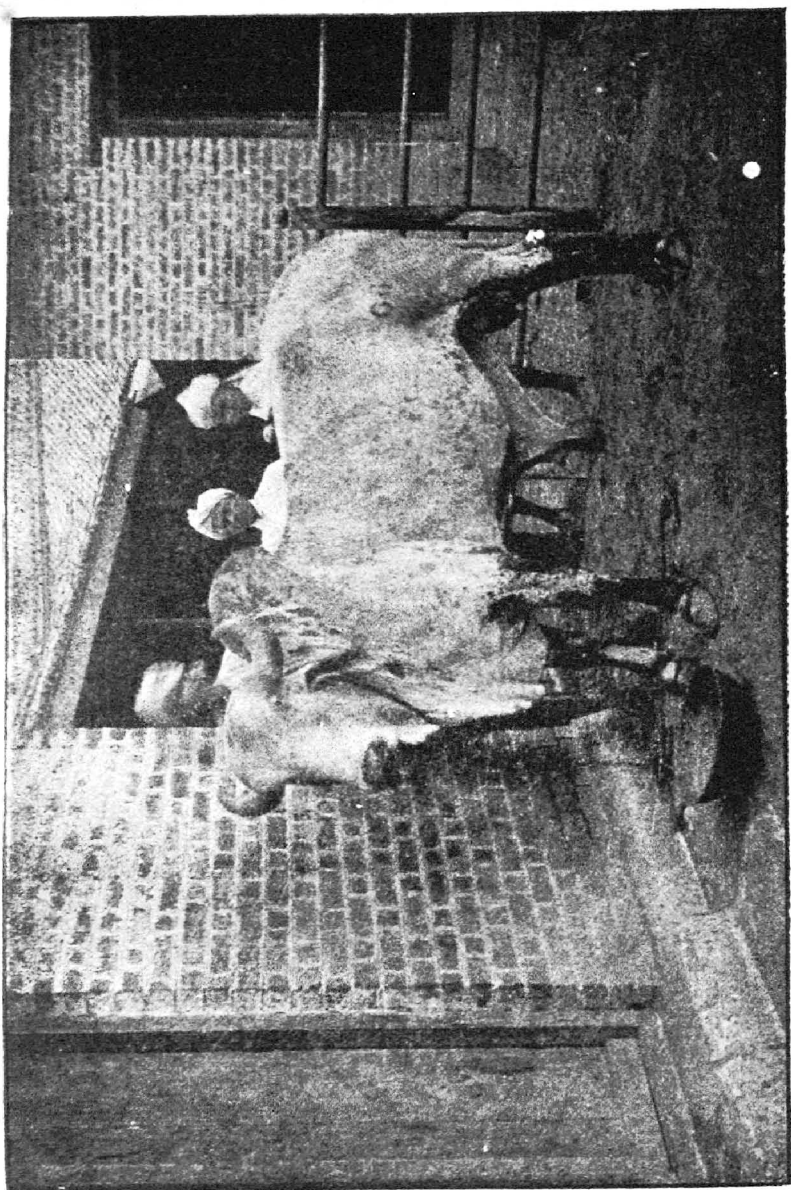
The breed may be classed as medium sized. The general conformation of the frame would not indicate in any particular way that the breed is specially useful as a milk breed. In average specimens the udders are fairly capacious and the milk veins prominent. These are about the only indications of deep milking capacity. The udders are not usually well shaped being too pendulous with large teats irregularly placed. The frame should be square and wide, but usually there is, in cows especially, a very decided droop in the quarters and deficiency of thigh. Very often animals otherwise well proportioned stand high and the term leggy can appropriately be applied. Usually Gir cattle stand fairly wide and square on their legs. The leg bones below the knees and hocks are, however, coarse, particularly so in bulls. The feet are large and soft—in old bulls particularly so—and often in cattle advanced in years get unshapely. In well bred specimens, the loose skin on the sheath of the bull is very conspicuous as also under the neck and on the dewlap. There is also much loose skin under the neck and dewlap of cows and also near the navel. The hump is very large in the bull, but only of medium size in the cow. The head, horns and ears are specially

characteristic. It must be confessed that there is hardly a feature in the fully developed head of an old Gir bull that calls for any show of admiration. Yet an interested cattle breeder finds an interesting study. He begins to wonder what combination of circumstances or freak of nature caused the peculiar combination of extraordinary features. The peculiarity of conformation may, in part, be explained if it is true that Gir bulls were in olden times trained for fighting in all Káthiáwár Native States. The head of a present-day Gir bull would make a first-class battering ram. It is curious, perhaps significant, that the Jáfferabadi buffaloes bred also round the Gir Hills have similar extraordinary development of frontal bone. This development of frontal bone gives to Gir cattle a peculiar prominent rounded appearance of forehead. The greatest convexity, measuring from the base of one horn to the base of the other, is in an old bull as much as two feet. The prominence of forehead is made to appear all the more so, because the horns take a backward inclination. In the male the horns are thick at the base and in the most typical specimens curve backward abruptly and then forward. They are longer and much thinner in the cow, but spring also backward with, however, a spiral inward sweep. The head looks short in the bull, but this is because it is so wide and massive. It looks long in the cow and in taking actual measurements it is found to be so. The muzzle is large and black. The eyes look sleepy and are shaded by a heavy prominent eye-brow, which gives a sinister appearance and indicates a treacherous irritable temper which is commonly, if not constantly, a characteristic failing. The ears droop as in a lop-eared rabbit and those of a calf reach to the nostrils. They have a characteristic nick near the point on the inside. (*See illustration No. 25 of typical Gir cow's head*). Gir cattle mature slowly. Heifers rarely breed in the Deccan before 4 to 5 years of age although reported to breed earlier in the Gir Hills. The cows are irregular breeders and do not maintain, at least in the Deccan, the same reputation as good milch cattle as in the Gir Hills. The irritable temper of the cows causes the milk yield to be readily affected by any irregularity in feeding, milking or management. Cows in the Deccan yield up to 12 seers, (24 lbs.) milk per day, but it is unusual to find them remaining long in milk, and an average of 6 to 8 seers after calving is more common yield than that noted.

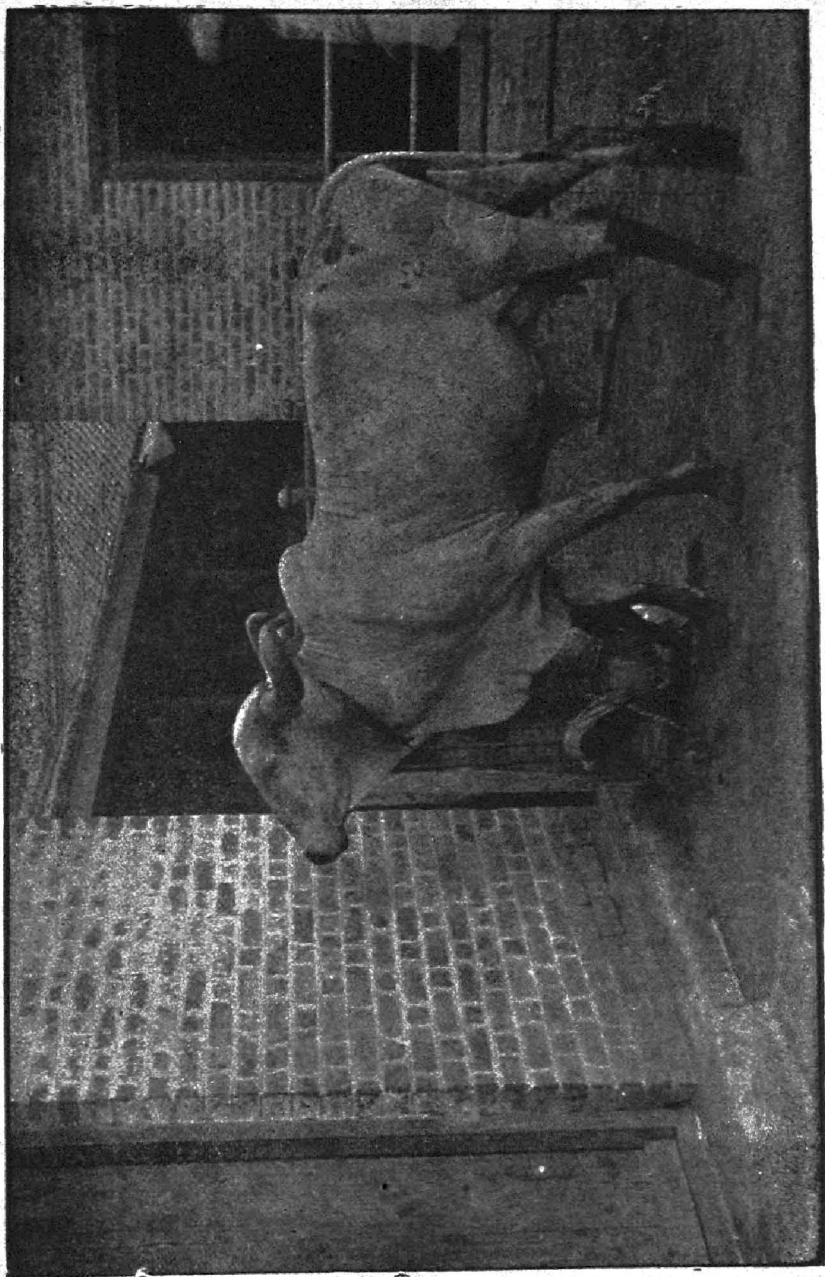
A good Gir cow is worth about Rs. 60 in Káthiáwár and Rs. 90 in Bombay. They are sometimes called Surtis, because brought from Káthiáwár to Surat in open boats and sold locally or railed to Bombay. Work-bullocks or bulls can be bought at cheap rate in Káthiáwár but are worth a good deal in the Deccan—Rs. 150 or so per pair. They are used for heavy cartage, but require careful shoeing on account of their soft feet. They are

Value.

slow at work. Old Gir cattle are very unsatisfactory for work because they get so lazy. When young they do fairly well at field or road work.



26.—Gir bull.



27.—Our cow.



28.—Gir cow.

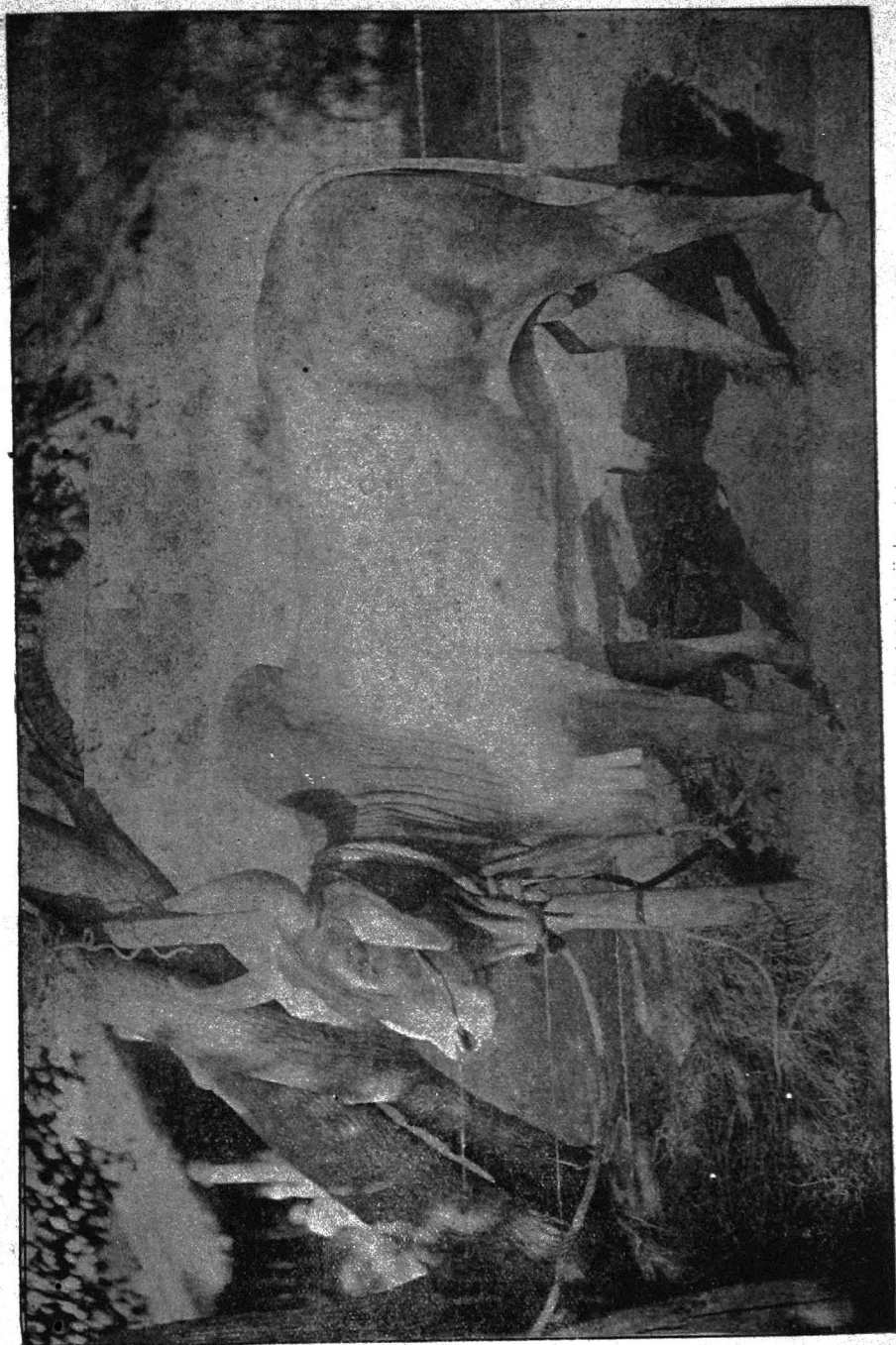
Measurements of Gir Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from point of pubis.	Length of quarter.	Width of pelvis.	Length of ears.	Length of horn outside curve.	Length of horn outside curve.	Circumference of horn at base.	Width of forequarter (measuring from the base of each horn).	Length of face from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
BULLS.															
1	Gir Bull, Rajkote State Breeding Farm, in breeding condition, 8 years.	4' 11 $\frac{1}{2}$ "	4' 11"	5' 8 $\frac{1}{2}$ "	5' 6"	1' 8"	1' 9"	1' 1"	1' 4"	1' 2"	1' 8 $\frac{1}{2}$ "	2' 0 $\frac{1}{2}$ "	0' 8"	0' 9"	
2	Stock Bull, Poona Government Farm. Colour: dull, red and tawny white, more or less intimately mixed. About 9 years old, in ordinary breeding condition	5' 3"	4' 5"	6' 2"	5' 10"	1' 8"	1' 7 $\frac{1}{2}$ "	1' 5"	1' 11"	1' 3"	1' 8 $\frac{1}{2}$ "	2' 2"	0' 6 $\frac{1}{2}$ "	0' 8 $\frac{1}{2}$ "	
3	Stock Bull, Baroda State Farm. White and brown intimately mixed. Ordinary breeding condition	5' 1"	4' 4"	6' "	5' 9"	1' 7"	1' 8"	1' 3"	1' 5"	1' 5"	1' 6"	2' 0"	0' 7 $\frac{1}{2}$ "	0' 8 $\frac{1}{2}$ "	
COWS.															
1	Baroda State Farm. Light roan, red and white. About 8 years.....	4' 7"	4' 2"	5' 6"	5' 9"	1' 5"	1' 5"	1' 1"	1' 8"	1' 6"	1' 3"	2' 0"	0' 8"	0' 7 $\frac{1}{2}$ "	
2	Do. do. colour and age much same as No. 1	4' 5"	4' 1"	5' 2"	5' 9"	1' 5"	1' 5"	1' 0 $\frac{1}{2}$ "	1' 4"	1' 1"	1' 4"	2' 1"	0' 8"	0' 7"	
3	Rajkote State, Káthiávar. Speckled red and white. About 8 years.....	4' 3"	4' 0 $\frac{1}{2}$ "	5' 4"	5' 2"	1' 4"	1' 4"	1' 0 $\frac{1}{2}$ "	1' 3 $\frac{1}{2}$ "	1' 6"	1' 5 $\frac{1}{2}$ "	1' 9"	0' 8"	0' 7 $\frac{1}{2}$ "	
4	Do. do. white cow with blotches or spots of light red	4' 3 $\frac{1}{2}$ "	3' 11 $\frac{1}{2}$ "	5' 2 $\frac{1}{2}$ "	5' 8"	1' 6"	1' 4 $\frac{1}{2}$ "	1' 3"	1' 4"	0' 11 $\frac{1}{2}$ "	1' 4"	1' 9 $\frac{1}{2}$ "	0' 8"	0' 8"	
5	Do. do. speckled red and white	4' 3"	3' 11"	5' 3"	5' 5"	1' 5 $\frac{1}{2}$ "	1' 4"	1' 1"	1' 5"	1' 0 $\frac{1}{2}$ "	1' 5 $\frac{1}{2}$ "	1' 9"	0' 7 $\frac{1}{2}$ "	0' 7 $\frac{1}{2}$ "	

GUJARÁT CATTLE.

The conditions under which Gujarát cattle are bred in the Northern Gujarát.

The indigenous cattle found in the fertile alluvial plains of Ahmedabad, Kaira and Baroda territory in Northern Gujarát are exceptionally large and fine. It would be indeed curious if a district so fertile as that referred to had cattle of inferior class. The district is pre-eminently suited for cattle breeding and its natural advantages are fully taken advantage of. Even in the purely agricultural parts the conditions are not unfavourable. The soil is deep alluvium, naturally well drained, and very fertile. Every arable field has its cactus hedge with hedgerow timber trees of magnificent proportions affording grateful shade to man and beast. The district was sorely stricken with famine in 1899, and many of the breeding cattle died, but before that trying season it had not felt scarcity for more than a century and was considered absolutely safe against famine. In 1899 the shade trees suffered severely having been pruned bare of leaves and small branches repeatedly to provide something for the starving cattle. In the arable land, crops in greater variety than in any other part of the Presidency are grown. Almost every pulse crop known in India is grown in the *charotar* villages. The feeding value of the pulse and of the fodder from such crops is very high. A wide border along the hedgerows in every field grows grass in large quantity and of the finest quality, and can either be fully grazed by tethered cattle or twice cut every season. The *charotar* villages of Kaira and Baroda are probably more fertile than those of any other part of India. The water of the numerous deep wells of Northern Gujarát or of the running streams is clear and good. In various parts of the district, but more particularly in the western *tálukas* of Ahmedabad and in Thásra and other parts of Kaira, there are extensive stretches of fine grazing lands which form the natural breeding grounds. These lands are not over-stocked and afford fairly abundant grazing during the greater portion of the year. Other fodder in full quantity is available when the grazing gets bare. Cattle and other descriptions of stock are grazed on the grass-lands at a cheap rate, very often at a nominal rate. The cattle breeders of the western parts of Ahmedabad are mostly Rabáris and Bharráds—the latter a wild and turbulent people—who understand their business full well and by hereditary right or use exercise grazing rights over wide areas in exchange for a purely nominal rent as compared with actual values. The superior holders are mostly Tálukdárs. The pressure on arable cultivation in these parts is small and is not materially extending. The arable cultivator goes in fear and trembling of the turbulent Bharráds and cattle breeding prospered until it got a very severe knock by the famine of 1899. The cattle of any particular village are herded together and large herds can be seen ranging over the grass-lands morning or evening, but during the



29.—Gujarat bull (Kankrej breed.)

heat of midday lie crowded together near the village site usually under grateful shade and close to the village tank. Parts of the grass-land referred to extend to the Runn of Cutch, and are somewhat swampy in the rains, but there is drier lighter land then open for grazing; and although the swamp land herbage looks coarse, it is liked by cattle and has peculiar relish because of the salt which the soil contains. The promiscuous herding of all village cattle in one herd would indicate that no special care is taken in mating animals. Such is to a certain extent the case. At the same time good bulls are mostly kept and all the male stock which it is intended to sell are sold young. It is exceptional to find young bulls in a village herd older than 18 months unless those which are being kept as sires, the reason being that at a year old they are each worth Rs. 20 to Rs. 30 and are sold at that age to the cultivators of the *charotar* villages of Kaira and Baroda. They are castrated before they are sold to the *Pátidár* cultivators and it is stated, no doubt with truth, that they grow into much finer work cattle if they are bought early and taken to be fed in the *charotar* villages, where pulse and other fodder of the finest quality is abundant.

The cattle in Southern Gujarat are of mixed breed for reasons given.

The Gujarát breed of cattle are extensively used by cultivators in the Broach and Surat districts and a few are bred in perhaps every village in these parts but many of the cattle found throughout Broach and Surat are not pure bred. In fact only a small proportion of the cattle can be classed as Gujarát cattle. The rest are cross-bred, more or less with a strong tendency to the Gujarát type. A good many Málvi cattle are owned in these districts. There was at one time a large trade in wheat and linseed with pack bullocks as carriers between Nandurbár and Surat, and Málvi cattle found their way into the district by this route. There is unmistakable evidence that many cattle have been brought from Khándesh and Holkár's Territory, also from Northern Gujarát and Kathiáwár. In the towns of Baroda, Broach, Surat, &c., a small breed is found which to a considerable extent resembles Deccani cattle. These cattle are mostly white or light grey with jet black muzzles and eye membranes. The bullocks are used as trotting cattle in light *ekas* and many of them are very fast and not much larger than Gainias. The influence of imported cattle in modifying, in the Surat and Broach districts, the character of the indigenous breed has no doubt been considerable. Gir cattle have been brought over from Káthiáwár in considerable numbers to the opposite side of the Gulf of Cambay, and throughout the Surat and Broach districts cross-bred Gir-Gujarátí cattle are freely met with. It is perhaps not surprising that districts circumstanced like Broach and Surat should have a non-descript breed of cattle. The deep black soil, the extensive areas under cotton, the restricted areas under grass, the quagmire condition of such grass-lands in the monsoon

especially in the Broach district, the absence of shade trees and of many wells or other local source of water-supply are conditions not favourable to cattle breeding. In every village there are a few breeding cows, but the system of breeding is more or less uncontrolled and the cattle taken as a whole are very mixed.

Typical Gujarāti cattle are either white, silver grey, grey or iron grey in colour. In grey specimens the head, neck and limbs are generally a darker shade than the body. The muzzle and eye membranes are black. The skin has usually a rich yellow colour and this is readily seen if the inside of the ears are examined. The frame is well formed, long, wide and deep with however generally a considerable droop in the hindquarters. The cattle are tall and perhaps stand rather high on the leg, but this can hardly be considered a fault at any rate in Kaira and Baroda where the soil is deep sandy alluvium (*gorādu*). The legginess referred to gives greater activity for heavy cart work on the roadways which are always several feet lower than the adjoining land, and are either knee deep with mud and water in the monsoon, or ankle deep with drift sand in the fair season. It is astonishing the pace at which a good pair of Gujarāti bullocks can draw a big, long, cumbersome, heavy-laden cart over these roadways. In a shigram or with an empty cart or a light load, they also trot well with however somewhat ungainly action. The legs of Gujarāti cattle are particularly shapely and well placed—muscular in the forearm and above the hocks—with flat, hard durable bone of fine quality. The feet are, for such large cattle, small, hard and well shaped. There is considerable extent of loose skin between the jowls and the dewlap, not a great deal on the sheath of the bull or near the navel of the cow. The cows are generally poor milkers. The hump is prominent in the bull, only moderately so in the cow or work bullock. The head is long, slightly bulged above the eyes, with a projecting vertical ridge of bone on the frontal bone midway between the horns. This ridge is sometimes prominent and several inches long; sometimes not nearly so prominent. The base of the horns for a length of one or two inches is usually covered with skin and hair—a common characteristic in the breed. The ears are very characteristic, being large, long, pendulous and open. I can think of no better adjective than the last to express a characteristic peculiarity. The horns of local-bred cattle rise vertically, neither incline forward or backward, but as they rise first bow outward and then inward.

The general and particular characteristics of pure bred Gujarāti cattle.

Gujarāti work cattle are both active and strong, and equally well adapted for the road or the plough. On the road or at ordinary field work they walk much faster than any breed used for agricultural operations in the Deccan. A Deccani cultivator urges his work cattle to greater activity by an incessant flow of language (the literal meaning of which need not be +

Gujarāt and
cattle at w
pared.

closely examined) and the occasional use of a whip with a short handle and a long leather thong. The Gujarát ploughman rarely speaks to his work-cattle. He guides by the nose reins and goads them on by sparingly using a long bamboo stick with a brad-awl iron point which penetrates the skin and occasionally draws blood. Unless the cattle are tired the brad-awl is scarcely used, a feint to use it at the base of the hump or some other *delicate* part is all that is required. The brad-awl is not unknown in the Deccan. It occupies the but end of the whip handle and with poor, tired, half-fed cart bullocks is often used with relentless cruelty, the skin being pierced most commonly over the loins.

Value.

Gujarát bullocks at 5 and 6 years of age are worth Rs. 250 per pair for good average specimens.

Kankrej cattle are the best type of Gujarát cattle.—The natural conditions of the districts where these cattle are bred, are described.

