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THE

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Editor
GILBERT H. GROSVENOR

Associate Editor
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Contributing Editors

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Arctic Explorer, Major Gen'l U. S. A.

C. HART MERRIAM
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O. H. TITTMANN
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U. S. Geological Survey

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ALEXANDER GRAHAM BELL

DAVID G. FAIRCHILD
In Charge of Agricultural Explorations, Dept. of Agriculture

HUGH M. SMITH
Commissioner, U. S. Bureau of Fisheries

N. H. DARTON

FRANK M. CHAPMAN

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CONTENTS

	Page
Here and There in Northern Africa, by Frank Edward Johnson	1
Battling with the Panama Slides, by William Joseph Showalter	133
The Panama Canal, by Lieut. Col. William L. Sibert, U. S. A., Engineer in Charge of the Atlantic Division	153
The Nation's Undeveloped Resources, by Franklin K. Lane, Secretary of the Interior	183
The Probable Effect of the Panama Canal on the Commercial Geography of the World, by O. P. Austin	245
Village Life in the Holy Land, by John D. Whiting	249
Encouraging Birds Around the Home, by Frederick H. Kennard	315
Redeeming the Tropics, by William Joseph Showalter	344
Scenes in the Byways of Southern Mexico	359
Castles in the Air: Experiences and Journeys in Unknown Bhutan, by John Claude White, C. I. E.	365
The National Geographic Society and Its New Building	455
Mexico and Mexicans, by William Joseph Showalter	472
Birds of Town and Country, by Henry W. Henshaw	495
A Naturalist's Journey Around Vera Cruz and Tampico, by Frank M. Chapman	533
A Mexican Hacienda: Life on One of the Baronial Estates of Our Southern Neighbor, by J. E. Kirkwood	563
The Home of a Forgotten Race: Mysterious Chichen Itza, in Yucatan, Mexico, by Edward H. Thompson	585
Discovery and Invention, by Alexander Graham Bell	649
Our Guardians on the Deep, by William Joseph Showalter	655
Honors to Colonel Goethals	677

INDEX FOR VOL. XXV (JANUARY-JUNE), 1914

(ENTRIES IN CAPITALS REFER TO ARTICLES)

"A"

Page

AFRICA, HERE AND THERE IN NORTHERN 1
Aguascalientes, Mexico,
Washing and bathing in stream at, illus.... 632
Alaska,
Climate of..... 186
Coal, Value of Alaskan..... 193
Enormous undeveloped resources of..... 185
Eskimo girls near Cape Nome, illus..... 198
Map of (*Supplement, February*).
Muir Glacier, The, illus..... 194
Proposed Administrative Board for..... 186
Railroads, Why the Government should build. 191
Self-supporting 189
Surveying under difficulties in, illus..... 672
Algeria,
Dancing girl of Tougourt, illus..... 22
Dancing girls of southern, illus..... 28
Plague of locust in..... 82
Tent town of southern, illus..... 29
Algiers,
Arab door in, illus..... 57
Arab women of, illus..... 54
Moresque beauty, A, illus..... 56
Mosque at Tlemcen, illus..... 77
Windows of the harem, illus..... 55
Ali, the Financier, An adventure with,
Described 31
American Red Cross Relief Corps,
Fighting the plague in China, illus..... 349
Apples,
Growing in the desert, Idaho, illus..... 214
Arab and his flower, An, illus..... 35
Falconers, illus..... 66
Salutations 103
Arch, The flat, at Panama, illus..... 182
Armadillo, Nine-banded,
Common in Mexico, illus..... 558
Arrowrock Dam, Idaho,
Locomotive in mid-air at, illus..... 213
Ashford, Dr. Bailey K.,
Work in Porto Rico..... 355
Austin, O. P.,
The probable effect of the Panama Canal on commercial geography..... 245

"B"

Bandits in Mexico,
Conquering peaceful..... 534
Bassariscus, or long-tailed cat, Mexico, illus..... 559
BATTLING WITH THE PANAMA SLIDES.. 133
Bauche, Chihuahua, Mexico,
Mexican troops at, illus..... 472
Bear,
Polar, and cub swimming, illus..... 201
Skin of an Alaskan, illus..... 200
Bedouin beauty, A young, illus..... 40
Bedouin girls, illus.....8, 80
Belgium,
Scene near the French border, illus..... 232
Bell, Dr. Alexander Graham,
Discovery and invention..... 649
Experiments by..... 649, 650, 651, 652, 653, 654
BHUTAN, CASTLES IN THE AIR, EXPERIENCES AND JOURNEYS IN UNKNOWN... 365
Bhutan,
Angduphodong Jong,
Described 438, 443
Illus. 418
Bridge, First large, after entering, illus..... 366
Bod-La Pass, View in, illus..... 451
Buddhas, A thousand, in..... 383
Buddhist ritual, The..... 383
Courtyard, A typical, in, illus..... 438
Durbar, The
Described 404, 405
Feeding the people after the, illus..... 414
Deb Rajas,
Last of the, illus..... 436

Page

Dug-gye Jong,
Described 370
Interior of, illus..... 373
Views of, illus.... 368, 371, 372, 373, 374, 431
Fortress, An impregnable, in..... 402
Gorges, Magnificent,
Described 445
Gorina Monastery, illus..... 380
Chorten or shrine at, illus..... 382
Goutsa, Frozen waterfall near, illus..... 367
Government headquarters of..... 381
Hah village, illus..... 403
Map of, showing journeys of John Claude White 453
Meal in a camp in..... 450
Paro-Ta-tshang, Monastery of,
Described 375
Hermit's house on road to, illus..... 378
Illus. 376, 379, 384, 385, 386, 387, 388, 430
Interior of the, illus..... 389
Private house of Governor of, illus..... 390
Paro Valley, Farm house in, illus..... 399
Poonakha,
Courtyard at, illus..... 408
Durbar at, illus..... 406, 407
Group taken in author's camp at, illus.. 413
Our reception at, described..... 394
Illus. 404
Prayer wheels driven by water..... 419
Punakha Jong, illus..... 440
Royal family of, illus..... 434
Sangachoiling,
House of Sir Ugyen's sisters at,
Described 423
Illus. 426, 447
Shabdung Rimpoches' house, illus..... 416
Simtoka Jong,
Described 394
Illus. 398
Ta-lo lama and attendants, illus..... 415
Tashi-cho-jong, described..... 381, 383
Views of, illus.... 392, 393, 395, 396, 397, 441
Tchin-Chu Gorge, described..... 377
View up the, illus..... 449
Timbered house, Good example of, illus..... 403
Tongsa Jong,
Described 419
Lama, An old, of, illus..... 448
Lamas and novitiates at, illus..... 424
Views of, illus..... 420, 421, 422, 423, 432, 433, 439, 444
Women at, illus..... 425
Ugyen Wang-Chuk, Sir, King of,
Castle and official residence of, illus.... 432
Councilors of, described and illus..... 412
Described 428
Family of, illus..... 434
Palace of, illus..... 437, 446
Portrait of, illus..... 429
Singing girls of, illus..... 435
Village, A, prettily situated in, illus..... 400
Water for irrigation,
Method of carrying, in, illuus..... 401
Bhutanese,
Fortress, In a, illus..... 381
Officials, Group of, described..... 377, 381
Illus. 411, 391
Orderlies, illus..... 411
BIRDS AROUND THE HOME, ENCOURAGING 315
Birds,
Audubon food-houses, illus..... 327
Barn-swallow on its nest, illus..... 324
Berlepsch bird-box, Flickers using a, illus.... 323
BIRDS OF TOWN AND COUNTRY..... 494
Blackbird, Yellow-headed,
Described 525
Illus. 524
Bold and timid, described..... 541
Bunting, Indigo,
Described 502
Illus. 503

Page

Bunting, Lazuli,
Described ... 502
Illus. ... 503
Bush-Tit,
Described ... 517
Illus. ... 516
Buzzard, Turkey,
Described ... 527
Illus. ... 526
Cardinal,
Described ... 521
Illus. ... 520
Cedar Waxwing,
Described ... 506
Illus. ... 507
Chat, Yellow-breasted,
Described ... 506
Illus. ... 507
Chickadee, Wild, feeding her young, illus.... 342
Chimney Swift,
Described ... 525
Illus. ... 524
Coot,
Described ... 531
Illus. ... 530
Cowbird,
Described ... 525
Illus. ... 524
Duck, mallard, A flock of, as visitors, illus.. 338
Duck, Wild black, on a game preserve, illus.. 338
Duck, Wood,
Described ... 531
Illus... ... 530
Eagle, Bald,
Described ... 527
Illus. ... 526
Egret, Reddish, illus... 544
Enemies of... 343
Evergreens as protection for... 321
Illus. ... 316, 317
Feeding and food-houses for... 331, 327
Illus. ... 329, 334, 335, 336
Finch, House,
Described ... 519
Illus. ... 518
Finch, Purple,
Described ... 519
Illus. ... 518
Flicker, Red-shafted,
Described ... 498
Illus. ... 499
Flickers using a Berlepsch bird-box, illus.... 323
Flycatcher, Black,
Described ... 504
Illus. ... 505
Food-bell, The, illus... 331
Food-plants, Some useful... 327
Goldfinch, American,
Described ... 519
Illus. ... 518
Goldfinch, Arkansas,
Described ... 519
Illus. ... 518
Grackles, Great-tailed,
Near Vera Cruz, Mexico, illus... 540
Grosbeak, Blue,
Described ... 521
Illus. ... 520
Gull, Herring,
Described ... 529
Illus. ... 528
Hawk, Marsh,
Described ... 527
Illus. ... 526
Heron, Black-crowned night,
Described ... 529
Illus. ... 528
Heron, Great blue,
Described ... 529
Illus. ... 528
Houses and shelters for,
Described ... 331, 337, 339, 341
Illus. ... 322, 323, 324, 325, 326
How to attract the... 315
Illus. ... 333, 343
Humming-bird probing an artificial flower, illus. ... 342
Humming-bird, Ruby-throated,
Described ... 512
Illus. ... 513

Page

Humming-bird, Rufous,
Described ... 512
Illus. ... 513
Ibis, White,
And young, described and illus.. 545, 546, 547
Index of... 497
Jay, Blue,
Feeding in weather-cock food-house, illus. ... 326
Jay, Blue,
Feeding on suet, illus... 332
Jay, Blue-fronted,
Described ... 510
Illus. ... 511
Jay, Long-tailed crested,
Described and illus... 561
Junco, Slate-colored,
Described ... 502
Illus. ... 503
Junco visiting an Audubon food-house, illus.. 327
Kingfisher,
Described ... 498
Illus. ... 499
Magpie,
Described ... 510
Illus. ... 511
Man-o'-War bird, with pouch inflated, illus.. 551
Mot Mot, Mexican, described and illus... 561
Nesting-place, Unsuitable for, illus... 320
Oriole, Baltimore,
After a bath, illus... 340
Described ... 508
Illus. ... 509
Oriole, Orchard,
Described ... 508
Illus. ... 509
Orioles, Giant tropical,
Nest of, in Mexico, illus... 560
Osprey,
Described ... 527
Illus. ... 526
Oven-bird,
Described ... 506
Illus. ... 507
Owl, Great horned,
Described ... 531
Illus. ... 530
Owl, Screech,
Favorite nest-box of the, illus... 322
Paradise for, illus... 318, 319, 321, 544
Pelicans,
On Tamiahua Lagoon, Mexico, illus... 543
Pewee, Wood,
Described ... 510
Illus. ... 511
Phœbe,
Described ... 510
Illus. ... 511
Protection given by the Government for... 496
Quail at a food station, illus... 329
Quail, California,
Described ... 510
Illus. ... 520
Redstart, American,
Described ... 500
Illus. ... 501
Road runner,
Described ... 512
Illus. ... 513
Sacrificed to fashion... 544
Sandpiper,
Described ... 531
Illus. ... 530
Services, Valuable, by... 496
Siskins, Pine and red-polls, feeding: New Hampshire ... 329
Sparrow, Lark,
Described ... 504
Illus. ... 505
Sparrow, Red-throated,
Described ... 502
Illus. ... 503
Sparrow, Vesper,
Described ... 521
Illus. ... 520
Sparrows, Song, taking a bath, illus... 339
Spoonbills, illus... 548, 549, 550
Starling,
Described ... 525
Illus. ... 524

Page

Suet will attract, in mid-winter, illus.... 328, 332
Swallow, Cliff,
Described 523
Illus. 522
Swallow, Tree,
Described 523
Illus. 522
Swallows, eave, A colony of, illus..... 341
Tanager, Scarlet,
Described 523
Illus. 522
Tanager, Western,
Described 523
Illus. 522
Tern,
Described 529
Illus. 528
Thrasher, Brown, bathing, illus..... 340
Thrush, Varied,
Described 517
Illus. 516
Thrush, Wood,
Described 517
Illus. 516
Towhee,
Described 508
Illus. 509
Towhee, California brown,
Described 508
Illus. 509
Veery,
Described 517
Illus. 516
Vireo, Red-eyed,
Described 504
Illus. 505
Vireo, Yellow-throated,
Described 504
Illus. 505
Warbler, Audubon's,
Described 500
Illus. 501
Warbler, Black and white,
Described 500
Illus. 501
Warbler, Yellow,
Described 500
Illus. 501
Whippoorwill,
Described 512
Illus. 513
Woodpecker, California,
Described 498
Illus. 499
Woodpecker, Hairy, at dinner, illus..... 330
Woodpecker, Red-headed,
Described 498
Illus. 499
Yellow-throat, Maryland,
Described 506
Illus. 507
Biskra, Algeria,
Great, Prayer at, illus..... 106, 107, 108, 109
Street in, illus.....53
Boiler in Alaska, Hauling a, illus..... 202
Boquilla, Chihuahua, Mexico,
Dam of the Mexican Northern Power Company project at, illus..... 576
Laborers of, illus..... 578, 580
Nurse and doctor's assistant at, illus..... 583
Work of..... 583
Brittany, France,
Scenes in, illus..... 235, 236
Bryan, Hon. William Jennings, Secretary of State, toastmaster at banquet of National Geographic Society 680, 684, 690
Buddhas, A thousand in Bhutan..... 383
Buddhist,
Monastery, At study in a, illus..... 228
Ritual, The..... 383
Burro, or "Mexican canary," The, illus..... 487

"C"

Calcutta, India,
Group taken during the visit of H. R. H. the Prince of Wales, illus..... 452
California,
Indian mother and her babies in, illus..... 218

Page

Camel and locust, Concerning the..... 62
Way to ride a..... 71
Camels, Superb racing, of the desert..... 71
Canary, used in mine rescue work, illus..... 207
Cape Nome, Alaska,
Eskimo girls near, illus..... 198
Caravan on the march, A, illus..... 130
CASTLES IN THE AIR: EXPERIENCES AND JOURNEYS IN UNKNOWN BHUTAN..... 365
Cat was worshipped, Why the..... 345
Cedros, Hacienda de, Mexico,
Described 563
Scenes on, illus..... 564, 565, 567, 570, 571, 572, 574, 575
Street in the village of, illus..... 568
Chagres River, Panama,
On the Upper, illus..... 155
Sport on the, illus..... 156
View on the, illus..... 154
Chapman, Frank M.,
A naturalist's journey around Vera Cruz and Tampico 533
Chenini, Tunis, Oasis of, illus..... 84
Chichen Itza, Yucatan, Mexico,
Astronomical Observatory at,
Described 593, 597
Illus. 600
Described 585
Legend of..... 601
Mayan mural paintings at,
Described 593
Illus. 596, 606
Mayan, Prison at,
Described 593
Illus. 598
Moles of ceremonial court,
Described 590
Illus. 592
Nunnery, The,
Described 597
Illus. 602, 603
Sacred well of, illus..... 591
Tablet of stone at,
Described 601
Illus. 605
Temple, Great Pyramid, of,
Described 585, 587
Illus. 586, 588, 589
Temples, Small, of,
Described 590, 593
Illus. 594, 595
Chihuahua, Mexico,
Cactus in, illus..... 473
Characteristic scene in, illus..... 582
Children of the south, of Tunisia, illus..... 74, 81
Chinese salt works, illus..... 226
Coaling stations, Importance of..... 246
Coal resources, Diagram illustrating..... 205
Colima, Mexico,
Pastoral scene near, illus..... 476
College of interpreters, Ha-noi, China, illus..... 227
Colon, Panama, Breakwater at..... 155
COMMERCIAL GEOGRAPHY OF THE WORLD, THE PROBABLE EFFECT OF THE PANAMA CANAL ON THE..... 245
Co-operation of Federal Government with States.. 210
Cordoba, Mexico, Market at, illus..... 681
Costumes,
Bhutanese, illus..... 427, 444
Hungarian, illus..... 233, 239, 240, 241
Courtyard,
In the harem, Tunis, illus..... 17
Of an Arab house, illus..... 38
Troglodyte, A, illus..... 7
Cucaracha slide, Panama,
Described 141
Steam shovels removing, illus..... 151
Cuernavaca, Mexico, Boys at, illus..... 612
Culebra Cut, Panama, illus..... 134, 135, 140, 142, 143
Slides, and the..... 163
Custom, A terrible, of the Sahara..... 79

"D"

Date culture, described..... 123
Illus. 89, 90, 91
Markets 132
Date-palm, The,
Allah's greatest gift, illus..... 37
Legend of the..... 117

Page

Department of the Interior,
Year's work of the..... 225
Desert, Superb racing camels of the..... 71
Scouting in the, illus..... 126
Diagram illustrating coal resources, illus..... 205
DISCOVERY AND INVENTION..... 649
Dress, Indoor, of a Tunisian maid, illus..... 42

"E"

Education, Modern, in Tunis..... 62
El-Oued, Tunisia,
Market day at, illus..... 116
Oasis near, illus..... 114
Views of, illus..... 112, 113
ENCOURAGING BIRDS AROUND THE HOME..... 315
England,
Scenes in rural, illus..... 229
Some English cave-dwellers, illus..... 230

"F"

Falconers, The, northern Africa, illus..... 34, 66
Fantasia, Arab horsemen ready for a, illus..... 10
Fig tree, Tamesi River, Mexico, illus..... 537
Fish, Flying, Mexico..... 534
Florida, Phosphate mine in, illus..... 208
Food-bell, The, illus..... 331
Food-plants, Some useful..... 327

"G"

Gabes, Africa,
Waterfall in an oasis near, illus..... 97
Gatun Lake, Panama Canal,
Drowning trees in, illus..... 175
Dying jungles in, illus..... 174
Floating islands of, illus..... 163
Gatun Locks, Panama Canal,
Cross-section of side wall compared to six-story building..... 181
Cross-sections showing how the locks are filled and emptied..... 181
Dredging fleet in the middle lock at, illus.... 167
Entrance to upper locks, illus..... 168
First boat through the, illus..... 162
Floating islands obstructing the, illus..... 172
Lock gates, The, illus..... 165
Locomotives of the, illus..... 171
Operating, for the first time, illus..... 164
Suction dredge entering, illus..... 166
Girl, A little Bedouin, illus..... 8, 80
Glacier Creek, Alaska,
Hydraulic mining in..... 190
Goethals, Colonel George W.,
Honored by National Geographic Society..... 677
Response of, to presentation of medal by National Geographic Society..... 683
Gorgas, Colonel,
Work in Panama and Cuba of..... 350
Graveyard in North Africa, illus..... 111
Grosvenor, Gilbert H., Director National Geographic Society, Address by..... 679
Guadalupe, Mexico,
Chapel of the well at, illus..... 610
Scenes at railroad station in, illus..... 611, 612
Stone sails at, illus..... 609
GUARDIANS ON THE DEEP, OUR..... 655
Guaymas, Mexico,
Scene in, illus..... 615
View of, illus..... 614
Guermessa, Africa, The curious Troglodyte town of,
Described..... 3
Illus..... 5
Gunsight Lake, Montana,
From Mount Jackson, illus..... 221

"H"

Halley comet, Effect of the, on Jews and Arabs.. 96
Ha-noi, Tonkin,
College of interpreters at, illus..... 227
Head-dress,
Tehuana Indians wearing famous, illus..... 360
Hemlock and pine, on Mt. Orizaba, Mexico, illus. 555
Henshaw, Henry W.,
Birds of town and country..... 494

Page

HERE AND THERE IN NORTHERN AFRICA 1
Holland, Dutch school-girls in, illus..... 238
HOLY LAND, VILLAGE LIFE IN THE..... 249
Holy Land,
Agricultural pursuits in the,
Described..... 276, 279, 281, 284, 296
Illus..... 272, 282, 283, 292, 311, 312
Bethlehem,
Grotto of the Nativity in, illus..... 304
Street scene in, illus..... 303
Building methods in the, illus..... 250, 252
Costumes,
Of men, illus..... 269, 313
Of women, illus..... 262, 307
David slew Goliath, How,
Described..... 295
Illus..... 280
Elijah, Where the ravens fed, illus..... 278
Family life in the,
Described..... 257, 261, 262
Illus..... 259, 267, 277, 314
Galilee, The Sea of, at sunrise, illus..... 290
Garden of Gethsemane, The, illus..... 302
Guest chamber, The village,
Described..... 253
Illus..... 254
Industries, in the, illus..... 274, 275, 286, 297, 299, 301
Jerusalem,
Scenes in, illus..... 287, 289, 293, 308, 310
Views of, illus..... 266, 268, 294, 298
Jewels of Bible times and today..... 264
Land, The, conserves the old customs..... 251
Marriage customs of the,
Described..... 273, 276
Illus..... 307, 309
Omar, Mosque of, Jerusalem,
Beneath the dome of, illus..... 305
Legend of..... 284
Poor, Care of the, in the..... 291
Roadside scene in the, illus..... 255
Roadway scenes in the, illus.... 260, 289, 300, 306
Shepherds and their flocks, illus.... 280, 282, 283
Types of village people in the, illus.... 265, 285, 288, 297, 299, 313
HOME OF A FORGOTTEN RACE, THE..... 585
HONORS TO COLONEL GOETHALS..... 677
Hookworm disease, The,
Cure, A simple and easy..... 353
Vanquished..... 353
Horsemen, Arab, ready for a fantasia, illus..... 10
Hungary,
Bride and bridegroom of, The, illus..... 241
Family group in, illus..... 240
Shepherd boys on the great plains of, illus... 233
Slovak girls in their best, illus..... 239

"I"

Idaho, United States,
Apple growing in the desert in, illus..... 214
Iguanas, Mexican,
Described..... 545
Illus..... 560
Ixtaccihuatl, Mexico,
Summit of, illus..... 641
View from, illus..... 563
View of, illus..... 640

"J"

Jalapa, Mexico,
Primary school in, A, illus..... 678
Jerico,
Medicine woman of, The, illus..... 265
Road to, illus..... 271
Jew, An Arabian, illus..... 288
Johnson, Frank Edward,
Here and there in northern Africa..... 1
Jusserand, Honorable J. J., the French Ambassador, Address of, at banquet of National Geographic Society..... 688

"K"

Kennard, Frederick H.,
Encouraging birds around the home..... 315
Keokuk, Iowa,
Generators of power plant at, illus..... 211
Power dam, Great, at, illus..... 210

Page
Kirkwood, J. E.,
A Mexican hacienda ... 563

"L"

La Beneficencia, Mexico,
Siesta, Daily, in, illus ... 362
Lake Patzcuaro, Mexico,
Described and illus ... 634
Lake Xochimilco, Mexico,
Boating on, illus ... 638
Lands, Timber ... 207
Arid, of great American desert ... 207
Lane, Franklin K.,
The Nation's undeveloped resources ... 183
Levee, Holding an early morning ... 32
Level, The most perfect, in the world, illus ... 675
Lobos de Afueva Islands, Peru,
Pelicans on, illus ... 514, 515
Locust,
As a food ... 83
Concerning the camel and the ... 62
Nymphs more destructive than the ... 83
Plague of, in Algeria ... 82

"M"

McDermott Lake and Falls, Montana, illus ... 216
Maidens, Tunisian, of high rank, illus ... 14
Malaria in the tropics, Fight against ... 350
Mann, Hon. James R.,
Address by, at banquet of National Geographic Society ... 687
Map-making from photographs,
Described ... 669
Illus. ... 674
Map,
Of Alaska, *supplement, February.*
Of Bhutan ... 453
Of Mexico, *supplement, May.*
Showing network of primary triangulation in the United States ... 664
Marabout, The tomb of a, illus ... 36
Matron, An Arab, of mixed blood, illus ... 15
Medicine, Map-changing ... 344
Meeting, A roadside, North Africa, illus ... 44
Mexico,
Agricultural possibilities of ... 475, 574
American girl in, An, illus ... 579
Ancient civilization of ... 493
Aqueduct of the Remedies, illus ... 626
Span of an, in, illus ... 648
Area of, described ... 473
Beggars of, illus ... 610
Birds of the North in ... 552
Climate of ... 471
Cock-fighting in, illus ... 478, 479
Competing with Panama ... 478
Costumes of, illus ... 611
Flora of ... 477
Food, Curious Indian, in ... 485
Industries of ... 481, 579, 584
Map of, in colors, *supplement, May.*
Mines of ... 481, 577
"Nopal" cactus in, illus ... 474
People of ... 491
Railroads of ... 477
Region, An unexplored, in ... 543
Revolutionist, Typical, in, illus ... 482
Rural guard on duty, in, illus ... 637
Kitchen in, illus ... 635
Scenes in, illus ... 616, 617, 625
Society of ... 489
Street scene in ... 627
Venders of sweetmeats in, illus ... 631
Watch-towers of the Aqueduct of the Remedies, illus ... 626
Wayside inn in, illus ... 613
Wheat thrashing in, illus ... 474
Women of, at work, illus ... 628
Women of the Federal army in, illus ... 483
MEXICO AND MEXICANS ... 471
Mexico City, Mexico,
Calendar stone in National Museum in, illus. 689
Cathedral in, described and illus ... 685
Post-office in, illus ... 486
Scene in market square in,
Described ... 485
Illus. ... 364, 618

Page
MEXICAN HACIENDA, A ... 563
Mexican,
Charro and his hat, illus ... 633
Hat store, A, illus ... 645
Highway, A, illus ... 646
Indian children, illus ... 639
Opossums, Long-tailed, illus ... 559
Peon,
Character of the ... 573
Children of, illus ... 629
Homes of ... 566
Street, Typical, illus ... 644
Wasps, Paper nests of, illus ... 558
Water carrier, illus ... 643
Mill, A primitive, North Africa, illus ... 75
Monument Rock, Arizona, illus ... 220
Moses, Tomb of, illus ... 263
Mosquitos,
Fighting the, in Panama, with oil, illus ... 346
How they spread disease ... 347
In the court of appeal ... 349
Mount Jackson, Montana,
Gunsight Lake, From, illus ... 221
Mount Ranier, Washington,
Ice wall on, illus ... 217

"N"

Naica, Mexico,
Coalcite crystal caves at, illus ... 480
National Geographic Magazine,
Letters from readers of ... 465, 468, 469
Where printed,
Bindery, illus ... 467
Exterior, illus ... 464
Press-room, illus ... 466
NATIONAL GEOGRAPHIC SOCIETY AND ITS NEW BUILDING ... 455
National Geographic Society,
Annual banquet of ... 677
Home of, The new,
Described ... 455, 457, 459, 465
Exterior view of, illus ... 454
General office of, illus ... 456
Index department, illus ... 463
Mail room, Corner of the, illus ... 462
Office of John Oliver La Gorce, Assistant Editor ... 461
Private office of Gilbert H. Grosvenor, Editor ... 460
Honors Colonel Goethals ... 677
Hubbard Memorial Hall,
Described ... 457
Exterior view of, illus ... 454
Interior, illus ... 464
Membership, Tables showing,
Domestic membership by States ... 468
Foreign membership by countries ... 470
In proportion to the population of each State ... 469
Number of towns in United States where Society has members ... 470
Note ... 132
Officers and members, Group of, illus ... 458
Work of the ... 459
NATION'S UNDEVELOPED RESOURCES, THE ... 183
NATURALIST'S JOURNEY AROUND VERA CRUZ AND TAMPICO, A ... 533
Nefta, Tunisia, illus ... 102
Nome, Alaska,
Getting the gold out of the gravel in summer, illus. ... 189
Gold avenue in winter, illus ... 193
Gold in the assay office at, illus ... 187
Gravel piles in winter at, illus ... 188
Hydraulic mining in Glacier Creek, illus ... 190
Normandy, France,
Shrimping in, illus ... 234

"O"

Oak, Mountain, in Mexico, illus ... 554
Oases of northern Africa,
Described ... 103, 109
Source of life of, The,
Described ... 117
Illus. ... 94
Typical scenes in the, illus ... 82, 85, 86, 87, 96, 98

Page
Oasis of Chenini, Tunis, illus. 84
Oil,
Deposits of, should be developed. 199
Need of, for the Navy. 205
Well near Tampico, Mexico, illus. 490
Orizaba, Mount, Mexico,
Ice miners on, illus. 556, 557
Pines and hemlocks on, illus. 555
Views of, illus. 532, 535, 555
Ornithologist's paradise, An, described. 541
Ouled nail, The, or dancing girl of northern Africa,
Dance of the, illus. 27
Dancing in the sand, illus. 30
Illus. 18, 20, 21, 23, 24, 26
In characteristic garb, illus. 43
Jewels of an, illus. 20
Mother of an, illus. 16

"P"

Pachuca, Mexico,
On the road to, illus. 620, 621
Palm, The life of a, illus. 88
Palm wine, Cutting leaves before making, illus. 92
PANAMA CANAL, THE. 153
PANAMA CANAL, PROBABLE EFFECTS OF THE, ON THE COMMERCIAL GEOGRAPHY OF THE WORLD. 245
Panama Canal, The,
Advantages of the route. 247
Chagres River, Views of, illus. 154, 155, 156
Colon, Breakwater at, described. 155
Comparison of French and American canals. 158
Cucaracha slide. 141
Illus. 146, 147, 148, 150, 151
Culebra cut, Views of, illus. 134, 135, 140, 142, 143
Designed, How. 155
Dredge grounded below sea-level,
Described 173
Illus. 179
Dredging fleet, The,
Described 159
Illus. 167
Earthquakes and the. 169
Effect of, on domestic trade. 248
Gamboa Dike, Blowing up the, illus. 176
Gatun Dam, The great. 173
Lake, illus. 163, 174, 175
Locks,
Described 169
Illus. 160, 161, 162, 164, 165
Spillway, illus. 170
Laborers on the. 177
Lock, Filling a, on the, illus. 180
Miraflores Lock,
First boat through the, illus. 178
Naos Island breakwater, Building the, illus. 152
Painting mosquitos on the. 159
Sea-level canal was impossible, Why a. 151
Sphere of influence of the. 246
Visitors to. 177
Panama, The flat arch at, illus. 182
PANAMA SLIDES, BATTLING WITH THE. 133
Parasites, Mexico,
Tree loaded with, illus. 538, 539
Parral, Mexico,
Bells, Old made into cannon, at, illus. 484
Cannon, "El Padre," made from old bells at, illus. 485
Phosphate and potash,
Deposits should be developed. 199
Mine, Open pit, in Florida, illus. 208
Pine and hemlock,
On Mt. Orizaba, Mexico, illus. 555
Plague, The,
In China, illus. 349
Missionaries fighting the, illus. 356
Preventing, in Manila, illus. 354
Source of infection, A, illus. 352
Popocatepetl, Mexico,
Crater of, illus. 630
View of, from Cholula, illus. 686
Power Dam,
Great Mississippi, at Keokuk, illus. 210
Prickly pear, Fence of, in North Africa, illus. 78
PROBABLE EFFECT OF THE PANAMA CANAL ON THE COMMERCIAL GEOGRAPHY OF THE WORLD. 245

"R"

Page
Radiograph of a key, illus. 225
Radium-bearing country, Characteristic, in Colorado,
Described and illus. 222, 223
Radium mine, Colorado, A, illus. 224
Rampart, Alaska,
Turnips weighing 12 pounds at, illus. 204
Reclamation work a success, Government's. 209
REDEEMING THE TROPICS. 344
Reindeer, Alaska, illus. 196, 197
RESOURCES, THE NATION'S UNDEVELOPED. 183
River-bed near an oasis, Sahara, illus. 100

"S"

Sahara, The,
Burial on, illus. 110
Caravans on the march in the, illus. 4
Checking moving sand-dunes in the, illus. 115
Custom, Terrible, of the. 79
Daughter of the, illus. 41
Flower of the, illus. 39
Nakhla, The Pearl of the, illus. 25
Policeman, A native mounted, of the, illus. 5
Prayer, The morning, in the, illus. 9
Scenes in, illus. 118, 119, 120, 121, 122, 124, 125, 126, 127, 128, 130, 131
School in, illus. 121
Salmon,
Cargoes of, arriving from an Alaskan cannery, illus. 184
Pair of large, A, illus. 203
Samaria, Women of, illus. 256
San Bartolito, Mexico,
Children of, illus. 629
San Juan, Teotihuacan, Mexico,
Pyramid of the Sun, The,
Described 636
Illus. 492, 619
Santa Gertrude, Mexico,
Carpet factory at, illus. 682
Santa Rosalia, Chihuahua, Mexico,
Old ranch and fort near, illus. 581
San Vicente Cañon, Lower California, Mexico,
Cacti in, described and illus. 622, 623
Shoshone Dam, Wyoming,
Government reservoir and twin tunnels near, illus. 215
Showalter, William Joseph,
Battling with the Panama slides. 133
Mexico and Mexicans. 471
Our guardians on the deep. 655
Redeeming the tropics. 344
Sibert, Lieut. Colonel William L., U. S. A.,
The Panama Canal. 153
Sicilian peasants, Types of, illus. 242, 243, 244
Slides, Panama,
Cannot be foretold. 137
Cucaracha, the famous. 141
Described 133
Different varieties of. 139
From both banks block canal, illus. 144
Have delayed completion of canal. 137
Railroad destroyed by a, illus. 136
Steam shovel buried by a, illus. 139
Tracks destroyed by a, illus. 138
What causes the. 145
Sousse, Tunisia,
Walls of, illus. 2
Sponge divers, The Greek. 93
Sponge industry, The. 95

"T"

Takin, Rare, or *Budorcas taxicolor, whitei,* illus. 417
Tampico, Mexico,
Oil well near, An, illus. 490
River front of, illus. 536
Tea, How Arabs drink. 106
Tehuana Indian belle, illus. 361
Tehuantepec, Mexico,
Street scene in, illus. 363
Tehuana Indians at, illus. 358, 359, 624
Tetuan, Morocco,
Street in, illus. 52
Thompson, Edward H.,
The home of a forgotten race. 585

Page
Tidal indicator, An automatic, illus. 659
Tide-predicting machine, A, illus. 676
Time, How Arabs measure 113
Tlemcen, Algiers,
Mosque at, illus. 77
Tomb of Moses, Traditional site of the, illus. 263
Tougourt, Algeria,
Dancing girl of, A, illus. 22
Tozeur, Tunisia,
Deserted inn in, illus. 104
Garden in desert near, illus. 105
Tripoli of Barbary,
Beggar of, A, illus. 46
Described 93
Weekly market at 103
TROPICS, REDEEMING THE 344
Troglodyte,
Cave-dwellers 2
Cave-dwelling, Interior 3
Courtyard, A, illus. 7
Town of Guermessa, illus. 6
Troglodytes of Tunisia,
Mountain climbing, The 1
Who emigrate, described 61
Why they live in caves 49
Tunis, Tunisia,
Bazar in, A, illus. 58
Education, Modern, in 62
Grocery store in, illus. 73
Home in, A, illus. 69
Inn, In the, illus. 60
Jewish beauty of, A, illus. 68
Jewish cemetery, The, illus. 67
Market-place in, illus. 72
Moonlight effect in a courtyard in, illus. 70
Mosque, great, Views of, illus. 50, 51
Street costumes in, illus. 76
Street scenes in, illus. 33, 58, 59, 63
Street of the Andalusians, illus. 63
University at the Mosque of the Olive Tree in 61
Water seller in, The, illus. 64
Tunisia, North Africa,
Boy of the extreme south of, illus. 81
Cave-dwellers of the mountains of 1
Cave-dwelling, Interior of a 3
Children of the south of, illus. 74
Girls of extreme southern, illus. 11, 12
Hebrew money-changer of, illus. 47
Laundry maid of, illus. 45
Maidens, Tunisian, of high rank, illus. 14
Mill, A primitive, in, illus. 75
Mountain climbing troglodytes of 1
Street scenes, illus. 33, 58, 59, 63
Sousse, The walls of, illus. 2
Tomb of a marabout in, illus. 36
Tunisian costume, A, illus. 42, 43
Turnips at Rampart, Alaska, illus. 204
"Typhoid Mary," Sad history of 347
Typhoid, Vaccinating for 248

"U"

United States,
Coast and Geodetic Survey,
Level used by, illus. 675
Page
Machine that prophesies, designed by the, illus. 676
Marks used by the, illus. 668
Signal light used by the, illus. 669
Survey party on mountain top, illus. 670
Work of the,
Described 657
Illus. 656, 657, 660, 661, 662, 666, 667
Department of the Interior,
Year's work of the 225
University at the Mosque of the Olive Tree, in Tunis 61
Uruapan, Mexico,
Street scene in, illus. 642
Ugyen Wang-Chuk, Sir, King of Bhutan,
Portrait of, illus. 429

"V"

Vaccination for typhoid 348
VERA CRUZ AND TAMPICO, A NATURALIST'S JOURNEY AROUND 533
Vera Cruz, Mexico,
La Plaza in, illus. 488
Sanitation, Primitive, at, illus. 351
Scene in the tropical forest near, illus. 553
VILLAGE LIFE IN THE HOLY LAND 249
Von Bernstorff, Count, German Ambassador,
Address of, at banquet of National Geographic Society 648

"W"

Wales, A bit of old, illus. 231
Wasp-nests, Paper, Mexico, illus. 558
Waterfall in an oasis near Gabes, North Africa, illus. 97
Water-power plant, Generators of largest, illus. 211
Water rights, Relief for the users of 209
Well, An old, illus. 99
Drawing water from a deep, illus. 101
White, John Claude, C. I. E.,
Castles in the air: Experiences and journeys in unknown Bhutan 365
Whiting, John D.,
Village life in the Holy Land 249
Wilson, Woodrow, President of the United States,
Address of, at banquet of National Geographic Society 680
Wonder, Greatest engineering, of the age 135

"X"

Xochimilco River, Mexico,
Soldiers transported on, illus. 647

"Y"

Yellow Jack, Victory over, in Cuba and Panama 350

"Z"

Zones, Three, in 75 miles, Mexico 536

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HERE AND THERE IN NORTHERN AFRICA

By Frank Edward Johnson

Author of "The Mole Men: An Account of the Troglodytes of Southern Tunisia" (October, 1911), "The Sacred City of the Sands" (December, 1911), and "The Greek Bronzes of Tunisia" (January, 1912), etc., in the National Geographic Magazine.

I

THE MOUNTAIN-CLIMBING TROGLODYTES OF TUNISIA

SIDI HADJ, the Holy Man, or *Marabout,* and his five sons were most hospitable people, and we had gotten to know each other well during my stay at the Cadhi's. There was seldom an evening when the venerable old "pilgrim," with his long, white, flowing beard and his green turban, did not drop in to have dinner with the Cadhi.

Our table could only seat eight, and it was always full; sometimes a sheik from the hinterland of Tripoli or a Touareg chief who had come for provisions. Many had never sat in a chair at a table before or had seen knives, forks, and spoons in use. They would watch the Cadhi and copy him.

With them a great platter of native wheat is brought in with a half or a whole sheep or lamb. The eldest son of the hosts cuts it into long strips; it is then pulled to pieces with the fingers, and each one takes from the huge dish the portion directly in front of him. Any dainty morsel is carefully put in front of the guest of honor. One or two bowls, or loving cups, are filled with water and passed around when one is thirsty.

Arabs eat to live, not live to eat, and, as a rule, they do not indulge in overeating. An ordinary Arab can live on a few handfuls of barley and some dried dates, water, and a cup of coffee. A European would die if forced to live on the same diet.

CAVE-DWELLERS OF THE MOUNTAINS

All the Troglodyte strongholds are wild and difficult of approach; hence lay their security in time of war. Their warriors could see the enemy approaching for many miles, unless they came by night, and then the zigzag path that led up to the great walls was too dangerous, for a stumble meant sudden death on the rocks hundreds of feet below.

Guermessa, the ancestral home of Sidi Hadj and his five sons, is one of the wildest and most difficult Troglodyte towns to reach. It is situated on the top of a sugar-loaf mountain, the sides of which rise precipitously for hundreds of feet (see page 6). The narrow zigzag trail has been worn smooth by centuries of hard use, and the surface of the rock is like polished marble. It is even difficult for the mountain goats, born and bred at Guermessa; therefore, how much more difficult for man and beast!

The inhabitants of Guermessa are a fierce, warlike race, who look with sus-

THE WALLS OF SOUSSE, TUNISIA — Photo by Neurdein

This ancient city was an important town when Carthage was in all its glory and it was spared by the Romans when they destroyed Carthage in 146 B. C. Like all Arab coast towns, it is protected by a wall

picion upon Troglodytes of other districts and with hatred on a stranger. Many were the looks of hatred cast at me by the inhabitants of the rock caves as we wound around the narrow and slippery trail in front of their dwellings.

My companions, Mohammed and Brebisch, were very quiet; this was unknown country to them, and they remembered the stories told in their childhood about their great enemy, the Troglodyte town of Guermessa.

About three months in the year the inhabitants of Guermessa live in their stone caves, dug deep into the sides of the mountain. Nine months of the year they spend as nomads on the borders of the Great Sahara, or in their *gourbis*—tents made of goats' and camels' hair woven together—on the mountain side, where their great herds of long-haired goats, broad-tailed sheep, and young camels can find pasturage.

Down in the valleys are to be found plantations of superb olive and fig trees, and here and there fields of barley. Every drop of rain has filtered down to the valley, and by a system of crude but practical stone walls the fields have been terraced, one below the other, so that all the water has been utilized; not one drop goes to waste.

When the olives and figs begin to ripen, the Troglodytes leave a few trustworthy men in their *ksar*, or fortified storehouse and citadel, fully armed, of course, and the rest move down to the valleys, where they can protect their olive and fig groves, for unless the fields were guarded day and night all the olives and figs would be stolen by Troglodytes of other districts.

Unlike the underground cave-dwellers of Matmata and the Houaia Mountains, the men of Guermessa have separate establishments for themselves, their wives and families.

How many caves were owned in Guermessa by the sons and grandsons of Sidi Hadj is impossible for me to state, but they owned a great number.

THE INTERIOR OF A CAVE-DWELLING

Sidi Hadj's own cave was large, and the rear part of the floor was raised about a foot higher than the front of the cave. Rugs from Kairowan and Persia were laid over the stone floor and numerous Touareg leather cushions stuffed with sheeps' wool were strewn about.

These thick Oriental rugs were intended to sleep on and not to walk upon. The uneven stone floor of a Troglodyte cave is a very uncomfortable place to sleep on, but use a couple of thick Oriental rugs and cover oneself with a *bernous,* or Arab cloak, and you have a most comfortable bed.

On the stone walls of the cave hung a miniature arsenal of flint-lock pistols and long-barreled guns and shotguns. A very large wooden chest, painted green, with Moorish designs in red and gold, stood at the back of the cave, which was about 7 feet high by 14 feet wide and about 24 feet deep.

Two Persian pictures of Mecca decorated the walls, and some ornamental *bernous* for wearing during a fantasia, and the usual *cous-cous* plates and platters brought from Ghadames, usually used for decoration by the Troglodytes. They reminded me of our Indian woven plates and baskets of certain tribes of the Far West and New Mexico. They are so well woven that they hold water or liquid like a dish, and they have simple but decorative patterns worked in color.

Being far away from the wells, none of our animals were watered that evening. Arab horses of southern Tunisia are watered but once every 24 hours, and frequently not for 48 hours. It seemed to me terribly cruel, but the animals are used to it.

About 5 p. m. is the usual time for watering the horses. Strange to say, when watered they do not seem to want to drink more than half as much as horses in America. They like to splash their noses and heads and play with the water.

We had an excellent dinner, prepared by the wives of Sidi Hadj's sons and Ben Saada, our own remarkable cook. About twelve of us ate first, including Mohammed ben Cadhi and Brebisch ben Kaliphe, my devoted friends and companions during my trip.

A CARAVAN ON THE MARCH

Photo by Bougalt

Here we see an Arab family on a journey. How carefully the privacy of the women is secured, even under the difficulties of travel, is shown by the fully draped palanquin for their use on the camel in the center of the picture

Sidi Hadji as host was most picturesque, and he entertained us with wonderful stories of his pilgrimage to Mecca and what he had seen and heard. He described the Kaaba, "The Holy of Holies," that curious rectangular building that contains the great uncut ruby that has turned black on account of the sins of the world and is now known as the Black Stone. He told us that Mecca was a sacred city centuries before Mohammed was born, and the Kaaba was already a great shrine. This is the reason:

HOW MECCA BECAME A HOLY PLACE

When Abraham led Hagar and her infant son, Ishmael, into the desert and abandoned them to die of hunger and thirst, Ishmael cried for water, and Hagar put him down in the sand and started off in search of water.

The desert lay between two ranges of sand-dunes, or mountains, and Hagar in her anguish crossed this valley seven times, but found no water. Almost exhausted, she dragged herself back to the small child.

Imagine her surprise and joy to see him creeping toward a pool of water that had miraculously sprung up since she had laid him on the sand! The pool was deep, and, fearing the child would fall in and be drowned, she cried out in Arabic: *Zem! Zem!* which, inter-

A NATIVE MOUNTED POLICEMAN OF THE SAHARA

This man belongs to the mounted police force, called the *oudjac,* which is commanded partly by French and partly by native officers. This force patrols the country, and one is as safe in Algeria and Tunisia as in any occidental land. Note the curious straw hat, with its brim some four feet in diameter.

THE CURIOUS TROGLODYTE TOWN OF GUERMESSA

The inhabitants of this strange town, which is composed of three separate villages, are a fierce, warlike people, as are all the mountain-climbing Troglodytes, or cave-dwellers, of southern Tunisia. Note the odd-shaped houses

preted, means "Stay where you are! Stay where you are!" or "Stop!" And the pool, or well, is known to this day as *Zem-Zem*. Around this spot was built the famous shrine of Mecca, toward which 220 million Mohammedans turn their faces and bow in prayer five times a day at the shrill sound of the muezzin's call to prayer:

"La il-ah-il-ah Allah.
Mohammed ar - ra - sou - la Allah!
Allah is Allah! There is no God but Allah.
Mohammed is the Prophet of God."

As these words rang out that evening at Guermessa my host, his sons, our escort, and the guests left the caves and walked a few steps to where an unbroken view could be had on all sides, and, turning toward Mecca, they knelt and bowed together, touching their foreheads to the ground several times (compare pages 9 and 106, 107, and 108).

None of the Troglodytes ever used a prayer rug; possibly they did in the mosques, but at prayer times I never intruded on their devotions, but out on the mountain sides and on the plains and the Sahara no prayer rug was ever used.

THE DESERT AT EVENING

The impression of that evening will remain with me as long as memory lasts. Range after range of purple-colored tableland mountains that we had ridden over day by

Photo by Soler

TROGLODYTE COURTYARD, OR PATIO OF THE SHEIK OF MATMATA, SHOWING ENTRANCES INTO VARIOUS CAVES

The holes vary in depth and width, but average nine meters deep by fifteen meters in circumference. This great hole is used as a "patio," or courtyard. Numerous caves dug in the sides of the hole serve as living-rooms and storehouses. One enters these dwellings by means of a passage tunneled through the earth or rock. Some of the ceilings are roughly ornamented with Arabic designs cut in bas-relief in the rock and the dates when the dwellings were dug. None of them seem to go back more than 100 years (see text, page 49; see also the remarkable series of illustrations of these cave towns in the October, 1911, number of the NATIONAL GEOGRAPHIC MAGAZINE).

A LITTLE BEDOUIN GIRL

The girls of this race of desert wanderers are quite attractive, but, owing to the hard life they lead, they soon become old and wrinkled. The women do practically all the labor of the camp—fetching wood, drawing water, pitching and striking the tents, milking the goats and camels, and preparing the food.

Photo by Bougault

THE MORNING PRAYER

The pious Moslem, far out in the desert, with his face turned to the East, in the direction of Mecca, performs the first of those five acts of devotion which punctuate the day of an orthodox son of the Prophet (see also pages 106-109).

HORSEMEN READY FOR A FANTASIA

Photo by Lehnert and Landrock

The Arabs greatly delight in these fantasias, which consist of some of the most remarkable feats of horsemanship. The participants dash forward at full speed, twirling their guns about their bodies and over their heads, shouting and firing their guns into the air, when suddenly, at a given signal, the whole line will bring their horses to so abrupt a stop that any but the most accomplished horseman would be immediately unseated.

day, hour after hour, loomed up in the distance.

In the foreground the figures of Sidi Hadj, his sons, and the Troglodytes silhouetted against a sunset sky of green and gold; beneath us to the south and west stretched a reddish golden mass of sand—the Great Sahara in all its fascinating mystery.

Almost 2,000 feet below us wound and wriggled what looked like an earthworm—a belated caravan of camels heading toward some *gourbis* (Bedouin tents) whose camp-fire dotted the distant landscape. Everything was still and no one spoke; all felt the spell of that glorious sunset. Even the horses, mules, donkeys, camels, and those vicious, yapping Kabyle dogs seemed quiet.

Twilight lasts about three minutes; then comes utter darkness, when the Troglodytes barricade their gates and doors and unloose their numerous dogs. The day's work was finished and we had had a hard day's ride. Those thick Persian rugs seemed very tempting.

What mattered it if 18 others slept in the same cave. But I could not let them close and lock the great cave door. A Troglodyte cave has air-tight walls, roof, and floor cut out of solid rock. Sidi Hadj begged and pleaded, saying that we would all be murdered; but I remained firm, and the door remained open.

Undressing is quite simple for an Arab. He takes off some of his garments, unfastens his belt, puts his slippers near him, also his gun or pistol, and rolls himself in his *bernous*. They sleep very heavily, and it is difficult to awaken them.

About 2 a. m. I was awakened by a queer noise that I thought was made by thieves. I grabbed my Browning and waited. All the men in the cave slept soundly. A moonbeam fell through the open door, and I saw a large Kabyle dog creeping into our cave. I threw one of my heavy boots at him and he rushed out howling; but, in spite of the noise, no one stirred. Twenty minutes later back he came; this time my other boot caught him on the head, and he made a fearful noise, but every one slept on.

A TRAGEDY WITH A HAPPY ENDING

Early in the morning, as I was examining Guermessa and taking some photographs of the caves, we heard screams,

WILL HE COME?

One of the great attractions of these daughters of the desert is the exquisite grace of their carriage and the unconsciously beautiful poses they adopt when at rest.

Photo by Lehnert and Landrock

A YOUNG GIRL OF EXTREME SOUTHERN TUNISIA

She wears two kinds of ear-rings, with great hoops of solid silver, and a chain of loops dangles down almost as far as her chin, and a charm attached—the hands of Fatima. These hands of Fatima are supposed to bring extraordinary luck. No Arab child or woman is ever without them. Fastening her garment is a curious pin, the kind used all over northern Africa. On her arms are silver open-work bracelets, and dangling from the pin is a silver chain with hands of Fatima and other charms. In countries where poverty is so great that it is impossible to wear these ornaments of silver they are made of a white metal and always greatly decorated.

Photo by Frechon

The fate of the *ouled naïl,* or dancing girl, of Biskra is often that described by the prophet Jeremiah: "Though thou clothest thyself with crimson, though thou deckest thee with ornaments of gold, though thou rentest thy face with painting, in vain shalt thou make thyself fair; thy lovers will despise thee" (Jeremiah 3:30).

and on turning saw an old woman pitch headlong into the abyss below. She had come out to throw rubbish down the precipice and had lost her balance and toppled over.

She hit the boulders and rebounded like a rubber ball, and brought up at last almost out of sight in the valley below. We all thought she was dead, for a fall of about 900 feet surely meant death, and it seemed as if every bone in her body must have been broken.

Her relatives and family went down to pick up her remains, and two hours later she was brought up, more dead than alive. I expressed my regret to the sheik of the village, and he said she was only a woman and an old one at that, and that her time had come.

This accident darkened my day's enjoyment, and for several days it was a very vivid and unpleasant memory. Imagine my relief on hearing later that she had entirely recovered, and that not a single bone was broken.

From the Troglodyte caves of Guermessa to the valley below, where the springs of drinking water are situated, is a drop of about 1,800 feet. The path is over 3 miles long and zigzags all the way up.

CAVE-DWELLERS THAT LIVE BY THEMSELVES

From Gabes to Dehibat, and from Matmata over the Tripoli border, one finds, scattered here and there, small groups of cave-dwellers living in caves in the mountain side, sometimes only one family.

Photo by Frank Edward Johnson

TUNISIAN MAIDENS OF HIGH RANK

The girl to the right is Mabrucka, the daughter of my host at Foumtatahouine, Mohammed-Es-Seghir, Cadhi of Djebel-El-Abiodth; the other her chum. A photograph of a girl of this class is very rare, as it is usually only those who have no social position to lose who will consent to pose for a picture. In this case, the young ladies being very sure of their place in society, made an exception in honor of my visit.

Photo by Lehnert and Landrock

AN ARAB MATRON OF MIXED BLOOD

As can be seen by her eyebrows, which meet, she is married. Owing to the conglomeration of tribes in Tunisia and Tripolitania, it is very hard to distinguish between the various races

Photo by Lehnert and Landrock

THE MOTHER OF AN OULED NAIL

The women of this tribe, even the older married women, do not, as a rule, wear the veil so universal among other Moslem peoples; instead, the head is bound up in a turban, over which is drawn a sort of white mantle.

Photo by Frechon

IN THE HAREM COURTYARD: TUNIS

Photo by Lehnert and Landrock

FINE FEATHERS MAKE FINE BIRDS

Nowhere is this proverb more true than in the case of the *ouled naïls,* for they enhance their somewhat scanty natural charms by carefully adorning themselves to the utmost. They affect the gayest of colors and a profusion of jewels; they mix their hair with wool and plaster it with grease, forming great braids, which they loop down over their ears, framing their faces, as it were, in ebony.

They build, with great care, water-tight cisterns, for wells and springs are not at all frequent in this country, and rain water is greatly valued for drinking purposes. In some parts there is actually not enough spare water even to brush one's teeth, and I do not believe the animals ever get sufficient to drink.

This condition has naturally led to the introduction of a breed of animals that can live fairly well on very little water.

Last May Brebisch and Mohammed took me to a Troglodyte town perched on the top of a table-land, and here in the bowels of the earth I saw a huge mosque, with great Gothic-like arches carved out of massive rock. Besides having caves in the rocks, they had skyscrapers made of *rhofas* (artificial caves of hardened mud) superposed one upon another to a height of from 8 to 12 stories.

Wild-looking Troglodytes, fully armed, were guarding this stronghold when we rode up, but as the Cadhi was known and greatly loved by my companions, we received a warm welcome.

I was stupidly induced to climb to the top of the *rhofas* to see the remarkable panorama. It seems to me that at last the missing link has been found, for certainly no beings ever climbed as agilely, except monkeys, as did these Troglodytes.

The climbing up was far more simple than the coming down. I longed to be a member of that curious brotherhood of the *Aissaiouas* that jump from great heights without hurting themselves. The little stone steps put in here and there had been worn by centuries of use until they sloped downward and projected only about three or four inches, so one could hardly get a foothold. Undressing as much as I could, throwing my shoes and clothes to the ground, and praying to Allah to guard me in the perilous moments, I descended as best I could, slowly and painfully, but finally in safety.

There is wild excitement in going over an unknown country and not being sure whether one can bring up at the right place before dark. Heat, thirst, and danger are forgotten in the glorious landscape, with its iridescent colors.

Mohammed and Brebisch were most picturesque, with their great straw hats, about four feet in diameter (see photo, page 5), decorated with embroidered gazelle leather, creamy white silken *bernouses* waving in the wind, and the gaily colored trappings of the Arab saddle and bridle, with solid silver mountings and massive silver stirrups. Mohammed was mounted on a dark-gray Arabian stallion, and Brebisch rode a pure white horse, about five years old and full of spirit.

Each boy carried shotguns and pistols. They did not care where they went and would never take a dare. It was useless to caution them. They would reply that Allah would take care of them, and he certainly did. Brebisch was always humming a weird tune in a minor key, and good-natured, no matter what happened.

In this part of the country messages are sent by runners, very thin, strong, wiry men, without an ounce of fat, who think nothing of a 30-mile run before breakfast.

We usually paused on our journey before the sun became too hot, and ate lunch in the cool of a Troglodyte cave. The lunch always consisted of *cous-cous* (native wheat prepared so that it looks like fine grains of rice), with vegetables when they were to be had—there were never any here—and steamed with a lamb or an entire sheep, cooked whole.

One of my favorite dishes was *chuck-chucks*, made of fried eggs, cooked with oil, and dried red peppers. The bread was always excellent—made of barley or millet. There were always quantities of dried dates at a meal.

THE DANCE OF THE HAIR

One evening Brebisch came in, all excitement, and said that we were to attend a betrothal ceremony about 9 o'clock.

Walking down by the light of the full moon, we were guided directly to the place by the shrill sounds of the native bagpipes and tom-toms (a species of drum), that were making a fearful din.

In the courtyard of a large *fonduk* (or inn) were gathered together a motley array of Arabs, Sudanese, Berbers, Touaregs, and weird creatures, dressed in the skins of small animals, with frightful, grinning masks, and bones and skulls dangling here and there. They were the dancers from Timbuktu, and were mak-

THE JEWELS OF AN OULED NAIL

Here we see one in all her glory. She has necklaces of gold coins, cunningly wrought amulets of gold and silver, innumerable bracelets of fine workmanship, and last, but not least, the wide golden crown of intricate design, embellished with turquoises and coral.

DREAMING OF THE FUTURE

A dancing girl dreaming of the day when she will have accumulated enough in coins and jewels to return to the tents of her tribe as a heavily dowered bride. Most travelers remark upon the passionate fondness of the *ouled naïl* for adornment, but with shrewd business instinct the girls regard their gems both as an attraction for their present profession and a provision for the future.

Photo by Lehnert and Landrock

A DANCING GIRL OF TOUGOURT, ALGERIA

These *ouled naïl* girls are very dark in complexion, their eyebrows are generally penciled until they meet, and small signs are made on the face by tattooing, as can be seen on the forehead of the girl in the picture. They heighten their charms by a liberal application of grease paint and rouge.

Photo by Bougault

IN HER ARMOR OF COINS

These necklaces of coins are usually composed of French 20-franc pieces and English sovereigns, as it is the fashion among the patrons of the *ouled naïls,* when particularly pleased with a dance, to toss them gold pieces, which are immediately added to the collection around their necks.

AT REST AFTER THE DANCE

This *ouled naïl,* with her robe of vivid crimson embroidered in gold, her soft silk veil of the palest blue silk, the wide gold girdle with its innumerable chains and pendants, the necklaces of coins, the bracelets of silver and gold, and the crown-like head-dress, is the personification of the gorgeous East.

NAKHLA, THE PEARL OF THE SAHARA

This is a famous beauty of the *ouled naïl* tribe, Nakhla by name, whose charms are more in accordance with Western taste than those of most reputed beauties of this people. Though belonging to a class regarded as outside respectable society, these girls never depart from what is perfectly proper in the matter of dress, and in the dance they are as fully clothed as in the street.

AN INTERVAL OF REST AND REFRESHMENT Photo by Lehnert and Landrock

When not engaged in the dance, the *ouled naïl's* greatest delight is to lounge in the sun—an object of interest and admiration from her bright clothes and her wealth of jewels. These periods of relaxation are invariably enlivened by the cigarette, to which every class of Moorish society is addicted.

THE DANCE OF THE OULED NAILS

The dancing of these girls consists of a series of posturings to music quite different to the usual Western idea of a dance. The women take their places to the sound of tom-toms and *derboukas* or pipes, then slowly and langorously they move the body from the waist up, gradually working up to a variety of turnings, twistings, and undulations, all accomplished without moving the feet.

DANCING GIRLS OF SOUTHERN ALGERIA

Photo by Lehnert and Landrock

In northern Africa the dance does not have the religious significance which invariably accompanies it in India. The dance of the *ouled naïl* is almost as foreign to occidental ideas as is that of the Nautch girl of Benares, and less attractive

A TENT TOWN OF SOUTHERN ALGERIA

In southern Algeria there are a number of temporary towns in the desert whose inhabitants dwell wholely in tents. These towns are in existence for about nine months each year, and are inhabited chiefly by Bedouins. In the picture we see such a town, with the groups of tents scattered about on the desert sands. In the foreground some of the inhabitants are watching the dance of two *ouled naïls*.

DANCING IN THE SAND

Europeans come into contact with the famous dancing girls of the *Ouled Naïl* tribe of desert Arabs chiefly at the city of Biskra, in Algeria, where two whole streets are inhabited by women of this class. They resort thither to earn dowries which will enable them to return to the desert and marry men of their own tribe.

ing so much noise that it was impossible even to think.

As we entered a semi-nude figure sprang out at us, howling, jumping, and making contortions; his only garment seemed to be a short skirt, that gave him the ludicrous appearance of a ballet dancer. The men in skins surrounded us, and amidst a deafening noise we were escorted to our seats of honor. Dusky forms had been busy making a great bonfire.

Then began a curious dance, that reminded me in a way of our North American Indian dancers and medicine men. The master of ceremonies went around in turn to each guest, and the bagpipes screeched and the tom-toms beat. Every guest gave coppers or a piece of silver to our host, and this devilish-looking man would spring high into the air, hitting his heels together several times, and spin like a tetotum. He improvised original songs, praising his various guests and their liberality. Judging from the eager expression of the spectators, the words of these songs must have been witty.

At last the noise of the bagpipes ceased, to be taken up by flageolets in a minor key. A row of young women and girls, with long hair falling down their back, had crept in, unnoticed in the dark, and taken up their position between us and the bonfire, so that they stood out like black silhouettes against the flame; all were unveiled. Slowly and gracefully they began to sway and twist their lithe bodies in rhythm to the weird music. Most of the time they danced on their knees, bending and twisting, their hair sometimes standing out almost straight, then falling about their heads.

It was the far-famed "Dance of the Hair," that few foreigners have ever seen. Toward the end of the dance the bonfire of esparto grass was allowed to grow dim, and the women vanished into the night, for clouds had obscured the moon.

I was curious to see the *fiancé* and kept asking Brebisch to point him out to me. About the time the "Dance of the Hair" began a dear little boy, not quite four years old (a son of the devil-man), had come over and snuggled close up to me. He was so tired that he fell asleep, but when the bonfire died down he awakened and scampered over to the women, and vanished with them. This small boy was the future bridegroom, and his two-and-a-half-year old *fiancée,* called Machla, which means "The Palm Tree," lived many miles away and could not be present at the "Dance of the Hair" on their betrothal.

OUR ADVENTURE WITH ALI, THE FINANCIER

On our arrival toward dusk at Foumtatahouine, when my luggage had been taken out of the two-wheeled cart and placed in the house the Cadhi had put at my disposal, I told Ali to go to the *fonduk* (Arab inn) and curry the mule, give it plenty to eat and water it four hours later. He was to spend all his time looking after that mule, for which I felt a great responsibility. The Caid of Medenine had lent it to me, no other animal being available, and it was his pet mule. In certain parts of the Orient a fine mule is preferred to a horse, and costs much more. It lives longer and can pull almost three times as much.

Ali was a worker, Ali was a hustler, Ali was a financier, and he loved animals and took splendid care of his master's mule. After 48 hours' rest, I told Ali to return to Medenine with the cart and mule.

On my arrival at Foumtatahouine I had told Ali, "You see to the mule and I will pay for its stabling and food. I do not wish the Cadhi to pay one centime."

Ali smiled and showed his white teeth and said, *"Oui, Monsieur,"* in his broken Arab-French.

The Cadhi said, "Now, Ali, Monsieur is my guest and I want to pay for the fodder of his mule."

Ali answered, "So be it, Sheik Cadhi."

When Ali arrived in due time at Medenine, he had carried a *Maribout* and his son from Foumtatahouine to Bir-El-Ahmar (the Red Well), and received three francs for that and a free lunch.

On his arrival home he said to his master, "O noble Caid, I took the stranger,

as thou didst command me, safely to Foumtatahouine. I cared for thy mule, watered and fed it with care. I remained three times one day at the inn and paid 22 piasters for barley and bran. Sheik Cadhi fed me; therefore, O Caid, thou owest me 22 piasters."

Three times 22 is 66; putting the price of the barley and bran at 12 piasters, Ali made almost 600 per cent, for all three thou owest me 22 piasters."

When Mohammed-Es-Seghir, Cadhi of Djebel-El-Abiodth, heard that I had paid and that he had paid, he thought it a huge joke; and, when a week later, we heard that the Caid had also paid, he laughed until the tears rolled down his cheeks.

Many weeks later, when calling on the Caid of Medenine to thank him for his kindness in lending me the mule, and to ask him if it came back in good condition, I asked him, "Why do you keep a servant that cheats all three of us?"

He smiled and said, "Ali is fond of horses and mules and gives them the very best of care; if an animal goes lame, he will walk for days rather than hurt it, and he always gives the animals enough to eat. I know that he often buys barley for less than he charges me, but then my stables are well cared for."

HOLDING AN EARLY MORNING LEVÉE

When I awoke in the morning I was obliged to open the shutters, that I had to keep closed on account of thieves; then the servants, Ben Saada among them, that slept in front of the various doors of my house would hear me and go and call the Cadhi and Mohammed.

In a minute or two they would come in and salute me. Then Kaliphe and Brebisch would next appear, followed by any Troglodyte sheiks that were in the village. These men would sit in solemn array while I would finish my toilet and dress.

When they arrived, in the midst of a sponge bath, it was, to say the least, a bit disconcerting, but the chief interest to them was to watch me shaving and brushing my teeth. Mohammed told me that he had tooth-brushes, but had never seen tooth powder or paste, and, moreover, he never used his brushes. (His teeth, by the way, were superb.)

After my bath, helping hands were not lacking to aid me on with my clothes.

Sometimes my rooms were so crowded that those that could not enter had to look in through the open windows.

Since Mabrucka told me that she and all the women of the harem had come in one day with her elder brother when I was sound asleep after a hard day's ride, I have never been quite certain if there were not peep-holes from some of the harem rooms, and that the fair dames of the various households had not watched me dressing! Who knows!

Every morning after shaving, when I turned to put my hand on my military hair-brushes, they would be missing, and Brebisch and Mohammed would be busy, fez in hand, brushing their caps. Mohammed would say, "*Cher ami,* these brushes are wonderful for smoothing a fez."

My nail-file and scissors were also much appreciated. Every time that Mohammed would cut his finger nails he would spread a towel, napkin, or newspaper to catch all the cuttings. It seems that the hair and nails of fingers and toes belong to the Evil One, and, unless the cuttings are burned or buried in the ground (sand), it gives possession of the living body to the Devil.

Even numbers bring good fortune; odd numbers very bad luck. Five is an exception and a very lucky number. The sudden change in the gait of a horse may lead to the most important decisions.

When the Cadhi started out on his long ride to Tripoli with the other members of the French Commission, he saw seven black crows and he was terribly downcast, but a moment later another crow flew up and joined the seven, making eight all told, and the Cadhi was all smiles and hope.

One must never say, "Tomorrow we will do so and so," or go to such a place; one must first say, "An-cha-Allah," which means "if God wills."