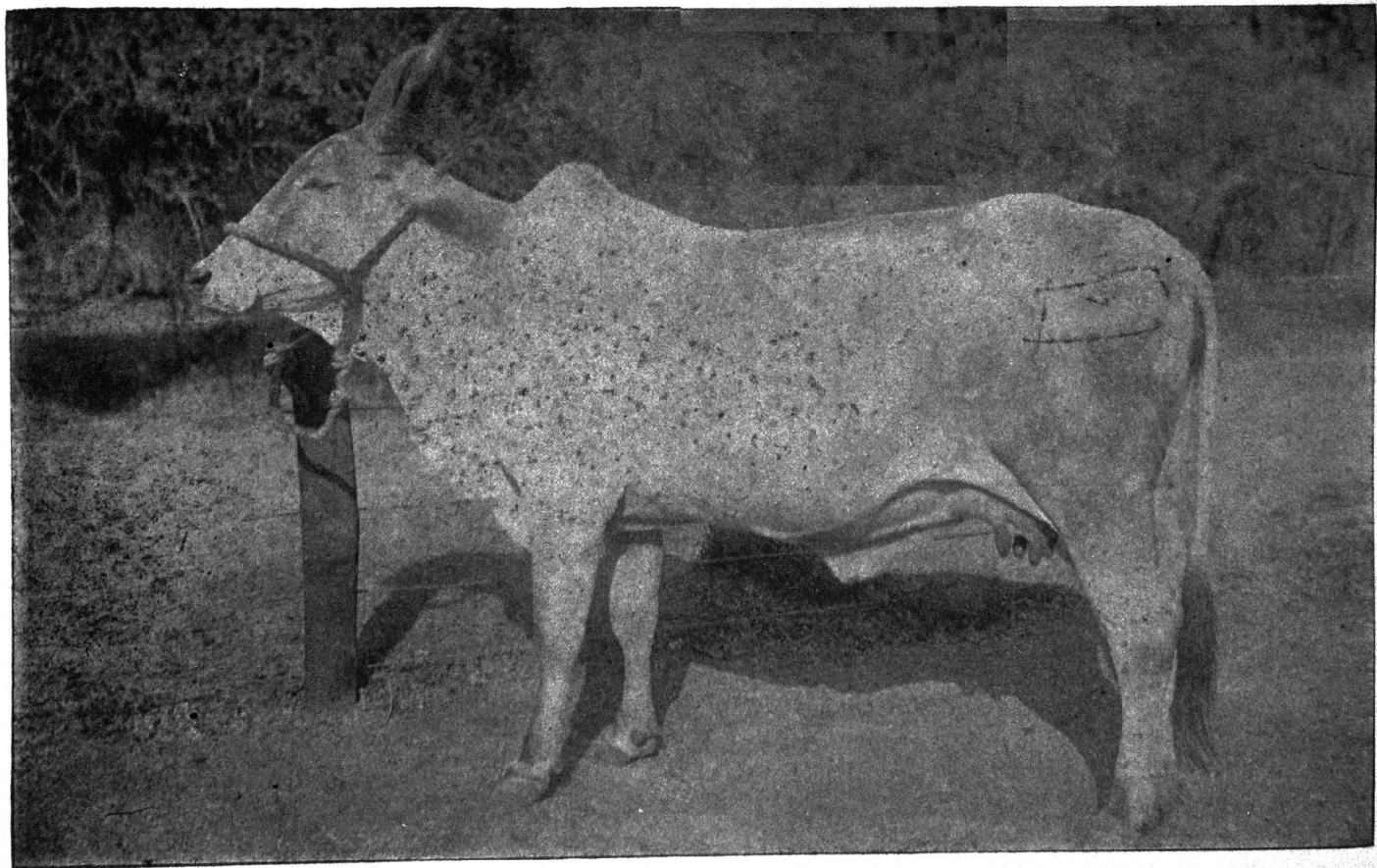
Wadiál or Kankrej cattle are bred within the limits of the Pálanpur Political Agency, a district which lies mostly south, east and west of Deesa. The district is partly hilly and wooded. The arable cultivation of lower lying lands is not particularly extensive and in general is not particularly advanced. There are extensive grazing lands but all are not good. Much of the grazing land is spoiled to some extent by salt encrusted on the surface, and this harmful influence appears to be extending. The soil is to a considerable extent light coloured alluvium of considerable depth with however the water-bearing subsoil stratum in many places not far from the surface. The best grazing lands are along the valleys of the rivers. These lands are well shaded. The annual rainfall is on the whole light, being 25 inches or less. The cattle have to a considerable extent to depend for drinking water upon tanks rather than upon perennial streams, which is an obvious disadvantage. The climate is very cold in winter and very hot during part of March, April, May and sometimes part of June. The best cattle-breeding districts in the Pálanpur Agency are Kankrej and Wadiál; next to these in importance are Sántalpur, Váráhi, Márwád, Bhábhar and Deodár. Then comes Deesa and part of Pálanpur. The stock breeders are mostly Rabáris and Bharváds. The former breed cows, buffaloes and camels; whilst the latter breed cows, sheep and goats. The Bharváds of Wadiál are noted as possessing good cattle of pure breed, and the stud bulls used through the Pálanpur Agency are bought at high prices from these breeders. The Kankrej cattle are next in importance, being mostly pure bred; but in other parts of the Agency individual owners are not so particular regarding the purity of their stock and their cattle are therefore not so good. The Bharvád and Rabári cattle breeders own from 10 to 15 up to 250 to 300 head of cattle each. Generally the number is 50 to 100 with one or two stud bulls to the herd. Cattle are never tied or sheltered. They are penned at night inside a strong fence of *bábhul* thorns on ground which is naturally dry. The cattle depend upon the grazing for food

except in May and June. Then they get *jowár* or *báji karbi*. The calf takes all the milk for a week after calving. Then the owner takes part of the milk if the calf is a cow calf; if a bull calf it gets all the milk. The cow, however, gets no extra feeding and does not give much milk. The heifer calves are turned out with the herd when the cows go dry; whilst bull calves are generally bought up eagerly by Pátidár cultivators as soon as they are weaned, and they are subsequently fed well on the mixed pulse and cereal fodder produced from arable holdings and also get concentrated food. They are grazed on good grass-land during the monsoon months. The best Bharvád and Rabári breeders are very particular in selecting their bulls. The best bull calves of a particular year are chosen. The second or third calves of exceptionally well shaped big young typical cows, and got by a first-class young bull of good pedigree, are chosen. The selected bull calves are branded, and fed and reared with great care, and allowed a full supply of good food at all seasons. Such bulls are fit for service and are used at stud when 3 to 3½ years. Stud bulls are used from this age until they are about 6 or 7. Then they are turned out of the herd and sold and young ones substituted. Rabári breeders object on religious principles to a bull covering heifers which are his own offspring, which would be objectionable in any case, and therefore sell or exchange a stud bull before there is any such risk. The heifers are of breedable age when about 3½ years. Bull calves are castrated when 1 to 3 months of age. Early castration does not in any way deteriorate the value of Kánkrej or Wadiál bullocks for work purposes.

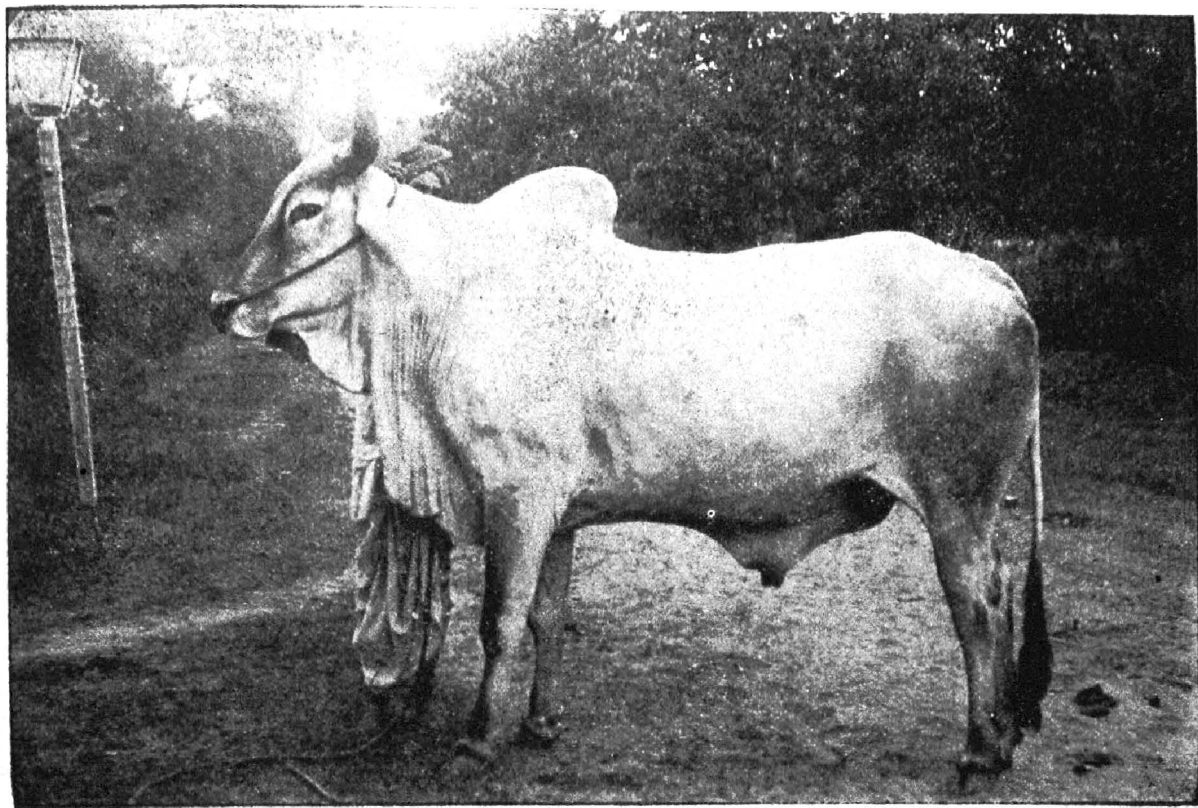
The best cattle owned in Gujarát proper are bred in Kánkrej or Wadiál and are brought down by dealers into the Gujarát and Baroda territory in droves annually. It is questionable whether the Gujaráti cattle proper can be differentiated from Kánkrej cattle. There is no definite boundary line between the best breeding parts of the two districts. Within the limits of the Pálanpur Agency a few cattle which are recognised as pure bred are black in colour, some are red or fawn, but the great majority are various shades of grey or pure white. Now in Gujarát proper indigenous cattle of the three former colours would certainly be considered not pure bred. In Kánkrej the people prefer that bullocks or cows be silver grey in colour. The cows are generally silver grey or iron grey or white, whereas the bulls are usually darker, being commonly iron grey or iron grey with nearly black extremities, sometimes, but not often, being nearly entirely black. Generally Kánkrej cattle are deeper, wider and longer in frame than Gujaráti and they do not appear so leggy. Their leg bones are perhaps coarser, and the feet bigger. But a Kánkrej bullock moves in walking or trotting action with great activity and pace. The ruling Chiefs of Gujarát and Káthiáw

It is difficult to differentiate between Gujaráti cattle and Kánkrej cattle.

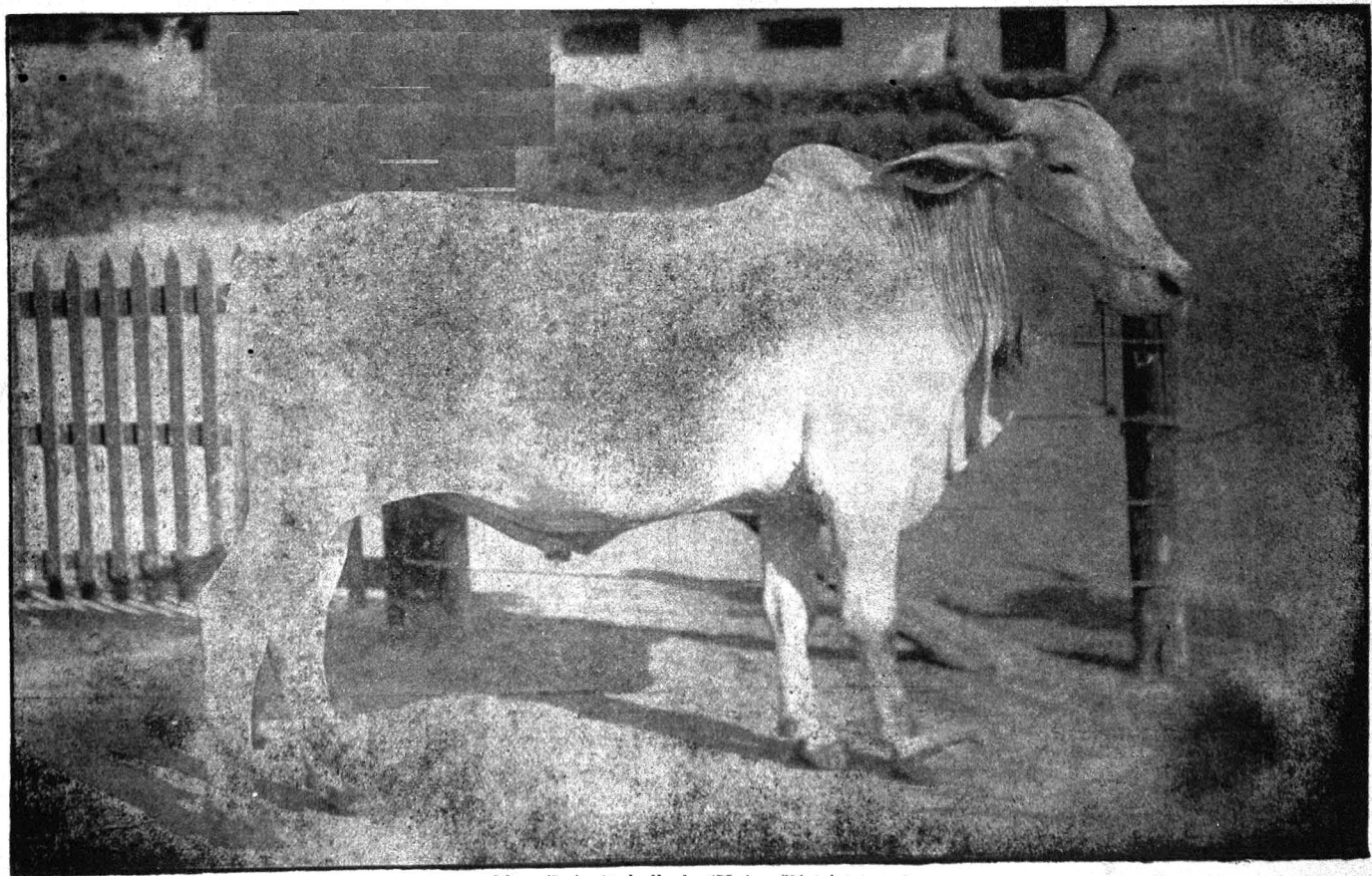
own large numbers of Kámkrejī cattle and use them chiefly as trotting cattle in shigrams. Gujaráti and Kámkrejī cattle may be considered as one breed if select specimens of each are examined. But the Kámkrejī cattle are better or more improved on the whole. The horns in old bullocks are certainly typical, differing considerably from those of Gujaráti cattle in being extremely strong, and taking a characteristic backward spiral sweep which gives the head a very bold appearance; but it is curious that this enormous development of horn is not observable in any particular way in bullocks which are young, or in bulls or cows of any age. In such the spiral turn in the horns is only marked in a slight degree, and in some cows is entirely absent. The only other noticeable feature in which Kámkrejī cattle differ from Gujarátis is that their pelvic or hook bones are perhaps more prominent.



39.—Gujarāt cow (Kānkrejī breed.)



31.—Gujarāt bullock (Kānkrejī breed.)



32.—Gujarāt bullock (Kaira District type.)

Measurements of Gujarati and Kankrej Cattle

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears outside curve.	Length of horn outside curve.	Circumference of horn at base.	Width of forehead, greatest convexity measuring from base of each horn.	Length of face, pole to muzzle.	Length of canon.	Girth of canon.	Remark.
1	2														
1	White.....	5' 4 $\frac{1}{2}$ "	4' 11"	6' 7 $\frac{1}{2}$ "	4' 0"	1' 8"	1' 11"	1' 4"	1' 7 $\frac{1}{2}$ "	1' 1"	0' 10 $\frac{1}{2}$ "	2' 1"	1' 10"	6' 2 $\frac{1}{8}$ "	All in ordinary working condition.
2	White.....	5' 3"	4' 6 $\frac{1}{2}$ "	6' 11"	4' 0"	1' 6 $\frac{1}{2}$ "	1' 10"	1' 3 $\frac{1}{2}$ "	1' 1"	1' 0"	0' 11"	1' 10"	1' 8"	6' 2 $\frac{1}{8}$ "	
3	White, with grey neck and legs.	5' 3"	4' 7"	6' 2"	3' 11"	1' 7"	1' 6"	1' 3 $\frac{1}{2}$ "	1' 1"	0' 10"	0' 10 $\frac{1}{2}$ "	1' 6"	1' 8"	6' 2 $\frac{1}{8}$ "	
4	Grey	5' 1"	4' 5"	5' 10"	4' 0"	1' 5"	1' 7"	1' 2"	1' 1"	0' 10"	0' 10"	1' 1"	1' 8"	6' 2 $\frac{1}{8}$ "	
Baroda State bullock, grey ..															
Baroda State grey bullock.															
Baroda State white bullock.															
1	White.....	4' 6"	4' 8"	5' 9 $\frac{1}{2}$ "	3' 5"	1' 3"	1' 3"	1' 2"	1' 4 $\frac{1}{2}$ "	0' 9 $\frac{1}{2}$ "	0' 8 $\frac{1}{2}$ "	1' 11"	1' 7"	6' 2 $\frac{1}{8}$ "	
2	White.....	4' 8"	4' 4"	5' 11"	3' 7"	1' 3"	1' 3 $\frac{1}{2}$ "	1' 2"	1' 5"	1' 3"	0' 10"	1' 11"	1' 7"	6' 2 $\frac{1}{8}$ "	

Kankrej bullocks

Gujarati (best class of Gujarati)

Gujarati bullocks.

cow.

Measurements of Kankrej Cattle at the Government Farm, Surat

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears outside the curve.	Length of horn outside the curve.	Circumference of horn at base.	Width of forehead, greatest convexity measuring from base of each horn.	Length of face, pole to muzzle.	Length of canon.	Girth of canon.
SURAT FARM COWS, ALL GREY IN COLOURS AND IN ORDINARY CONDITION.														
1	Káshi	4' 10"	4' 7"	5' 6"	3' 7"	1' 4"	1' 7"	1' 1"	1' 5"	0' 10 $\frac{1}{2}$ "	0' 10"	1' 8"	...	0' 7"
2	Prayág	4' 6"	4' 4 $\frac{1}{2}$ "	5' 5"	3' 10"	1' 3"	1' 6"	1' 1"	1' 2"	0' 10 $\frac{1}{2}$ "	0' 8"	1' 8"	...	0' 6 $\frac{1}{2}$ "
3	Ganga.....	4' 6"	4' 4"	5' 6"	3' 9"	1' 4"	1' 3 $\frac{1}{2}$ "	1' 1"	1' 6"	0' 10"	0' 8"	1' 9"	...	0' 6 $\frac{1}{2}$ "
SURAT FARM STOCK BULL, GREY, ORDINARY CONDITION.														
1	Deoman	5' 3"	4' 9"	6' 9"	4' 0"	1' 6"	1' 9"	1' 2 $\frac{1}{2}$ "	1' 6"	1' 1"	0' 8"	1' 8"	...	0' 8 $\frac{1}{2}$ "

KRISHNA VALLEY CATTLE.

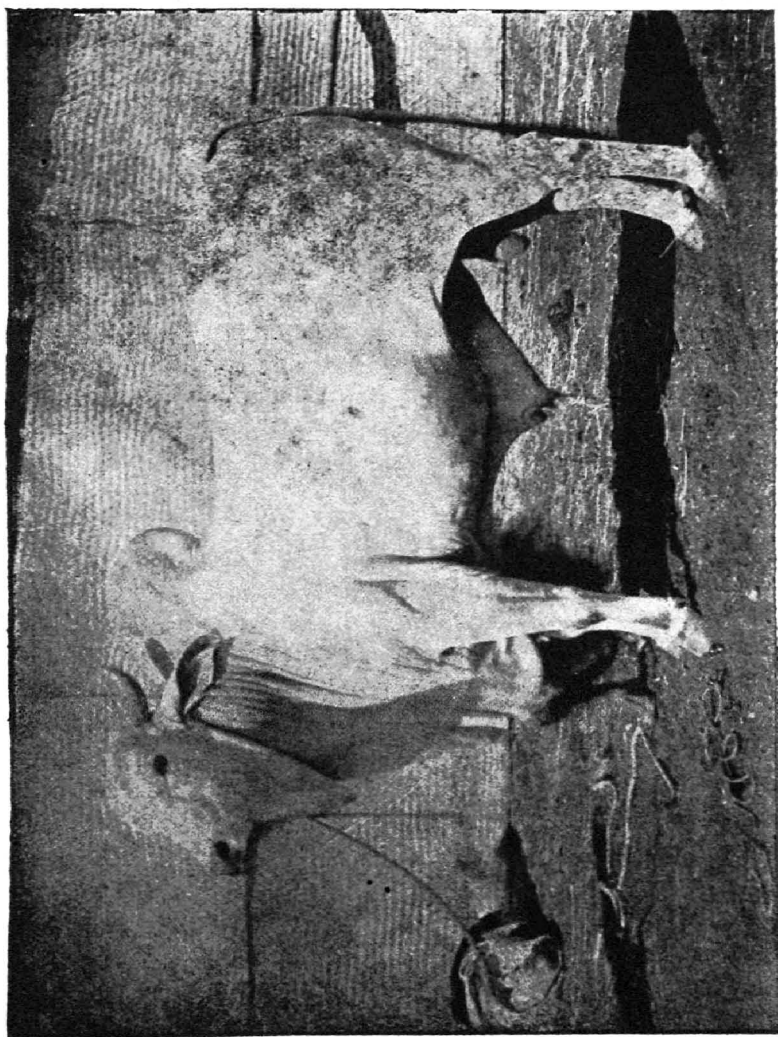
The general and particular conditions under which these cattle are bred.

Selected specimens of this breed, such as the best of those exhibited at the Chinchli shows in the Kolhápúr State, are magnificent cattle. They are bred generally throughout the Southern Marátha country and in particular in the Kolhápúr and Ichalkaranji States, also in the States of Sāngli, Miraj, Kurundwád, Rāmdurg, Jamkhandi and Mudhol, in the *tálukas* of Athni and Chikodi in the Belgaum District and in parts of Sātára and Bījápúr. The best of the cattle are believed to be bred by occupants of the valley lands fringing the course of the Krishna and its more important tributaries. The soil is deep black and fertile. Individual cattle breeders own only a few cows and keep a limited number of young stock. Natural grazing except in riverside lands which are shaded by *bábhul*, is of limited extent, and these lands are chiefly reserved for hay. The chief fodder is the *karbi* of *jowári* supplemented, as occasion requires, by cotton seed and oil-cake. There is no doubt that the present type of Krishna Valley cattle is the result of judicious crossing. In this connection the introduction of Nellore and Gujaráti cattle into the Sāngli State by the father of the present Chief has had an important bearing.

The characteristics of the breed described.

It cannot be said that Krishna Valley cattle are particularly true to type, but the best of them for heavy slow work are particularly useful. Like all cattle bred in districts with soft, deep soil, their feet are soft and large; consequently for road work these cattle require to be carefully and regularly shod. Even with this precaution they get tender footed when worked continuously for any length of time on hard macadamized roads. Large Krishna Valley bullocks are enormously powerful, and well adapted for heavy tillage work or slow heavy haulage. Krishna Valley cattle show considerable variety of colour. This is a natural consequence of recent improvement by crossing. The predominating colours are either pure white or grey. Illustration 33 represents a 5 year old bull, 1st prize in his class at Chinchli and sold by the breeder for Rs. 300. This was an enormously massive animal beautifully proportioned, and in every way typical of a first-class specimen of the breed. His head is wide and massive, forehead somewhat bulged, muzzle large and black. The eyes are placed somewhat on the side of the head as in Nellore cattle and have a quiet placid appearance indicating docile temperament. The ears are long, more or less pendulous, and a rich orange colour inside. The horns spring more or less horizontally with a gentle upward curve. They are of medium length (in most cattle of the breed they are comparatively short) fairly thick at the base, blunt at the point and flattened throughout the entire length. The neck is short, very deep and thick, and made to appear more massive than it really is by an extraordinary development of loose wrinkled skin extending

from the jowls to the brisket. The development of loose skin on the sheath is also conspicuous. The frame is, as it ought to be, long, wide, deep, with comparatively level upper and under lines and very little tendency to droop in the hindquarters. The quarters are long and level. The thighs are deep and fleshy. The fore arms are well developed. The hump is very large. The legs are short but well placed. The leg bones are large, but are flat and of good durable quality. The canon bones in Krishna Valley cattle are generally characteristically short. This is not particularly noticeable in the bull under description.



33.—Krishna Valley bull.

Illustration No. 34 represents a very good specimen of a cow in show condition. The cows of the breed are generally poor milkers. They breed with fair regularity. Heifers are sufficiently mature for breeding purposes when three years old and bullocks are put to light work at the same age. Bulls are castrated at 3 or 4 years in the ordinary native way. *Pol* bulls of superior class, dedicated to village gods, are common, and probably exercise some influence in improving the breed, but as they are allowed to roam anywhere and eat anything, they get excessively fat, and for stud purposes are less active than younger leaner animals.



34.—Krishna Valley cow.

Measurements of Krishna Valley Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horn, outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from the base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	Bull 1st Prize, Chinchli Show, 1896, in show condition. Light silver grey, nearly white. 5 or 6 years	5' 9"	4' 10"	6' 8"	4' 3"	1' 10"	1' 10"	1' 0"	0' 8"	0' 10"	1' 1"	2' 1"	0' 9"	0' 9"
2	2nd Prize, Silver grey, neck darker shade. 6 years.	5' 6"	4' 10"	6' 11"	4' 9"	1' 10"	1' 10"	1' 0"	0' 6"	0' 9"	1' 1"	2' 1"	0' 9"	0' 9"
1	1st Prize, 1896, Kolhapur State Fair, Chinchli. Pure white.	4' 11"	4' 8"	6' 10"	4' 0"	1' 7"	1' 10"	1' 1"	0' 9"	0' 9"	0' 11"	1' 10"	0' 8½"	0' 8½"
2	3rd Prize, Cow at above Fair. Colour white. 5 years	4' 11"	4' 6½"	6' 1"	3' 9"	1' 7"	1' 9"	1' 1"	0' 9"	0' 9"	0' 11"	1' 9"	0' 8"	0' 8"

Krishna Valley Bulls. Krishna Valley Cows.

NELLORE CATTLE.

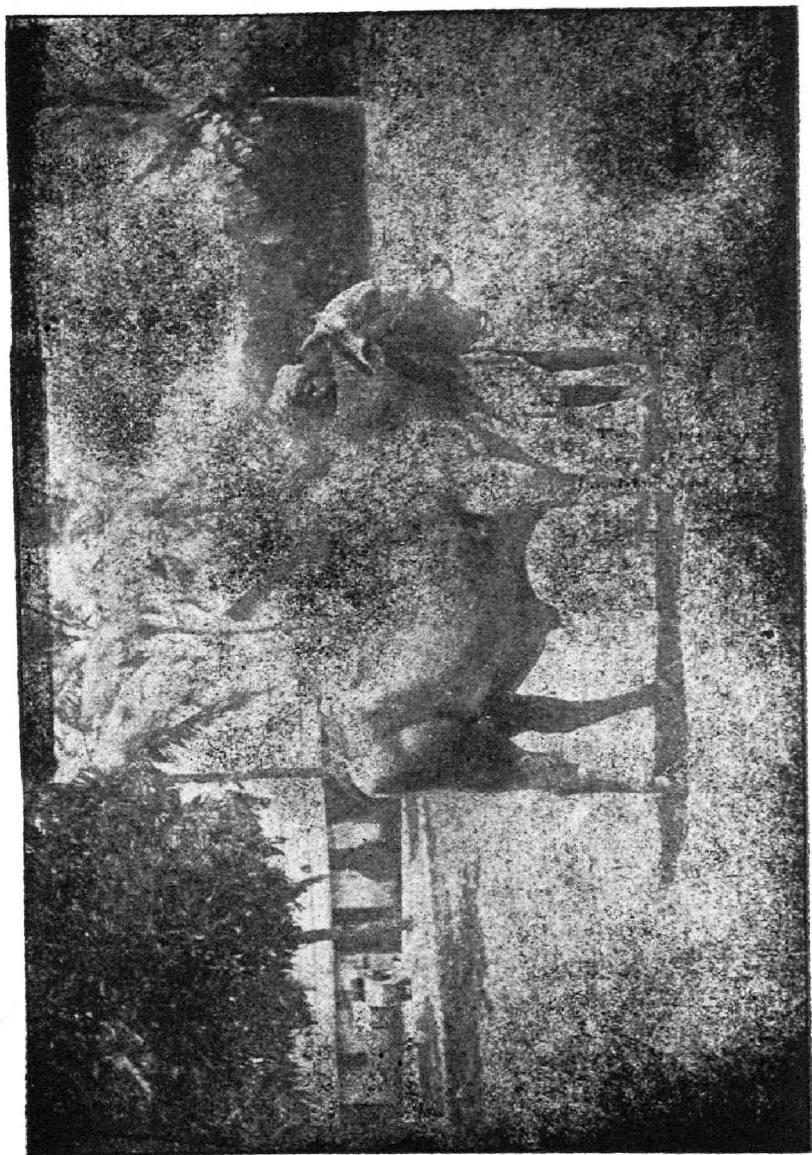
Nellore & Krishna
Valley cattle are
probably of common
origin.

A large breed which is chiefly bred in the north-eastern districts of the Madras Presidency. The cattle of this breed resemble in some respects the Krishna Valley cattle of the Bombay Presidency. Both breeds may have had a common origin. The Nellore cattle are not so true to a particular type as most of the pure Indian breeds, and there are indications that some, at least, of them inherit a slight dash of Mysore blood. I judge of this chiefly by the appearance of the horns and eyes. The variableness of colour and of type indicate mixed breeding within recent times. Nellores are essentially the milk breed of Madras. Many of the cows milk well, but they do not by any means all do so. They could, no doubt, by careful selection and breeding be bred up to a generally high standard as milch cattle. This breed as it now exists takes a prominent place amongst other Indian breeds in providing work cattle of superior class. Large bullocks when young command high prices being worth Rs. 300 or more per pair.

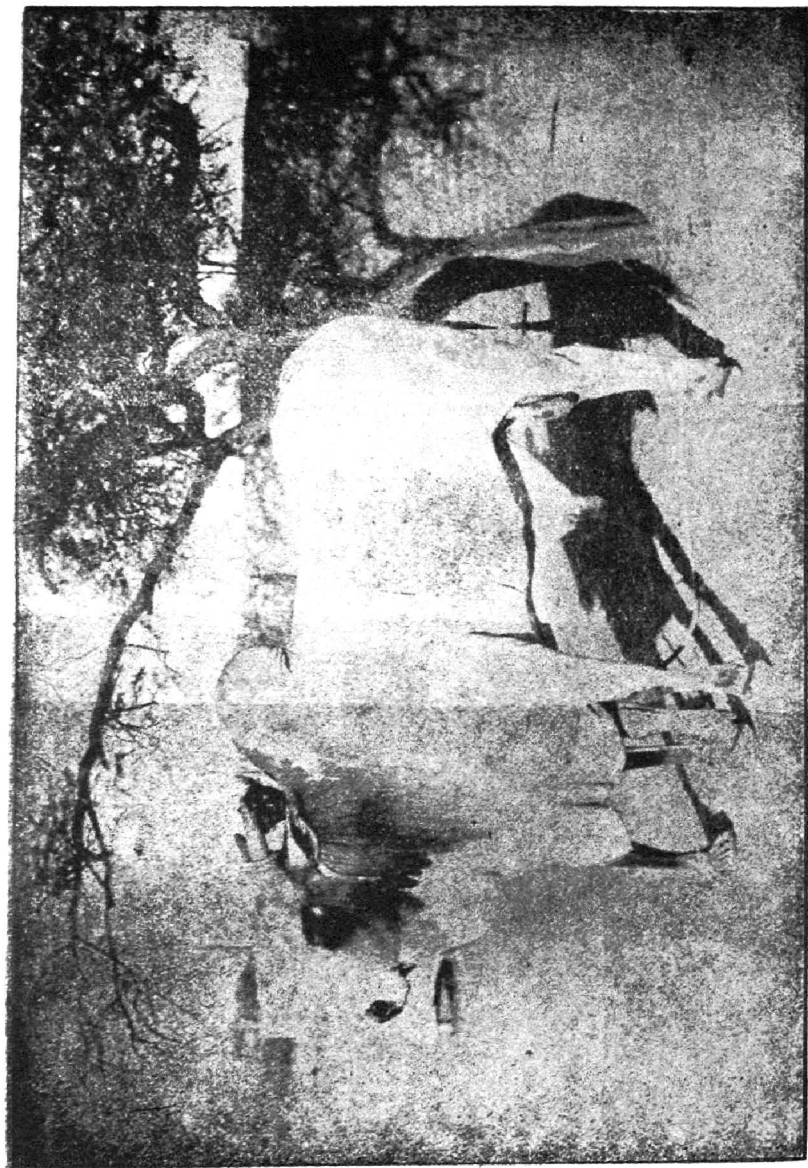
The general characteristics of the breed described.

It is not by any means easy to select specimen cattle as typical of the breed, owing to variations in type and colour. The prevailing colour is in the cow pure white. Bulls or bullocks are not very commonly pure white. They may be light grey, or grey with the neck, hindquarters and legs very often a darker colour. A yellowish red colour is not uncommon, but this colour as well as broken colours indicate, I imagine, mixed blood. Nellores taken as a breed are leggy cattle and often narrow in frame, but then, again, good specimens are not badly proportioned. They are usually docile tempered—an essential characteristic in a good milk breed. The bullocks are not particularly active, neither are they particularly slow at work. They are good useful cattle for ordinary agricultural operations, and the biggest and best of them are suitable for heavy transport at a moderately slow pace. Illustration 35 represents a typical specimen of the breed—a grey bull in ordinary condition. The neck and hindquarters are a darker shade of grey than the rest of the body. This bull is deep and wide, but not so long in frame as he should be. The droop in the hindquarters is decided, and there is a decided shortness there, which may be considered a fault. The head is typical. It is long between the eyes and the large black muzzle. The eyes occupy elliptical sockets placed on the side of the head. The forehead bulges out above the eyes, and this roundness becomes more apparent, because the flattish, short, blunt horns incline backwards in a characteristic manner. The horns are closer together as they spring from the head, than at the points. The ears are of moderate length, alert and sharp pointed. The short thick neck and the extraordinary development of loose skin from the jowls to the brisket are characteristic features, and also the loose skin on the

sheath extending forward to the dewlap. This bull stands as he ought to do squarely on his legs and unlike the majority of cows and heifers of this breed is not leggy. The leg bones are as usual in the breed fairly coarse, and the feet moderately large.

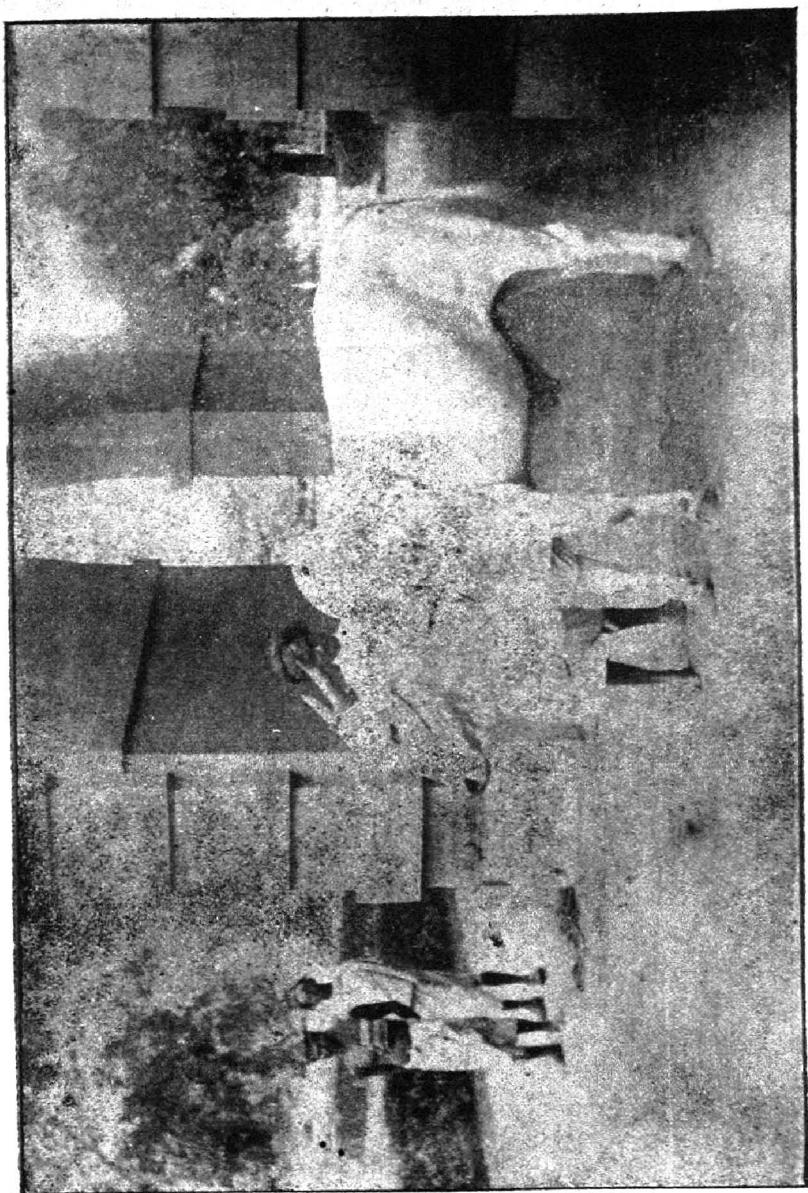


35.—Nellore bull.



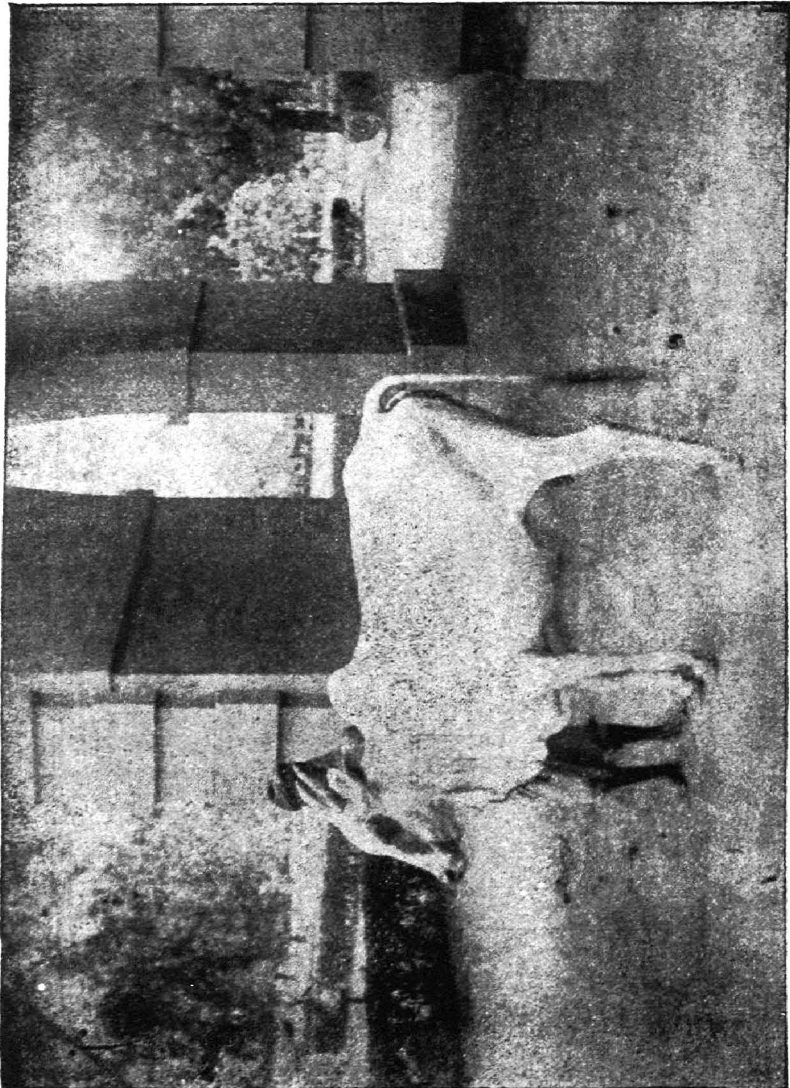
36.—Nellore bull.

Illustration 37 represents a typical work bullock, pure white in colour.



37 —Nellore bullock.

Illustration 38 represents a good cow, white in colour excepting light grey markings on the face. The horns of a Nellore cow are generally larger, thinner and sharper than those of a bull or bullock. Nellore cows have not usually very well shaped udders but there are exceptions. In good milkers the udders are capacious but often the teats are close together in a cluster and the udder not so shapely as is desirable in a good milch cow.



38.—Nellore cow.

Measurements of Nellore Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Length from behind hump to point of pubis.	Girth.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horns, outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from base of each horn.)	Length of face, from pole to muzzle.	Girth of canon.
1	Cow, Saidapet College, 6 years, grey...	5' 5 $\frac{1}{2}$ "	4' 3"	3' 9"	5' 8 $\frac{1}{2}$ "	1' 2"	1' 1"	0' 7 $\frac{1}{2}$ "	0' 9"	0' 7"	0' 7 $\frac{1}{2}$ "	1' 6 $\frac{1}{2}$ "	0' 6 $\frac{1}{2}$ "
2	Bullock, 7 $\frac{1}{2}$ years, white.....	5' 1 $\frac{1}{2}$ "	4' 6 $\frac{1}{2}$ "	3' 8"	6' 1 $\frac{1}{2}$ "	1' 6"	1' 5"	0' 9"	0' 9 $\frac{1}{2}$ "	0' 7 $\frac{1}{2}$ "	0' 8"	1' 8 $\frac{1}{2}$ "	0' 8 $\frac{1}{2}$ "
3	Bullock, 7 years, white	5' 1"	1' 8"	4' 2"	6' 4"	1' 6"	1' 5"	0' 9"	0' 10"	0' 7 $\frac{3}{4}$ "	0' 8"	1' 9"	0' 8"

LOWER SIND CATTLE.

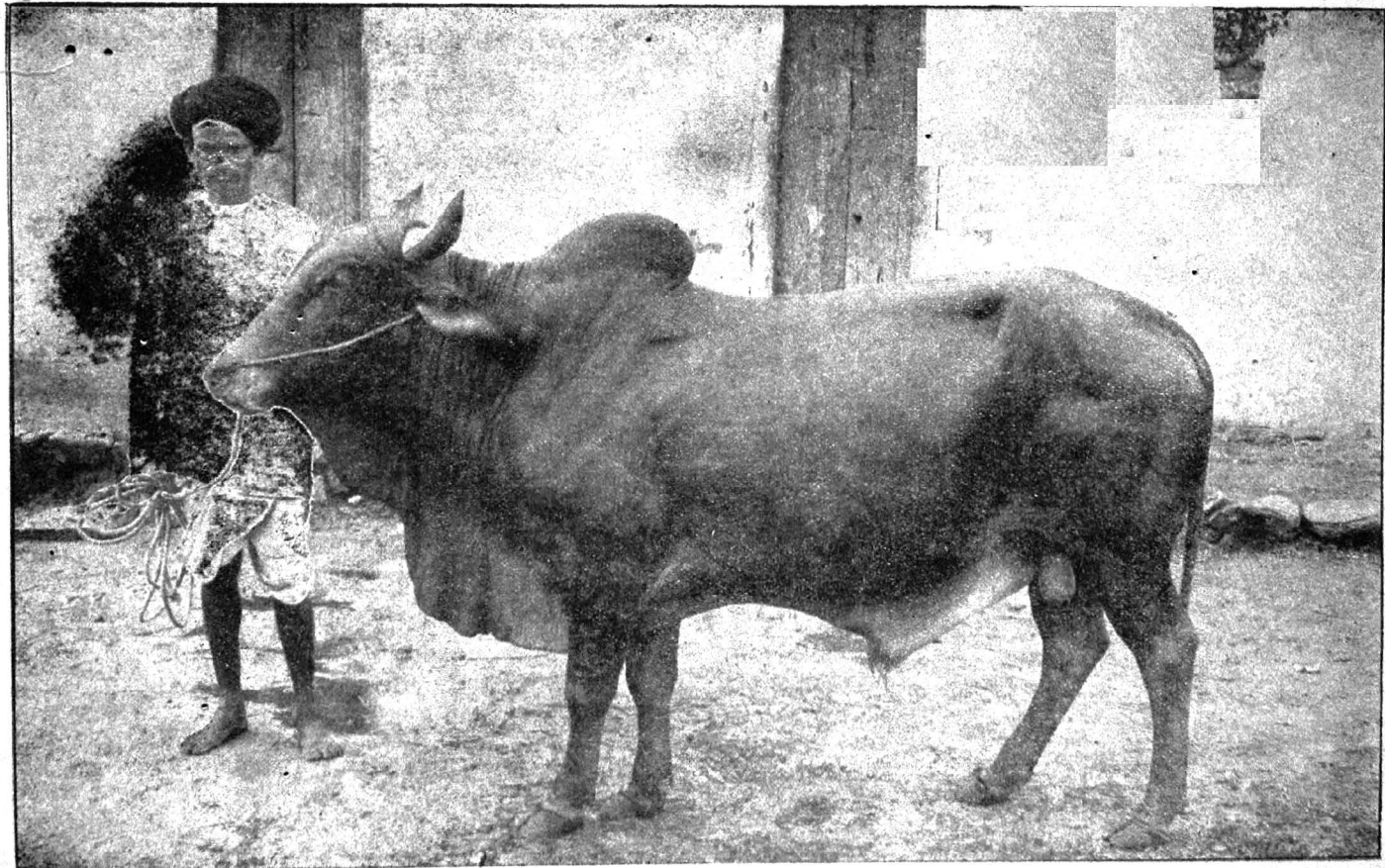
The general conditions under which these cattle are bred.

The best of these cattle are bred within a radius of 30 or 40 miles from Karáchi, and chiefly in the hill tracts where there is good grazing, shade trees and water. Drinking water for the greater part of the year is drawn from shallow wells. The cattle breeders are nearly all Muhammedans. Some few well-to-do owners have each 400 to 500 cattle. Many have 40 or 50 and a great many 20 or less. Little or no shelter is provided for the cattle at any season. *Katcha* huts are built at convenient places for the attendants and the cattle are milked there. Cattle owners do not usually cultivate land to any extent and move their cattle from one jungle pasture to another as occasion requires. When home pastures get bare the cattle are moved to distant parts of the country where pasture is more abundant. Dry cows and young stock are generally thus sent away in charge of attendants. The grazing places are called *rakhs*, and can be rented from Government for grazing at Re. 1 per acre per annum or for four months when grass is at its best at annas 12 per acre. Hay in quantity is saved by most cattle owners. The best two qualities called *khe* and *dirce*; inferior kinds *putar* and *damán*. The two former are of high nutritive value. Milk commands a ready sale in Karáchi at 16 to 40 lbs. per rupee according to season. Cows in milk are kept as near Karáchi as grazing is available. When in full milk they get concentrated food. Cotton seed, oil-cake, *chuni* and bran are given. The cows are milked early, and the milk is sent either on camels or donkeys to reach Karáchi by 6 A.M., and again in the afternoon by 6 P.M. The cattle owners are particular in selecting their bulls and seldom part with a really good one. Bull calves from poor milkers are castrated when two years old, and sent away to distant pastures and eventually sold as work bullocks or to the butchers.*

The general and particular characteristics of Sind cattle.

Sind cattle show a greater variety in type and colour than most other pure Indian breeds. It is probable therefore that the cattle as now found in Lower Sind are more or less of mixed blood, and that no special efforts have been made to breed up to a recognized standard as regards form and colour. Although this is true of the cattle taken as a whole, yet if the best cattle are selected and compared, it will be found that they have certain characteristics in common which would class them as being pure bred. The cows are noted as being deep milkers, and in consequence many of the best of them are shipped from Karáchi to Bombay and elsewhere. Sind cows can easily be recognized as such amongst the other milch cattle of Bombay—a fairly convincing proof that at least the best of the cattle are pure. There is also indication of the same conclusion in the fact that the cattle breeders of Lower Sind have an intimate knowledge of the pedigrees of their best cattle for several generations. The bull calves from the best milking

* This information has been obtained from Mr. S. G. Háji, Veterinary Officer, Karáchi.



39.—Sind bull.

cows are reserved for stock purposes and owners of good milch cows take particular care that such cows are served only by bulls of this class. Under the latter circumstance it is not surprising that Sind cattle should have a high reputation as a milk breed. The milk breeds of Europe have been improved to their present high standard by following a line of breeding much the same as that practised in Sind. In breeding for milk it is a fully recognized maxim that the effect of the bull is just as potent as that of the cow. Whole colouring is not considered an indication of purity of breed. Many good Sindi cattle are spotted in colour. The majority are red, a deep rich red, with occasional white markings, a white mark on the face, white ankles or a white udder being very common. In cattle of deep red colour the surroundings of the eyes are frequently deep brown, almost black in colour. The breed is of medium size. The best cattle stand so near the ground that they are much heavier than height measurements would indicate. The frame is long, deep, massive and wide, and is supported on short well set legs. The length below the knees and hocks is particularly short. The shank is round and coarse, and the feet large and soft. In the best cattle there is no great extent of droop in the hindquarters. The long level quarters, deep well filled thighs, wide loins and large paunch give such massiveness of hindquarters as is usually found in good milk cattle; but the Sind cattle have also specially heavy forequarters. The heavy head, the thick short neck and the ponderous dewlap are points not ordinarily found in good milch cattle. The thickness of neck is somewhat exaggerated by a great deal of pendulous loose skin which extends from the brisket to the jowls. Occasionally there is a good deal of loose skin on the sheath of the bull and near the navel of the cow, but in many animals is either absent or not prominent. The hump is large, particularly so in the bull. The cattle have mild placid tempers. The appearance of the head and eye would indicate such to be the case. Bulls need not be castrated in anticipation of being used as work cattle, because they are naturally so docile and tractable. The cattle of a herd take no special notice of strangers or Europeans, when approached in their jungle grazing lands. This cannot be said of any other indigenous breed. Gir cattle in their jungle grazings are positively dangerous if approached. The horns in Sind cattle somewhat spoil the appearance of an otherwise attractive head. They are in many instances decidedly coarse, so coarse in fact as often to give the animal what might be called a common bred appearance. This defect might possibly be got rid of by careful breeding. The horns are generally coarse, rather long, blunt pointed and spring from the head in an upward outward direction, sometimes with an easy curve, but very often so as to give the head that common appearance already referred to. The horns are sometimes somewhat flattened. The head is wide and medium in length and may be termed large. The

eyes have a sleepy placid appearance and are not prominent. The ears are moderately long and more or less pendulous.

The udders of the cows are large, but in many cases somewhat fleshy. They do not collapse sufficiently after milking and are too pendulous to be called well shaped. The cows milk well, and remain a long time in milk during any period of lactation. In Sind they give often 30 lbs. per day and more after calving, but not so much in the Deccan. The cows breed with fair regularity.

Cows imported from Sind into the Deccan are peculiarly liable to inflamed udders, if not regularly milked for some days before parturition and medically treated to arrest milk secretion. Even with these precautions a deep milking cow is almost certain to get inflammation of the udder more or less severe. The use of warm dry litter in the stalls has been tried with no material advantage. Sind cattle bred in the Deccan are not subject to inflamed udders in this way like imported animals. The chill induced by dampness has an undoubted effect in causing inflammation of the udder and it is easy to understand that cattle brought from the almost rainless district of Lower Sind and from its alluvial soil which is naturally well drained, would in the Deccan especially in the monsoon, be subject to the ailment referred to. It is perhaps also noteworthy that in an outbreak of rinderpest at the Poona Government Farm, the disease was not nearly so fatal amongst Sind cattle as amongst other breeds, but then, it is well known that the disease is habitually present in Sind and affects the cattle there in a milder form than in the Presidency proper. Is this because they are constitutionally inured to it?