One night after twilight, when squatted in front of our Troglodyte caves, some mighty hunters of the Great Tents (Sahara) told me the following fable:

IN A TUNISIAN STREET

Nowhere in the world does the "Arabian Nights" come home to the traveller so vividly as in North Africa. Here is the changeless East, the same today as it was a thousand years ago, with all its wealth of color, its sunshine and its picturesqueness.

THE FALCONER

In Northern Africa the falcon is still used in the pursuit of game. The bird must always be let slip with the words, "In the name of Allah, the great Allah," otherwise the game seized is not lawful food, as this formula must be pronounced over all animals killed for the table.

AN ARAB AND HIS FLOWER

About the end of June each day at sunset, every Arab, rich or poor, buys a small bunch of jasmine from the itinerant vendors who cry their wares in the streets. The flower is then fastened in the turban over the ear, as shown in the picture.

THE TOMB OF A MARABOUT

In Northern Africa the term *Marabout* has a very wide meaning. It is applied to every man who in any way devotes himself to religion, from dignified and influential scholars of holy life—justly esteemed as saints—to wandering mendicants who subsist on alms or by the sale of spells, charms or other objects of pious superstition.

ALLAH'S GREATEST GIFT—THE DATE PALM

In Northern Africa the date palm is the Queen of Trees, and not for its beauty alone. Its shade is a protection from the heat, its leaves give mats, its fibre ropes, its juice a drink and its fruit is one of the most satisfying and nourishing foods in the world.

IN THE COURTYARD OF AN ARAB HOUSE

Here are some children working in the courtyard of a house in Tunis. The beautifully carved columns are worthy of a museum, as are the antique Moorish tiles always found in the houses of the wealthy classes.

A FLOWER OF THE SAHARA

It is not their beauty alone which makes the Arab girls so attractive to the eye, for their charms are enhanced by the picturesque costumes they wear. These striped garments are of most wonderful colors—pale yellow, green, orange or purple—and often embellished with equally vivid embroidery.

A YOUNG BEDOUIN BEAUTY

In tropical lands children mature very rapidly. The attractive girl in the picture, though only eleven years old, is as much a woman as a child of the North would be at twice her age.

A DAUGHTER OF THE DESERT

The women of the Nomad tribes who wander in the south of Tunisia are singularly beautiful. The characteristic tatooing on the chin and cheeks is not considered to detract from but rather to add to a maiden's charms.

THE INDOOR DRESS OF A TUNISIAN MAID

The clothing worn by the sexes is the exact opposite of that which prevails among western nations, for it is the women who wear trousers while the men wear skirts. Though somber when abroad, the Arab woman is resplendent with color at home, for the richest of silks and the most gorgeous embroidery are none too good for the privacy of the women's apartments.

TWO OULED NAÏLS IN CHARACTERISTIC GARB

The Ouled Naïls are a tribe of desert-Arabs living in Algeria, whose girls resort to the cities to earn money by dancing. As they appear unveiled and bedecked in jewels, they are outside the pale of respectable women. The goldpieces which form their headdress make up their dowry when they return to their tribe to get married.

A ROADSIDE MEETING

Here is a characteristic scene such as can be found in almost any oasis in North Africa. The donkey is ubiquitous as a beast of burden, and, as the traveller in these regions knows, North Africa could be properly called a land of boys.

A LAUNDRY MAID OF TUNISIA

A native woman in the Oasis near Gabes ready to return home after having done her washing at the stream. Her dress is caught together by curious safety-pins of a primitive type which have been in use from time immemorial. Note the heavy silver anklets and large earrings.

A BEGGAR OF TRIPOLI

Beggars are numerous in all Moslem countries, and alms are given freely, as the Koran enjoins. There are ways, however, of lawfully avoiding a donation. "In the name of Allah give alms," wails the beggar. "May Allah satisfy all thy wants," says the wealthy man piously—but he passes on.

THE MONEY CHANGER

There is a considerable Hebrew colony in Tunis which is very active in commerce. Though for the most part they have adopted the costume of their Arab neighbors, there are certain little differences in dress by which the members of this race can be distinguished.

THE OASIS

The canal shown here irrigates the oasis and makes it fertile. It takes but a little irrigation to transform a barren stretch of sand into a garden as verdant as the Garden of Eden.

"A lion of the Sahara, the king of beasts, said to himself, 'An-cha-Allah, tomorrow night I will kill a buffalo with a stroke of my paw and carry it to my cubs. The next day, 'God willing,' I will slay a horse and carry it back. The third day I will kill a calf, 'God willing;' then I will kill a sheep;" but, despising so small a creature as a sheep, the lion omitted to say "An-cha-Allah," and when he killed the sheep, to punish him, God made him drag it on the ground.

And the king of beasts does so even today, so say those hunters of the Great Sahara, and there is no reason to doubt their word.

WHY THE TROGLODYTES LIVE IN CAVES

Many letters have been written me since the publication of my article on "The Molemen" in the NATIONAL GEOGRAPHIC MAGAZINE of October, 1911, inquiring why the Troglodytes live in caves and do not build houses, asking details of their life and habits, and laying stress on birth, death, and burial.

One man wrote: "If they have no wood or stones to build houses with, why do they not use bricks?" How can they make bricks without mud, or mud without water, and of what use are bricks without cement?

Were we Americans to be suddenly placed in a country like theirs, without wood or water, and so far away from the world that importation of these commodities was impossible, we would have to follow the example of the Troglodytes or die of exposure. On these mountain table-lands climatic changes are great, and some sort of dwelling is needed.

The Troglodytes of extreme southern Tunisia speak Berber-Arabic and have adopted the Mohammedan religion.

At an unknown period the ancestors of these Troglodytes of today were all mountain Troglodytes, living on the tops of high table-lands overlooking the surrounding country, usually on sugar-loaf peaks with precipitous sides, so that an enemy could be killed by stones being rolled down upon them.

Driven out of their mountain abodes by the scarcity of food and water, the inhabitants of some of these villages came down to the plains, where they have lived ever since. But, having been accustomed to their cave-dwellings, they preferred them to any other kind, so they built artificial caves, such as we see in Medenine, Metmetemur, and other towns farther south. These caves not only serve as homes, but also for the purpose of huge storehouses for their food, guns, *gourbis* (tents made of camels' and goats' hair), harnesses, extra ammunition, plows, and other agricultural implements.

A SEMI-NOMADIC PEOPLE

These people are pastoral, and most of the tribes are nomadic during nine months of the year. Their towns are built in ovals, or small horseshoes, only one entrance for each tribe, so that a few brave men, armed to the teeth, can easily protect their strongholds from thieves. One might say that these Troglodyte towns were the safe-deposit vaults of the cave-dwellers (see the illustrations in the NATIONAL GEOGRAPHIC MAGAZINE, October, 1911).

Each man has his individual key, which he never forgets to take with him wherever he goes, for if he did, on returning, he would find his cave empty. These keys look something like a banjo handle made of wood. Each key has plugs that fit in it, and no two designs are alike; so that, unless the plugs fit the holes, it would be impossible to unlock the front door.

On the return of a wanderer, he takes his key from one of his saddle-bags and screws or fastens it into a stick that he leaves behind. He then inserts it through a hole to the right of the door and thrusts in his arm, turning the stick at right angles, and scratches the door with the key until he finds the lock. The plugs of the key finally catch into the holes of the lock and, on pulling, the door opens.

TROGLODYTES THAT BURROW LIKE THE MOLES

The tribes of the Houaia Mountains, comprising the villages of Matmata, Benioussa, Benizelten, and Hadidiji,

THE MINARET OF THE GREAT MOSQUE: TUNIS

The Mosque of the Olive Tree, founded in 698, is the chief mosque of the city. One of its most attractive features is the handsome minaret of interlaced brickwork shown in the picture. Attached to the mosque is a Moslem university, where about 1,000 youths receive instruction in the Koran and other branches of orthodox learning (see pages 61-62).

Photo by Lehnert and Landrock

ENTRANCE OF THE MOSQUE OF THE OLIVE TREE: TUNIS

This mosque is reputed to be very beautiful, but no European is allowed to enter it or even to inspect the university which is connected with it. Set in a deep niche on one side of the door can be seen the large sign, on which is written in English, French, German, and Italian the warning, "This mosque is reserved for Moslem worship. Entrance forbidden."

A STREET AT TETUAN

Northern Africa, notwithstanding political divisions, is very similar everywhere. Here is a picture taken in Tetuan, a city of Morocco, nearly a thousand miles distant from Tunis, yet its architecture, its pavements, its veiled women, and hooded men are the same in almost every detail as those found in Tunis.

IN A BISKRA STREET

Biskra is a town in Algeria, situated in an oasis of the Sahara, some three miles long by about one mile broad. The houses in the native quarter are built of hardened mud, with doors and roofs of palm wood. There is also a fine modern town, which is a favorite winter resort for French and other European visitors.

Photo by Lehnert and Landrock

ARAB WOMEN OF ALGIERS

Here is a picture taken at the entrance of a cemetery to which Moslem women resort once a week, usually on Fridays, the Moslem Sabbath. On the day of the weekly visit the cemeteries are by no means gloomy places; all men are excluded, and the ladies, laying aside their veils, indulge in impromptu picnics, with much laughter and gossip.

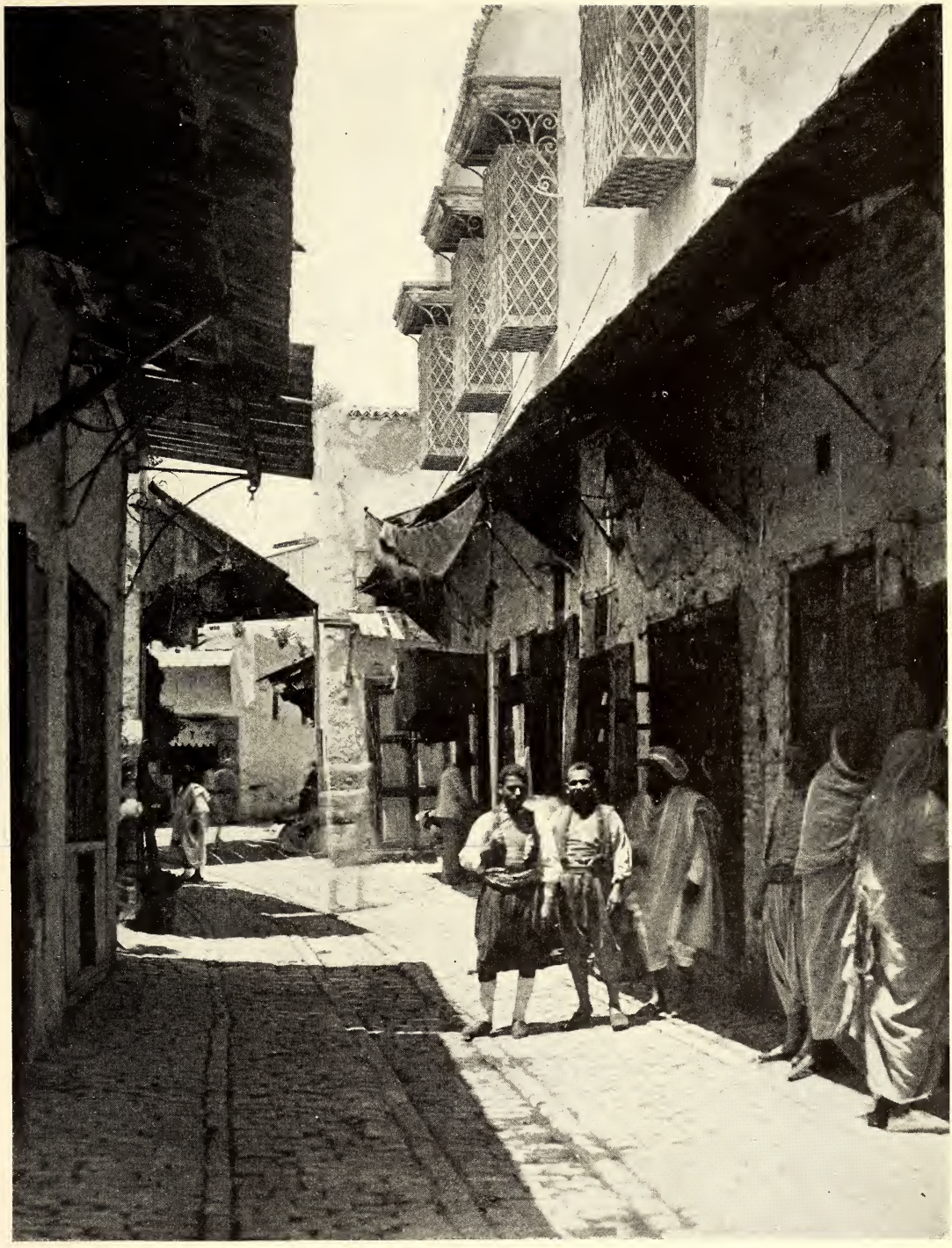


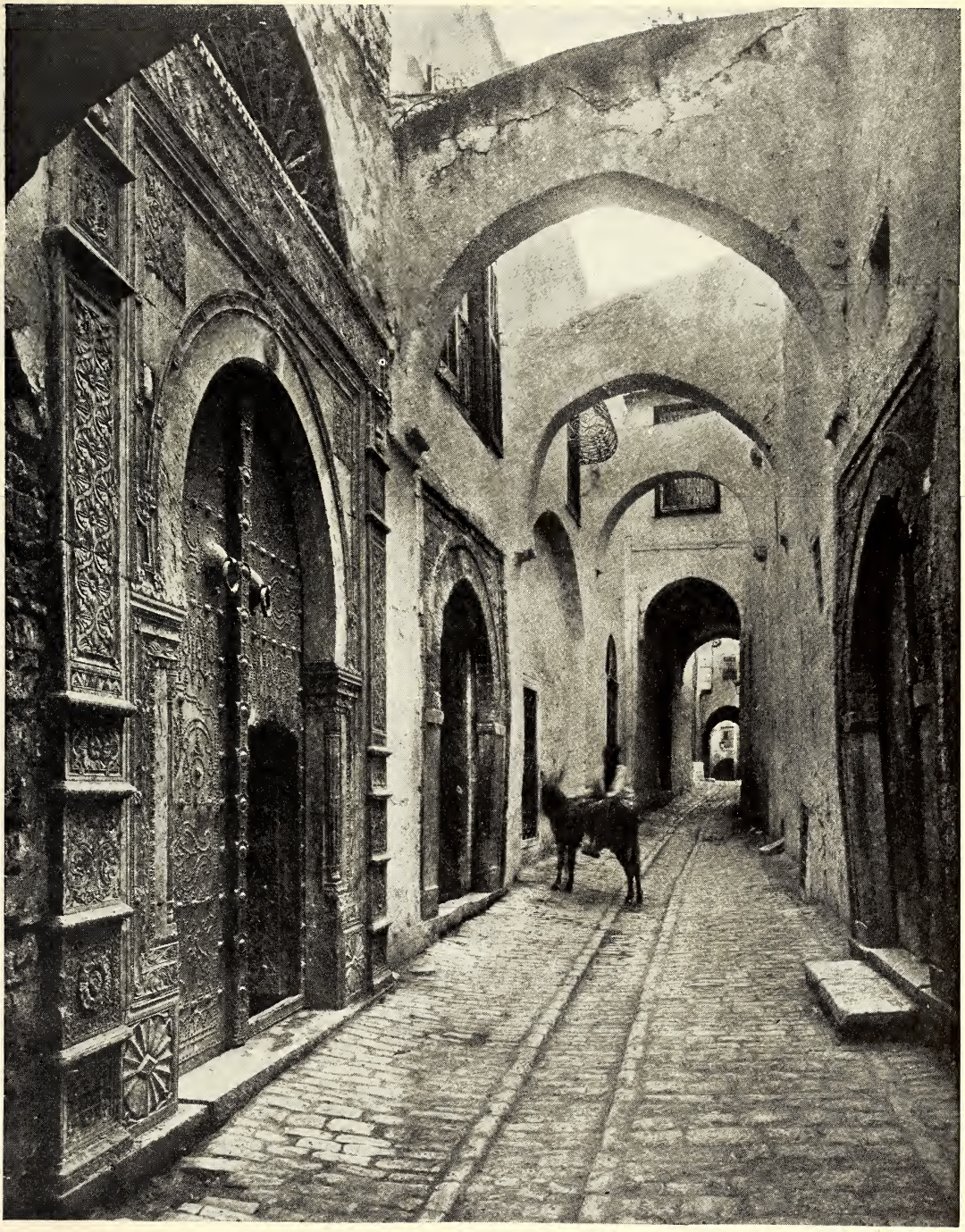
Photo by Lehnert and Landrock

THE WINDOWS OF THE HAREM

The windows so heavily latticed and barred show how jealously the Moslem guards the privacy and seclusion of his women folk. This seclusion is accepted by the women as a visible sign of their husbands' love and they would strongly resent any evidence of carelessness on his part in this respect.

A MORESQUE BEAUTY

The term Moresque is applied to those Moslems of mixed blood who are found chiefly in the cities on the North African coast. In their veins flows the blood of Roman, Berber, Arab, Spanish, and often other Christian ancestors, and many of their women are strikingly handsome.



AN ARAB DOOR

The Arabs have always expended much artistic care upon the doors of their homes. Wherever the Arab civilization has dominated, as far to the west as Tangier, to the east as Bagdad, and to Zanzibar in the south, these beautifully carved brass-studded portals can be found at the entrance to the houses of the wealthy.

Photo by Lehnert and Landrock

A BAZAR IN TUNIS

The bazars, or *souks,* of Tunis are narrow, winding streets, some of them vaulted and many covered in with a roof of boards. There are five chief bazars; el-Attarin, the market of perfumery; el-Farashin, of carpets and cloths; el-Serajin, of saddlery, and el-Birka, of jewelry. The Souk-el-Birka was formerly the slave market.

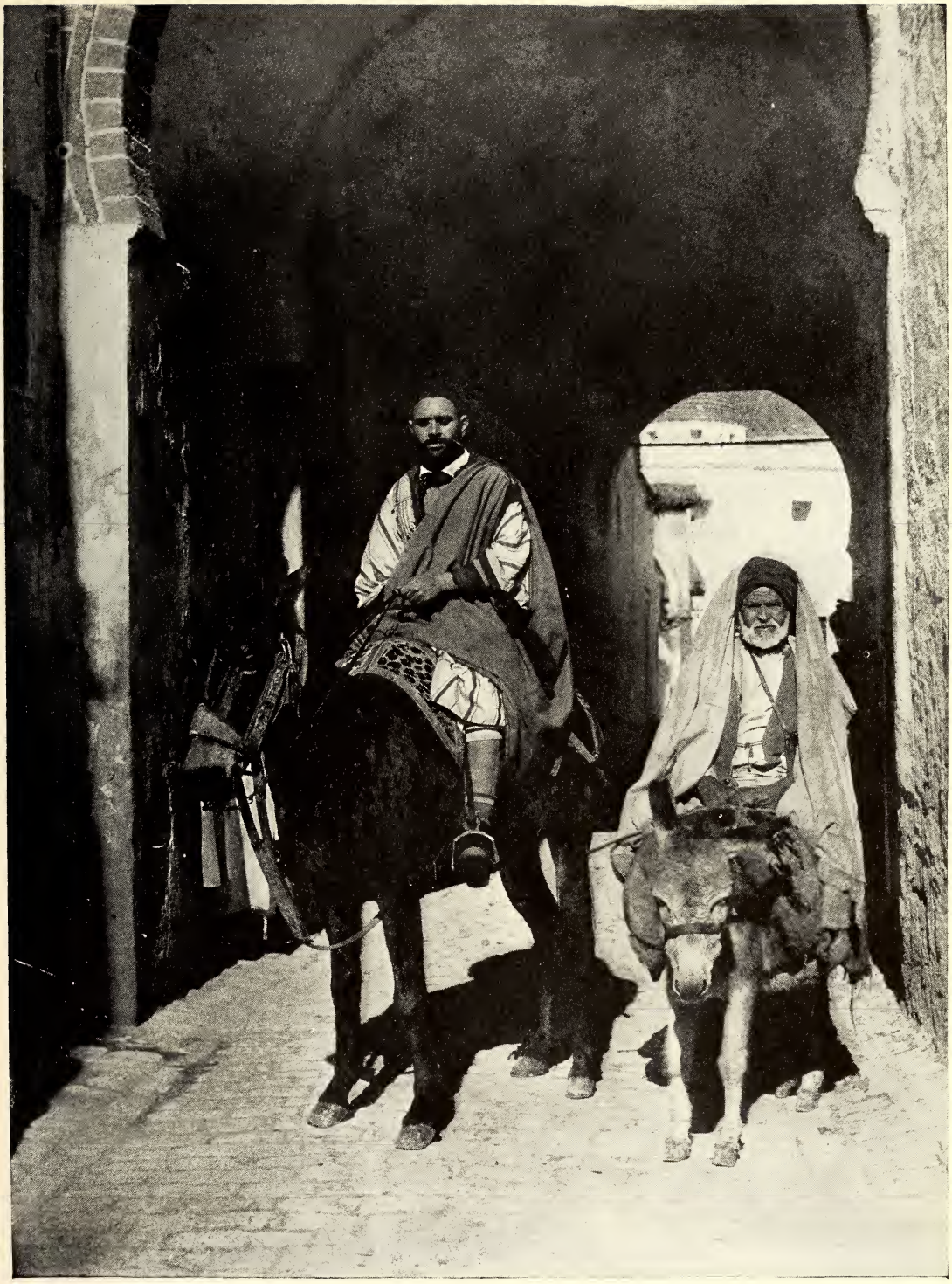


Photo by Lehnert and Landrock

THE RITUAL OF GREETING

"No matter the state of one's birth, or power, or dignity, he that is on horseback should greet the man on foot. . . . A man on horseback should speak first to the man he meets riding a mule. A man on a mule should greet first a poor man riding a donkey. . . . These rules of etiquette are most scrupulously kept" (see text, page 103).

Photo by Lehnert and Landrock

IN THE INN

Here are two Arabs from the South resting in their room in the *fonduk,* or inn. The man on the left is holding his rosary or prayer beads. These rosaries are very much in evidence among the Arabs and are—among the wealthier classes—usually made of amber.

tired of living on the high table-lands, where climbing up and down was difficult, decided, about a hundred years ago, to come down and live in the valleys.

But wood was lacking and water scarce and it was therefore impossible to build houses, so instead they dug enormous circular holes in the earth. These holes averaged about 27 feet in depth by about 195 feet in circumference. One enters these great courtyards, which are open to the sky, by means of underground tunnels cut out of rock, which is quite soft and can be dug through with a spade, but it hardens on coming into contact with the air (see page 7).

These subterranean caves are so dry that grain will keep indefinitely when stored in them. The dwellings are cool in summer and warm in winter, and out of the way of sand when the sirocco blows.

The people in these underground dwellings live like the patriarchs of old. The head of the family is lord of all he surveys, and lives with his sons and his son's sons, their wives and their children. Frequently almost 100 people live in a single dwelling, each family having their individual cave to themselves.

TROGLODYTES WHO EMIGRATE

The men of Matmata have more energy than most Arabs. Often two or three adventurous youths receive permission from their fathers (for without that permission they could do nothing) and start on foot or on donkeys for Tunis.

The journey is long. Kairouan, Sacred City of the Sands,* is usually visited en route; also the tombs of several celebrated *Marabouts*. Arriving penniless and unknown in Tunis, these young Troglodytes earn money by carrying trunks, running errands, or going to market and carrying vegetables and provisions for housekeepers.

When they have earned enough money to buy two or three copper pots and what looks like a large flower-pot, they hire a small shop, hardly as large as a closet, with an open front facing on the street. Here, about 4 o'clock in the morning, they begin frying cakes in their copper pots, which taste something like apple fritters. These they sell for five centimes, or one cent. The day laborers, going to work, are their patrons.

About 7 o'clock the morning's work is over, and they close the shutters, clean up, and go to sleep. About half past three in the afternoon the shop is again opened. The embers in the flower-pot, which is in reality a stove, are blown by small bellows until they glow, and more fritters are fried. The demand seems greater than the supply.

In about four years' time these young men can lay aside enough money to buy some broadtail sheep, and goats, and several camels, and return to their native Troglodyte town, where they take to themselves a Troglodyte maid and establish a small but happy home of their own.

* See the Sacred City of the Sands, NATIONAL GEOGRAPHIC MAGAZINE, December, 1911.

II

THE UNIVERSITY AT THE MOSQUE OF THE OLIVE TREE IN TUNIS

Few people outside of Tunisia know of the Mohammedan University, where about 1,000 students annually study various branches of history, religion, ethics, and sciences.

Several years ago the students went on strike because the professors came late to their lectures, and some did not turn up at all.

Some of the Arab professors were not particularly interested in the instruction they gave. The students desired a larger curriculum that would include chemistry, physics, physical geography, and several of the modern branches as taught in the smaller American colleges.

The strike was a passive one and lasted about two months. A few of the students were arrested, but almost immediately released. A deputation of students called upon the Bey and the Resident of Tunis and begged them to look into the matter.

The Tunisian government answered that from henceforth the professors would be forced to attend their lecture courses punctually, and that if sufficient funds could be raised some of the modern

courses would be adopted by the University of the Olive Tree

The university headquarters are in the interior of the Grand Mosque of the Olive Tree, so that no foreigner can ever catch a glimpse of it, owing to the mosque belonging to the Malachite rite, where only persons going to pray are allowed to enter (see page 51). Even the *Sheik ŭl Islam* (a Moslem ecclesiastic occupying in northern Africa a position corresponding to that of the Pope in the Roman Catholic Church) could not grant me permission to enter, although he was most desirous of my seeing the mosque, university, and its various branches. It was suggested by some of my Arab friends that I slip in dressed as an Arab, but this seemed to me a very improper proceeding and I refused to do so.

A Mohammedan society has been formed for the betterment of all classes. This society is known as the *Khaldoŭnia.* Wealthy Arab gentlemen volunteer their services as instructors, each one teaching his particular subject. The *Khaldoŭnia* has met with tremendous popularity. They have comfortable reading-rooms, an auditorium, and a small but excellent library. The members meet frequently and discuss all sorts of questions.

MODERN EDUCATION IN TUNIS

During the past ten years a school for Arab girls has been founded and has met with great success. The head of it is a French woman, who thoroughly understands Mohammedan ways.

No effort is made to proselytize or influence them in any way, the desire is simply to make these young girls intelligent and useful members of the community, so that when they marry they may have attractive homes and be intelligent companions to their husbands. They are taught plain, common-sense sewing, hygiene, common-sense cooking, how to set a table properly, to read and write; also arithmetic and bookkeeping.

The school is very largely attended by the daughters of the aristocrats and wealthy families. The Arabs are taking much interest in the school, and its headquarters have had to be changed several times since it was started, so all its scholars could be housed.

The French have made public instruction compulsory throughout Tunisia, and even in the far-away Troglodyte villages small schools are to be found, which as a rule are attended only by the boys, but some of the broad-minded and intelligent Arabs are sending their daughters. These public schools have both Arab and French instructors, who teach history, geography, reading, writing, and arithmetic.

The Arab teacher instructs the natives in the Koran and in reading and writing Arabic. The Koran is not only a religious book, but it contains excellent advice on daily life that is quite practical. When an Arab boy has learned to read the Koran, he is an excellent Arab scholar.

The result of these public schools is that the younger generation can speak, read, and write excellent French, whereas most of the older men do not understand a word.

The French government has allowed the natives absolute independence of thought and religion. In the far-off Troglodyte towns, where no mosques existed, some have been built by the government. This has been a very wise move, because it has endeared the French to the hearts of the Tunisians.

Justice is administered to the natives according to the ancient laws of the country. A foreigner, be he French, Italian, or English, is judged by a French court, just as if he were in France.

The Oriental mind cannot quite grasp the French (Roman) laws, and this native and French dual tribunal is most effective in dealing with justice. The law is swift, just, and severe. Evil-doers are always caught and punished, so that from the lowest to the highest there is strict law and order.

Tunisia has a French and Arab police and mounted police, called *oŭdjac,* that patrol the country (see page 5).

III

CONCERNING THE CAMEL AND THE LOCUST

There are almost as many varieties of camels as horses. The Arab name for camel is *djemel.* Those of Tunisia, Tripolitania, and Algeria have one hump

Photo by Lehnert and Landrock

THE STREET OF THE ANDALUSIANS: TUNIS

This is a typical quiet street in the older part of the city of Tunis—narrow, tortuous, and in places vaulted over, while under foot are the age-resisting but uncomfortable cobblestones

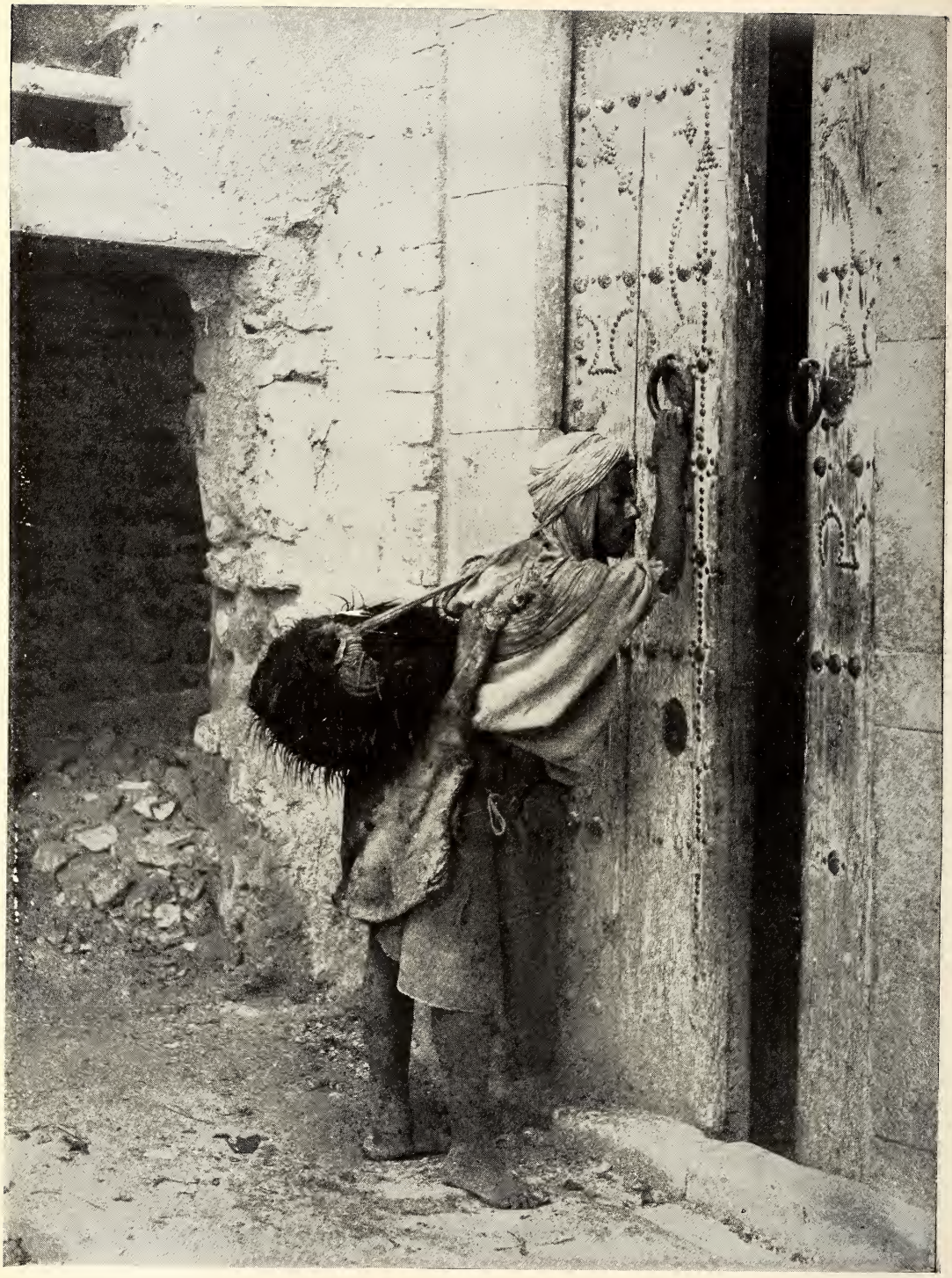


Photo by Lehnert and Landrock

THE WATER SELLER

Here is a picture of an itinerant water seller taken in the streets of Tripoli of Barbary. The water is carried today in a skin just as it has been from time immemorial

and are really dromedaries. Certain breeds of camels can withstand the great heat of the Sahara Desert and others that of the zero weather of Tibet and China.

The ordinary camels of northern Africa (dromedaries) cost from 150 to 300 francs (30 to 60 dollars) apiece, and they live on almost anything that they can find to eat by the roadside; hence it costs next to nothing for their native Arab owners to keep them. Should a European own camels and attempt to feed them with hay and grain, he would find that they ate a great deal, and that it would cost at least a dollar a day for each one.

During the Italian war in Tripoli the usual price for hiring a camel and its driver to take food supplies from Ben Garden to the Turkish camp was from 3 to 3½ francs a day (60 to 70 cents). Between Kairouan and Sbeitla are many miles of bad land, where almost nothing thrives save the prickly pear. This has been cultivated by the natives, is rented out in great tracts, and has become a source of comfortable income.

It is amazing to see the rapidity with which a herd of 500 camels will eat to the ground a large pasturage of prickly pear from 8 to 10 feet high. Leaves, stems, prickles and all, disappear like magic.

HOW THE CAMEL'S HUMP GETS FAT

Throughout southern Tunisia and Algeria the natives keep all their date stones and give them to exhausted camels, weary from their long Sahara march.

The camel resists at first, and the date stones, moistened in a little water, are pushed forcibly, by the handful, down the camel's throat, after it has been made to kneel, and then securely fastened. In two or three days the camel learns to eat them of its own accord. The natives say that these date stones make the hump of the camel strong and stiff.

The camel in its long march across the Sahara frequently finds very little to eat and lives on the fat of its own hump. When this continues during a long time, the hump of the camel becomes flabby and almost disappears. The African broad-tailed sheep lives in the same way on the fat of its own tail.

The flesh of a camel is eaten by the natives throughout the Sahara and northern Africa. The greatest delicacy is the hump, which contains a great deal of fat. One can always tell the condition of the animal by observing its hump. When a camel is weary, after a long march across the Sahara, its hump almost disappears, whereas when it starts out on a journey the hump is well defined.

Camels of Tunisia, Algeria, and Tripolitania are used almost entirely as beasts of burden, although in Tunisia one occasionally sees them drawing two-wheeled carts, or plowing. The usual weight of the burdens carried by a camel varies from 550 to 600 pounds; this is the average for the camels going from town to town along the coast or the borders of the Sahara.

Should they be planning to cross the Sahara, the weight of the burden would be less, as the strain of the month's journey through the desert is tremendous. The usual march when crossing the desert is 30 kilometers a day (about 20 miles), with an occasional day's rest.

When a camel is being ladened it keeps up a continual snarling, and should it be overburdened it refuses to arise.

Most camels are vicious and their bite is very dangerous. Hardly a week passes at the large native hospital in Tunis but some unfortunate camel driver dies of blood poisoning caused by a camel's bite.

The grinding motion of a camel's jaw crushes to pulp whatever it bites; so that the arm or leg has to be amputated, and blood poisoning usually sets in before the patient can reach the hospital.

The ordinary camel would have difficulty in crossing the desert unless it were born and bred in it, and it would be folly for a man setting out on such a journey to select camels that were unused to the desert. The probabilities are that his caravan would never reach its journey's end.

Great care must be taken in selecting beasts of burden for a caravan trip across the Sahara, and camels must be secured at towns in the desert, where Sahara camels, accustomed to the great wastes of sand, are obtainable. Those

ARAB FALCONERS

Throughout northern Africa hunting with falcons is a favorite sport with the native Arab population The female of the peregrine falcon is the best bird for purposes of the chase, representing the highest and most courageous type of all the birds of prey (see also page 34)

THE JEWISH CEMETERY: TUNIS

Photo by Lehnert and Landrock

Tunis has a very ancient Jewish colony, numbering some 50,000 souls, many of whom are descended from families which settled at Carthage before the destruction of Jerusalem by Titus in A. D. 70. Though both sexes wear a special costume, that of the men is with difficulty distinguishable from that of their Moslem neighbors; but the high sugar-loaf cap and all-enveloping cloak render the Jewish woman at once apparent.

A JEWISH BEAUTY OF TUNIS Photo by Lehnert and Landrock

Throughout northern Africa beauty and fat are thought to be the same and nowhere is this more true than in the Jewish colony in Tunis. This gaudy costume, the satin breeches, the pink silk jacket covered with embroidery in silk and gold thread, the tall sugar-loaf cap, and the curious slippers ending under the instep, while still common, is slowly but surely giving place to the ordinary Paris fashions.

A HOME IN TUNIS

Photo by Lehnert and Landrock

This courtyard, in an Arab home in Tunis, is a remarkably fine specimen of Moorish architecture. The capitals and columns are of marble, antique Moorish tiles ornament the walls, while the arches are of hand-carved stucco-work of Arab design. On the second floor a balcony runs round all four sides of the court, and the women's apartments open on to it.

A MOONLIGHT EFFECT IN THE COURTYARD

Photo by Lehnert and Landrock

The courtyard of this Moorish house by moonlight brings home to us the charm and mystery of the East. The delicate pillars of the court, the rich tile-work of the walls, the sleeping figures, and the moonlight make up a picture such as Haroun-al-Raschid must have seen when seeking the adventures recounted in the "Arabian Nights."

bred near the coast have become more or less accustomed to drinking at frequent intervals and require water every two or three days. Those of the Sahara can go much longer without water and do not suffer in the least. A camel can abstain from drinking for six to ten days during the winter, spring, and autumn. In the hot summer months of July, August, September, and October, five days' abstinence seem to be the limit without inflicting unnecessary suffering upon the animal.

SUPERB RACING CAMELS OF THE DESERT

In the interior of northern Africa is a superb race of camels known as the *mehara* (singular, *mehari*), or racing camels. The *mehara* owe a great deal to the care taken in their breeding during the past 2,000 years. Ancient writers speak of camels used by the army of Xerxes, more than 2,000 years ago, that had the speed of the fastest horses; these were doubtless *mehara*.

When a baby *mehari* is born it is swathed in bandages to prevent the stomach from getting too large, and is taken into the family tent, where it is nursed and watched over with care and tenderness. When a year old, it is sheared, and is known from then on as a *bou-keutaa*, which means "the father of the shearing." Arabs are very fond of nicknames and everything and everybody is given one.

For the first year it is allowed to wander at will and follow its mother. The *bou-keutaa* is weaned by a pointed stick being run through one nostril and left in the wound. When the young camel tries to suckle its mother the stick pricks her and she kicks the baby camel away. It soon leaves the mother and learns to eat fresh green shrubs. In the spring it is sheared again and the name of *heug* replaces that of *bou-keutaa*.

When it is two years old its training begins. A halter is placed around the head and a cord tied to one of the fore feet. It is kept quiet first by gestures and the voice; later by the voice alone. Then the cord is loosened, but should it make a step it is tied again. Finally it understands what is required, but the lessons are only terminated when it will stand in one place without moving for an entire day.

To make a *heug* kneel, the rider cries out, "Ch-ch-ch," and a person standing near strikes it with a stick on the knees at the same time the rider speaks to it. The camel soon learns to kneel without being struck. To make it a fast runner, the rider whips it on both flanks alternately with a rhinoceros-hide whip and cries out in Arabic to excite it. A young *mehari* is very fond of its own skin, and on being struck starts on a gallop. The whipping keeps up and the camel tries to get away by running faster. The long legs seem like wings, and it flies past with the speed of an ostrich. It will stop instantly at a pull on the rein, no matter what speed it has been making.

When the rider jumps off, or should he happen to fall, a well-trained *mehari* will stand quite still and wait, while should the master happen to be injured the faithful beast will never leave him.

When a *heug* can turn in a narrow circle around a spear and start off at full speed the instant it is pulled up, the period of training is considered finished. The camel is no longer a *heug;* it has become a *mehari* and is ready for the races or the war-path.

THE WAY TO RIDE A RACING CAMEL

A *mehari* is never used as a beast of burden; all it ever carries is a saddle (something like a Mexican saddle, made of gazelle skin, dyed red, with a high pommel and a cross in front), two saddlebags, and a rider

The rider is buckled into the saddle by two belts. His feet are crossed in front of the saddle and rest on the neck of the *mehari*. His slippers are usually slung across the pommel, and the *mehari* is guided by the wriggling of the rider's toes.

An iron ring passes through one nostril of the animal and a rein of camels' hair is attached. Should the *mehari* nibble from the bushes on the wayside, the slightest jerk of the rein will bring it up, and a pull to the right or left will make it take the direction wished, although the voice and the toes are the usual guides.

IN THE MARKET-PLACE

The market of a North African town is always the place of greatest interest to the traveler: the brilliance of the semi-tropical sun, the quaint houses, the heavily turbaned Moors in their snowy *bernouses,* the blind beggars, the public writers, and an occasional marabout, clad, like John the Baptist, in camel's hair, are objects of never-ceasing interest to the Western eye.

GROCERY STORES IN TUNIS

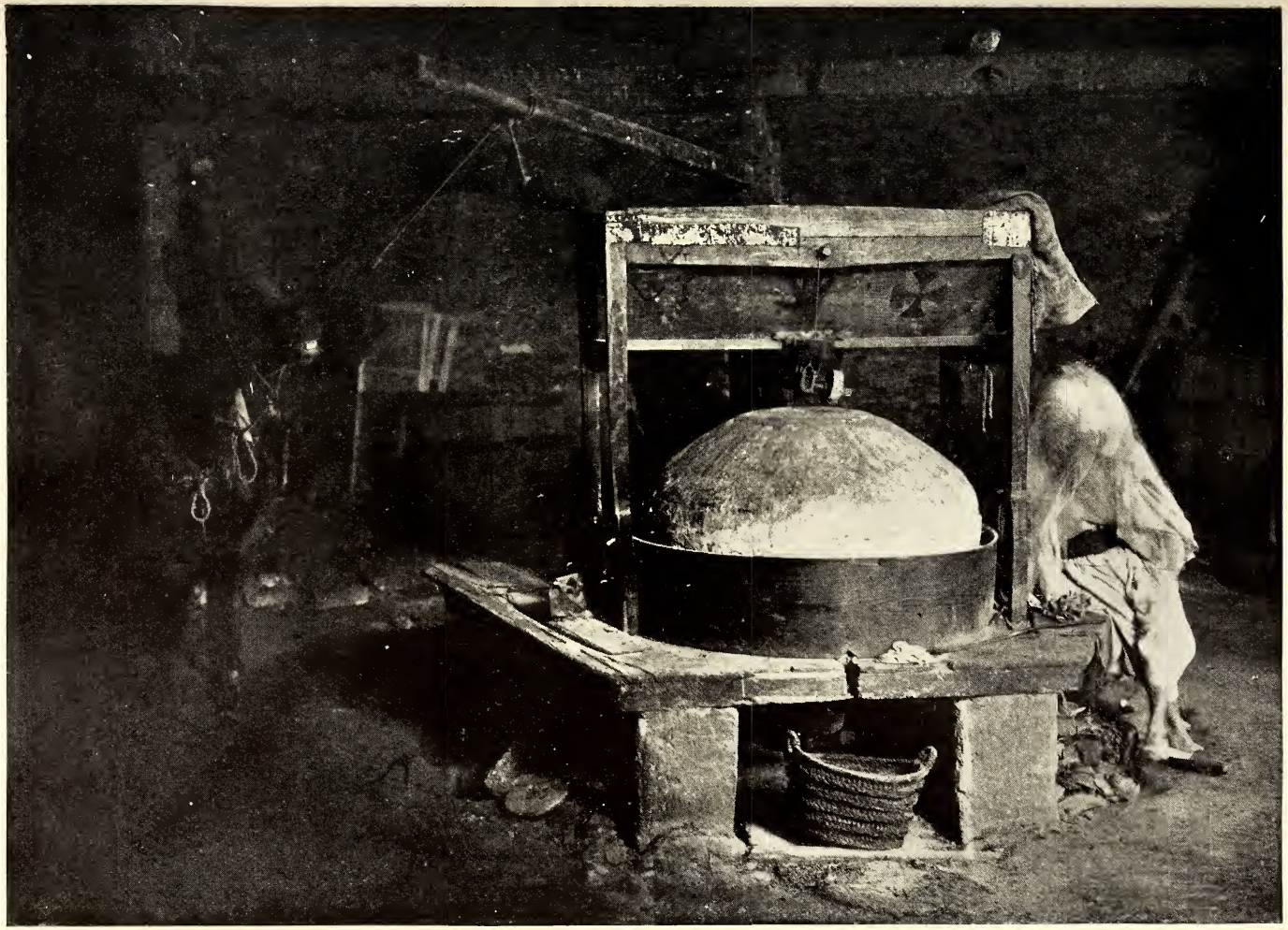
Photo by Garrigues

In Tunis those who trade in the same wares keep their shops all together in a single street; thus one street is entirely devoted to grocery stores, another to perfume sellers, and so on. Notice the Arab lady with her heavy black veil

Photo by Lehnert and Landrock

CHILDREN OF THE SOUTH

These children—half Arab, half negro—are descendants of negro slaves from the west coast of Africa. "The French have made public instruction compulsory throughout Tunisia, and even in the far-away Troglodyte villages small schools are to be found, which as a rule are attended only by boys, but some of the broad-minded and intelligent Arabs are sending their daughters. . . . The result of these public schools is that the younger generation can speak, read, and write excellent French, whereas most of the older men do not understand a word" (see text, page 62).



A PRIMITIVE MILL

Photo by Lehnert and Landrock

This is a typical mill for grinding cereals, such as is found all over North Africa, the motive power being furnished by the mule, that can be dimly discerned in the darkness. The Arab owner did not want to be photographed, so he threw his *bernous* over his head at the critical moment.

LADIES IN STREET COSTUME: TUNIS

"During the past ten years a school for Arab girls has been founded and has met with great success. The head of it is a French woman, who thoroughly understands Mohammedan ways. No effort is made to proselytize or influence them in any way; the desire is simply to make these young girls intelligent and useful members of the community, so that when they marry they may have attractive homes and be intelligent companions to their husbands" (see text, page 62).

IN THE MOSQUE AT TLEMCEN

This picture shows the *mihrab,* or small niche, found in every mosque, to indicate the direction of Mecca, and to it all the worshipers turn for prayer. This view is taken in the mosque of Sidi Bou Medine, the chief one in Tlemcen, a large city of Algeria.

A FENCE OF PRICKLY PEAR

Photo by Lehnert and Landrock

From Morocco to Egypt the prickly pear, or Barbary fig (*Opuntia ficus indica*) is used to form the hedges. "It is amazing to see the rapidity with which a herd of 500 camels will eat to the ground a large pasturage of prickly pear from 8 to 10 feet high. Leaves, stems, prickles and all, disappear like magic" (see text, page 65).

The nostrils of the *mehari* are as sensitive as those of a bull and the least pressure of the rein insures obedience.

The wives of the rich caids and sheiks travel on *mehara* and are hidden from the gaze of mankind by the curtains of ornate palanquins.

The *mehara* are used entirely by the Arabs when on the war-path, or *razzia.* Arab friends have told me how caravans in the Sahara have gone many days' journey to reach a certain oasis, to find, on arriving, that the water had all been used by previous caravans and the springs dry.

To run short of water half way across the Sahara is a very serious proposition, which the natives overcome by killing a *djemel,* or ordinary camel, and drinking its blood, after it has cooled and the froth at the top, which the Arabs claim is very poisonous, is skimmed off. The water found in the camel's stomach is also drunk, and, thanks to the blood and the water, the caravan can continue to an oasis further on, where springs of water are found.

A TERRIBLE CUSTOM

A terrible custom used to prevail among certain tribes of the Sahara. Before starting on a *razzia,* or war-path, old camels of not much value were kept from drinking as long as possible, and just before starting out were allowed to drink their fill; then, according to the Arabs, their tongues were cut or torn out. I think I misunderstood their words. They may have meant that certain nerves or tendons were cut. Without the use of these tendons of the tongue it was impossible for the camels to use the water in their stomachs, but they could live for a long time. When drink and meat were needed, one or two of these camels were slaughtered, the flesh eaten, and the water and blood drunk.

When the camels were killed, the horses are said to have pawed the ground in their eagerness to eat some of the fresh meat. I have never witnessed this cruel treatment of the camels, nor the conduct of the horses, however, and cannot vouch for the truthfulness of these statements, but some French generals of my acquaintance have confirmed them.

Living or dead, a camel is wealth to its master. To the Arabs of the Sahara a camel is like a reindeer to the Laplanders. Living, it carries the tents and provisions. It fears neither hunger, thirst, nor heat; its hair makes their tents (*gourbis*) and *bernouses;* the milk of the female nourishes rich and poor, enriches the dates, and fattens the horses. Its skin makes water-bottles (*mezad*) in which water never becomes cloudy from the action of wind or sun, and shoes and boots with which one can tread without danger on a viper, and protect the feet from the terrible burns made by the sands of the desert when one is barefooted.

A *mehari* on the war-path can save three men. Two ride it and the third takes hold of its tail and is pulled along. The latter changes places with the riders at intervals. When a war-party has lost so many camels that there remains but one camel for every three men, it always retreats.

Mehara are usually fawn-colored, with soft, intelligent eyes. They have pointed ears like a gazelle's. Their chests are very well developed, and they have a small girth, almost like that of a greyhound. Their slender legs bulge with muscles as hard as steel. There is not a pound of superfluous flesh on the entire body.

When at full speed a *mehari* has a most remarkable single-foot or pacing step, the motion of which is not at all disagreeable, and it can cover quite easily 100 miles in a day without undue fatigue. The feet of camels and *mehara* act on the sand like snowshoes on snow. They spread out and prevent the animal from sinking in too deeply. Camels, and *mehara* especially, prefer the soft sand to traveling on macadamized roads.

The camel is the only animal I know of that eats esparto grass as it grows. Horses, mules, and donkeys are very fond of it when it has been made into hay, but they would die of starvation rather than eat it green. Camels also eat the leaves of the prickly pear, thorns and all.

Photo by Lehnert and Landrock

A LITTLE BEDOUIN GIRL

On her head and body she wears a piece of old sacking as a protection against the winter winds, which are often piercingly cold, even in the Sahara. Her only other garment is a single piece of cloth, which she wears draped round her body somewhat after the fashion of a Roman toga.

Photo by Lehnert and Landrock

A BOY OF THE EXTREME SOUTH

The Arabs of the extreme south of Tunisia are very poor. Here we see an Arab boy clad in his one garment, made of old sacking. Despite his rags, he seems to be enjoying his meal of rich golden-yellow dates, fresh plucked from the palm.

A TYPICAL SCENE IN ONE OF THE LARGER OASES OF NORTHERN AFRICA

Photo by Bougault

"The beautiful oases of southern Tunisia are as near an approach to the Garden of Eden as one can hope to find. Almost everything thrives that can be grown in a semi-tropical country, owing to the rich soil and abundance of water" (see text, page 132)

When a *mehari* returns to the tent of its owner in the Sahara, exhausted from a long journey, the women feed it on camels' milk in which has been mixed pulverized dates.

An ordinary camel lives, on an average, to be about 18 years old, a *mehari* from 25 to 30, the 12 extra years being probably due to the better care.

A PLAGUE OF LOCUSTS IN ALGERIA

Last year Tunisia and Tripolitania were free of that dreadful scourge, the loctust (*Schistocerca peregrina*). These creatures resemble large, green grasshoppers, and are from three to four inches long, with red legs and iridescent wings, which make a loud noise as the swarm flies past. Often the sun is obscured for hours at a time, the locusts being hundreds deep and flying at a height of from 15 to 50 feet, and on alighting they have been known to stop a train.

It is impossible for any one that has not seen a plague of locusts to realize their size and numbers and the horrors of living for weeks at a time in a country where locusts fly into your face, enter your house, and even drop into your food.

Friends of ours had a great place, about 20 miles from Oran, considered one of the most fertile plantations of Algeria, and our first visit there showed acres upon acres of vineyards, culti-

vated as far as the eye could reach, toward the Mountain of the Lions; golden grain with ears so full that the stalks could hardly stand upright; lemon groves with their yellow fruit and fragrant blossoms; great groves of mandarins and oranges, so verdant, so beautiful, and so fertile it seemed like the Garden of Eden.

A south wind blew, and the locusts came. They were probably the same sort as in the days of Pharaoh and the plague. At first they came in small swarms. Men, women, and children were impressed to help battle against this terrible foe, for wherever the locusts alight nothing green remains when they pass on.

The fertile plain, rich vineyards, and verdure are in a few hours turned into a barren desert, with only stumps and tree trunks with the leaves gone and the bark all off.

It was a curious sight to see hundreds of Arab and Spanish laborers, overseers, and even wealthy French land-owners themselves, and semi-naked Arab children walking abreast in an almost straight line, each beating an old wooden pail, an empty box, a vegetable can, or a drum and blowing a tin trumpet or twirling a policeman's rattle. Each person or child walks in a furrow to himself, and the deafening noise keeps the locusts from settling. Frequently the owners of the plantations build fires and make them smoke to keep away the swarms of locusts.

When the locusts have alighted late in the afternoon, nothing can drive them off. They take wing the following morning, shortly after sunrise, unless the time has arrived for the female locust to lay her eggs.

THE NYMPHS OF THE LOCUSTS MORE DESTRUCTIVE THAN THE LOCUST

The females excavate holes in the earth two and three inches deep, in which they deposit from sixty-two to sixty-eight eggs, enveloped in a glutinous secretion, shaped somewhat like an ear of wheat.

Men have to plow and spade every inch of ground, for the nymphs are more destructive than the locusts, and the only way to prevent the eggs from hatching is to uncover them and leave them in the sun.

The period of incubation is twenty-one days; then tiny creatures—called nymphs—crawl out. They remain quiet for two days and then begin to eat. They eat and eat and eat.

Men with torches burn the nymphs by the millions, but they crawl out of the earth faster than the hand of man can destroy them. The first one to come out takes the lead, and the others follow in swarms many feet wide. They make a curious noise, like the sound of the sea.

It seems incredible that a thing so small and insignificant is so difficult to destroy. Build great fires and the swarms of crawling, wriggling nymphs will smother them, those in front being burned by millions, and those in the rear pushing on and passing over the burned bodies of the leaders. They will block and fill up a sluggish African stream, and the millions in the rear will pass over unharmed.

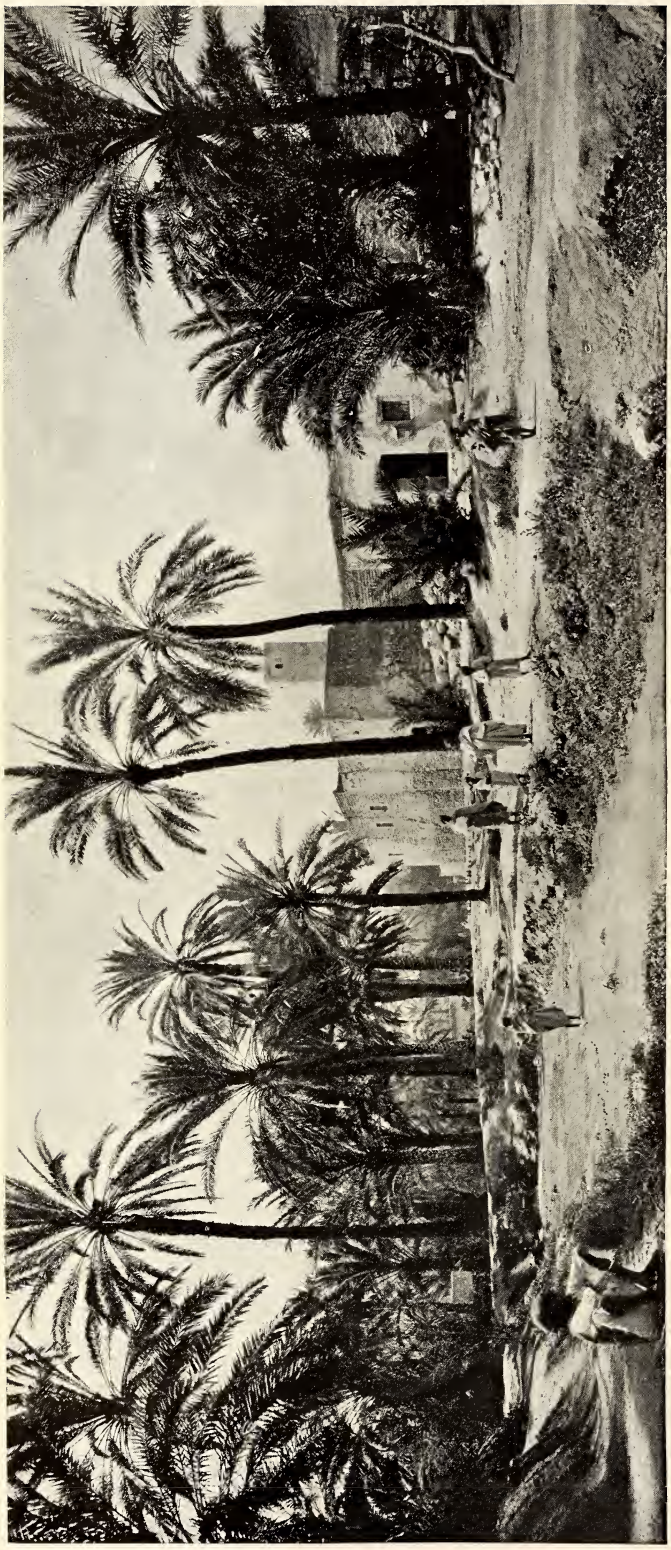
The government sends troops to aid in the defense, for it means ruin and starvation to thousands of people, besides heavy money losses. Great trenches are dug and the nymphs fall in, and when three-fourths full kerosene oil is poured on them and they are set afire, or else earth is thrown on them to a depth of about two feet. They can crawl out of the earth if only covered with a few inches, but when deeply covered they smother to death.

The young locusts are most destructive, selecting the choicest vegetables or tender shoots and green leaves. It takes weeks for them to develop from a tiny, black nymph into a full-sized locust, but they increase rapidly in size, and one can almost see their legs and wings develop.

LOCUSTS AS A FOOD

Saint John the Baptist is spoken of as having lived on locusts and wild honey. From the earliest times the tribes that dwelt on or near the great deserts of Persia, Arabia, and Africa have eaten dried locusts as food, and they will keep on doing so as long as huge swarms fly out of the desert.

Arabs eat the flesh of locusts when



THE OASIS OF CHENINI, TUNIS

Photo by Lehnert and Landrock

This oasis, near Gabes, is extremely fertile and contains hundreds of thousands of palm trees, which bear a rather poor quality of dates. The oasis is irrigated by the small stream in the foreground

killed by themselves, but refrain if their death has been caused by cold or the hand of an infidel, as they are then considered impure. Locusts are eaten after the legs, wings, and heads have been picked off.

They are either grilled or boiled and prepared with native wheat. If dried in the sun they are ground to powder and mixed with goats' or camels' milk and cooked in fat or butter and salt. Almost every animal devours locusts; even camels appear to like them as food.

Mohammed, the Prophet, said: "Allah permits the Arabs to eat only two kinds of animals without cutting their throats—fishes and grasshoppers," and when asked by a friend if he liked locusts, Mohammed replied: "I wish that I had a large basketful to eat immediately."

Arab friends told me the following legend: "The Virgin Mary, Meriem Beut Omran (Mary, the daughter of Omran), as she is called in Arabic, prayed Allah to give her flesh that contained no blood; so Allah sent locusts."

A French officer in Tunisia told me the following story that illustrates the Arab character:

An Arab Caid sowed one of his large fields with wheat. When it was ripe and ready for harvesting,

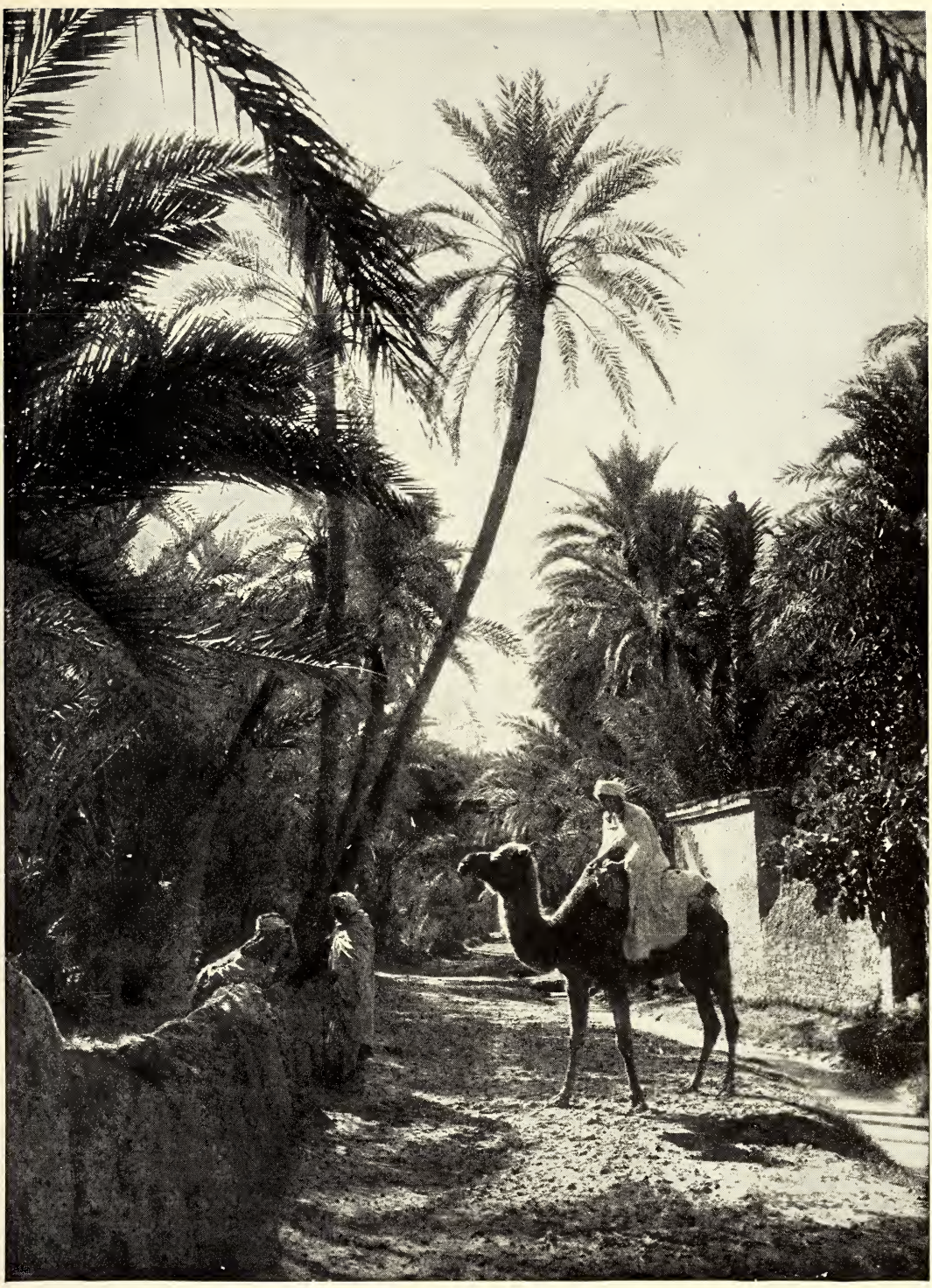


Photo by Lehnert and Landrock

THE ROAD BETWEEN THE GARDENS

"Were the gardens of the oases owned by Europeans and cultivated with modern methods, the result would be phenomenal. Unfortunately, the Arab owners of the oases are not fond of hard work, and content themselves with comparatively little" (see text, page 132).

A QUIET CORNER IN A GARDEN OF EDEN Photo by Lehnert and Landrock

"A Frenchman has a trial garden where one-half is planted by the old Arab method, the other half according to the latest American and French agricultural methods. He also uses chemical fertilizers, for this particular garden has been cultivated since the Roman occupation, and the ground probably has never been fertilized. The result of his work appears like magic. Palm trees planted four years ago and fertilized have grown as large as Arab palm trees ten years old" (see text, page 132).

A FIELD OF DAISIES IN AN OASIS OF TUNISIA

The wild flowers of the north of Tunisia are so beautiful during the months of February, March, and April that they constitute a distinct attraction in themselves and are responsible for many visitors during this period

THE LIFE OF A PALM

"A palm begins to bear a few dates between the age of ten and twelve years. At fifteen it bears a good crop, and at thirty it is considered to be in its perfection. At forty it is still strong and vigorous. At the age of fifty the palm has grown so tall that it is weakened and its annual crop of dates is not abundant" (see text, page 129).

Photo by Lehnert and Landrock

THE WAY DATES ARE GATHERED

The harvest is gathered in November and December and all the population of the oasis take part. A small boy, with a primitive sickle, climbs the palm; others follow him. The top boy cuts the great bunches and hands them to the boy beneath him, who passes them down from boy to boy until they reach the ground.

PICKING THE DATES

Photo by Lehnert and Landrock

When the clusters have been collected, busy workers begin to strip off the dates and gather them into heaps, roughly in accordance with their size and quality

PACKING DATES FOR SHIPMENT

Photo by Lehnert and Landrock

When the dates have been sorted into the various grades, the best quality is then packed into wooden boxes of various sizes, containing from 22 to 66 pounds, loaded upon small donkeys, and taken to the adjacent village, to be transported later in large shipments to the nearest seaport

CUTTING LEAVES BEFORE MAKING PALM WINE

Photo by Lehnert and Landrock

"When no longer of use for bearing dates, most of the palm leaves are cut off and an incision is made in the top of the trunk just below where the leaves grow. A large pottery jar is hung underneath the incision and a bamboo tap fastened to carry the sap to the jar. This juice is called *lagmi* by the natives and is greatly esteemed as a beverage" (see text, page 129).

swarms of locusts arrived and devoured every green thing. The Caid watched the locusts eating, and improvised a poem, without trying to drive them away. When my friend saw him he asked the Caid if it were true that the field had been planted with wheat.

"Yes," answered the Caid, "but swarms of locusts arrived, armed with pitchforks (legs) like the gleaners. They have gleaned everything and have not left a thing. Praise be to Allah, who permits such a small and feeble animal to destroy everything!"

IV

IN TRIPOLI OF BARBARY

Tripoli of Barbary has an area of about 400,000 square miles. The capital, Tripoli, is one of the most Oriental towns on the Mediterranean, and combines a mixture of Moorish and Turkish architecture.

The low, flat-roofed houses resemble those of Tunisia, but, instead of being creamy white, the Turkish population have painted them red, pink, orange, or blue. The numerous minarets of the mosques are round and have graceful, pointed spires, covered with copper, that glisten in the sun.

Before the Italians took possession, the population consisted of about 1,200 foreigners, including Italians, Maltese, Greeks, French, English, and Germans, and over 36,000 native Turks, Arabs, Berbers, and Sudanese.

An extremely high stuccoed wall of stone and cement, many feet in thickness, encircles the town of Tripoli like a half-moon. It was built to keep out the wild tribes of the Sahara and has aided the Italians in protecting the city on three sides. The wall only stops on reaching the emerald and sapphire waters of the Mediterranean. (Compare page 2.)

Tripoli lacks a natural harbor, but there is a series of great boulders and rock islands that would enable the government to build, for less than $1,000,000, a splendid harbor where the largest steamers would be safe. Now when Neptune is angry all sailing ships and steamers have to leave the harbor and put out to sea.

Small craft, with raking masts and huge lateen sails, anchored in the harbor, remind one of the Barbary pirates that less than a century ago were the dread of all Europe.