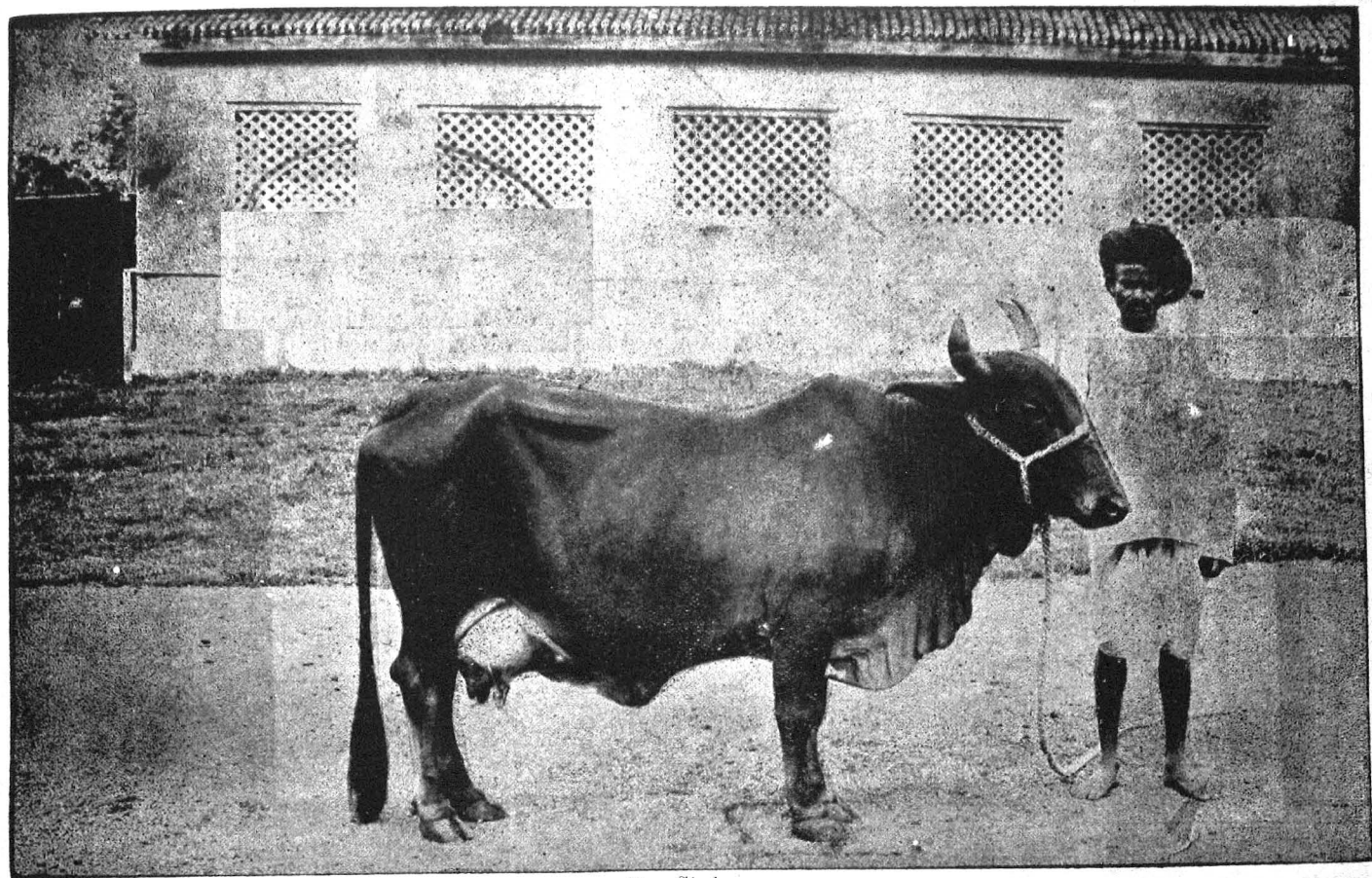
A particular failing.

Good cows cost in Sind Rs. 45 to Rs. 60 depending upon the season when bought. A pair of good strong work bulls can be bought at Rs. 60 to Rs. 80. As work cattle they are slow and better adapted for the plough than for road work. They are too slow for light quick road work and not strong enough for heavy slow cartage.

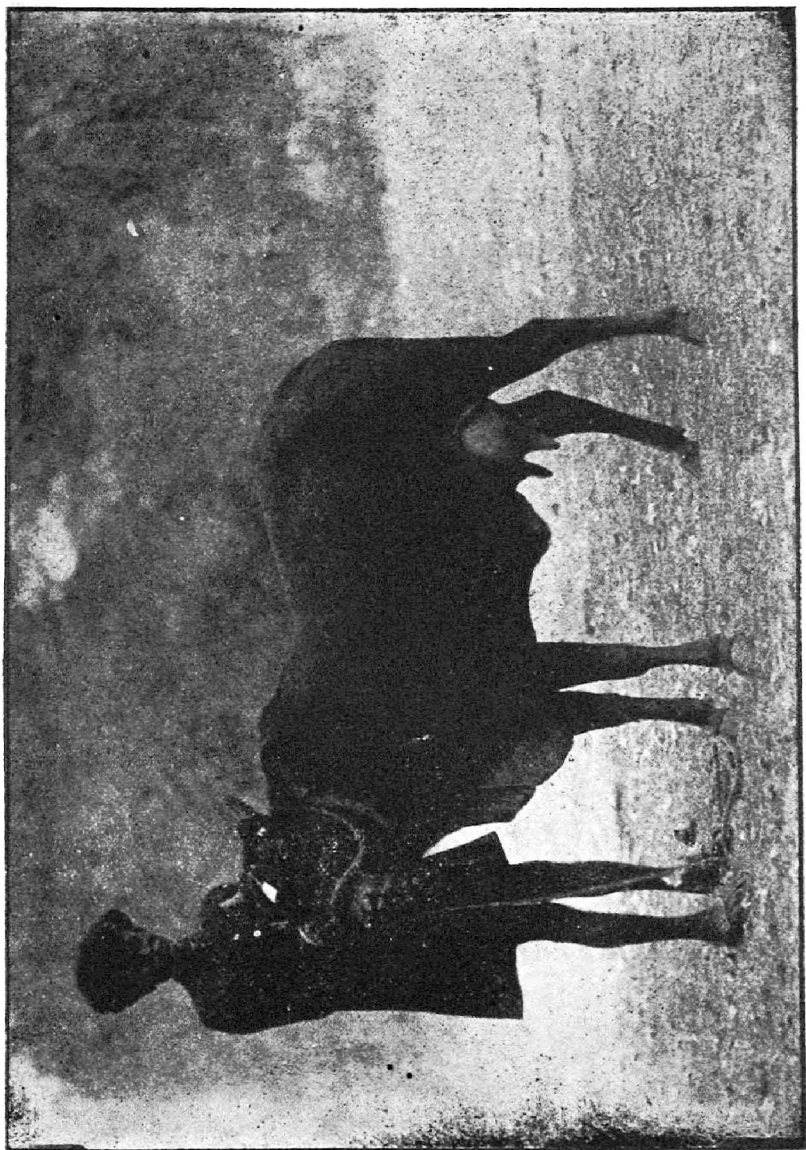
Value.

The bull represented in illustration No. 39 is very dark red in colour. He is somewhat short in the hindquarters and deficient in thigh, otherwise he is a shapely typical specimen. He was bred at the Poona Government Farm and is now used at stud there for a few of the cows. Illustration No. 40 represents an exceptionally good cow, a grand specimen of the breed. The shapely red heifer (illustration 41) is a daughter of No. 40 and bred at the Poona Government Farm. No. 42 is faulty in colour but a good milker.

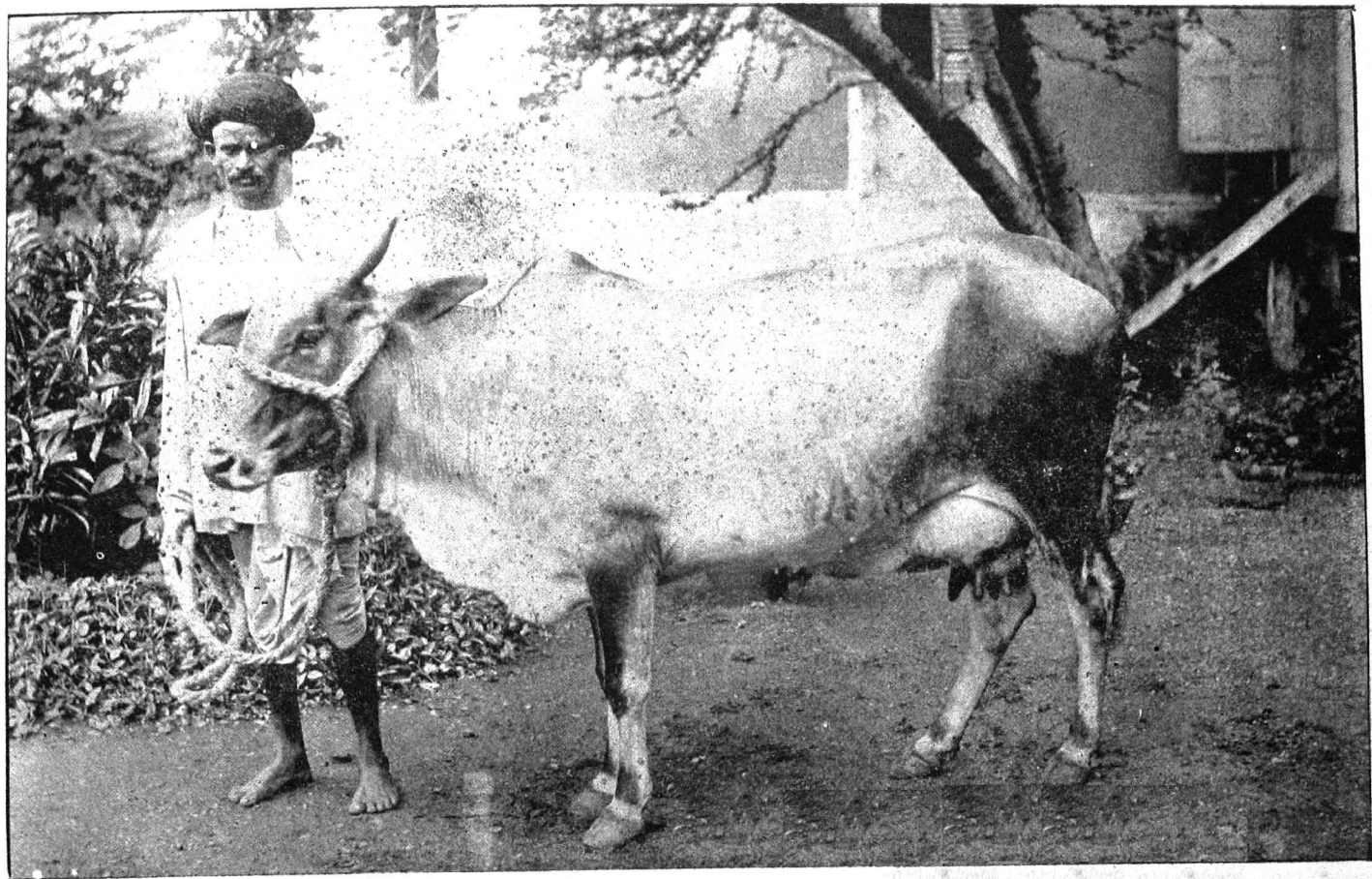
Illustrations



40.—Sind cow.



41—Sind cow, 4 years,



42—Sind cow, 4 years.

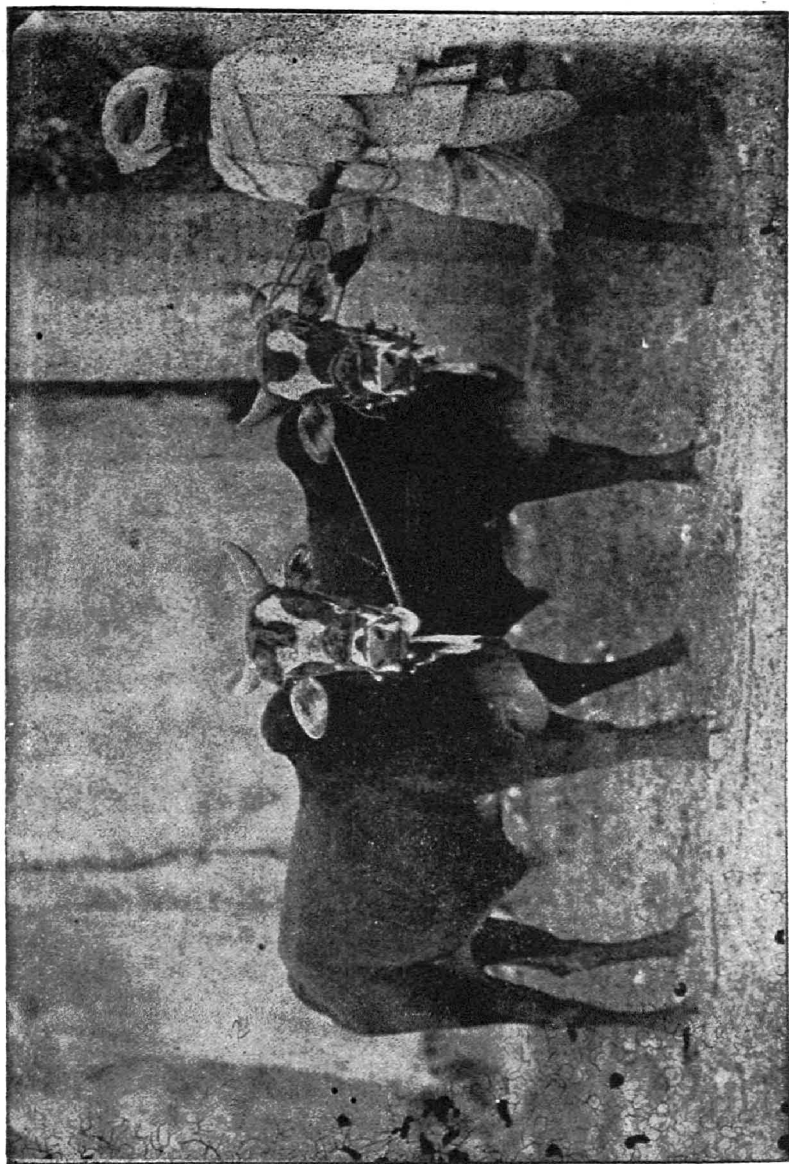
Measurements of Sind Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horns, outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from base of horns.)	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BULLS.														
1	Red Sind bull, Stock-bull, Poona Farm, 8 or 9 years...	4' 10"	4' 2"	5' 6"	3' 6 $\frac{1}{2}$ "	1' 5"	1' 5"	0' 10 $\frac{1}{2}$ "	1' 3"	0' 10 $\frac{3}{4}$ "	0' 10"	1' 10"	0' 6"	0' 7 $\frac{1}{2}$ "
2	Black and White Sind bull, Poona Farm	4' 9"	4' 1 $\frac{1}{2}$ "	5' 7 $\frac{1}{2}$ "	3' 7"	1' 4 $\frac{1}{2}$ "	1' 4"	1' 0"	0' 7"	0' 10 $\frac{3}{4}$ "	0' 10 $\frac{1}{2}$ "	1' 8"	0' 5"	0' 7"
3	Dark Red Sind bull, 5 years old, Poona Farm	4' 8"	4' 2"	5' 8"	3' 5 $\frac{1}{2}$ "	1' 4"	1' 3 $\frac{1}{2}$ "	0' 11 $\frac{1}{2}$ "	0' 11 $\frac{1}{2}$ "	0' 9 $\frac{1}{2}$ "	0' 10 $\frac{1}{2}$ "	1' 7"	0' 6"	0' 7"
COWS.														
1	Red Sind cow, Poona Farm (Guljâr)	4' 2"	3' 10"	5' 6"	3' 8"	1' 4"	1' 4"	0' 10 $\frac{1}{2}$ "	1' 1"	0' 8"	0' 9"	1' 7 $\frac{1}{2}$ "	0' 5"	0' 7"
2	Red Sind cow, Poona Farm (Amini)	4' 3"	3' 10 $\frac{1}{2}$ "	5' 2"	3' 5"	1' 4"	1' 3 $\frac{1}{2}$ "	0' 9 $\frac{1}{2}$ "	0' 11"	0' 8 $\frac{1}{2}$ "	0' 9 $\frac{1}{2}$ "	1' 7"	0' 6"	0' 7"
3	H. E. the Governor's cow imported from Sind	4' 4"	4' 1"	5' 1"	3' 7"	1' 4 $\frac{1}{2}$ "	1' 4"	0' 10 $\frac{1}{2}$ "	0' 10 $\frac{3}{4}$ "	0' 8 $\frac{1}{2}$ "	0' 9"	1' 7"	0' 6"	0' 6 $\frac{1}{2}$ "

DECCANI CATTLE.

The conditions
under which these
cattle are bred.

Throughout the Deccan and the Southern Maratha Country the ordinary cattle are of no fixed type, or particular breed. The districts referred to are subject to periodical scarcity and occasional famine, and are in no special way suited for cattle breeding. It is true that the Western Gháts and the Sâtpura hills provide large supplies of grass in ordinary years and in years of famine are made available to the cattle of the adjacent Collectorates for grazing grounds. The Gháts, though producing much grass, cannot be considered as suitable for cattle breeding on account of the excessive rainfall and because of the coarse character and inferior quality of the grass produced. There are good grass-lands of considerable extent, more inland with a lighter rainfall and giving fair yields of grass of good quality; but such land is mostly reserved as Government Forest, and the grazing of cattle or other stock is prohibited except when those "*kurans*" are opened under the express orders of Government in famine years. It is probable that throughout the Deccan before grass-lands were reserved as forest the facilities for cattle breeding and for keeping the old Deccani breed pure were considerable. Under existing conditions the grazing grounds available beyond what is under arable cultivation consist of little more than trap-rock and spear-grass. The cattle owned by the average occupant of arable land are almost entirely hand fed, and upon the produce of the arable areas. There are no owners of large or even moderately large herds of cattle. The number of breeding cattle owned by an average cultivator is small. He may own one or two cows and a few head of young stock. He cannot afford to herd them by themselves. The cattle of any particular village are herded together by children, and the common grazing ground is commonly as bare of vegetation as a macadamized road. After harvest there is a picking in the stubble and on the boundaries of fields, but for six or more months of the year any herding that is required is to keep the cattle out of the crops. The system of breeding, if system it can be called, is haphazard to a degree. In the Deccan, as a whole, there are not as many work cattle bred as are required for agricultural and other purposes. Large droves of Málvi and Khillári cattle (many of them 4 and 5 year old bulls) are annually brought in from Holkar's Territory and Málva and a large proportion of cattle used in carts in towns and by the better class of cultivators growing irrigated crops and cultivating good black soil are of the Málvi breed. The restriction in grazing area, the introduction of other breeds and the present haphazard or uncontrolled system of breeding have resulted in producing a general non-descript type of cattle. A fair proportion of the old Deccani sort still remains, but in course of time, the breed as a pure breed must inevitably disappear unless in every village the owners of cattle are compelled to castrate their male stock at the age of 2 years or younger, excepting such promising young bulls as should be reserved specially as sires.



43.—Pair of Deccan bullocks,

The general characteristics of the old time Deccani breed.

The old time Deccani was nothing if he was not hardy. He inherited hardiness, because the breed for generations, probably for centuries, had been inured to periods of scarcity every year and periodic famine. It was a case of the survival of the fittest. The pressure on this survival was in older times less severe than now because of more extensive grazing areas. It was severe at all times and only a small hardy active breed could exist under such trying conditions. Any attempt to increase the size or any effort towards other improvements must inevitably fail unless there is a corresponding improvement in the food supply and a guarantee that it will not fail on occasion. I give below what I conceive to be a fairly accurate description of the old Deccani as represented now by only a comparatively small proportion of the cattle in the Poona, Sholápur, Sátára, Ahmednágär, Násik and Khándesh Collectorate, and in the Southern Marátha Country and also to some extent below the Gháts. There is considerable variety in colour. The predominating colours are black, white or grey; but red, brown and spotted colours are not unusual. Very often an animal otherwise whole coloured has a peculiarly irregular marking of white or rather dingy or smoky white on the face. This feature is excellently shown in illustration 43. The frame is short, thick-set and very shapely, the lines being rounded rather than straight. The legs are squarely set, small, with neat bone and small hard feet. There is considerable droop in the quarters behind the loins. There is not much loose skin on the dewlap or neck and is either absent or sparingly present on the sheath. The cows are very poor milkers, and the appearance of the udder and its size denote this. The head is characteristic. The forehead is often or nearly always narrow above the eyes, whilst the muzzle is large. This gives the face a narrow appearance. The eyes are prominent. The ears are moderately short and not inclined to droop much. The eye and other exposed membranes and muzzle are usually jet black. The horns of the cows generally spring from the head in an upward direction, then sometimes bow with rather an abrupt curve outward and then inward. They are of moderate length being neither thick at the base nor very sharp at the point. The horns of bulls and bullocks are thicker, shorter and not so sharp at the point as those of cows. The *nimburi*, a small projection of bone between the horns, is always present. The bullocks, though small, are extremely active and strong and fit for a long day's work if fairly fed. They are very suitable for light road work, and with a light plough do also good work. They are often used in a light cart as trotting bullocks. A good pair costs Rs. 60 to Rs. 80.

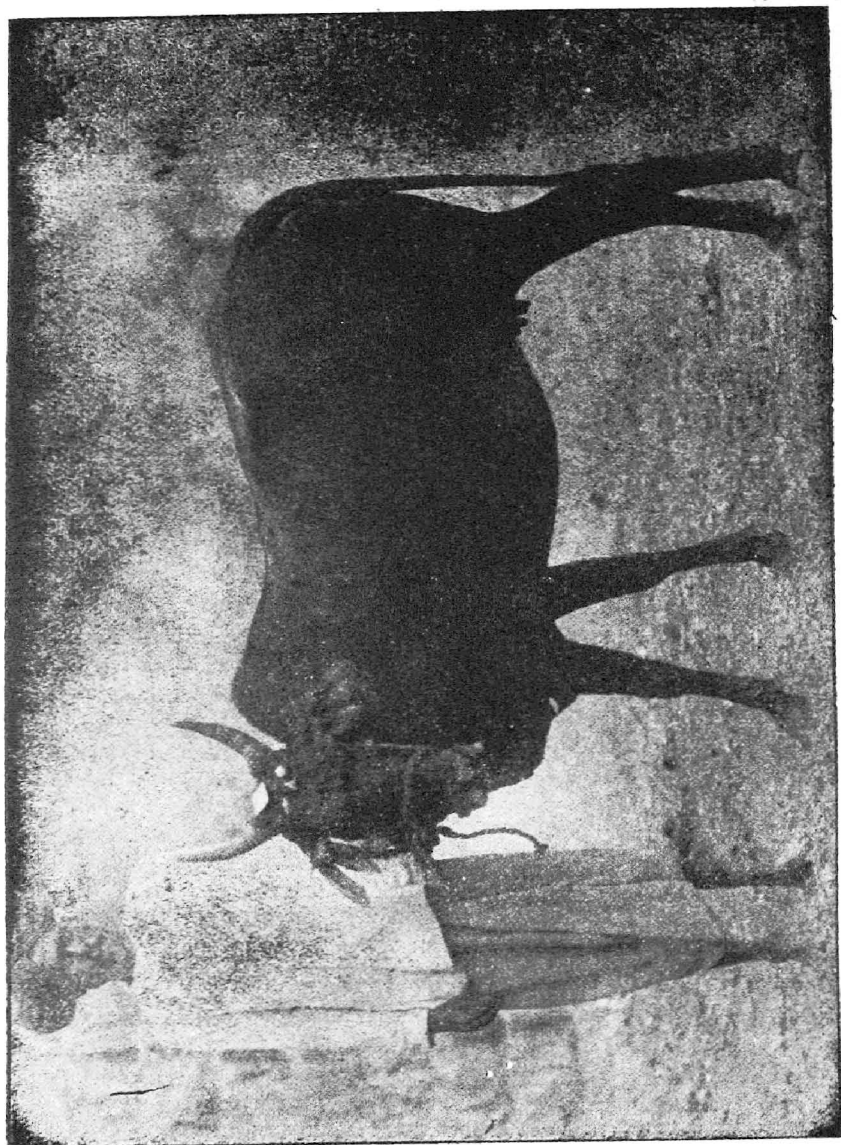
Cross-bred Deccani cattle.