Other picturesque boats are those of the Greek sponge fishers, that under full sail resemble huge "Portuguese men-of-war" or *Physalia*, a curious species of jellyfish that floats on the water and raises at will a thin membrane that acts as a sail. One sees them in summer near the coast of North Africa and in the tropical waters of the Atlantic Ocean near the Canary and Cape Verde Islands. Their iridescent colors make them a thing of beauty, but their sting, which is like an electric shock, often proves fatal to the swimmer.

THE GREEK SPONGE DIVERS

The sponge divers come from Greece and are men of superb physique. Their calling is a difficult and dangerous one. In civilized countries the limit of depth for diving is placed somewhere around 130 feet, but here it is not unusual for them to work at from 180 to 200 feet under water, and the pressure is, of necessity, enormous.

The sum paid to each diver on his arrival from Greece is 60 pounds sterling ($300). After he has gathered enough sponges to pay for the money advanced him, he works on a commission, and each sponge that he brings up nets him a few cents.

After toiling weeks and accumulating a large quantity of sponges, it behooves the diver to have a brother or friend to manage the pump for him on the diving boat; otherwise the captain has been known to pinch the air tube. Pressure for a few seconds suffices, and the diver is pulled aboard, dead.

The commissions and the profits in the sponges go into the pocket of this unscrupulous Shylock, and another "accident owing to tremendous pressure" is reported to the authorities of Tripoli!

These divers are a jolly, happy-go-lucky set of young men, hardly more than boys, who spend their money freely. "Let

THE SOURCE OF LIFE OF THE OASES

Photo by Lehnert and Landrock

"Many oases of northern Africa and the Sahara owe their existence to large springs of hot or cold water that bubble up close to each other, forming a great pool or natural reservoir, whence runs the stream that irrigates the oasis" (see text, page 109)

us enjoy life while we live" is their motto.

They are hard workers and nothing daunts them. They remain under the water as long as the human frame can stand the pressure.

Instead of being pulled up, as divers usually are, they inflate their rubber diving suits by letting the air accumulate instead of escaping and rise to the surface with great rapidity, almost shooting out of the water. This sudden change in atmospheric pressure often causes paralysis and apoplexy, so that on most of the boats there are at least half a dozen crippled divers recovering from this kind of paralysis.

The Greek government in days gone by tried to render aid by sending over two well-equipped hospital ships, but the owners of the diving boats resented this interference and hoisted the Turkish flag, thus preventing the hospital ships from being of service. After two years of fruitless effort on the part of the government, the effort was given up.

THE SPONGE DIVERS AT PLAY

On Sundays and legal holidays the divers, dressed in their holiday clothes, enjoy life as best they can in the little town of Tripoli, where theaters and even cinematographs are unknown. One of their favorite pastimes is to hire Berber horses and race at full tilt up and down the desert just outside the walls of Tripoli, a harmless pleasure and most amusing to onlookers, for they are poor riders and usually fall off.

At night they go to some native house, where, in the patio, or large rectangular courtyard, brilliantly illuminated with incandescent lights, they sit about long tables and drink coffee or beer. Six or eight blind musicians play weird strains in a minor key, while man after man gets up and dances a *pas seul.* The steps are indescribable, but always graceful. They rarely become intoxicated, and toward midnight they go home.

THE SPONGE INDUSTRY

The sponges are dried, cleaned, and sent to France and England, where they bring good prices. An ordinary sponge takes about five years to grow and costs from 8 to 20 francs ($1.60 to $4). The Biological Laboratory at Sfax, on the coast of Tunisia, is making a study of the diseases and artificial propagation of sponges, as their ruthless destruction over the coast of northern Africa bids fair to exterminate this industry in a very few years. Great progress has been made in these investigations.

It was my good fortune to be in Tripoli while the Turkish and French commissioners were settling the boundary question between Tripoli and Tunisia, and they enabled me to take some delightful excursions with them to various oases in Tripolitania.

The different consulates were on friendly terms with each other, and all vied in lavishing hospitality upon us. Three days in the week were holidays, Friday being the equivalent of our Sunday for the Mohammedans, Saturday the Jewish Sabbath, and Sunday the Christian Day of Rest.

In the evening, after dinner, we would often stroll down and take a cup of Turkish coffee at a café overlooking the bay, while the waves rolled in at our feet and the stars shown like electric lights in a blue-black sky. The Oriental town about us seemed asleep, but the distant beating of tom-toms and the shrill notes of bagpipes, or flageolets, that occasionally reached our ears showed that somewhere a fête was taking place.

The *souks,* or bazars, of Tripoli are not remarkable, but are interesting nevertheless. The *souks* of the silversmiths are composed entirely of Jews. One never sees an Arab silversmith or blacksmith.

THE EFFECT OF THE HALLEY COMET ON JEWS AND ARABS

Rain water is the only drinking water used and is kept in huge cisterns built under the houses. During the passing of the Halley comet the Jews of Tripoli were afraid of dying and took refuge in their great cisterns, which they had pumped dry for the purpose. Twenty-four hours having elapsed, they came out of their hiding places to find the world the same as before.

Photo by Bougault

UNDER THE FURNACE OF HEAVEN

The prime necessities in the cultivation of the palm are water and a hot sun. There is an old Arab proverb which, speaking of the palm, says "its feet shall be in a stream of water and its head in the furnace of heaven"

The Arabs said that they were in the hands of Allah and refused to take refuge in their cisterns. So the few foreigners and the Arabs were the only ones that had any drinking water left, and the Arabs sold drinking water to the Jews until the next rains, about six months later.

THE HOUSES OF TRIPOLI

From the street the houses look like great painted or whitewashed walls, with here and there a small iron-barred window and wooden lattice-work, painted green (see page 57). The roofs are all flat, and at twilight veiled figures may be seen outlined against the sunset sky.

Many of the interiors are beautiful. Once inside these buildings, one is astonished by the graceful courtyard and marble columns (see page 38). In localities where there is water flowing fountains are often seen, and palm and banana trees. Frequently tame gazelles come up and gaze at you. The courtyard is open to the sky and a great balcony runs around the second floor, opening into the women's apartment (see page 69).

Arab ladies are fond of visiting each other and may frequently be seen driving in their carriages from house to house, with thin black veils over their faces, through which one can see their profiles (compare page 54). The wives of some of the richer people are cultivated and charming, speaking several languages and quite in touch with the modern ideas of our Western world.

Until Khartum came under the British flag, Tripoli was one of the centers to which caravans came from the Sudan or the Sahara, bringing slaves, ivory, and ostrich feath-

Photo by Lehnert and Landrock

THE WATERFALL IN AN OASIS NEAR GABES

This waterfall only runs when the irrigation canals are full, for water in the desert is too precious to waste. Note the little Arab boy in the foreground, who, like all boys the world over, delights to play about in the water.

Photo by Lehnert and Landrock

THE LUNCH HOUR IN THE OASIS

"The Sheik's sons wait on their father, for nowhere in the world is such respect shown to a parent. A son may not smoke in the presence of his father. . . . In extreme southern Tunisia the more noise one makes in drinking tea, the better pleased appears the host" (see text, page 107).

THE OLD WELL

Photo by Lehnert and Landrock

The most dreaded scourge in Algeria and Tunisia is the locust. "It seems incredible that a thing so small and insignificant is so difficult to destroy. Build great fires and the swarms of crawling, wriggling nymphs will smother them, those in front being burned by millions, and those in the rear pushing on and passing over the burned bodies of the leaders. They will block and fill up a sluggish African stream, and the millions in the rear will pass over unharmed" (see text, page 83).

A RIVER BED NEAR AN OASIS

Photo by Lehnert and Landrock

The rainy season generally begins in January and lasts two months, during which the temperature drops down to a mean of about 60 degrees. The summer lasts from May to October and is entirely rainless. During the autumn months occasional showers herald the approach of the rainy season proper.

DRAWING WATER FROM A DEEP WELL

Photo by Lehnert and Landrock

In some parts of Tunisia it is necessary to bore to a great depth before water is reached. Over these deep wells a primitive arrangement of pulleys is erected and oxen are used to draw the water, as shown in the picture

THE CITY OF NEFTA, TUNISIA (SEE TEXT, PAGE 129) Photo by Lehnert and Landrock

This city, which is really a collection of villages, stands on the western bank of the great salt lake of southern Tunisia, known as the Shott-el-Djerid. Once inlets of the Mediterranean, these Shotts are today not really lakes at all, but smooth, sunken areas, covered with incrustations of gray salt. During the rainy season, however, they hold a little water, which soon disappears.

ers. Now the best qualities of feathers are sent direct to London by parcel post via Khartum, and it is no longer one of the centers for buying ostrich plumes, though second and third rate feathers can still be bought at Tripoli.

A thriving trade is done in esparto grass, which is shipped to England to be made into paper. The Japanese, by the way, are endeavoring to cultivate esparto grass in their country, and for the past two years they have imported quantities of this paper for their own use.

THE GREAT WEEKLY MARKET

Every Tuesday morning a curious market formerly took place on the crescent-shaped beach, to which natives came from far and near to sell, barter, and exchange camels, donkeys, mules and horses, wool and hides, cereals, fruit, vegetables, and meat.

The market was a conglomeration of different tribes of northern Africa. Each tribe has its individual tattoo marks, or brands, some of which disfigure their faces terribly. Here the Bedouin from the Sahara has his head shaved and shampooed. Touaregs come in on their racing camels, called *mehara,* for supplies. They dislike towns and prefer their desert homes. The men are fierce and warlike, and can be distinguished from the other tribes by a cloth that almost covers their faces to protect them from the cutting sandstorms. They usually wear thick woolen *bernouses,* and their heads are wound with a heavy, long turban or cloth. They claim that the sun burns through the garments, and in order to keep out the heat and sun they wear heavy clothes, even in midsummer.

Men from Timbuktu were always present at the market, dressed in the skins of wild animals and decorated with shells and animals' teeth. They wore face masks of skins and skulls, and danced to the beating of iron castanets, about two feet long, with heads as large as saucers. These men of Timbuktu remind one of the Indian medicine men of New Mexico and the Southwest.

Owing to the failure of crops during the past five years, thousands of Bedouins have come up from the interior of the Sahara, hoping to find work and a little food with which to sustain life. Poverty is so great that, until the Turkish-Italian war, one could see daily numbers of Bedouins, with small brooms made of palm leaves, sweeping up manure in the streets in the hope of finding a few undigested grains of barley or millet that they could eat.

V

THE OASES OF NORTHERN AFRICA AND THE SAHARA

ARAB SALUTATIONS

When, traveling in the interior of North Africa, one encounters a caravan or a band of mounted Bedouins, the salutation, *Salam aalikoum,* "Peace be upon you," may mean nothing to a stranger, *but how eagerly listened to* by one who knows, as it means his personal safety and the welfare of all that are with him.

No one using the greeting *Salam aalikoum* would ever dare bring down the wrath of God upon his head by attempting to rob your caravan or murder you in your sleep. One can safely pitch one's tents next to the Bedouin using the above greeting, knowing that all will be well.

But if they do not salute you with those words, *then beware.* Danger lurks very near. The greeting *Salam aalikoum* is only used between Mohammedans. Should a Christian be in the caravan, they would say "May peace be upon those that accompany the stranger."

Even in speaking to a friend, or a stranger that one meets alone, one should always say "Peace be upon you"; *you,* used in the plural, because this man that you see alone is accompanied by the guardian angel, that you do not see, and you must salute them both.

No matter the state of one's birth, or power, or dignity, he that is on horseback should greet the man on foot. He that is walking should greet the man that he sees sitting down. A man on horseback should speak first to the man he meets riding a mule. A man on a mule should greet first a poor man riding a donkey.

The greeting should always be from the highest to the lowest, and never from

A DESERTED INN IN TOZEUR

Photo by Lehnert and Landrock

This picture, taken in the courtyard of a deserted inn in extreme southern Tunisia, shows how the rider sits a *mehari,* or racing camel, and guides it by the pressure of his toes upon its neck (compare text, page 71)

Photo by Lehnert and Landrock

A GARDEN ON THE DESERT'S EDGE, NEAR TOZEUR (SEE PAGE 132)

Photo by Bougault

THE GREAT PRAYER AT BISKRA (1)

Twice in the year a great prayer meeting is held on the plain outside the city of Biskra, in Algeria, which is attended by hundreds of devout Moslem men. This picture shows the first posture of prayer, that of standing

the lowest to the highest. These rules of etiquette are most scrupulously kept, on account of the spirit of humility.

Should two men of equal rank pass each other, either on foot or horseback, then the younger man should first salute the elder man, in order to show respect to age.

Before eating there is a sort of grace asked that runs about like this: "O my God! Bless this that thou givest us to eat and drink, and when it has been consumed, reproduce it." *Always eat and drink* with the *right hand,* as only a demon eats and drinks with his left hand. After having finished drinking, one should say to the person: *Sahha,* "May Allah give you force!" He then replies, *Sel-meck!*

HOW THE ARABS DRINK TEA

Tea-making is a great ceremonial among the Arabs. It was first introduced in Morocco, and during the past 20 years has spread over all northern Africa; even the Puritan *Sennoussi* drink tea, coffee being forbidden.

Green tea is preferred to all others. I have sent presents of the best quality of English (Ceylon) tea to Arab Sheiks and Caids, asking them to tell me frankly how they liked it in comparison to their green tea, and the answer always came back that it was most excellent, but they did not like the flavor

Photo by Bougault

THE GREAT PRAYER AT BISKRA (II)

This picture shows the second posture of prayer, a profound inclination with the hands resting on the knees. The third posture is a complete prostration, as shown in the picture on page 108. The spectacle of these hundreds of men all bowing and chanting in unison is singularly impressive.

as well as their green tea.

A Troglodyte Sheik when serving tea sits in his rock cave behind a low table about five inches high, on which are arranged several teapots, often brought from Mecca, made of copper or brass, and damascined with Persian designs in silver. As many tiny cups as there are guests are placed on the tray.

The Sheik's sons wait on their father, for *nowhere in the world* is such respect shown to a parent. A son may not smoke in the presence of his father.

An entire sugar loaf has been brought in and placed with a hammer near the Sheik. The teapots having been filled with water, they are set on glowing coals, often of dried camel's dung, as charcoal and wood are almost unknown. When the water boils, the tea is added and great lumps of sugar are broken off with the hammer and put into the teapots.

Then each cup is slowly filled and the Sheik sips a little to see if it tastes right; then all the cups are emptied into the teapots and shaken up and then poured out again. This process is continued for a long time until the tea is almost like a liquor; mint and other ingredients are often added, so that the beverage does not resemble tea.

In extreme southern Tunisia the more noise one makes in drinking

THE GREAT PRAYER AT BISKRA (III)

Photo by Bougault

The third posture of prayer is a complete prostration—the symbol of the adoration of the unity of God, the central doctrine of Islam. "The French government has allowed the natives absolute independence of thought and religion. In the far-off Troglodyte towns, where no mosques existed, some have been built by the government. This has been a very wise move, because it has endeared the French to the hearts of the Tunisians" (see text, page 62).

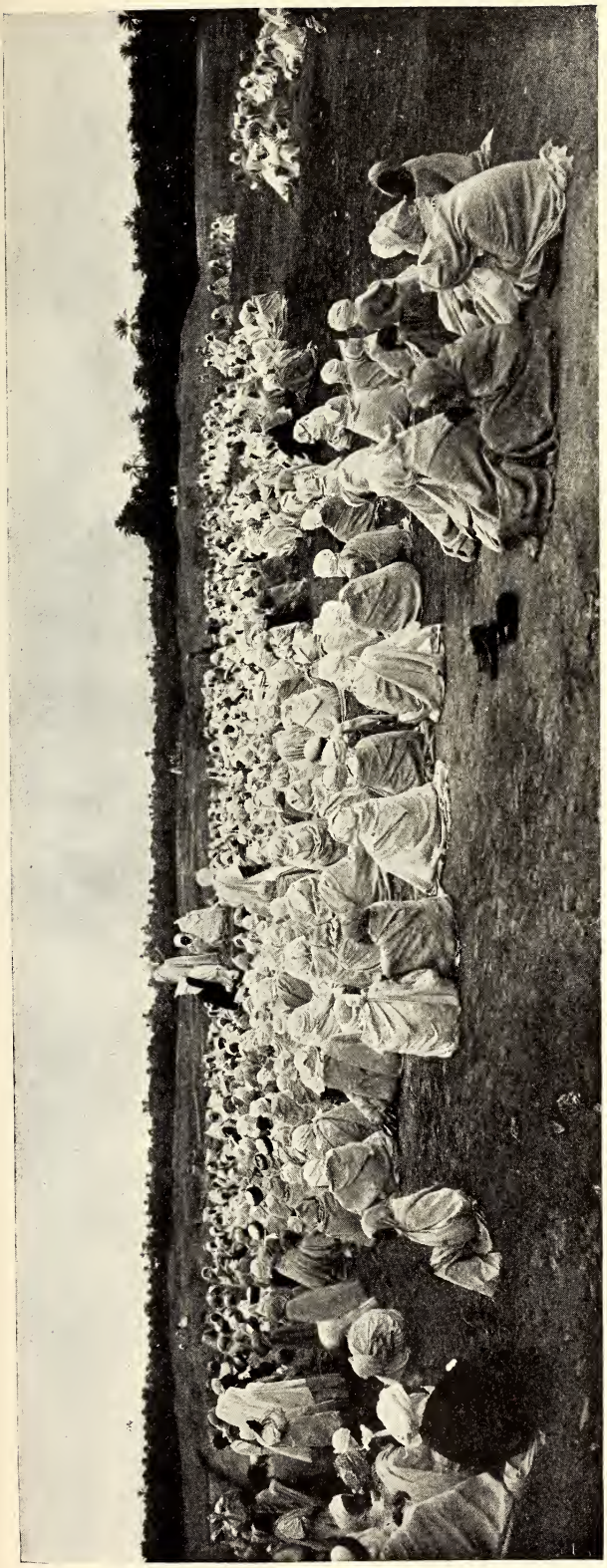


Photo by Bougault

THE GREAT PRAYER AT BISKRA (IV)

After the set liturgical prayers have been finished, the worshipers gather in a circle round an old Iman (or leader), who preaches to them. The sermon is not long, in deference to one of the Prophet's pithiest sayings, "The length of a man's prayers and the shortness of his sermons are signs of his common sense."

tea the better pleased *appears the host.*

OASES OF NORTHERN AFRICA AND THE SAHARA

Many oases of northern Africa and the Sahara owe their existence to large springs of hot or cold water that bubble up close to each other, forming a great pool or natural reservoir, whence runs the stream that irrigates the oasis. This stream, called by Arabs an *oued,* is divided and subdivided a great many times, so that as much land as possible can be irrigated. The sand of the Sahara is not like that of the seashore, for when irrigated it becomes as fertile as virgin soil; hence the fortunate owner of a garden with water privileges in an oasis, is, as a rule, a wealthy man.

In the thirteenth century there lived at Tozeur the Arab historian Iman Ibn Chabbath, who planned and carried out the simple system of irrigation that one sees today when roaming through the oases. The river (*oued*) that runs from the springs was divided into three streams of equal volume; each of these three main streams was again subdivided into seven smaller streams of equal volume, so that the oasis of Tozeur was entirely irrigated by these 21 streams.

The Iman Ibn Chabbath died in the year 1282 A. D. and was buried at Bled-el-Hader. His system of irrigation

A BURIAL ON THE SAHARA

Photo by Lehnert and Landrock

The mourners are separated into two groups—one composed of men and the other of women—who are all howling and wailing at the top of their voices, the inevitable sign of mourning in the Orient

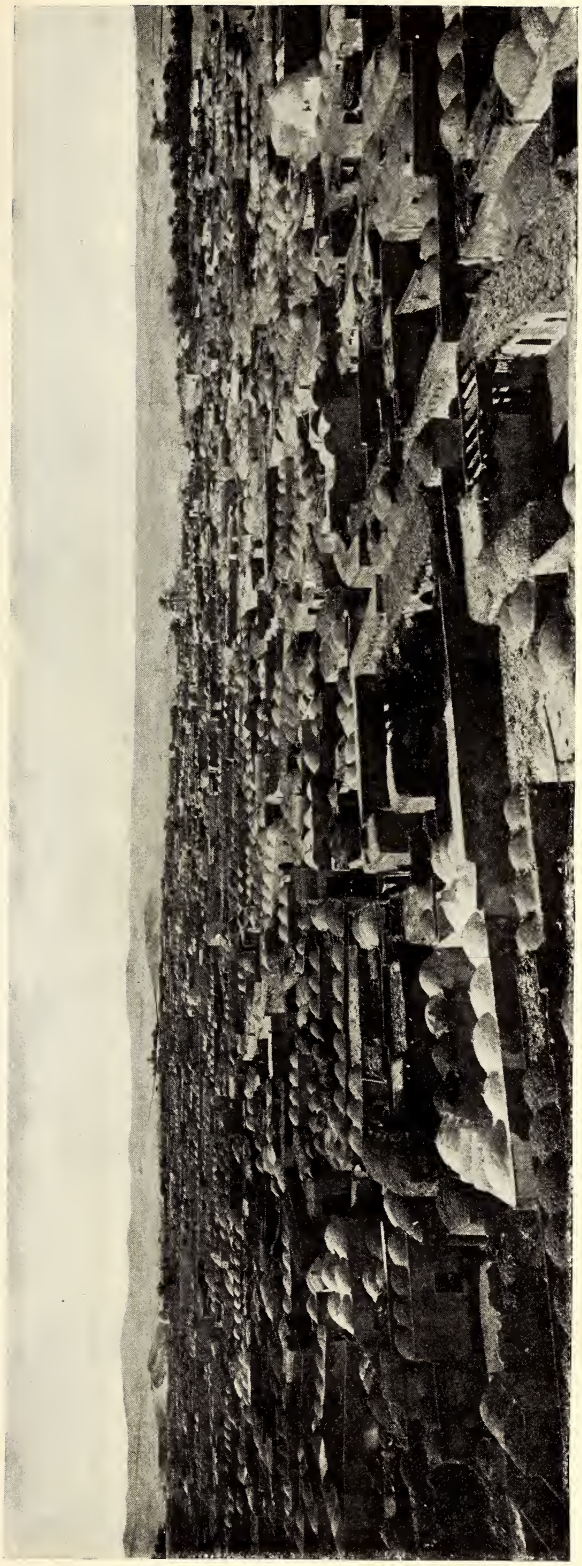
Photo by Lehnert and Landrock

A North African graveyard is often much neglected; indeed, one Moslem sect thinks it meritorious to neglect their graves, believing it to be in accordance with the wishes of the Prophet. Graves are usually mounds of mud, with unbaked bricks set at the head

A DISTANT VIEW OF EL-OUED

Photo by Lehnert and Landrock

Far out in the Sahara, in the extreme south of Tunisia, lies the almost unknown city of El-Oued, which is built upon a number of tiny oases which lie surrounded by the barren sands of the desert. Note the small group of mud houses on the right and the larger group of houses in the distant center.



A GENERAL VIEW OF EL-OUED: NOTE THE SAND-DUNES SURROUNDING THE TOWN (SEE PAGE 117) Photo by Bougault

was copied in many other oases where there was plenty of water and it worked well for centuries.

Complications have arisen since the thirteenth century, and the ownership of water rights in an oasis today has become very tangled, so that the owners of the gardens in the oasis of Tozeur do not themselves know the exact amount of water they are entitled to, but leave it in the hands of their *khammes,* sort of head gardeners and experts on the volume of water the gardens of their masters are entitled to.

Centuries ago the owner of each garden had a right to let the water from one of the 21 equal streams flow (irrigate) over his ground for a fixed period of time every month during the year, so many days or so many nights, as the case might be. Time went on, and the heads of the families died. Three or four sons inherited the property and the garden would be divided into smaller parts.

An Arab being badly in need of funds and having more water than he actually needed for his garden would sell for a fixed sum the extra water that he did not use.

The water rights became so complicated that the long periods of a night or a day were reduced to periods timed between the calls to prayer of the *muezzins.*

These were again shortened to a period equal to five minutes.

HOW THE PERIODS OF TIME ARE MEASURED

Instead of an hour-glass the head gardener uses a primitive native pottery bowl, or in certain oases a gourd, with a tiny hole at the base. This implement takes just five minutes

A SMALL OASIS NEAR EL-OUED

Photo by Lehnert and Landrock

"The natives, centuries ago, dug enormous holes in the sand and planted palm groves in the holes, which were so deep that the roots of the palms have sufficient moisture throughout the year. A continual war is waged by the inhabitants against nature, for each sandstorm, and these are many, tends to fill in the holes and all the sand that is blown in has to be taken out again in small baskets" (see text, page 117, and pictures.

CHECKING THE MOVING SAND-DUNES

Photo by Lehnert and Landrock

By planting certain coarse grasses along the ridges at the top of the sand-dunes, the desert Arabs are enabled to check to some extent the movement of the sand toward their date gardens

MARKET DAY AT EL-OUED

Photo by Lehnert and Landrock

To the market at El-Oued come the inhabitants of those small but numerous oases which lie around this remote and little known city of the desert, and which are the only source of its trade

by the clock to empty itself of water. By means of a simple water gate one of the 21 equal streams is entirely turned into the garden to be irrigated.

The *khammes* plunges his gourd into the stream, fills it to the brim, and hangs it up and ties a knot into a long fiber of palm leaf to keep count of the number of periods. As soon as the gourd is empty the *khammes* refills it and ties a second knot.

He keeps this up until his number of periods have come to an end. The water gate is closed, the gourd wiped, and the small hole at the base carefully plugged to prevent sand and dirt from clogging the aperture.

Four hundred and seventy-nine *khammes* are employed in the oasis of Tozeur. The occupation descends as a rule from father to son and the men are greatly respected. At Tozeur the volume of water used during the period it takes a gourd to empty itself (five minutes) is equal to ten cubic meters* (2,641 gallons) and such a water right is bought and sold in perpetuity for 120 to 180 francs.

The volume of water varies at each oasis. The combined springs at Tozeur have an output of 740 liters a second, or 44 cubic meters a minute and 63,936 cubic meters every 24 hours, which is equal to 16,879,104 gallons. The oasis of Nefta has a total output of over 800 liters a second.

Of course, these two oases are especially favored by nature; curiously enough, the more abundant the water the less the natives use it for performing their ablutions. Never have we seen such filthy natives as at Tozeur and Nefta. They use sand instead of water.

Between Nefta, Tunisia, and Biskra, in Algeria, in a region called Souf, there are to be found curious oases.

The most important is called El-Oued; it is a large and wealthy native town, and there is a French military outpost. The natives centuries ago dug enormous holes in the sand and planted palm groves in the holes, which were so deep that the roots of the palms have sufficient moisture throughout the year. A continual war is waged by the inhabitants of El-Oued against nature, for each sandstorm, and these are many, tends to fill in the holes, and all the sand that is blown in has to be taken out again in small baskets (see pages 105 and 114).*

Most of us think of an oasis as an ideal cluster of tall palm trees with a beautiful pool, in which is reflected the azure sky and the waving palm leaves. Time and again while riding over the borders of the Sahara we have looked up and seen such an oasis with a wonderfully limpid lake, but it was a magic oasis that vanished on our approach, and the blue lake turned into scorching yellow sand—an optical illusion, a mirage!

Oases vary in size and are measured by the number of date palms in them; a small one contains several hundred palm trees and a large one 300,000 or 400,000.

A LEGEND OF THE DATE PALM

The Arabs call the palm tree "My Aunt," and say that it resembles a human being more than any other variety of tree.

"Cut off its head and the palm will die. Its head likes sunshine and its feet (roots) like moisture."

An old Arab legend runs something like this: "When Allah created Adam, a few grains of dust fell between his fingers; these grains made the palm trees."

Another legend† runs as follows: "The Emperor of Byzantium wrote one day to the Caliph Amor Ben El Khattab: 'It has been told me that in your country there grows a tree that bears pods, the shape of which reminds one of donkey's ears; when these open they expose to view a substance of immaculate whiteness, as white as milk, which afterward becomes the green color of an

*1 liter contains 2.113 American pints, or 1.76 English pints.

1 cubic meter contains 264.18 American gallons of 231 cubic inches.

1 meter is equal to 39.37 inches.

1 kilogram is equal to 2 1/5 pounds avoirdupois.

*See also "The Country of the Ant Men," by Thos. H. Kearney, in the April, 1911, number of the NATIONAL GEOGRAPHIC MAGAZINE.

† Translated from the Arabic Commentaries of Iman Ibn Amor Ibn Chabbath by Monsieur Lucien Fleury, who has kindly permitted the writer to use his unpublished work.

THE WAVES OF THE DESERT

Photo by Lehnert and Landrock

There is a greater similarity than would at first sight be supposed between the landscape of the desert and that of the ocean. The sand-dunes look like great petrified ocean breakers, broken here and there by little waves, caused by the action of wind

FOOTPRINTS IN THE SANDS OF TIME

Photo by Lehnert and Landrock

Of late years many a man—and woman, too—has heard the "call of the desert," and, weary of the stress of life in our crowded, overcivilized communities, has gone out to seek the silent charm of those huge wastes and has come back invigorated in body and restored in mind

THE CREST OF THE WAVE

Photo by Lehnert and Landrock

The charm of the desert landscape is the wonderful play of lights on dunes and hills of sand as they stretch away into the distance till sand joins sky. The insignificance of the camel in the center of the picture shows how high are the sand hills beyond

A SCHOOL IN THE DESERT

A DESERT LANDSCAPE

Photo by Lehnert and Landrock

Those who know the nomad Arabs say that they are possessed of a love for the desert which is passionate and unquenchable. They love that perfect solitude, and in spite of all the hardships and danger of desert life, no reward is great enough to make them forsake it. Note the tracks made by the soft, spreading foot of the camel.

emerald, then turns as yellow as gold, to redden at last like a great ruby. This fruit is said to have the sweetness of taste of cake made of honey and butter and can be dried and used as food by the inhabitants of towns or by travelers on their journeys. If this report is true, surely this is a tree from Paradise!"

Caliph Amor Ben El Khattab wrote back:

"That which has been told you is true, O King. Allah commanded Meriem beut Omran (the Virgin Mary) to take shelter under this tree when Aissa (Christ) was born. Believe, therefore, in Allah and do not acknowledge any other divinity!

"God said to Meriem beut Omran (the Virgin Mary), 'Go to the base of a palm tree and thou shalt give birth to a tender child, and nourish yourself with the fresh dates.'

"If God had known any better food, he certainly would have given them to Meriem when Christ was born.

"Allah reserved for the city of Medina the glory of being the refuge and dwelling place of The Prophet from the time of the *Hegira* throughout his life, and after his death the resting place of his blessed body, and has honor and glory as the Cradle of Islamism, for Medina is remarkable on account of its palm trees."

THE DATE CROP AND HOW IT IS HARVESTED

The dates are gathered during the months of November and December, and this is the busiest time of the year. It seems as if all the male population, from feeble, gray-bearded old men to tiny infants, were gathered together in the oasis and divided into companies in the various great gardens.

A small boy with a primitive sickle climbs the date palm; others follow him. Before the first cluster of dates is cut every one on the tree and in the garden join in chanting a song of thanks to Allah for having given them the harvest.

Then the top boy, deftly balancing himself between the palm leaves, quickly cuts the great bunches of transparent golden dates and hands them down one at a time to the boy under him, who passes them on to the youth below, and so on until they reach the ground (see page 89).

Then two clusters are carried at a time to a group of natives squatting on the ground, busily employed assorting the dates into different grades (see page 90). The best quality is then packed into wooden boxes of 10, 20, and 30 kilograms each (one kilogram equals two and one-fifth pounds) (see page 91), loaded upon small donkeys and taken to an adjacent village. When there are sufficient boxes ready to form a caravan, they are laden upon camels and taken to the nearest seaport or railroad station.

Before the boys descend from the palm tree that has just been denuded of its fruit a second invocation is chanted, the signification of which runs as follows: "May Allah in his loving kindness preserve this palm tree from all harm and permit it to bear a good harvest in the season that is to come."

HUNTING THE RATS

While the palms are being stripped of their fruit rat after rat is spied by the boys, who immediately climb after them. The rat takes refuge on the end of a palm leaf, while scores of infants too young to climb gather underneath. The older boys who have climbed the tree shake the leaves until the rat jumps or falls off. In spite of the height, the rat never seems to be hurt.

There is a wild scrimmage among the small children to catch it, and one of them carries it in triumph to an Arab, who immediately cuts off the rat's teeth and fastens a string made of palm fiber to its hind leg. It is then given to one of the tiny girls or boys as a plaything.

About three o'clock of an afternoon, when the day's work is almost finished and many palms have been stripped of their fruit, there is not an infant to be seen without at least one rat, frequently two or three. They are fat and have soft, silver-gray skins, with white bellies. These unfortunate playthings are finally killed, split open, broiled over coals, and eaten.

THE LIFE OF THE PALM

A palm begins to bear a few dates between the age of 10 and 12 years. At 15 it bears a good crop and at 30 it is considered in its perfection; at 40 it is still

ONE SOURCE OF FOOD AND WATER

Photo by Lehnert and Landrock

"Living or dead, a camel is wealth to its master. To the Arabs of the Sahara a camel is like a reindeer to the Laplanders. Living, it carries the tents and provisions. It fears neither hunger, thirst, nor heat; its hair makes their tents (*gourbis*) and *bernouses;* the milk of the female nourishes the rich and the poor, enriches the dates, and fattens the horses" (see text, page 79).

IN THE TRACKS OF A CARAVAN

Photo by Lehnert and Landrock

All that is left of a camel 24 hours after its death. When a camel is slaughtered on the march, the water in its stomach, its blood, and as much of its meat as possible is consumed by the members of the party. What is left falls to the share of the birds of prey, which appear in hundreds as, if by magic, out of a clear sky.

DESERT SCOUTING: A NOMAD ON HIS MEHARI

Photo by Lehnert and Landrock

"In the interior of northern Africa is a superb race of camels, known as the *mehara* (singular, *mehari*), or racing camels. . . . Ancient writers speak of camels used by the army of Xerxes, more than 2,000 years ago, that had the speed of the fastest horses; these were doubtless *mehara*" (see text, page 71).

AT THE CLOSE OF DAY: A MÉHARI AND HIS OWNERS AT REST

Photo by Lehnert and Landrock

"*Mehara* (racing camels) are usually fawn-colored, with soft, intelligent eyes. They have pointed ears like gazelles. Their chests are very well developed, and they have a small girth almost like that of a greyhound. Their slender legs bulge with muscles as hard as steel" (see text, page 79).

THE SAVIOUR OF THREE

Photo by Lehnert and Landrock

"A *mehari* (racing camel) on the war-path can save three men. Two ride him and the third takes hold of its tail and is pulled along. The latter changes places with the riders at intervals. When a war party has lost so many camels that there remain but one camel for three men, it always retreats" (see text, page 79).

strong and vigorous, but no longer gives forth shoots. At the age of 50 the palm has grown so tall that it is weakened and its annual crop of dates is not so abundant.

When no longer of use for bearing dates most of the palm leaves are cut off and an incision is made in the top of the trunk just below where the leaves grow. A large pottery jar is hung underneath the incision and a bamboo tap fastened to carry the sap to the jar.

This juice is called *lagmi* by the natives and is greatly esteemed as a beverage. It is bluish white in color and has an insipid sweetish taste when fresh, rather refreshing when one is thirsty. It ferments quickly and is then extremely intoxicating. Europeans do not like it.

Every date-bearing palm tree over 20 years old is taxed by the Tunisian government.

The average yearly harvest of common dates amounts to 32,000 quintals of 100 kilograms, or 7,040,000 pounds, and the *Degla* variety 4,000 quintals of 100 kilograms, or 880,000 pounds. When one realizes that the above figures are for one oasis, and that within 15 miles of Tozeur are two other great oases—Nefta and Deggache, often called El-Oudiane—that yield an equal amount of dates, one begins to comprehend the importance of the date harvest.

Only the female palm bears dates. The male palm has a few large white flowers that somewhat resemble ostrich plumes. Unless fertilized artificially the female palm produces few, if any, dates. A small piece of the male flower about the size of an ear of wheat is tied into the pod of the female flower. Any flower not thoroughly fertilized produces half of the bunch of dates immature and hard, useless as food, and despised even by camels.

SCIENTIFIC AGRICULTURE WOULD VASTLY INCREASE THE DATE

On visiting the plantation of a French friend I noticed that all of his date palms bore perfect clusters of well-ripened dates, and expressed my astonishment that his were so perfect when the adjoining gardens owned by Arabs had only one-half or one-third of their dates ripened, the remainder being a total loss.

He laughed and said, "You know that it is the custom of the country to pay the men partly in dates. I told all of my Arab gardeners that if they neglected properly to fertilize the female palm trees that their pay would be in the immature, useless dates. Since then there has been no shirking of the fertilization and my date harvest has increased enormously; before it was too much trouble for the Arabs to climb up and attend thoroughly to each palm and they frequently slighted their work."

This gentleman is an up-to-date "colonial," born in Tunisia of French parents. He is one of the rare exceptions, a Frenchman that owns property in an oasis, and it is interesting to compare the result of his agricultural methods and those of the Arabs.

He has been in America and studied our methods and has adopted what he found best suited to his work in southern Tunisia, and he attributes a great part of his success to the Department of Agriculture at Washington, D. C.

He has a trial garden where one-half is planted by the old Arab method, the other half according to the latest American and French agricultural methods. He also uses chemical fertilizers, for this particular garden has been cultivated since the Roman occupation and the ground probably has never been fertilized.

The result of his work appears like magic. Palm trees planted four years ago and fertilized have grown as large as Arab palm trees ten years old. Everything seems to thrive, and one sees underneath the superb date palms, orange and lemon trees, figs, pomegranates, apricots, and bananas and grapevines and numerous varieties of vegetables.

Were the gardens of the oases owned by Europeans and cultivated with modern methods the result would be phenomenal. Unfortunately the Arab owners of the oases are not fond of hard work and content themselves with comparatively little.

The beautiful oases of southern Tunisia are as near an approach to the Gar-

A CARAVAN ON THE MARCH

Photo by Lehnert and Landrock

Photo by Lehnert and Landrock

THE NEVER-ENDING STRIFE OF SAND AND WIND

The action of the wind builds up huge and ever-shifting hills of desert sand. One can judge of their great size by comparing the sitting figures at the foot of the hill with the man and his camel at the top.

den of Eden as one can hope to find. Almost everything thrives that can be grown in a semi-tropical country, owing to the rich soil and abundance of water.

To give a vague idea of an oasis, let me describe that of Tozeur, in southern Tunisia. Eleven thousand Arabs live underneath the shadow of the palms of this oasis, which covers an area of about 2,200 acres (900 hectares), and 4,000 occupy small villages on the outskirts. Most of them were born and have always lived in this oasis, and when they die they will be buried in the desert sand near Tozeur.

The oasis has nourished these 15,000 souls and many thousands more; their wants and needs are simple. Families composed of husband and wife, or wives, and three or four children frequently live on less than ten cents (50 centimes) a day.

Their mainstay consists of dried dates and a few boiled beans with a little pure olive oil. At almost any turn of the road in the oasis one can buy from an Arab vender, crouched over a large Standard Oil can and fanning the live coals, a copious supply of beans cooked until they are mealy and ladled out of the can boiling (see page 98). One cent buys enough for a very hungry man.

THE GREAT DATE MARKETS

Caravans of nomads come from far and near to buy the dates.

An hour before sunset the sand dunes around Tozeur seem to be alive with camels, and caravan after caravan arrives and encamps for the night just outside the town. A curious acrid odor pervades the air, coming from the thousands of camels. The noise is deafening; each camel snarls and groans when forced to kneel; baby camels bleat like a calf, and swarthy men of the desert call to each other in shrill voices.

There are camels of all ages and sizes, dark brown, fawn, and cream colored. Frequently six or eight large male camels stampede and, rushing to another camp, become mixed up with two or three hundred camels of another caravan.

The burdens and saddles are placed in a large circle that forms a sort of wall, and the camels are forced to kneel inside in rows close to each other. When once down, their knees are tied so that they cannot escape during the night. It is no small matter to settle a caravan composed of four hundred camels.

At last, when the camels are all secured, small camp-fires are built of dried sage-brush and a frugal meal of beans is cooked and some dried dates eaten afterward. The wants of these nomads are few; they are like happy, primitive children.

As the twilight fades into a wonderful deep blue and the camp-fires flicker and die down a great silence falls over the oasis; the barking of the dogs has ceased; the camels are asleep.

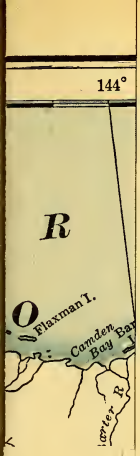
Only the motionless figures of a few nomads guarding their caravans wrap their *bernouses* more tightly about them as they stand outlined against a blue-black sky, for the cold is bitter. The sleeping men, wearied from their long march, lie huddled close together, as near as possible to the camels for warmth and protection from the wind.

Suddenly the piercing cry of a *muezzin* breaks the stillness of the African night, and it is taken up by a score of other *muezzins* in their fifth and last call to prayer of the day, and Bedouins dwelling in their tents made of woven camel's or goat's hair far out on the sand dunes distinctly hear the words "Allah is Allah! there is no God but Allah! Mohammed is his Prophet!"

NOTE

The Index for the 1913 volume, together with the Table of Contents and Title-page, is now ready, and members who desire copies can obtain them by application to the National Geographic Society, Hubbard Memorial Hall, Washington, D. C.

Owing to the ever-increasing growth of the NATIONAL GEOGRAPHIC MAGAZINE, the yearly volume has now become so large that it cannot be conveniently handled. It has therefore been decided that, beginning with the year 1914, the magazine will be published in two half-yearly volumes, containing approximately 800 pages in each. Indexes will be prepared in future at the end of every six months and will be available to members, on application, in July and January of each year.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The National Geographic Magazine

Map of

ALASKA

Showing latest explorations by U. S. Geological Survey and U. S. Coast and Geodetic Survey

SCALE 1: 5,000,000 or approximately 80 miles to one inch.

ENGLISH STATUTE MILES

KILOMETERS

EXPLANATIONS.

International Boundary:

Railroads: Finished / Proposed

Telegraph and Cable Lines:

Steamship Lines:

Overland Postal Routes:

- Settlement
- Post Office
- Capital
- Mission Station
- P. S. U.S. Public School for Natives
- Mines
- Telegraph Station
- Post Office and Telegraph Sta.
- Wireless Telegraph Sta.
- Lighthouse or Light
- Volcanoes
- Northwest Mounted Police (Canada)

M. Res. Military Reservations

Glaciers in Blue thus:

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Western Extension of

ALEUTIAN ISLANDS

SCALE 1: 5,000,000

ENGLISH STATUTE MILES

THE MATTHEWS-NORTHRUP WORKS, BUFFALO, N. Y.

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THE NATIONAL GEOGRAPHIC MAGAZINE

BATTLING WITH THE PANAMA SLIDES

By William Joseph Showalter

Author of "The Panama Canal" and "The Countries of the Caribbean," in the National Geographic Magazine

THE only reason why ships have not been using the Panama Canal since last October is that Nature has been battling to the last ditch in her efforts to thwart the purpose of man to put a shipway through the vitals of proud old Culebra Mountain. But for this great battle, Culebra Cut would have been a finished job two years ago.

The weapons used by Nature in her efforts to confound the plans of the canal engineers have been slides and breaks in the banks of the canal, and effective weapons indeed have they proven. How, with them, she has stood between the canal army and the completion of the task to which it addressed itself constitutes the most thrilling episode in the history of canal engineering.

Over 250 acres of ground lying outside of the intended banks of the canal, and containing over 30 million cubic yards of material, have swept, with silent but terrific force, down into the canal. Now this onslaught has demoralized an entire railroad system; now it has put the compressed air and water systems out of commission; now it has bottled up one end of Culebra Cut with an avalanche of debris; now it has imprisoned dirt trains and wrecked steam shovels. But with all the wreck and ruin and chaos there have been men with wills of iron who have met each new situation with a new spirit of determination; men who have never permitted any catastrophe to turn them aside from their ultimate purpose; men whose achievements in the face of unprecedented difficulties make a story as inspiring as anything in human history.

No one who failed to visit the Isthmus during the construction period can understand the full import of the coming of these slides into Culebra Cut. With each passing year they have renewed and redoubled their attacks on the canal plans. They seem to be maneuvered by the hand of some great marshal and sent forth to the fray in every way calculated to put the canal engineers to discomfiture.

Now they are quiescent, attempting to lull the engineers into a false security; now they make a feint, stopping short of an actual conflict; now they come in the dead of night, spreading chaos and disrupting everything in whatever direction they move; now they set up the appearance of being rendered thoroughly harmless by allowing dikes of basalt to peep out which seem to tie them to the bowels of the earth, only to destroy the hopes which these dikes arouse in the hearts of the besiegers, by shearing them off as if they were but pipe-stems, and then flowing, unrestrained, into the cut.

Consider what the removal of 30 million cubic yards of material means. It is enough to build a sort of Chinese wall 7 feet thick and 7 feet high reaching from New York to San Francisco. It is

Photo and copyright by Edith H. Tracy

THE DEEPEST PART OF CULEBRA CUT

Looking south from the west bank of the canal, near Contractor's Hill, Cucaracha slide shows on the left side of the picture. Some 10 million pounds of dynamite have been exploded in Culebra and enough material removed to make 26 pyramids, each as large as the Great Pyramid of Cheops, in Egypt, or 2,500 shafts, each as large as the Washington Monument.

LOOKING INTO THE CULEBRA CUT FROM THE TOP OF A SLIDE, SHOWING THE BROKEN BANK

more than could be drawn by all the horses and mules in the United States. It would fill a million and a half big Lidgerwood cars, enough to make a string 12,000 miles long. These figures show that the mere getting rid of this surplus material is no mean job.

But when you reflect that each yard of this sliding material has rendered doubly difficult the getting out of three yards of other material, the true meaning of the slides will begin to appear. There have been times when 170 trains were going out of the cut one day at the south end, only to be stopped entirely the next day by the Cucaracha slide getting busy. Now there may be a dozen tracks in use in the cut, and 24 hours later half of these will be out of commission. That is what makes the slides such serious things to combat.

THE GREATEST ENGINEERING WONDER OF THE AGE

It is no wonder that the lamented Colonel Gaillard lost his health and his life fighting them. It is no wonder that Colonel Goethals has aged 20 years in six while struggling with them. But it is a wonder, the greatest engineering wonder of the age, that in spite of these difficulties they have been able to remove 106 million cubic yards of material from the cut in less time than it was estimated that they could remove 53 million cubic yards. And this wonder grows when I look at their cost sheets and see them removing a cubic yard for an average of 60-odd cents, when it was estimated that, unhindered by slides, the cost of removing a cubic yard would be 98 cents.

Speaking of the terrific strain involved upon those who are responsible for the battle with the slides at Panama, no incident in my life can stand out more vividly than one I will now relate, illustrating the meaning of it all to the engineers. Cucaracha slide resumed her old tricks when I was on the Isthmus last May. She had been quiescent for some time, and it was believed that she had retired from the fray for good and all.

THE RAILROAD DESTROYED BY A SLIDE

Colonel Gaillard, who had charge of the work in Culebra Cut, never knew, when he returned to work in the morning, that tracks and shovels would be found as left the night before

Culebra Cut began to look like a finished job, with only a little hump in the middle mile to be taken off. Then one night, while the canal army was asleep, she poured down into the south end of the cut an avalanche of material that filled it up to the 67-foot level, bottled up the railroad exits from that end, and did sundry other evil things to the plans of the engineers (see page 146).

When I heard about it I went up to Culebra to talk with Colonel Goethals as to its bearing on the immediate future. After passing the time of day I asked him how he was, to which he replied:

"Well, about the best way I can express it is to say that I am 'home-sick.' Cucaracha looks bad, but she is not by any means the greatest of my woes. I trampled over her this morning, and the basalt dikes that are peeping out seem to indicate that she will be 'dead' before very long. But over here on this side of the cut," pointing out the window of his office as he spoke, "there is beginning to show an indication of a new break, and if the actualities prove as bad as the indications suggest, it will outdo anything we have had to contend with yet."

And as he spoke I saw the tears well up in the eyes of that man of iron, and I understood what those slides were costing him. I knew then whence had gone that buoyancy of youth which I had met in 1908 and that enthusiasm of purpose which I had seen in 1910. Now instead there was the grim determination of a veteran of a thousand conflicts, who would fight on to the end only because Duty's voice ever spoke louder in his ear than Pleasure's.

NO ONE COULD FORETELL THE SLIDES

The determined character of the slides that beset the canal engineers is strikingly shown by the amount of their material that had to be removed in comparison with the total excavations for each year. Prior to 1910 they presented no serious obstacle, since the canal was not deep enough to create the unbalanced condition necessary for their development. Up to that year the excavations on account of slides were only 7.87 per cent of the total excavations.

During 1910, however, they became more active, and seven weeks out of the 52 would have been required to take care of the 14.83 per cent of all excavations which represented the slide debris taken out. In 1911 there was a still greater activity in slides, and, omitting the extra difficulties they imposed, it required 13 weeks to take out the material they brought into the cut, this material amounting to 26.30 per cent of the total excavations for the year.

The succeeding year saw the cut going still deeper and the slides growing larger and still more bothersome, so that 34.5 per cent of the excavations of that year were of slide material, whose removal required 18 weeks.

During the year 1913 the cut approached final grade and the slides set a new record, requiring 46 per cent of the total excavations for the year, which accounts for 24 weeks' work.

The present year, beginning July 1, 1913, saw only two months required for the final bottom to be reached in the cut, outside of the material brought in by the slides, so that at least 44 weeks of this year are chargeable against the slides.

SLIDES HAVE DELAYED THE COMPLETION OF THE CUT BY 22 MONTHS

From all this it must appear that the bare work of removing the material from the cut brought into it by the slides, leaving entirely out of the reckoning the immense handicap in the prosecution of the regular work that they involved, held back the completion of the cut by 22 months at least.

It is certainly reasonable to suppose that all the delays the slides imposed held up the work by eight months, so that but for them we might have seen a cut through Culebra Mountain, with a bottom width of 300 feet, completed by January 1, 1912, in five years; whereas the most conservative estimate had set down eight and a half years to make a cut with a bottom width of 200 feet. As a matter of fact, the amount of material that was contained in the cut as originally planned, 53,800,000 cubic yards, was removed before the end of the calendar year 1910, or in less than four

BREAKS IN THE CANAL BANK DESTROY THE TRACKS

One type of slide was caused by cracks occurring in the banks of the canal, and often these were 300 or 400 feet back from the edge of the cut. The ground would settle, and after a time the whole mass would slide gracefully into the canal, wrecking the railroad tracks and engulfing steam shovels.

A STEAM SHOVEL HALF BURIED BY A SLIDE

Many miles of railroad track and steam shovels by the dozen have been destroyed by slides in the cut. Often, however, the slide has bodily raised the bottom of the cut, leaving steam shovels standing on their tracks, hardly out of alignment, but 15 feet or more above the place where they should normally be.

years of actual work and at a total cost of about 50 million dollars.

One of the wonderful things about the building of the canal was how, in the face of all the unforeseen difficulties that the slide problem involved, Colonel Goethals and Colonel Gaillard were able to drive down unit cost as the mercury in the difficulty thermometer sped upward. In 1908 it was estimated that the cost of removing a yard of spoil would be around 98 cents for the whole cut.

For the fiscal year 1909 they hammered this cost down to 78⅔ cents; the next year they lowered it to 73⅝ cents; in 1911, although the slide problem became much more acute, they forced it still lower—to 63⅜ cents.

But they were not satisfied even then; 1912 saw the slides more troublesome than ever, and in spite of this they forced the unit cost down to 54⅜ cents. Than this, there is no prouder showing in the history of business economy or of engineering.

Even in 1913, with the slides requiring nearly half of all the work and imposing unprecedented difficulties upon the engineers, they managed to hold down the yardage cost to 59 cents. And that is why they were able to save 20 cents on every one of the 107 million cubic yards taken out of the Central Division up to July 1, 1913—enough in the aggregate to finance the removal of all the slides, with a handsome little nest-egg left over.

DIFFERENT VARIETIES OF SLIDES

The slides with which the canal engineers have had to deal in solving the problems of Culebra Cut are of four classes. The most troublesome of these

A BREAK IN THE CANAL BANK AT CULEBRA, SHOWING LOADED FLAT CARS CAUGHT IN THE SLIDE

"Over 250 acres of ground lying outside of the intended banks of the canal, and containing over 30 million cubic yards of material, have swept, with silent but terrific force, down into the canal. Now this onslaught has demoralized an entire railroad system; now it has put the compressed air and water systems out of commission; . . . now it has imprisoned dirt trains and wrecked steam shovels" (see text, page 133).

are, more properly speaking, structural breaks.

As the big ditch neared final grade the depth was so great that the downward pressure from the top of the embankment forced the weak rock at the bottom to crumble, and this led to great fissures in the ground back some distance from the edge of the embankment. These would gradually widen, and the material would sweep downward and outward and upward into the bottom of the canal, often raising the bottom 10 to 20 feet higher than it was a few hours before.

The great slide on the west bank at Culebra, covering some 75 acres of ground and involving millions of cubic yards of material, is the best example of this kind of slide. Nearly half of all the sliding material on the canal strip was embraced in this great movement.

It began in 1907, and during the more than six years of its activity it required the dismantling and removal of half of the village of Culebra to keep out of its way. Now it was the American living quarters that had to go; now it was the big Y. M. C. A. club house, after being shored up repeatedly in the hope of saving it; now it was the penitentiary, and so on. If the cut had gone much deeper it might have been the very Administration Building itself that would have been next to go.

THE FAMOUS CUCARACHA SLIDE

The other principal type of slide is represented by Cucaracha, a mass of soft earth with no rock reaching down deep enough or holding strong enough to keep it from sliding in, slipping across a smooth surface beneath it.

Cucaracha scared out the French. It is said that when they were working along at her toe and she began to give them a tropical imitation of a glacier sliding down into a stream, they saw their visions of a sea-level canal disappearing into the realms of impossibility. At any rate, they promptly quit excavating at the bottom of Cucaracha and left her as a problem for the Americans; and a problem she declared herself to them back as far as 1905.

Cucaracha has been like the poor—a problem always with the canal engineers. Every time they got a little nearer toward the final bottom of the cut, Cucaracha would take a fresh slide, sometimes shooting millions of yards of material down the embankment and across the cut with such force that her toe would turn to the opposite bank, some 60 feet or more (see page 146). She kept this up in season and out, bottling up the south end of the cut, and so preventing the work from going forward that Colonel Goethals finally determined to let the water in and to dredge her out. He is now inviting her to do her very worst. He has a dredging fleet ready to take her out as fast as she comes in, and it now looks as if she has slid until she can slide no more (see page 148).

Meanwhile Colonel Goethals, in keeping with a suggestion made by Division Engineer Cole, decided to attack Cucaracha in the rear. She had slid and kept a-sliding until she went away back past the summit of the hill, and so it was decided to sluice off all the material that would drain away from the canal.

The plan worked well, and Cucaracha, in her final struggle against the engineers, finds herself beset before and behind, and soon she will become a thing of the past forever. But during her unremitting fight she has shut up Culebra Cut dozens of times, has brought 50 acres of ground, scenery and all, into the cut, and has required the removal of some eight or nine million cubic yards of material.

Fortunately the two great hills, Gold Hill and Contractor's Hill, stand like Gibraltars, and rear their heads proudly above the majestic scene below. They seem to be of solid rock wherever there might be danger of slides if they were not. Gold Hill is flanked by Cucaracha on the south and by East Culebra slide on the north, but has never given any sign of wanting to join the flowing procession into the cut. It rises 652 feet above the sea and is the highest hill in the canal region.

HOW THE MOUNTAIN CAME TO MOHAMMED

The slides have played many fantastic tricks in the course of the construction

A VIEW ALONG THE BOTTOM IN THE CULEBRA CUT

Where the cut was not impeded by the slides it looked just like this picture. When the water was let in about nine-tenths of the cut was in this condition

THE CUT AT BAS OBISPO, SHOWING DEEPEST PART OF THE EXCAVATION

The intention of the canal engineers is to cover the banks of the canal through Culebra Cut with vegetation, in order to prevent those small slides that come down through erosion. When the ships of the future use the canal they will sail between banks of tropic green

SLIDES FROM BOTH BANKS BLOCK THE CANAL: SEPTEMBER 20, 1913

"The slides seem to be maneuvered by the hand of some great marshal and sent forth to prey in every way calculated to put the canal engineers to discomfiture; now they are quiescent, attempting to lull the engineers into a false security; . . . now they come in the dead of night, spreading chaos and disrupting everything in whatever direction they move" (see text, page 133).

of the canal. At one time Cucaracha picked up a steam shovel, track and all, and moved it 50 feet away, but still standing ready for operation as though nothing had happened, except that it was cut off from the dirt-train tracks. At another place and time Mohammed did not have to go to the mountain, for it came to him; so at Panama a shovel was able to make a hundred trips or more back and forth along the base of a slide without moving a step closer to the dirt, for the slide came down just as fast as the shovel worked.

During their history the Culebra Cut slides destroyed over 200 miles of railroad track. Sometimes a slide would come down, forcing one track out of position, passing under the next one without disturbing it at all, and then upheaving the material under the third track mayhap as much as 10 or 20 feet.

All manner of efforts were put forth to prevent slides. It was once proposed that cutting off the top of the bank above the cut would prevent those that developed through structural breaks. But this work was vigorously prosecuted for awhile with no important bearing on the ultimate result. At another time it was suggested that a revetment of concrete along the banks of the cut would protect it, but this was a failure also. The water that seeped down from the surface got in behind the concrete and caused it to loosen its hold and scale off.

At another time it was suggested that letting water into the cut would tend to develop an equilibrium and thus prevent additional slides. But this method of treatment succeeded no better than those methods which were tried out before; and so the settled policy became one of inviting all slides that intended to come down to do so quickly, so as to have it all over with.

WHAT CAUSES THE SLIDES

The causes of the slides at Panama must be traced to the geologic history of the Isthmus. There are 11 groups of bedded rock and six of igneous rock on the canal line. The two oldest rocks are the Bas Obispo formation and the Las Cascadas agglomerate. Neither contains any fossil remains, and so their age cannot be fixed with any degree of definiteness. The Bas Obispo formation is of volcanic origin and crops out at Bas Obispo, Miraflores, and Old Panama. The Las Cascadas agglomerate is made up of basalt breccia, cemented together with volcanic clay and tufa and other lava flows.

Culebra Cut contains fossils of sea-living animals, thus proving, along with other evidence, that this great barrier which has stood between man and his dream for more than four centuries was once at the bottom of the sea.

It is stated that Gold and Contractor's hills, which now stand as the huge posts of the Panama Gateway, are composed of comparatively young volcanic rock blown up to a height some 300 feet or more above their present summits, and that they settled down to their existing level soon thereafter. The evidence of the rocks of the Isthmus is that there were two eras of volcanic activity, the one of terrific force and the other much more gentle, with a long quiescent period between them.

During the first volcanic era islands arose in the shallow ocean that linked the Atlantic and the Pacific. During the second period the whole land arose and the rivers became active, assorting the rocks as they hurried to the sea. The original bed of the Chagres at Gatun, as it existed then, is now 375 feet below sea-level. After this the ground sank to 8 feet below its present level on the Atlantic side and to 25 feet below its present level on the Pacific side. This level seems to have been maintained until a time approximating the dawn of the Christian era, when it rose to the present level.

Interesting proof of this is afforded some 80 miles from Ancon. The Indians there have been using the contents of a shell mound, found at the base of a 75-foot hill, for burning lime. The plain here is about 25 feet above sea-level. The mound contains many varieties of shells and much broken crockery, indicating that it was once used as a kitchen midden. About 2 inches of soil cover these deposits, and near-by is a place which shows that it was used as a canoe

CUCARACHA SLIDE BEFORE THE CUT WAS FLOODED

This slide "so prevented the work from going forward that Colonel Goethals finally determined to let the water in and to dredge her out" (see text, page 141). This is the last photograph taken before the cut was flooded

BLASTING A CHANNEL THROUGH CUCARACHA SLIDE

The slide completely blocked the canal, and, in the attempt to force a channel through it, a mass of dynamite was buried and exploded on October 16, 1913

A DREDGE REMOVING THE SLIDE

This dredge came from the Pacific side, and across the slide can be seen the smoke-stacks of the dredge that came from the Atlantic through the Gatun locks. Note the pipe-line through which the dirt from the slide will be pumped away to a safe place.

landing, while the remains of an ancient fishing village are in evidence.

The intention of the canal engineers is to cover the banks of the canal through Culebra Cut with vegetation in order to prevent those small slides that come down through erosion. As soon as the angle of repose is reached this work of tropical forestation will begin, and when the ships of the future use the canal they will sail between banks of tropic green except at those places where the living rock defies the efforts of the forester.

I can find no more striking way to convey to my readers the meaning of the slides at Panama than by asking them to remember that at one place where the consulting engineers said the slope should be such as to give a top width 670 feet that width is now 1,800 feet; the vastness of the difficulties created by this difference can thus be somewhat appreciated.

It is a most striking thing to look back to the days of the consulting engineers, in the light of what the completion of the canal has shown, and to see how well they appreciated conditions in Culebra Cut, especially those who advocated a sea-level canal. These men were so sure that they knew what was beneath the soil of Culebra Mountain that they did not hesitate to proclaim with confidence that Culebra Cut dug to 40 feet below the sea was no problem except that of removing material.

A member of the Isthmian Canal Commission of 1899-1901 testified that it was thoroughly known exactly what materials would be encountered in the cut, and the consulting engineers, taking their cue from this, reported that the whole proposition was an easy one. Henry Hunter, chief engineer of the Manchester Ship Canal, was so sure that a sea-level Culebra Cut would present no difficulties that he announced it as his belief that such a cut could be completed long before the locks of a lock canal could be built.

The entire majority declared that it was as clearly demonstrable as anything of such a nature could be that it would be possible to use a hundred steam shovels in the cut alone, and that a sea-level cut could be finished in 11 years at the outside.

One engineer laughed at the idea of encountering any trouble from Cucaracha slide. "Why, I have tramped over it every day for months, and with my experience with such slides I know that it is only a question of proper drainage."

Never did any set of men miss a proper statement of conditions that would be encountered more widely than the majority of the board of consulting engineers. They said the banks would stand up; that there would be no slides; that a hundred steam shovels could be used in Culebra Cut; that the cut could be built to sea-level in less time than it would require to construct locks; that a sea-level cut would require the excavation of only 110 million cubic yards of earth.

The facts are that the banks failed to stand up, to the tune of 30 million cubic yards; that there have been over 250 acres of slides; that no more than 40 steam shovels ever could be worked in Culebra Cut; that locks a fourth larger than those the majority members of the board of consulting engineers had in mind were built in less time than even a lock-level cut was dug, and that a lock-level cut has required the excavation of almost as much material as they said a sea-level cut would require.

A FORTUNATE CHANGE OF PLAN

The American people may thank their stars that at such a juncture as we were facing at the time the consulting engineers made their report, there was a man in the White House and a man at the head of the War Department who dared ignore the recommendations of the majority of that board.

Had the change to a lock canal not been made we would have worked up to about the present time on a sea-level canal, digging a tremendous ditch all through that broad country from Gatun to Gamboa, 20-odd miles, building a six-million-dollar set of tidal locks at Sosa Hill, building a six-million-dollar masonry dam at Gamboa, and doing divers other things unnecessary to a lock canal, at a total cost of some $50,000,000, only to find, after all, just as the French discovered, that a sea-level canal could not be built within the limit of money and patience set by the people behind the project.

DREDGING AWAY THE SLIDE

Courtesy of New York Herald

Here we see the Cucaracha slide after the water was let in and the dredges had got to work on it. It is composed mainly of clay, and by placing a relay pump in the pipe-line the clay can be sucked out and pumped over the banks of the canal out of harm's way

STEAM SHOVELS REMOVING CUCARACHA SLIDE

This particular slide, one of the many, completely filled the canal. The flat cars are standing on the west bank of the canal, 70 feet above the bottom of the cut

We would either have been forced to acknowledge a humiliating defeat or to have started at this late date to transform the sea-level canal that was to have been into a lock canal such as we have now. It is very easy to imagine that, with a sea-level canal fiasco staring them in the face, the American people might not have been willing to accept the lock canal, with its Gatum Dam and its great locks, and there would have been no canal in the end.

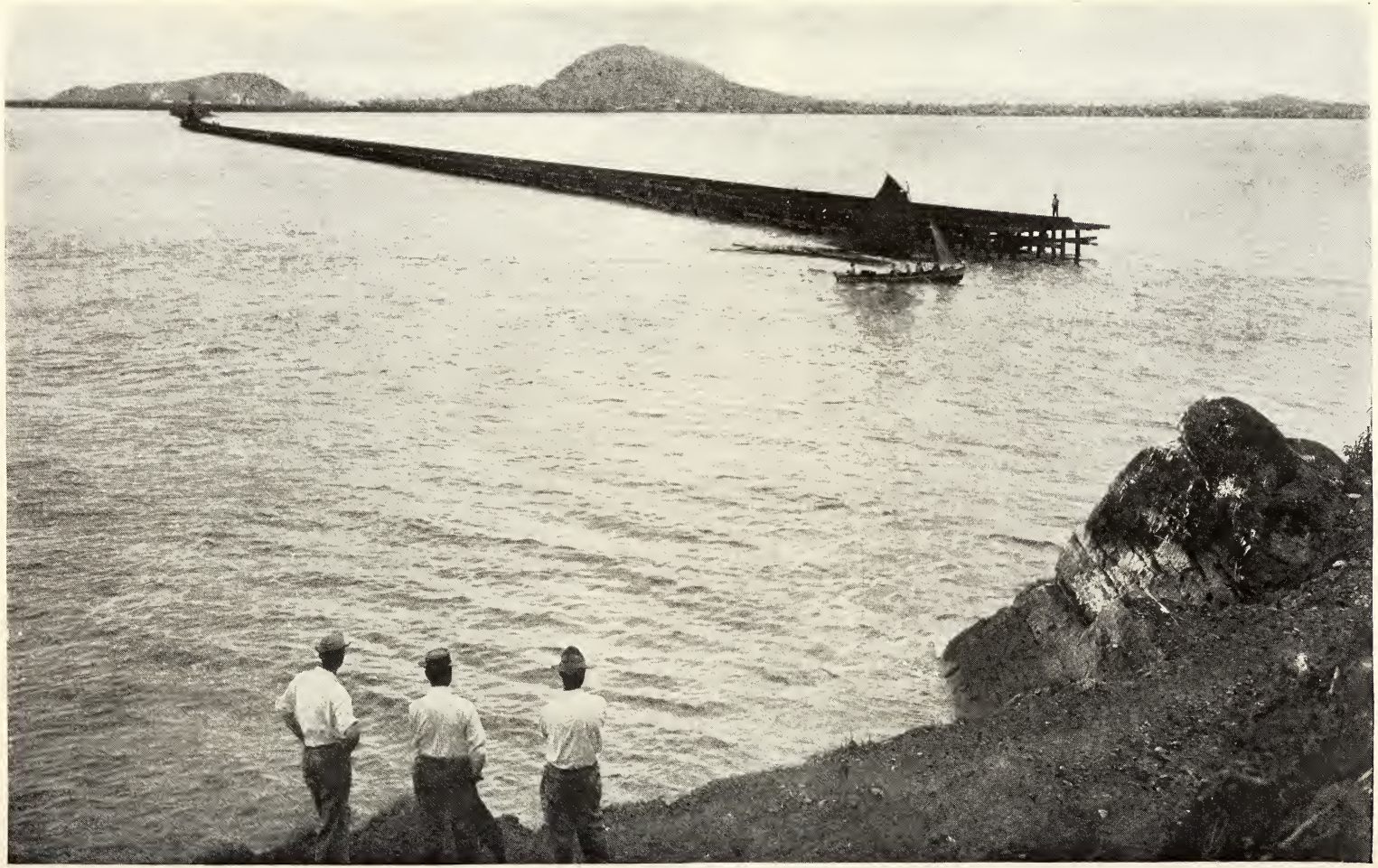
WHY A SEA-LEVEL CANAL WAS IMPOSSIBLE

Let us consider for a moment, in view of what actual work has proven, how much more excavation would be required to bring the present cut to sea-level. We have seen that the slides have grown vastly more serious as the cut has deepened.

During my last trip to the Isthmus I asked every engineer I met, from Colonel Goethals down, to estimate for me, roughly, how much more material would have to be removed from the cut to bring it to sea-level. Not one of them would risk a prediction, but all agreed that it would be more than cross-section measurements plus the slide experience of the fiscal year 1913 would indicate.

Such a cross-section measurement would involve about 50 million cubic yards. Even if the slides were no worse than they were in 1913, the extra excavation which would be required to convert the present cut into a sea-level cut would amount to approximately 75 million cubic yards.

The probabilities, therefore, are, in the light of experience, that it would require the removal of as much more material as has been taken out to make a sea-level cut; in other words, that from the vantage point at which we stand today we might fairly conclude that a sea-level Culebra Cut would have required the excavation of 210 million cubic yards of



BUILDING THE NAOS ISLAND BREAKWATER

At both the Atlantic and Pacific ends of the canal great breakwaters have been built to afford protection to the shipping and to keep the channels free. This Naos breakwater at the Panama end is 17,000 feet long and is built of material excavated from the Culebra Cut. The rock was dumped into the water from railroad trucks which ran along the wooden trestle shown in the picture.

material instead of the 110 million cubic yards the majority members of the board of consulting engineers fixed.

But suppose such a prospect would not have staggered the American people into a refusal to go further with a sea-level canal, what would we have had when it should be completed? A tortuous channel, with a tidal lock at the Pacific end in greater danger of destruction than those at Gatun; a masonry dam at Gamboa nearly twice as high as Gatun Dam and a much fairer mark for the dread man in the flying machine; a canal in which not one of the recently built big ships could be handled, making it out of date before its completion.

When the American people come to celebrate the opening of the present canal, they owe a hymn of thanksgiving to that happy fate that led them—yes, led them against their will—to build a lock canal at Panama. To have pursued the course the majority of us—for I am one of that majority—wanted the United States to pursue would have involved us in one of the most calamitous undertakings in all history.

The meaning of the slides cannot be misunderstood or misinterpreted. They mean that Nature would have interposed such tremendous obstacles in the way of a sea-level cut through Culebra Mountain that even the might and power and wealth of the giant of the household of nations would have arrayed themselves against her in vain had that nation determined upon the wedding of the oceans by the commingling of their waters at Panama.

In conclusion, I wish to call attention to a story that seems to find acceptance in some quarters. It is to the effect that shipping and insurance circles stand in dread of slides in the future in the canal.

There are two reasons why there is not the slightest ground for that dread, even if there should be for the story. In the first place, the canal is not going to be pronounced a finished waterway until every yard of debris that can come in has arrived and has been removed. In the second place, the United States government has pledged its solemn word, through definite legislation, to indemnify any ship-owner for delays or damages caused by the canal or its operatives. And Uncle Sam makes the process of recovery easy and prompt in its action.

When the shipping of the world passes through the great waterway, some time this year, it will behold the most wonderful shipway that ever has opened its gates to the nations of the earth. And there will be read in the majestic proportions of the present Culebra Cut the reason why a sea-level canal was not built, and why it could not be built within the toiling and money-spending power of the United States.

THE PANAMA CANAL*

By Lieut. Colonel William L. Sibert, U. S. Army

Engineer in Charge of the Atlantic Division

For a map of the Panama Canal, see "Bird's-eye View of the Panama Canal," 9 by 18 inches, in National Geographic Magazine, *February, 1912, and also "Map of Central America, etc.," 12 by 19 inches, in the February, 1913, number.*

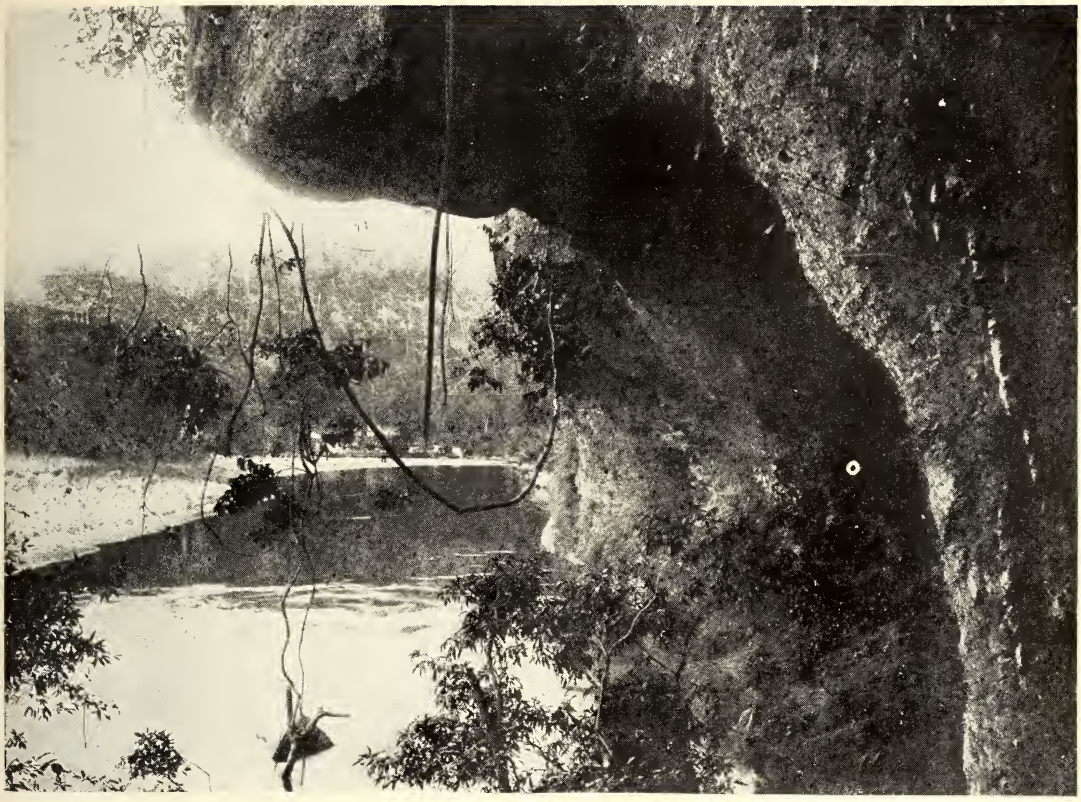
THE Panama Canal, as all know, is being built by the President of the United States through a commission of seven members, the chairman and chief engineer of which is Col. George W. Goethals, of the Corps of Engineers, United States Army. As a member of the commission and as division engineer of the Atlantic Division, I have had charge of the construction of the Gatun locks, the Gatun Dam, the breakwaters in Colon Harbor, and the excavation of the channel between the Gatun locks and the Atlantic Ocean.

If there are any people who yet hold the idea that the waters of the Atlantic

*An address to the National Geographic Society, November 29, 1913

A VIEW ON THE CHAGRES RIVER

It is the Chagres River that has made the Panama Canal possible. It supplies the water for the Gatun Lake—the largest artificial lake in the world—across which the vessels will steam for nearly two-thirds of the entire distance from coast to coast



ON THE UPPER CHAGRES

This picture gives some idea of the many beauty spots found along the banks of the Chagres River

and Pacific will mingle in this canal, I think that two statements of fact will dispel that idea forever.

One of the statements is that for about 32 miles this canal is 85 feet above the level of the Atlantic and Pacific. The second statement is that water will not flow uphill.

HOW THE CANAL IS DESIGNED

What has really been done is that a great dam has been built across the lower end of the valley of the Chagres, entirely blocking the flow of that river to the sea. The height of the dam and spillway is so fixed that the Chagres River will rise and rise until it reaches a stage 85 feet above the level of either ocean. At this stage the Chagres River will form a lake 165 square miles in area and 45 feet above the bottom of the cut that has been made through the Continental Divide at Culebra.

The Chagres, therefore, can flow into both oceans—to the Atlantic through the locks at Gatun and to the Pacific through the locks at Pedro Miguel and Miraflores. The water of the Gatun Lake not needed in passing ships through the locks goes to the Atlantic Ocean through a spillway (see page 170).

THE BREAKWATERS AT COLON

Starting at the Atlantic side, the first work that has been done is the construction of the west breakwater at Colon. It was thought that that breakwater would be sufficient to insure a safe harbor. The line of the canal at Colon is due north and south, and the most destructive storms, the "northers," are from a little west of north; so that the west breakwater will provide a safe anchorage for ships during such storms.

The prevailing winds at Colon, however, are the trade winds, that blow from the east or north and continue for more than nine months of the year. These winds do not produce a sea destructive to shipping, but they make a rough har-

SPORT ON THE CHAGRES

One of the diversions very popular among the sporting members of the canal staff was alligator hunting. The upper waters of the Chagres could usually be relied upon to produce excellent sport, though these great reptiles are found in all the principal streams on the Isthmus

bor, stir up the soft bottom of Limon Bay and create currents, with the result that there is a large amount of silting in the channel through the bay. For two years in succession this silting amounted to more than two million cubic yards of material.

In order to remedy this condition, and for other reasons, it has been decided to construct an east breakwater also. Its end will be opposite the end of the west breakwater, leaving an opening of 2,000 feet. When this breakwater is completed, the silting in the channel will cease and all difficulties of transfers from one boat to another in the harbor will be eliminated. The west breakwater should be completed in the summer of 1914, and the work on the east breakwater has just commenced.

HOW THE BREAKWATERS ARE BUILT

The method of building the breakwaters is as follows:

A trestle, suitable for a double-track railroad, was driven from the shore, extending for two miles out to sea. The rock forming the bottom of the breakwater was run out on cars and dumped or plowed off until the fill was made alongside the trestle to an elevation of 15 feet below sea-level (compare page 152). Between that level and 10 feet above sea-level the breakwater was built of hard trap rock, obtained from Porto Bello, the stone ranging in weight from 1,500 pounds to 15 tons.

The stone for the armor of the breakwater, as well as all crushed stone for the Gatun locks, came from this seacoast town of Porto Bello, situated some 20 miles northeast of Colon.

This place has given all kinds of trouble. The first year we attempted to crush stone for the Gatun locks, we had at Porto Bello a rainfall amounting to 237 inches—3 inches less than 20 feet; 9 feet of rainfall in two months; 58 inches in one month.

Everything happened at Porto Bello that could happen. Slides that no engineer would dream of occurring did occur. On an average 300,000 cubic yards of crushed stone every day were necessary for the concrete at Gatun. We had a young officer of engineers there, Captain Stickle, who was doing the best he could, but we were pushing him anyway; so, after he had been urged and urged and then urged again to do more, one day he sent a wireless, "Fifty-eight inches of rain this month. Anything over fifty inches considered an act of God."

THE FRENCH CANAL WOULD HAVE BEEN USELESS NOW

A little to the north of the Gatun locks the American and French canals intersect, and the picture on page 158 shows the relative sizes of the two. Had the French canal been completed it would now be out of date, for its locks would not be of a size sufficient to pass the boats that would now offer.

In the French project the sea-level part of the canal on the Atlantic side extended about 10 miles farther up the Chagres Valley than the American project. The water supply would have been materially less than in the American plan and would not have been sufficient for the substitution of locks of the size now built, and those now adopted are none too large to meet the requirements of Congress that the Panama Canal should be built of such size as reasonably to meet the demands of the future as to the size of ships.*

The canal is at sea-level from the Atlantic to Gatun; it then goes up a flight of three steps to Gatun Lake and continues at that level for 32 miles. Then down one step at Pedro Miguel to Miraflores Lake, which is 55 feet above sea-level; thence through the Miraflores locks, and the canal from there to the Pacific is at sea-level again.

The proudest day that Gatun has yet had was on the 26th day of September, 1913, when the little tugboat *Gatun* was lifted from sea-level to the surface of Gatun Lake, and was the first boat to pass through any lock of the Panama Canal (see page 162).

*The full length of each lock compartment is 1,000 feet. The largest ship in the world, the *Vaterland*, of the Hamburg-American Line, which is not yet completed, has a length of 950 feet. While it is unlikely that the huge liners used in the transatlantic passenger service will often be required to pass through the canal, still the locks are big enough to accommodate the largest ship in the world.

A COMPARISON OF THE FRENCH AND AMERICAN CANALS

This is a picture looking toward the Atlantic Ocean from the Gatun locks at the point where the present canal crosses the French excavations. Had the French canal been completed, it would now be out of date, as it was much smaller than the present one and its locks would not be of a size sufficient to pass the large ships of the present day.

As soon as a boat passes the lower lock gates they are closed behind it, and water is let into that box or lock chamber from the lock above until the same level of water exists in the lower and middle locks, the boat being lifted 28⅓ feet in this operation. After that the gate separating the lower and middle lock will be opened and the boat will pass into the second lock, the gates closed behind it, and the process repeated, the boat being lifted another 28⅓ feet. That operation repeated once more will cause the boat to float out on the level of Gatun Lake.

The filling of the lower chamber of Gatun lock for the first time is shown in the picture on page 164. The gate on which all the men are standing is called the east gate or guard gate. These gates were completed as soon as practicable and then closed, so as to keep the sea out of the locks while dredges were completing the excavations in the lock entrance, thus not interfering with the work on the other gates nor with the machinery installation.

PAINTING MOSQUITOES

On both sides of the channel at Gatun were extensive swamps. They were great breeding places for mosquitoes, and in digging the channel through the soft, swampy bottom pipe-line dredges were used. These dredges cut up the material near the suction of the pumps, draw it in with water, and force it long distances through pipe-lines. In making the channel excavation those swamp areas were built up high enough to enable the sanitary department to drain them.

In 1912 Gatun had probably the greatest influx of malarial mosquitoes in its history; they came by the thousands. The Gatun Lake was rising at that time, and it was not known whether these mosquitoes were coming from that lake or not; so the sanitary department determined to locate all the breeding places for mosquitoes near Gatun, catch mosquitoes at each place, and after painting them turn them loose, and determine by the color of the mosquitoes caught in Gatun from what point they came.

It was found that the largest breeding place was off to the west of the locks, in an old swamp that had given no trouble previously. A few mosquitoes had bred in this place all the time, but there were enough wild animals in the swamp to supply food, so the mosquitoes were not forced to migrate. When salt water was pumped into the swamp water, making the mixture about 30 per cent salt, mosquitoes began to breed by the trillions.

I went down there one morning to see how the mosquitoes were caught and painted. Walking along the edge of the water, mosquito bars were seen suspended from limbs tied up at the bottom. They had thousands of mosquitoes in them ready to be sprayed with a colored liquid, and the sanitary inspector was asked how he caught them.

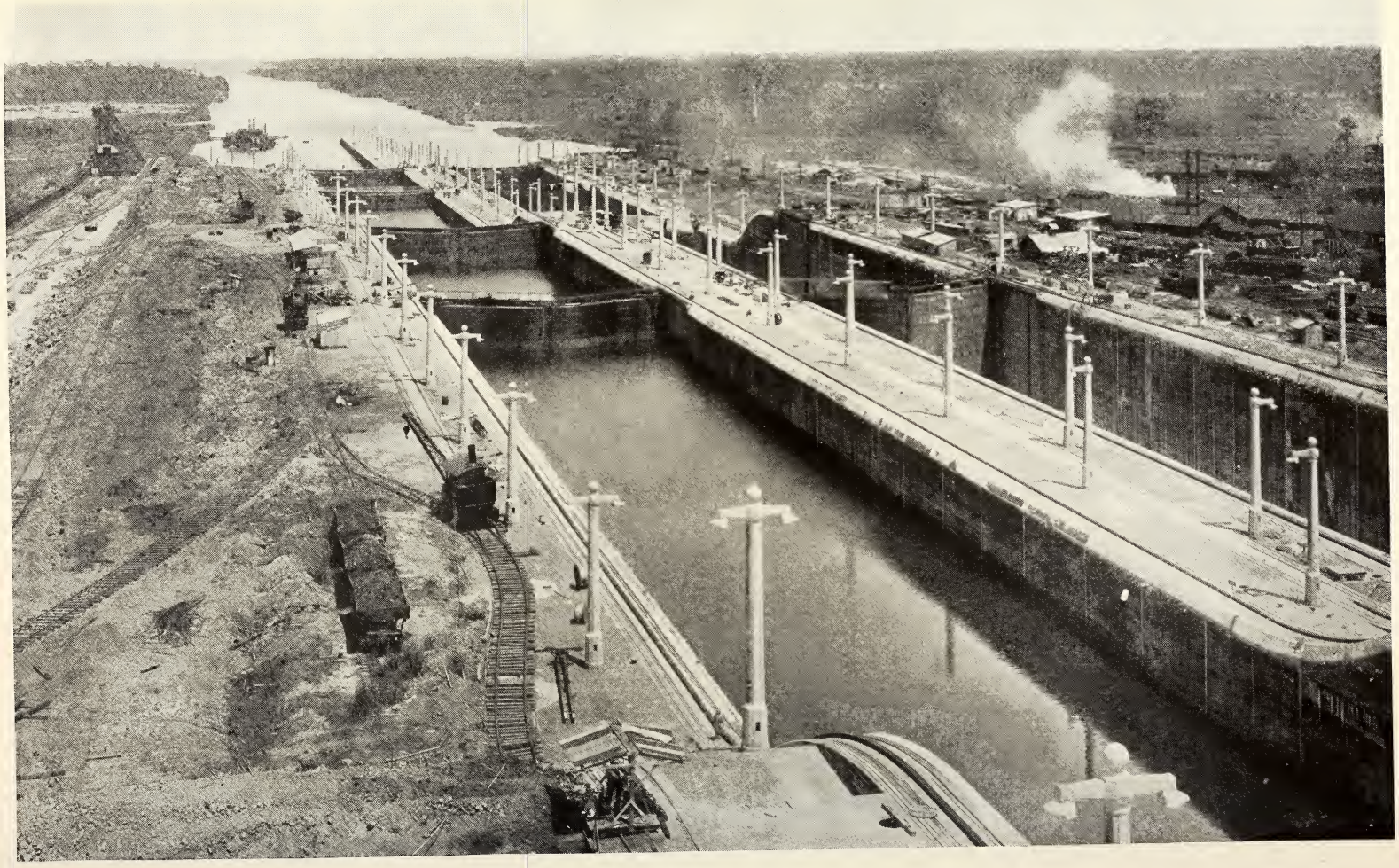
He said, "We have a more scientific way, but this had to be done in a hurry. We simply let the mosquito bar down, as you would over a bed, left one side of it open, and put a Jamaica negro in there for bait." As soon as the mosquito bar was full the bait was removed and the end tied up.

I saw some Jamaican negroes sitting out in front, and I said to one fellow, "John, were you the bait in that bar?" and he replied, "Yes, boss; that is the easiest money I ever earned—ten cents an hour for sitting there and doing nothing but just inviting the mosquitoes in."

THE DREDGING FLEET

Just prior to the time that water was let into Culebra Cut, a fleet of dredges was brought up preparatory to removing Cucaracha slide, the last one that obstructed the passage across the continent. The picture on page 166 shows part of the fleet assembled for passing through the locks, and gives a good picture of a pipe-line dredge, showing the cutter in front. When this cutter is revolved, those blades loosen the dirt, the intake of the pump is just behind, and when the water is drawn in by the pump it carries in from 15 to 20 per cent of solid matter, and the pump gives it velocity enough to be carried from one-half to three-quarters of a mile through a pipe.

The entire dredging fleet is shown in the picture on page 167. There were



THE GATUN LOCKS, LOOKING TOWARD THE ATLANTIC

The waters of the Atlantic flow into the canal for seven miles, until they reach the first gates of the lower lock at Gatun. The lower and middle locks are shown in the picture, while the incline leading to the upper locks appears in the foreground. The swamps in the distance at the left were a constant source of trouble while the locks were being made, owing to the innumerable mosquitoes which bred in them (see page 159).

THE LOCKS AT GATUN, LOOKING IN THE OPPOSITE DIRECTION TOWARD GATUN LAKE

These are the upper locks at Gatun, where vessels lie during the last of the three stages of being lifted from sea-level, on the Atlantic side, to the level of the Gatun Lake, 85 feet above, after which there is 32 miles of clear sailing before Pedro Miguel, the first lock on the Pacific side, is reached. Beyond the locks we see Gatun Lake, 165 square miles in extent. Note the floating islands.

FIRST BOAT THROUGH THE GATUN LOCKS

One of the memorable days in the history of the Panama Canal was September 26, 1913, when the tugboat *Gatun* was lifted from sea-level to the surface of Gatun Lake, being the first boat to pass through any lock on the canal

about ten vessels of various sorts in one lock chamber, and even then it was not full. Attention is especially called to one piece of plant in the fleet, and that is the old French dredge, a ladder dredge distinguished by the endless chain with buckets. This old French dredge has served loyally two administrations and is still in the advance guard going to attack Cucaracha slide. By a peculiar coincidence, M. Bunau Varilla, the former chief engineer of the French Canal Company, passed through the locks during this event aboard one of the boats in the fleet. He, as you know, was a great advocate of a sea-level canal.

More precautions have been taken probably in the Panama Canal locks than in any other locks in the world. In addition to having duplicate gates at each end of the lock, a great chain is attached to a system of hydraulic cylinders and kept in the position shown until a boat makes a landing alongside the guide wall and a towing locomotive takes charge of it. Then the chain is lowered into a groove in the bottom of the canal. This fender chain across the entrance is shown in the picture on page 168.

THE FLOATING ISLANDS OF GATUN LAKE

A large part of the bed of what is now Gatun Lake was formerly swamp land. In that swamp were logs on which grass and small trees had grown. When the lake rose, the entire bottom floated. The wind broke it into pieces, sometimes an acre or more in extent, and since that time these pieces have been floating aimlessly about the lake (see page 172).

During the fall of 1912 the water was allowed to flow 6 or 7 feet deep over the uncompleted spillway, and a large number of these floating islands were passed over it. As soon as the lake reaches normal height and water can be spared, these floating islands will be towed systematically to the spillway and passed over and out to the Atlantic.

As the waters of the Chagres River came down and encountered the dam at Gatun the lake was gradually formed, and during this process much vegetation was submerged. As the lake rose it gave the ladies of Panama great opportunities for collecting orchids.

The most beautiful orchids have a way of growing on the largest trees, and so high that they are difficult to get; but while the lake was rising to 85 feet above sea-level, one could row around in small boats through the trees and pick them off (see pages 174 and 175). A Kipling should have been at Panama to write a jungle story that would describe the action of the wild animals when this great permanent flood of the Chagres came.

The last natural barrier that held back the water of Gatun Lake from the cut that had been made across the Continental Divide was the dike at Gamboa. Up to this point the canal has followed the Chagres Valley. It now leaves the valley and cuts across the Continental Divide to Pedro Miguel, and there commences to go down the Pacific slope.

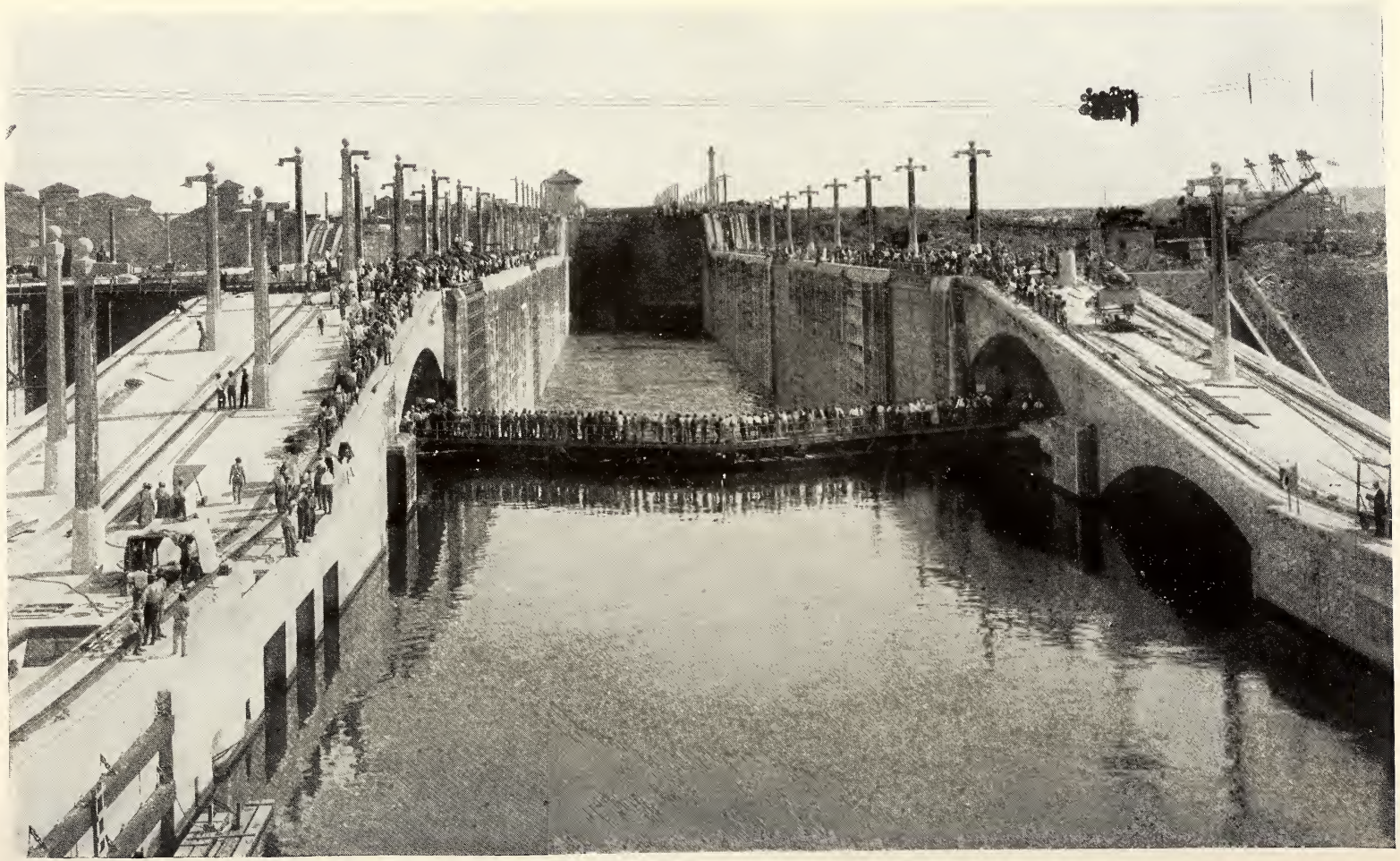
The Gamboa dike was broken down on October 10, 1913, by the explosion of a charge of dynamite which had been stored in it. This charge was fired by the depression of a telegraph key in the White House at Washington by President Wilson (see page 176). Before the dike was blown up, water was allowed to enter the Culebra Cut through pipes, so as to fill it to within 5 or 6 feet of the level of the lake. Had it been blown up with 30 feet difference in level, some damage might have resulted.

THE CULEBRA CUT AND THE SLIDES

The Culebra Cut will, it is thought, be the most striking of all the features of the canal. The Gatun Lake, when all the trees are gone, will be beautiful with its green islands and green promontories; but the most striking feature, I think, will always be the great cut across the Continental Divide.

The most difficult slides to handle have occurred in that part of the canal near the Continental Divide, marked by Gold Hill and Contractor's Hill, all comprised in a length of about 1½ miles of canal. Just beyond Gold Hill is the famous Cucaracha slide (see pages 147 and 151), the surface of which was above the lake level when the water entered Culebra Cut, and it prevented the water from flowing through the cut to Pedro Miguel.

An unsuccessful attempt was made on the same day that the dike at Gamboa



OPERATING THE GATUN LOCKS FOR THE FIRST TIME

The gate on which all the men are standing, while watching the lower chamber of the lock being filled for the first time, is the sea gate or guard gate (see page 159)

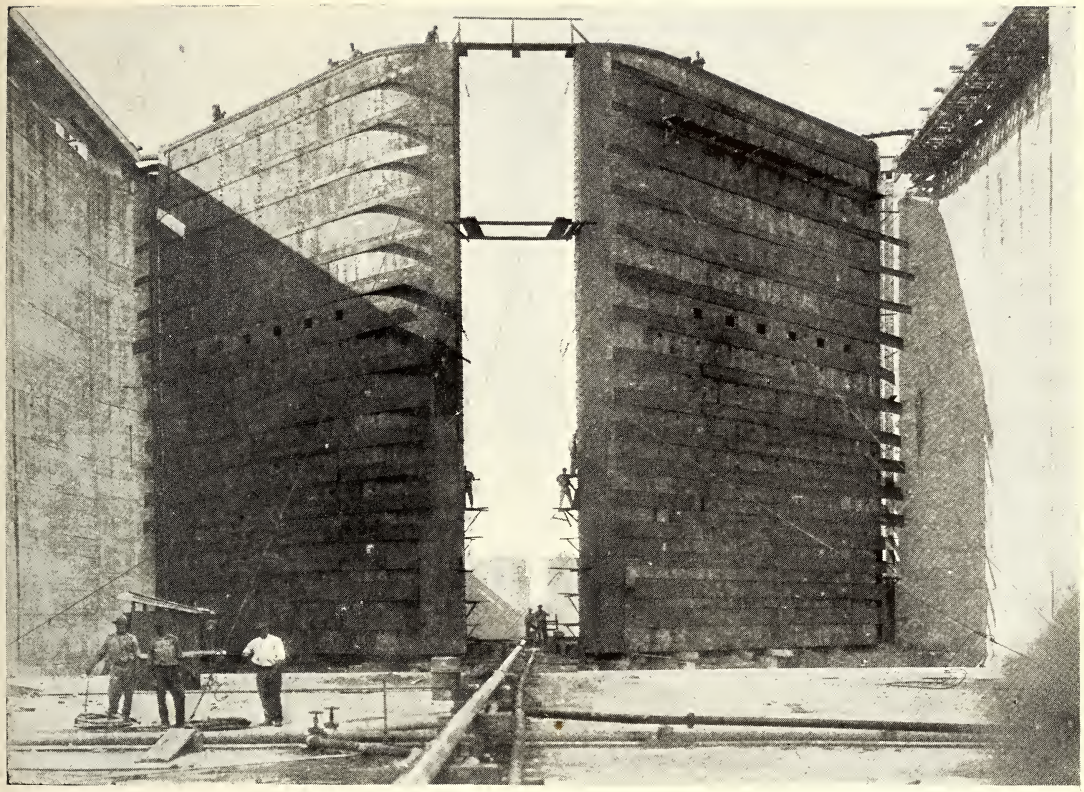


Photo and copyright by Edith H. Tracy

THE LOCK GATES

The lock gates are a most interesting feature of the canal. There are 46 of them, each having two leaves, and their total weight amounts to 58,000 tons. They vary in size from 47 to 82 feet in height and it takes no less than six million rivets to put them together. Some idea of their enormous size can be gained by comparing the men working on them with the gates themselves.

was destroyed to blast a channel through this slide. A ditch, however, was finally made across it, through which that part of the canal between Cucaracha and Pedro Miguel was filled with water. This allowed dredges to be towed from the Pacific end of the canal to assist those already brought from the Atlantic side in completing the channel excavations.

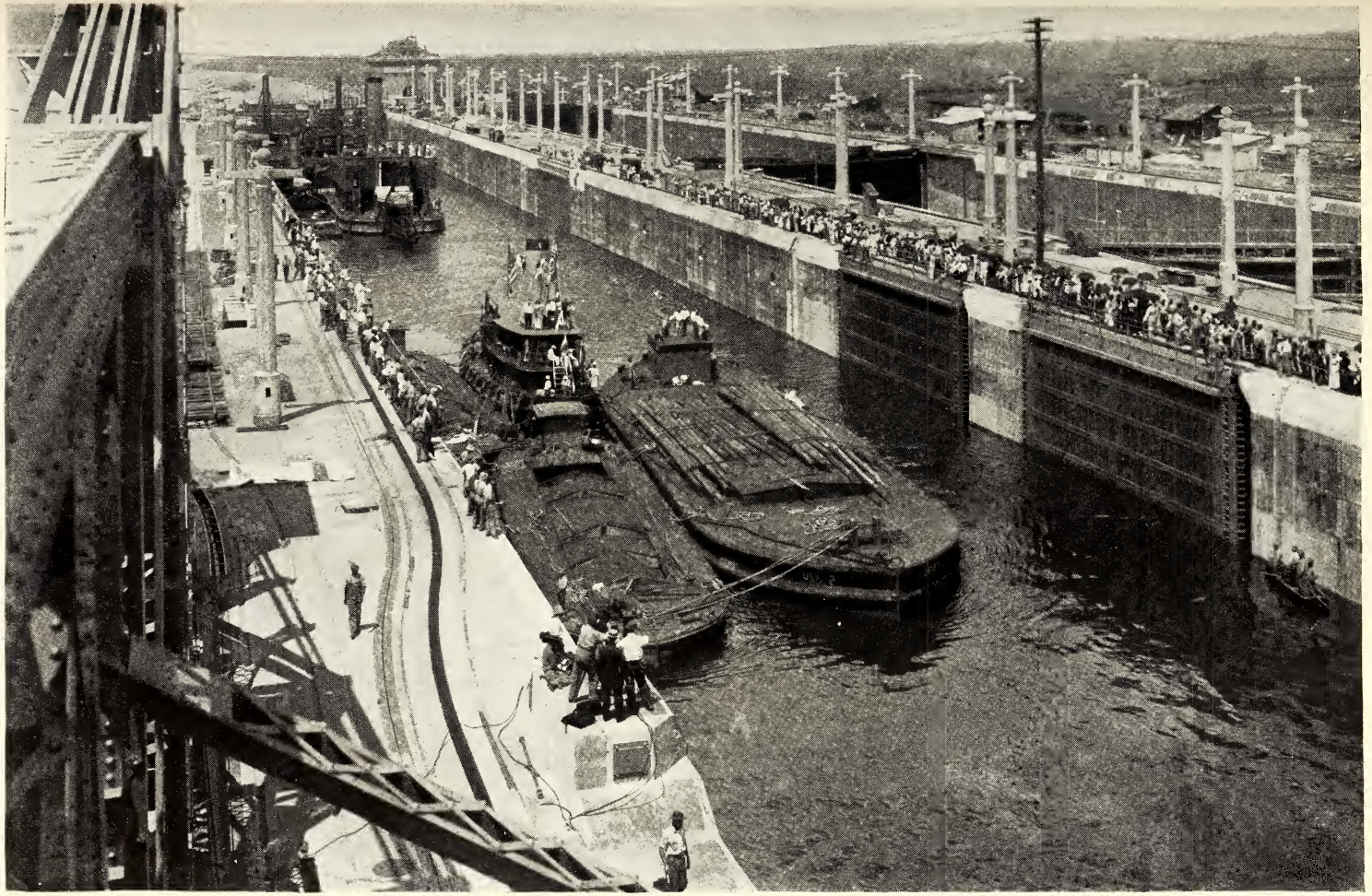
The Cucaracha slide has broken back to the crest of the hill behind Gold Hill, a half a mile or more from the prism. Since the slide is now broken back to the crest of the hill, and since the face of the hill away from the canal is being artificially removed, a fairly close calculation can now be made as to the number of cubic yards of material that can slide into the canal from that source and the approximate time that it will take to remove it.

A large part of the material composing this slide is clay, and it is hoped that it can be removed by pipe-line dredges. By placing a relay pump in the pipe-line, material can be forced over the banks of the canal. The pipe-line dredge is very efficient in digging and transporting material away from the site, providing the distance or lift is not too great. Material can be so transported from a half to three-quarters of a mile with great ease.

One of the dredges getting ready to attack the Cucaracha slide from the south is shown in the picture on page 148. This dredge came from the Pacific side, and across the slide can be seen the smoke-stack of the dredge that came from the Atlantic through the Gatun locks. It is hoped that within two or three months a channel can be made of sufficient width and depth for the passage of ships. How-

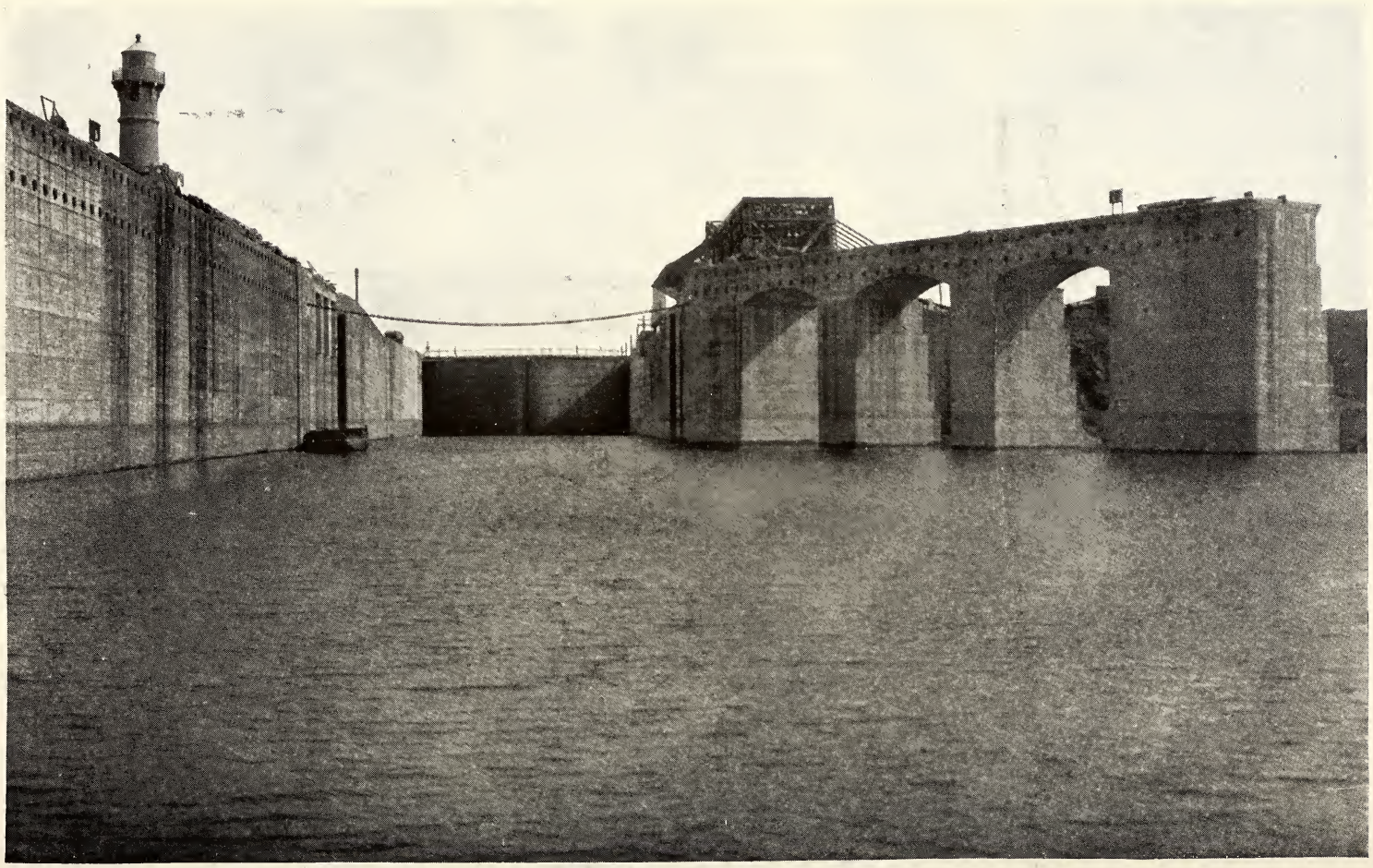
ONE OF THE GREAT SUCTION DREDGES ENTERING GATUN LOCKS

This is one of the great suction or pipe-line dredges, showing the cutter in front. When this cutter is revolved the blades loosen the dirt; the intake of the pump is just behind it, and when water is drawn in by the pump it carries in from 15 to 20 per cent of solid matter, and the pump gives it velocity enough to be carried from one-half to three-quarters of a mile through a pipe (see page 159).



DREDGING FLEET IN THE MIDDLE LOCK AT GATUN

The fleet is on its way to the Culebra Cut to help in removing the Cucaracha slide. The last dredge in the lock is an old French dredge of the ladder type, having an endless chain with buckets. This dredge has served loyally through two administrations and at the end was still in the advance guard. The immense size of the locks can be realized from the fact that there are ten vessels in this lock and yet it is not full.



ENTRANCE TO THE UPPER LOCKS AT GATUN, SHOWING THE GREAT GUARD CHAIN

"More precautions have been taken probably in the Panama Canal locks than in any other locks in the world. In addition to having duplicate gates at each end of the upper lock, a great chain is attached to a system of hydraulic cylinders and kept in the position shown until a boat makes a landing alongside the guide wall and a towing locomotive takes charge of it. Then the chain is lowered into a groove in the bottom of the canal" (see text, page 163).

ever, no one who has served on the canal would try to make a definite prediction. A picture of this slide before the water was let in is shown on page 146.

Gold Hill is a hard trap rock, with a volcanic neck extending down to an unknown depth, and is there to stay. On either side of it, however, the strata were very much disturbed and slides have occurred of all kinds of material, both clay and rock. The slides on the north side are nearly all of soft rock.

Colonel Gaillard, who had charge of the work in Culebra Cut, never knew, when he returned to work in the morning, that tracks and shovels would be found as left the night before. He struggled with the cut for six long years, until it was practically completed, but finally broke and died under the strain.

Two distinctive kinds of slides are encountered in Culebra Cut. In one case the entire body of material moves practically on an inclined plane, this plane being sometimes rock, sometimes clay. The Cucaracha slide is of this character and is called a true slide.

In slides of the other character, the first indication is a crack in the bank, sometimes 300 or 400 feet back from the edge of the cut. This crack or break opens, and the ground there will often settle down before it does at the edge of the cut. When the general movement comes, the bottom of the cut comes up. Steam shovels have been lifted by one of these slides as much as 18 feet, with the tracks hardly thrown out of alignment.

EARTHQUAKES AND THE CANAL

One of the great arguments against a lock canal at Panama was the earthquake argument, which prophesied that the locks would inevitably be destroyed by earthquake shocks. The picture shown on page 179 is the answer to that argument. It shows the famous flat arch in the now ruined church of Santo Domingo in Panama City, which has stood there for more than 200 years. The existence of this old and apparently unstable structure is a proof that Panama is free from serious earthquakes.

An examination of this arch, taken in connection with the fact that it has stood for the length of time it has, seems to warrant the conclusion that Panama has been more free from serious earthquakes during the time in question than Tennessee, Missouri, or Arkansas, when it is remembered that Reel Foot Lake, in Tennessee, and the "Sunk Lands," in Missouri and Arkansas, along the basin of St. Francis, were formed during an earthquake in 1812, a little more than a century ago, while this structure has stood for more than twice that period.

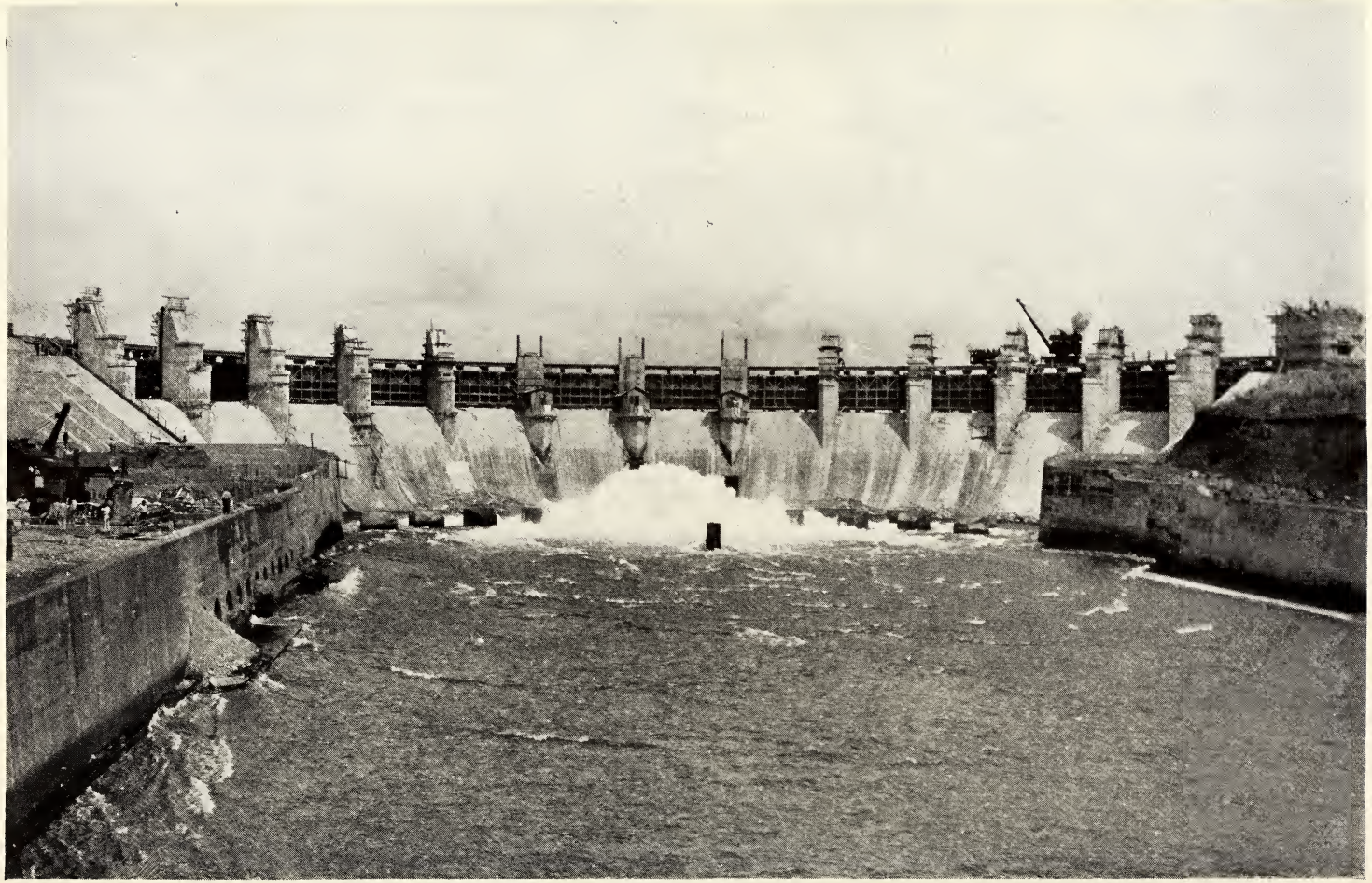
Panama has been visited by a few earthquake tremors lately, one of them being of sufficient intensity to cause vases to fall from shelves, but careful examination of the locks failed to show the slightest cracks in the masonry, and the dam showed no tendency to settle or change its form in any way whatever. The center of the disturbances which produce the tremors is usually about 200 or 300 miles away. I do not know where the center of these last disturbances was, but when the serious earthquakes occurred in Costa Rica two or three years ago, only slight tremors were felt at Panama.

While I was away, in November, my wife wrote me that there had been another little earthquake since I left. She was upstairs and had a Jamaican woman sewing at the time, and just as the house commenced to shake the Jamaican woman fell down on her knees to pray. While my wife believes in the efficacy of prayer, she told the woman that the best place to pray during an earthquake was outside. The advice is thought to be good.

THE GATUN LOCKS

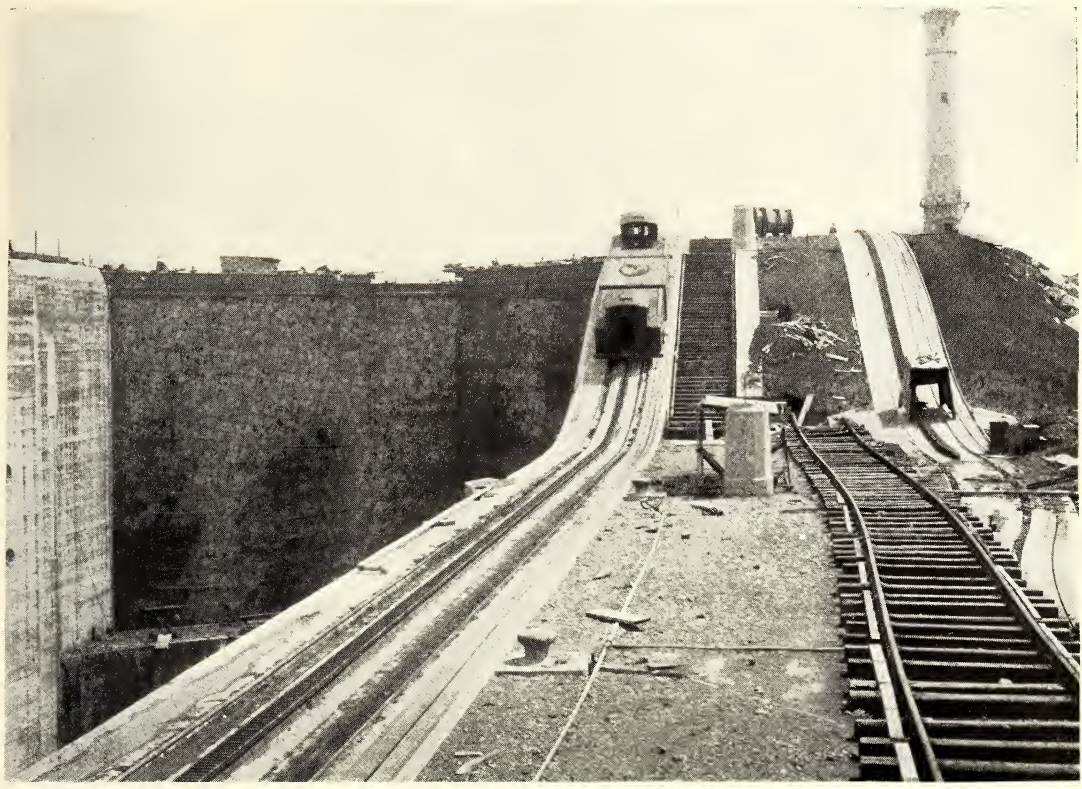
All the essential features of the Gatun locks are situated on rock. It is a soft rock and was called indurated clay in the first description of it; but people did not understand what indurated clay meant, and so the name was changed to argillaceous sandstone.

This stone is solid and makes a good foundation when not exposed to the air. If so exposed, however, it acts like shale and goes to pieces. In making an excavation for the locks and as soon as grade was reached, the foundation was immediately covered with concrete, thus re-



THE SAFETY VALVE FOR THE CHAGRES RIVER AND GATUN LAKE: THE GATUN SPILLWAY

The surplus waters of the Gatun Lake escape to the Atlantic Ocean through this spillway. It is a large semicircular concrete dam, along the top of which are 13 piers, which furnish it with 14 outlets. These outlets are closed by huge steel gates, 45 feet wide and 20 feet high, each weighing 42 tons. Should the Chagres River fill Gatun Lake so full of water as to endanger the locks at Gatun, this spillway would act as the safety valve. Even if the lake rose to the improbable height of 92 feet above sea-level—its normal height is 85 feet—it would not be necessary to open all the gates on the spillway. Three or four of them would carry off all the water necessary to avert danger.



THE LOCOMOTIVES OF THE LOCK

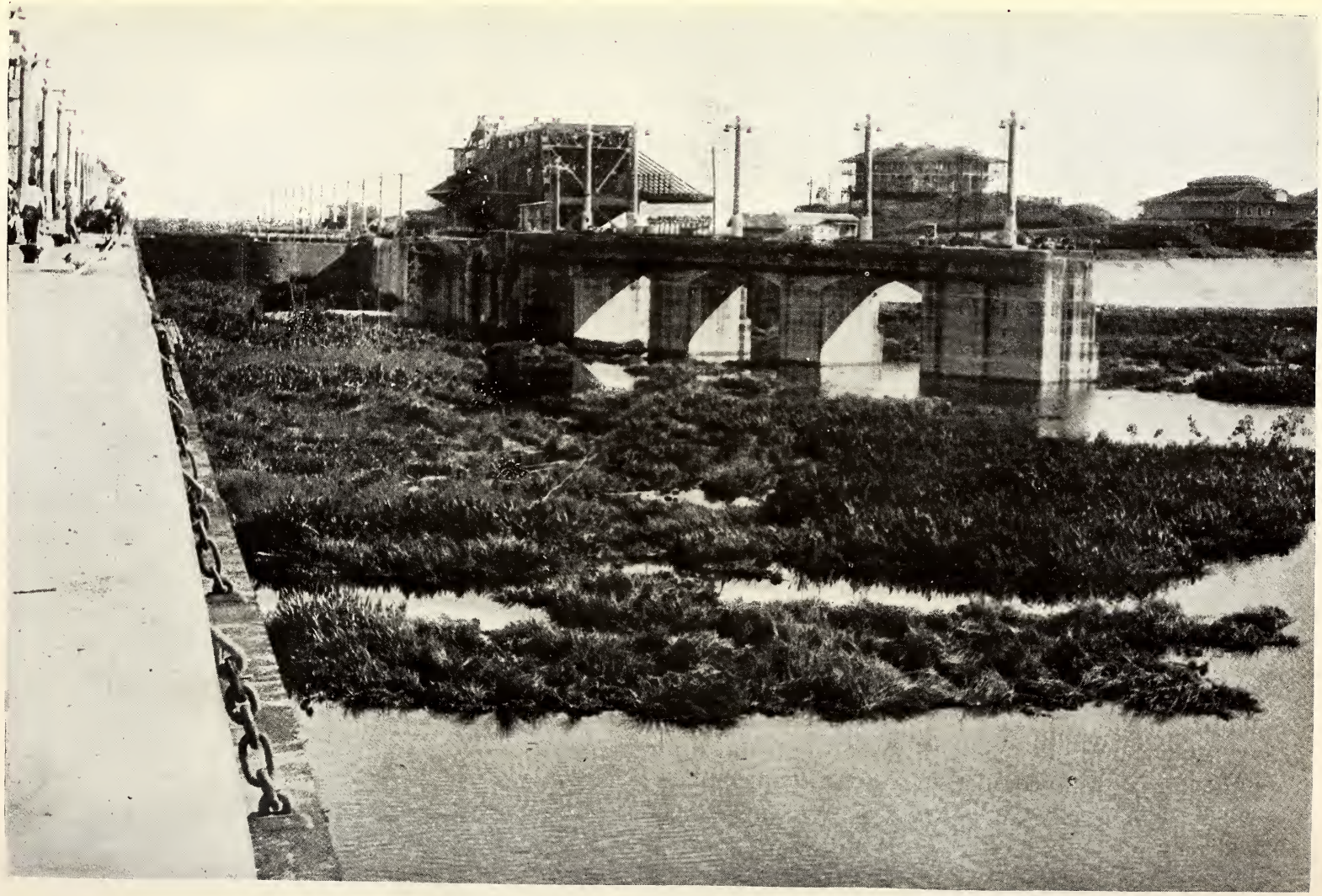
These little electric locomotives, here shown climbing the incline between the middle and upper locks at Gatun, are very powerful and will be used to draw the big ships through the locks. No ship will be allowed to go through the locks under its own steam (see page 173). Note the men at work on the huge lock gates.

producing the same condition under which nature has kept the rock sound.

There can be no question as to excellence of the foundation of the locks at Gatun. They are completed and have been subjected to the most trying conditions without the slightest settlement or crack. As stated before, all the essential parts are on rocks; the only exception is the south guide wall, the one that leads into Gatun Lake. This is built on piles and is of as light construction as possible. It has no particular function except that ships will land on both sides of it.

Prior to the construction of the Gatun locks, many holes were made with a diamond-drill outfit into the rock foundation to depths of 100 feet or more below sea-level in order to ascertain the character of the foundation and determine whether or not the rock was sufficiently creviced to transmit pressure from the lake to the lock floor. After the holes were bored the ground water showed in them. By pumping the water out of some of the holes and observing to what extent and how quickly the water was lowered in the others, conclusions were drawn as to the probability of the rock being sufficiently creviced to transmit pressure.

These experiments indicated that minute crevices were in the rock, not enough for the passage of any appreciable amount of water, but probably enough to transmit pressure. Consequently the floors in the Gatun locks from the emergency dams to the intermediate gates of the upper locks are so built that if the full lake pressure does come under them they will stand it. Below that, provision is made for carrying any leakage to sea-level through drains behind the lock walls.



FLOATING ISLANDS OBSTRUCTING THE LOCK

Photo and copyright by Underwood & Underwood

A large part of Gatun Lake bed was swamp land. In that swamp were logs on which grass and small trees had grown. When the lake rose the entire bottom floated. The wind broke it into pieces, sometimes an acre or more in extent, and since that time these pieces have been floating aimlessly about the lake.

In case a ship should break the upper lock gates and the Gatun Lake should start to flow through the flight of locks to the sea, a swing bridge is provided for each upper lock, by means of which an emergency dam can be built across the locks. The operation of these swing-bridge dams is as follows: The bridge is first swung across the lock chamber and heavy girders are then lowered, one end of each of them finally resting against a sill previously built in the bottom of the lock entrance. Steel curtains are then run down in tiers on tracks on the girders, gradually building a dam and stopping the flow of water. The girders and curtains are all lowered under power and the entire operation can be carried on through swiftly flowing water.

It is purposed to allow no ship to go through the locks of the Panama Canal under its own steam. A ship will be required to land alongside the guide wall at either end of the locks.

Towing locomotives, four of them, will run down the guide walls, pass lines to the ship, two forward and two aft, and will then tow the ship into the locks, hold it during the time it is being raised or lowered, and finally deliver it alongside the guide wall at the other end. This is a precaution that has never been taken before in operating locks. One of the experimental towing locomotives is shown in the picture on page 171.

Ships are ordinarily allowed to pass through locks under their own steam. The wrong ringing of a bell or the misunderstanding of a bell has ordinarily been the cause of wrecking a lock gate.

HIGH AND DRY BELOW SEA-LEVEL

One of the most difficult problems at Gatun was the preparation of a foundation at the lower end of the locks. It was necessary to go 70 feet below sea-level through soft mud to find rock suitable for foundations. The material was so soft that steam shovels could not be supported on it, so it was decided to do the excavation by dredges. A sufficient width of land between the space to be excavated and the canal toward the Atlantic was left to act as a dam when the excavation was finally completed and unwatered.

A dredge was allowed to cut a narrow channel through this dam into the space where the walls were to be built. This dredge dug the entire space to a depth 40 feet below sea-level, which was its limit. A dam was then placed across the narrow entrance cut, with the result that the dredge lowered itself as it continued its work. When it had lowered itself to 30 feet below sea-level, it could excavate to the required depth—70 feet below sea-level.

After completing the excavation, the dredge pumped all the water out of the space, leaving itself grounded 55 feet below the level of the sea, in which position it remained until the walls were completed. Water was then let in from the sea; the dredge floated and cut its way out (see page 179).

THE GREAT GATUN DAM

Gatun dam, across the Chagres Valley, is about a mile and a half long, a third of a mile thick at the base, with a top elevation of 105 feet above sea-level. A small hill existed in the center of the valley at the dam site. While it was 200 feet below sea-level to rock in the portion of the valley to the east of the central hill and 260 feet to rock in that portion to the west, rock was found at 40 feet above sea-level in the central hill itself—a fortunate condition, because a stable channel for the temporary diversion of the Chagres could be easily cut through this hill, across which channel a masonry spillway, founded on rock, could be built later.

A spillway through an earthen dam is generally looked upon with disfavor. While the Gatun Dam is earthen, it is really two dams, one extending from the locks to this central hill and one from this central hill to the west side of the valley. Rock existing at a high elevation in this central hill made it an ideal location for a spillway or waste weir.

When the building of the Gatun Dam was commenced, the Chagres River was flowing through three channels at the dam site—its own, the old French canal, and a diversion channel dug by the French to the west of Spillway Hill. The first operation was to block the flow of

THE DYING JUNGLE IN GATUN LAKE

"As this lake rose it gave the ladies great opportunities for collecting orchids. The most beautiful orchids have a way of growing on the largest trees and so high that they are difficult to get, but as the lake rose to 85 feet above sea-level, one could row around in small boats through the trees and pick them off" (see text, page 163). When this photograph was taken the water had only risen to 52½ feet above sea-level.

THE DROWNING TREES IN GATUN LAKE

When this picture was taken there was only 52½ feet of water in Gatun Lake, but when the lake is full these trees will be entirely submerged

the Chagres through its own channel and through the old French canal, thus forcing all the water through the west diversion channel.

This enabled the work of building the east half of the dam to be started while a channel was being dug through the Spillway Hill. As soon as this latter channel was finished the Chagres River was turned into it by damming the west diversion channel.

The bed of the west diversion channel being below sea-level, with soft banks and bottom, and the bottom of the Spillway channel being 10 feet above sea-level, this last diversion of the Chagres proved to be a troublesome undertaking. As soon as this last diversion was accomplished work on the west half of the dam was commenced.

The watertightness of the Gatun Dam was never a subject of serious apprehension. The material under it and that in the center of it are practically impermeable. The great problem concerning the Gatun Dam has been to make the material on which it was built carry the load.

I referred to the rock being 200 feet below sea-level on one side of Spillway Hill and 260 feet on the other. These old gorges, so the geologists say, were made by the Chagres River when all the country in the vicinity of Gatun was about 300 feet higher than it is now. When the site of the Gatun Dam was lowered 300 feet during some early volcanic disturbance and its old beds lowered 200 feet below sea-level, the sea backed up the Chagres Valley and in time filled these old gorges with deposits, largely of clay, which in some places were soft. In order to make such a foundation carry a heavy load, an exceedingly broad base was necessary.

Dams are ordinarily built with quite steep slopes, one in two, or one in three,

BLOWING UP THE GAMBOA DIKE (SEE PAGE 163)

The last land barrier between the two oceans was broken down on October 10, 1913, by the explosion of a charge of dynamite stored in the Gamboa Dike. The charge was fired by the depression of a telegraph key at the White House by President Wilson

whereas the Gatun Dam was built with a slope of about one in ten. The foundation was simply spread, making the dam about a third of a mile through at the base, so that the underlying material would carry the load. This underlying material was compressed under the load in some places as much as 15 feet. As the load was gradually placed on it, the material in the base became more and more compact, until finally settlement has practically ceased.

Every two or three months borings have been made through the material in the dam itself, and that under it, for the purpose of ascertaining any changes in the character of such materials. This data shows that the material, both in the dam and under it, is continually becoming more compact. It stands today, safely carrying its full load, and tomorrow it will be able to carry more.

THE JAMAICAN IS HARD TO KILL

The dam was built by constructing trestles in both edges of it and from these trestles making rock fills or "toes." When these toes had reached a height of 60 feet on the south face and about 30 feet on the north, dredges commenced to pump an impermeable mixture of sand and clay in between them. This central core constitutes the real barrier to the passage of water through the Gatun Dam.

As the hydraulic fill was built up the rock fills were carried up, so as always to constitute levees, holding the additional hydraulic fill. A pipe-line dredge pumps about 20 per cent solid material and 80 per cent water, so in building a dam in this way it is necessary to provide some means for draining off the surplus water.

This was done where the dam joins the hill, a 20-inch pipe being laid in a trench on the rock and carried in to the lower edge of the hydraulic fill. An elbow was then placed on the end of the pipe, and as the water and hydraulic fill rose other sections were added to the elbow. A cage was placed around the intake end of this pipe to keep the drift away, and men were sent occasionally to remove such drift from the pipe intake.

At one time when water was running through this pipe under a 30-foot head, three Jamaicans were removing drift and one of them fell in the 20-inch pipe. The other two tried to pull him out but could not. They let him go and ran as quickly as they could to the other end of the pipe. The man traveling in the pipe reached the end first, notwithstanding the fact that he turned a corner at an angle of 90 degrees. His ears were scratched a little!

There was a great deal of emulation between the employees in the different divisions. The part of the story so far told is true, but Colonel Gorgas made the addition that the man jumped up and said that there wasn't anybody on the Pacific Division who could do that.

The spillway over which the surplus waters of the Gatun Lake find their way to the Atlantic Ocean is found on page 170. This is a picture of the spillway when practically complete.

The gates on top are 45 feet wide and the lake will stand 16 feet deep against them when no water is being wasted; consequently if one or more of the gates is lifted water will flow between the piers 16 feet deep. These gates are raised and lowered like a window-sash. These movable gates constitute the regulating works, by means of which the level of Gatun Lake is controlled.

"THE QUEEN OF AMERICA" AND THE LUNCHEON PARTY

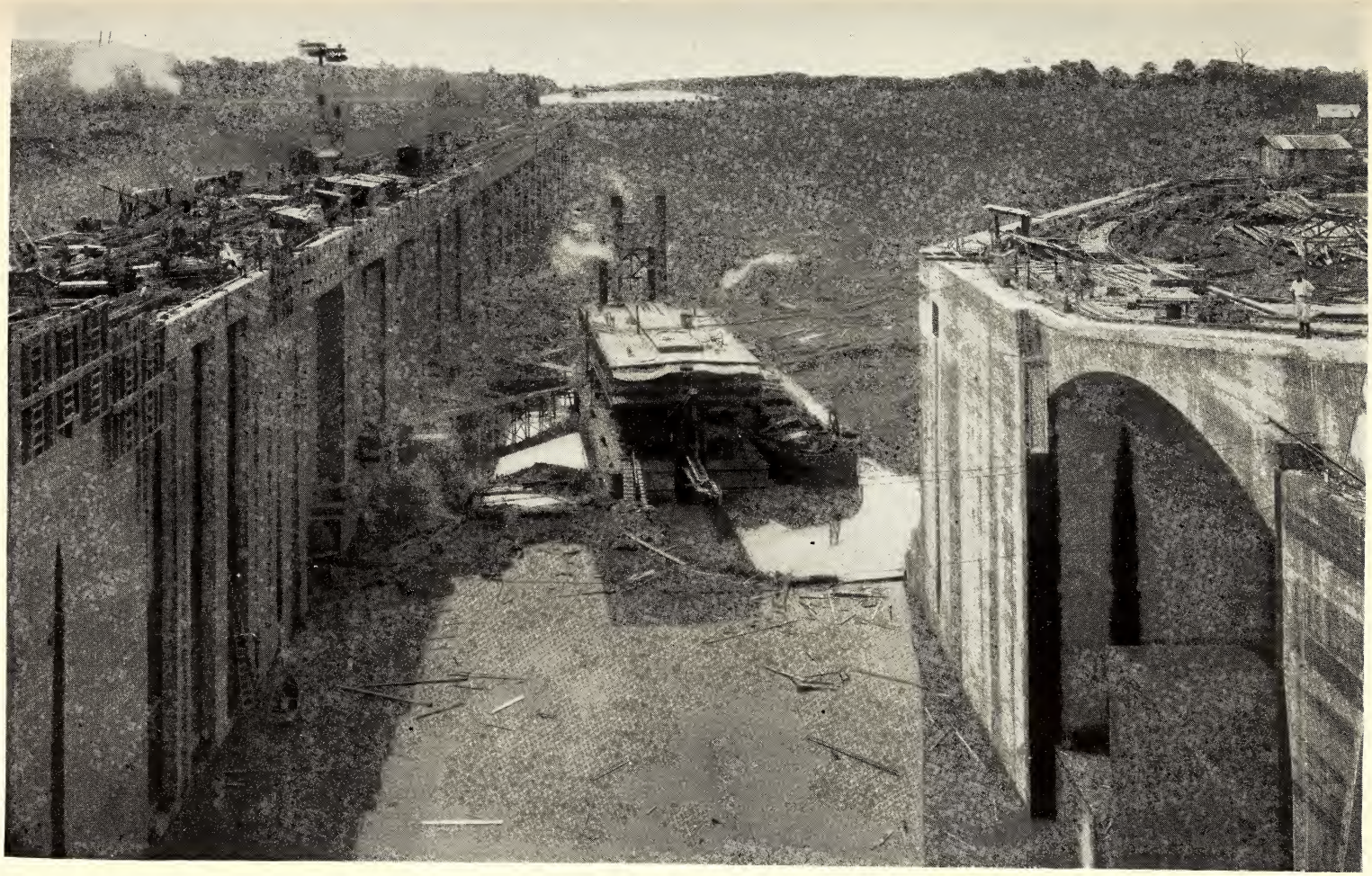
In the beginning but very little provision was made for quarters for families of the canal employees. It soon became evident that order could not be maintained, contentment prevail, and a permanent force kept unless the wives of the men were there; so the commission undertook to build family quarters.