A reference has been made to the influence of importations of Khillári and other cattle in changing the Deccani breed. The illustrations 45 and 46 of two pairs of work cattle fairly show the influence referred to. The bullocks in illustration 45 are half-bred Deccani-Khillári. They are well matched and show more Khillári blood than Deccani, but this is

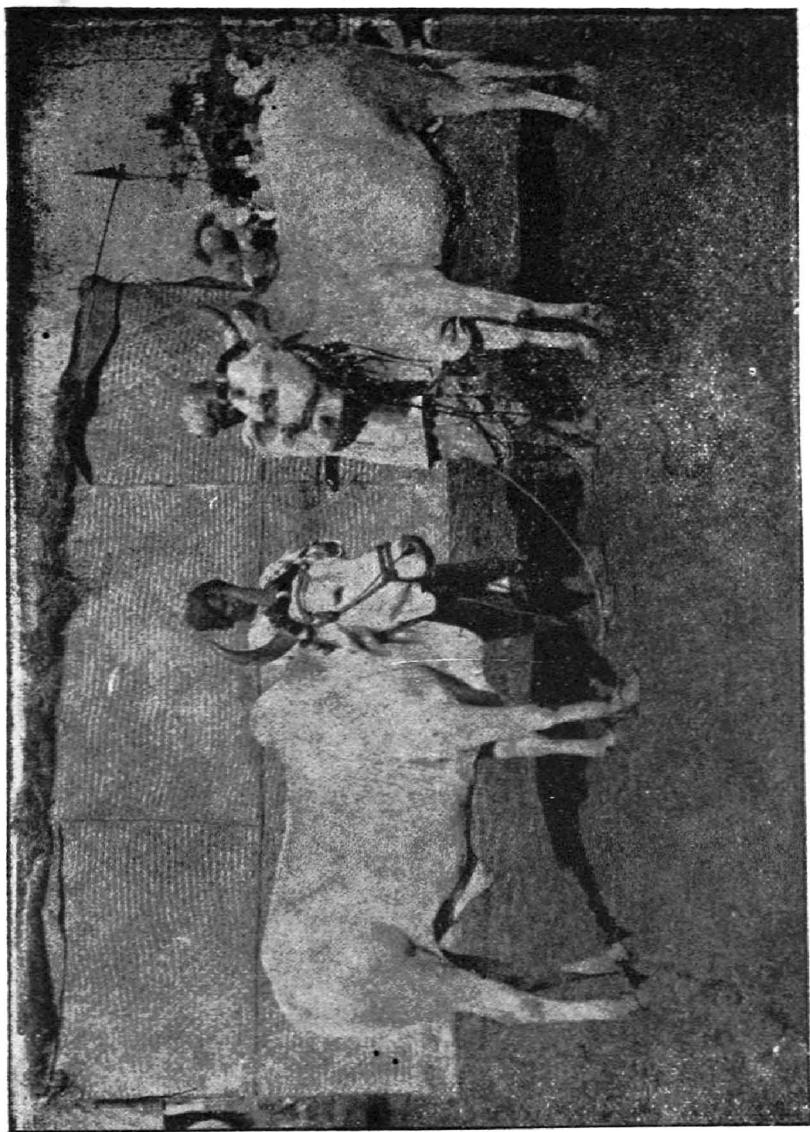
probably due to the greater impressiveness of pure Khilláris. These bullocks represent a very useful class, it is true. They are considerably larger than pure bred Deccanis. They represent the class of cattle which would be found in every way suitable for fairly heavy cartage or for agricultural operations on good deep soil. They are sufficiently active and strong for these purposes. The most prosperous class of cultivators in the Deccan would prefer pure bred Málvi cattle. A good cultivator—the occupant of a fair sized holding of good soil, and having a well, and growing a fair extent of irrigated crop—would be able to feed such cattle liberally at all seasons. Even in a year of famine he would not be without his resources. If these cattle had to live under the same conditions as Deccani cattle in a year of famine, they would survive only for a very short period, and are therefore unsuitable for the occupants of poor light upland soil—a description of soil which is very extensive throughout the Deccan. If work cattle of the class referred to are numerous, cows and young stock of the same class must also necessarily be numerous, and the danger to be apprehended is not that work cattle of this class will not survive a year of famine, but that the cows and young stock will die wholesale. Without expensive hand feeding they will assuredly die, and it will not pay to keep them alive if the feeding is expensive.

The change which the Deccani breed is slowly undergoing is strikingly illustrated by observing the gradual change in the type of cattle as one travels southward from Poona by the Southern Marátha Railway or from Dhond through Sholápur and Bijápur to Dhárwár. The Deccani gradually changes until, in the south of the Presidency, we find many of the common cattle closely resembling those of Mysore and Madras. The half-way change between the old Deccani type and that of Mysore and Madras is shown in illustration 46. These cattle for ordinary agricultural purposes—for field and road work—will bear favourable comparison with very good Deccanis. Their measurements show that they are larger than Deccanis and they are not deficient at work, in endurance, activity and strength, but it is very doubtful whether these cattle would in a year of scarcity or famine exhibit that degree of hardiness that a Deccani exhibits.

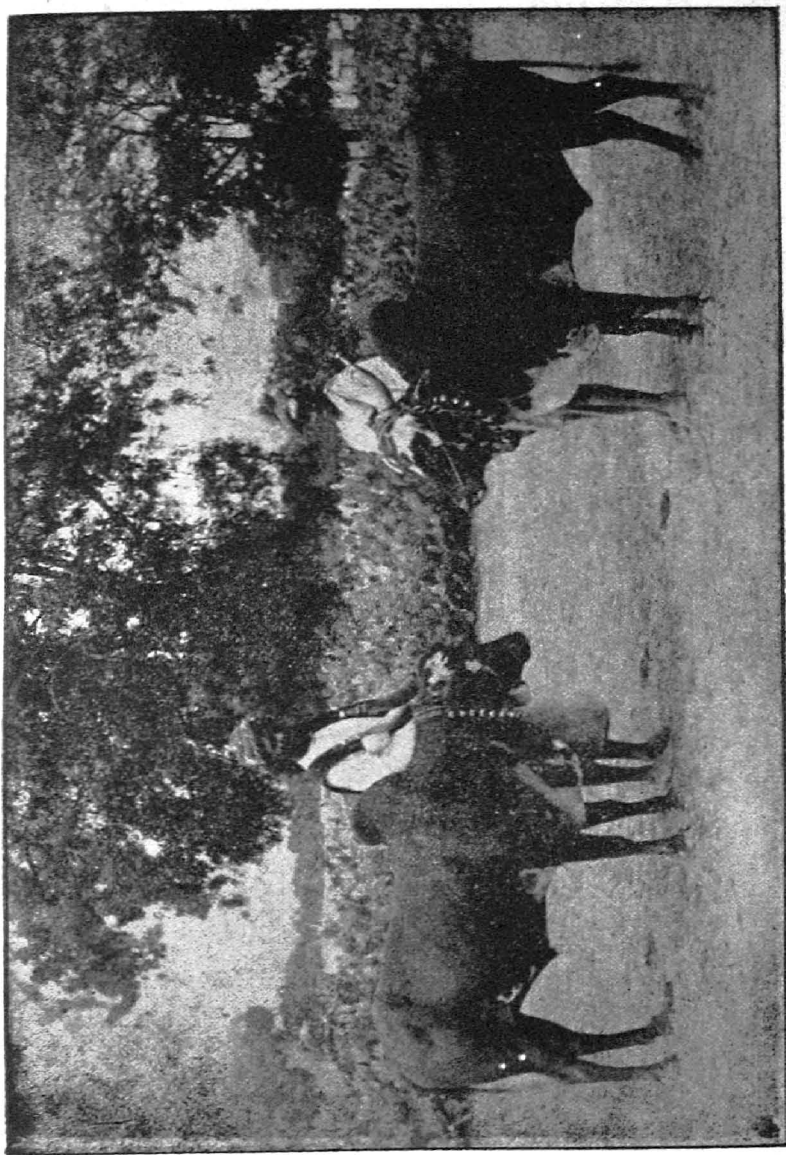
The changes induced by mixed breeding in the Deccan is strikingly illustrated.



44.—Decem cow.



45.—Half-bred Deccan-Khillari bullocks.

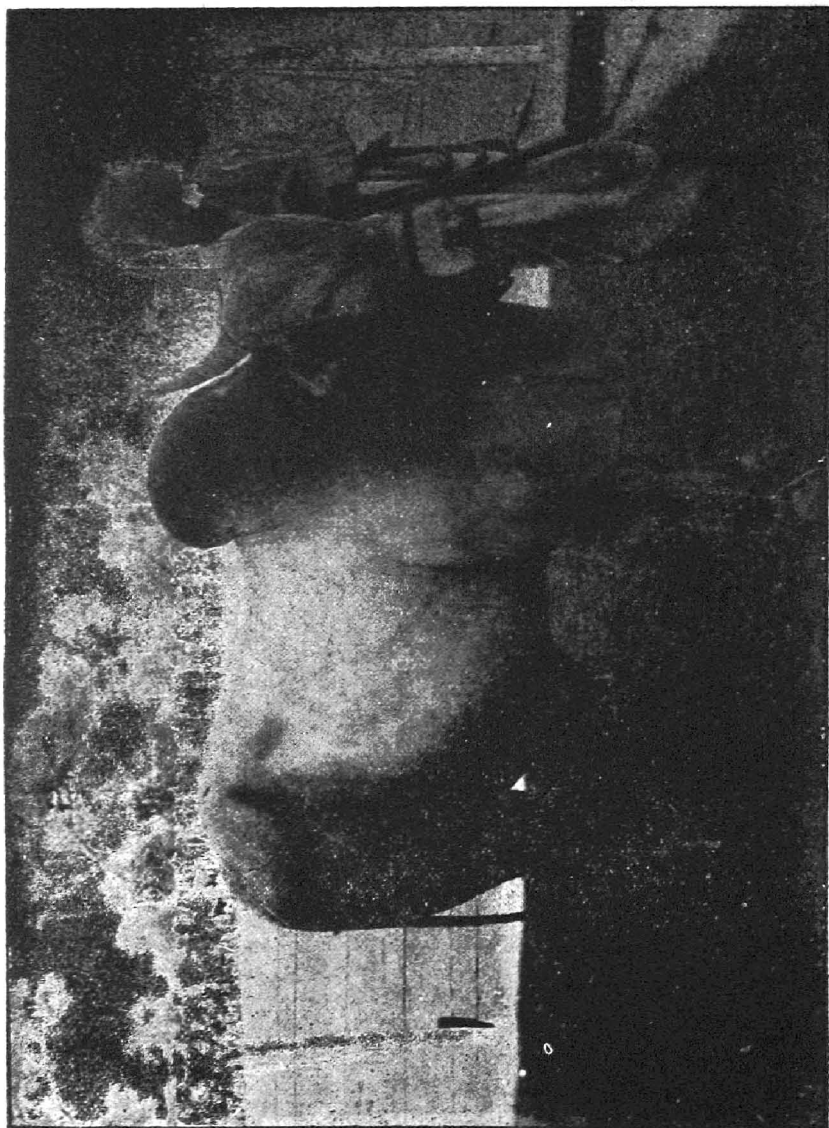


46,—Half-bred Deccan-Mysore cattle,

KHILLÁRI CATTLE.

Khillári cattle are bred extensively by professional herdsmen in the Sát-pura range of Hills, chiefly in Holkar's Territory to the north of Khándesh. These cattle are bred by Khilláris or Dhangars and Vanjáris. The former are cattle or stock breeders and dealers, pure and simple. The latter may also cultivate land. Each owner has 25 to 200 cattle, and generally about 100 head are herded together with 2 men in attendance. Bulls specially selected as suitable sires are herded with the cows and young stock. Young bulls are generally sold when 1 to 2 years old at Rs. 15 to 20 each. Cows or cow calves are rarely sold. The herdsmen generally remain in their own *tálukas*, but wander from place to place in the hills, moving from one place to another as the grazing gets bare. There is never absolute scarcity of grazing except perhaps occasionally in May. At this season the grass is very dry and innutritious and sometimes half a lb. per head per day of cake or cotton seed is given. The leaves of *anján* (*Hardwickia binata*), and *pipar* (*Ficus tsiela*), are given to the cattle also at this time. The cattle are rarely brought near villages, and are extremely wild except with their own herdsmen. They are never sheltered. In the rains a rocky place in *barad* soil, naturally dry and well drained, is selected, and the cattle are penned here at night but never tied. During daylight they graze in the adjoining jungle grazing grounds. The Khilláris pitch *páls* as shelter in the rains and the Vanjáris build huts with coarse *jowári* stalks plastered with cowdung and mud. The grazing fees are annas 4 per head per annum. Khillári cattle are mostly bred in the following places in the Sátpurás: Chhodi, Borádi, Dhodváda, Háted, Sápání, Badváni, Melan, Ketia, Sàngvi and Palasner. The rainfall is sufficient. The soil is mixed black with *morum* or rock below. The streams are perennial and drinking water is abundant. The grazing is good and shaded with *mohwa* (*Bassia latifolia*), *rohín* (*Soymdia febrifuga*), *beheda* (*Terminalia belerica*), *salai* (*Boswellia serrata*), *anján* (*Hardwickia binata*), *sádada* (*Terminalia tomentosa*). The following afford less shade *dháwdá* (*Anogeissus latifolia*), *khair* (*Acacia catechu*), *ság* (*Tectona grandis*), *tivas* (*Ougeinia dalbergioides*), *hevar* (*Acacia leucophlea*), *lodhya* (*Symplocos Beddomei*). The common jungle shrubs are *Arkati* (*Mimosa hamata*), *bori* (*Zizyphus jujuba*), and *anjár* (*Acacia tomentosa*). Cultivated crops occupy very limited areas in these parts. In January and February the cattle are brought down from the hills to the cultivated plains, and range over the fields which at the time are bare of crop, but afford a fair picking in the stubble and headlands. The cattle get a complete change and thrive. The owners of the arable lands do not object as their fields are benefited by the droppings from the cattle. Heifers breed when about four years old but cows only produce calves about every second year. The calf suckles as long as the cow remains in milk. The

The conditions under which Khillári cattle are bred.



47.—Khillári bull.

cow comes in "heat" only when she goes quite dry. The young bulls are bought up by local dealers, and when sold are herded separately from the cows for a month in the hills and are then driven in small droves towards the Deccan for sale. They are as far as possible handled and made more or less domesticated, but they are not easily tamed. It takes at least three months to make them at all tractable. A good many of these cattle are brought annually into the Ahmednagar and Poona districts, and those of good quality are readily saleable at fair prices, Rs. 40, 50 or 60 each. The purchasers of the younger animals have to keep them for two or three years before they become fit for regular work. Meantime they become quiet and domesticated by kindly handling.

Khillári cattle resemble Mysore cattle in conformation and those now bred in the Sátpuras must have sprung originally from imported stock. It is said that one Gowdia Dhangar of the Násik district some 80 years ago owned Mysore cattle and in a year of scarcity took them to the Sátpuras. The present Khilláris are descendants of these cattle. The original pure bred bulls are said to have been used on white Varádi cows. The fact that Khillári cattle are now bred true to a particular type in a district where Málvi cattle are also extensively reared is a clear indication that the breeders know the advantage of keeping a good strain as pure as possible.

Khillári bullocks are a general purpose sort, excellently adapted for field or road work and are in high favour with the better class of cultivators in the Deccan. They are sufficiently strong for all ordinary work purposes, and inherit a good deal of fieriness of temper, activity, endurance and hardiness which are valuable characteristics in pure bred Mysore cattle. The purest strain of Mysore cattle is the Amrit-Mahál which occupies the position amongst other Indian breeds of cattle that the thorough-bred horse occupies amongst other breeds of horses. The Khillári though unmistakably of Mysore type is by no means so highly bred. He is bigger in frame and coarser in bone. He has lost the high bred appearance of head and horn which the Mysore possesses. He retains a remnant of the fierce fiery temperament, and though an excellent trotting bullock with a light load bears no comparison in this respect with the pure bred Amrit-Mahál; the latter is essentially suitable for road work and capable of performing quick journeys of a long distance with a light or moderate load. The loose skin of the neck, dewlap and sheath which is never very prominent in the pure Amrit-Mahál is fairly well developed in the Khillári and interferes to some extent, with trotting action. Amrit-Mahál cows are always invariably white or light grey. The Khillári, though sometimes nearly white in colour, has often a yellow-ochre tinge and if grey the lighter shading is tawny.*

The general and particular characteristics of Khillári cattle.—This breed and pure bred Mysore cattle compared.

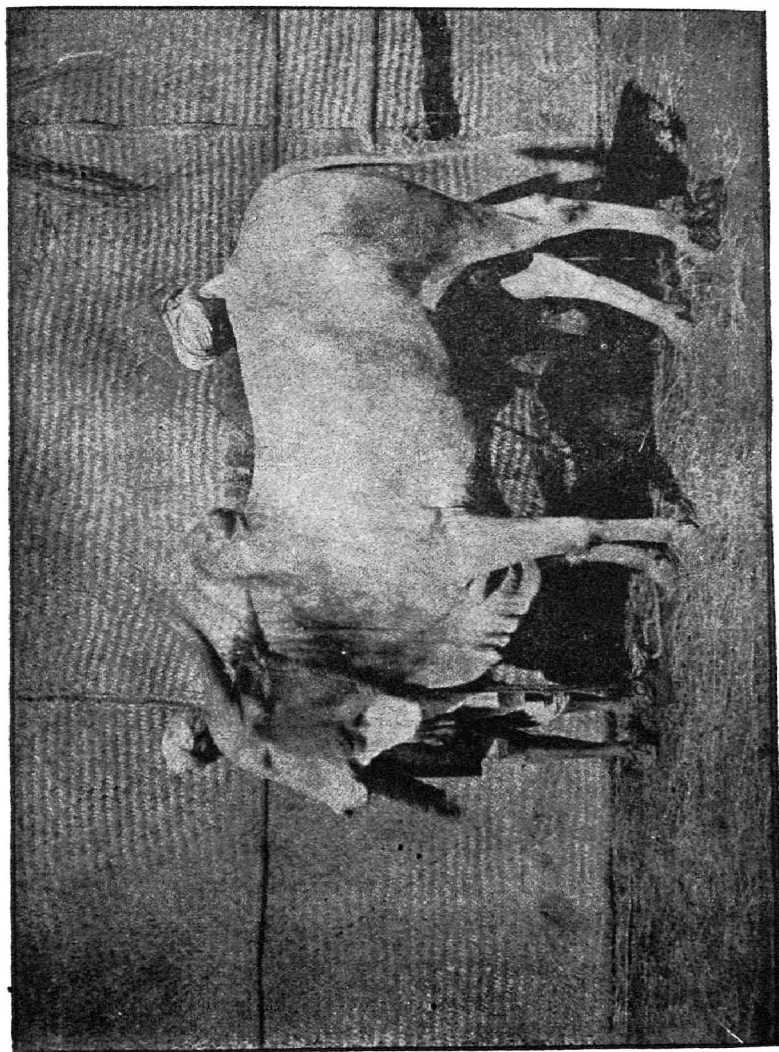
* I am indebted to my Assistant Mr. Kelkar, Superintendent of the Poona Government Farm, to a considerable extent for this information.

The droop in the hindquarters of the Amrit-Mahál is much more marked than in the Khillári. I am not at all sure that a decided droop in the hindquarters is not associated in a remarkable way with increased activity. Any way slow heavy work cattle have invariably square or level quarters.

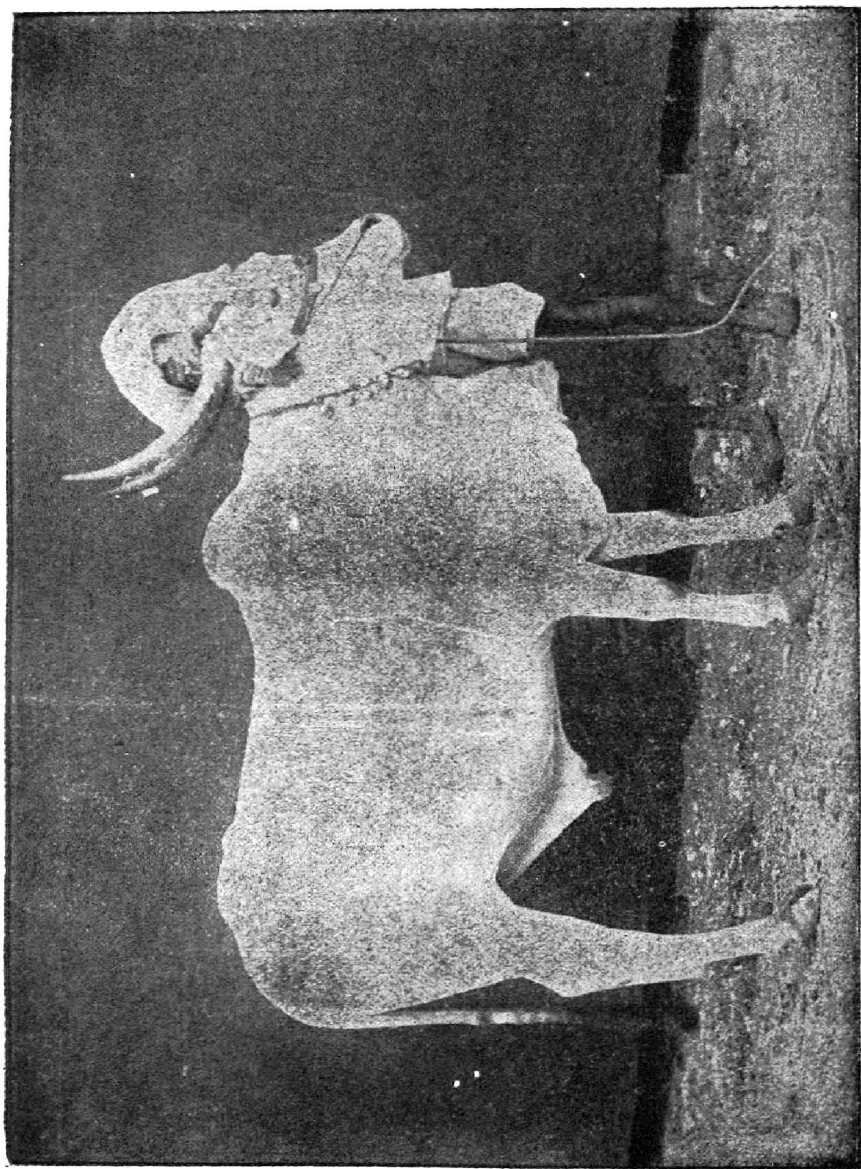
Illustrations.

Illustration 47 represents a typical Khillári bull. His colour is grey with a tawny tinge. The head, neck and hindquarters take a darker shade than the body. This combination is not unusual. Illustration 48 represents a bull with a decided tawny or yellow-ochre tinge particularly on the neck. He is not such a good specimen as 47. The latter has a well proportioned frame, wide, deep and well coupled, but not long, with great girth. He stands well on his legs, has muscular thighs and forearms with plenty of bone below the knees and hocks and small hard well shaped feet. It will be noticed that there is considerable development of loose skin on the dewlap and sheath and that the neck is short and thick and the hump large. The muzzle and eye membranes are flesh coloured—a common occurrence when the hair has a tawny colour. (Amrit-Mahál cattle have always black muzzles and black eye membranes.) The Khillári head is very typical, long between the eyes and the muzzle, the sockets of the former being elliptical in shape and placed on the side of the head. The eyes are placed deep in the sockets and look treacherous. The forehead bulges above the eyes and slopes backwards. There is a vertical valley extending from the poll nearly to the level of the eyes. The ears are short, pointed and carried in an alert way. The horns which spring close together at the base take a backward sweep, gradually diverge and near the points bow abruptly upwards in a graceful curve. They are fairly thick at the base and very sharp at the point, of medium length in the bull, but considerably longer in a cow or in a work bullock that has been castrated before reaching maturity. If the Illustrations 50 and 51, which represent pure Mysore cattle, be examined, it will be easily seen that Khillári and Mysore cattle have many characteristics in common, yet to a practised eye the identity of each cannot be confused. The pure Mysore as shown in these Illustrations has a better bred appearance, a finer head and finer longer horns, with no extra development of loose skin to interfere with trotting action. The frame lacks massiveness though not badly proportioned. There is the decided droop in the hindquarters, the deer-like limbs are particularly well shaped, and well set. The feet are small, durable, well shaped and black. The whole conformation in fact is indicative of combined endurance, activity and strength. The Khillári in common with the Mysore reaches maturity slowly. The cows are miserably poor milkers. They show great maternal instinct and strangers, especially Europeans, better keep at a safe distance whilst the calf is young ; and should not uncautiously approach either cows or bulls at any time.

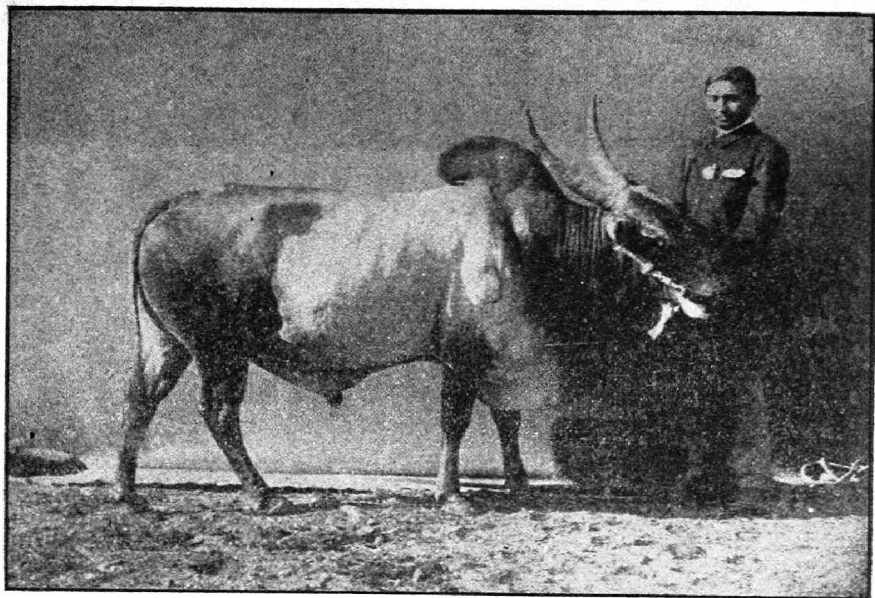
Illustration 49 represents a well bred Khillári bullock. Illustration 52 represents a pair of Madras cattle. They are of Mysore type to a considerable extent, but the broken colours indicate impure blood to some extent. Big heavy cattle such as those of this illustration are suitable for fairly heavy cart or transport work. Well bred Khillári bullocks are worth Rs. 200 per pair, while pure Anrit-Makál bullocks are worth Rs. 300 to Rs. 400 per pair according to quality and size.