It was announced in circulars, etc., that employees would be provided with family quarters within ten months after arrival on the Isthmus. Not only all the married men immediately applied for quarters, but nearly every unmarried man on the job applied. Family quarters carried with it free light and fuel.

Nearly every one of the young unmarried men the first time they came back from leave brought a wife if they could get one. The building department was

THE FIRST BOAT THROUGH MIRAFLORES LOCK

The lock-chambers here and at Pedro Miguel are the same size as those at Gatun. At this lock, the last on the Pacific side, boats can be let down to the level of the Pacific from that of the Miraflores Lake, through which the canal runs after leaving the Pedro Miguel locks at the termination of the Culebra Cut. The boat shown in the picture is entering the lock from the Pacific Ocean.

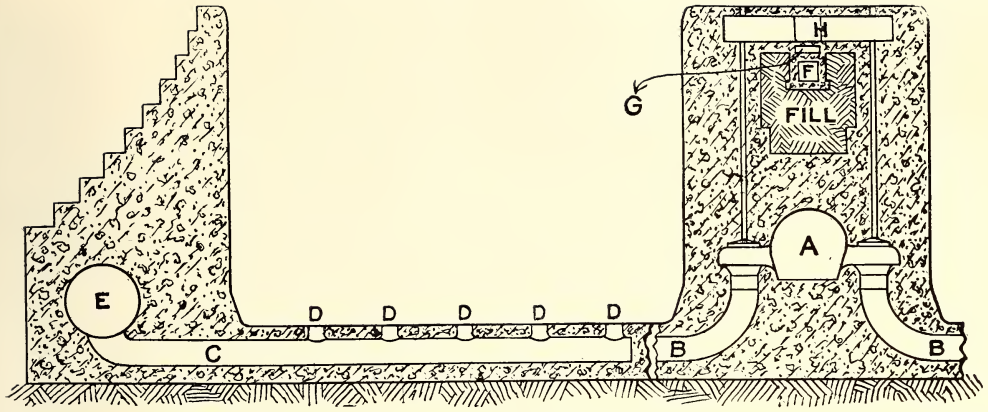


DREDGE GROUNDED 55 FEET BELOW SEA-LEVEL (SEE PAGE 173)

This dredge was used to excavate the foundations of the Gatun lock and dug down 70 feet below sea-level. "After completing the excavation, the dredge pumped all the water out of the space, leaving itself grounded 55 feet below the level of the sea, in which position it remained until the walls were completed. Water was then let in from the sea; the dredge floated and cut its way out."

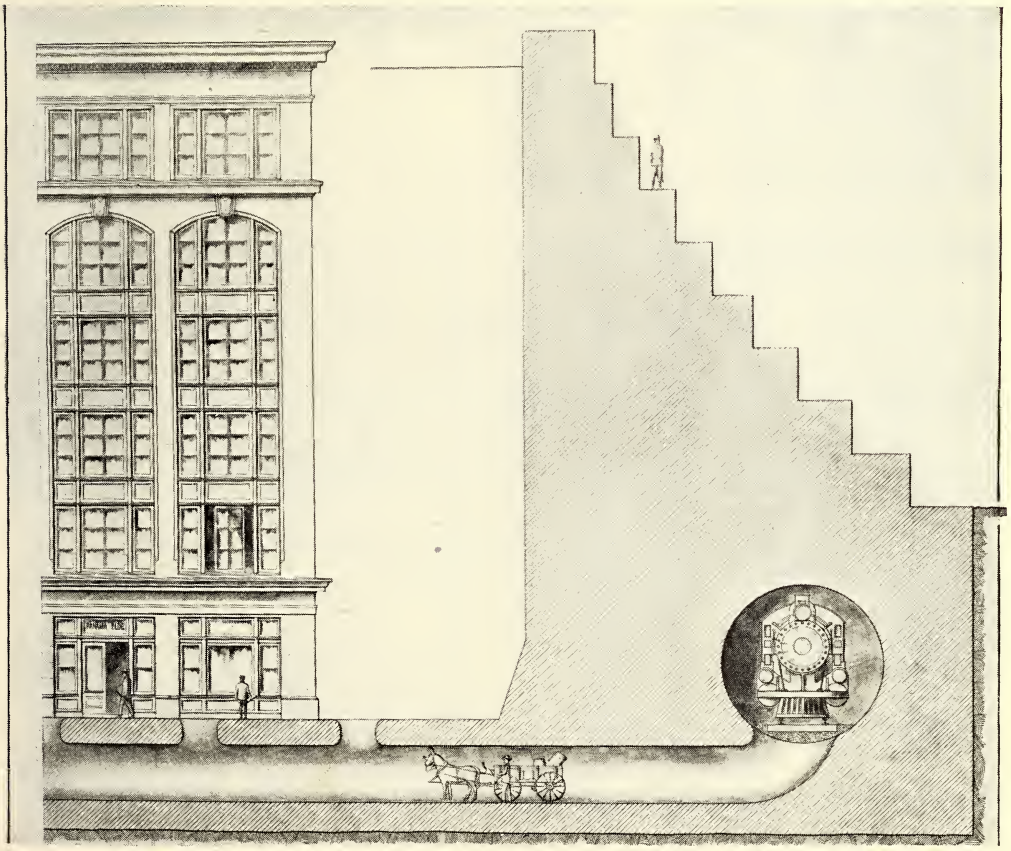
FILLING A LOCK

The water enters through a series of apertures arranged in rows of five along the floor of the lock. The barrel-shaped objects on the right of the picture are jets of water which have not burst into spray like those on the left (see page 181)



A CROSS-SECTION OF A LOCK CHAMBER AND WALLS, GATUN LOCKS, SHOWING HOW THE LOCKS ARE FILLED AND EMPTIED

A. Culvert in center wall.
B. Connections between center and lateral culvert.
C. Lateral culvert.
D. Wells opening from lateral culverts into lock chamber.
E. Culvert in side wall.
F. Drainage gallery.
G. Gallery for electric wires.
H. Passageway for operators.



THE SIDE WALL OF ONE OF THE GATUN LOCKS COMPARED TO A SIX-STORY BUILDING

The size of the culverts may be appreciated from the engine and dray. The "steps" have been filled in with earth and stone and graded to the top

THE FLAT ARCH AT PANAMA

One argument against the construction of a lock canal was that the great locks at Panama might be destroyed by earthquakes. This flat arch, which any serious earthquake shock would destroy, has stood for nearly three centuries in the now ruined church of Santo Domingo at Panama, proving that fear of earthquakes is groundless (see page 169).

consequently overwhelmed and the commission was forced to withdraw its literature and make no promises. An attempt was made after that to provide a certain percentage of the employees with family quarters.

The greater part of the laborers on the canal were Jamaican negroes. They were British subjects, but were ordinarily called "British objects." They make good servants if thoroughly trained and the routine is not varied.

To illustrate the effect of varying the routine: Visitors often came rather unexpectedly for lunch at Gatun, and in order that things might go right if my wife happened to be away when company came, she had prepared menus for lunches—number 1, number 2, number 3, etc. All I had to do was to telephone the cook that so many people were coming and to prepare lunch number so and so.

One day Mrs. Roosevelt and her daughter came with Mr. Bishop to see the work at Gatun, and after asking them to lunch, my wife being away, I telephoned the cook that there would be three extra people and to prepare luncheon number 1. I, unfortunately, said that Mrs. Roosevelt would be there.

The Jamaican has great respect for royalty. Before reaching home I heard that our servants had passed the word around among the other servants at Gatun that the Queen of America would take lunch at our house today. On entering the house it was evident that every piece of cut glass, silver, or pretty China in the place was out where it could be most easily seen.

On reaching the table it was soon seen that we had lunches 1, 2, and 3 combined. But finally, when four tiny cups of coffee were passed on a large salver resurrected

from an old chest upstairs, the ridiculous side of the situation was complete.

Now that the canal is essentially finished, what are the American people going to do with it? Shall the new markets brought into existence on the Pacific shores of Central and South America by this new cheap transportation route be supplied by the United States or by foreign countries?

In my judgment, that depends, more than anything else, upon whether the Congress of the United States enacts such laws as will bring into existence a United States merchant marine engaged in foreign commerce.

THE NATION'S UNDEVELOPED RESOURCES

By Franklin K. Lane

Secretary of the Interior

The following article gives such a constructive and national presentation and discussion of our country's undeveloped resources that it should be read by every American. It forms the annual report to the President of the United States by Mr. Lane, Secretary of the Interior, and is here published in full. For a map of Alaska, see the Supplement to this number of the National Geographic Magazine.

THERE exists a feeling in the West that its affairs and needs have not been given that consideration at the hands of the national government which they merit. This feeling is not confined to speculators or exploiters. It is the sentiment of many who are without selfish motive and regard the matter wholly from the standpoint of national growth. They point to the conditions which obtain in Alaska as unparalleled among people of our aggressive and nation-building stock.

So, too, they are unable to understand why ways have not been found by which the great bodies of coal and oil lands, of phosphate and potash lands, may be developed, and the waters of the mountains made available for the generation of power and the redemption of the desert.

There is one very simple explanation for the existence of this feeling. We have adventured upon a new policy of administering our affairs and have not developed adequate machinery. We have called a halt on methods of spoliation which existed, to the great benefit of many, but we have failed to substitute methods, sane, healthful, and progressive, by which the normal enterprise of an ambitious people can make full use of their own resources. We abruptly closed opportunities to the monopolist, but did not open them to the developer.

Formerly We Tried to Get Rid of Our Land as Quickly as Possible

I have said that we had put into force a new land policy, which caused dismay and discontent. Let me explain what I mean by this. It was, in fact, but a new application of an old policy. Congress has always been most generous as to the disposition of the national lands. One cannot read our land laws without being struck with the fixed determination which they show that it was wisest to be quit of our lands as quickly as possible. It might almost be said that the government regarded its lands as a burden rather than an asset. We gave generously to our railroads and to the States. There was land for all, and it was the government's glad function to distribute it and let those profit who could.

There was no thought then of creating timber barons or cattle kings, or of coal monopoly. The sooner the land got into hands other than those of the government the better.

And this generous donor was not so petty as to discriminate between kinds of lands, the uses to which they could be put, or the purposes which those might

CARGOES OF SALMON ARRIVING AT AN ALASKAN CANNERY

"The purchase of Alaska was made as a means of protection against the possible aggression of a foreign nation and without the hope that it would be even self-supporting. In the intervening 46 years we have given it little more than the most casual concern, yet its mines, fisheries, and furs alone have added to our wealth the grand sum of $500,000,000" (see text, page 185).

have who got them. Land is land, save when it contains minerals; this was roughly the broad principle adopted. To classify was a task too difficult or not worth while. The lands would classify themselves when they arrived in individual ownership. And so the door was opened for monopoly and for fraud.

If the government did not appreciate the invaluable nature of its assets, there were men who did. Great fortunes were laid in the vast holdings of what had but a short time since been the property of the people. There was danger that the many still to pour into the West would by necessity become the servitors of a fortunate and early few. On this discovery our indifference at once took flight. And so out of the abuse of the nation's generosity there came a reaction against a policy that was so liberal as to be dangerous.

The nation wanted home-makers, but found its lands drifting into the hands of corporations which were withdrawing them from the market, awaiting a time when lands would be more scarce; it gave opportunity for many competing coal operators and iron manufacturers, but found the sources of raw material centering into a few large holdings; it wished its lands to be cleared of forests to make way for farms, but it found hundreds of consecutive miles reserved from use by the fiat of those who appreciated their worth, and many more miles of watershed despoiled of its needed covering in places where homes were not possible.

A REACTION WAS INEVITABLE

A reaction was inevitable. If lands were to be withdrawn from public service, why might not the government do the withdrawing itself? The old philosophy that "land is land" was evidently unfitted to a country where land is sometimes timber and sometimes coal; indeed, where land may mean water—water for tens of thousands of needy neighboring acres; for the lands of the West differ as men do, in character and condition and degree of usefulness. We had not recognized this fact when we said "land is land." Lands fitted for dry farming and lands that must forever lie unused without irrigation; lands that are worthless save for their timber; lands that are rich in grasses and lands that are poor in grasses; lands underlain with the non-precious minerals essential to industry or agriculture; lands that are invaluable for reservoir or dam sites—these varieties may be multiplied, and each new variety emphasizes the fact that each kind of land has its own future and affords its own opportunity for contributing to the nation's wealth.

So there has slowly evolved in the public mind the conception of a new policy—that land should be used for that purpose to which it is best fitted, and it should be disposed of by the government with respect to that use. To this policy I believe the West is now reconciled. The West no longer urges a return to the hazards of the "land is land" policy, *but it does ask action.* It is reconciled to the government making all proper safeguards against monopoly and against the subversion of the spirit of all our land laws, which is in essence that all suitable lands shall go into homes, and all other lands shall be developed for that purpose which shall make them of greatest service; but it asks that the machinery be promptly established in the law by which the lands may be used; and this demand is reasonable.

ALASKA HAS ENORMOUS UNDEVELOPED RESOURCES

The largest body of unused and neglected land in the United States is Alaska. It is now nearly half a century since we purchased this territory, and it contains today less than 40,000 white inhabitants, less than 1,000 for each year it has been in our possession. The purchase was made as a means of protection against the possible aggression of a foreign nation and without the hope that it would be even self-supporting. In the intervening 46 years we have given it little more than the most casual concern; yet its mines, fisheries, and furs alone have added to our wealth the grand sum of $500,000,000.

For almost a generation it was the rich harvest field of a single company. Individual fortunes have been made in that country larger than the price paid to

Russia for the whole territory. How rich its waters are we know, because they have been proved; but how rich its lands are in gold and copper, coal and oil, iron and zinc, no one knows. The prospector has gone far enough, however, to tell us that no other section of our land today makes so rich a mineral promise.

And in agriculture the government itself has demonstrated that it will produce in abundance all that can be raised in the Scandinavian countries, the hardy cereals and vegetables, the meats and the berries off which nine million people live in Norway, Sweden, and Finland. It has been estimated that there are 50 million acres of this land that will make homes for a people as sturdy as those of New England. Whether this is so or not, it would appear that Alaska can be made self-sustaining agriculturally.

This vast and unsurpassed asset lies almost undeveloped. A territory one-fifth the size of the United States contains less than a thousand miles of anything that can be called a wagon road. It has a few inconsiderable stretches of railroad which terminate, with one exception, either in the wilderness or at a private industry. Only the richest of its mines can be worked, and one of its resources of greatest immediate value to the people, its coal lands, lies unworked.

The one constructive thing done by this government on behalf of Alaska in nearly half a century was the importation of reindeer for the benefit of the Eskimo on the border of the Arctic Ocean. For the white man we have done nothing—so little, in fact, that to mention what we have done is matter for chagrin and humiliation. I have thought that perhaps the scandals that have developed in Alaska have been in some part the result of a feeling that it was a No Man's Land, where the primal instincts and powers were the only law.

SOUTHEASTERN ALASKA HAS A MORE EQUABLE CLIMATE THAN WASHINGTON, D. C.

This unfortunate condition cannot be explained on the ground of the inhospitality of the Alaskan climate. A careful study of isothermal lines shows that some of southeastern Alaska has a climate more temperate and more equable than that of Washington, D. C., while much of the greater portion to the north has a kindlier climate than Stockholm or St. Petersburg. Moreover, our people are not stayed in their quest for homes or wealth by the rigors of a long winter. The spirit and purpose which brought them from Europe to Virginia and to Massachusetts take them today to Montana and Saskatchewan. The United States lately opened to entry a tract of land in Montana for which there were 46,000 applicants for registration, and only 7,000 of these could be given an opportunity to homestead. There is more railroad building 500 miles north of the Canadian border than there is for the same distance south of it.

Why has not this land been developed? The frank answer is that we did not realize until within a few years that it was worth developing. As soon as we discovered its value as a national asset we became alarmed and drew back, affrighted at the thought that we might lose it, or at least that it would become the property of those who would exploit it without respect to the public interest. Since then we have been waiting to make up our minds as to what wisely could be done. We have hesitated and halted out of the very keenness of our appreciation of what Alaska might become.

It has rather been in compliment to Alaska than in derogation of her value that we have done so little for her in late years. It was a new land, to be opened under new conditions. The mistakes made there and here we did not wish to repeat. But now, after a long pause, it would seem to be the sense of the people that we shall proceed at once and in a large way to deal with the problem of Alaskan development.

PROPOSED ADMINISTRATIVE BOARD

We have withdrawn Alaska from the too aggressive and self-serving exploiter. What have we to substitute as a safer servant of public interest? To this question I have given much thought, and my conclusion is that if we are to bring Alaska into the early and full realization

A PILE OF GOLD IN THE ASSAY OFFICE AT NOME, ALASKA

"Individual fortunes have been made in that country larger than the price paid to Russia for the whole territory" (see text, page 185)

of her possibilities we must create a new piece of governmental machinery for the purpose. We should undertake the work in the spirit and after the method of a great corporation wishing to develop a large territory.

In my judgment, the way to deal with the problem of Alaskan resources is to establish a board of directors to have this work in charge. Into the hands of this board or commission I would give all the national assets in that territory, to be used primarily for her improvement—her lands, fisheries, Indians, Eskimos, seals, forests, mines, waterways, railroads—all that the nation owns, cares for, controls, or regulates. Congress should determine in broad outline the policies which this board in a liberal discretion should elaborate and administer, much as is done as to the Philippines. This board would, of course, have nothing whatsoever to do with the internal affairs of the organized Territory of Alaska, for it would exercise no powers save such as Congress granted over the property of the United States in Alaska.

THE BLACK BEAR IS CARED FOR BY ONE DEPARTMENT AND THE BROWN BEAR BY ANOTHER

There are several reasons which appeal to me as supporting this suggestion:

1. Such a board could advise Congress as to what should be done, without prejudice, out of a deep national interest and with first-hand knowledge of conditions.

2. Such a board would coördinate the present enterprises of the government in Alaska. As it is now, the control of lands is in one department, of forests in another, of roads in another, of fisheries

A WINTER SCENE AT NOME, SHOWING GREAT PILES OF GRAVEL WHICH ARE HEAPED UP DURING THE WINTER BY THE MINERS

During the summer, or rather as soon as water can be used without any danger of its freezing, these great piles of gravel are carefully washed by the miners and the gold extracted (see picture on page 189)

GETTING THE GOLD OUT OF THE GRAVEL IN SUMMER: NOME

in a fourth, of railroads in still another. The care of black bear is in one department and brown bear in another.

3. There can be no satisfactory administration of land laws nor any other laws at a distance of 5,000 miles from the point of action. Much less is this possible where the two sections of the country are separated by an ocean, and the land calling for attention is closed to the world one-half of the year. The eye that sees the need should be near the voice that gives the order.

4. Alaska's opening and improvement should be treated as one problem. Each step in such an administration should be part of a plan, not an isolated act. We should have a unified and consecutive program, based on immediate knowledge governing this work. Each line of activity within the Territory should be correlated with all other activities. The opening of lands and the building of railroads or wagon roads, for instance, should be part of one scheme.

5. Alaska should be developed so far as possible out of her own revenues and resources. She should have a Federal budget of her own. Her revenues and expenditures should be presented to Congress on a single sheet. The funds raised from her lands and fisheries, her furs, her forests, and her mines should be used for the construction of her roads, railroads, telegraph and telephone lines, or for any other purpose which would make her resources more quickly available to the world.

ALASKA IS ALREADY SELF-SUPPORTING

I believe it could be shown that Alaska is self-supporting today, or, what is more to the point, that by proper taxes and charges imposed upon those who are deriving large return from their enterprise in the Territory, such revenue could be derived as would support a large policy of expansion and improvement. In short, I would construct the administrative machinery that would most surely lead to a prompt and continuous development of Alaska as a part of the United States

HYDRAULIC MINING IN GLACIER CREEK, NOME

The gold placer fields of interior and northwestern Alaska no longer give employment to as many men as in former years, because of the adoption of new methods of mining. The gold output is still large, the amount produced in 1912 being valued at more than $17,000,000

upon a plane commensurate with her possibilities industrially, agriculturally, and socially.

The members of such a board appointed by the President would be selected presumably with reference to their fitness for the work to be done. Each one could be made the administrative and residentiary head of a department or division, so that there might be a commissioner of the Alaskan land office, another commissioner of highways, another, perhaps, commissioner of Indian affairs and fisheries, and so on. All would sit together, as in the commission form of municipal government, and would work for a common end, the upbuilding of Alaska as an integral and contributing part of the Union.

I apprehend the fear that with such a commission there would be danger of corruption or indifference creeping into its work. This, however, is incident to the bestowal of all authority. The commission would not go unchecked, of course, for it must report to the head of some department at Washington, and through that head to Congress, and would be always subject to investigation. Moreover, no method has yet been invented by which dishonesty or poor judgment can be guarded against in public or in private life. In the end the character and wisdom of the men appointed is the only insurance that can be given against conduct that is foolish or worse.

Alaska should not, in my judgment, be regarded as a mere storehouse of resources upon which the people of the States may draw. She has the potentialities of a State. And whatever policy may be adopted should look toward an Alaska of homes, of industries, and of an extended commerce.

WHAT SHOULD BE DONE AT ONCE

Strongly as I would urge this method of management—for it offers a rare opportunity to exhibit the efficiency of a republic—I would not have Alaska wait for needed legislation until the merits of such a plan could be passed upon by Congress. Those things which appeal to me as of immediate necessity upon which independent action may be taken are (1) the construction of railroads in the Territory and (2) the opening of her coal lands.

I have already expressed to Congress my belief that it was wise for the government itself to undertake the construction and operation of a system of trunk-line railroads in Alaska. And I am led to this view irrespective of the possibility of private enterprise undertaking such work, although my belief is that no railroads would be privately constructed in Alaska for many years to come excepting as adjuncts to some private enterprise. Be that as it may, it would seem wise for the government to undertake this task upon grounds of state.

The rates and the service of such railroads should be fixed with reference to Alaskan development—not with regard to immediate returns. The charges fixed should be lower for years to come than would justify private investment.

I would build and operate these highways in the same spirit that the counties or the States build wagon roads—not for revenue, but for the general good. After all, a railroad is little more than an operated wagon road. In many countries they still call railroad cars "wagons." Our laws as to railroads are evolved from our old laws as to carriage by wagon. Our courts speak of railroads as property charged with a public interest and so justify the regulation of their rates. But no court would justify the imposition of rates made for the purpose for which Alaskan rates should be made—the creation of a Commonwealth. If this is our task, it should be done whole-heartedly and with a consciousness that the dollar spent today on an Alaskan railroad will yield no more immediate return on the investment than the dollar spent on the Panama Canal.

WHY THE GOVERNMENT SHOULD BUILD THE ALASKAN RAILROADS

These, then, are the persuading reasons for the belief that the government should undertake to drive from the coast inland one or more lines of railroad: (1) The government already regards it as its duty to build wagon roads. Such roads when well built are almost as costly as

GOLD AVENUE AT NOME IN WINTER

the construction of a railroad, which is the essential modern means of transportation. (2) There can be no assurance that without surrendering our resources in Alaska private railroads will be built. (3) The opening of this new country demands that the highways of travel and commerce should be made wholly subservient not to private interest, but to the upbuilding of this territory, that they may be the real servants of the national purpose.

If it is thought wise to recoup the government for its original outlay, it can be done, at least in part, by following a plan not unknown to our people—by giving a land subsidy to the owners of the road. Retain in the government one-half of the land on each side of the railroad until it has appreciated in value by the growth of the lands given to the public. Thus the government would subsidize itself and reap some of the benefits accruing to its land from the construction of the road. Judging by the increase in land values in the newly opened sections of Canada, who could say but that long before the bonds were due the government would thus have an asset sufficient to meet the original debt?

There seems to me no necessity for barring the way to minor privately owned roads because of the presence of longer systems of publicly owned roads. The two exist together in other countries. I would not even apply the principle of the commodities clause of the act to regulate commerce to such roads. They should be built, however, under governmental supervision, capitalized and operated under the strictest regulation, and be at any time subject to purchase by the government at their cost, minus depreciation.

THE VALUE OF ALASKAN COAL

It is not necessary to set forth here the extent or character of the coal fields of Alaska. Neither could I add to your knowledge or that of Congress as to the need for this coal both by the navy and by the industries and the people of the Pacific coast generally. There are almost unlimited quantities of a high grade of lignite in the interior which may not stand extended storage or transportation. This could be converted into electricity at the mouth of the mines and widely distributed for lighting, heat, and power. Toward the southern coast of the peninsula there are two well-known fields of a high-grade bituminous coal and some anthracite. These are the fields which have given rise to the troubles with which all are familiar.

These coal fields should be opened not to speculators, but to operators. Those should have these lands who will use them. None should be opened as a basis for a gamble in future values. If these premises express a sound public policy, there appears to me but one conclusion that can be reached as to the manner in which they may safely be turned over to the public—under a leasing and royalty system similar to that under which the State of Minnesota leases its ore lands and the States of Montana and Colorado their coal lands.

The tracts opened should be disposed of to those who within a certain time would develop mines and make their product commercially available. This means that where a railroad is necessary to the operation of a mine the applicant should take a lease so conditioned for a limited period. Sufficient land should be leased as a body to justify long-continued and economical operation. As the average of all operations in the United States is 2,600 acres, including many small holdings, this might be taken as a maximum unit.

There has been much dispute between those who favor making a lease for an indeterminate period, dependent alone upon continued operation, and those who believe it wisest to fix a term for the lease, 20, 30, or more years. This dispute seems to me of much more academic than practical interest. There should be no disposition to change the lessee. If a fixed term of lease is decided upon, the original lease should have an assured preferential right to a renewal until the mine is worked out. So that in the end the fixed term is a reservation of the right on the part of the government to make new terms at the end of a number of years, a reservation which could be fixed in an indeterminate lease.

THE MUIR GLACIER: ALASKA

Photo from F. E. Kleinschmidt

This glacier, which is the largest in the world, has a frontage of seven miles along the sea. During the summer it affords a wonderful spectacle to tourists, for great masses of ice, often larger than an average house, break off and plunge into the water

SOME COAL LANDS SHOULD BE HELD FOR THE NAVY

A fixed minimum annual royalty would conduce to operation and prevent the holding of lands out of use. These are matters, however, of regulation upon which much thought should be expended, and the experience of other lands will be found helpful. If the principle of the homestead law is adopted, and one lease only permitted to any one person or group of persons, and all leases made non-transferable, excepting with the consent of a designated authority, it would seem that monopoly could be prevented. I would, however, add one other precaution—that in each field a large body of the coal land be reserved, so that the public and the navy might be rendered independent of private supplies if that should become necessary.

The attraction of a leasing system is that it enables an operator to put all of his capital into the promotion of his enterprise, no investment being needed for the purchase of the land. This makes it possible for the man of comparatively small means to become a coal mine operator. The lessee is pleased to pay the government a royalty in lieu of tying up a large amount of capital in the land itself.

There is this further consideration, which those interested in Alaska's future might well consider. The royalties arising from these mines (as well as from oil) would for a long time be a source of revenue to the government. To stimulate the opening of mines, all royalty might well be waived for a brief period; later, however, these royalties would be a not inconsiderable addition to the resources available for Alaskan development, for I would think it the wisest policy to give to this new land the full return from her properties to be used in her improvement, at least for many years.

WESTERN COAL

There are many isolated places in Alaska where small mines may be opened to supply a local and small need. A license to mine a small acreage without any charge whatever on the part of the government would meet this need.

It might be well at this point to consider the coal land situation in the Western States. For the policy I have suggested as advisable to apply in Alaska I think the sensible policy to adopt throughout the rest of the country. We have tried two experiments in the United States as to coal lands. We allowed our coal lands to slip from us under the old land-is-land policy until we came into the presence of a coal monopoly or a series of such monopolies in various parts of the country. If this is questioned we may at least say, with exactness, that we realized that we had been putting priceless assets into the hands of a comparatively few far-sighted men for an inconsiderable consideration.

Then we tried the other plan of appraising such properties on a scientific estimate of contents upon which the land is sold. This is the present plan, and it is really nothing more than a demand for a full but discounted royalty in advance. It has against it, in my opinion, at least two objections. Our coal land is not being used under this plan save under exceptional conditions of local and immediate demand, and the purchaser, when there is one, is speculating on the best guess that an honest geologist can make as to the amount of coal in the ground.*

It is certainly not for the public interest that our coal deposits shall be opened rapidly and ruthlessly. We may reforest lands that have been devastated, or feed again into fruitfulness a soil that is starved, but we cannot replace the car-

*The outstanding withdrawals of public lands valuable for mineral fuels and fertilizers or in connection with the water resources of the public domain now aggregate 66 million acres. The coal-land withdrawals awaiting classification constitute the larger part of this acreage, being 56,316,410 acres on December 4, 1913, not including the blanket withdrawal of coal lands in Alaska. It is noteworthy that a larger area than this has been restored within the past five years, and nearly 20 million acres have been classified as coal lands and are open to entry at appraised prices. The lands classified and restored by executive order to appropriate entry since March 4 last total 10 million acres, every restoration being based upon careful consideration within the Department of the Interior. About 400,000 acres of mineral lands in the same nine months have been withdrawn.

TRAVELING WITH REINDEER IN ALASKA

Photo by W. T. Lopp

"The one constructive thing done by this government on behalf of Alaska in nearly half a century was the importation of reindeer for the benefit of the Eskimo on the border of the Arctic Ocean. For the white man we have done nothing; so little, in fact, that to mention what we have done is matter for chagrin and humiliation" (see text, page 186).

HERD OF REINDEER ON A HILLSIDE IN ALASKA

Photo by W. T. Lopp

In 1891 Dr. Sheldon Jackson brought 16 reindeer across the Bering Strait into Alaska; today that herd, with a few importations since, has increased to nearly 40,000, of which some 62 per cent are owned by the natives. From their herds of reindeer the natives enjoyed last year an income of $44,885.

FOUR ESKIMO GIRLS NEAR CAPE NOME, ALASKA

The dress of the Eskimo consists entirely of skins of seal, reindeer, bear, and fox, the first two being the most common. The dress of the women differs but little from that of the men—a suit with a long jacket and trousers tucked into seal-skin boots. The jacket, which has a hood to

bon deposits underground, once they are removed. I cannot, however, feel that we should sacrifice any present need for fuel or willingly surrender ourselves to a demand for exorbitant prices because of a fear that some day the coal supply may be exhausted (see page 205).

Already there has been developed a substitute for coal in the flowing stream. The turbine converts melted snow into heat and light, which can be distributed over a constantly widening area. I think we have now arrived at that point in scientific achievement which justifies the belief that the wheels of industry will not cease, nor our houses go unlighted or unheated, so long as dams may be built upon our streams. Water will be—indeed already is—the greatest conservator of coal.

We must seek to make use of our coal, the fullest use that society requires. This principle seems a truism. But here lies the difficulty. We wis' cheap coal and at the same time a minimum of waste. We wish society to take the lion's share of the profit and yield no more to the operator than will make his work sufficiently attractive to keep him at it. In short, we desire competition without waste—a frank impossibility.

Other countries have wrestled with this problem. Some have gone into government operation. But those who are nearest to us in institutions and tendencies have found that in a new country, where there must be large development and higher rewards for enterprise, the safest practicable method is to lease the land, the government taking a modest royalty and retaining some measure of control over operation.

OUR OIL, PHOSPHATE, AND POTASH DEPOSITS SHOULD BE DEVELOPED

The United States is beginning to appreciate the extent and value of its oil deposits, and for the disposition of these lands no better plan has been suggested than one analogous to that offered as to coal lands.

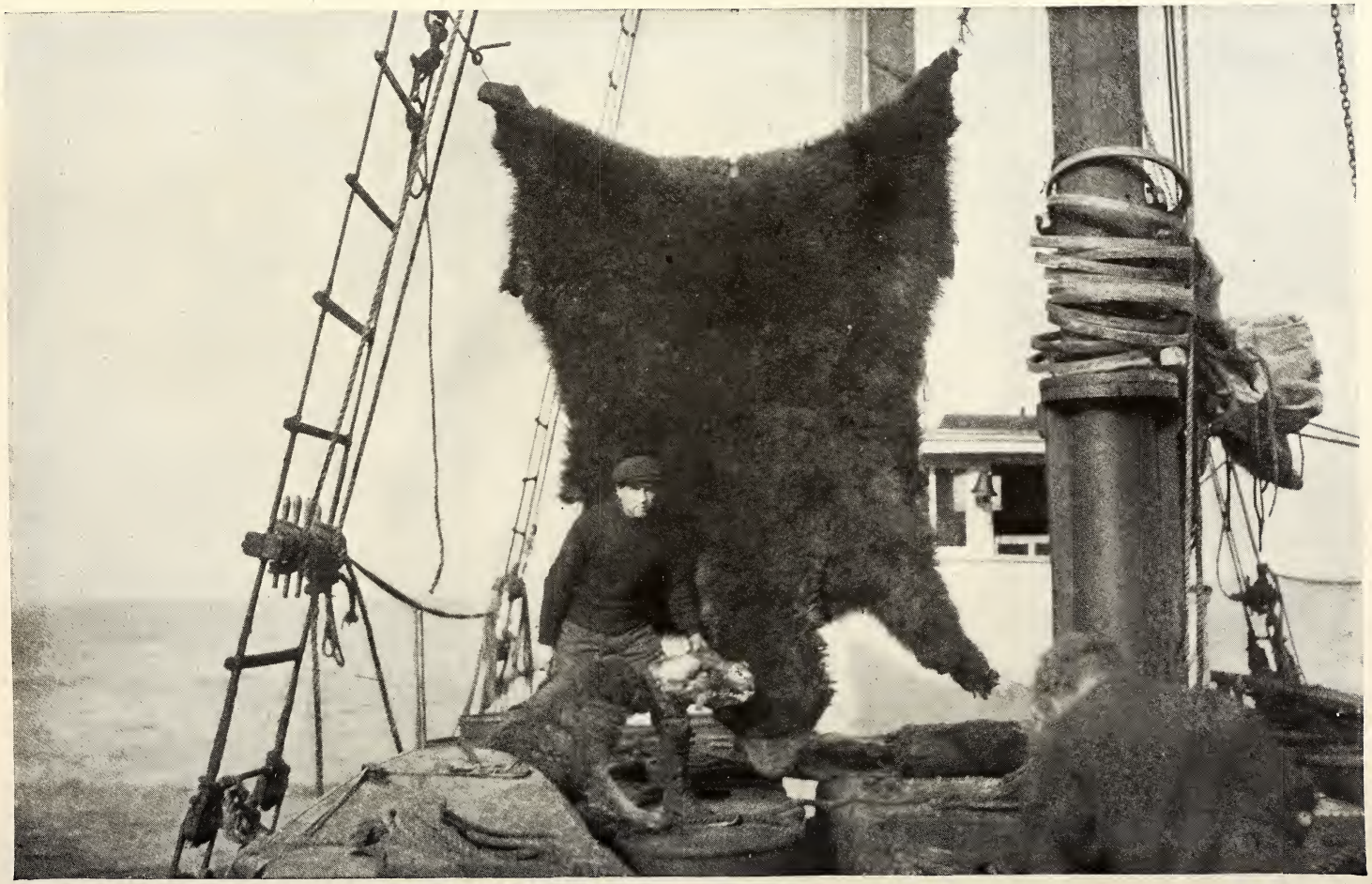
I would call your attention to the absurdity of applying the placer mining law to the development of petroleum lands. This law, which was based upon the fundamentals of the miners' codes of early days, was passed without thought of the occurrence of other deposits than placer gold. However, the land department, and later Congress, applied the law to oil lands.

The placer law provides, in the main, that no location shall be made without a discovery of valuable minerals on the claim, that the boundaries of the location shall be plainly marked on the ground, that no claim for an individual shall exceed 20 acres or for an association 160 acres, that $100 worth of assessment-work must be done each year, and that upon the expenditure of $500 in labor or improvements and upon compliance with certain minor requirements the claimant is entitled to a patent to his claim.

The claimant who has gone upon lands for the purpose of making mineral location, and is engaged in work looking to the discovery of minerals, is protected against adverse agricultural claimants on the ground that the land which he occupies is not vacant and open to settlement. The extent of his protection against adverse mineral claimants is, however, a matter of serious doubt. He cannot be ousted by the forcible or fraudulent entry of another mineral claimant, but if such adverse claimant enters peaceably, openly, and in good faith, prospects the claim and first discovers minerals, thus perfecting his location, his title is superior and he dispossesses the original occupant.

On the other hand, in some of the fields large areas are held indefinitely by assessment-work which makes little pretense of exploring the claims or developing them. Useless roads which make the claims no easier of access, drilling rigs incapable of reaching the oil sands, building-stone locations where no building stone is to be found, and locations on worthless deposits of gypsum are among the subterfuges adopted to hold possession of lands prospectively valuable for oil.

Thus, where occupancy without discovery is respected, large areas are withheld from exploration and development, and where such occupancy is not respected the oil prospector must assume undue



THE SKIN OF AN ENORMOUS ALASKAN BEAR

Photo from F. E. Kleinschmidt

This bear, whose skin measured 12 feet 8 inches in length, was killed near Kodiak, in Alaska, for the collection of the Carnegie Museum at Pittsburgh. The man and the large St. Bernard dog bring out the great size of the skin

POLAR BEAR AND CUB OUT FOR A SWIM

Photo from F. E. Kleinschmidt

The cub hangs on to the mother's tail and is towed along. Sometimes the mother objects to this, and, turning round, severely cuffs the baby or takes it by the neck and puts it under water

HAULING A BOILER IN ALASKA

"A territory one-fifth the size of the United States contains less than a thousand miles of anything that can be called a wagon road. It has a few inconsiderable stretches of railroad which terminate, with one exception, either in the wilderness or at a private industry. Only the richest of its mines can be worked, and one of its resources of greatest immediate value to the people, its coal lands, lies unworked" (see text, page 186).

Photo from Leonard Davis

A PAIR OF SALMON, ONE WEIGHING 65 POUNDS AND THE OTHER 82 POUNDS, CAUGHT AT KETCHIKAN: THE PORPOISE SHOWS THE COMPARATIVE SIZE OF THE SALMON

risk of the loss of his investment prior to discovery.

PRESENT MINING LAWS DO NOT SUFFICIENTLY REWARD PETROLEUM PIONEERS

An objection of equal force to the placer law as applied to petroleum arises from the fact that the mineral is fluid. It moves underground. A well on one tract is likely to draw from a neighboring tract. Thus it becomes necessary for each operator to drill wells along his boundary lines before his neighbors do so. Otherwise, they will draw off a part of his oil. He is therefore forced to drill whether it is otherwise to his advantage or not, in order to protect his oil deposits from exhaustion through adjacent wells.

We should, I believe, stimulate the search for oil and protect the prospector. The government is withholding from entry certain considerable bodies of land in the belief that they contain oil, when this has not been demonstrated. It is our practice as soon as there has been a producing well discovered, and sometimes earlier, to withdraw all lands in the neighborhood which, in the opinion of experts, are of similar geological formation. The lands on which the discovery has been made or upon which exploration has been begun may or may not be included in the withdrawal. If they are, the law offers to protect the rights so acquired.

I feel, however, that we are not sufficiently rewarding the pioneer. A plan could readily be evolved by which any one wishing to prospect for oil on the public lands could obtain a license from the government to prospect exclusively a large tract of land for a period of time—perhaps two years—and in the event that oil is found in commercial quantities the government should be paid a royalty fixed in advance.

This method is similar to that by which the Indian lands in Oklahoma have been developed and which has proved of the highest value in bringing capital into this

Photo from Leonard Davis

TURNIPS WEIGHING 12 POUNDS GROWN IN A PRIVATE GARDEN AT RAMPART, ALASKA

"And in agriculture the government itself has demonstrated that it will produce in abundance all that can be raised in the Scandinavian countries, the hardy cereals and vegetables, the meats and the berries off which nine million people live in Norway, Sweden, and Finland. It has been estimated that there are 50 million acres of this land that will make homes for a people as sturdy as those of New England. Whether this is so or not, it would appear that Alaska can be made self-sustaining agriculturally" (see text, page 185).

work and insuring large returns to the Indians. In the Oklahoma case one great corporation, however, was given so large a body of land that after the original discovery it found it profitable to farm out its rights to subsidiary companies. This might easily be prevented by regulations under which the government would reserve to itself the adjoining lands.

Indeed, I would not be adverse to granting such a license in unexplored country for, say, four sections of land, and in the event of discovery permitting patent to issue to the discoverer for a full

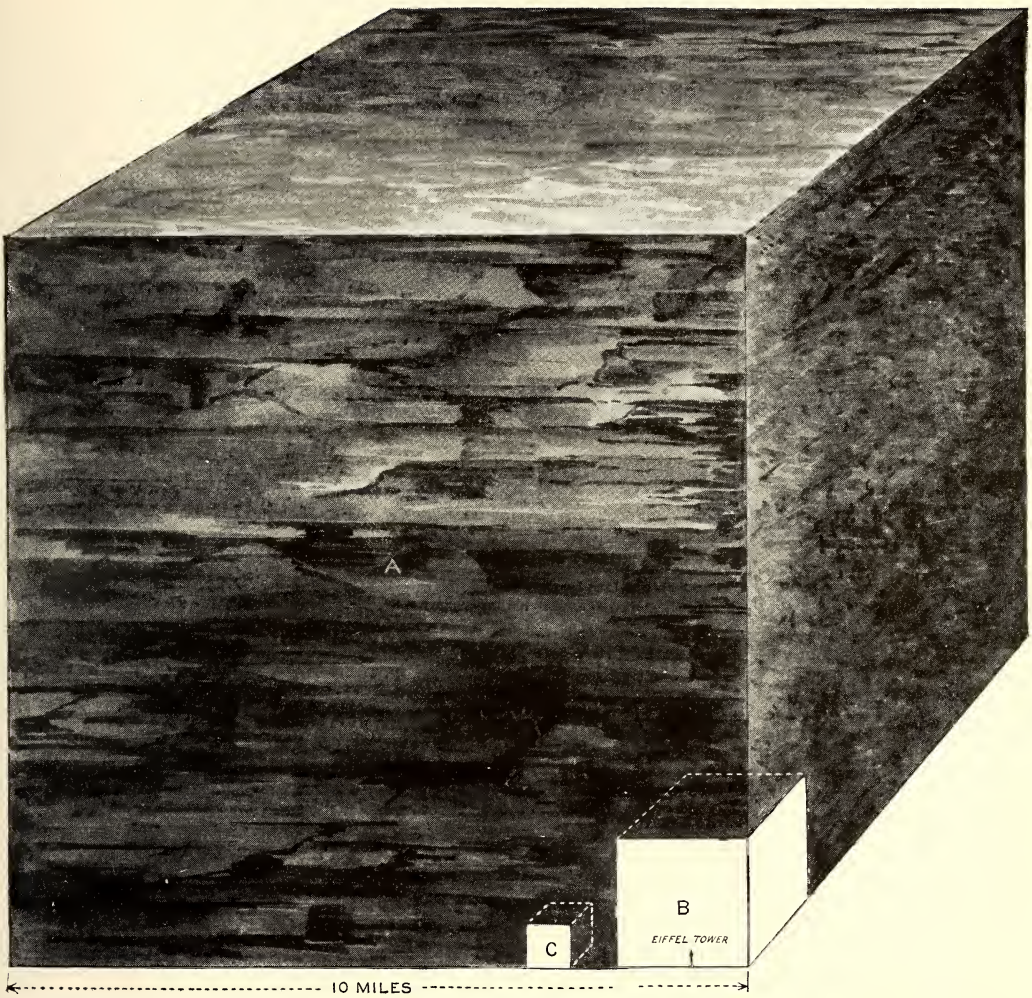


DIAGRAM ILLUSTRATING OUR COAL RESOURCES, THE AMOUNT THAT HAS BEEN USED AND THE AMOUNT STILL REMAINING UNUSED IN THE UNITED STATES

A represents the total coal supply of the United States. B represents the amount used to the end of 1912. C represents the amount consumed in a single year. This diagram was prepared by Edward W. Parker, Chief of the Division of Mineral Resources of the U. S. Geological Survey.

section, the balance of the licensed land to remain in the government to be leased in small parcels to other parties on a royalty basis under the more advantageous terms that could then be secured.

THE NEED OF OIL FOR THE NAVY

The United States will need oil for its navy as well as coal, and probably in increasing quantities as the modern oil-burning or gas-burning engines are recognized. It would be economical to substitute oil for coal for many reasons; to reduce labor cost, to avoid the building and maintenance of colliers, and the purchase and support of coaling stations.

The Diesel engine can, with the fuel carried from the home port, take one of our greatest ships around the world without dependence upon a renewed supply of fuel. England's adventure in this direction will presumably force other nations into like enterprise, and yet England has no oil fields on which to draw, while we have already the largest producing fuel-oil fields in the world, and others are appearing.

Already we know of oil in Alaska, and

Photo from Bureau of Mines of the Department of the Interior

A CANARY USED AS A PROTECTION IN MINE RESCUE WORK

It has been found that canaries will show signs of distress at the presence of harmful gases in mines long before human beings are aware of any danger. It is now the practice to carry one of these birds with all rescue parties, as it will indicate the point beyond which it is not safe to proceed without wearing protective helmets.

within a few weeks a fine grade of oil has been found on the Quinaielt Indian Reservation in Washington. The Indian oil lands we do not own. They belong to the Indians, and their product must be sold for the Indians' profit.

The one sole reservation of oil lands for governmental use is that in California, over the withdrawal of which litigation is now pending. Under these conditions it would seem of the highest expediency that the government make such offers as will induce the proving of our lands, and of these proved lands retain sufficient to make our ships independent of the world and as fully competent as their rivals.

Some years since the Department of the Interior announced the discovery within the United States of a deposit of potash which it was hoped would render our farmers independent, for a time at least, of all other sources. This deposit still lies unused. No proper laws have been passed by which it can be put into use. A common-sense view of the matter would be to treat these lands as it has been suggested we should treat coal lands.

So, too, should our vast deposits of phosphate rock, undoubtedly the world's world's supply. We are giving a constantly increasing volume of thought to the scientific methods by which the fertility of our soils may be increased. And the time is likely to come when the deposited phosphorus in our western lands will be regarded as of almost priceless worth.

Few appreciate how very extensive these deposits are. They run for hundreds of miles through Wyoming, Utah, Montana, and Idaho, and in other States similar deposits of lesser extent are known to exist. We have millions of acres of phosphate lands which are estimated to contain several billion tons of phosphate rock; undoubtedly the world's largest known reserve. In 1910 the United States produced 52 per cent of the world's output of phosphate rock, and last year over 40 per cent of our product was exported. It would certainly be well if we could insure the preferential use of this fertilizer on American farms and export it in the form of farm products rather than as raw material.

TIMBER LANDS

I am not satisfied with the operation of the homestead law as to the timber lands of the far western lands. As the law now is, a man may enter upon 160 acres of these lands, and by living a total of 21 months on the land during three years and cultivating at a maximum 20 acres of the land it becomes his. He promptly proceeds, if he is wise, to sell it to some lumber company for from $10,000 to $20,000. The land is allowed to lie for an indefinite period as a part of the company's forest reserve or is logged off, leaving the stumps in the land, and eventually sold for agricultural purposes, if so adapted.

Experience justifies the statement that few men take up these heavily timbered lands under a bona fide attempt to meet the purpose of the law, which, as its name implies, is to convert the public land into homes. By the investment of a few months' time and a few hundred dollars the homesteader gains a property worth many thousands of dollars. Yet all the conditions of the law are complied with and patent must issue. The government loses the timber and the land and does not gain a real home-maker. Such homesteaders add nothing to the wealth of the nation. The law should punish them, in fact, as frauds. Whether with the connivance of the lumber companies or not, they are the agencies by which the law is defeated and the lands conveyed where it is not intended that they should go.

There is a remedy for this condition of things, and it lies in the selling of the land and the timber separately. I am beginning to doubt the wisdom of applying the homestead law to any land which has not first been declared fitted for agriculture. It is now a blanket law which is used to cover a multitude of frauds. Such legislation would also cure the abuses resulting from the use of certain classes of scrip.

THE ARID LANDS OF THE GREAT AMERICAN DESERT

"The Great American Desert," as it was designated upon the map some 40

OPEN PIT PHOSPHATE MINE IN FLORIDA

Photo from U. S. Geological Survey

"We have millions of acres of phosphate lands which are estimated to contain several billion tons of phosphate rock, undoubtedly the world's largest known reserve. In 1910 the United States produced 52 per cent of the world's output of phosphate rock, and last year over 40 per cent of our product was exported" (see page 204).

years ago, has become one of the richest portions of our country. This desert included a variable area, generally all west of the Missouri River to the Sierra Nevada. Today it is harvest field, cattle range, mining camp, and orchard—where there is water. And where there is no water it remains desert.

There are at least four States which can never increase greatly in stable population unless their lands are brought under irrigation. And in all of the Western States there are tens of thousands and in some millions of acres that will remain waste land, fit only for the poorest cattle range, and much not even for that use, without the expenditure of large sums for reservoirs, dams, canals, and ditches.

That there is not water enough even with the fullest storage to supply the demands of all the arable land can safely be said. That, however, there is sufficient to care for a large part of this territory and bring it into fruitfulness there is no doubt.

The government, seeing this condition, undertook to lend itself to the development of these lands by what is known as the Carey act. This was a form of coöperative effort in which the Federal government turned over any required body of lands to a State, which the latter undertook through private enterprise to irrigate. When to irrigate meant nothing more than to divert a portion of a stream from its bed and convey it by gravity to the desert, this plan was attractive. But since these simpler methods had to be abandoned as no longer adequate, this act has done little in the promotion of such enterprise.

The successful Carey act projects are a distinguished few. Great wrongs to trustful or none-too-wise farmers were done in its name, and the suffering which it caused has made it difficult to make it serviceable, even under the more careful scrutiny of later and more cautious officials.

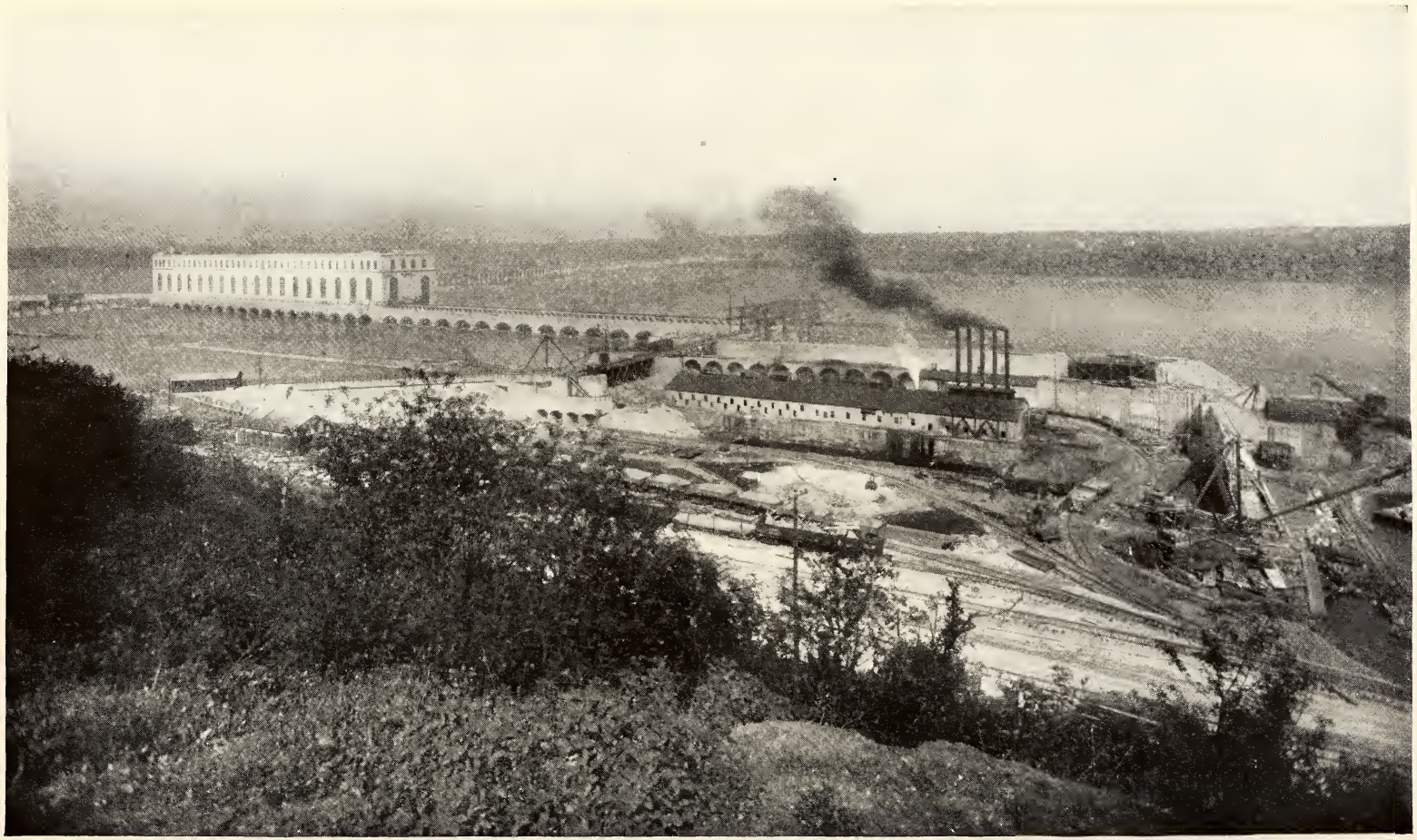
THE GOVERNMENT'S RECLAMATION WORK IS A SUCCESS

Because of the magnitude of the money investment required, and appreciative of the need, Congress in 1902 adopted the policy of undertaking irrigation projects of its own. The moneys received from the sale of public lands—less 5 per cent—went into a reclamation fund, administered by the Department of the Interior. The result has been the construction of some 25 projects, scattered through all of the arid-land States. In these the government has invested approximately $76,000,000. One of these, a pumping plant in Kansas, is now unused; another, a flood-storage system in New Mexico, is only in partial use; both of these, however, represent less than 1 per cent of the total investment. The others are in operation, and less than 3 per cent of all the land which is served or which we are ready to serve is unoccupied. This work has been a success.

Soon after taking office I received a number of letters complaining of the reclamation service. To inquire into these complaints I first called a conference in Washington of representatives from all the projects and later visited most of those from which most serious complaint had been received. I cannot here review the matters considered or the information gained. My conclusion was that mistakes had been made by the service, some of which grew out of ambiguities or defects in the law, some out of inexperience, and others out of a misconception of the relationship that should exist between such a governmental service and those with whom it was dealing. A larger degree of frankness with the farmer on our part and a fuller appreciation of the responsibilities assumed on the part of the farmer will mend much of the feeling that I found.

RELIEF FOR THE USERS OF WATER RIGHTS

But there is one matter of great moment to these people which should be corrected by law as soon as possible. We mistook the ability of the farmer to pay for his water rights. Ten years was the time given. His optimism and our own was too great. That time should be doubled. This should be done not alone because of the inability of many to meet their obligations to the government, but because it will prove wise policy to give



THE GREAT MISSISSIPPI POWER DAM AT KEOKUK

Photo by Anschutz

This great dam across the Mississippi forms the largest water-power plant in the world. It is nine-tenths of a mile in length, while the power-house is a third of a mile long, half a city block wide, and as high as a 15-story skyscraper. Over $27,000,000 have been spent in the construction of this plant, which will produce 310,408 mechanical horsepower, at least two-thirds of which will be available for manufacturing purposes. Each horsepower developed in a manufacturing community eventually supports five persons, so that it is estimated this new dam will support one million new inhabitants within a radius of 150 miles of Keokuk.

THE GENERATORS OF THE LARGEST WATER-POWER PLANT IN THE WORLD

Photo from Anschutz

The picture shows part of the row of 30 electric generators in the power-house at Keokuk. Through these generators the flowing stream of the Mississippi is converted into heat and light. From them electric power will be sent to St. Louis, 137 miles distant, where it can enter into successful competition with the cheapest coal and the cheapest steam power in the United States.

a free period within which the farmers may more fully use their farms. They can put their lands to a more profitable use, both to themselves and to the country, by being allowed to cumulate their earnings in the early years and be thus enabled to make investments in stock and machinery which will make for larger profits later.

I feel the keenest sympathy with those upon these projects who are entering into this work of putting the desert into public service. They are genuine pioneers in a new field of work, on the success of which depends greatly the rescuing of a vast territory. The enemy of the government and of the farmer is the land speculator. He is of two kinds. Sometimes he is a farmer who does not expect to farm but to sell out at a higher price and go elsewhere. Generally, however, he is the holder of a large tract of private land within the project, who creates false values and burdens those who buy and attempt to farm with a load of debt which handicaps them in their efforts. Both of these are hostile to the welfare of the enterprise and tend to destroy the value of the service which the government is attempting. But such matters may, I trust, be overcome by new methods of administration.

It is my hope that the government will find its way to enter with zest upon more works of a similar character. Not to do this will leave undeveloped much of the most fertile land of the West. What is to be the future of Arizona and of New Mexico, of Nevada and Utah, of southern Idaho, central Oregon, eastern Washington, much of Montana and Colorado, and more of Wyoming and Nebraska, if the government does not aid in their development?

Private capital will not, for many years at least, risk undertakings of such magnitude as these States require. Experience has made the irrigation-bond buyer extremely wary. Within a few weeks the most promising of the great private enterprises in Idaho has met with the misfortune which had befallen so many others in neighboring States. The most successful irrigation plants are founded on the wrecks of their pioneer exploiters. The government has rescued others.

It has been with these projects much as it has been with our western railroads. They had to descend into the hands of the receiver before they could be resurrected into a new and glorified life.

THERE IS MUCH MORE IRRIGATION WORK FOR THE GOVERNMENT TO DO

But where are the funds to come from to carry on such work? My answer is, From the public lands in these States. We sell these lands now and the proceeds go into the reclamation fund. This is the policy of Congress—that we shall for a time use the moneys which the government derives from the sale of its lands to create new values within the States. Two years ago the government went further and set aside $20,000,000, to be used in the completion of the irrigation schemes now under way. This is an advance by the government for which it takes what might be termed a mortgage on the moneys which the projects will yield from the sale of water rights. Why not extend this policy?

The West can use profitably and wisely $100,000,000 in the next 10 years to the advantage of the whole country. Indeed, without this expenditure the asset which the government has in its desert lands will lie unused and be of no national value. The government will recover all of the money it advances, not to speak of the homes and the values created by its enterprise.

If the government will place upon a leasing basis these western resources with which we have been dealing, it can have an increased fund for the continuance of this work and an increased assurance of the return of its advances. Just as I would aim to make Alaska pay in the end out of her own resources for a liberal advance made to her for the opening and improvement of her territory, so should we aim to make these lands of the West bring into being the latent values of the West. With a little foresight we can transform coal and oil, phosphate and timber, into green fields and electric power.

Railroads and power plants, street railways and waterworks, are built with 50-year bonds, which rest upon the foundation of their probable earnings.

A LOCOMOTIVE IN MID-AIR Photo from U. S. Reclamation Service

Moving an engine from the bottom of the site of the Arrowrock Dam in Idaho to the top of the future spillway, 350 feet above. The Arrowrock Dam, which is part of the Boise Reclamation Project, will be the highest dam in the world.

GROWING APPLES IN THE DESERT

Photo from U. S. Reclamation Service

This thriving young apple orchard is growing on what a few years ago was part of the desert plain of Idaho. This transformation is due to the water furnished by the Boise Project of the U. S. Reclamation Service, upon which the government has spent more than eight million dollars. Ninety-seven per cent of all the land which is served by the government reclamation projects, or which is ready to be thus served, is occupied (see page 209).

Photo from U. S. Reclamation Service

THE GREAT GOVERNMENT RESERVOIR AND TWIN TUNNELS, THREE-QUARTERS OF A MILE FROM THE SHOSHONE DAM, WYOMING

"Stored water means more than fields of alfalfa, generous orchards, and the homes of hearty husbandmen; it means power for industries, light and heat for town and farm. These two—irrigation and hydro-electric power—are companions. One does not think of the one without suggesting the other. And the magic worked by each is rivaled by its mate" (see text, page 219).

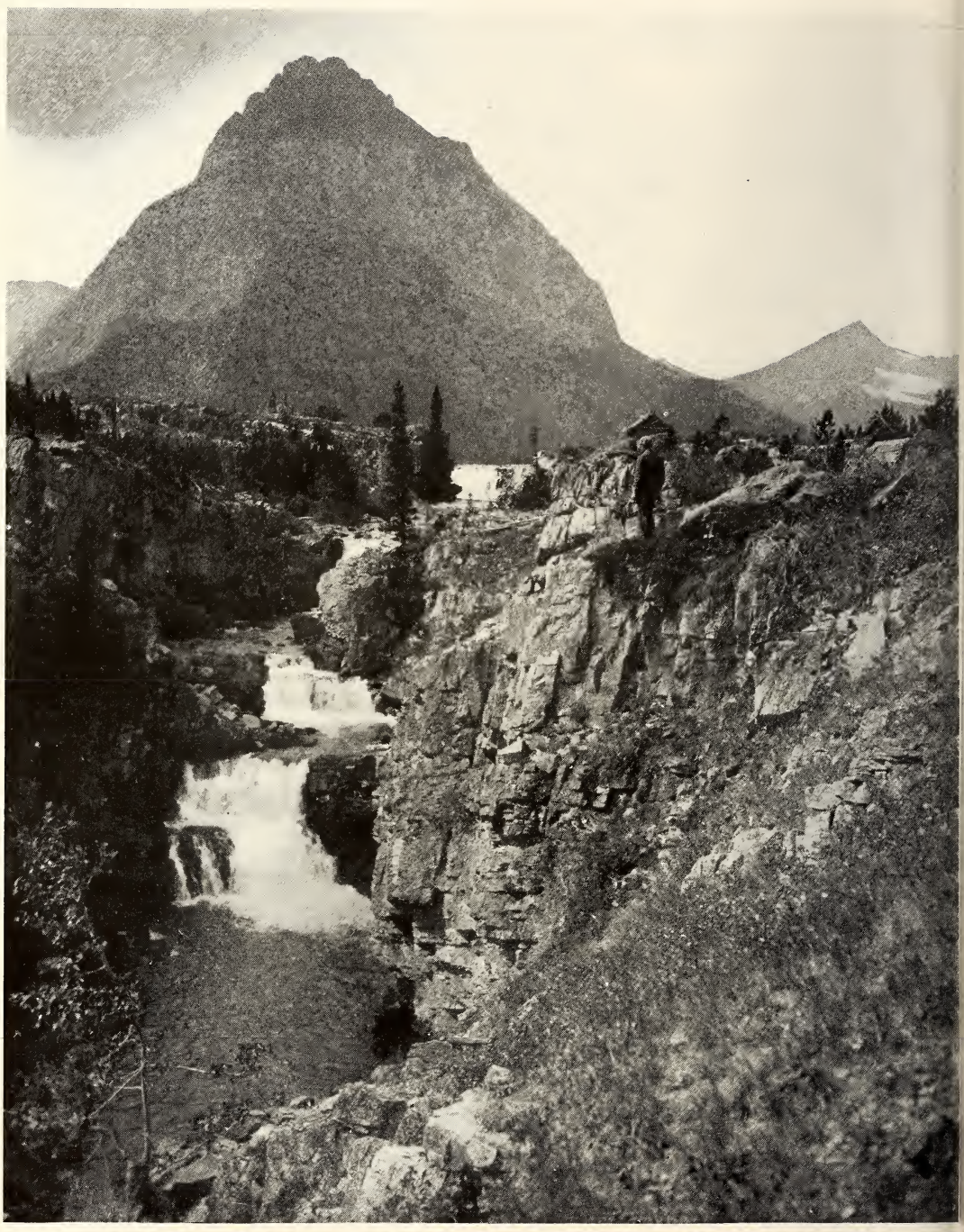
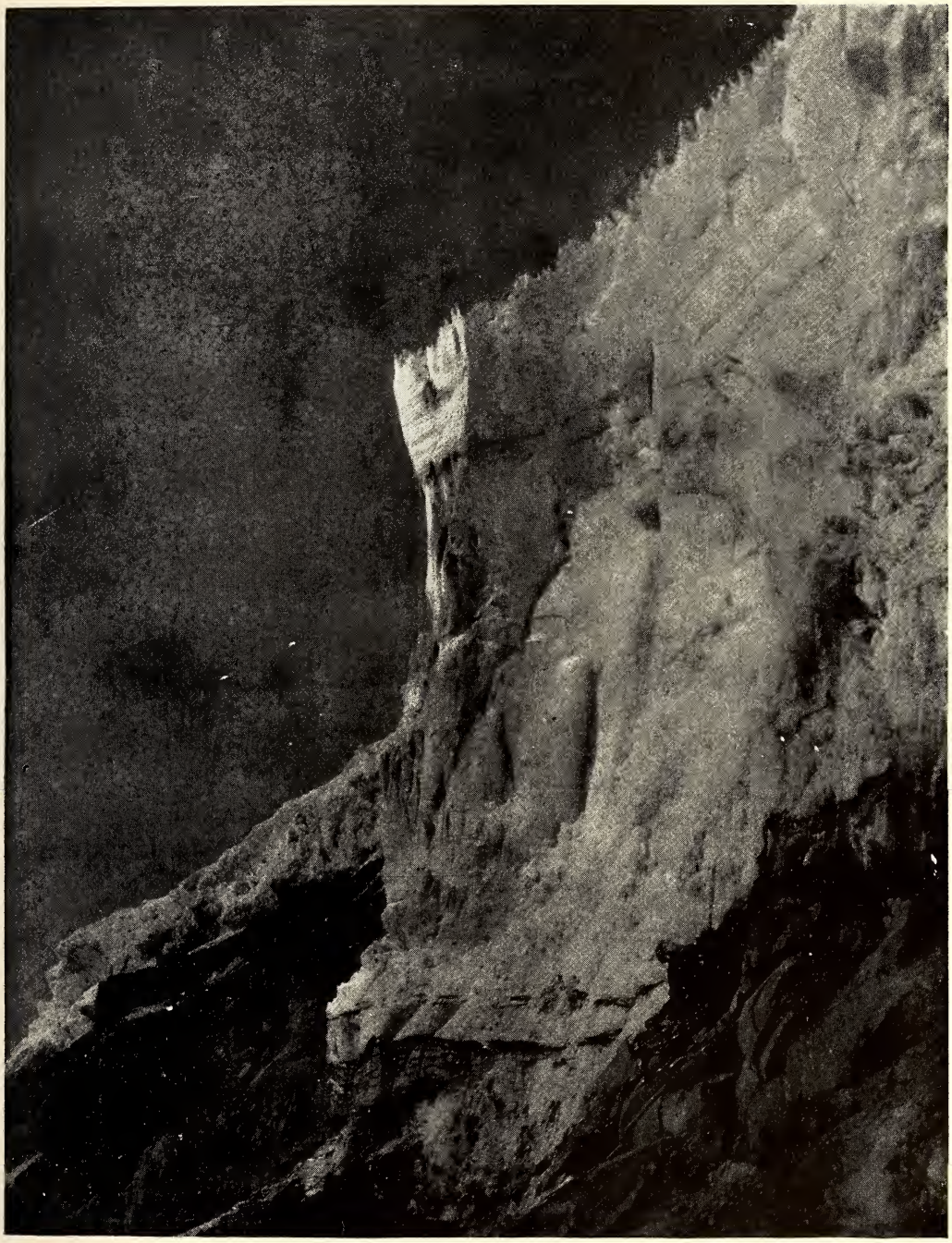


Photo from U. S. Reclamation Service

THE MCDERMOTT LAKE AND FALLS, MONTANA

The dam of the St. Mary Project of the Reclamation Service will be built across the canyon at the foot of the falls shown in the picture. While it will destroy the beauty of these picturesque falls, it will be the means of bringing under cultivation great tracts of land which are now arid.



AN ICE WALL ON MOUNT RAINIER Photo by A. H. Barnes

This great ice wall, with its face of 400 feet, stands on the upper part of the mountain. Mount Rainier, the Great White Monarch of the Pacific Northwest, is included in the Mount Rainier National Park and is one of the wards of the Secretary of the Interior.

CALIFORNIA INDIAN MOTHER AND HER BABIES

California has an Indian population of over 16,000, who are looked after by the office of Indian Affairs of the Department of the Interior. The Indian Service has some 6,000 employees distributed over twenty-six States, and it administers one billion dollars' worth of property which belongs to the various Indian tribes.

It is not without precedent in principle or in fact for the United States to improve its own property and for its advances take a mortgage upon the wealth it creates, and in one-half of 50 years we would regain our capital.

Inasmuch as the title to these oil and other lands would remain in the government and be excluded from State taxation, it would seem to be fair that a certain percentage of the royalties received should go to the States within which the revenues are raised. Twenty-five per cent might be a minimum, but a higher percentage would seem advisable if the whole might remain for a time in the government's hands to be used in such coöperative irrigation enterprises as the State might desire, and after such use has been made and the fund replenished, be fully released to the State.

COÖPERATION OF THE FEDERAL GOVERNMENT WITH THE STATES

This suggestion of coöperation with the State is not made idly. I look forward with confidence to a more intimate relationship between the States and the Federal government in undertaking this work of developing the West. The mass of the people are sympathetic with the purposes of the government. They regard with pride the great engineering works of this service, which stand as monuments to the interest of the nation in their welfare.

So cordial, indeed, is the spirit of the West toward this work that within a few months the State government of Oregon and the Federal government, through the Reclamation Service, have become partners in several projected irrigation plans, one involving no less than the pumping of water from the Columbia River by electric power generated by the river itself. A similar coöperative enterprise has been entered upon with the State of Washington.

The plan is that we shall do the work, supplying one-half the funds and the State one-half. This is a tendency which it is well to foster; for the State will well appreciate the effort of the nation when it makes like sacrifice itself. And nothing could more induce to the success of the nation's effort than to have some local check and interest. To place at a State's service a large sum gathered from the resources of the public lands within her borders would enable this character of mutual effort to expand.

This can be done if we will retain for national improvement a portion of the national resources. And this may be done, I believe, with the hearty good will of the people who are chiefly concerned—the people of the West.

One reason stands out demanding the promptest possible action in this matter. Reservoir sites are few and becoming fewer each succeeding year. Those that may be had are rising steadily in value. So valuable, indeed, have some sites become since the institution of the Reclamation Service that projected enterprises are not now regarded as feasible, for the dependent lands which it was intended to irrigate can not make a return sufficient to pay the increased cost.

And let this not be forgotten, that stored water means more than fields of alfalfa, generous orchards, and the homes of hearty husbandmen; it means power for industries, light and heat for town and farm. These two—irrigation and hydro-electric power—are companions. One does not think of the one without suggesting the other. And the magic worked by each is rivaled by its mate. Electricity is coal and kerosene which need no railroad to transport them. The significance of these irrigation reservoirs from this point of view is but beginning to be appreciated and will grow greater as the country becomes more thickly populated and factories come to supplement the farms.

THE ENORMOUS VALUE OF POWER SITES

And this brings me to the consideration of the government's policy toward the use of the public lands for reservoir and dam sites. It is one of the most perplexing problems that engages the mind of the man who wishes to see the West thrive more abundantly. What is such land worth? Are we justified in measuring its value by the use to which it is put, or should we yield this strategic resource without compensation?

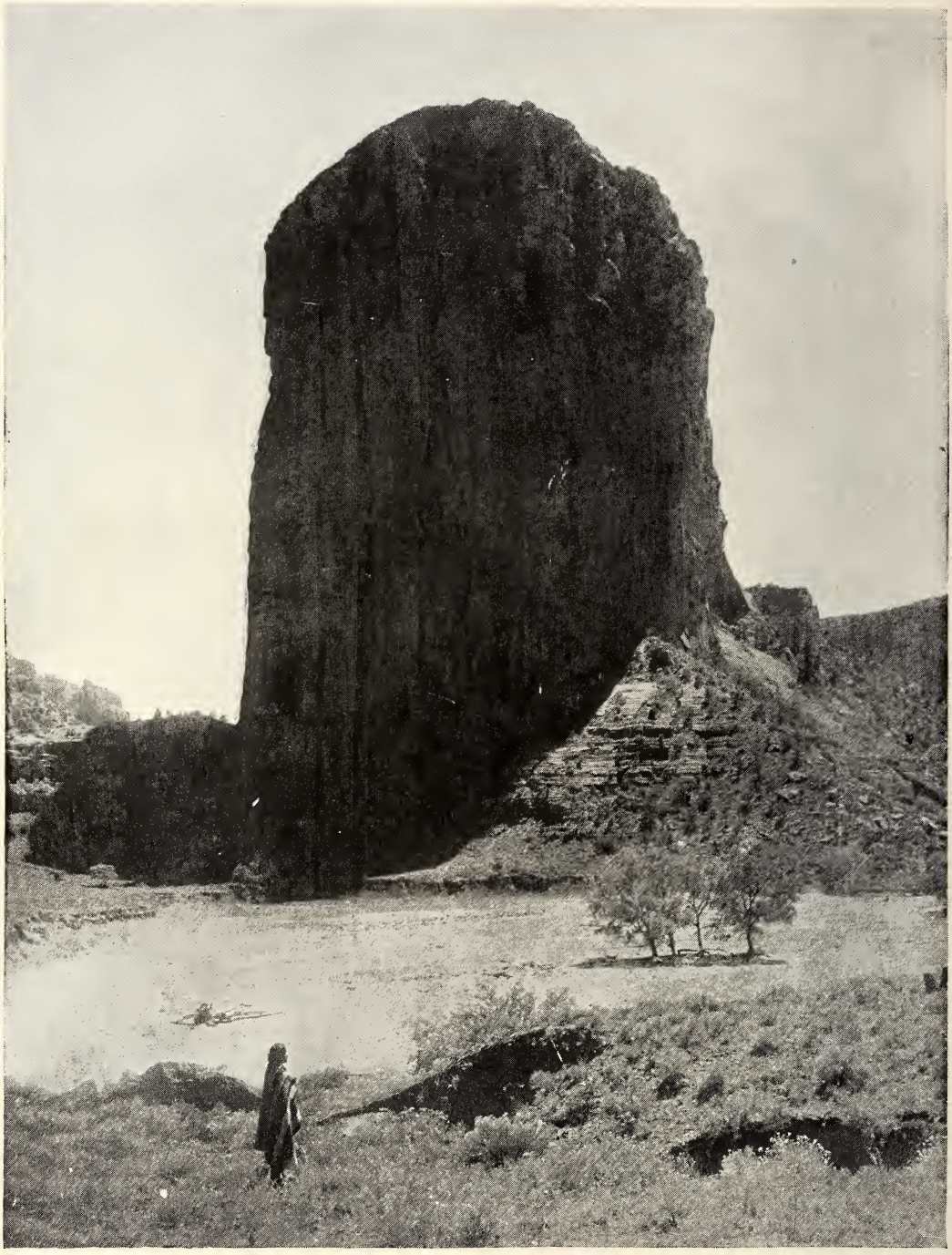
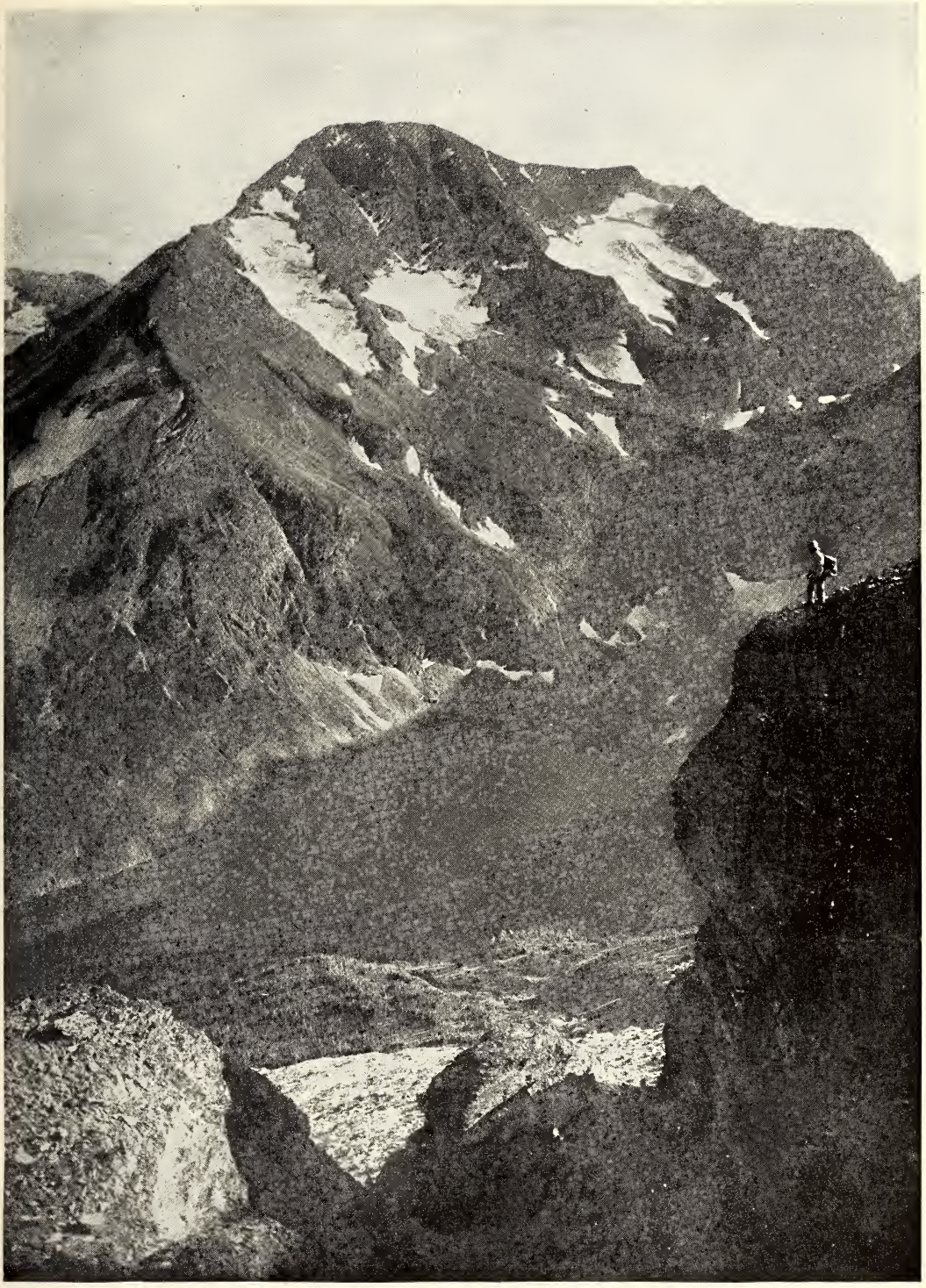


Photo by George R. King

ONE OF OUR NATIONAL MONUMENTS

This towering mass, known as Monument Rock, stands in the Canyon de Chelley in Navajo County, Arizona, within an Indian reservation. It forms part of a collection of natural wonders situated in an area of 360 acres which were declared National Monuments in 1912, and, as such, are preserved by the Department of the Interior.



GUNSIGHT LAKE FROM MOUNT JACKSON Copyright, Kiser Photo Co.

One of the beauty spots in Glacier National Park, Montana. The national parks are under the jurisdiction of the Secretary of the Interior, who is charged with the duty of preserving the wonders of Nature contained in them from desecration. Glacier National Park contains over 900,000 acres and is the youngest of our twelve parks.

A SCENE IN A CHARACTERISTIC RADIUM-BEARING COUNTRY IN COLORADO Photo from U. S. Geological Survey

The ridges are of white sandstone, containing the carnotite ores from which radium is extracted. The Secretary of the Interior, Mr. Lane, has recommended that the President be empowered by Congress to withdraw from the public domain lands containing carnotite, pitchblende, or other minerals or ores from which radium may be derived. The law at present does not permit the withdrawal of mineral lands except coal, oil, potash, and phosphate lands.

The country has been aroused too late to save the very richest of these points of vantage. Private power companies hold the most accessible of these sites under rights of which they can never be deprived.

So much more compelling the reason why we should not yield what remain unwisely. The temptation to grant generously without condition that which may be put to so beneficent a use must be resisted if we are not to meet a spendthrift's fate. At the same time there must surely be a rational way by which capital may be brought into this public service. The present condition of stagnation does no one good. Within a generation I believe the people will be as alive to the value of public ownership of hydroelectric power plants as they are today to municipally-owned waterworks.

The people not being prepared, however, to proceed to put these lands to their highest use, I am not in favor of keeping them from being utilized by private capital in the public interest. Because we do not know what is best to be done is not a reason either for doing nothing or for getting rid of the trouble as soon as possible, on the old "land-island" policy.

How may the needed advantage be gained for the present and the needs of the future be cared for? This is the immediate problem. What may capital reasonably demand? A fair and attractive return upon its investment yearly and the full return of its capital. And what may the public served reasonably require? Good service and fair rates. Who

Photo from U. S. Geological Survey

IN THE RADIUM COUNTRY: COLORADO

The greater part of the world's supply of radium is obtained from radium-bearing ore mined in the United States. At present the ore is exported to Europe, where, in the laboratories of France, Austria, Germany, and England, the radium is extracted from it. There appears to be in the United States today less than two grams of radium—that is, less than one-fourteenth of an ounce. This is valued at $120,000 a gram. Thus while we are supplying the world with radium, we have practically none at home, as heretofore no steps have been taken to preserve for our own people this invaluable metal.

shall make these rates? Within the State they must be subject to State regulation; between the States, Federal authority must control.

WHAT WILL THE GOVERNMENT RECEIVE FOR ITS LANDS?

What return shall the Federal government have for its lands? My answer would be, no return whatsoever, provided the plant reverted to the government without cost at the end of 50 or 60 years, or so much of the plant as was based on the land itself and the improvements directly attached thereto, such as reservoirs, dams, water rights, and rights of way. For the tangible property of the plant, such as the distributing system and machinery, the government might well agree to pay an appraised price, so as to insure its being maintained and extended during the later years of the life of the franchise.

The right to buy the complete plant at an appraised figure at any time after 20 years would be a further protection and one not burdensome, while for better service it would seem advisable that all plants be permitted, in fact encouraged, to combine physically, just as our railroads are required to couple themselves into through routes and thus make their

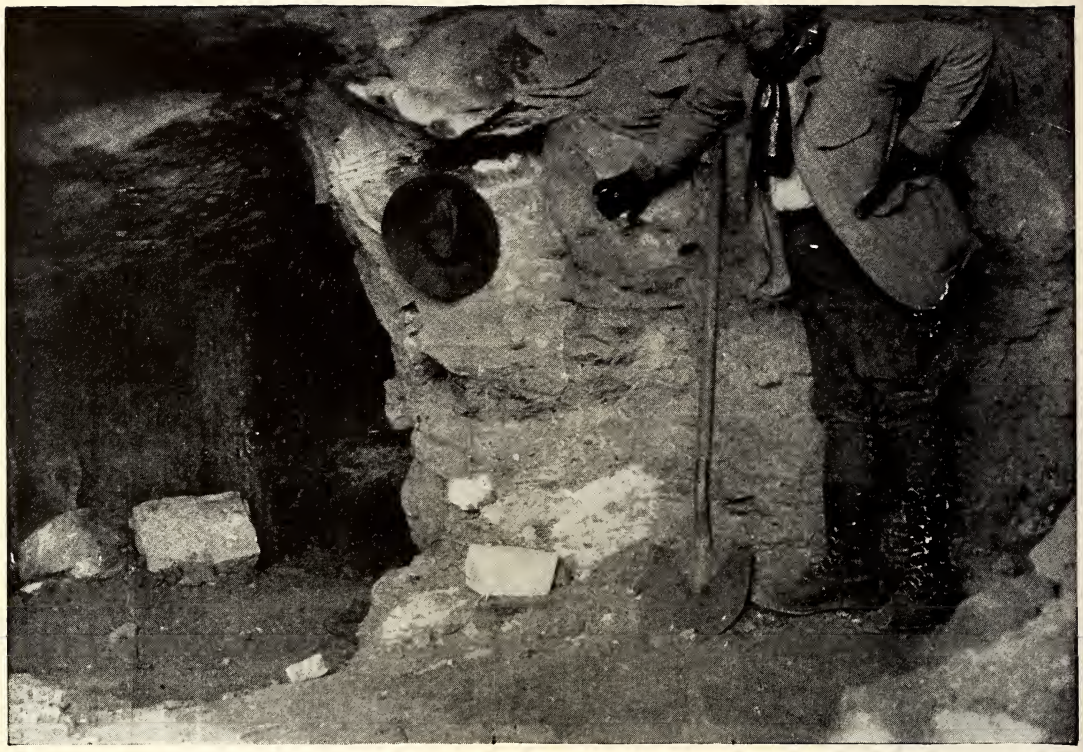


Photo from U. S. Bureau of Mines

IN A COLORADO RADIUM MINE

This picture shows the 4-foot stratum of radium-bearing ore, carnotite and vanadium in the Cliff Mine, Paradox Valley, Colorado. Radium is found in ores carrying uranium and vanadium, which are used extensively in the arts, and the processes by which it is extracted are secret. A process has been invented by the chemists in our Bureau of Mines which promises, from the laboratory experiments thus far made, to be successful. Under the endowment of two Americans, a building is now being erected in Denver (which, with its equipment, will be opened for work in the coming month) in which an effort will be made to prove the commercial possibility of this American process. If successful, this process will be given to the world, and all of the radium secured over and above a small minimum will be the property of the United States, and will be put into the hands of the United States Hospital Service for public use.

service continuous and interdependent; but they should not be allowed either to agree as to rates or to merge their capitalization or their identity.

Such plan as is here suggested should be attractive to capital wherever there is bona fide need for such water-power development, for it is definite in its terms and can be made a precise basis for capitalization. The term of the franchise would be long enough to permit of the amortization of the plant upon such a percentage as would lay no heavy burden upon each year's earnings.

Where a reservoir site is also used for the storage of irrigation waters, the right to which attaches to certain lands which should enjoy that use forever, it could be provided that at the end of the franchise period the government would either turn over the plant to the water users or the State or otherwise provide for its operation.

I have endeavored herein barely to outline such a constructive program as would meet any reasonable demand and with the least burden place our resources at the service of the people. It should not be impossible to hearten the hopes of those who live in Alaska or the many who would engage in her development were the doors of opportunity open to them. And if we can follow some such plan as has been suggested, by which, sensibly

and conservatively, the resources of the West may be utilized for her upbuilding and improvement by the fullest recognition of their interdependence, I believe that we would meet the demands of all whose ambition to gain fortune has not closed their eyes to the general good.

WHAT THE DEPARTMENT OF THE INTERIOR DOES EACH YEAR

The Department of the Interior has to do not alone with general policies, but with an infinitude of administrative detail. Its embarrasments arise out of the large number of matters as to which administrative discretion may be exercised. That you may, however, appreciate the scope of the department's activities, permit me to note here that we care for the Eskimo in Alaska and for the insane in the District of Columbia; for 324,000 Indians scattered throughout the continent, for whom we hold property in trust approximating in value $1,000,000,000; that the choice beauty spots of our country have been set aside as national parks, which are in our care; that we distribute to over 800,000 pensioners, their widows and dependents, a round sum of over $165,000,000 a year; that we issue to inventors of the United States and foreign countries an average of more than 3,000 patents each month; that every miner in the land is interested in those means which we are taking to prevent mine accidents and more fully to realize the mineral wealth of the land; that the schools of the Indians and the national university of the colored people are under our jurisdiction, together with the Hot Springs of Arkansas and the cliff dwellings of Colorado; that the internal economy of the Territory of Hawaii, as well as that of Alaska, fall within the purview of this department; that it is our part to measure the waters of a thousand streams, survey the lands of all the States, and look beneath the surface to see what they contain; that we have still in our care a great body of public land (some 300 million acres outside of Alaska), out of which each year approximately 60,000 farms are carved; that we have a bureau of education, which should be provided with the equipment by which it may adequately do a great work for the schools, the teachers, and the children of this country, or be abolished.

A RADIOGRAPH OF A KEY

This picture was made by placing a key on the outside of a light-proof plate-holder containing a photographic plate. A block of radium-bearing ore three-quarters of an inch thick was then placed on the key and the photograph resulted.

CHINESE SALT WORKS

Deposits of salt are very numerous in China and the production of commercial salt is a government monopoly. At the producing center the salt costs about three-eighths of a cent per pound, but when shipped by the government to the distributing centers it sells for eight and often ten times that amount. Hence the importance to China of the salt *gabelle,* as it is called.

AT THE COLLEGE OF INTERPRETERS, HA-NOI

The French, since their arrival in Tonkin in 1884, have pursued a very liberal educational policy. Primary schools have been established at convenient points, and a college of medicine for natives exists at Ha-noi, as well as the College of Interpreters, which is designed to give natives a thorough training in the French languages. The students are mainly Annamese, but there are also a few Chinese. The collegians live together during their course and it will be observed that at table they follow European customs.

AT STUDY IN A BUDDHIST MONASTERY Photo by Dr. W. E. Grubl

The children are studying the Buddhist Scriptures, which are written in a language called Pali on curious oblong tablets made of palm leaves. The monks are distinguished by their shaven heads and by their single garment, the famous yellow robe. In Burma all boys become monks for a year or two and in this way a part of their education is acquired.

A WAYSIDE SCENE IN RURAL ENGLAND

The entrance to one of the quaint old cottages in the village of Cockington in the south of Devonshire. All the houses in this village have thatched roofs and are very old; many of them have been standing for over three hundred years. Photo by A. W. Cutler.

SOME ENGLISH CAVE DWELLERS

This is one of a group of rock dwellings known as Holy Austin Rockery in Worcestershire, England. Recent investigations have proved this to be the oldest inhabited rock dwelling in England, its earliest occupation dating back 900 years. Before the Reformation, the rock was occupied by Augustinian friars whence it derives its present name. This old lady and her little grandson now live in the Rockery which

A BIT OF OLD WALES

This old fish-wife is wearing the fast disappearing Welsh costume, the most curious feature of which is the high beaver hat worn over a frilled muslin cap. The top basket is used for cockles and mussels, the lower one for fish. The picture was taken at Llangurn in South Wales. Photo by A. W. Cutler.

A REST BY THE WAY

A quiet scene in the countryside of Belgium near the French border. The old man is on his way home with his little granddaughter, seated in the cart drawn by dogs. These dog carts are often seen in Belgium and Holland, bakers, milk dealers, and peddlers using dogs to assist in the distribution of their wares.

SHEPHERD BOYS OF THE GREAT HUNGARIAN PLAINS

The immense sheepskin coat is typical, so are the long pipes. The younger boy is not wearing skirts but trousers so full and baggy that at first sight they appear to be articles of female attire. Photo by A. W. Cutler

SHRIMPING IN NORMANDY

Along the Norman coast, where shrimps are abundant on the sandy shores. this is a common sight at low tide. The girls wade through

AT THE SPINNING-WHEEL

Brittany today remains the most primitive part of France. The peasants cling tenaciously to their ancient costume, the men to their short, velvet-trimmed jacket and the huge broad-brimmed hat with great streamers of ribbon hanging down behind. The women wear white caps, the shape of which is different in each locality.

GOOD CHEER FOR THE FISHERMEN

Along the coast of Brittany are found perhaps the most intrepid fishermen in all France, and strangely enough hardly one of them can speak a word of French. They have a Celtic [illegible]

HUNGARIAN MOTHERS AND THEIR BABIES

Hungarian peasant women have a curious custom of swaddling their infants on immense pillows. The lady on the left is in her best costume, the skirt of which is embellished with a number of vari-colored ribbons hanging straight down from the waist. The other two women

LITTLE DUTCH SCHOOLGIRLS

In the outlying districts of Holland, especially on the islands of the Zuider Zee, many quaint costumes are found. The caps the girls are wearing are held in place by coiled springs of gold set over each temple. These springs are often of ancient workmanship and great artistic merit.

SLOVAK GIRLS IN THEIR BEST, HUNGARY

To see these girls, coming from church on Sunday, in all the glory of their best, it is difficult to realize that throughout the week they work in the fields from early morn to sundown. A curious feature of this much be-ribboned costume is the lack of head-dress. The girls [illegible] just a cloth bound round the foot to make the high boot fit snugly. Photo by A. W. Cutler.

A FAMILY GROUP IN HUNGARY

These peasants have a passion for embroidery. Note the long black apron worn by both sexes, with its richly ornamented designs in colored wools—sometimes in silks. The puffed sleeves of the women are very stiff and uncomfortable, in striking contrast to those of the men, which are flowing and beautifully worked. Photo by A. W. Cutler.

THE BRIDE AND BRIDEGROOM, HUNGARY

The enormous ornament on the bride's head is not so heavy as it looks, being composed largely of tinsel. It will be noted that the bridegroom's hat is also gay with flowers and tinsel. Note the ribbons hanging from the bride's belt, as also on page 237. Photo by A. W. Cutler.

PEASANT LIFE IN SICILY

A typical scene

WITH THE SICILIAN MOUNTAINEERS

The old lady on the left has dropped off into a doze while watching her turkey and chicks. Note the woman looking through the hole in the door. This hole serves both for window and chimney, the fire being kindled in a corner of the room on the stone-flagged floor. Photo by A. W. Cutler.

SOME JOLLY SICILIAN BOYS

These youngsters come from a little mountain village just above Taormina in Sicily. Though they are all of them poorer than Job, they

THE PROBABLE EFFECT OF THE PANAMA CANAL ON THE COMMERCIAL GEOGRAPHY OF THE WORLD

By O. P. Austin

WHAT will be the effect of the Panama Canal upon the commercial and travel geography of the world? Will it change travel routes, stimulate commerce, and bring the people of great land-masses into closer relationship?

The Suez Canal, opened in 1869, shortened the travel distance between western Europe and eastern Asia by 3,400 miles, and in doing so opened new highways of travel and traffic, multiplied interchanges of merchandise, and developed closer relations between the Occident and the Orient. The Panama Canal will shorten travel routes between New York and Yokohama by 3,750 miles; between New York and Shanghai, about 2,000 miles; between New York and Australia, about 3,000 miles, and between New York and western South America by from 3,500 to 7,000 miles. It will also reduce the distance from Europe to western South America by 3,000 miles and to western North America by more than 5,000 miles.

Will it also divert travel and traffic from the present established routes, stimulate commerce, and develop closer relations between the people of the countries thus brought closer together?

International commerce doubled in the 30 years following the opening of the Suez Canal, and business and personal inter-relationship between the Occident and the Orient was increased in like proportion. Will similar results follow the like shortening of trade and travel routes by the Panama Canal?

WHAT DETERMINES STEAMSHIP ROUTES

Highways of travel on the ocean are influenced by surrounding conditions just as are those on land. The shortest distance between two given points is not always the best on the ocean any more than is the case on a continent or island. True, the ocean surface gives a level "road-bed" for a direct line of travel, while a route over a land surface must make frequent detours to obtain even approximate levels for moving great quantities of merchandise.

But there are other important conditions which affect the ocean route. Plentiful freight supplies, present and prospective, interchangeability of the products of the countries forming the termini of the routes, "way stations" on such routes, plentiful coaling stations, and cheap coal of a quality suitable for steamship engines, and even favorable winds and ocean currents are among the factors contributing to the success of routes of travel upon the ocean.

Argentina, for example, has ample supplies of freight, but steamship lines do not develop rapidly between that country and the United States because most of the Argentine products are similar to our own, and there is no reason why she should send her wheat and corn and pork to this country, which has a surplus of those articles. Cuba, the world's greatest producer of cane sugar, sends little if any of it to Europe, because that part of the world produces from beets all the sugar it requires. England, the world's greatest coal exporter, sends no coal to the United States, which has unlimited supplies of her own. So, shortening of distances between great sections will not develop steamship business unless the products of the two sections are of such character as to justify exchanges.

In some instances, however, steamship routes adjust themselves to locally adverse conditions. The steamer which carries wheat and corn and meat from Argentina to Europe may bring the silks and woolens and laces of Europe to the United States and then return to Argentina loaded with agricultural implements, iron and steel manufactures, and mineral

oil from the factories and refineries of this country.

THE IMPORTANCE OF COALING STATIONS

Coaling stations and coal supplies are an important factor in determining routes of travel for steamers. The stations are numbered by hundreds and scattered over the entire travel world, yet the quality and prices of the material which they offer and the distances between ample and cheap supplies have much to do in determining steamship routes.

British coal is the standard for steamships in Europe, the Mediterranean, and western Asia; India, Australia, and Japan are the chief sources of supply for eastern Asia and the western Pacific, and the United States chief purveyor to all of America and adjacent waters. Australian, Japanese, and American coals are somewhat cheaper than the English, and if the stations tributary to the Panama routes were so near to each other that the steamship could get supplies at frequent intervals, and thus devote most of its carrying space to merchandise rather than to large coal supplies, the routes via the Panama Canal would offer special attractions.

Coal is nearly one-half the cost of running a freight vessel. A large share of the freight now moved on the ocean is carried in "tramp" steamers of from 3,000 to 5,000 "net register" tons capacity, but an actual carrying power of about twice as many tons of dead weight.

To charter a vessel of, say, 3,000 register tons, including the officers and crew, costs about $200 a day, while the coal required to run such a vessel at the very moderate speed of 10 miles an hour would cost about $150 per day. For passenger steamers, making higher speed, the cost of coal is much greater, and would probably be quite as much as the hire of the vessel and all of her officers, crew, subsistence, and incidental expenses.

A freight vessel of the type above described, carrying about 5,000 tons dead weight and making about 10 miles per hour, would probably burn about 3,000 to 4,000 tons of coal on a trip from New York to Yokohama or Shanghai and return, and if a saving of $1.50 per ton could be made by going via Panama and using the cheaper coal offered by that route, the economy in coal alone might turn the scale in favor of that route.

So it is apparent that coaling stations, coal supplies, and coal prices are factors of considerable importance in determining the choice of routes where distances are nearly equal.

THE SPHERE OF INFLUENCE OF THE PANAMA CANAL

The sections of the world which may be considered as probably within the "sphere of influence" of the Panama Canal are the eastern and western coasts of America, the eastern coast of Asia, and the islands of the Pacific. All of western America will be nearer to Europe than at present, and all of western America and most of eastern Asia and Oceania will be nearer to the eastern coast of America than at present.

A study of the production and consumption of the various countries lying within the canal's sphere of influence shows that their various products are thoroughly interchangeable. The western coast of South America offers chiefly natural products. Chile has nitrates, copper, and comparatively small quantities of wheat and other grains. The nitrates are needed by both the United States and Europe; the copper comes to the United States to be smelted and refined and the grains are wanted by Europe. In exchange for these Chile takes manufactures, and both the United States and Europe have manufactures for sale in ever-increasing quantities.

The Philippines and the Dutch East Indies offer sugar, tobacco, hemp, and other tropical products, and both Europe and the United States want these and pay for them chiefly in manufactures, which form the bulk of the imports of these countries. Australia and New Zealand offer meats, wool, and hides and take manufactures in exchange; and both the United States and Europe want the wool and hides, and Europe wants also the wheat and meats, and she, as

well as the United States, wants to pay for them in manufactures.

It will be seen, therefore, that the products of the various sections within the canal's "sphere of influence" are of a thoroughly interchangeable character.

DOES THE CANAL REALLY SHORTEN TRADE ROUTES?

Next we must consider the relative distances via the Panama Canal and other existing routes, measured between great trading centers. From Europe we may take Liverpool as a representative point. It represents, with a fair degree of accuracy, the initial point for the trade of Europe.

For the western coast of America we may consider the chief ports from Chile to Washington. For the Far East we may consider Yokohama, Shanghai, Hongkong, Manila, Sydney and Melbourne, Australia, and Wellington, New Zealand, as more or less within the "sphere of influence" of the Panama Canal, while Singapore, Colombo, and the ports of India are so much nearer to both Europe and the United States via the Suez that they need not be considered in a comparison of distances via the two routes.

Distances via Panama to Western Ports of America from Liverpool, New York, and New Orleans Respectively (in nautical miles)

Via Panama to—	From Liverpool.	From New York.	From New Orleans.	Advantage over Liverpool.	
				New York.	New Orleans.
Valparaiso	7,207	4,633	4,054	2,574	3,153
Iquique	6,578	4,004	3,425	2,574	3,153
Callao	5,937	3,363	2,784	2,574	3,153
Guayaquil	5,384	2,810	2,231	2,574	3,153
Acapulco	6,017	3,443	2,864	2,574	3,153
Honolulu	9,276	6,702	6,123	2,574	3,153
San Francisco	7,836	5,262	4,683	2,574	3,153
Portland	8,486	5,912	5,333	2,574	3,153
Port Townsend	8,606	6,032	5,453	2,574	3,153

Distances from New York, New Orleans, and Liverpool Respectively to Principal Ports of Eastern Asia and Oceania (in nautical miles)

To—	New York via Panama.	New Orleans via Panama.	Liverpool by shortest route.*
Yokohama	9,798	9,219	11,678
Shanghai	10,649	10,070	10,607
Hongkong	11,691	11,112	9,785
Manila	11,548	10,966	9,701
Melbourne	10,028	9,427	11,654
Sydney	9,811	9,232	12,235.
Wellington	8,540	7,939	11,975

* Via Suez, except to Wellington via Magellan Strait.

THE ADVANTAGES OF THE PANAMA ROUTE

It will be seen from the above tables (1) that both New York and New Orleans will be so much nearer to all of western America than is Liverpool that we may expect that an increasing share of the trade of that section will fall to the lot of eastern North America, and (2) that the eastern ports of the United States will be considerably nearer to Yokohama, Melbourne, Sydney, and Wellington than is Liverpool by her shortest route, but (3) that Liverpool will be still

nearer Hongkong and Manila than either New York or New Orleans via Panama.

It may therefore be expected that while the canal will give us decided advantages in the trade with western America and increase the share which we have of that trade, we are not justified in expecting marked changes in the share which we shall get of any part of the Orient except that with Japan and Australia and New Zealand.

However, the Panama route so much shortens the distance to the western coast of America, both from eastern America and western Europe, that we may expect to see most of the trade with western America go via Panama, except perhaps in case of European commerce with the southern ports on the west coast of South America.

EFFECT OF THE CANAL ON OUR DOMESTIC TRADE

One of the most important results of the opening of the canal will doubtless be found in its effect upon the movements of merchandise between the eastern and western sections of the United States. This trade is already very large.

While exact figures are not available, the data at hand seem to justify an estimate of about 3 million tons per annum of freight moved by rail and about a half million tons by water from the Atlantic Coast section to the Pacific Coast section, and about an equal amount from the Pacific Coast section and Hawaii to the Atlantic Coast section. The sums paid as freight charges on these 7 million tons moved between the Atlantic and Pacific Coast sections are estimated at from 250 to 300 million dollars per annum.

Only about one-fourth of the tonnage which now moves westward across the Rocky Mountains originates east of Buffalo and Pittsburgh, while most of the remaining three-fourths originates in the Mississippi Valley, which is the great producing section of the country and rapidly increasing its production of manufactures, which are the most important factor in the west-bound traffic. Of the east-bound traffic across the Rockies, a large share originates near the Pacific coast, especially the fruits, vegetables, fish, wine, barley, and lumber; but only a part of this reaches the Atlantic coast, a considerable share being consigned to the communities of the Mississippi Valley.

At present the railway rates between the Mississippi Valley and the Pacific coast are but little if any less than for the entire distance across the continent, but this will probably be somewhat modified when the steamship rates via Panama become sufficiently low to attract the Mississippi Valley trade toward the Atlantic and Gulf ports. In the actual cost of transportation between the eastern and western sections it may be expected that there will be a marked reduction in the tonnage rates charged.

The water rates between New York and San Francisco, even with the present handicap of transferring to the Panama or Tehuantepec railways and retransferring to steamer, are from 20 to 60 per cent of those charged by the railways, and about one-third of this present water rate is paid for the transferring across the Isthmus.

To sum up, it seems probable that the Panama Canal will carry most of the freight passing between the eastern coast of the United States and the western coast of Latin-America, and that the shorter distances and lower rates which it offers will greatly increase that trade; that the trade between the eastern and western sections of the United States will be greatly increased and transported at a much lower charge per ton; that it will sufficiently shorten the distances to Japan, northern China, Australia, and New Zealand to increase steamship service and materially increase the traffic with those countries, and that the European countries will use the canal in most of their traffic with western America and in exceptional instances with northern Asia, Australia, and New Zealand.

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VILLAGE LIFE IN THE HOLY LAND

BY JOHN D. WHITING

A description of the life of the present-day inhabitants of Palestine, showing how, in many cases, their customs are the same as in Bible times. Illustrated by photographs by the American Colony Photographers, Jerusalem.

PALESTINE, often called the Holy Land, is in a general way familiar to all of us from our study of the Bible. Few, however, realize that the manners and customs which prevailed there in Biblical days are still unchanged, even after an interval of 3,000 years. The land today is inhabited by three distinct classes: the *Bedouin,* or nomads, a wandering, war-loving race; the *Fellaheen,* who are the agriculturists, shepherds, and village dwellers, and the *Madaniyeh,* who live in the towns and cities and are artisans.

With the advent of civilization the townspeople are fast losing their ancient customs and quaint costumes, but the villagers adhere to both far more tenaciously. Still, no one knowing the country can fail to see that a time is not far distant when many of their interesting and long-lived habits of life will be things of the past.

THE VILLAGE HOME

The present-day villages are located, as a rule, either on the tops of hills, originally for protection, or near some spring or source of water. Many are built upon the foundations of dwellings whose origin dates back thousands of years. There does not exist a single example of a peasant village that has been founded in modern times.

With almost every village or district there are, to a greater or lesser extent, variations in the dialect of the Arabic they speak, their style of dress, and the homes they live in.

On the Plain of Sharon, where stone is rare or non-existent, the houses are made of sun-dried brick, the roofs thatched and covered with clay to shed the rain, while in the mountains they are built of stone, since of that material there is an inexhaustible supply.

Many have pictured in their minds Mary and Joseph, after arriving at the "inn" at Bethlehem and finding no room, being forced to turn into some barn built of timber, with lofty roof, hay mows, wooden mangers, and stalls for cattle and sheep. Such a stable has been the subject of many medieval and modern artists, but it does not present a really true picture. Let us consider the old-style village home that is most common in the districts around Jerusalem and Bethlehem, for that will give us a better idea of what happened on that first Christmas day.

The village streets are crooked, narrow, and unpaved. As in many of the countries of the Orient, farmers live close together for protection, and not on their lands; therefore in the villages there are no open fields or gardens, but house is next to house, except for the small walled-

MIXING THE MORTAR FOR THE ROOF

When a house is ready to roof over, all the villagers, both men and women, lend a helping hand. In this picture we see the men mixing the mortar and placing it on boards, which are passed along by the women to the men working on the roof.

in inclosures or sheepfolds through which one generally passes when going into the dwelling.

The house itself consists of one large room, usually square. The walls, from 3 to 4 feet thick, are built of blocks of stone roughly dressed and laid in mortar, roofed over with a dome, also of stone. The outside of this roof is covered with a coating of mortar made of clay, which, on being pressed with a small stone roller or pounded with a board, becomes hard and compact enough to shed the rain (see page 252).

A steep outside staircase, unprotected by any railing, is built up to the roof, for the surface must be repaired at times. The flat, open space of the roof also forms a handy place on which to dry figs and raisins, and during the hot weather the family may sleep there at night.

THE UPPER ROOM OF THE HOUSE

Entering the door, we find that about two-thirds of the space is devoted to a raised masonry platform, some 8 to 10 feet above the ground and supported by low-domed arches. This raised space, called *el mastaby,* is the part occupied by the family, while the lower part is used for the cattle and flocks (see page 310). A few narrow stone steps lead up to the *mastaby,* and a couple of small windows pierce the wall, high up from the ground. These, as a rule, are the only means of admitting light and furnishing ventilation to the entire house. Until about half a century ago it was thought unsafe to build even medium-sized windows, and any man presuming to do so would have been considered as challenging the rest of the community.

On one side is an open fireplace, with a chimney running through the wall and terminating on the roof often in an old water jar whose bottom has been knocked out, and so becomes a sort of smokestack. Many houses have no chimney at all; small holes through the wall, or the windows, furnish the only exit for the smoke, which on winter days fairly fills the house.

The furniture is very simple and, as a rule, consists of a crudely decorated bridal chest in which the mother of the family has brought her trousseau; a straw mat or heavy woven woolen rug which covers part of the floor, and mattresses, with thick quilts and hard pillows, which at night are spread on the floor.

The cooking utensils are few in number—one clay cooking pot, a couple of large wooden bowls in which to knead the dough, and a couple of smaller ones used to eat from. Wheat is ground in a hand-mill of black basalt, the lower stone being imbedded in a sort of sun-dried clay trough shaped to receive the flour as it is ground. These, with a sieve or two, a large wooden cooking spoon, a small brass coffee-pot, a few tiny coffee-cups, and perhaps a clay dish in which to roast and grind the coffee beans, comprise the entire outfit.

Having inspected the dwelling portion, which at once is kitchen, store-room, bedroom, and living-room, let us descend the steps into what the natives call the stable.

Below the *mastaby,* or raised platform, just described, among arches so low that a man can scarcely walk erect, are the winter quarters of the goats and sheep. To shut the flocks in, these arched entrances are obstructed with bundles of brush used as firewood for the winter. The rest of the floor space, which is open to the ceiling, is devoted to the few work cattle and perhaps a donkey or camel. Around the walls are primitive mangers for the cattle, built of rough slabs of stone placed on edge and plastered up with mortar.

Often the owner makes a small raised place on which he sleeps at night to enable him to keep better watch over the newly born lambs, lest in the crowded quarters some get crushed or trodden down by the older ones. Here he often sleeps by preference on a cold night, for he says the breath of the animals keeps him warm.

THE LAND, NOT THE PEOPLE, CONSERVES THE OLD CUSTOMS

One cannot become even tolerably acquainted with Palestine without perceiving that it is the *land* that has preserved the ancient customs. Its present-day inhabitants, who have nothing in common with the modern Jews who crowd Jerusa-

ROOFING A VILLAGE HOME

"The outside of the roof is covered with a coating of mortar made of clay, which, on being pressed with a small stone roller or pounded with a board, becomes hard and compact enough to shed the rain" (see page 251).

lem, are still perpetuating the life of Abraham and the customs and ways of the people who lived here at the time of Christ.

To know the heart of the land, to have learned the hospitality of its people, which is always offered, no matter how primitive or simple, makes it easy to picture Mary and Joseph returning from the inn, already filled with guests, and turning aside into a home such as we have described, the regular dwelling portion of which may have been none too large for the family which occupied it. It may have been crowded with other guests, but they find a welcome and a resting place for the babe in a manger.

Such a use of the *rowyeh,* or stable portion of the house, by human beings is not the exception, but an every-day occurrence. You can occasionally find men working their primitive looms there or the mother preparing the food or doing her little sewing near the door, where there is more light on a dark winter's day.

We have all perhaps noticed that in the two Gospel narratives where the birth of Jesus is dwelt upon* neither of them mentions a stable, barn, or anything equivalent, while Matthew, speaking of the wise men, says: "And when they were come into the *house,* they saw the young child with Mary his mother."

Many of these dwellings, placed as they are on ancient sites, are built over old caves or caverns which are incorporated into the lower or stable portion. Today, in Bethlehem's church, such a cave is shown as the actual birthplace of Jesus. Its walls are covered with costly tapestries and paintings, and from its ceiling hang lamps of gold and silver (see page 304).

THE GUEST-CHAMBER OF THE VILLAGE

Each village has an upper room or guest-chamber (see page 254). During the summer the shade of some large tree is often substituted for this room. However, in either case this guest-chamber or tree is the social center for all the village men, where many spend the evening or the entire day when they have nothing with which to occupy themselves. Sociability is one of their characteristics; they love to gossip and chat about the local news. Of course, not a single newspaper is to be had; so all their information is derived from those who have been last to town.

A servant is hired to attend to this guest-chamber, and every day, by turn, one of the villagers furnishes the coffee beans and sugar for the coffee to be served to the men thus congregated; he, too, supplies the food and bedding if some ordinary guests come along.

They are, of course, great respecters of persons; so that if a common man happens in, a couple of fried eggs with bread and olives will do for him. If a more important personage arrives, a pair of roast chickens is provided for his supper; but if a still more honored one, a sheik of a village, or a large company of men appear, a lamb or kid is killed, and in all cases horses are furnished with nose-bags full of barley. The supplying of these more expensive meals is apportioned among the various men by turn, while they furnish barley according to the amount of land possessed.

In the possession of the man attending the guest-chamber are three small wooden bows, on the cord of which are strung slips of paper, each bearing the name of one of the men of the village. The slip first in order indicates the name of the person whose turn next comes to serve, and in this simple way the proper accounts are kept, since one of the bows represents chickens, the next lambs and kids, while the third is for the barley. As each one fulfills his obligation the paper representing it is torn off, and when all are gone, a new set is written and the turns begin again.

Let us now watch a company of distinguished visitors arrive at the village guest-chamber.

The young men run to help the guests dismount, and, leading the animals away, tie them in the courtyard or in the stable, which is below the "upper room." Others hasten to spread rugs and mats on the floor and mattresses around the wall, furnished with cushions, for on them the guests sit cross-legged or recline. Many of the men of the village now join the

* Matt. 2: 1-12; Luke 2: 1-20.

THE VILLAGE GUEST-CHAMBER

"Each village has an upper room, or guest-chamber. During the summer the villagers often substitute the shade of some large tree for this room. This guest-chamber or tree is the gathering place for all the village men, where many spend the evening or the entire day when they have nothing with which to occupy themselves, for sociability is one of their characteristics" (see page 253).

THERE ARE NO SUFFRAGETTES HERE

The proper etiquette of the Holy Land bids the wife follow meekly on foot while her husband rides majestically in front. In the good old days the gentle sex never was seen riding, but the modern spirit is creeping in, and "today it is a common sight to find a woman astride of a donkey" (see text, page 261).

WOMEN OF SAMARIA

The Samaritan woman wears the bloomers of the North under the loose long robe, or *tobe,* of the South, her costume emphasizing her geographical position. The graceful carriage of the Syrian woman is due to her custom of bearing heavy loads upon her head

guests, and for a while there are long exchanges of salutations, while tiny cups of coffee are sipped, and the more they enjoy it, the louder they smack their lips.

Bitter coffee is generally offered and is served with only a sip at the bottom of a very small cup, while when sweet coffee is made, the cups are filled to overflowing. This, as will be readily seen, has a symbolical meaning—"May bitterness be little and sweetness abundant."

AN INGENIOUS INSULT

Traveling with a friend some years ago, we were thus entertained. Entering the guest-chamber, we noticed that the occupants were unusually quiet and that one man had no turban on. It was whispered to us that this man, who was a stranger, had been robbed the night before by one of the men of the village who had a notoriously bad reputation, even among his own people. The victim had appealed to the elders of the town. Without a word, coffee was prepared.

As we were foreigners, they made sweet coffee for us, thinking we would not like the bitter, and filled our cups full, while the bitter kind was passed to all the rest in little doles; but to the man suspected of robbery a full cup was served. This was such an insult that he flew out of the room; a fight ensued, his house was searched and the goods recovered, and the stranger again donned his headgear, which was among the things that had been stolen.

As they thus sit chatting and drinking coffee they also smoke. Each man carries a leathern pouch of tobacco from which he rolls his own cigarettes or fills a long-tubed water-pipe or nargheli.

Little preparation is made for the midday meal. Some hot bread, a plate of fried eggs, another of curdled milk, or a dish of fresh butter with a pile of fine sugar on top, suffices. This meal is for the guests alone.

A FEAST FOR THE STRANGER

The person whose turn it is to give the supper does not start preparations till the flocks come home in the evening, when a fatling is slain, cut into pieces, and boiled as a stew in a great kettle. Another large pot of rice is cooked.

All the men of the village now slowly congregate at the guest-chamber, each throwing down on the coat, spread for this purpose, a couple of thin loaves of bread that he has brought with him.

When all are assembled, the pile of bread is torn up into small pieces and placed in large wooden bowls. Over this, in each bowl, a large pile of rice is put and the meat on top, while a liberal supply of the gravy is added.

Sitting on the floor, first the guests, with the older and more important men, fall into circles around the bowls, and before partaking each one says *Bismallah* (in the name of Allah), to drive away the genii. With the aid of the thumb and first two fingers, great balls of rice and soaked bread are made, which are dexterously popped into the mouth.

The food is eaten very hot, and it is surprising how much one man can consume when at such a feast and how little it takes to sustain him ordinarily.

As each set finishes eating they wash their hands, water being poured on them by a servant, as we read of in Old Testament times.* Then they drink coffee and smoke until time to retire, when beds are spread on the floor for the guests, some of the villagers remaining with them, sleeping in their coats. The party usually leaves the village early the next morning.

The guest-chambers are not for women; so, if a man is traveling with his family, he does not go to this regular reception place, but waits about the village until some one passing invites him into his house. This happens today just as in the case of the Levite of old who was traveling with his concubine and servant from Bethlehem-judah, and was entertained at Gibeah by the old man from Mount Ephraim who found them waiting in the street of the city.†

CONCERNING FAMILY LIFE

Children in the peasant family are always welcome, girl babies sometimes excepted. The father prides himself on his boys, and even the mother prefers them, and, when questioned as to the number of her offspring, she will invariably say

* 2 Kings 3: 11.
† Judges 19: 15-21.

that she has five *children* and two girls, or as many as the case may be.

Not to have a boy is a great hardship to the family and is especially felt by the mother, for failure to have a son may become the cause of her divorce or her husband's excuse for marrying again. This feeling is hard to understand, since they look upon a girl as a profitable possession, for a would-be husband must pay a comparatively handsome price for her. The boy, on the other hand, is a greater expense, and his wife and wedding are costly affairs. The only explanation is that their great aim in life is to perpetuate the name of the father.

To be polite the *fellah,* in speaking of a pig, dog, donkey, or anything out of good taste, invariably says, *b'eed 'annak,* meaning, "Be it far from you!" So, also, when a girl or woman is spoken of, they often say, "Be it far from you!"

Although women are thus looked upon as something inferior, still when they have become well advanced in years and are perhaps the grandmothers of large families, or have signalized themselves by some special attainment, they are frequently the object of the respect and reverence of the younger women and of the men as well (see page 265).

The woman may never call her husband by his first name, but "O father of Ahmed," or whatever the eldest son's name may be, which indeed is the name by which he is generally known.

In naming the first son it is customary to give him the name of his grandfather on the father's side; therefore, even before a youth is married he will often be addressed as the father of Ali, or Mohammed, or Suleiman, as the case may be. The first daughter is usually named for the grandmother, again on the father's side.

The wife likewise takes the name of her first-born son. The husband, speaking of her, especially to men, will never say "my wife" or mention her first name, but will say either "the mother of Ahmed," or "my family," "the relative in my house," "the forbidden," or "the daughter of my uncle."

The reason for this is that a man marries his first cousin in preference to any one else, and in fact she cannot marry another if he wants her. Gauged by our conception of the subject, the women are rigorously ruled by the men; still the men feel that in these days the women are becoming too independent, as what follows will illustrate.

ESSA'S LAMENTATION

Only yesterday Essa, who tends the vineyard of a friend near the village of Sharafat, lying between Jerusalem and Bethlehem, was heard thus complaining to another:

"Oh! my master, when I was young I used to rule 'my family' with a hard heart, for her ways did not please my mother, and I used to beat her much. My father, may God have mercy upon him,* often said to me: 'My son, these are the days of women, and if you so treat your wife you will not be able to live with any woman. Their ways are perverse, but you cannot change them. The days of men are passed.'

"In former days, my master, a woman would not dare to go to her father's house or that of a neighbor for a visit without first getting her husband's consent, and much less would she think of addressing her husband before people. If he happened to be in the village guest-chamber with the men and she desired to call him, she would say to some man sitting by, 'Tell *him* to come,' and sometimes, to amuse ourselves, the man would inquire, 'Who?'; to which she would repeatedly answer only, 'he,' for modesty would prevent her mentioning his name or saying 'my husband'; but now my woman calls me 'Essa' in the midst of the village and I hold my peace.

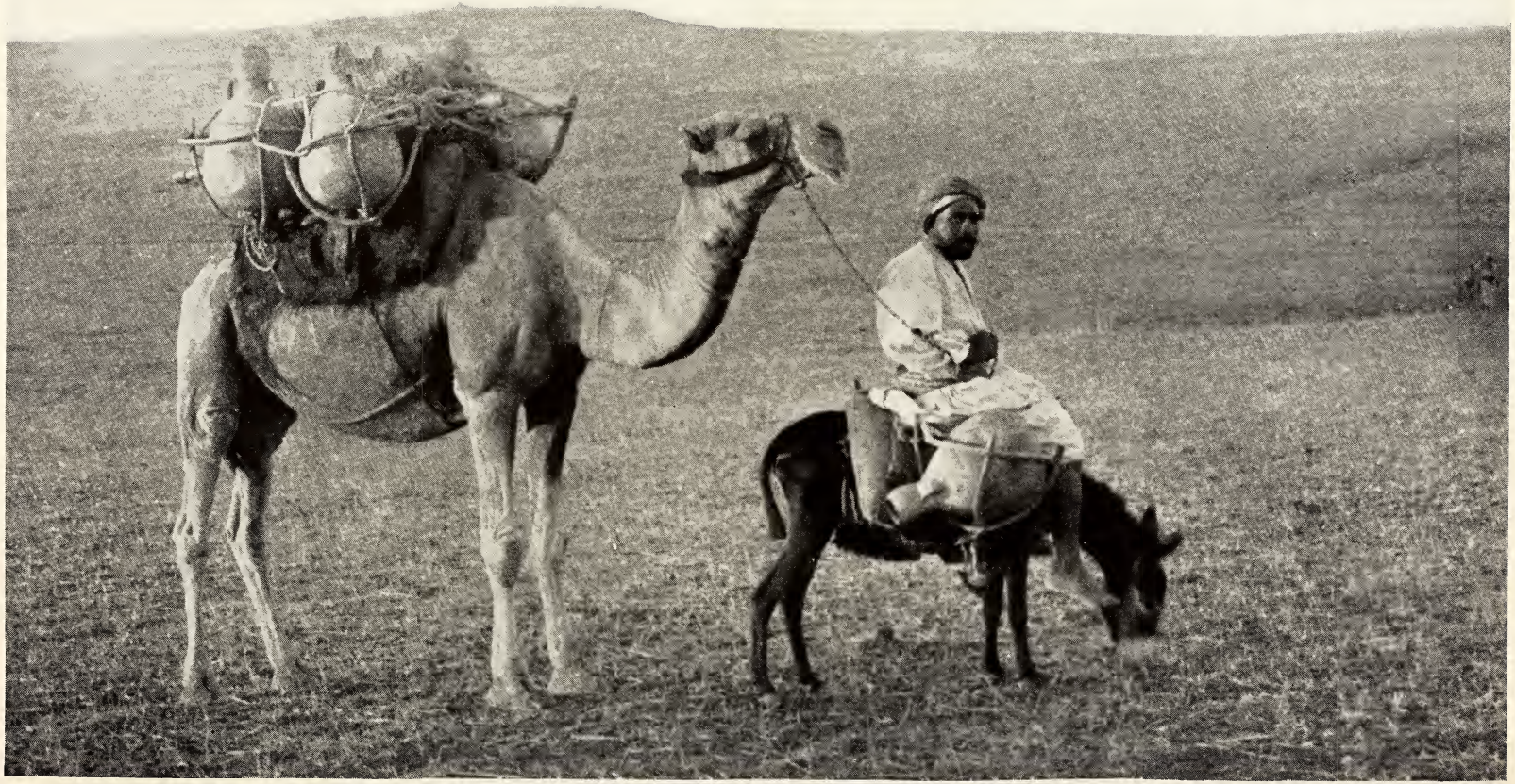
"Women formerly, when passing men on the road, would cover their faces with their hands and keep their eyes on the ground; but now when we meet them they are not shy, so we men keep our eyes on the ground until they have passed.

"A common saying among the women used to be, 'O Preserver, protect me from my husband's displeasure!' Now

* This expression is always used when speaking of a deceased relative or friend, while when mentioning an enemy or evil person they say, "May God not have mercy upon him!"

MARRIED AND SINGLE IN THE HEBRON DISTRICT

It is a very simple matter to tell if a woman is married or single in the neighborhood of the ancient city of Hebron. All the unmarried girls wear a large silver coin on their foreheads, like the girl in the picture. When no such coin appears, it is a sign that the woman is or has been married.



AN UNUSUAL SIGHT

From time immemorial the task of furnishing the village with water has fallen to the lot of the women, who can be seen morning and evening returning from the stream or well with their water-pots on their heads. In exceptional instances the men bring the water on the backs of donkeys and camels, as shown in the picture.

it is reversed and we men say, 'O Preserver, protect me from my wife's displeasure!' Women never in former times were seen riding, but today it is a common sight to find a woman astride of a donkey, and the other day I met one so mounted, and she was even singing aloud *until she caught sight of me.*"

THE BIRTH OF THE BABY

When the *fellah* or peasant child is born, its tender skin, without being washed, is rubbed with olive oil and salt. For seven consecutive days it is re-oiled, and when a week old gets its first bath and is again oiled, and each week until it is forty days old the bath is repeated. In some localities they consider it unsafe to bathe it before it is forty days old.

Into the little eyes they put drops of liquid tar, and when two days old begin the periodical application of *kohl.* This is a dye used to blacken the eyelids of not only babies, but of women and sometimes also men, and is considered both beautifying and beneficial to the eyesight. They believe the tar to be a preventive of weak eyes, and that a child who has not been salted will develop into a weakling.

How old a custom this salting is can be seen from Ezekiel's reproachful words to Jerusalem: "And as for thy nativity, in the day thou wast born . . . thou wast not salted at all, nor swaddled at all." *

Swaddling clothes like those of Bible times† are still in use. A small shirt is the only real garment put on, around which may be wrapped some old rags, care being taken to keep the arms tightly pressed against the sides.

A cap, perhaps decorated with a blue bead or some charm to keep off spirits and the evil eye, completes the apparel (see page 314).

When one looks at a child, before admiring it or speaking of it, in order to avert a calamity, one must say *Bismallah* (in the name of Allah), or "May Allah encircle you!" or "May the evil eye be frustrated!"

Mortality among the babies is great and is not to be wondered at, for in view of the rough treatment they receive, it becomes a question of the survival of the fittest.

HOW THE BABY IS CARRIED

In the Judean mountain districts a cradle is often kept for the baby while at home, and a sort of small hammock is used to carry the child around in when out-of-doors. The mother when going to work in the fields will be found with this hammock, called *hiddil* in Arabic, on her back suspended by a rope which passes across her forehead, often with nothing indicating that life is in it except an occasional squeal from one end.

It is a common sight when passing through the bazars to find a baby in this sling hung on a small nail or on the lock or bolt of a turned-back shop door, while the mother sits in the street behind the basket of produce she is selling, seemingly unmindful of her child's hazardous position.

When in the fields she erects a tripod of sticks, from which she suspends the hammock, and she protects it from the rays of the sun by covering it with one of her garments.

In the Samaria district and along the plain of Sharon a crudely decorated wooden cradle is the fashion and is carried by the mother on her head wherever she goes.

We cannot refrain from narrating a story heard from an eyewitness.

THE GENII CAPTURE A BABY. A TRUE STORY

A woman of Abou Shoushey,‡ waking up late one morning and picking up the cradle in haste, started off for the harvest fields.

She had no more than entered the narrow path between the stretches of standing grain when she felt her babe leap from the cradle on her head and heard it glide rapidly through the wheat.

Terror-stricken and trembling, she screamed for help, calling to the men to pursue the genii that had taken her babe.

* Ezekiel 16:4.

† Luke 2:7.

‡ Abou Shoushey is ancient Gezer, which was given by Pharaoh as a dowry to his daughter when she married King Solomon.

After a heated chase some returned to inquire further particulars of her.

Unable to get a reply, for she still stood screaming, "The genii have taken my boy!" they lowered the cradle from her head and found the child still sound asleep.

The others soon returned to say they had overtaken the supposed enemy, only to find that it was her domestic cat, which had jumped from its hiding place near the baby.

HE HAD THREE DAUGHTERS BUT NO CHILDREN

Essa met us at the gate one evening and his face showed that something out of the ordinary had occurred. After the usual salutations he said, "I come to you for the reward of good news."

"And what is it?"

"My *family* gave birth to a baby."

"*Imbarak*" (May it be a blessing!); to which came his reply, "*Imbarak feek*" (A blessing by your presence!).

"What is it, Essa?" He hung his head and replied, "Be it far from you, a girl."

"How many children does this make?" he was asked. Essa looked embarrassed, and said, "I have no children; this is my third girl. When I went into the village this morning both women and men said to me, '*Imbarak*, Essa! May it be granted that she die!' but I replied, 'May Allah not listen to you!' for I have become like you foreigners and I am satisfied, although I had taken upon me certain vows in case it was a boy."

THE COSTUMES OF THE WOMEN

The costumes of the women differ sufficiently in each district to enable one to distinguish readily where the wearer comes from. From the variations of the headgear one can tell whether a woman be single or married; but, although differing from one another in the details, the costumes have much in common.

The dress, called a *tobe,* is like a long loose shirt, the sleeves narrow at the shoulders and widening out something like the Japanese pattern. The front and back are made each of one width of cloth, with a gore on each side to widen the skirt. A girdle either of white linen or bright striped silk is wound around the waist and the *tobe* is pulled up a little to produce a full bosom.

This *tobe,* when for common use, is of dark-blue cloth, the bosom is covered with cross-stitch embroidery and perhaps a little on the sleeves and skirt.

In the districts north of Jerusalem the *tobe* for the bride or for gala occasions is made of heavy white linen almost covered with embroidery, the prevailing colors being dark green and red with a little orange mixed in (see page 307). Around Samaria the *tobe* is made of white cotton cloth in which are woven bright strips of red, yellow, and green.

The shoes are crude affairs, the tops being of bright red or sometimes yellow sheepskin, with soles of raw cow, camel, or buffalo hide.

WEARING HER DOWRY ON HER HEAD

The headgear is of two parts: first, what we shall for convenience sake call a cap, and over it a veil. The Bethlehem women wear a high cap, in shape something like a man's *fez,* called *shatweh,* on the front of which are sewn rows of gold and silver coins.

A woman never parts with the coins from her headgear except in dire circumstances, and for her to admit that she has lost one of these is considered a great shame, for an evil meaning is put upon it. This throws a strong light upon the parable of the woman who lost one of her ten pieces of silver.*

The woman in the Gospel had not lost a piece of money merely valuable as a medium of exchange, but a part of her ornament and dowry, and had thus brought a reflection upon her character. So it was vital for her to recover it.

No wonder, then, she is pictured as lighting a candle, sweeping the house, and seeking diligently until she finds it, and then calling her friends and neighbors to rejoice with her.

THE CAPACIOUS, USEFUL VEIL

The veil is a large affair, some 6 feet long and 4 feet wide, and placed over the

* Luke 15: 8, 9.

THE TOMB OF MOSES

This photograph shows peasants, town folk, and Bedouins assembled at the traditional site of the Tomb of Moses. Pilgrimages to this spot are quite popular, for among the Moslems the "Prophet Moses," as they call him, is held in high honor.

cap it covers the entire headgear, except the coins in front. It is considered improper for women to have their head or hair showing in public. At home they put off the veil.

Ordinary veils are made of heavy white linen, with sometimes a little embroidery, while in the districts north of Jerusalem each girl makes one almost covered with needlework, so that it will match the white embroidered *tobe* for her wedding (see page 307).

Whenever a woman lacks a basket or bag, the veil comes into use. She places what she has to carry in one end of her veil, gathers and ties it around with one corner, and places the burden on top of her head.

The story of Ruth, when Boaz says to her, "Bring the veil that thou hast upon thee, and hold it; and when she held it, he measured six measures of barley, and laid it on her: and she went into the city,"* clearly shows that this use of the veil is the survival of a very ancient practice.

Those not acquainted with this land of ancient customs may find themselves unable to understand how Ruth's veil could contain so much grain, because of their having in mind a veil of gauze and of small dimensions. The *khirka,* as the veil is called, is not only large and strong enough for this work, but such usage is very common down to the present day.

Nor is it only the veil that has survived, but the entire costume. Ezekiel the Prophet gives us a matchless description of the woman's attire of his day when, speaking allegorically of Jerusalem, he says:

"I clothed thee also with broidered work, and shod thee with badgers' skin, and I girded thee about with fine linen, and I covered thee with silk. I decked thee also with ornaments, and I put bracelets upon thy hands, and a chain on thy neck. And I put a jewel on thy forehead, and earrings in thine ears, and a beautiful crown upon thine head. Thus wast thou decked with gold and silver; and thy raiment was of fine linen, and silk, and broidered work." †

* Ruth 3: 15.
† Ezekiel 16: 10-13.

THE JEWELS OF BIBLE TIMES AND OF TODAY

Jewelry is very much prized, although it is mainly confined to heavy silver pieces.

A heavy silver chain is attached to the cap on either side and hangs down about the neck and below the chin (see page 307). A collarette made of plaited silver wire with many chains hanging from it used to be extensively worn by Bethlehem women, but is fast disappearing.

In the Hebron district the unmarried girls wear a large silver coin on their forehead (see page 259). Earrings are used and silver finger-rings, with Mecca stones or glass imitations, are much prized.

Were we living much later we would find it difficult to learn the meaning of the prophet's word, "And I put . . . a beautiful crown upon thy head." The *tasseh,* a disk of wrought silver or gold which, according to the old men, used to be so common, and was worn by the women sewed to the crowns of their caps, is today almost non-existent. They can occasionally be picked up at the silversmith's, where they have been sold for the silver that is in them, but the present writer has not seen a single one in use among the peasants.

In the Nazareth district European material is fast displacing hand-made goods. Even around Jerusalem the women are taking to shawls of foreign manufacture in place of the handsome hand-embroidered veils whose colors harmonize, which cannot be said of these shawls, with their flaming roses and pink backgrounds.

Few of these peasant women can be said to be handsome; still, they make an interesting and picturesque sight, as they walk in companies along the roads, going to town with their baskets of produce, or returning, chattering like magpies over the day's transactions.