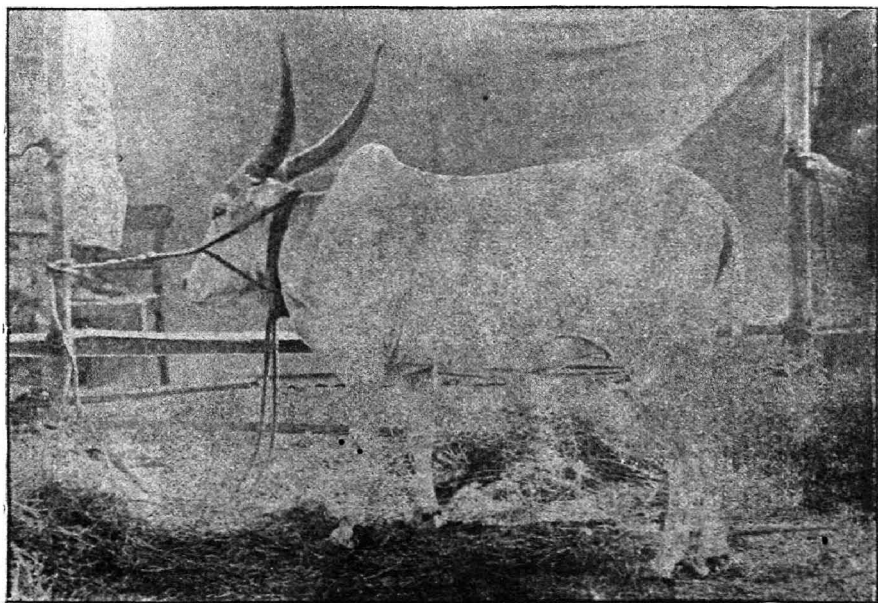
48.—Khillári bullock



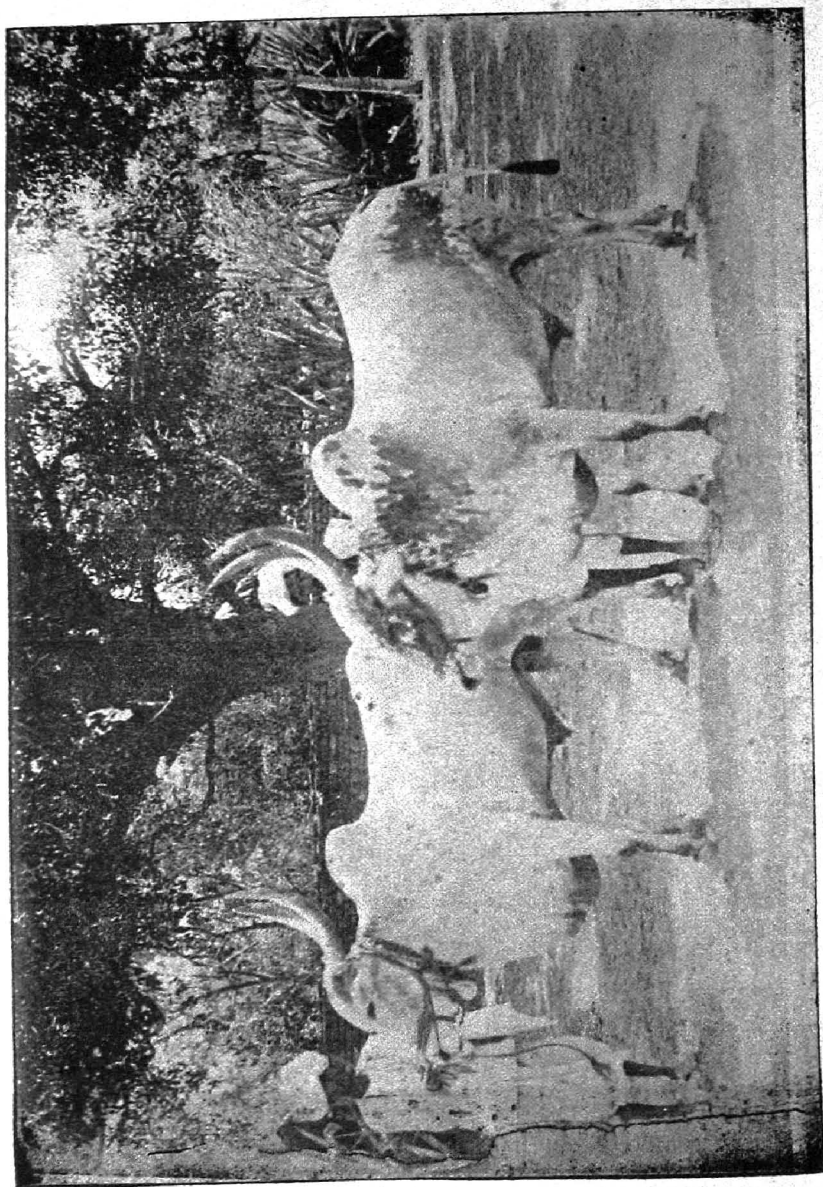
49.—Kullari bullock.



50.—Amrit-Mahál bull.



51.—Amrit-Mahál cow.



52.—Madras cattle of Mysore type. •

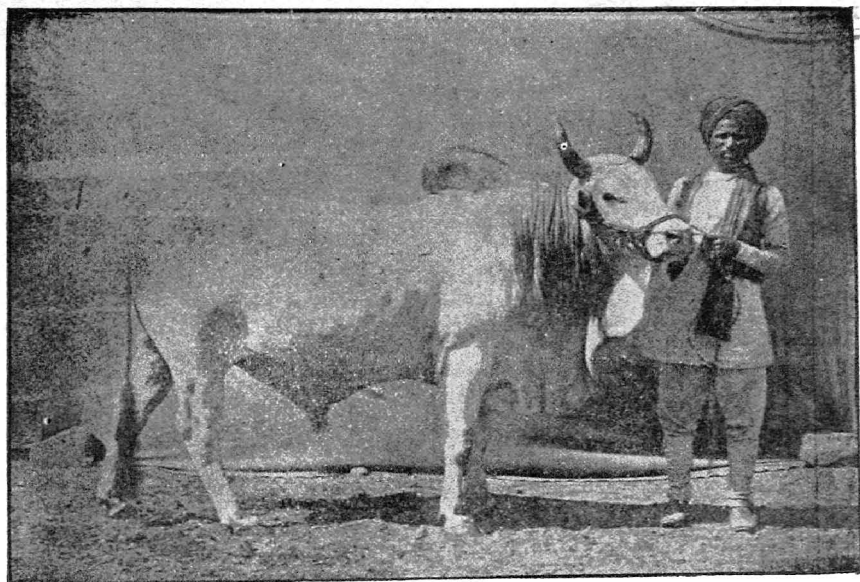
Measurements of Khilári Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horn, outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bulls.	1 Grey bull, Chinchli Show..	5' 0"	4' 4"	6' 5"	3' 7"	1' 7"	1' 7"	0' 8½"	1' 2"	0' 11½"	1' 2"	1' 11"	0' 8"	0' 8½"
	2 Yellow ochre or tawny coloured bull, Chinchli Show, 5 years.....	5' 0"	4' 6"	5' 9"	3' 10"	1' 7"	1' 6"	0' 9"	1' 5"	1' 0"	0' 11½"	2' 0"	0' 8½"	0' 8"
Bullocks.	1 Yellow or tawny colour bullock	4' 11"	4' 6½"	6' 0"	3' 10"	1' 7"	1' 6½"	0' 11"	1' 4"	0' 11½"	0' 10½"	1' 10½"	0' 8½"	0' 7½"
	2 White bullock, medium size	4' 7"	4' 4"	5' 6½"	3' 10"	1' 6"	1' 5½"	0' 9½"	1' 6½"	0' 10½"	0' 8"	1' 9"	0' 8½"	0' 7½"
Cow 1	1st Prize Chinchli Show, pure white, 5 years.....	4' 2½"	4' 0"	5' 3"	3' 9"	1' 4"	1' 4"	0' 8"	1' 5"	0' 9"	0' 8"	1' 9"	0' 7"	0' 6¾"

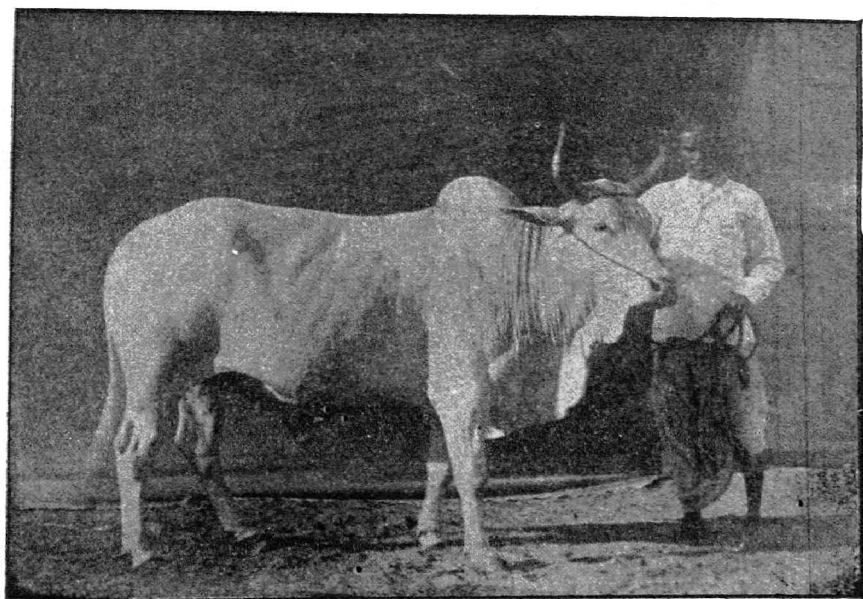
MALVI CATTLE.

The general conditions under which Málvi cattle are bred.

Málvi cattle are bred in the Territories of H. H. the Maharája Holkar and the Maharája Sindia. The cattle breeders do not generally own large herds. Very few owners possess more than a dozen breeding animals. Some few breeders possess larger herds (up to 200 animals). Almost all occupants of land own a few. The cattle of each village are grazed in a common herd—300 or more together. *Polis* or bulls dedicated to village gods are numerous and generally of superior class. Cows are covered by these and by young bulls, which graze with the village herds until they are castrated and put to work or otherwise disposed of. The system of breeding is therefore more or less uncontrolled. The only professional herdsmen are *gavlis* who depend for their living on cattle breeding and the sale of milk, *ghee* and other milk products. The other castes who breed cattle are husbandmen also. They are the Anjanis, Khatís, Sendhos and Sondhías. Anjanis and Sendhos are sub-castes of the Rajputs. The Khatís are Gujarátis. The following are the chief centres where Málvi cattle are bred; Zárda, Mánpur, Ujjain, Jogoti, Kálukheda, Gotampura, Tarána, Bichdod, Sájápur, Alot and Jávera, and other smaller villages of minor importance. The best description of Málvi cattle are believed to be bred in Newri, Sonkas, Tonk and Agar in the Sájápur district. The rainfall of these places varies from 36 to 40 inches. There are perennial streams. The soil on the lowlands is black and fertile. There is first-class grass and grazing in the upland low hills which are shaded with *bábhul* (*Acacia arabica*), *ság* (*Tectonia grandis*), *anjan* (*Hardwickia binata*), *dháwda* (*Anogeissus latifolia*), *palas* (*Butea frondosa*), and *sáwda* (*Terminalia tomentosa*) trees. Throughout Málva generally, the conditions for cattle breeding are not so favourable as those referred to above, but there is nowhere any great pressure on cultivation. Grazing grounds and grass-lands are extensive. Grass is cut in quantity, made into hay, and saved for use during the hot season when other fodder becomes scant and for feeding at night at all seasons. The chief cultivated crops are *jowár*, *maize* and linseed. Breeding cattle get no feeding except what they pick up in the grazing grounds along with hay or *karbi* at night. Cows, young stock and bulls are herded together. Heifers are of breedable age at 3 to 4 years. Cows generally produce two calves in three years. Very few of the cows milk well. They seldom yield more than 4 to 6 lbs. per day. The *gavlis* probably through a process of selection possess cows which yield a fair amount of milk, and sell *ghee*. The cows belonging to ordinary cultivators and other breeders are rarely milked. The calf suckles the whole. In the rains the cattle are sheltered in open sheds at night, but are not tied up. In the fair season they are kept during the night in open yards. At the weekly bazars of the villages, where Málvi cattle are bred Vanjáris or



53.—Malvi bull.



54.—Malvi bullock.

Longotas purchase young bulls or bullocks as they get the opportunity at Rs. 10 to Rs. 15 per head. A good pair of work bullocks costs Rs. 60 in Málwa and a good cow Rs. 20. Generally the Vanjáris purchase young bulls or bullocks in April. They are taken to the Sátapura Range in the hills of Shendva, Jalwana and Thikari in the Holkar's Territory where they are kept till July. In August the owners then return with their cattle home and start with their droves for the Deccan and pass through Chálisgaon, Náydongri Rájápur, Yeola, Kopergaum, Ashi, Umbri, Shipalápur, Kanur, Pathár, Ghodnadi, Poona, Bárámati and then on to Sholápur. After they purchase from the breeders the following charges are payable for grazing, &c.

Annas.

1	Per head	...	...	...	...	Málwa.
1	Do.	...	...	...	...	Khalghát.
4	Do.	...	...	...	...	Shendva.
8	Do.	...	...	...	...	Sángvi.
8	Do.	...	...	...	...	Nagar.
8	Do.	...	...	...	...	Poona.

The cattle are mostly three to five years old. The drovers drive their cattle from 10 to 15 miles per day as far as possible through forest and other waste land. The cattle graze as they travel. The camp is pitched near a village at night. The cattle are sold as customers are found, but the price is not paid at the time. When all the cattle except such as are required for pack purposes have been disposed of, the drovers return and collect their money. A purchaser in any particular village has to keep the whole tribe as guests until the price is paid, and in consequence there is as little delay in making payment as possible.

The general and particular characteristics of Málvi cattle.

Málvi cattle have been bred pure for a very long period. They are particularly true to type and have certain peculiar characteristics which leave no doubt as to their purity of blood. The predominating colour is pure white. Grey or silver grey specimens are common, but broken colours are unknown. In a grey or silver grey specimen usually the limbs, neck and head are a darker shade than the body. Málvis are essentially work cattle, medium in size, and adapted for any description of ordinary work. They are spirited, active and strong and equally good for the plough, the cart, or for well work. It is not surprising therefore that the well-to-do Deccan Kunbi prefers Málvis to any other breed. The Málvi is generally very shapely in appearance having the frame wide and deep but not very long. It is supported on squarely set, well shaped limbs, with good flat bone and round hard feet. There is a slight droop in the hindquarters. There is not much loose skin on the sheath, but that on the neck and dewlap is well developed. The hump is large. The head and horns are very characteristic.

The muzzle is large and jet black, the eye membranes and the hair immediately surrounding the eye socket are also jet black. This characteristic a "hall mark" invariably found in pure bred Málvis. The head is short the eyes are dark, prominent and have a docile appearance. The ears are short with little or no tendency to droop. The horns are very characteristic. They are moderately thick at the base, of fair length and are sharp pointed and invariably spring in a forward and upward direction from the head with a graceful outward bend.

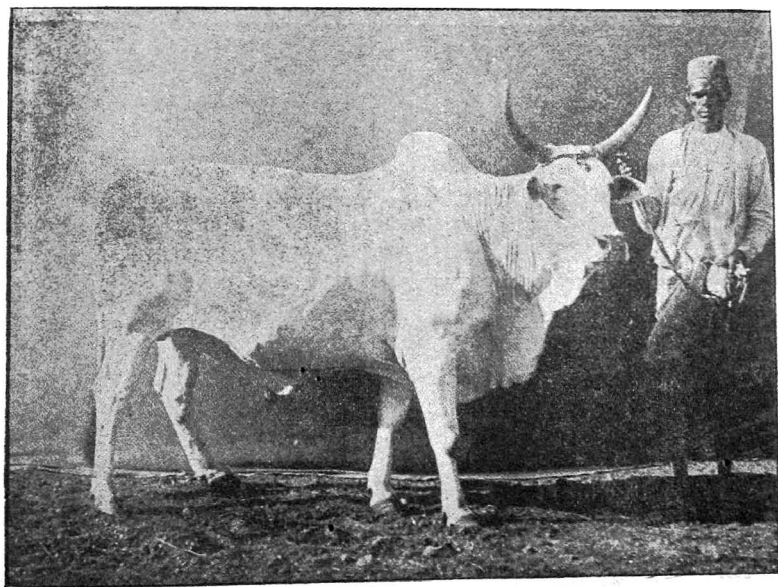
Many of the cart cattle of the towns of the Presidency are of this breed. This is notably the case in Poona. Many of the Bombay Municipal cart bullocks are Málvis. Málvi work cattle are widely distributed throughout the Deccan and also in Southern Gujarát.

This breed is widely distributed.

A good pair of young Málvi bullocks cost in the Deccan Rs. 150 to Rs. 175, when fully broken and seasoned to work. The Deccan cultivator generally keeps young cattle bought from the drovers idle or at light occasional work for fully a year after he buys. The drover gets Rs. 35-40 up to Rs. 50 for good single bullocks or bulls 3 or 4 years of age.

Value.

Illustrations 53, 54, 55 represent excellent specimens of the breed—a bull and two bullocks.



55.—Málvi bullock.

Measurements of Malvi Cattle.

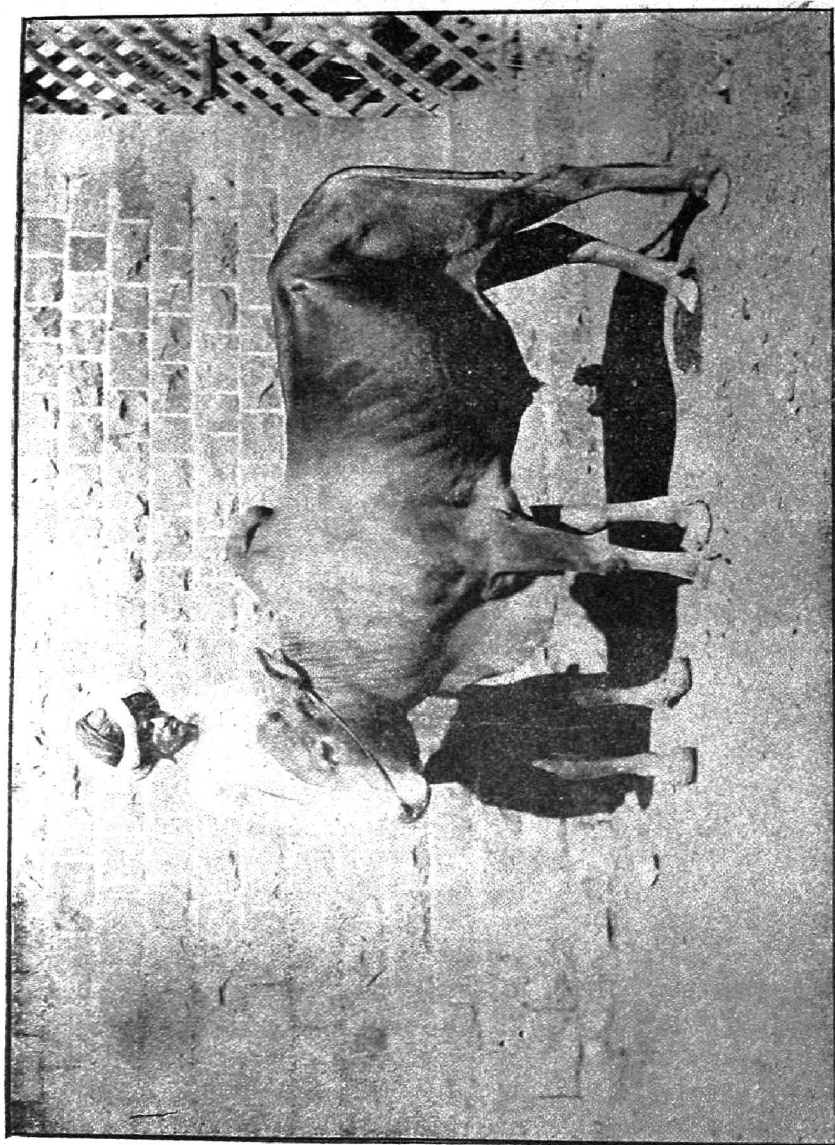
Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horns, outside curve.	Circumference of horns at base.	Width of forehead (greatest convexity measuring from base of each horn.)	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Malvi bullock, white.....	4' 8"	4' 5"	5' 7"	3' 10"	1' 6"	1' 5"	0' 10½"	1' 0"	0' 10"	0' 7½"	1' 8"	0' 7"	0' 7"
2	Malvi bullock, white	4' 6"	4' 3"	5' 5"	3' 10"	1' 6"	1' 6"	0' 10½"	0' 11"	0' 9"	0' 7"	1' 7"	0' 7"	0' 7"
3	Commissariat bullock, Poona, white.....	4' 6"	4' 3"	5' 7"	3' 8"	1' 5"	1' 5"	0' 11"	1' 2"	0' 9"	0' 6½"	1' 8"	0' 7"	0' 7"
4	Do. do.	4' 7½"	4' 3½"	5' 10"	3' 8"	1' 5"	1' 4"	0' 10"	1' 0"	0' 9"	0' 6½"	1' 8"	...	0' 8"
5	Do. do.	4' 7"	4' 2½"	5' 8"	3' 6"	1' 5"	1' 3¾"	0' 10"	1' 2"	0' 9"	0' 7"	1' 8"	...	0' 7½"
6	Do. do.	4' 6½"	4' 3½"	5' 5½"	3' 7"	1' 4"	1' 4½"	0' 10½"	1½' 1"	0' 8"	0' 7"	1' 9"	...	0' 8"

THE ADEN CATTLE.

The general conditions under which Aden cattle are bred.

Aden cattle are bred in the districts of Zaida, Al Hasiki, 'Shaka., Al Anad, Al Hautah in the Abdali (Lahij) country, the Abyan in the Fadthile country, Al Kasha in the Alawi country, Somali, and Jerabi districts in the Subaihi country and in Yemen. These districts are approached by land *via* Aden. The general character of the soil is dry and sandy; climate cool and temperate. Rainfall generally abundant in the hot season, but occasionally, as in 1896 and 1897, scant. The streams are perennial but small, affording, however, sufficient drinking water for stock, but not used for irrigation. The only grass-lands of importance are on the banks of streams. A grass called *suda* grows to a height of about 3 feet in the rains. The cattle are mostly bred by Arab agriculturists each owning a few animals, but many people, the well-to-do as well as farmer classes, keep a cow or two for the value of the milk for domestic purposes. The cattle of different owners are kept distinctly separate or generally so. Young stock and older ages go together. Bull calves are castrated when one year old, and in consequence cows or heifers are mated only with such bulls as have been selected as specially suitable for stud purposes. Such bulls are carefully looked after. The cows in their own district are regular breeders producing a calf every year if fed well. Heifers mature quickly and are put to the bull for the first time when about 18 months old. Calves are allowed to suckle only for a month. Subsequently they are reared on other food. Well fed cows yield about 18 lbs. milk daily and the majority of the cows milk well. The cows are fed much in the same way as Indian cattle, the concentrated food being cotton seed, oil-cake and grain of *jowdri*. The daily ration of concentrated food is about 8 lbs. In addition green or dry *jowdri kadbi* is given. The cattle are sheltered in open sheds in towns and villages, but are not housed in the open country (jungle). The cattle are thoroughly domesticated and accustomed to be handled by their owners from the time they are quite young, and are in consequence very docile tempered. Bullocks—not bulls—are used at work for ordinary agricultural operations and in carrying water from the wells. There is no other breed of cattle in the district or brought into the district. The best cattle are whole coloured. They have been maintained pure for a long time and are closely bred. A few cows are exported to Aden and the Somali Coast, and cost from Rs. 40 to Rs. 70 according to quality, supply and demand. The chief dairy product sold is *ghee*, but much of the milk is required as such for domestic requirements. Butter is made by churning the milk in a "leather receptacle by shaking it up and down," a primitive method requiring improvement.*

* This information has been obtained through Brig.-General Ormest, Political Agent, Aden, to whom the acknowledgments of the Bombay Agricultural Department are gratefully offered.



56.—Aden bull.

Such Aden cattle as are imported into Bombay are usually bought in Aden and the breed is in consequence known in India as Aden cattle. They are exceedingly true to type. It might safely be conjectured from their general smallness of size, the deer-like appearance of their heads and limbs, and the uniformity of colour that the breed has been maintained pure for a long time, and also that it has been in-bred to a considerable extent. The information obtained from the Political Agent, Aden, in answer to direct questions on these points proves such to be the case. Pure bred specimens are always whole coloured. The most common colour is a yellow fawn, changing to a lighter or darker shade on various parts of the body, the head, neck and limbs being generally a lighter or darker shade than the body. Pure white and light red are not uncommon colours. Generally the muzzle, eye and other exposed membranes are a tawny dull yellow colour, but a black muzzle and black eye membranes are often met with. The inside of the ears and the udder are usually deep rich yellow in colour, a characteristic common to other milk breeds giving rich milk, as for instance, "Channel Island" cattle. The general form is that of a milking type, being deeper and heavier in the hindquarters, than in front. It cannot, however, be said that there is any deficiency in proportion. On the contrary these cattle in a miniature style are beautifully proportionate. The frame may be said to be more or less rounded in all its lines, rather short but deep, particularly in the hindquarters, and fairly wide. There is no decided droop in the hindquarters behind the loins as in most indigenous Indian breeds. The quarters are in good specimens, square, and the thighs muscular and well filled. The tail should be long and thin, a characteristic peculiarly associated with good milking capacity. The frame is supported on short legs, squarely set with small deer-like canon bones and feet. The hump is large in the male, not particularly so in the female. There is no loose skin on the sheath and that on the neck and dewlap is not nearly so prominent and pendulous as in many Indian breeds. The udder is generally very shapely, although not very large, and does not extend so far forward along the abdomen as it ought to do for large milking capacity. The milk vein is generally very prominent. The teats are well placed but are not generally so large as they should be. Usually they are so small that they cannot be fully grasped in the act of milking except by a small hand. The appearance of the head and the prominent placid eyes indicate a docile temperament which is in no way belied, and of course a valuable characteristic in milk breeds. The head is neat, short, broad across between the eyes and near the muzzle, but rather narrow between the horns. The ears are small, sharp pointed, carried square with the head, with no tendency to droop, and are moved forward in an alert manner when the animal expects to be fed or is taking notice of anything unusual. This alertness as indicated by the ears is mentioned,

The general and particular characteristics of Aden cattle.

because those Indian cattle which have particularly long lob ears look stupid to a European eye, when they ought to be on the alert, because they have so little muscular control over their long limp ears. The horns in Aden cattle are short and crumbled (often) in the cow, and very short and blunt in the bull. The breed matures very quickly. Heifers, if well fed and well grown, will breed in India when 2 years of age. Sometimes even at a younger age, but such precocity is not desirable. The cows are regular breeders coming into "season" for the bull in 6 to 8 weeks after calving and yield milk, if allowed, almost up to the time they are again due to calve. The milk yield owing to the docile tempers of these cattle is not easily affected by mismanagement or any irregularity in feeding, milking, &c., as in most Indian breeds, nor does travelling by road or rail to reasonable extent or changes in the weather, &c., materially affect or permanently reduce the milk yield in any period of lactation. A good Aden cow for this reason is a god-send to a district officer if he moves camp often as he necessarily must do.

Aden bulls are very
impressive.

Aden bulls when used for crossing with any other breed are often particularly impressive in stamping certain of their characteristics on their offspring. The Aden peculiarity of colour, the absence of loose skin on the sheath and docility of temper are particularly noticeable characteristics of half-bred Adens.

Milk yield and
value.

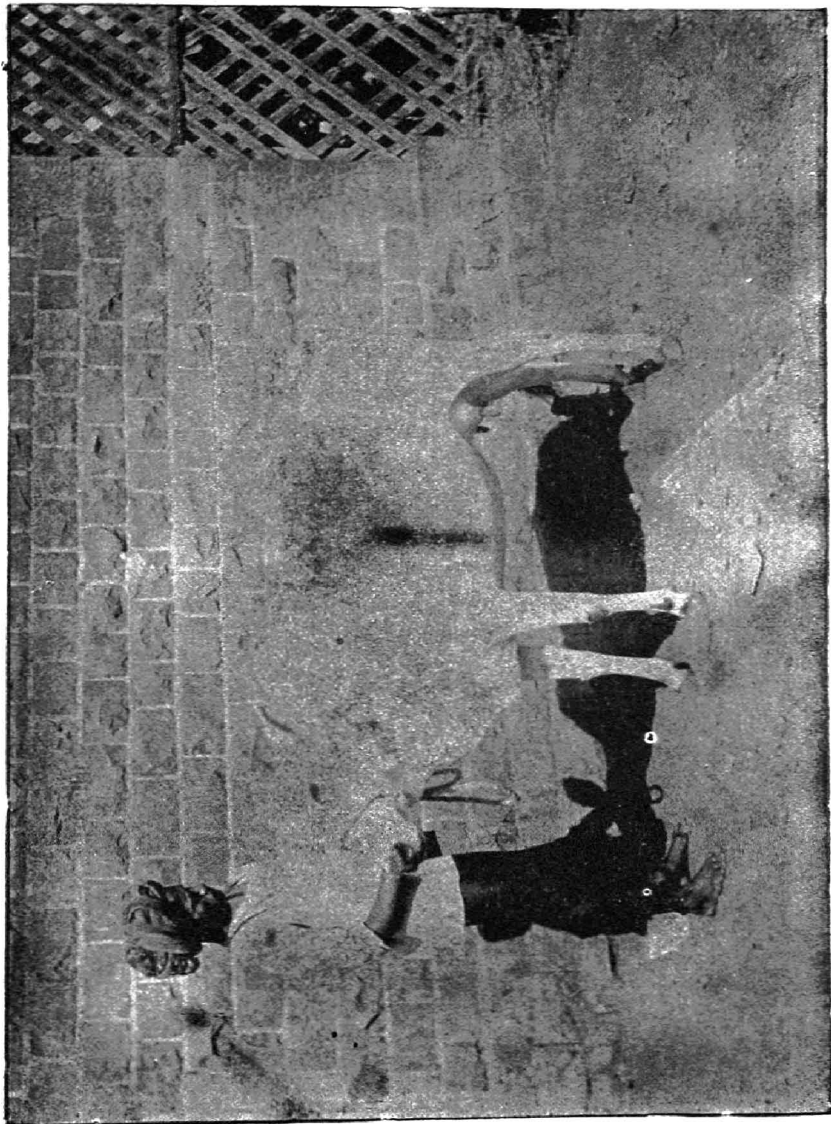
The best imported Aden cows or good ones bred in India yield up to 22 lbs. of milk per day, on a ration moderate in quantity as compared with that required for the best indigenous breeds when in full milk. In Bombay Aden cattle are scarce and young good cows are worth Rs. 100 each.

Aden bulls are use-
ful work cattle.

Bulls make good work cattle and being docile tempered need not for work purposes necessarily be castrated. They are not strong enough for heavy haulage, but are exceedingly active and hardy, and for ordinary agricultural purposes will bear favourable comparison with the better class of Deccani cattle. They are not so well suited for cartage or for ordinary field work as Málvis, because they are not so big and strong, but are quite as active.

Illustrations.

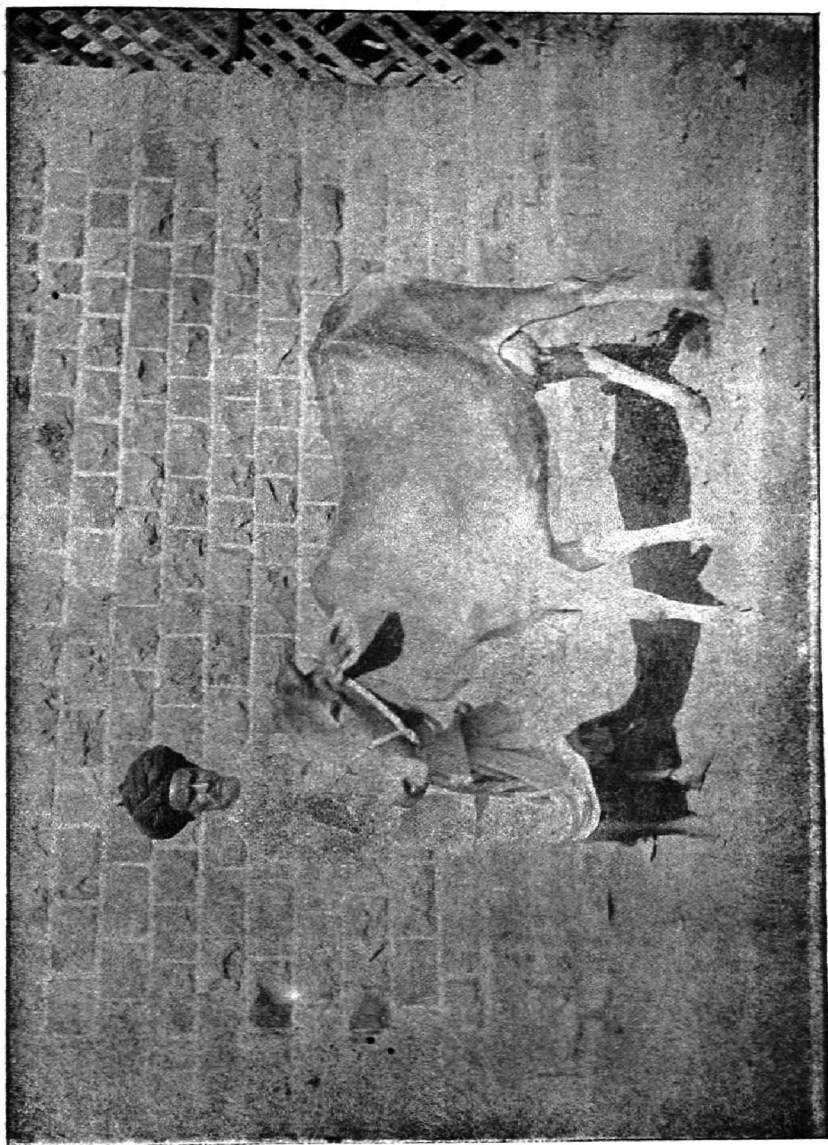
Illustration 56 represents a typical specimen of a bull. He is deficient in his quarters and light in his thighs, otherwise is very shapely. Illustrations 57, 58 and 59 of cows are good specimens, the white cow (No. 57) being the best. These cows were not in full milk when the photographs were taken, so their milking capacities are by no means fully indicated by the appearance of the udders.



57.—Adeu co r.



58.—Aden cow.



59.—Aden 4 year old cow.

Measurements of Aden Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horn, outside curve.	Length of horn, outside curve.	Circumference of horn at base.	Width of forehead, (greatest convexity measuring from the base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Kolhapur State bull, dull red and fawn colour. About 8 years.....	4' 6"	3' 11"	5' 8"	3' 7"	1' 4"	1' 3"	0' 8"	0' 3"	0' 6"	0' 9"	1' 9"	0' 6 $\frac{1}{2}$ "	0' 7 $\frac{1}{2}$ "	
* 2	Red Aden bull, Stock bull, Poona Farm, 5 years ...	4' 6"	3' 10"	5' 2"	3' 4"	1' 5"	1' 3"	0' 9"	0' 2 $\frac{1}{2}$ "	0' 5"	0' 7 $\frac{1}{2}$ "	1' 6"	0' 6"	0' 6"	
3	Fawn coloured Aden cow, Poona Government Farm, 6 years	4' 0"	3' 9"	4' 9"	3' 4"	1' 2 $\frac{1}{2}$ "	1' 1 $\frac{1}{2}$ "	0' 8"	0' 2 $\frac{1}{2}$ "	0' 3 $\frac{1}{2}$ "	0' 7"	1' 4"	0' 6"	0' 5 $\frac{1}{2}$ "	
4	Red Aden cow, Poona Government Farm, 6 years ...	3' 10"	3' 8"	4' 10"	3' 2"	1' 2 $\frac{1}{2}$ "	1' 1"	0' 9 $\frac{1}{2}$ "	0' 2"	0' 3 $\frac{1}{2}$ "	0' 6"	1' 4"	0' 6 $\frac{1}{2}$ "	0' 5 $\frac{1}{2}$ "	
5	White Aden cow, Poona Government Farm, 9 years...	3' 9"	3' 7"	4' 10"	3' 4"	1' 3"	1' 2"	0' 8"	0' 2"	0' 3"	0' 5 $\frac{1}{2}$ "	1' 4"	0' 5 $\frac{1}{2}$ "	0' 5 $\frac{1}{2}$ "	

SINGALESE OR CEYLON CATTLE.

This is a very small hardy breed of cattle. They are variable in type and colour. The best of them resemble Aden cattle to a considerable extent, but the cows differ from Aden cattle in being generally very poor milkers. These cattle also mature much more slowly than Aden cattle do. A good many of their characteristics have probably been induced by close breeding. There are certainly no indications that they have been crossed with Madras cattle or any other Indian breed.

These cattle resemble Aden cattle.

The predominating colours are whole colour—black, brown, red and fawn. But spotted cattle are occasionally met with and speckled or speckled roan cattle are quite common. Many of these cattle are exceedingly shapely with small, short, rounded, compact bodies, supported on short shapely legs, squarely set, with exceedingly neat bone and hard small feet. The limbs like those of Aden cattle resemble deer. The head is very neat, muzzle large. The head widens from muzzle to the eyes which are wide apart and very prominent. The face rapidly contracts above the eyes and the distance between horns from base to base is very narrow. The horns are short and crumpled as in Aden cattle. The ears are also exactly like Aden cattle, being short, quick-set, pointed, carried square with the head and have no tendency to droop. There should be very little development of loose skin on the dewlap and none on the sheath or navel. The droop in the hindquarters is generally considerable. The bullocks are exceedingly active and hardy and for their size very strong. They are first rate trotting cattle and in light carts are capable of going a long distance in quick time. They are either driven single in *ekkas* or in pairs in light carts.

The general and particular characteristics of the breed.

Ceylon cattle are branded to an extraordinary extent. Some brands are distinguishing marks, but many are put on because the owners believe, that muscular development on certain parts is thereby increased, and the muscles hardened and strengthened.

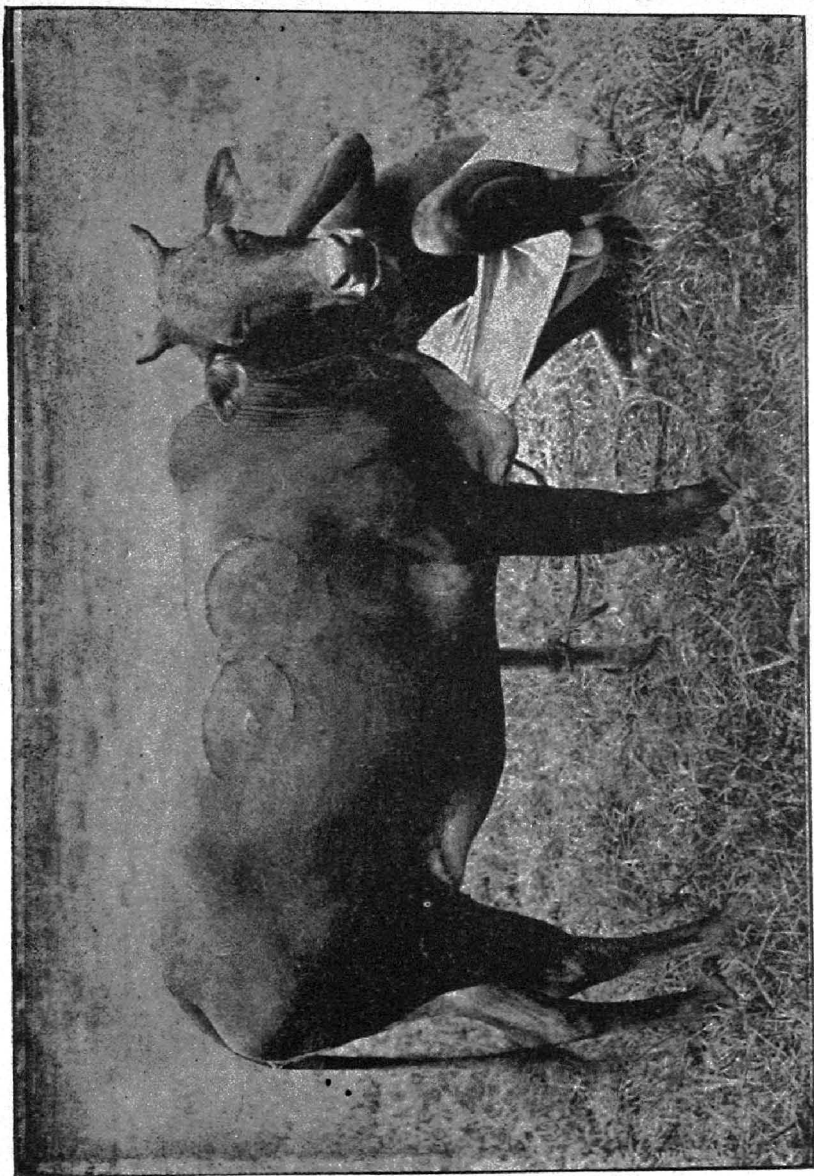
Branding.

Illustration 60 shows a speckled bull.

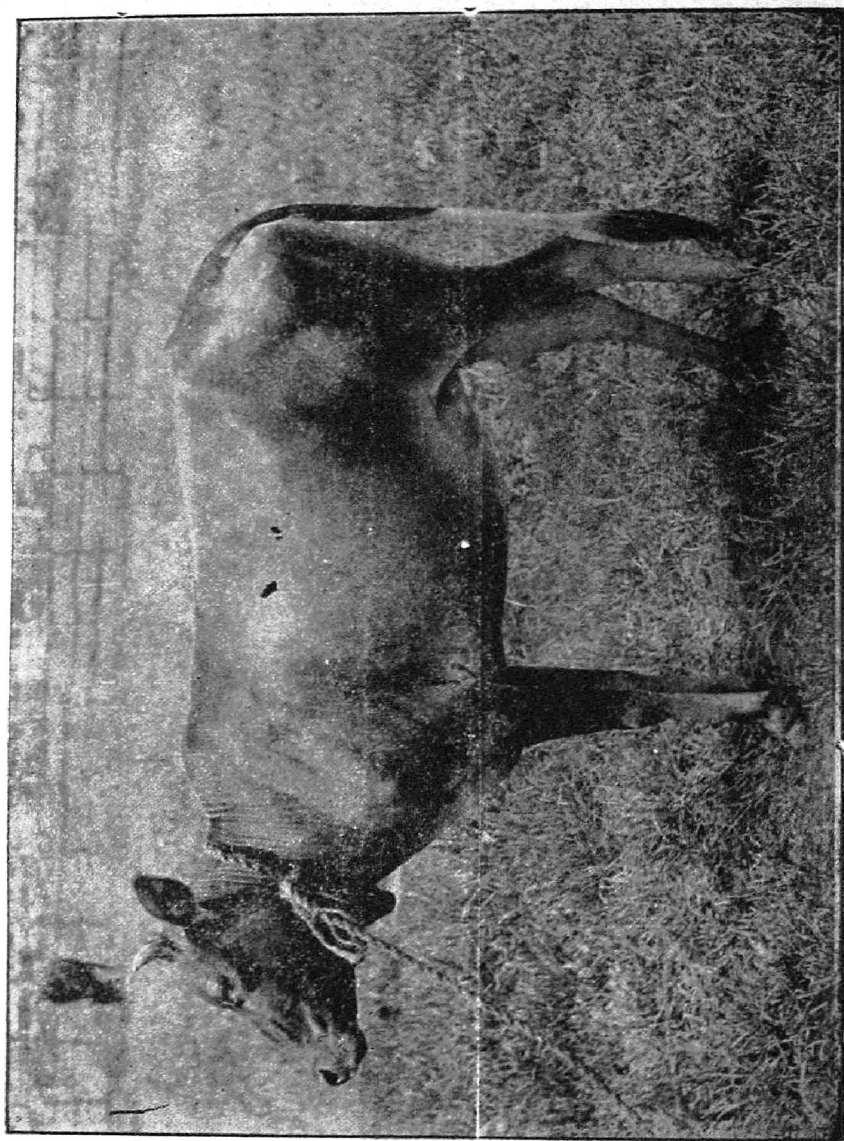
Illustrations 61 and 62 of heifers are exceedingly typical of the breed. These are much better specimens than the bull No. 60.



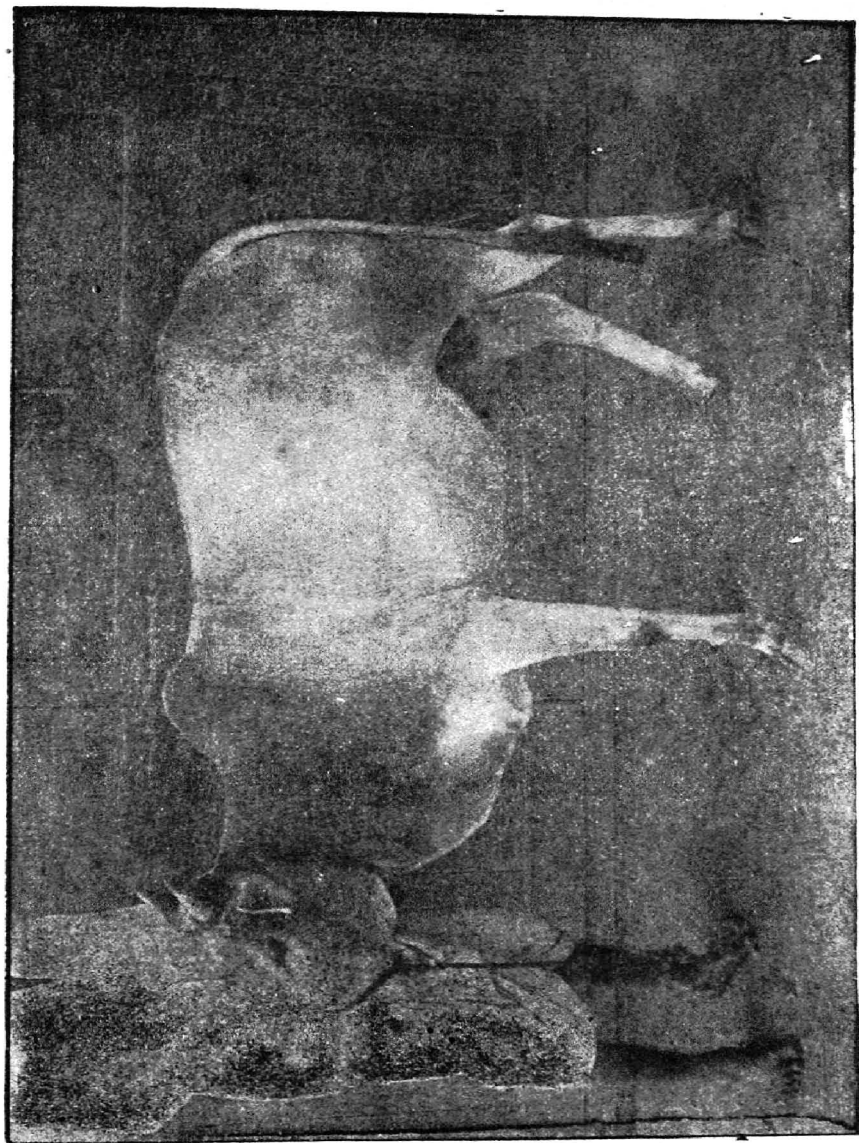
60.—Singalese bull.



61.—Singalese heifer.



62.—Singalese heifer.



63.—Gaṇiā or dwarf bullock used extensively for trotting with light *ekka* carts.

Measurements of Singalese Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarters.	Width of pelvis.	Length of ears, outside curve.	Length of horn, outside curve.	Circumference of horn at base.	Width of forehead (great est convexity measuring from base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Spotted bull, 5 years	3' 9"	3' 6"	4' 4"	3' 3"	1' 5"	1' 5"	0' 7"	0' 3½"	0' 5"	0' 9"	1' 4"	0' 7½"	0' 5"
2	Spotted bull, father of No. 1, 9 years	3' 11"	3' 8"	5' 0"	3' 4"	1' 1½"	1' 1½"	0' 7"	0' 5½"	0' 6½"	0' 8"	1' 4"	0' 8"	0' 5"
3	Black heifer, 4 years	3' 1½"	3' 1"	4' 8"	3' 2½"	1' 2"	1' 2"	0' 7½"	0' 5"	0' 4"	0' 6"	1' 2½"	0' 8"	0' 5"
4	Brown heifer, 3½ years	3' 3"	...	4' 5½"	3' 2"	1' 2"	1' 1"	0' 6½"	0' 2½"	0' 3½"	0' 6"	1' 3"	0' 8½"	0' 5"

NIMÁR CATTLE.

These cattle are bred in Nimár, a district which borders on Eastern Khándesh. Many of them are used in the Khándesh district as cart bullocks, and may in particular be seen in heavy *bandis* on the Dhulia-Agra main road. The best of them are large and adapted for slow heavy road work. Select specimens are used by the Commissariat Department for heavy transport. They are bred by ordinary agriculturists mostly. They can readily be recognised by two typical characteristics, *viz.*, by their colour and by their horns. The colour is generally broken red and white in large distinct patches. Sometimes but rarely the colour is nearly whole red with a slight extent of white markings. The red is always a light red, sometimes almost a yellowish red, and the white markings are never pure white. They are bluish or dingy white. The latter appearance being due to a slightly mottled appearance caused by small spots of red being mixed through the white patches. The horns are thick at the base, blunt at the point, flattened, and curled over the head somewhat like those of a Delhi buffalo. The muzzle, eye and other exposed membranes are very often flesh coloured. In fact this may be said to be characteristic, although mottled, or black muzzles are occasionally seen. The head is distinctly coarse and large, big at the muzzle, wide and long. The eyes are not prominent, the ears are large and pendulous. The appearance of the head and eye indicates that Nimári cattle are slow, lazy and have no great capacity for hard work or endurance. The neck is of moderate length and is thick. The pendulous skin underneath is well developed but it is thick, leathery, and unlike that on other indigenous breeds. It does not swing loosely when the animal moves. The loose skin on the sheath and navel is also well developed. The frame is long, square and deep. The hump is large. The pelvic bones are particularly prominent. The quarters are long and level and the thighs deep and muscular. Nimári cattle stand well on their legs but the leg bones are large, round and coarse, and the feet big, unshapely and soft.

General and particular characteristics of the breed.

I have made no personal enquiry regarding the history of this breed, but I imagine if the facts were known that some of the characteristics could be traced to foreign blood.

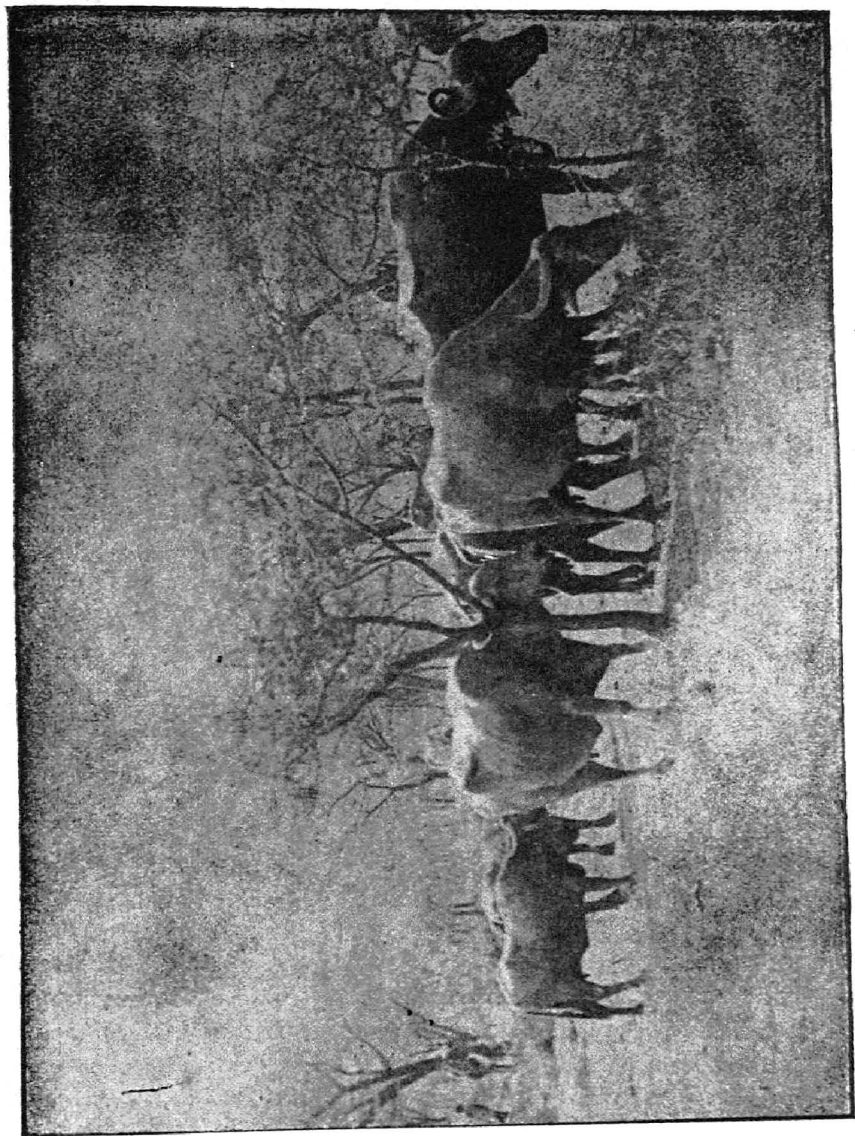
Origin.