When the road is very stony or wet, it is a common custom for them to take off their shoes to save them, placing them on top of their loaded baskets (see page 306). It takes *metaliks* (coppers) to mend shoes, but feet mend themselves.

The Bethlehem women have the repu-

THE JERICHO MEDICINE WOMAN

ALTHOUGH women are looked upon as something inferior, still, when they have signalized themselves by some special attainment, they are frequently the object of respect and reverence. The Jericho women dress like the Bedouin, but live in villages. Photo by the American Colony, Jerusalem.

"BAB-SITNA-MIRIAM": JERUSALEM

THIS gate is called by the Arabs the "Gate of Our Lady Mary," and is otherwise known as St. Stephen's Gate. The lions that appear are said to have been placed here by the masons to commemorate the meeting of the two gangs of workmen at this point on the completion of this wall.

WASH DAY: NAZARETH

"Unfortunately, in the Nazareth district European materials are fast displacing the handmade goods."

"BAB-EL-HABIS"

This street is called in Arabic the "Door of the Prison," since it leads to the jail.

tation of being handsome. Their faces are a full oval, their complexion fairer than the ordinary *fellaheen,* often having very red cheeks, and attractive in the setting of their striking headgear. Their Nazareth sisters have gained a little less renown. Both are Christians and supposed to have a considerable strain of Crusader blood in their veins.

THE ATTIRE OF THE MEN

The clothing worn by the men is very varied, and so we will consider only the most typical. There is a long shirt made of white cotton cloth, also called a *tobe,* and in form much like the women's. Over this is a sort of gabardine made of striped goods, the waist being girt about with a leather, wool, or silk girdle. The colors are quite bright, red and yellow or black and yellow being favorites.

The headgear costs him, like the woman's with its silver attached, more than all the rest of his outfit. A low dome-like fez, with a blue silk tassel, is wound round with a turban (see page 313).

This turban indicates where he comes from or his class. In the district north of Jerusalem the turban consists of a large square of white linen, with a colored border woven in; around Hebron it is of silk, golden yellow and red.

A plain white one denotes a man of letters; a plain red, that he is a dervish or holy man, and a plain green again, that he claims to be a direct descendant of Mohammed. Inside this fez is a heavy felt cap, and often between them one or two old fezzes are found, while next to the head there is still another cap of white cotton cloth. The object of these many layers is to make the headgear heavy, which is commonly believed to prevent headache.

Similarly the women with their heavily weighted caps do not remove them night or day. Between the layers of the turban the man stows away his snuff-box, jackknife, often a large pack needle, sometimes money and valuable papers if he has any. They have a witty saying to the effect that if one lacks a place of safekeeping let him make his head his custodian.

Little boys are dressed like the men, with the exception that they have no turban until about 12 years old, and when his father gives a boy his first he feels just as proud and important as any American boy over his first long pants.

The men shave their heads clean, leaving only a central topknot of long hair, and to shave the beard, once it has been allowed to grow, is considered a great disgrace. To swear by one's own beard, or the beard of the one with whom the controversy is being waged, is the usual thing, as well as bringing in that of the Prophet to add weight.

The trick of shaving off half the beard of an opponent as a sign of contempt is practiced even today among the peasants exactly as it was in the days of King David when he sent his servants to Hanun, king of Ammon.*

AN OVERCOAT, CARRY-ALL, AND BED-CLOTHES COMBINED

The top garment or overcoat of the *fellah* is of coarse, woolen cloth woven in broad stripes of black and white or dark blue and white. In some districts the men do the spinning themselves in their spare time (see page 313), take the yarn to the village weaver to be converted into cloth, and then the women sew them.

This coat is as simple in form as it is possible to be. It is nearly square and in length extends a little below the knees, is open down the front, and has an opening in each upper corner to pass the arms through. The best of them are made of only one piece of cloth, the width of which is the length of the coat, so that the only seams required are along the shoulders.

Such a garment undoubtedly was the "coat" over which at the crucifixion the Roman soldiers "cast lots" rather than "rend it," for it "was without seam woven from the top throughout." †

It serves as a kind of carry-all, the wearer carrying various things in it; on rainy days it is pulled up over the head and sheds the rain fairly well, and at night it is the covering in which he sleeps.

It is strange how fond both men and women are of keeping their heads well wrapped up in cold and wet weather, both when walking and sleeping, while

* 2 Samuel 10: 4-5.
† John 19: 23-24.

the feet and legs can be quite bare and exposed to the cold and wet with seemingly but little discomfort.

When the native men travel and night overtakes them far from a village, they lie down in an open field or by the roadside, thrust the head into one corner of the *abayeh,* and, wrapping it round the body, have little care whether the legs be bare or not. It is quite common to see men thus sleeping with a stone for a pillow, just as Jacob did of old at Bethel.*

In the Mosaic law we read: "If thou at all take thy neighbor's raiment to pledge, thou shalt deliver it unto him by that the sun goeth down: for that is his covering only; it is his raiment for his skin: wherein shall he sleep?" † Today the giving of small articles as a pledge or security is quite common; still, any one taking an *abayeh* from a poor man to deprive him of it over night is considered as unmerciful and a kind of Shylock.

THE OLDEST EXISTING TYPE OF HEAD-DRESS

In some districts or villages the men wear the Bedouin headgear, consisting of a large square of cloth called *kaffeyeh.* It is doubled cornerwise, laid on the head, and held in place by an *'agal,* a thick double coil made of wool or goats' hair and black in color. The variations of this *'agal,* or coil, show from where the person comes (see page 271).

It is probable that this form of headgear is the oldest of those now in use in the country. A small Canaanitish figure in pottery, dating back to about the 14th century B. C., now in the Whiting collection at Yale, although of necessity very crude, has such a band around the head, and shows how very ancient is the origin of this *kaffeyeh* and *'agal.*

Among certain Bedouin, at the death of a woman these *'agals* are removed from the head and placed on the corpse as it is being carried from the tent to the grave; and in the Book of Ezekiel a "tire" is twice mentioned‡ as part of a man's headgear, and he was told by God that his wife was about to be taken away with a stroke; but he was not to mourn or weep, but to "bind the tire of his head upon him." This leads us to suppose that the "tire" of that time must have been the same in principle as the present-day *'agal.*

THE MARRIAGE CUSTOMS OF THE HOLY LAND

The villagers of Palestine are mostly of the Mohammedan faith, while fewer in number are the Christians belonging to the Catholic and Greek Orthodox churches. Some villages are entirely Christian, and there are a few which have both religions represented, but in this case each class has its own quarter.

We are, throughout these descriptions of the life of the present inhabitants of the Holy Land, devoting our observations to the Mohammedans, who are not only by far the most numerous, but also, from our standpoint, the more interesting, as they follow the ancient customs more closely than the Christians.

Marriage takes place at an early age, the young men at about 20 and the girls between 12 and 16. So long as the father is living, the burden and expenses of marrying his sons fall on his shoulders.

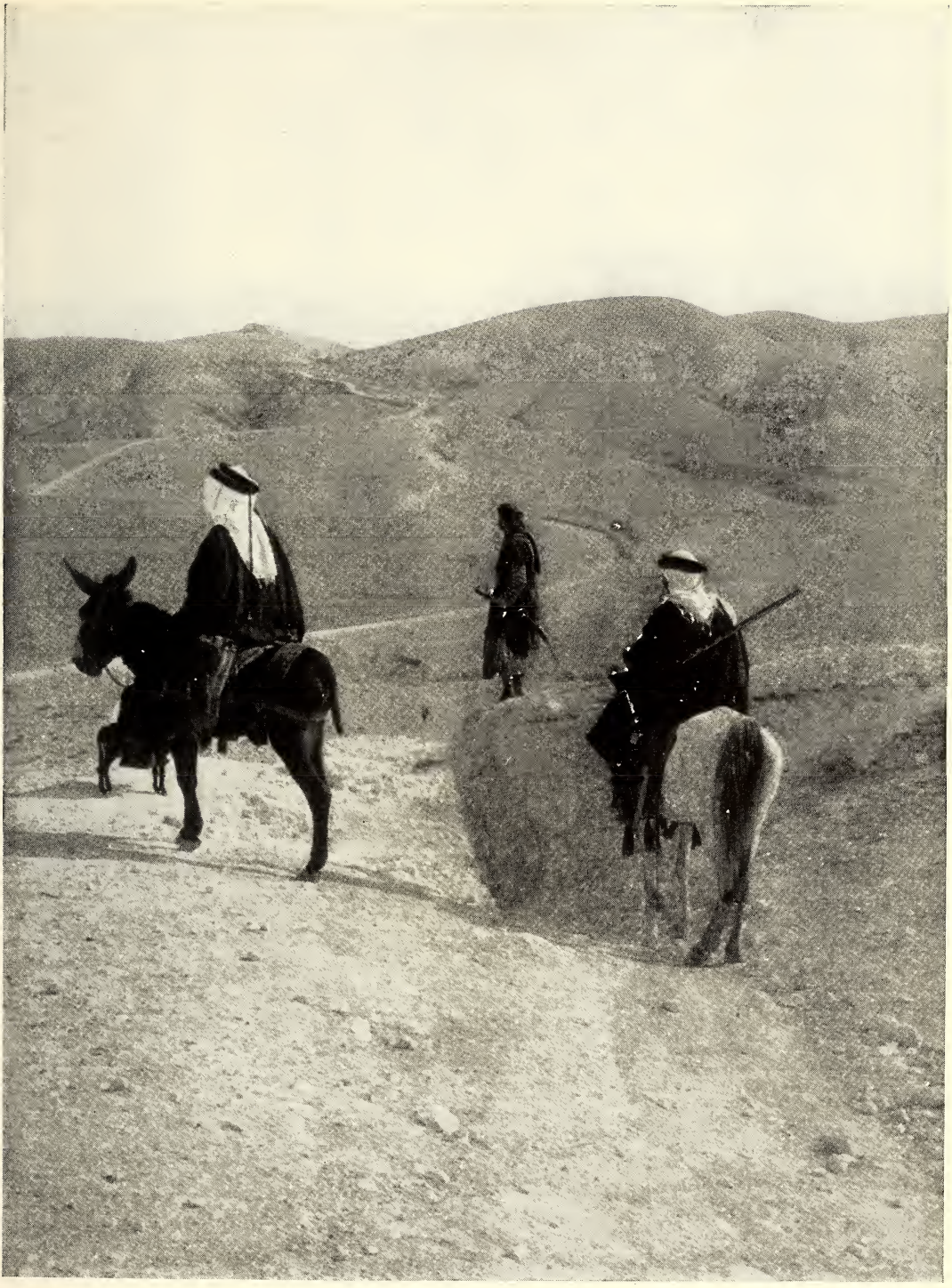
When a youth has reached a marriageable age and the expenses that a wedding involves can be defrayed, he begins in a business-like manner to look for a bride. When his choice seems to rest upon a certain girl from simply seeing her in the village, for no courtship is allowed, or if a girl is heard of in another hamlet that strikes his fancy, then the mother of the bridegroom, with a retinue of her daughters and women friends, goes to see the prospective bride.

If she is from another village, they may spend a couple of days "looking her over," as the expression is, learning whether she bakes well and is handy at all kinds of work, seeing if she is good looking, and, above all, that her eyes are perfect. One who, like Leah of old, is "tender-eyed,"§ is but little sought after.

FIXING THE PRICE OF THE BRIDE

The young man, with his father, uncles, and other male relatives and friends, next makes a visit. They formally ask for the girl's hand. It would be considered impolite for the girl's father to meet the

* Genesis 28: 11.
† Exodus 22: 26, 27.
‡ Ezekiel 24: 17, 23.
§ Genesis 29: 17.



THE ROAD TO JERICHO

The two Bedouins in the foreground are wearing their characteristic head-dress, the white cloth and double coil of goats' hair. This is reputed to be one of the oldest known forms of headgear still in use and has been traced back to the fourteenth century before Christ (see page 270).

TREADING OUT THE GRAIN

"Threshing by the primitive methods employed is the most tiresome task of all the *fellah's* round of toil. In many places it is done entirely by treading out beneath the feet of the animals, which are tied together abreast and driven round and round over the spread-out grain. The mules and horses are provided with flat sheet-iron shoes for all kinds of work, and the cattle, just as the threshing season begins, are specially shod" (see page 281).

request with a refusal, for if he objects to this suitor, he will not agree to the amount to be paid for her. The groom's father then offers for the bride a sum far in excess of what he really expects to give, thereby exhibiting his generosity; but this is only byplay.

Different men present urge that for their sakes the price be lessened by a certain sum, and so on until the amount is brought down to what the bride is actually known to be worth—that is, to about the habitual price. This offer being finally accepted by the father of the girl and the details of the betrothal contract arranged, the kid or lamb which the visiting party has brought with them is killed and dressed.

As these preparations are in progress, and others drop in from the village, the bridegroom or his father will rehearse the contract with the bride's father over again, so that several witnesses may hear the terms agreed upon in case of a dispute arising later. The bride has nothing to say in the matter; she is not consulted.

WHAT A BRIDE IS WORTH

The price of a bride depends on her age, beauty, usefulness, and the family to which she belongs. The daughter of an influential sheik is greatly sought after and will bring many times the price given for even superior girls from families of less importance.

The prices range in sums which represent in American money from $100 to $400, besides which the minor expenses bring up the total considerably, often doubling it.

Among these the bridegroom, according to his ability, must give a present to the guest-chamber of the bride's village, a new dress to the bride's mother, and an *abayeh* (outer garment) to her father; and her oldest uncle on both her father's and mother's side must each receive a new garment with a gold coin in the pocket. He has also to provide two feasts, for which a man in average circumstances must furnish 15 fatlings.

Meantime the father of the bride has given her from the money paid as her price, say from $20 to $40, with part of which she gets the proper coins and with them makes her first married woman's headgear. With the rest she buys a couple of pairs of bracelets, some finger-rings, and an *iznak,* or neck chain.

The balance of the money the father keeps, just as if he had sold some cattle or produce, except that it is the custom for him to give her an every-day *tobe,* or dress, a veil, and a mattress, pillow, and quilt.

THE BRIDE LEAVES HER NATIVE VILLAGE

From the time the trousseau is bought until the actual wedding day, a period from a week to 10 days, there will be dancing every night in the guest-chamber by the men, while the women make merry in the bridegroom's home.

When the bride belongs to another village, they go for her the day before the wedding, the company consisting of the bridegroom and his men and women relatives and a lot of his young men friends, all dressed in their best and armed with whatever weapons they may possess, and many of them mounted. They take with them several sheep or goats.

Upon reaching the village, they slaughter all the animals they have brought, and the entire village partakes of the feast. The bride is now arrayed in her new costume, puts on the married woman's cap and all her jewelry, her face is covered with a green or red gauze veil, and finally there is thrown over her entire person a man's gabardine.

She is mounted on a horse or camel, and with the firing of guns, the racing of horses, and a great send off, they leave the village, the bride's mother carrying the bridal chest along on her head, she being about the only person who goes with her, except perhaps a sister or female friend.

As the bride leaves the village she receives a gold coin of about $2 in value from the villagers, which in fact is part of the amount paid by the groom to the guest-chamber, and each of her uncles gives her a present in money. In each village through which she passes on her way she is met and a piece of money given her.

The bridal party has now arrived at

A VILLAGE INDUSTRY

During harvest time the village women can be seen selecting fine straw from the grain piles, which they subsequently weave into straw baskets and trays. The process of manufacture is quite simple, as can be seen from the picture.

DRYING STRAW BASKETS

After the baskets have been made they are laid in the hot sun to dry. The women will then carry them long distances to market, where they sell them for an amount corresponding to five cents in American money. To the Western mind this does not seem a very great reward for labor, but they are satisfied.

the bridegroom's village, and the bride and those with her become by invitation the guests of the first house they reach, and this opportunity of entertaining them is looked upon as a distinctive honor. The host kills a fatling and prepares a feast to which only women are admitted, and here, under the protection of her mother, the bride spends her first night in her new village.

When the bride has arrived safely, messengers are sent back to invite her father and male relatives to the ensuing ceremonies, and if the groom be prominent or wealthy he calls all his friends in the surrounding country to take part in the marriage feast.

THE WEDDING CEREMONIES

Early the next morning the wholesale slaying and cooking is begun, and a special dish is prepared for the women. During the day the religious formalities are attended to with great secrecy. The bride, in the presence of two witnesses, appoints her father or nearest male relative as her representative.

The groom and the bride's representative are now seated facing each other, and a certain exact formula is thrice repeated with much punctiliousness. The parties are prompted by the *khatib* (teacher), or the religious head of the village, who does not allow the slightest mistake to pass uncorrected. In this manner the young man accepts the bride as his wife and the representative of the girl in her stead agrees that she be his wife. At this time the marriage contract is written, which gives the names of both parties, the sum paid for the bride, with all the minor details.

The explanation of the secrecy observed while the couple is thus being married is that they believe that should an enemy be present and either spill flour on the ground or tie knots in a string a specific calamity will surely befall the newly married pair.

Toward evening the young men dress the bridegroom in his best, and with the entire village go out into some open field, where they have horse-racing and shooting (see page 309), in both of which the groom is supposed to demonstrate his skill, while the women stand by and sing.

Returning to the village, the men go to the guest-chamber and the marriage supper begins, while the women congregate at the groom's home and likewise feast. A portion is also sent to the bride and another to the family where she is a guest. The details of these customs vary, however, in each district.

When the feasting is over in the guest-chamber, each guest drops a coin as a present for the groom into a handkerchief spread out for the purpose. Amid much joyous excitement a herald announces the name of each donor and the amount given, calling upon Allah to recompense him.

Meanwhile the women have taken the bride, with much rejoicing and merriment, from the house where she has been visiting to her new home, going either mounted as she came from her village or on the shoulders of two women, while in some localities she walks.

They dress her in her bridal attire, her arms and legs having been previously dyed with henna, the face is decorated with gold leaf, and the eyelashes and eyebrows blackened with *kohl,* which to the *fellah* is the acme of beauty. Her head and face are finally covered with a thin veil. The men are notified when all is ready, and with much pomp and firing of guns, they escort the groom to his house, when all retire and he alone enters.

Removing the bride's veil and wiping off the gold leaf, they stand together, while presents of money are given to the bride by her male relatives and the women, as the groom had received his previously. The husband begins by giving his first. No men are admitted except the male relatives of the bride, and they only long enough to present the bride with their gifts.

For the first few days the bride keeps on her finery and does no work; but this luxury and immunity she does not long enjoy, for we soon find her at the regular hard work which falls to the woman's lot.

AGRICULTURE IN THE HOLY LAND

In the mountain districts the farm land is usually owned by peasant proprietors, each man's property being composed of various small pieces scattered about near

GATHERING FUEL

"After the day's baking, the woman adds as fuel some dried manure or stubble, which ignites from the hot ashes and keeps smouldering, and so heats the oven for the next day's baking" (see page 291).

WHERE THE RAVENS FED ELIJAH

In a deep ravine a few miles east of Jerusalem runs the brook Cherith, alongside of which Elijah was fed by the ravens (1 Kings 17:5). The picture shows the brook as it turns the corner under the convent of St. George.

the village in which he lives. The raising of olives, grapes, and many other fruits is the leading occupation, but almost every farmer grows some grain.

Down on the plains larger fields exist and cereals are largely planted. The land of a given village is frequently owned in common by the villagers, and a division of it takes place every year or every alternate year, and is so arranged that each man gets portions of the good as well as of the less desirable land.

Fences, in the western sense of the word, are unknown. In the mountainous country lands are inclosed by loose stone walls, still called by the ancient Hebrew name *jedar,* and on the plains by thorn hedges. When the open fields are owned individually, the boundary lines are indicated by deep furrows, in which at intervals stones are laid as "landmarks." It is therefore readily seen how easily these boundaries could be changed by an avaricious neighbor, undeterred by the Mosaic warning, "Cursed be he that removeth his neighbor's landmark." *

LAND STILL SOLD BY THE "YOKE" AND "REED"

Until a comparatively short time ago real estate was bought and sold by the use of a contract, which the chief men of the place witnessed and sealed; nor has this custom become entirely obsolete. Farming land is estimated by the *faddan,* which, being literally translated, is "yoke," but implies a piece of land "that a yoke of oxen might plow" in a day. (Compare 1 Samuel 14: 14.) City property, on the other hand, is measured by a standard known as a "reed." We can trace its use far back into ancient times in the writings of Ezekiel and St. John.†

PLOWING AND PLANTING

Rain‡ begins to fall about November, after a rainless summer, and as soon as the ground is well moistened the *fellah* starts planting the winter cereals—wheat, barley, lentils, beans, etc. The plow is a crude affair, made of oak, the bent parts being natural curves held together with iron bands; these bands and a small plowshare, which only scratches the ground a few inches deep, are the only metal parts.

Oxen are the favorite animals for yoking to a plow. Cows and donkeys are employed by the poorer people. Horses, mules, and camels (the latter only along the Mediterranean coast) are harnessed singly to plows, while sometimes one sees an ox and camel yoked together. In the Bible the command was "Thou shalt not plow with an ox and ass together." §

The *fellah* sows the grain on the bare ground and then plows it in. In rocky ground a man or woman follows with a pick to loosen the earth in the spots that may have been skipped by the plow. The soil is not fertilized. The disintegration of the underlying limestone feeds the soil, so that for thousands of years it has continued yielding crops.

The manure and rubbish, instead of being utilized, are allowed to accumulate in heaps outside the villages until they surround it like small mountains. Immediately a house is deserted and the roof falls in the women find it more convenient to dump their rubbish there than to go farther, and in a short time the ruined house becomes a dunghill.¶

After the winter crops have all been planted the vineyards and olive groves are plowed a couple of times and also the fields reserved for the summer planting. These latter crops are not put into the ground until the rains have entirely ceased.

Watermelons and muskmelons, tomatoes, a species of cucumber, vegetable marrow, are all raised without a drop of rain or of water by irrigation, but are sustained by the moisture stored in the ground from the winter rains, aided by the copious summer dews. The natives consider that rain falling after the summer crops have been planted is extremely detrimental to them.

During harvest time the fields are lively and picturesque; the entire family has a part in the work, the small children playing about among the sheaves, and even the babies are brought to the fields.

A large toothed sickle is employed by the reapers when the grain is long, but

* Deut. 27: 17.

† Ezekiel, 40th to 42d chaps.; Rev. 21: 15, 16.

‡ The annual average rainfall for the past 50 years has been 26 inches.

§ Deut. 22: 10.

¶ Ezra 6: 11; Daniel 3: 29.

THE SHEPHERD'S SLING

"With this he becomes expert in throwing stones to a great distance and with great precision. With such a simple weapon . . . the stripling David . . . encountered Goliath and slew him" (see page 295).

if short a smaller one is used, the edge being quite dull; so that it does not cut, but simply uproots the grain. Sheepskin aprons and a large glove are often worn by the men harvesters; but the women, who are doing the very same work as the men, are provided with neither.

Destitute women and girls are allowed to follow the reapers and glean the fallen ears, which they tie into neat little bundles, dropping them on the ground as they go along, and these they gather up every evening and beat out the grain with a stick, just as Ruth did of old in the fields of Bethlehem.*

During the reaping period what the Bible calls "parched corn" is made in almost every field. Some wheat not fully ripe is cut down and set on fire, the straw only being consumed. The roasted heads are rubbed between the hands and the chaff winnowed out in the wind. Without further preparation, this roasted wheat forms one of the common articles of diet of the reapers. Undoubtedly such was the "parched corn" which Boaz reached to Ruth.†

THE THRESHING-FLOOR

A large flat rock in the mountainous country or a hard piece of ground on the plains is selected for the threshing-floor, and this, up to the present time, bears the Biblical name *joren*. Here all the grain is gathered.

We read that Jacob, after his dream at Bethel, promised to God one-tenth of all he should receive.‡ Later, when this land was possessed by the Israelites, they were enjoined to give a tenth of their produce to the Levites.§ We also find Samuel telling Israel what they could expect if they were determined to have a king to reign over them, saying: "He [the king] will take the tenth of your seed, and of your vineyards, . . . and he will take the tenth of your sheep." ¶

Nor does this custom ever seem to have ceased, for the tithe is still collected. There are numerous mosques, schools, and other religious institutions which receive it from specified properties on which it is charged, and from all other tillable land it is collected by the government, the right of exacting these taxes from each village being farmed out to the highest bidder.

The sheaves are brought to the threshing floor on the backs of camels, mules, and donkeys, and in big bundles on the heads of the women, and are stacked up in the requisite number of piles. One of these is first chosen by the tax collector and has to be separately trodden out and the grain delivered to him before the rest of the work begins.

Threshing by the primitive methods employed is the most tiresome task of all the *fellah's* round of toil. In many places it is done entirely by treading out beneath the feet of the animals, which are tied together abreast and driven round and round over the spread-out grain (see page 272).

The mules and horses are provided with flat sheet-iron shoes for all kinds of work, and the cattle, just as the threshing season begins, are specially shod. On each half of the cloven hoof a small iron shoe is nailed, and this not only facilitates the work of separating the grain, but prevents the animal from becoming lame.

HOW THE GRAIN IS WINNOWED

In the simple treading-out process the animals are driven around slowly over the grain, while the men, with wooden forks, keep stirring it up. When thoroughly threshed, the straw has been chopped up into short bruised bits and all is then heaped up.

To separate the grain, "the fan," which is a wooden fork, is used, the farmer waiting until the wind is blowing hard enough without being violent. Such conditions are best found in the evenings or during moonlight nights. The winnower tosses up the trampled grain into the air, and, being heavier than the straw, it falls into a heap by itself, while the fine straw separates into a neat pile a little distance away. The dust and very fine particles are completely blown away. This refuse is called *ur* by the Arabs, the original Hebrew name.

A sieve is now employed, and through this the grain is passed to take out the

* Ruth 2: 17.
† Ruth 2: 14; 1 Sam. 17: 17 and 25: 18.
‡ Gen. 28: 22.
§ Lev. 27: 30.
¶ 1 Sam. 8: 15, 17.

THE SHEPHERD'S FLUTE

These simple pipes have been popular in the land for thousands of years and are doubtless similar to those used when Solomon was anointed. "And the people piped with pipes and rejoiced with great joy, so that the earth was rent with the sound of them" (1 Kings 1:40)

SUNRISE ON THE FLOCK

"Those unacquainted with the pastoral life of this land, who do not know the almost human relationship between the flocks and their keepers, may wonder how the sheep are separated by their different owners when morning comes. The sheep respond to the voice of their own shepherd, but, so well do they know the individual members of the flock of which they are part, that when the morning breaks each flock gathers itself together as a matter of habit" (see page 296).

coarse stubble that is too heavy to be blown away. Sometimes a wooden shovel is used to give the grain a final winnowing. The presence of the stubble is accounted for by the fact that during harvest the grain is largely pulled up by the roots.

This fine straw is kept as fodder for the animals, for hay is unknown. The Arabic name for this is *tiben,* being identical with the Hebrew word which has been translated "straw," and in Bible times as now was fed to the animals or mixed into the clay when making bricks. We read in Exodus that when Pharaoh refused to give the Hebrews straw (*tiben*) to make bricks they were scattered throughout all the land to gather stubble instead.*

It might be interesting to note in passing that when the mounds covering the ruins of the Jericho of Joshua's time were unearthed by German explorers a few years ago the ancient bricks were found to be identical in size and texture with those made now by the inhabitants of modern Jericho, having *tiben* mixed in just in the same way.

THE THRESHING-FLOOR MOSQUE

In the southeast corner of Jerusalem, close by the old city walls, is an inclosure some 30 acres in extent, in which stands the far-famed Mosque of Omar. Its graceful dome, tiled exterior, and richly decorated interior, with superb mosaics and stained-glass windows of arabesque designs, make it one of the chief attractions of Jerusalem to the tourist (see pages 298 and 305).

Besides its beauty and grandeur, the past history of the site demands attention. Thither Abraham came to sacrifice on the summit of Mount Moriah his only son, Isaac.† Later King David bought the threshing-floor located on this site from Ornan, the Jebusite, and built an altar to offer sacrifice in order that the plague then raging in Israel might be stayed. "Then David said, This is the house of the Lord God, and this is the altar of the burnt offering for Israel." ‡ Although David made great preparations, the actual building of the temple on this spot was left to his son Solomon.

A second temple, far less grand, was erected there by the Jews after the return from captivity in Babylon, and the third and magnificent one was reconstructed and enlarged by Herod.

After the complete destruction of Jerusalem in A. D. 70, Hadrian erected here a temple to Jupiter. Between this and the time that the present mosque was built by Abd el Melik, little is known of the history of the site.

To the Moslems this mosque, erroneously attributed to the Caliph Omar, is the most sacred shrine after the Kaaba at Mecca. Under the gorgeous dome, seen only in the subdued light which filters in through matchless stained glass, is the flat rock supposed to be part of the original threshing-floor (see page 305).

THE LEGEND OF THE MOSQUE OF OMAR

The legend runs thus: Two brothers were threshing out their grain upon this floor. The older one wakes one night and sees all about him his large family of children, while his brother lies on his grain piles alone. Thus contemplating his many blessings, the abundance of the crop, his large pile of grain catches his eye, and again thinking of his bachelor brother, and wishing to add some happiness to the life of one who has no family to love and be loved by, rises and from his own pile adds a quantity to that of his brother.

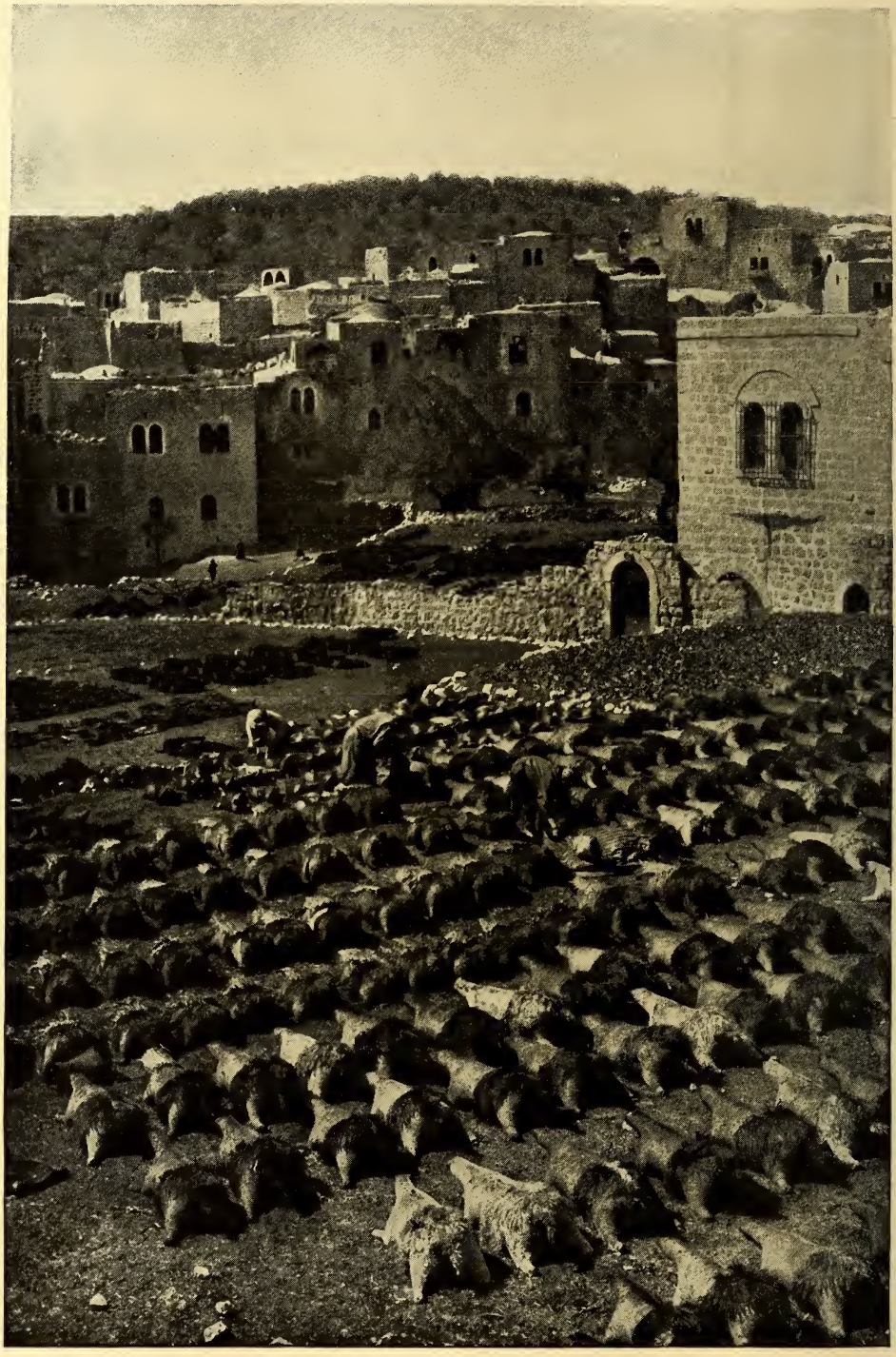
After the elder brother has again fallen asleep, the younger awakes, meditates on the many bounties he should be grateful for—a full crop and health and strength—his brother and his large family attract his thoughts. He reasons that he who has no one dependent upon him could well spare some of his crop and thereby perhaps add joy to his brother's life. Unwittingly he returns to his brother's pile exactly the amount that had shortly before been taken from it, and in the morning, neither knowing what the other had done, both were surprised to find their grain undiminished.

As soon as the grapes, figs, and other fruits begin ripening, the *fellah,* with his

* Exodus 5: 12.
† Gen., ch. 22.
‡ 1 Chron., chs. 21 and 22.

SISTERS

"But in the Samaria district they braid their hair in two plaits, on the ends of which hang silver tubes with small coins or ornaments attached." Photo by the American Colony, Jerusalem.



A TANNERY THAT USES NO VATS

Goat skins are shown here being tanned to be sold to the city water-carriers. They are filled with oak bark and water and laid out in the tannery yard to cure.

IN THE CHRISTIAN QUARTER: JERUSALEM

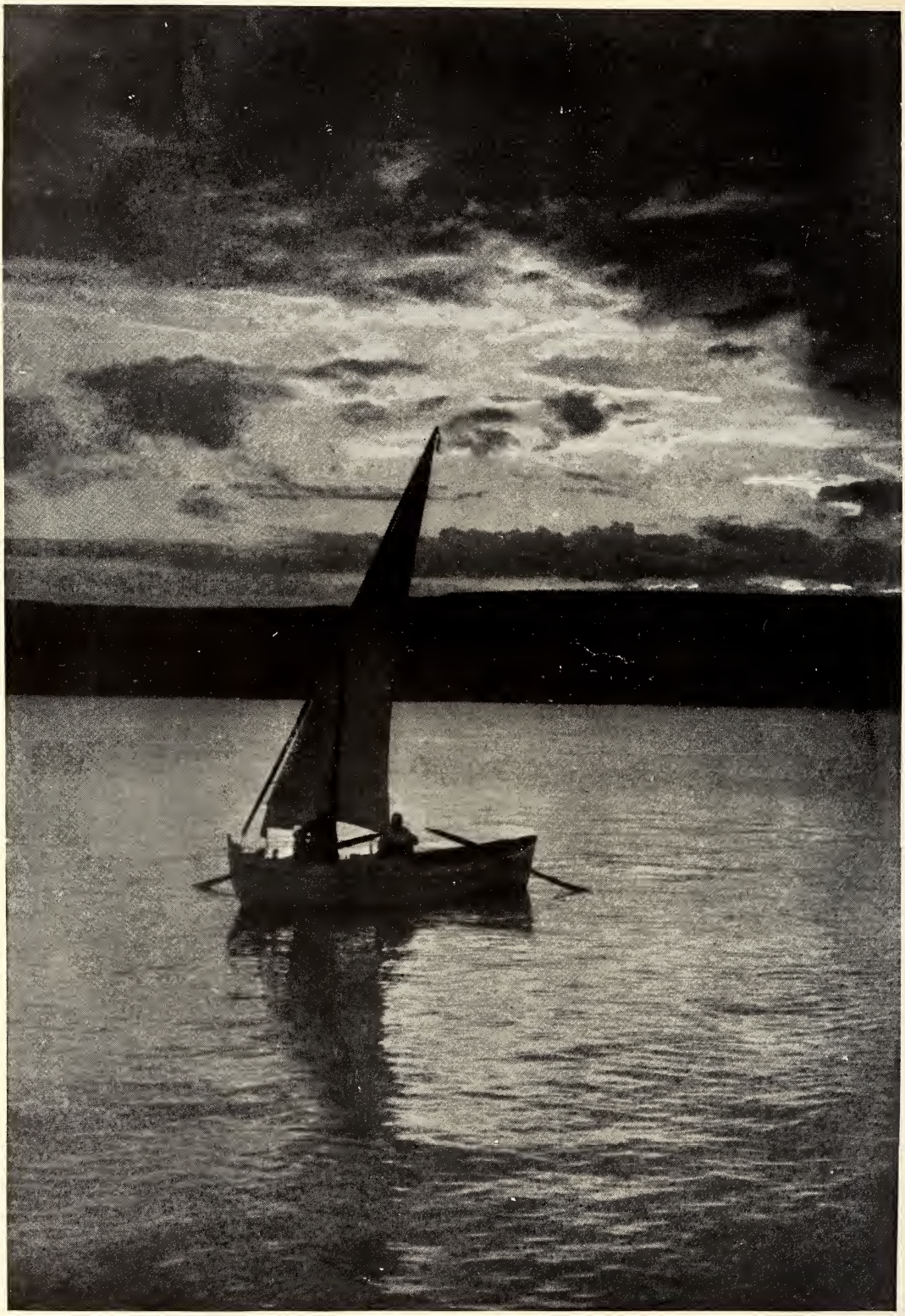
This street is peculiar in respect to the number of projecting windows.

AN ARABIAN JEW

These Jews, claiming to be of the tribe of Gad, have lived for centuries in Yemen in Southern Arabia. They are more like the present-day inhabitants of the land than any other Jews.

THE SMILING BUTCHER

The dweller in Jerusalem has no scientific prejudices. As long as he gets his meat, it does not worry him if the delivery is effected under conditions that would horrify an American inspector of public health.



ON THE SEA OF GALILEE: A FISHING BOAT AT SUNRISE

The Sea of Galilee, known also in Biblical times as the Sea of Tiberias, the Lake of Gennesaret, and the Sea of Chinnereth, is about 13 miles long and 7 miles broad, while it lies 700 feet below the level of the Mediterranean.

entire family, moves out of the village into the vineyard.

The grape season is looked forward to as the best part of the year, and at this time the natives live for the most part on fruits and bread. Jokingly, the *fellaheen* say that they get so fat from eating grapes that their fezzes burst.

BEATING THE OLIVE TREES

A saying among the peasants likens the vine to a city woman, for it cannot stand being neglected for a single year; the fig tree to a Bedouin woman, for it can withstand about five years of neglect, and the olive tree to a *fellaha* woman, for it is still found alive after 60 years of neglect.

This simile is given to illustrate how hardy the olive tree is as compared with the fig and the vine. To an Occidental, familiar with the almost indestructible qualities of the olive, it also serves as an example of the hardiness of the women of this sturdy mountain race.

The olives are harvested in the fall, but by a method so injurious to the trees that they yield a full crop but once in two years. Instead of picking them by hand, for time is not money with these easy-going people, they beat the trees with sticks to knock off the fruit, which at the same time results in destroying the tender shoots which should bear the next year's fruit.

When questioned, they admit the folly of this beating, but add that their fathers did so and why should they change. Evidently they are copying not only their fathers, but the Israelites before them, for we read in the Mosaic writings, "When thou *beatest* thine olive tree, thou shalt not go over the boughs again: it shall be for the stranger, for the fatherless, and for the widow." *

The olives when salted or pickled in brine are valued food, for a peasant can make a meal of only bread and olives, with perhaps the addition of a raw onion. The oil is a food staple, taking the place of meat. It is also, to a limited extent, burned in small clay lamps, identical in shape with those found in Canaanitish tombs, many of which were buried here before the Israelites possessed this land.

* Deut. 24: 20.

CARE OF THE POOR

A characteristic of these poor peasants is their hospitality and their kindness to the destitute.

One can any day see a party of women coming to town with their baskets for the market, and as they pass the beggars sitting by the roadside, they drop them a bit of bread or a little of the produce brought in for sale, and frequently the donor will be seemingly as poor as the receiver.

One of the prettiest, perhaps, of all Arabic words is the one for bread, namely, *aish,* meaning life, for with them it is veritably the "staff of life." Bread is looked upon as almost sacred, and they will never allow a crumb to fall where it will be trodden upon, and if a fragment is found dropped, perhaps by some child, on the ground it is lifted and kissed and laid up on a wall or put into a crack where some animal or fowl may find it.

The village home has near it a small hut containing the oven, called the *taboon.* It is a dome some 3 to 4 feet in diameter, made by the women, of clay, with an opening in the top and is provided with a cover of the same material. It stands on the ground, slightly raised by stones beneath its rim. In the bottom is a thick layer of loose pebbles. It is heated by banking up around the outside a quantity of hot ashes.

After the day's baking the woman adds as fuel some dried manure or stubble (see page 277), which ignites from the hot ashes and keeps smouldering, and so heats the oven for the next day's baking. Bread is made from soft and elastic dough. The woman brings a bowl of it to the *taboon,* makes a rather thin loaf by throwing a piece of the dough from hand to hand, and then flops it on to the pebbles at the bottom of the oven.

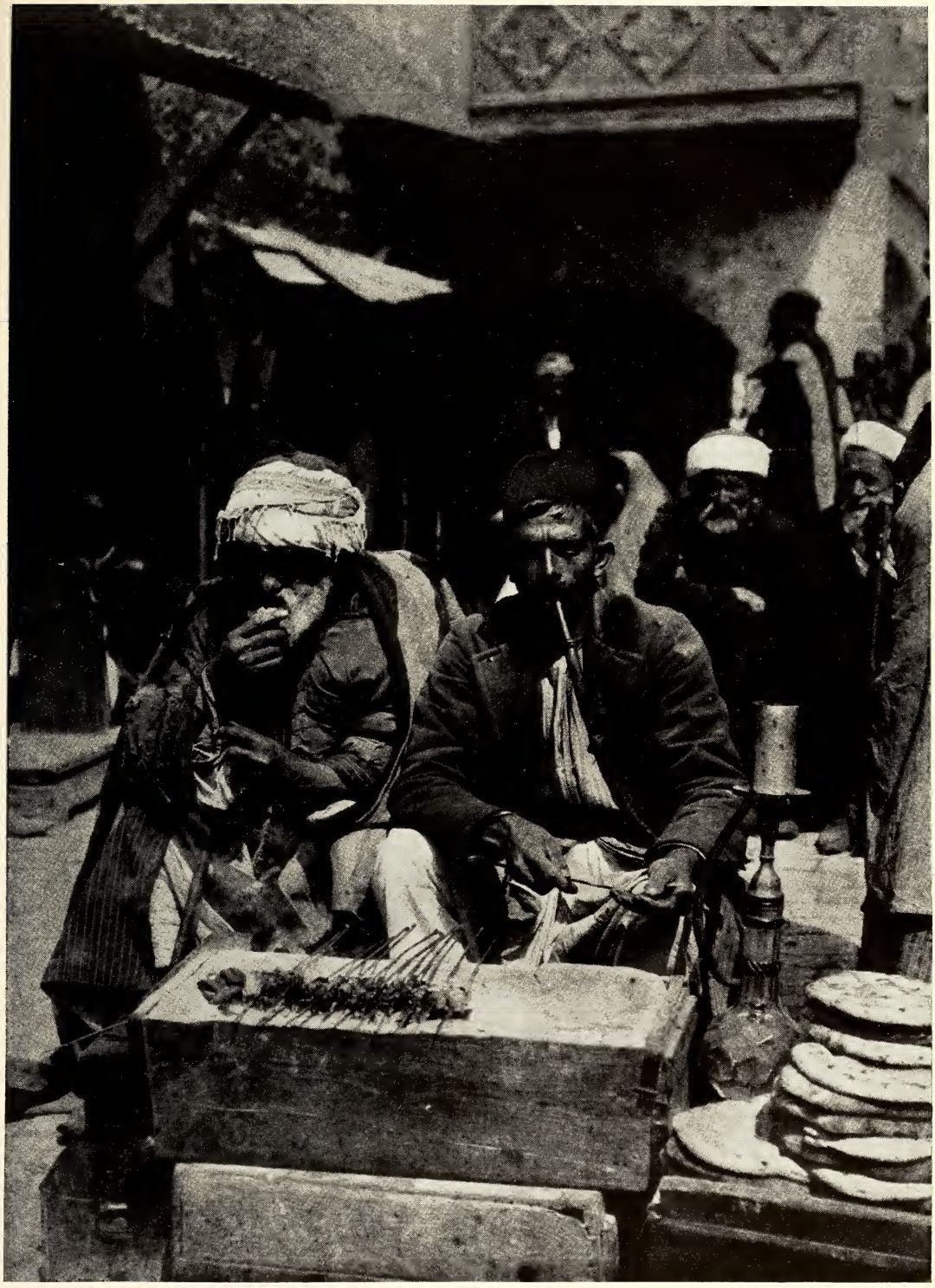
About six of these loaves fill the oven, and when baked they are full of the indentations made by the small stones. When well made and eaten warm, this bread is very good.

"THE MOTHER OF ALL TURTLES"

A story is told of a woman who refused to allow her neighbor to bake some dough in her *taboon.* The neighbor then

PICKING JAFFA ORANGES

Around the coast town of Jaffa are large orange groves, irrigated by water from numerous wells. Here are grown the Jaffa oranges which are world-famed for their size and flavor. Most of these oranges are shipped to England, where they are highly esteemed and bring good prices in the markets.



A QUAINT STREET RESTAURANT

The man shown here is roasting meat on iron spits over a tiny fire of charcoal. During the whole operation he is busily smoking his water-pipe, or *narghile*. Note the flat loaves of bread. These little restaurants are by no means uncommon in the streets of the larger cities of the Holy Land.

THE WALLS OF JERUSALEM

This is the northeast corner of the old city wall. Jerusalem was fortified by the Crusaders and later by Saladin in 1192. The fortifications were dismantled in 1219 and restored ten years later, only to be destroyed again in 1239. The present walls were built in 1542 by Suleiman the Magnificent.

begged the loan of a loaf of bread, to be returned as soon as she baked, for her oven was still too cool and her boy crying from hunger.

This was also refused, which so called down the wrath of the Almighty that an angel was sent, who, lifting up the hot *taboon,* or oven, placed it on the back of the merciless woman, leaving only the limbs and the head protruding.

So she who thus refused bread became the mother of all turtles, and if you seem to doubt it, the *fellah* will prove it to you by calling your attention not only to the fact that the turtle's shell resembles the *taboon* in shape, but also to the markings on the top of the shell like the pebbles used in the oven.

The shells of small turtles are much in vogue as charms, by peasants and city people alike, and are often to be seen strung on a cord along with blue beads, a bit of alum, etc., and worn by the children.

A story told by a peasant living at Artas, where King Solomon had his gardens,* runs thus: A certain *fellah* living by the seaside was in the habit of feeding every day a loaf of bread to a whale. The chief of the genii noticed it and, addressing him, said: "For your kindheartedness you shall be rewarded. Gold and riches you can obtain by working for them, but I will give you something you cannot otherwise get. You shall have the gift of understanding the animals, but mind you do not tell any one about it."

When he returned home with his tired oxen from the day's plowing he heard the donkey say to one of the oxen, "If only you would not eat your food the master would think you were sick and would not take you out to plow."

Hearing this the man began laughing, and his wife asked the reason, but he did not tell her. The next morning, to repay the donkey for his intriguing, he hitched him to the plow instead of the ox. When he was brought back in the evening the ox asked him how he liked plowing. He pretended not to be tired, but advised the ox that if he continued not eating, the master would slaughter him.

The farmer, hearing this, laughed heartily, but would not reply to his wife's queries as to the reason of seemingly laughing at nothing. Next morning he took out the ox to plow, and the beast, fearing that the man might be leading him away to slaughter, as the donkey had said, pulled back and did not want to move. The man, knowing the reason, again began to laugh, which so aroused his wife's curiosity that she insisted if he did not tell her the cause of his amusement it was because he did not love her.

After much importuning, he at last told her the whole story, and no sooner had he done so than he lost this peculiar gift and could no longer understand the language of the animals.

HOW DAVID SLEW GOLIATH

Some experience as a shepherd befalls almost every peasant boy whose family has flocks.

As he watches over the feeding sheep, he cuts a little wool from the back of one, spins it with the aid of only a smooth pebble, and then converts the yarn into a sling such as is always carried in the scrip.

With this he becomes expert in throwing stones to a great distance and with much precision. It not only serves as a weapon of defense, but when a sheep or goat wanders off and will not return at his call he will drop a stone near it, and this at once has the desired effect.

With such a simple weapon, and a stone taken from his shepherd's bag, which was undoubtedly similar to the one above described, it will be remembered the stripling David, while still caring for his father sheep, encountered Goliath, the Philistine giant, and slew him† (see page 280).

When the owner of a flock has no son to care for the sheep, he hires a shepherd, and not only feeds him, but supplies a stipulated amount of clothing and shoes. The wages paid in money amount to only a few dollars a year.

It is not uncommon for a shepherd or a plowman thus serving a master to receive, instead of wages, one of the man's

* Eccl. 2: 5.

† 1 Sam. 17: 40, 49.

daughters as a wife, just as Jacob contracted with Laban for his two daughters, Leah and Rachel.* The usual time served for a wife is from five to seven years.

PRIMITIVE METHODS OF DAIRYING

As long as the flocks are kept in the village, the sheep, as well as the goats, are milked by the women, and the milk turned into cheese and butter, to be sold in the city markets.

Butter is made in a goat skin like those used for carrying water. This is only half filled with the milk, which previously has been allowed to sour. The skin is blown full of air, the opening tied up, and it is hung on a tripod of sticks and shaken back and forth by one or two women until the butter is formed (see page 312).

We have no record of how the ancient shepherds of this land made their butter, but could it have been by a cruder or more primitive process? This butter is quite white, and is not eaten, spread on bread, as with us, but is mostly converted into a cooking requisite by boiling until all the watery parts have evaporated, when it is stored in goat skins, and keeps indefinitely.

Fresh butter is also eaten served in a bowl, with usually a quantity of sugar, honey, or molasses made of grapes added,† in which each dips their morsel of bread.

During the day each shepherd pastures his flock independently, but in the evening all meet at the selected rendezvous. It may be a large open field or a spot where they are protected from the wind. Here all the flocks intermix in one great company during the night.

The shepherds arrange among themselves for a watch, each set of four or five men keeping guard for an hour or two, while the rest sleep curled up in their sheepskin. Sometimes they stand like sentinels over the sheep in the solitude of the still, starlit night, just like the shepherds of old on the first Christmas eve.

CALLING THE SHEEP BY NAME

Those unacquainted with the pastoral life of this land, who do not know the almost human relationship between the flocks and their keepers, may wonder how the sheep are separated by their different owners when morning comes.

The sheep respond to the voice of their own shepherd, but, so well do they know the individual members of the flock of which they are part, that when the morning breaks each flock gathers itself together as a matter of habit. Then the shepherds start off in different directions, each calling his own sheep, sometimes standing on a rock or elevated place, and the sheep prick up their ears and look around, and seeing their shepherd, follow him because they know his voice.

The shepherd, to make sure that none is left behind, causes his flock to pass under his rod between him and a rock, and as they pass he counts them.‡

As a rule, when the shepherd calls one by its name it will answer with a bleat or come running expecting a treat, as a bit of bread from his scrip or a twig of leaves broken from a tree.

Each shepherd carries a club or crook, and uses it for defense and protection and not, as in other countries, to drive the sheep with, for here the shepherd always precedes the flock and they follow him. In case of danger, such as the intrusion of some wild animal, the sheep rush to him, and this weapon on his shoulder seems to allay their fears, reminding one of the words, "Thy rod and thy staff they comfort me." §

To know these shepherds is to understand how the Shepherd Psalmist and King, contemplating all the incidents and vicissitudes of his pastoral life, could compose that matchless psalm, of such solace and strength, "The Lord is my shepherd, I shall not want." ¶

* Gen. 29: 15-29.
† Isaiah 7: 15, 22.
‡ Lev. 27: 32.
§ Psalm 23: 4.
¶ Psalm 23: 1.

THE VILLAGE CARPENTER

Each village in Palestine has a carpenter who repairs the ploughs and receives in exchange from each farmer a stipulated amount of grain. Note the primitive tools and the great toe used to hold the wood. Photo by American Colony, Jerusalem.

JERUSALEM IN A WINTER STORM

The great dome, which stands out so prominently, is that of the Mosque of Omar, which covers the site of the threshing floor of Ornan, the Jebusite. (See also page 305.) This is one of the most sacred spots in the world, the place where Abraham was ready to offer up Isaac; where David sacrificed to stay the plague and where Solomon built his great temple. The Mosque of Omar ranks among the Moslems as second only in sanctity

THE SPINNING WOMAN

This woman belongs to a class like that of the people of Jericho, neither Bedouin nor peasant, but a compound of both. Her costume, like her blood, is a mixture, her dress is Bedouin in character but her head-dress is similar to that worn by the peasant women. Photo by American Colony, Jerusalem.

ON THE WAY TO THE WELL

"Women formerly, when passing men on the roads, would cover their faces with their hands and keep their eyes on the ground but now when you meet them they are not shy." It will be noted that the woman on the extreme left observes the more modest custom. Photo by American Colony, Jerusalem.

MAKING OLIVE OIL

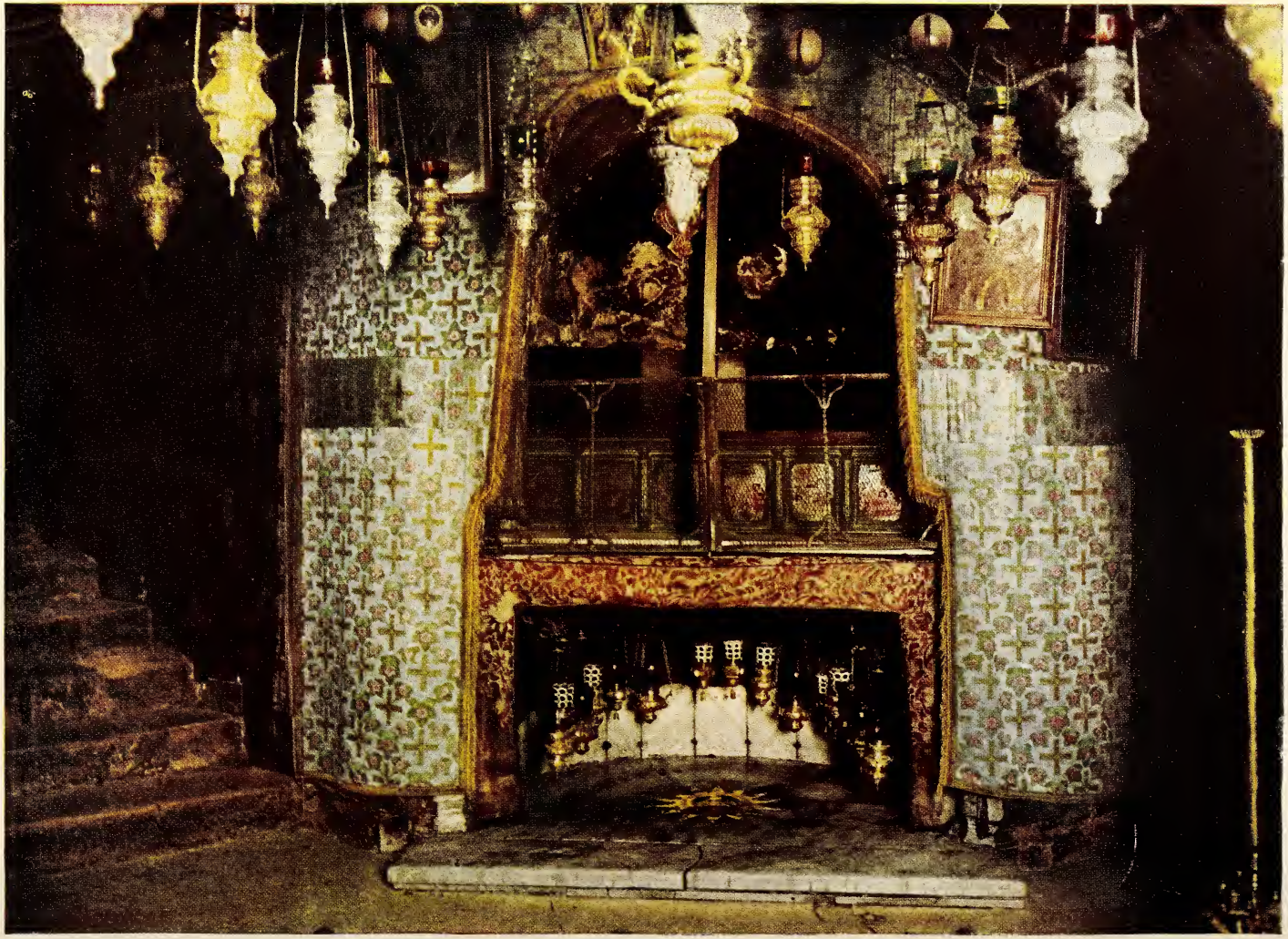
"A piece of an ancient column serves as a roller, the olives being placed on a rock and crushed by passing this stone back and forth over them." Note the rich blue black color of the ripe olive. Photo by American Colony, Jerusalem.

THE GARDEN OF GETHSEMANE

The garden of Gethsemane is now in charge of the Capuchins, an order of Franciscan friars belonging to the Roman Catholic Church. They tend it with the greatest care and it is one of the beauty spots of the Holy Land. It contains a few olive trees of great age, some of which are believed to have

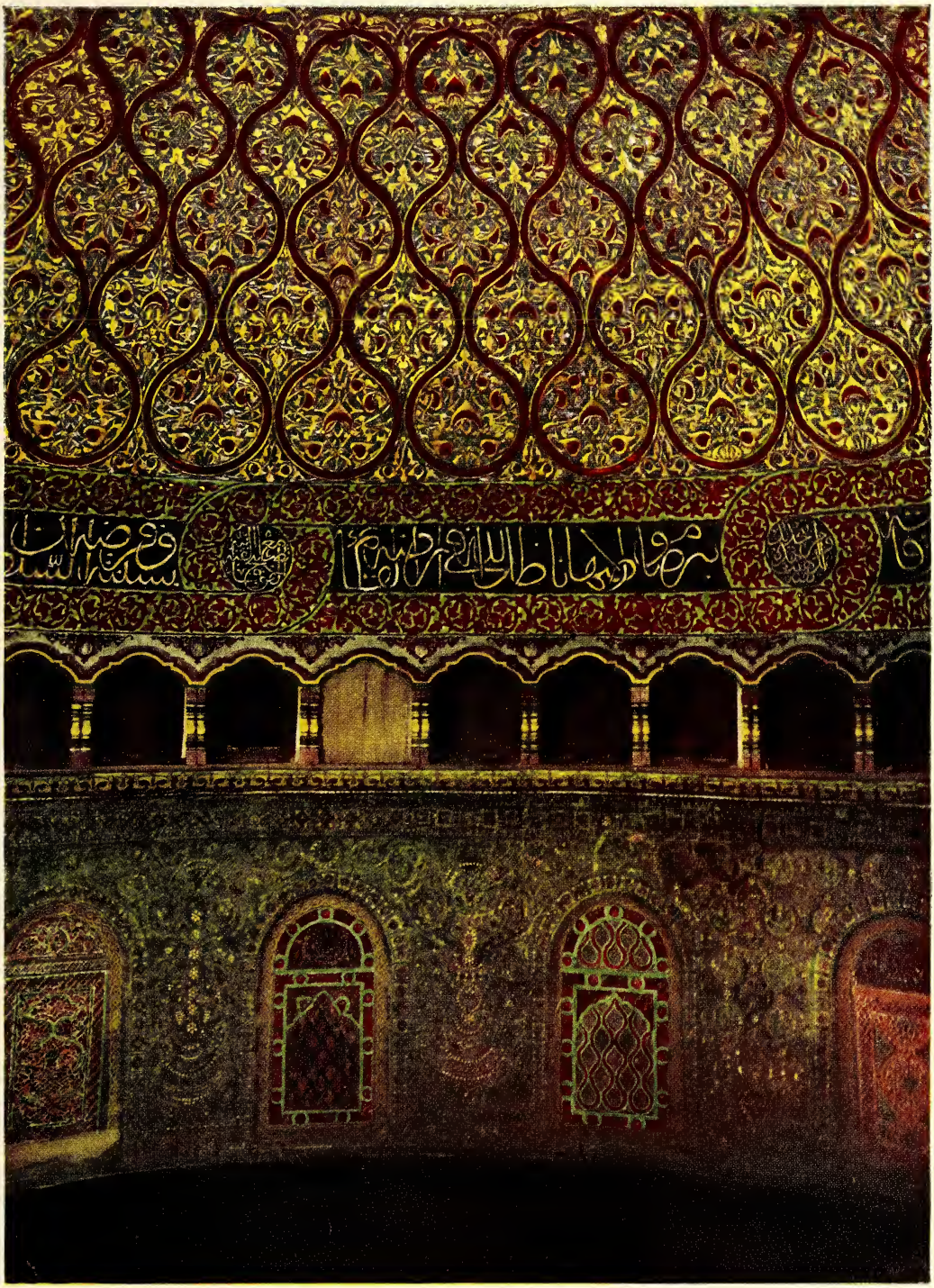
STREET SCENE IN BETHLEHEM

Bethlehem stands in the midst of a fertile district producing an abundance of wheat, barley, olives, vegetables and grapes and in consequence its market is always well supplied. Since 1834, when the entire Moslem colony was destroyed by Ibrahim Pasha after an insurrection, there have been comparatively few Moslems among its inhabitants. Photo by American Colony, Jerusalem.



THE GROTTO OF THE NATIVITY

"To-day, in Bethlehem's church, such a cave is shown as the actual birthplace of Jesus. Its walls are covered with costly tapestries and from its ceiling hang lamps of gold and silver." The church over the grotto was built by the Empress Helena, the mother of Constantine the Great. Photo by American Colony, Jerusalem.



BENEATH THE DOME OF THE MOSQUE OF OMAR

Under this gorgeous dome, with its superb mosaics of Arabesque design, seen only in the subdued light which filters in through the ancient stained glass windows, is a great flat rock, the summit of Mount Moriah, part of the threshing floor of Ornan, the Jebusite. I Chron. xxi and xxii. (See also page 298.) Photo by American Colony, Jerusalem.

ON THE WAY TO MARKET

Like all Orientals these peasant women carry their produce to market on their heads. It is a common custom with them to take off their shoes and place them on top of their loaded baskets. The woman on the left is practising this form of economy. Photo by American Colony, Jerusalem.

THE BRIDE, PALESTINE

She is wearing her wedding dress, the white embroidered garment known as the *tobe*, and the large white veil to match,—the embroidery being all the work of her own hands. The head-dress of coins and the neck chain,—the marks of a married woman—are formed from a part of the money which her father received for her from the bridegroom. The average price of a bride is from $20 to $40. Photo by American Colony Jerusalem.

IN A JERUSALEM MARKET

This market, known as the *Bab-khan-el-Zeit*, is the chief one in the old Moslem Quarter. The different faiths and races in the Holy City dwell more or less apart and each patronize separate markets. Photo by American Colony, Jerusalem.

THE VILLAGE WEDDING

"Towards evening the young men dress the bridegroom in his best and, with the entire village, go out into some open field where they have horse-racing and shooting." Note the palanquins on the camels from which the ladies of the family watch the festivities. Photo by American Colony, Jerusalem.

THE UPPER ROOM

"To make use of the *rowyeh*, or stable portion of the house, by human beings is not the exception but an every-day occurrence. . . . Many of these dwellings, placed as they are on ancient sites, are built over old caves or caverns which are incorporated with the lower or stable portion." (See text.) Photo by American Colony, Jerusalem.

MEASURING THE GRAIN

This is one of the scenes of the threshing floor, as primitive to-day as it was in the Biblical period 2000 years ago. It helps us to understand the phrase, "good measure, pressed down and shaken together and running over." Luke vi: 38. Photo by American Colony, Jerusalem.

MAKING BUTTER

Butter-making in the Holy Land is a very primitive affair. A goat's skin is half filled with milk, then inflated with air and sealed. It is hung with ropes on a tripod roughly made of sticks and is rocked to and fro by the women until the butter is formed. Photo by American Colony, Jerusalem.

A TYPICAL VILLAGER'S COSTUME

THERE is a long shirt made of white cotton cloth. Over this is a sort of gabardine made of striped goods; red and yellow or black and yellow are the favorite colors. A dome-like red fez is wound about with a turban. In the districts north of Jerusalem the turban consists of a large square of white linen with a colored border woven in. Photo by the American Colony, Jerusalem.

THE VILLAGE MOTHER: PALESTINE

"A cap, perhaps decorated with a blue bead or some charm to keep off spirits and the evil eye, completes its apparel." The child shown here has outgrown the swaddling clothes.

ENCOURAGING BIRDS AROUND THE HOME

By Frederick H. Kennard

NOW that our country has really awakened to the importance of bird life to the citizens, and at last enacted some very wise legislation, forbidding the killing of migratory and insectivorous birds, putting migratory game birds under Federal control, and forbidding the importation of plumage from abroad, public interest in birds and their great economic value seems to have been stirred as never before.*

Spring will soon be here, and those of us who are thinking of doing our little toward attracting the birds must be getting ready for the early arrivals from the South.

Birds come north for the very special purpose of finding a proper place for the rearing of their young, and, this task accomplished, as autumn approaches, soon depart in search of areas where there will be throughout the winter plenty of food and cover and a more congenial climate.

If we want to make our homes attractive to birds, we must always keep the above facts in mind. If in summer we want to attract the migrants from the South, as well as the permanent residents, we must furnish them with proper places for the rearing of their young, which should include not only nesting sites, but cover, food, and water; and if in winter we want to keep some of the permanent residents about our homes and attract migrants from the North, we must remember that they are again in search of food and cover.

Once having attracted the birds, a sharp lookout must be kept in order to protect them from their enemies—cats, bird-hunting dogs, red squirrels, skunks, foxes, and other predatory animals, not forgetting the small boy that used to be ubiquitous; English sparrows, horned owls, and sometimes crows and jays, cooper and sharp-shinned hawks, and last, but not least, the black snake.

HOW TO ATTRACT THE BIRDS

To sum up, if we are to attract birds in summer, we must furnish them with proper nesting sites, cover, food, and also water; and if we want to keep them in winter, we must again furnish them with cover and food, and always protect them from their enemies.†

The most important factor in attracting birds is the supplying of cover suitable for their wants. With this properly done, except in the case of birds that nest about buildings or in holes, nature will supply the nesting sites, as well as take care of the food supply, except in winter.

At "The Pines," my place in Newton Center, Mass., we have had for eight years under close observation about 44 acres, comprising three acres of lawn dotted with a few old apple trees, six acres of wet meadow, which are allowed to grow up with tussocks of grass, cedars, alders, wild roses, and the like, and the remaining 35 acres divided in two areas of about equal size. The first of these areas, that about the house, is covered with a growth of pines, hemlocks, cedars, birches and various other deciduous trees, among which we have taken pains to cultivate suitable coppice and undergrowth, while the second area, covered with deciduous woods, is, on account of a fire that ran through it a number of years ago, almost devoid of the smaller evergreens or protecting coppice and undergrowth (see pages 319 and 320).