A good pair of Nimári bullocks is worth Rs. 200 to Rs. 250.

Value.

Measurements of Nindri Cattle.

Number.	Description.	Height at hump.	Height behind hump.	Girth.	Length from behind hump to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears outside curve.	Length of horn outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Old red and white bullock	4' 11 $\frac{1}{2}$ "	4' 9"	6' 1 $\frac{1}{2}$ "	4' 8"	1' 7"	1' 8"	1' 0"	1' 4"	0' 10"	0' 6 $\frac{1}{2}$ "	1' 9"	.....	0' 8 $\frac{1}{2}$ "
2	Red and white bullock	5' 0"	4' 9"	6' 6 $\frac{1}{2}$ "	4' 0"	1' 6 $\frac{1}{2}$ "	1' 9"	1' 1"	1' 5"	0' 10 $\frac{1}{2}$ "	0' 7"	1' 10"	.....	0' 8 $\frac{1}{2}$ "
3	Red and white bullock	5' 0"	4' 8"	6' 2"	4' 1"	1' 7"	1' 7 $\frac{1}{2}$ "	1' 0"	1' 4"	0' 10"	0' 7"	1' 10"	.....	0' 8"



64.—Buffaloes in a *laguna karau* in the hot weather.

BUFFALOES.

He-buffaloes are suitable work cattle in districts of heavy rainfall.

Buffaloes are naturally water animals and thrive better in districts of heavy rainfall than ordinary cattle do. In such districts he-buffaloes are used for draught purposes in preference to ordinary bullocks. Large he-buffaloes are exceedingly strong and for slow heavy work are probably more powerful than any breed of bullock. They are certainly stronger than bullocks of their own size either in drawing loads or in carrying a pack load or a *pakhál* of water. They are very cheap when full grown being rarely worth more than Rs. 40 and generally less. It, therefore, does not pay to rear them except in districts where grazing is abundant and cheap. He-buffaloes bred in the Deccan are sold when weaned at nominal prices, Rs. 2, 3 or 4 each. They are taken below the Gháts and fed cheaply on the Ghát grazing lands and rice straw, until they are fit for work, or old enough to be sold to the butcher. If a buffalo cow will yield milk without the calf suckling, the calf (if a bull calf) is generally either starved to death, or surreptitiously killed, or thrown out into the street or roadway by the owner, to be taken in and fed at the Pinjrápole.

The general conditions under which buffaloes are successfully bred and reared.

Although the buffalo thrives better than a cow in a wet climate the best buffaloes like the best of ordinary cattle are bred in districts of moderate rainfall and where the conditions for cattle breeding are most favourable. Buffaloes should be bathed twice a day if they have not access to a deep running stream or deep water of some kind. They should be shaved several times a year. The sparse coarse hair on the body (the growth is thicker on the legs) gives no protection from sun or rain, but it harbours lice and other vermin. Ticks on buffaloes, especially inside the ears, and on the underparts, are persistently present especially in the hot weather and should be removed or killed by means of an insecticide wash ; otherwise the cattle rapidly loose condition. The black shining skin gets very hot when the sun's heat is strong, and it is usual to cover buffaloes when working with *jhools* made of coarse sacking. Buffaloes differ from cows chiefly in the following respects :—(a) In giving milk which is much richer in butter fat ; (b) in voice ; (c) in having no hump. Milch buffaloes show great maternal instinct and also get much attached to their attendants especially to the men who feed and milk them, also to companion animals in adjoining stalls. If separated from the calf, from companion animals, or from the man that regularly feeds and milks them they are almost certain to refuse to yield milk, and the milk-yield may be permanently reduced. When ill, even with a trifling ailment, they rarely will allow milk to be drawn. This is a safeguard in India considering the danger to the public which would arise from the sale of milk from diseased animals.



65.—Typical head of Jafferabadi buffalo.

JAFFERABADI BUFFALOES.

Four distinct
breeds.

There are four distinct breeds of buffaloes known in Bombay, *viz.*, Jafferabadi, Delhi, Surat and Deccanis.

Jafferabadi buffa-
loes.

Jafferabadi buffaloes are bred in the Gir hills and in almost every village and town throughout the south of Káthiáwár. Cattle of the purest blood are believed to be owned by the Bhávnagar State. Jafferabadi buffaloes are very large, but even the best of them are not shapely. They stand high on the leg. The legs, bones and feet especially in old cattle are excessively large and coarse. These cattle are very ponderous in front, the brisket being characteristically prominent and large. The withers or crops are usually very sharp and narrow. On the other hand the pelvic bones are so prominent that they disfigure the animal. The quarters are square and fairly level, and the thighs deep and muscular. The upper line is very uneven. Altogether a Jafferabadi buffalo is by no means shapely. The prevailing colour is mostly black, with a few white markings. But sometimes the white markings are considerable, especially on the legs and face. Cattle so marked have usually one or two wall eyes and the muzzle and other exposed membranes are either white, or flesh coloured, or partly so. The head of a Jafferabadi buffalo is very characteristic. The horns particularly in the male are extremely coarse and large. There is extraordinary development of the frontal bone and this appears to be continued to form the base of the horn. This extraordinary development of bone at the base of the horn forms what may aptly be described as large excrescences which occupy each side of the face from the forehead to the cheeks extending considerably below the level of the eyes. This development of bone increases with age and in old cattle the eye sockets are almost completely surrounded. Therefore old bulls are often blind or nearly so. Each horn, as it starts from the base of the bone excrescence, takes a downward backward spiral sweep. The horn at the base is not round; it is comparatively flat and broad, but gets more rounded towards the point. The development of frontal bone and excrescence are not so great in the cow. The horns take the same downward curve on each side of the head as in the bull. They bend downward, outward and then upward, the bend generally forming about $\frac{3}{4}$ ths. of a circle. As in bulls so in cows the eyes are generally sunk deep in the head especially in old cattle. The necks of cows are long and thin. Bulls have thick and muscular necks. A good Jafferabadi cow costs Rs. 150 or more in Bombay and yields a large quantity of milk in Káthiáwár; 30 to 40 lbs. daily usually. The udders are not usually well shaped although generally very large. The teats are usually very large and are contracted curiously into a neck at the junction with the udder.

General and parti-
cular characteristics.

Value.

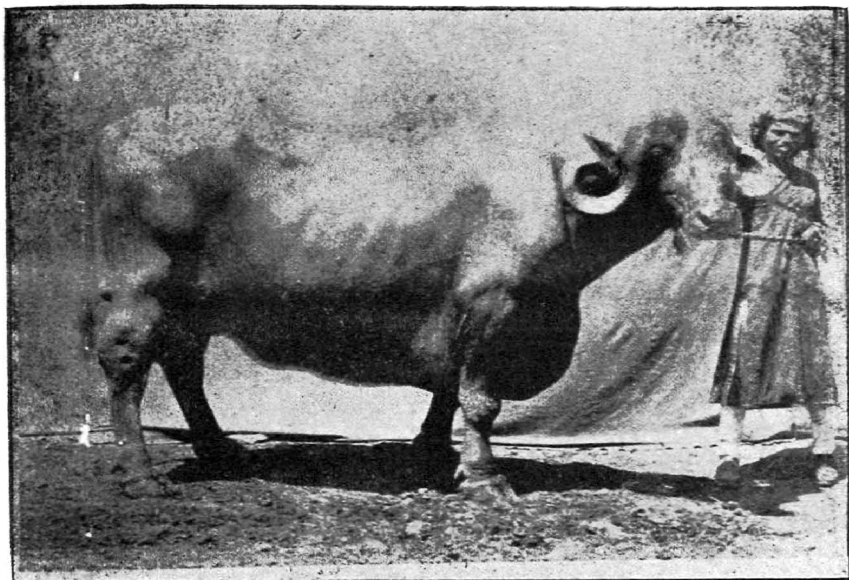
Illustrations.

A typical head of an old Jafferabadi bull is excellently shown in Illustration No. 65. Illustration 66 shows a full length portrait of the same

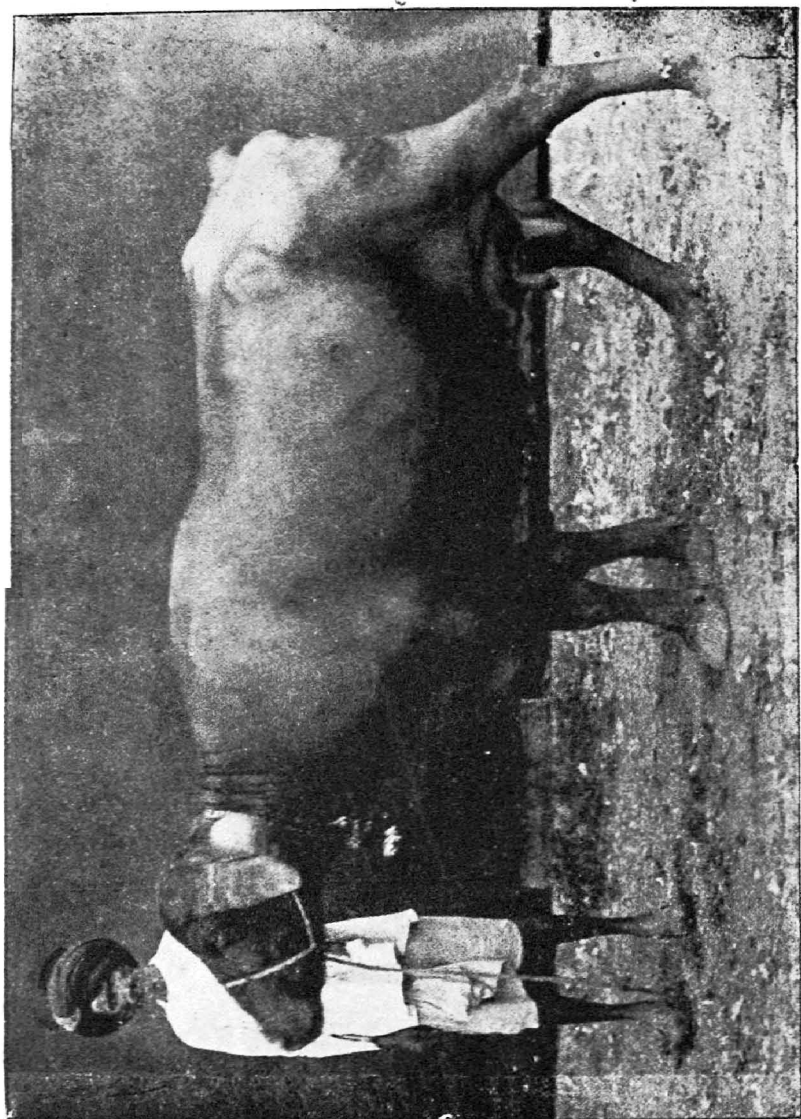
bull. It cannot be claimed that he is a good looking specimen, but he is nevertheless perfectly typical of a pure bred Jáfferabadi. His legs and feet have got extremely coarse and large with age. The callous growth as shown on the stifle joint is often seen in old heavy buffaloes. It is caused by lying upon and rising from the hard floor of a stall. In Illustration 67 the prominence of the pelvic bones and heaviness of forequarters which are so characteristic in Jáfferabadis are clearly exhibited. This cow was exhibited by the Bhávnagar State at the Bombay Show (1890) and is a grand specimen of the breed. Illustration 68 represents the common type of Jáfferabadi cow as ordinarily met with.



66.—Jafferbadi buffalob ul.



67.—Jafferabadi buffalo cow.



68. — Jafferbadi buffalo cow.

Measurements of Jafferabadi Buffalo Bulls and Cows.

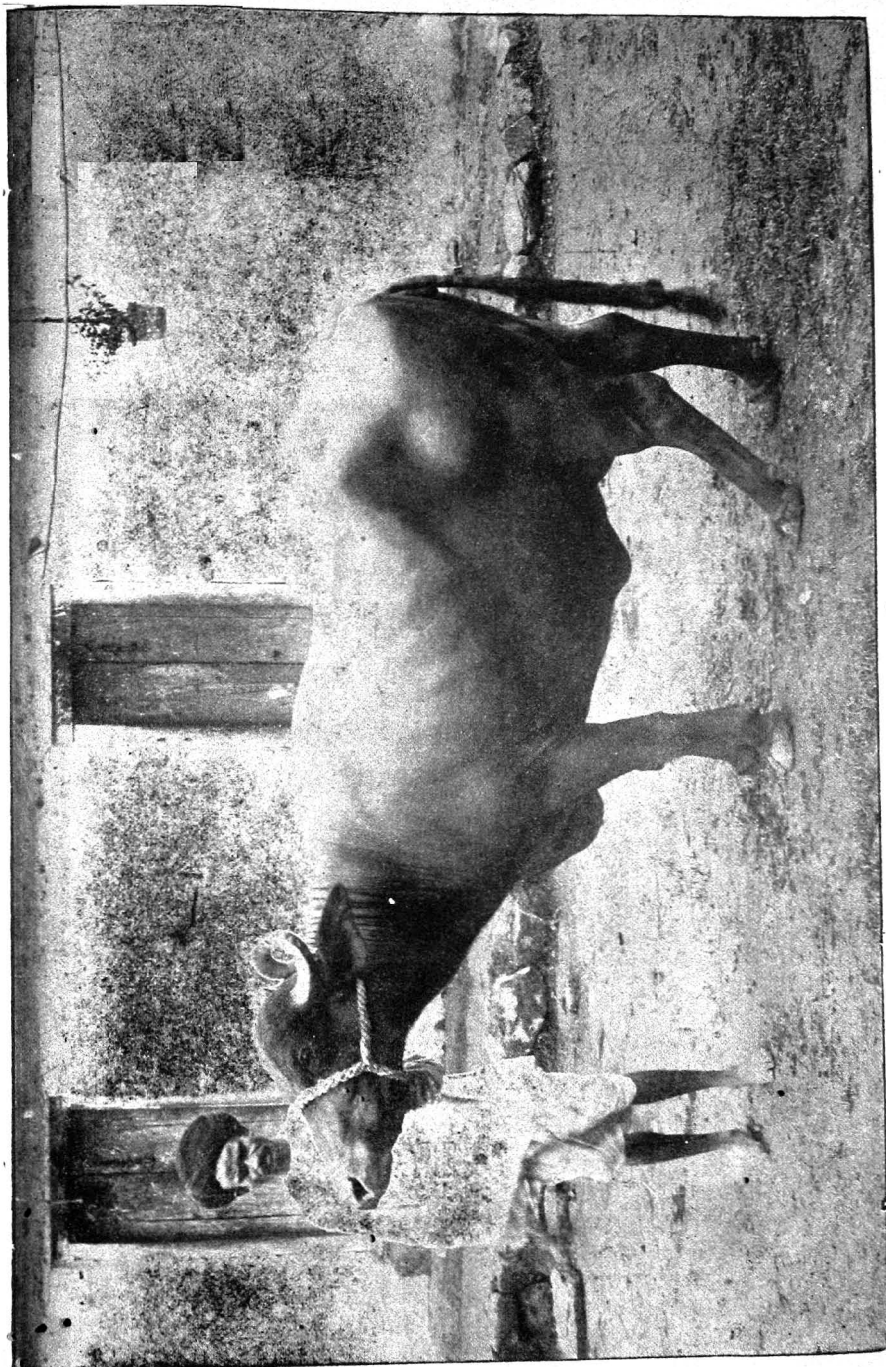
Number.	Description.	Height at Shoulder.	Girth.	Length from shoulder to point of pubis.	Length of quarter.	Width of pelvis.	Length of ear, outside curve.	Length of horn, out- side curve.	Circumference of horn at base.	Width of forehead (great- est convexity measuring from base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Kolhapur State bull, Chinchli Show ...	5' 9"	8' 1"	5' 10"	2' 1"	2' 2"	0' 10 ³ / ₄ "	2' 10"	1' 9"	2' 3"	2' 5"	0' 8"	1' 1 ¹ / ₂ "
2	Junágadh State bull	5' 0"	7' 9"	5' 0"	1' 11"	2' 1"	Mutilat- ed and impos- sible to measure	2' 7"	2' 4"	2' 3"	2' 2"	0' 7"	1' 1"
1	Kolhapur State cow, Chinchli Show ...	5' 1"	7' 4"	4' 8"	1' 9"	2' 2"	0' 10"	3' 2"	1' 3"	1' 8"	2' 4"	0' 8"	0' 11"
2	Junágadh State cow	4' 11"	7' 4"	4' 10"	1' 8"	2' 2"	0' 11"	3' 7 ¹ / ₂ "	1' 3"	1' 9"	1' 10 ³ / ₄ "	0' 8"	0' 10"
3	Junágadh State cow	4' 9"	7' 4"	4' 9"	1' 9"	2' 2"	1' 0 ³ / ₄ "	3' 6"	1' 2"	1' 10"	2' 1"	0' 7"	0' 10 ¹ / ₂ "

DELHI BUFFALOES.

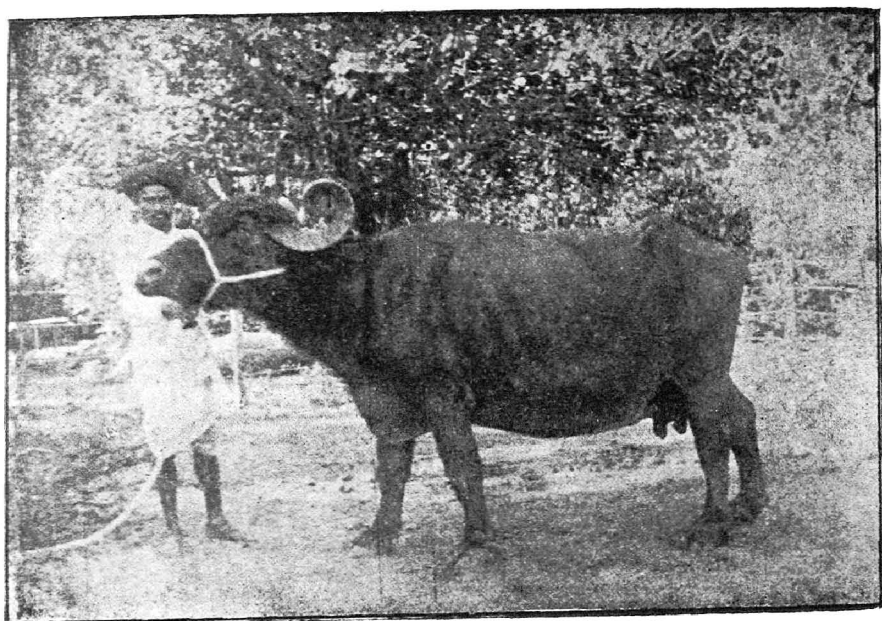
These buffaloes are bred throughout the North-Western Provinces and Sind. A few are bred in Pálanpur Agency but nowhere else in Bombay.

General characteristics of Delhi buffaloes.

They are very large cattle, with deep, wide, rather short frames, and stand on short thick legs, which are squarely set, rather wide apart. The withers or "crops" like those of Jáfferabadis are thin and narrow and stand up like a spine. This conformation together with a slight dip or hollowness of back and an abrupt elevation of the spine behind the pelvic bones cause an uneven upper line. Delhi buffaloes are not so heavy in the forequarters as Jáfferabadis: neither are the points of the pelvic bones so prominent. These cattle may be described as massive and square all over—heavier, however, in the hindquarters than in front. The colour is usually jet black, but occasionally white markings are met with. The head is short, neat and clean cut (no superfluous flesh)—large at the muzzle and rather wide at eyes. The forehead is slightly prominent and the face is always hollow or indented between the forehead and muzzle. The term "dish faced" as used in England is aptly descriptive of the conformation referred to. The horns are very characteristic. They are thick at the base and fairly sharp at the point. They have a rugged, uneven surface somewhat like the uneven surface of certain curled shells of sea molluscs. They rise from the head in an upward and backward direction and then curl over the head like the horns of a ram. If the full outside length of horn is measured then the horns are found to be long although being curled they look short. The neck is short and very thin considering the size of the frame. A good Delhi buffalo gives in the north of India up to 50 lbs. milk per day, but such superior milkers are rarely brought to Bombay. The udder is generally very large and commonly is also well shaped. The teats are properly placed and of moderate size. Five teats on an udder are common, the 5th giving less milk than the others. A good young Delhi buffalo is in Bombay worth Rs. 150 to Rs. 200. Heifers come to maturity sooner than Jáfferabadis and generally breed when $3\frac{1}{2}$ to 4 years old, if well cared for. The cows (illustration Nos. 69 and 70) are well bred and typical. They belong to the Poona Government Farm herd.



69.—Delhi buffalo cow.



70.—Delhi buffalo cow.

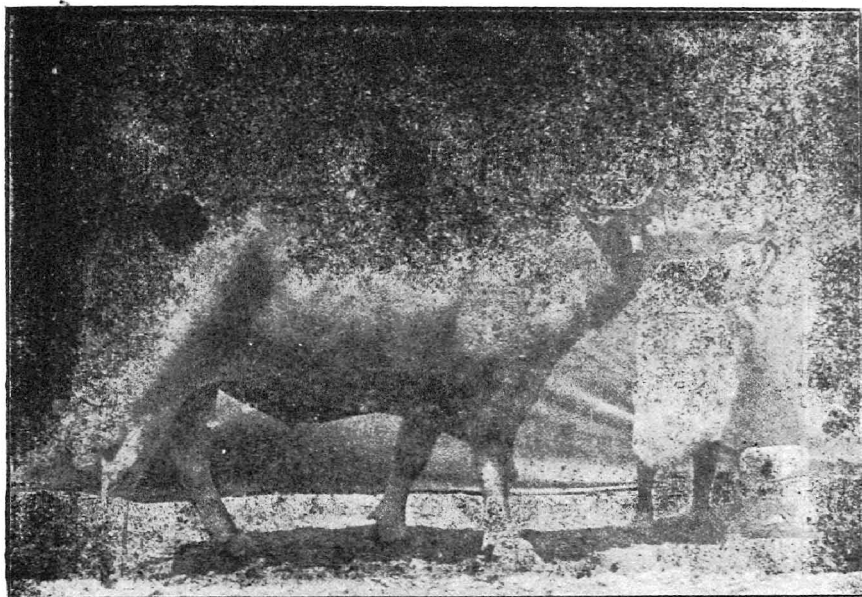
Measurements of Delhi Buffalo Cows.

Number.	Description.	Height at shoulder	Girth	Length from shoulder to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horn, outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Old cow	4' 6"	6' 9"	4' 5"	1' 8"	2' 0"	1' 1"	2' 11"	5' 10"	1' 3"	1' 9"	0' 4 $\frac{1}{2}$ "	0' 9"
2	Young cow	4' 0"	6' 7"	4' 2"	1' 6"	1' 10"	1' 0"	1' 11"	0' 6 $\frac{1}{2}$ "	1' 1"	1' 10"	0' 5 $\frac{1}{2}$ "	0' 7 $\frac{1}{2}$ "

SURAT AND DECCANI BUFFALOES.

General character-
istics of Surat and
Deccani buffaloes

Surat and Deccani buffaloes are much smaller than the Jáfferabadi or Delhi breeds. There is little or no difference in conformation between Surat and Deccani buffaloes except in the horns. The horns of a Deccani are long, straight and sharp and extend back to the shoulders, or sometimes to the middle rib. Those of Surat buffaloes extend along the side of the neck and turn up near the shoulder with an inward easy curve at the point. This inward curve often brings the point in contact with the neck or shoulder. The colours are black, black with white markings, grey and albino. In grey cattle the hair has a dun colour, but the skin has a reddish brown tinge and in cattle of this colour the muzzle is often a peculiar slate colour. Albinos and cattle with broken colour have usually wall eyes, and the exposed membranes are partly white or flesh coloured. A good Surat buffalo has a long, fairly level, wide, deep body, with no particular prominence of pelvic bones. The withers or crops are narrow. Otherwise the body is well formed and rounded rather than square in its lines. It is near the ground and very shapely. The forequarters are light but not unduly so. The leg bones are short and somewhat coarse and the feet are fairly large. Tufts of thick long hair grow on the knees. The neck is long and muscular in the bull, but in both sexes is usually very well formed tapering gradually from the throat to the chest. In Surat buffaloes the udder is a much better shape than in Jáfferabadis or Delhis, and the teats are of moderate size and well placed. A good Surti buffalo gives up to 16 seers or 32 lbs. milk per day and costs in Bombay from Rs. 100 to Rs. 120. Illustration 71 represents an excellent specimen of a Surti buffalo bull. Illustration 72 represents a good Surti cow.



71.—Surat buffalo bull.



72.—Surat buffalo cow,

Measurements of Surat Buffaloes.

Number	Description.	Height at shoulder.	Girth.	Length from shoulder to point of pubis.	Length of quarter.	Width of pelvis.	Length of ears, outside curve.	Length of horn, outside curve.	Circumference of horn at base.	Width of forehead (greatest convexity measuring from base of each horn).	Length of face, from pole to muzzle.	Length of canon.	Girth of canon.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Junagadh State bull	4' 5"	6' 9"	4' 4"	1' 3"	1' 11"	0' 9"	2' 8"	1' 4"	1' 1"	1' 8½"	0' 6"	0' 9½"
1	Poona Farm cow	4' 5"	6' 2"	4' 2"	1' 5"	1' 9½"	0' 10½"	1' 10"	0' 8½"	1' 0½"	1' 7½"	0' 4½"	0' 7½"
2	Poona Farm cow	4' 8"	6' 5"	4' 8½"	1' 6"	1' 9½"	0' 11"	1' 8"	0' 7¾"	1' 0½"	1' 8½"	0' 5"	0' 8"