In the first of these areas (page 319) some thirty different species of birds

* Numerous reports on the economical value of birds have been issued by the United States Department of Agriculture. One of the best books on the subject is entitled "Birds in Their Relation to Man," by Weed and Dearborn, published by J. B. Lippincott & Co., Philadelphia, Pa.

† A useful book that every one should read who is interested in birds is "Methods of Attracting Birds," by Gilbert H. Trafton, published by the Houghton-Mifflin Co. of Boston, Mass.

ATTRACTIVE PLANTING, PARTICULARLY OF EVERGREENS, ENCOURAGES THE BIRDS Photo by Thomas E. Marr and Son

"Almost every one who lives in the country can do something in the way of attractive planting about their houses and grounds, and even in the more closely settled suburbs almost every place, no matter how small, can by judicious planting be made attractive to birds. Even a back yard may in its limited way with

WHERE BIRDS GET FOOD AND PROTECTION

Photo by Thomas E. Marr and Son

A turn of the driveway at The Pines, showing plantation of rhododendrons, flowering dogwoods, and black alders, with an undergrowth of ferns and fox-gloves. Much frequented in summer by catbirds and chewinks, while in winter it affords both food and protection for many winter birds—provided there are no cats about the place.

A BIRD PARADISE

Photo by Thomas E. Marr and Son

A woodland path within a few feet of the residence at The Pines, flanked by undergrowth, ferns, blueberries, huckleberries, dogwoods, etc. Along this path a ruffed grouse builds its nest, as do also chewinks, black and white creepers, and oven birds, while in the trees pine and black-throated green warblers, bluejays, and robins also build their nests.

Photo by Thomas E. Marr and Son.

ANOTHER PLACE WHERE BIRDS LIKE TO NEST

A wood road at The Pines. In the thickets along its sides the catbird, cuckoo, golden-winged warbler, chestnut-sided warbler, bluejay, brown thrush, chewink, purple finch, tanager, and other birds find attractive nesting sites. This wood road runs through that portion of Mr. Kennard's place on which the undergrowth has been encouraged, and on which over thirty varieties of birds breed each year (see page 315). Contrast with the scene on page 320.

Photo by George R. King

BIRDS DO NOT LIKE THIS LAND, BECAUSE OF THE ABSENCE OF UNDERGROWTH

"The most important factor in attracting birds is the supplying of cover suitable for their wants. With this properly done, except in the case of birds that nest about buildings or in holes, nature will supply the nesting sites, as well as take care of the food supply, except in winter" (see text, page 315).

A BIRD-LOVER'S GARDEN Photo by Joseph H. Dodson

The garden of Mr. Dodson, at Evanston, Ill., showing the various devices used by him in attracting birds: bath, weathercock food-house, houses for great-crested flycatchers, bluebirds, tree-swallows, and martins, from left to right in the order named.

breed nearly every year, while in the second area only from three to five different species build their nests.

Almost every one who lives in the country can do something in the way of attractive planting about his house and grounds, and even in the more closely settled suburbs almost every place, no matter how small, can by judicious planting be made attractive to birds. Even a back yard may in its limited way, with proper treatment, be made a regular rendezvous for birds in the vicinity.

THE IMPORTANCE OF EVERGREENS

On suburban places and in the country the use of evergreens, large plantations when possible, is of prime importance as a protection from the elements, as a source of natural food supply, and on account also of the nesting sites they invariably offer. Nothing is finer than a plantation of white pine or hemlock. Spruce and balsam are beautiful and offer tempting nesting sites, while the native red cedar seems a favorite tree for the nest-builders and also contributes its berries toward the winter supply of food.

There is a huge hill at the edge of the sand dunes at Ipswich, Mass., swept by all the storms that come in from over the ocean, that years ago was as bare as a billiard ball, but upon one side of which the enterprising owner set out a large plantation of evergreens. Today that hillside is a Mecca for the birds from miles around, and noted among the bird lovers of the region for its varying bird life both winter and summer.

From an artistic standpoint, also, the use of evergreens is to be recommended. In these days, when there seems to be such an exodus from city to country, why shouldn't our country homes be made to look as attractive in winter as in summer? While we of the North may not in

A SCREECH-OWL'S FAVORITE NEST-BOX Photo by George R. King

"Of bird-houses, to be supplied for those birds that nest about buildings or in holes of trees, there seems to be an almost infinite variety; tree stumps, real or artificial, boxes, cottages, houses, large and elaborate mansions, barrel-houses, gourds, flower-pots, tin-cans, shelves, and all kinds of contraptions" (see page 339). The nest-boxes "on my place have been occupied by screech-owls, bluebirds, chickadees, tree-swallows, flickers, white-breasted nuthatches, and great-crested flycatchers" (see page 341).

winter be surrounded by the verdure of summer, we need not content ourselves with the bare poles of deciduous growth. Evergreens protect us and delight our eyes with their color and varying lights and shadows, and what is more beautiful than a pine wood or group of evergreens after a snow-storm?

Those of us who possess farms, while naturally jealous of every encroachment on our fields, can always find some place which may be planted. The immediate

Photo by Ernest Harold Baynes

FLICKERS USING A BERLEPSCH BIRD-BOX

"I have used the Berlepsch type of vertical boxes with considerable success. These are simply sections of logs, hollowed out by special machinery in a very particular manner to represent woodpeckers' cavities, with entrance hole in side of desired diameter, and covered by a wooden cap or roof that may be lifted for purposes of investigation or in order that the nests may be cleaned out from time to time, the whole bolted to an oaken batten, by which they may be fastened to trees" (see page 339).

surroundings of our farm buildings are in many cases much too bare and bleak. The average house when surrounded by proper planting almost invariably looks better than if left to stand out cold and hard and with base-line unbroken. Wind breaks may almost always be planted somewhere, both with benefit to the farm

Photo by Joseph H. Dodson

A NEST SHELTER

A nest shelter on a tree, with a catbird going into its nest. Robins and brown thrashers also nest in them. "Of bird enemies, cats are undoubtedly the worst, and maudlin sentiment should not be wasted upon them, for they are incorrigible" (see text, page 342).

Photo by E. H. Forbush

BARN-SWALLOW ON ITS NEST

The barn-swallow is the most common of our swallows, and he arrives from the tropics in the middle of April and stays till late in September. He is a clever architect and builds his nest of mud and lines it with feathers. He generally chooses a beam or supporting shelf for his nest in the barn, and the little fellow in the picture considers that he has found an ideal location for his house.

Photo by Ernest Harold Baynes

AN AIRING ON THE ROOF

This family of young bluebirds have left their nest, which is inside the bird-box attached to the post, to take an airing on the roof of their home.

Photo by Louise Birt Baynes

LEAVING HER NEST

A female bluebird snapped as she was leaving her nest, which she has built in a Berlepsch bird-box fastened in the gate-post of Corbin Park at Meriden, N. H.

Photo by Ernest Harold Baynes

BLUEJAYS FEEDING IN WEATHERCOCK FOOD-HOUSE

"The same man builds also a sheltered food-house that turns with the wind like a weather vane, so as to present always a lee side for the better protection of the birds" (see page 332).

Photo by Thomas E. Marr and Son

A JUNCO VISITING AN AUDUBON FOOD-HOUSE

"The Audubon food-house has been much used on this side of the water and is most satisfactory. It consists of a square hip roof, with vertical glass sides suspended beneath and open at the bottom, the whole supported on a central rustic cedar post, encircled with food trays beneath the roof. The glass sides protect the food trays from the weather and at the same time admit light and allow of easy observation. These, when placed among the shrubbery about one's house, prove most attractive" (see pages 331 and 332).

as well as to the birds, while lanes may be bordered with trees and shrubbery and walls covered with vines without any possible encroachment on the fields. An old pasture planted with savin and white pine, hawthorns, elders, barberries, cornels, viburnums, and the like, may easily be metamorphosed into a bird reservation and still be useful as a pasture.

For deciduous growth to be used for cover, choose those berry-bearing trees and shrubs whose berries are most popular with the birds; and, when possible, choose also those that may offer most convenient sites for nest-building.

SOME USEFUL FOOD PLANTS

Care must also be taken in the choice of species, so as to get, if possible, a continuous supply of food, using such plants as the cherry, mulberry, raspberry, blueberry, huckleberry, etc., for the summer supply; elder and the various kinds of dogwood and viburnum, etc., for autumn; while for winter choose those plants which hold their fruit longest, such as the hawthorn, buckthorn, mountain ash, barberry, bayberry, sumach, wild rose, and the like.

Hedges, particularly if they are evergreen, are favorite resorts for birds, both in winter and summer, and an arbor-vitæ hedge is the best of them all. I remember such a hedge about one side of my father's old-fashioned garden that in summer invariably held its quota of robins', song sparrows', and chipping sparrows' nests, while in winter it was the

PAYING A MIDWINTER VISIT Photo by Wilbur F. Smith

This shows a bird visitor attracted by the lump of suet fastened to the old pear tree. A lump of suet set in some convenient place is perhaps the surest way of securing bird visitors in midwinter, for it is a food supply they greatly appreciate.

protected resort of such birds as stayed with us.

In the Year Book of the Department of Agriculture for 1909 there is a most interesting article on "Plants Useful to Attract Birds and Protect Fruit," by W. L. McAtee. In this there is a list, on page 186, of the best trees and shrubs for attracting birds, given in the order of their attractiveness, as follows: Elders, raspberries and blackberries, mulberries, dogwood fruits, sumachs, wild cherries, blueberries, wild grapes, pokeberries, Virginia creeper berries, bayberries, juniper berries, service berries, holly berries, strawberries, the fruits of viburnums, hackberries, huckleberries, haws, spicebush berries, rose hips, sarsaparilla, sour gum, gooseberries, currants, and snowberry.

To the above list is added the following supplementary list of some other plants known to be attractive to birds, and to this the names of other species doubtless might be added: Manzanita, barberry, buffalo berry, silverberry, buckthorn, mountain ash, China berry, California Christmas berry, pepper tree, magnolia, nockaway, lote bush, and bluewood.

With the above very comprehensive lists to choose from, it is not a difficult matter to make out a list of trees and shrubs for almost any place, no matter how small, that will supply its quota of birds' food from early summer to the following spring, while if the place is a large one, or the problem at all difficult, it may be the best policy, as well as in the end the most economical, to consult some competent landscape architect as to the proper disposition of the proposed plantations. What is worth doing at all is always worth doing well.

Besides the trees and shrubs in the above lists, there are many herbaceous plants whose seeds are attractive to birds.

Photo by Ernest Harold Baynes

FLOCK OF QUAIL AT A FOOD STATION

"In bad weather, however, particularly in the North, where we are so apt to be covered up with snow, more artificial means of feeding should be resorted to, and food stations, food-houses, and food shelters of various sorts should be established in proper places. If quail or grouse are to be fed, inconspicuous bough shelters may be built in protected places among the fields or woods most frequented by them" (see page 331).

Photo by Ernest Harold Baynes

PINE SISKINS AND RED POLLS FEEDING ABOUT A HOUSE: NEW HAMPSHIRE

The pine siskin is a lover of evergreens and spends the winter wandering from copse to copse in search of seeds and pine cones. The red poll is a winter visitor from the far North, and with its rich crimson head and breast makes a pretty picture in the snow.

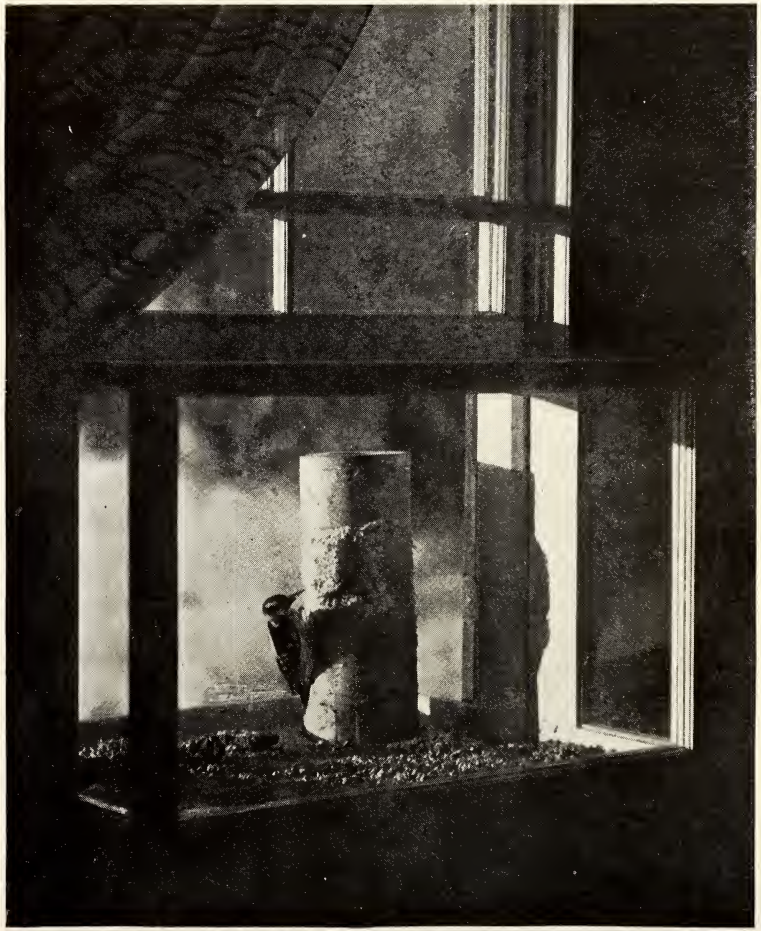


Photo by Ernest Harold Baynes

A SHY HAIRY WOODPECKER AT DINNER

The hairy woodpecker is a somewhat shy bird, who prefers the forest to the orchard and is not often seen about the house. His note is louder and sharper than that of most woodpeckers and cannot by any stretch of the imagination be

Photo by Louise Birt Baynes

A FRIENDLY CHICKADEE

The chickadee is found in all parts of the East, from Labrador to Maryland, and in all seasons of the year, but is seen most often in winter. They are unusually companionable birds and their tameness,

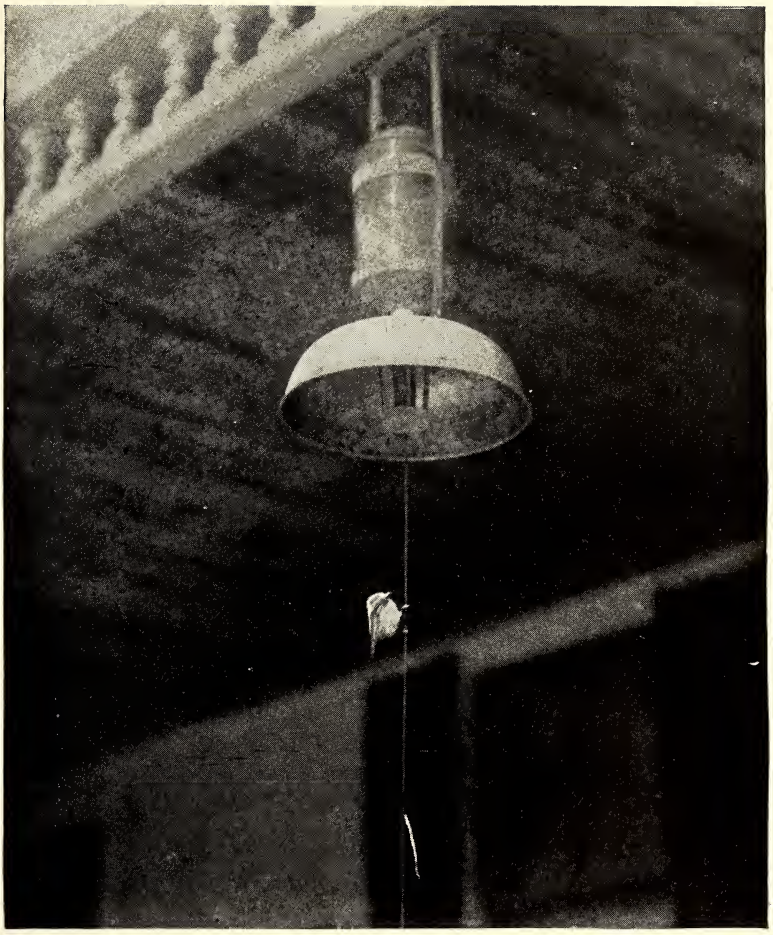


Photo by Ernest Harold Baynes

THE FOOD BELL

"Baron von Berlepsch has invented a food bell that supplies grain, etc., automatically from a receptacle above, and which may be suspended from a tree or piazza roof or any other place that seems best" (see page 332).

Sunflowers may be planted in groups about the flower garden or in lines among the rows of vegetables; wild sarsaparilla and pokeberry along the boundary walls; while if you have a corner somewhere in the fields that can be planted with buckwheat and Japanese millet, it will prove a great attraction, particularly in winter.

FOOD-HOUSES AND SHELTERS

In bad weather, however, particularly in the North, where we are so apt to be covered up with snow, more artificial means of feeding should be resorted to, and food stations, food-houses, and food shelters of various sorts should be established in proper places. If quail or grouse are to be fed, inconspicuous bough shelters may be built in protected places among the fields or woods most frequented by them, while about the house or among the neighboring plantations all sorts of devices may be resorted to.

Baron von Berlepsch, in Germany, has invented a food-house, an adaptation of which, called the Audubon food-house, has been much used on this side of the water, and is most satisfactory (see page 327). It consists of a square hip roof, with vertical glass sides suspended beneath and open at the bottom, the whole supported on a central rustic cedar post, encircled with food trays beneath the roof. The glass sides protect the food

Photo by Ernest Harold Baynes

A BLUEJAY FEEDING ON SUET

"Perhaps the simplest scheme of feeding, the least trouble, and the most attractive to numbers of birds, is the tying of a piece of suet to a convenient limb, or perhaps to the balustrade of one's piazza, preferably in a protected spot and one that can at the same time be easily watched from some window" (see page 333)

trays from the weather and at the same time admit light and allow of easy observation. These, when placed among the shrubbery about one's house, prove most attractive.

Baron von Berlepsch has invented also a food bell that supplies grain, etc., automatically from a receptacle above, and which may be suspended from a tree or piazza roof, or any other convenient place (see page 331).

Window boxes are a never-ceasing source of enjoyment. Mr. Ernest Harold Baynes built the first I ever saw at his home in Meriden, N. H., a particularly attractive one, which has helped him to become intimate with an astonishing variety of birds (see page 336).

Food shelves may be put up in all sorts of protected places—about houses, against tree trunks, etc.; and a food car, a sort of moving free-lunch counter, which may be run conveniently on a wire from window to neighboring tree, is actually manufactured by one enterprising gentleman; and the same man builds also a sheltered food-house that turns with the wind like a weather vane, so as to present always a lee side for the better protection of the birds (see page 326).

Baron von Berlepsch originated also what he calls a food tree, a freshly cut evergreen, preferably spruce or fir, or perhaps a discarded Christmas tree, set up in some convenient place, over which has been poured hot, and then allowed to cool, a mixture of food that is attractive to both insectivorous and graminivorous birds, the receipt for which is given in the little book, "How to Attract and Protect Wild Birds":*

"White bread (dried and ground), 4½ oz.; meat (dried and ground), 3 oz.; hemp, 6 oz.; crushed hemp, 3 oz.; maw, 3 oz.; poppy flour, 1½ oz.; millet (white)

* For sale by the National Association of Audubon Societies, 1974 Broadway, New York City, N. Y. Price, 40 cents.

3 oz.; oats, 1½ oz.; dried elderberries, 1½ oz.; sunflower seeds, 1½ oz.; ants' eggs, 1½ oz."

A SIMPLE AND ATTRACTIVE FOOD SUPPLY

Perhaps the simplest scheme of feeding, the least trouble and the most attractive to numbers of birds, is the tying of a piece of suet to a convenient limb, or perhaps to the balustrade of one's piazza, preferably in a protected spot and one that can at the same time be easily watched from some window (see page 332).

In all these food-houses various kinds of food should be supplied — suet, crumbs, millet, hemp, rape-seed, canary-seed, and the like. On my place the birds have such a wealth of natural food that it is only during the winter storms and when the ground is covered with snow that they visit the food-houses; but on many other places— as, for instance, in Meriden, N. H., where Mr. Baynes and the Meriden Bird Club are doing such good work—there have been food-houses erected on places along the main street, entirely apart from any protecting shrubbery or natural food supply, and many of these food-houses seem to be well patronized both winter and summer.

Photo by B. S. Bowdish

ON INTIMATE TERMS

This jolly little white-breasted nuthatch has just taken a dainty morsel from the lips of its friend. These little birds are very clever climbers and can run up and down tree trunks in the most agile manner.

Water, particularly during the summer months or times of drought, is, of course, necessary for the birds. If they can't get it on your place, they will be forced to look elsewhere. The proper installment of a drinking fountain or bird bath is a simple affair, and one that is almost sure to prove a great attraction to the birds, as well as a never-failing source of entertainment to the owner.

Drinking fountains may be purchased ready made or manufactured at home. Almost any shallow receptacle will do when placed in some quiet spot not too far from protecting shrubbery, but out of reach of skulking cats. Where the cats have not all been eliminated, it is sometimes safer to place the bath on a pedestal.

A pool with foundation of concrete sunken in the ground, partially filled with earth and stones and planted with cat-tails, Japanese iris, or other moisture-loving plants, or perhaps with water-lilies and inhabited by a few goldfish, can be made a very interesting feature of any garden, to say nothing of its attractiveness to birds. It is essential, however, that the slope of the sides should be gradual and the water at the edges shallow (see pages 338 and 339).

If one has a brook or natural pond on the place, much can be done, particularly if the bottom of the pond is suitable for the planting of food for ducks. If the lay of the ground is such that a meadow

LUNCHEON FOR TWO

Photo by Louise Birt Baynes

In the midst of a tramp across the winter snow the naturalist halts for a rest and a little lunch, to which he invites a passing bird friend. Cordial relations have already been established, but the repast has not yet been begun (see picture, page 335)

A SANDWICH FOR TWO Photo by Louise Birt Baynes

Having accepted the invitation, the bird settles down to enjoy his meal. The fact that he must share a sandwich with his host does not disturb him, for, like all birds, he is quick to recognize and trust a human friend (see picture, page 334).

or woodland glade may be flooded and a pond thereby installed, there is hardly any limit to the enjoyment that may be derived from a pond of this sort.

ATTRACTING THE WILD DUCK

There is a little woodland glade, containing an acre or so, on my place, an opening in the woods surrounded by red maples, birches, alders, poison sumach, white azalea, high-bush blueberries, etc., which I flooded one winter merely as a safe skating pond for the children in the neighborhood.

Imagine my surprise and delight when one spring day, after the ice had gone out, I discovered there a whole flock of wild wood-ducks, and later during the summer was able to watch a flock of little "flappers," the progeny of a pair of wild black ducks that had bred there. Herons came there, too, and red wings frequented the edge of the pond. From an uninteresting swamp the place had been

THE HOSTESS ENTERTAINS — Photo by Ernest Harold Baynes

"Window boxes are a never-ceasing source of enjoyment. Mr. Ernest Harold Baynes built the first I ever saw, at his home in Meriden, N. H., a particularly attractive one, which has helped him to become intimate with an astonishing variety of birds" (see page 332).

TAKING THE CAKE — Photo by Louise Birt Baynes

This photo shows how responsive birds are to a little attention and how tame they may become. This wild chickadee will enter the house, perch upon his favorite delicacy, and enjoy a meal in no way affrighted by the presence of his human entertainers.

WHAT BIRDS CAN DO

Photo by Joseph H. Dodson

A great-crested flycatcher house, with bluebird, suspended from a pear tree, from which Mr. Dodson last year picked eight bushels of pears with not a worm hole in one, and that notwithstanding the fact that the tree had never been sprayed. A flycatcher is certainly a cheaper investment than a spraying-machine.

"About houses and buildings, particularly those on our farms, the ordinary type of bird-house rather than the hollow log is perhaps more appropriate. Bluebirds, tree-swallows, and house-wrens take to them readily, and if you have a large house on a high pole you may be lucky enough to attract a colony of martins" (see text, page 341).

completely metamorphosed into a very attractive and interesting spot, replete with bird life.

If wild rice can be made to grow, ducks will be sure to come in greater numbers each year, while regular feeding with corn at proper times may prove an additional attraction to whole flocks of ducks during the migration. Tame call-ducks may be introduced, and if there are near-by woods nest boxes for the attraction of the wood-ducks should be put up.

One may even go into the raising of ducks, though this is often both bothersome and expensive, while the simple flooding of a meadow and intelligent planting of its shores is comparatively little trouble.

Mr. Herbert K. Job, State Ornithologist of Connecticut, is having some very interesting experiences on a game preserve in Connecticut, where low-lying areas have been flooded and the wild ducks attracted in increasing numbers each year from miles around (see picture, page 338).

I know of one man in Canada who several years ago fed a small flock of wild geese that chanced to alight in a pond close beside his house. The geese appreciated the treatment so much that they later returned with friends, and have kept it up from year to year until now I believe that he has had at one time several hundred wild geese virtually in his front yard, and in a very exposed

A FLOCK OF MALLARDS AS VISITORS Photo by Dr. John C. Phillips

"If wild rice can be made to grow, ducks will be sure to come in greater numbers each year, while regular feeding with corn at proper times may prove an additional attraction to whole flocks of ducks during the migration. Tame call-ducks may be introduced, and if there are near-by woods, nest-boxes for the attraction of the wood-ducks should be put up" (see page 337).

WILD BLACK DUCK ON A GAME PRESERVE Photo by Herbert K. Job

"Mr. Herbert K. Job, State Ornithologist of Connecticut, is having some very interesting experiences on a game preserve in Connecticut, where low-lying areas have been flooded and the wild ducks attracted in increasing numbers each year from miles around" (see page 337).

SONG-SPARROWS TAKING A BATH Photo by Ernest Harold Baynes

"A pool with foundation of concrete sunken in the ground . . . can be made a very interesting feature of any garden, to say nothing of its attractiveness to birds. It is essential, however, that the slope of the sides should be gradual and the water at the edges shallow" (see page 333).

position at that. They seem absolutely fearless, come and go at will, though only a short distance away are gunners who are waiting to take a crack at them.

Only a few of us have ponds to which geese may be attracted, but the above experiment shows what can be and has been done in the way of attracting and taming locally the shy wild geese.

HOUSES FOR THE BIRDS

Of bird-houses, to be supplied for those birds that nest about buildings or in holes of trees, there seems to be an almost infinite variety; tree stumps, real or artificial, boxes, cottages, houses, large and elaborate mansions, barrel-houses, gourds, flower-pots, tin-cans, shelves, and all kinds of contraptions.

Mr. Ernest Thompson Seton went so far as to construct on his place in Connecticut a huge artificial stump, filled with imitation woodpeckers' holes, etc. He attracted numbers of different kinds of birds and animals, and he seems to have had no end of fun with it. It is not allowed to all of us, however, to be given either the opportunity or the enthusiasm possessed by Mr. Seton.

Of the various kinds of houses space will allow but brief mention. On my own place, which is covered largely with woods, I have used the Berlepsch type of vertical boxes with considerable success. These are simply sections of logs, hollowed out by special machinery in a very particular manner to represent woodpecker cavities, with entrance hole in side of desired diameter, and covered by a wooden cap or roof that may be lifted for purposes of investigation or in order that the nests may be cleaned out from time to time, the whole bolted to an oaken batten, by which they may be fastened to trees (see pages 323 and 325).

These may be obtained in Germany,

A BALTIMORE ORIOLE AFTER A BATH Photo by Ernest Harold Baynes

The Baltimore oriole is remarkable for its bright colors, and to these it owes its name, as the livery of the Lords Baltimore, who founded Maryland, was orange and black of just those tones that the bird exhibits. Cats have been eliminated on this place.

A BROWN THRASHER BATHING Photo by Louise Birt Baynes

"Water, particularly during the summer months or times of drought, is necessary for the birds. If they can't get it on your place, they will be forced to look elsewhere. The proper installment of a drinking fountain or bird bath is a simple affair, and one that is almost sure to prove a great attraction to the birds, as well as a never-failing source of entertainment to the owner" (see text, page 333).

A COLONY OF EAVE SWALLOWS Photo by Fred B. McKechnie

This colony of swallows built their nests beneath the eaves of a barn at Luenburg, Vt. Note the partial support given by the narrow molding. These eave swallows become much attached to their homes, and if undisturbed will return year after year with unfailing regularity.

but are now manufactured by at least two people in this country. Those on my place have been occupied by screech-owls, bluebirds, chickadees, tree-swallows, flickers, white-breasted nuthatches, and great-crested flycatchers. House-wrens, which are very local in our part of the country, have so far avoided them, and I have failed ignominiously to attract either the downy or the hairy woodpeckers, both of which frequent my woods.

One firm makes bird-houses out of natural hollow logs or limbs, a hole bored in the side, and with wooden cap and bottom, while another makes an imitation woodpecker's nest of pottery. The Berlepsch type are, however, in my opinion, far and away ahead of these others.

BIRDS THAT WILL NEST IN PREPARED HOUSES

About houses and buildings, particularly those on our farms, the ordinary type of bird-house rather than the hollow log is perhaps more appropriate. Bluebirds, tree-swallows, and house-wrens take to them readily, and if you have a large house on a high pole you may be lucky enough to attract a colony of martins. Chickadees, great-crested flycatchers, and screech-owls may use these boxes, and the following is a list of birds recorded as having bred in nest boxes of one sort or another:

Wood-duck, sparrow-hawk, screech-owl, flicker, red-headed woodpecker, great-crested flycatcher, starling, Eng-

Photo by Louise Birt Baynes

THE DAINTIEST GUEST

A picture of an inquisitive and very puzzled humming-bird probing an artificial flower

lish sparrow, house-finch, tree and violet green swallow, purple martin, house-wren, Parkman's wren, Bewick's wren, Vigor's wren, and Texas Bewick's wren, white-breasted nuthatch, tufted titmouse, black-capped chickadee, Oregon chickadee, Carolina chickadee, robin, and three varieties of bluebirds—eastern, western, and mountain. To this list the Carolina wren ought probably to be added; though while I do not know personally of any record of its actually building in a bird-box, it builds about houses and in the most unheard of and crazy places.

Robins and phœbes may be encouraged by shelves conveniently placed beneath the roofs of porches, piazzas, and sheds, while the insect-eating barn and eave swallows may often be helped in their choice of nesting sites by a supporting shelf. Vines on trellises or about the piazza posts are attractive nesting sites for chipping sparrows, as well as robins, and I once knew of a bluejay that built in a wistaria vine overhanging a friend's front porch.

One can never tell just what birds are going to do. Crows are reported to have nested in one of the squares in the city of Philadelphia and on Beacon Hill in Boston, while a pair of sparrow-hawks have bred beneath the eaves of the Lawrence Scientific School in Cambridge, Mass.

Chimney swifts should also be encouraged, and when possible the chimneys

MOTHER AND DAUGHTER

Photo by Ernest Harold Baynes

This is a photo of a wild chickadee feeding her young in June. She does not fear in summer the hand that feeds her in winter

Photo by Ernest Harold Baynes

THE BEST KIND OF A BIRD ON A HAT

left open at the top, and so constructed as to admit of their ready occupancy.*

THE ENEMIES OF THE BIRDS

Of bird enemies, cats are undoubtedly the worst, and maudlin sentiment should not be wasted upon them, for they are incorrigible. The plain, ordinary alley cat should be eliminated when possible, and they make fine fertilizers when planted about the roots of one's favorite grape-vine. Cat-possessing neighbors should be warned that if their cats are caught trespassing they will be turned into fertilizer.

Red squirrels are next on the list and should be shot on sight, but I have never found the depredations of the gray squirrel to warrant similar treatment. Bird-chasing dogs are a nuisance and should be restrained during the breeding season.

Skunks and foxes should both be discouraged, and the wily raccoon and elusive weasel also, if perchance they are found to lurk about.

Of the hawks, the cooper and sharp-shinned hawks should both be shot at sight, while of the owls, the great horned is incapable of reform. The little screech-owl is almost always beneficial on account of the numbers of mice it often de-

* One of the most absorbing and interesting books of the present day, replete with information on the above subject, called "Useful Birds and Their Protection," by Edward Howe Forbush, State Ornithologist of Massachusetts, has been published by the Massachusetts Board of Agriculture and may be obtained from them for the sum of $1.00.

stroys, but individual screech-owls are often destructive to bird life.

Crows and jays will bear watching. There seem to be good crows and jays, and then again individuals among them of exceeding bad habits, as many a long-suffering bird family knows to its sorrow.

In many places the English sparrows are pests and should be shot and trapped relentlessly. They are pretty canny birds, and if once they learn you are after them with a gun they quickly desert the premises. If owing to surrounding conditions gunning for them seems undesirable, traps may be used with telling effect. There are several kinds in use in this country.

Last, but not least, the black snake should be killed whenever found; its large size, great activity, tree-climbing propensities, and taste for eggs and small birds have fairly won for it the reputation of being one of the birds' deadliest enemies.

REDEEMING THE TROPICS

By William Joseph Showalter

Author of "Battling with the Panama Slides," "The Countries of the Caribbean," "The Panama Canal," in the National Geographic Magazine

IN THESE days when medical science has been recording one triumph after another over germ-produced diseases, when the germ-hunter in his laboratory has been ascertaining the causes of so many mysterious afflictions and laying the foundations for one preventive measure after another, people all but lose sight of the tremendous debt humanity owes to the expert in experimental medicine and the sanitarian. Indeed, he would be a prescient mathematician who could calculate what the vast amount of this debt is.

It is only when we look back over the records of the past, when civilization was young and humanity without knowledge of the causes of the great epidemic diseases, that we can have a faint appreciation of what the patient man of the microscope has wrought in humanity's behalf.

When we see Naples, in the seventeenth century, as helpless as a new-born babe in the grip of a plague during which 380,000 souls perished in six months; when we see Constantinople, in 1812, with 144,000 deaths; when we see London, in the days of the great plague, with 70,000 of its population carried off; when we go back to China and behold a few short years in the fourteenth century with a "black death" mortality record of 13 million souls, and to Europe, in the great scourge of 1347-1350, and see 25 million people dying; when we come on down the years and see the untold millions who have died from the numerous pestilences which have inflicted death upon mankind; then, and not till then, can we begin to appreciate what it all means.

Even then our appraisal will fall far short of the truth, for in those times the world was, in a sense, larger, the seas were broader, and the distances on land much greater than in these days of highly developed transportation and commerce. How can the mind conceive of the terrible toll epidemic diseases would take today, with our world-wide commerce, with our metropolitan and cosmopolitan cities, and with the constant commingling of the peoples of all lands, were it not for preventive measures?

MAP-CHANGING MEDICINE

Throughout the history of the ages one may read of great changes in the maps of the earth that have resulted on the one hand from the ravages of disease and on the other from the discovery of methods of combatting it.

We see the "glory that was Greece" depart because of the terrible toll exacted by malaria; we see a Panama Canal made possible because of the knowledge of the causation of yellow fever that came to

us through the patient and heroic work of a group of army surgeons; we see cities like Havana and Rio de Janeiro transformed from pest-holes into municipalities where epidemic diseases are under control.

Today thousands, nay millions, of human souls living between Cancer and Capricorn are being freed from the thralldom of those terrible visitations that came periodically only a few years ago. Africa is rising up against the terrible sleeping sickness and the insidious malaria that have made it the "Dark Continent" for generations without number.

Wherever we turn we find places where once a man gambled with death when he visited them being converted into regions where good health conditions exist. Preventive medicine everywhere, and in the tropics in particular, is writing a new geography of inhabitable territory and of commercial opportunity.

Where yesterday the barriers of disease were up against the peaceful and resource-developing invasion of capital and enterprise, there today is found health and happiness and prosperity. Where yesterday a man going to the tropics, even for a short stay, was bidden good-bye by his friends as one who stood an even chance of never returning, today men and women go there for long periods; and in some places are quite as safe as at home, and in hundreds of others only a little less so.

HOW IT ALL HAPPENED

Truly the story of how all this has been brought about is the world's most splendid exemplification of the proverb that truth is stranger than fiction. For hundreds of years man stood helpless and appalled in the face of the onset of great epidemics. He saw millions of his fellow-beings visited with deaths more horrible than ever torture chamber could invent, but not knowing whence the affliction came or whither it went. He surmised and guessed, and finally saw a certain relation between dirt and disease, and gradually the elimination of dirt checked the ravages of some epidemic diseases.

Then came the microscope with its discovery of infinitesimal worlds, and with it Pasteur and his discovery of the relation between bacteria and disease. One by one new germs were discovered, and soon medical men came to understand the methods of the transmission of most of the epidemic diseases of temperate climates.

Still no one knew the cause of the epidemic diseases most characteristic of the tropics, and without this knowledge no satisfactory superstructure of preventive tropical medicine could be reared. Tropical humanity was attacked by myriads of enemies so subtle that men did not know even that they existed, and yet so terrible that the carnage of the world's battlefields paled in comparison.

For centuries on end men had been seeking after the truth of the causation of yellow fever, bubonic plague, sleeping sickness, and allied diseases. Some of them had nearly guessed it. Sir Henry Blake tells of having seen a medical work in Ceylon, some 1,400 years old, which charged the mosquito with being a carrier of malaria. The word canopy itself was brought into the language from a Greek word meaning gnat.

WHY THE CAT WAS WORSHIPED

There were many strangely close guesses at the cause of disease in the early history of the human race. Far back in Egyptian history the people came so near to guessing the cause of plague that they made the cat a sacred animal. They noticed that where there were cats there was no bubonic plague, and if they had only stopped to think a little further they might have seen that where there were cats the rats were scarce. But this relation did not strike them, so they went on worshipping the cat, and thinking that it was the animal's supernatural power that saved them from contracting plague.

The honor of having written the first modern work charging the mosquito with being a responsible agent in the spread of yellow and malarial fevers belongs to an American, Dr. Nott, of Mobile, Alabama. In 1848 he published a treatise upon yellow fever in which he charged the mosquito with the crime of spreading these diseases. A little later Dr. Louis Beauperthuy, studying an epidemic of yellow fever in Venezuela, also laid the

FIGHTING THE PANAMA MOSQUITO WITH OIL

These sanitary drip-barrels automatically spread oil, drop by drop, over pools, streams, and marshy places, thereby preventing the mosquito from breeding in the water. "He (Ross) proved beyond any peradventure that the Anopheles mosquito is the intermediate host, and that no one can contract malaria except he be bitten by a mosquito which has previously bitten a person suffering from that disease" (see page 347).

blame upon the mosquito, and charged that it introduced a poison similar to snake venom into the human system through the biting process.

Step by step a closer approach to the truth was made, and in 1883 Sir Patrick Manson demonstrated that the mosquito was the intermediate host of the blood parasite *filaria*.

But it was not until Sir Ronald Ross arrived upon the scene with his investigations that the real truth of the principle of insect-borne diseases came to be understood. Prior to this Laveran had succeeded in isolating the germ of malaria; and, building upon this foundation, Ross labored to ascertain the exact relation between man and the mosquito.

His efforts were rewarded with success. He proved beyond every peradventure that the Anopheles mosquito is the intermediate host, and that no one can contract malaria except he be bitten by a mosquito which has previously bitten a person suffering from that disease.

In telling of his achievement, Ross declared: "The exact route of infection of this great disease, which annually slays its millions of human beings and keeps whole continents in darkness, was revealed. The minute spores enter the salivary gland of the mosquitoes and pass with its poisonous saliva directly into the blood of man. Never in our dreams had we imagined so wonderful a tale as this."

But even Ross little dreamed when he made his great discovery that the wonderful tale his astute mind had unfolded was to be but the beginning of a long series of related discoveries which would end entirely humanity's helplessness in the face of epidemic diseases.

The medical world had hardly ceased to wonder at the work of Ross when Reed, Carroll, and Lazear, of the U. S. Army Medical Corps, proved—Lazear at the cost of his life and Carroll at the cost of a severe spell of yellow fever—that the Stegomyia mosquito plays the same role with yellow jack that the Anopheles does with malaria.

HOW MOSQUITOS, RATS, AND FLIES SPREAD DISEASE

Then came others with their discoveries that bubonic plague is transmitted by fleas carried on rats and ground-squirrels; that sleeping sickness is carried and transmitted only by the tsetse-fly; that dengue is carried by other species of mosquitoes, and more recently that the body louse is the culprit which carries typhus from man to man.

Likewise has our increasing knowledge of the principles of the spread of typhoid fever led us to the point where the only reason we contract it is because some one has been careless with the excreta that comes from persons having typhoid in their systems. We know that milk is a frequent vehicle of infection. We know, through the researches of Dr. Howard and his associates, that the house-fly, which he has christened the "typhoid fly," constantly furnishes free transportation for germs that are seeking an entrance to some human system. We know how much water has to do with its dissemination, from the fact that in cities in Europe where there is a perfect water supply the number of cases is seldom above ten per hundred thousand people, and in America seldom above twenty per hundred thousand, while in cities where there is impure tap water the rate goes up to two hundred and even three hundred per hundred thousand population. It has come now to be accepted by sanitarians that in any average city of considerable population and ordinary sanitary regulations all sickness from typhoid fever over twenty cases per hundred thousand inhabitants is attributable to the water.

How much the fly has to do with the spread of the disease is illustrated by the experience of the army encampment at Jacksonville during the Spanish-American War. The lime that was carried on the feet of the flies from the latrines to the mess-tables showed that nearly all of the hundreds of cases of typhoid that infested the camp were caused by germs carried to the food of the men from the latrines. The fly has been caught red handed in divers instances. Some of them have been permitted to walk over infected material and then to walk over culture plates. In every case almost every point on which they set their feet brought forth a colony of typhoid germs. In other cases flies have been caught and given a bath in sterile water, with the result that a single bath has brought a hundred thousand germs from the body and legs of one fly.

THE SAD HISTORY OF "TYPHOID MARY"

There is one class of people who are a permanent menace to humanity. About 2½ per cent of those who contract typhoid fever live to become germ carriers. The germs like them so well that they agree to dwell in peace and harmony with their hosts; but as they go about they spread a trail of typhoid fever. An illustration of this is to be had in the case of that celebrated woman, "Typhoid Mary." She had suffered an attack of

typhoid fever, but got well. Then she returned to her duties as a cook. Six cases of the disease broke out in the family, and she left and was lost sight of for a long time. Although Dr. Soper tried to trace her, it was not until a long time afterward that she was found—this time in service in a family in a small town in New Jersey. Then her history was traced, and it was found that during the time between her two appearances she had cooked in five other homes, and in each and every one she gave the inmates the disease—27 cases in all.

TYPHOID VACCINATION

But while all sorts of prevention in the line of sanitation help to check the spread of the disease, the final blow was given to it by the discovery of the principle of inoculation for typhoid. The germs of typhoid are grown in beef broth, and when they number millions for every thimbleful of the broth they are killed by the application of heat. The dead germs are then injected into the blood with a hyporderme syringe, and three doses of these dead germs are nearly always enough to make the body immune from the invasion of live germs; perhaps because they do not like to dwell amid the sepulchers of their race.

The success of vaccination for typhoid has been remarkable. In the history of hundreds of thousands of cases only a third as many vaccinated people have contracted the disease as unvaccinated people. Furthermore, the disease terminates fatally only a third as many times with vaccinated people as with unvaccinated ones. In other words, vaccination against typhoid divides the chances of dying from the disease by twelve.

Typhoid fever, however, is not so much of a tropical scourge. It does flourish in semi-tropical countries and among white people who go to the tropics. The natives seem to be rather immune from it, mayhap because the typhoid germ refuses to dwell in the same body with amœbic dysentery germs, with which so many tropical people are afflicted. But the lessons which our studies of the principles of the spread of typhoid fever have taught us fit in so beautifully in tropical campaigns to master dysentery and cholera that they are almost as serviceable in the tropics as they are in the temperate zones. The fly carries the germ of cholera and of dysentery just as it carries the germ of typhoid. These germs use the same vehicles and travel in the same general way from the intestines of one person to the mouth of another.

The sum of all of these discoveries is that they place in the hands of mankind the power to overcome the most terrible diseases with which the tropical world has been afflicted.

CAPITALIZING THE DISCOVERIES

And now, having looked far into the past to see the vast need there has been for such discoveries, and into recent history to learn something of how they were made, let us journey around the tropical world today and see how they are being applied.

Of course, we go first to Panama, for there they are being applied on a scale that is extensive and with a thoroughness that shows the possibilities of such application. Indeed, no factor for putting the new science of tropical medicine to the most rigid test is wanting there.

Before the United States took control and Colonel Gorgas began to apply the lessons that had been learned in Cuba, yellow fever was endemic, malaria almost universal, bubonic plague not exceptional, and smallpox not infrequent in its occurrence. Things had been so bad that they defeated the French in their efforts to dig the Panama Canal, and when the despair of the bubble-burst boom days settled like a night over the wrecked hopes of the French failure, conditions grew even worse.

Colon was a swampy mire of filth which bade warm welcome to every germ that came along, and extended hearty hospitality to every mosquito and flea that traveled that way, bidding them all to "be fruitful and multiply"—an invitation as heartily and as appreciatively accepted as it was extended.

Panama offered a haven to every disease borne upon the wings of commerce. The water-carriers who peddled water from contaminated springs became the

Photo from American Red Cross Bulletin

THE PLAGUE IN CHINA

American Red Cross Relief Corps, showing method of protection against infection. The variety of plague during this epidemic was that known as pneumonic, and to guard against infection, both the skin and the air passages, such as the mouth and nostrils, had to be closely covered with antiseptic wrappings.

allies of suffering, and the result was a death rate of vast proportions. Stretching across the country between the two cities lay a vast expanse of untamed jungle and undrained swamp that was a paradise to the mosquito world. And then the masses of the people were hopelessly ignorant of all things sanitary and as careless as they were ignorant.

To add to the unlovely state of affairs, the ships that came in from South and Central America carried diseases with them. And so it was that one might look over the entire tropical world in vain for a place to put the new science to a severer test.

The United States was not willing to undertake the sanitation of the Canal Zone without including Panama and Colon as a part of the sanitary district, and so it was insisted that Uncle Sam should have perpetual sanitary control over the two major cities of the Isthmian republic, and Panama agreed.

After the international problems were settled Colonel Gorgas and his aides got busy. They built for Panama and Colon up-to-date sewer and water systems, the cost thereof to be returned to the United States in small annual payments. They cut down 16 million square yards of brush a year, drained a million square yards of swamps, cut 30 million square yards of grass, maintained nearly three million feet of ditches, emptied 300,000 night-soil cans and a million garbage cans, fumigated 11 million cubic feet of residential space, and did other things in proportion in the Canal Zone and in equal proportion in the two terminal cities.

THE MOSQUITO IN THE COURT OF APPEAL

For awhile the rigid methods of the Sanitary Department met with success, and the morbidity and mortality rates both showed a remarkable decline. But then came an epidemic of yellow fever.

The mosquito, tried and convicted in the researches of Ross and Reed, and with that sentence confirmed by the sanitary work in Cuba and elsewhere, now came to appeal to its final court for a reversal of judgment. He claimed an alibi, and he proved to the minds of thousands that he was not responsible. Hundreds tore off the screens from their houses and thousands pronounced the criminal a maligned individual. Indeed, the revulsion of sentiment went so far that men in the highest places were lining up on the side of the mosquito.

But Colonel Gorgas remained firm, and finally former Governor Magoon came upon the scene to back him up, and to give him a chance, as the counsel for the prosecution, to prove again the guilt of the accused. For three months the trial went on, and as soon as the yellow-fever mosquito was banished the epidemic terminated, and Colonel Gorgas was able to offer $50 for each yellow-fever mosquito that could be brought him. Thus for the last time in all medical history the mosquito had his day in court and was finally and forever pronounced a creature beyond the pale of the law.

Rats and mice came in for the same stern measures of repression, and the result has been that where yesterday the grim specter of death held Panama as a favorite abode, today it has to seek other regions for its preferred haunts. Where, at the beginning of our work at Panama, all the dangerous diseases in the catalogue held high carnival and gave little heed to the despair of the people, today one may see there a sort of combination between a national tropical park and an international tropical health resort.

Every possible difficulty in the way of the accomplishment of this end was encountered when the work began, and the triumph has been as inspiring as the situation seemed hopeless.

THE VICTORY OVER YELLOW JACK

What the United States has done in Panama is no more than might have been expected in the light of what it had done in Cuba. There Colonel Gorgas, with the support of Gen. Leonard Wood, faced a terrible yellow-fever situation. In 47 years more than 35,000 residents of Havana alone had died of yellow jack. In a year or two yellow fever was banished from the island, bubonic plague was gotten rid of, and smallpox came under control.

The experience of Cuba and Panama has been duplicated throughout the tropical world wherever the lessons of those sanitary triumphs have been enforced with proper vigor.

Consider Brazil, which in times past had come to be regarded as the natural habitat of yellow fever. In the year following the discovery of the mosquito's part in the transmission of that disease, there were 35,000 deaths from it. The wonderful influx of young men from the outside world, the "conquistadors of a new era of commerce," was about to be checked and the development of the great tropical republic set back for years. But Brazil would not have it so.

Rio got busy, a perennial clean-up day was ordered, and where, in its harbor, ships once had rotted because their crews had died from yellow fever and none could be secured to replace them, there soon was not a case to be found. Thus Rio, Santos, and other Brazilian cities have become health resorts by contrast.

THE FIGHT AGAINST MALARIA

What has happened with yellow fever has not happened with malaria simply because the world does not dread it as much and will not make the thorough fight against it that has been made against yellow jack; and yet malaria has been a greater curse to humanity through more centuries than yellow fever has ever been.

Where yellow fever has slain its hundreds, malaria has slain its thousands. It has not visited mankind as a grim messenger, smiting whole nations today, and tomorrow disappearing; rather its onset has been so gentle and its reign so persistent and so general that the public mind has never been wrought to the pitch necessary to its eradication.

The fact that it results in less direct suffering and fewer proportionate direct fatalities than yellow fever has held the fears of the people in check and has permitted malaria to remain endemic in al-

Photo from A. W. Cutler

PRIMITIVE SANITATION: BUZZARDS AT VERA CRUZ FOLLOWING A SCAVENGER'S CART

These birds are protected by law and may be seen strutting sedately about the streets in every direction. They are largely responsible for the present excellent sanitary condition of Vera Cruz, now looked upon by the Mexicans as a health resort.

most every country in the world. It plies its nefarious trade day in and day out, year in and year out, killing its millions of souls, some directly, but more through undermined constitutions which have permitted other diseases to be written upon the death registers.

We do not have to travel to the tropics to see humanity living in close contact with the malarial mosquito and apparently indifferent to the ravages of the disease. Dr. L. O. Howard, perhaps America's foremost authority in economic entomology, estimates that the financial loss inflicted at home upon the people of the United States by malaria amounts to a hundred million dollars a year.

Sir Ronald Ross gives an idea of the extent, economic consequences, and geographical influence of malaria when he says that it "is important not only because of the misery it inflicts upon mankind, but because of the serious opposition which it has given to the march of civilization in the tropics. Unlike many diseases, it is essentially endemic, a local malady, and one which unfortunately haunts more especially the fertile, well-watered, and luxuriant tracts—precisely those of greatest value to man. There it strikes down not only the barbaric indigenous population, but, with still greater certainty, the pioneer of civilization, the planter, the trader, the missionary, and the soldier.

"It is therefore the principal and gigantic ally of barbarism. No wild deserts, no savage races, no geographical difficulties, have proved so inimical to civilization as this disease. We may say that it has withheld an entire continent from humanity—the immense and fertile tracts of Africa; what we call the Dark Continent we should call the Malarious Continent; and for centuries the successive waves of civilization which have flooded and fertilized Europe and America have broken themselves in vain upon its deadly shores."

Africa affords no statistics of the widespread prevalence of malaria, but in India, which at its worst is better than Africa, nearly five million souls died of fevers in a single year recently, and the

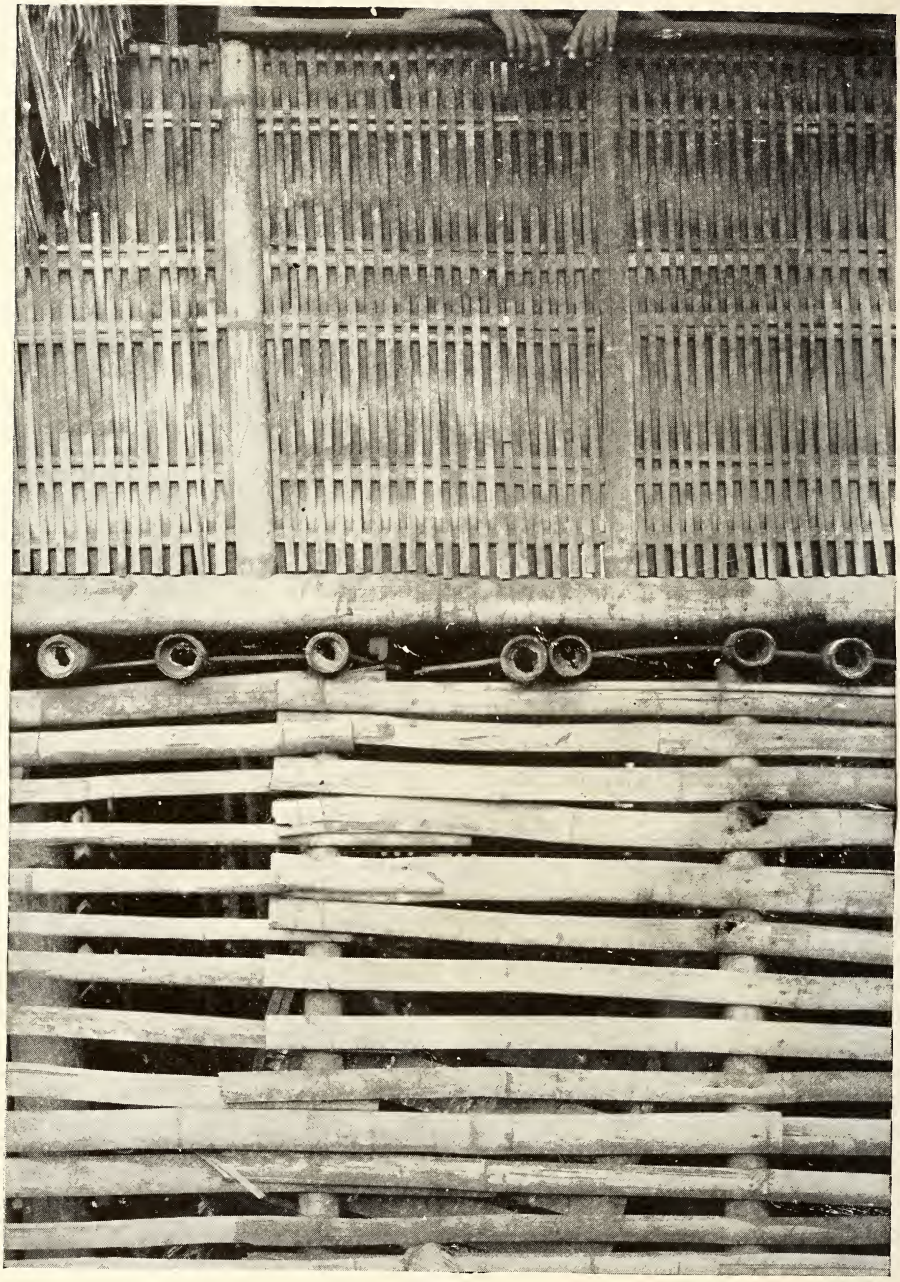


Photo from Bureau of Insular Affairs

A SOURCE OF PLAGUE INFECTION

These holes in the bamboo house-supports in Manila were found to afford shelter and nesting-places for rats, and so became dangerous to the public health of the city, for bubonic plague is transmitted by fleas carried on rats. How this danger was removed is shown in the picture on page 354.

majority must have been directly or indirectly victims of malaria.

But where steps as stern against malaria are taken as are required for the eradication of yellow fever, the results are magnificent. In Italy an anti-malarial campaign cut down the number of deaths from 16,000 a year to 4,000. In Greece, on the plains of Marathon, in 1906, 90 per cent of the sickness was due to malaria; in 1908 only 2 per cent of the sickness was due to it.

The wonderful results attained in fighting malaria at Ismailia, on the Suez Canal, surpasses anything that has been done in any part of the world. In 1900 there were 2,284 cases of malaria in that town. Sir Ronald Ross was called there to consider methods of banishing the disease, and laid out a program in that direction. In 1901 the number of cases fell to 1,990; in 1902 to 1,551; in 1904 to 90; in 1905 to 37. Since that time there have been no cases reported except such as were infected before visiting Ismailia. The malarial mosquito was absolutely exterminated there—something which probably has not been done in any other part of the earth.

One might go on indefinitely citing cases where cities and districts have arisen in their might to put an end to malaria and with magic results.

HOOKWORM DISEASE VANQUISHED

If vast consequences have grown out of the solution of the mysteries of yellow fever and malaria, they are probably no greater than are destined to come to the people of tropic and semi-tropic regions through the mastery of the hookworm.

Around the earth there stretches a belt 66 degrees wide, embracing 47 countries and an area of 15 million square miles, in which there lives a population of nearly a billion people. This belt is the hookworm belt of the world. How many cases of this distressing and strength-wrecking disease there are in this vast territory cannot be estimated with any degree of approximation.

In 1904 some 90 out of every 100 of the working population of Porto Rico had the disease. In Colombia 90 per cent of the people living between sea-level and the 3,000-foot level were suffering from it. Fifty per cent of the people in British Guiana are said to be afflicted. Not less than 1,800,000 of the people of India are reported as having the disease, and in the southern part of China it is estimated that three out of four people are sufferers.

The economic loss involved is beyond estimate. In Porto Rico the physically sound coffee-picker picks from 500 to 600 measures of coffee a day; scores of those suffering from hookworm disease can pick only from 100 to 250 measures a day. In some regions it is estimated that not more than 33 per cent of the natural efficiency of any force of men can be exercised because of the terrible problem of hookworm disease.

Yet hookworm disease is about the most easily mastered of all the diseases in the category. Its cause is easily demonstrable to the laymen, even to the ignorant layman, because he can see, without the aid of a microscope, the little hair-line worms that cause it. Its spread is easily checked, because the wearing of shoes and a little care against soil pollution is all that is demanded.

A SIMPLE AND EASY CURE

It is easily cured, because in most cases simply a dose of epsom salts, followed by a dose of thymol, and that in turn by another dose of salts, is effective. Thymol is made from the thyme of the garden, and is just about as simple and as harmless in its action as the epsom salts. If the first treatment does not answer, the second one usually will. Furthermore, the disease is one that lends itself admirably to the getting of quick results. It converts a lazy, sickly, good-for-nothing boy or girl into a sprightly, energetic one in the course of a few weeks.

That has been the secret of a major portion of the success of the Rockefeller Sanitary Commission in its work of ridding the South from the disease. The results were so striking that the States and the counties were glad to help along the task. Tens of thousands of so-called "poor white trash" have been cured of it,

Photo from Bureau of Insular Affairs

PREVENTING PLAGUE IN MANILA

In order to guard against infection spread by rats, the sanitary authorities of Manila organized a special corps whose duty was to seal with cement all openings which could serve as rat refuges. Compare photo on page 352.

and the results are so visible that the work is spreading everywhere. The fight of the commission and its forces is to establish sanitary privies in the country, and to teach the children and their parents that either the prevention of soil pollution or the wearing of shoes will prevent the disease, and that both together insures one against it.

The remaining problem is one of getting the people who have the disease to take the salts-thymol course of medicine. In Porto Rico, Dr. Bailey K. Ashford and his associates have cured well nigh half a million cases, and the work is still going on to the extent of some twenty thousand cases a year.

The entire work of Dr. Ashford in Porto Rico has been a wonderful success. He went there with a death rate as high as that at Panama. The people were hopelessly ignorant, wholly indifferent to sanitation, and without a single idea of the cause of ordinary diseases that are contracted by infection. But with all that, the principles of sanitary science that were laid down in Cuba triumphed in Porto Rico as brilliantly as they have triumphed anywhere else in the world. Notwithstanding the fact that they were handicapped for funds and had hookworm disease added to their list of troubles, Dr. Ashford and his aides were able to bring about a death rate that is lower than that of Panama itself today.

WONDERFUL RESULTS IN THE PHILIPPINES

What happened in Porto Rico finds something of a counterpart in the Philippines. When the Americans took possession of Manila the death rate averaged 46.11 a thousand during a period of four years. By strenuous work and a faithful adherence to the principles of sanitation there were laid down in Cuba, the death rate has been forced down until it is now about 35 per thousand.

A death rate reduced in the same proportion in the United States, with our present population, would mean a saving of 1,100,000 lives annually in this country. They were able over there to make a showing of a death rate of only 4.84 per thousand among the employees of the Philippine government. They had cholera knocking at their doors all the time and several times running past their defenses. But they have kept hammering away year in and year out, and have set a record in public sanitation there that is a fit companion-piece to the work at Panama and Porto Rico.

They have cut down the number of new cases of leprosy each year from 700 to 200, and have reduced the number of lepers in the island from 5,000 to 2,000. They had a hand in proving that beriberi is a disease caused by a prolonged diet of polished rice. The phosphorous in the pericarp of the rice is needed by the system and its absence is responsible for the disease. Chickens fed constantly on polished rice contract the disease, while those fed upon unhulled rice never do. But perhaps the most striking achievement in the Philippines has been the practical abolition of smallpox. When we went into the Philippines there were 40,000 deaths a year from the disease, where today there are only about 300 a year. Vaccination triumphed.

THE NEW ERA

Throughout the latitudes where insect-borne diseases reign a new sentiment has arisen which promises, under the stress of persistent campaigns of education, to sink deep into the public mind. Its motto is the banishment of these diseases.

The fundamental principles of the fight are expressively laid down in simple terms like these: "No mosquitoes, no malaria, no yellow fever, no dengue. No fleas, no bubonic plague; no lice, no typhus; no tsetse fly, no sleeping sickness; no ticks, no spotted fever." Wherever governments have power to get back of these campaigns and compel the people willy-nilly to adopt the proper measures, remarkable results can be obtained.

Not only does sanitary science open up the tropics for the benefit of man himself, but for his domestic animals as well. When the United States took over the Philippines there had been introduced a terrible epidemic among cattle, carabao, and horses. The disease promptly was diagnosed as the terrible rinderpest. It killed untold thousands of head of horses, cattle, and carabao, in some places nine out of every ten dying from the disease.

Photo from Catholic Foreign Missionary Society of America

MISSIONARIES FIGHTING THE PLAGUE

"When we see Naples, in the seventeenth century, as helpless as a new-born babe in the grip of a plague during which 380,000 souls perished in six months; when we see Constantinople, in 1812, with 144,000 deaths; when we see London, in the days of the great plague, with 70,000 of its population carried off; when we go back to China and behold a few short years in the fourteenth century [illegible]

Prompt restrictive measures were taken, a quarantine was set up, vaccination against the disease was resorted to, and 10,000 carabao were imported from Asia to take the places of the ones the small farmers had lost. All these measures promptly served to put an end to the epidemic and the Philippines were once more safe from a live-stock famine.

With the mastery of the secrets of the tsete fly and its fatal bite on live stock, England has set out to render Africa inhabitable to horses and cattle wherever the English flag floats over it. Anthrax fever is going the same way, as is the fever caused by the cattle tick. Perhaps as much has been done in the direction of rendering the tropics habitable to our domestic animals as has been done for ourselves.

In the generations to come, there can be no doubt that with a sanitary science that is broad enough to reach both man and beast, the great plains of the highlands in the tropics will be converted into vast cattle ranches, where cattle can be brought to the stock cattle stage and then shipped to the temperate climates for feeding and finishing, thus adding to the world's meat supply to the extent of billions of pounds.

THE ECONOMIC VALUE OF THE CHANGE

The discoveries that have brought about this era of control of tropical diseases have a deeper significance than would appear upon the surface. Not only do they bring health and at least a greater degree of happiness to the hundreds of millions of human beings who live in the tropics, but also to the overcrowded temperate zones a prospective relief from the great food shortages that have been impending.

We find the price of meat growing higher every year as the grazing areas of the beef-producing countries have been encroached upon for farming purposes. Each generation finds the corn and the wheat areas of the world growing smaller in proportion to its population, and it has become evident that if humanity is to continue to be well fed it must look to the tropics.

Here, indeed, lies the hope of the world's future food supply. Untold millions of tons of provender might be raised where now dense jungles of unprofitable vegetation grow. What the United Fruit Company has done with the banana may be repeated with innumerable crops. Banana flour might take the place of wheat flour, and so on down through the category.

Meanwhile, with the restrictions imposed by disease removed, tides of immigration might set into the tropics, populating them with people who would cease to be a drain upon the food supplies of the temperate zones and become, on the contrary, contributors thereto. Tropical deserts may be irrigated, tropical swamps drained, tropical jungles tamed, and millions of acres of the richest land on earth added to the productive areas which feed and clothe the world. These times are coming not rapidly, but with a stride certain and inevitable as the world's population is increasing.

And what benefits they must bring to the race! New blood in the tropics is needed. The suns of centuries have burned out much of the initiative, the easy methods of gaining a livelihood have taken out much of the thrift, and the lazy ways of the tropics have eliminated much of the natural love of cleanliness of the people. New blood coming in may change these things to a very appreciable degree, and an even newer and better era of public health may ensue.

A CALL TO DUTY

When one contemplates what the heroes of medical science have made possible, and reflects that they have put into the hands of humanity powerful weapons of knowledge with which to combat our most deadly diseases, he cannot avoid feeling that their efforts will have been partially in vain unless all humanity is induced to aid in the work of capitalizing them.

The world's death rate is probably about thirty per thousand. He who clips just one from that thirty saves more than a million and a half of lives a year. In a single quarter of a century the United States clipped five from its death rate, and if the world could only do as well in the next quarter of a century as the

United States has in the past 25 years, a population equal to that of the Republic of China might be saved from premature graves.

Surely such consequences challenge the support of all mankind, and call for an army of volunteers who will go out into the world and preach to the people that cleanliness is next to godliness, and if it lacks the power to produce life, it possesses the power to prolong it. Such a campaign would be fraught with enormous economic, geographic, and humanistic consequences, but it would require long years of patient work. For if we in this enlightened America, with our boasted universal education and our splendid free institutions, cannot successfully combat such barbaric and unnecessary diseases as tuberculosis and typhoid fever, it certainly would be too much to expect that the ignorant masses of the tropical regions would accept and live up to these preachings in a few months.

There is one redeeming feature about the governments which lie within the tropics. While in America the people order the government to do and it is done, in the tropics the government orders the people to do and it is done. Whatever else free institutions bring in the way of blessings, they do not yield the same prompt results in protecting the public health that we find when tropical governments decide to act. And therein lies the most hopeful note in the movement, now a little more than a decade old, for banishing epidemic disease from the tropics.

A MEXICAN INDIAN HOME

Photo from A. W. Cutler

Typical family of Tehuana Indians at Tehuantepec, Mexico. The sides of the hut are made of a reed and the roof is of red tile. The naked boy is very typical, as also is the pig

PRIMITIVE BUT HAPPY

Photo from A. W. Cutler

How the little Mexican Indian children play around the wooden-barred windows down at Tehuantepec. Tehuantepec is in the State of Oaxaca, about 60 miles from the border of Guatemala.

A LAMP-SHADE HEAD-DRESS

Photo from A. W. Cutler

A front and rear view of the famous head-dress worn only by the Tehuana Indians of Mexico

A TEHUANA INDIAN BELLE

Photo from A. W. Cutler

The curious head-dress is worn by the Tehuana Indians of Tehuantepec, Mexico. It consists of a huge fan-shaped mass of stiffly starched ribbons and lace

THE ORPHANS HAVE THEIR NAP

Photo from A. W. Cutler

Daily *siesta* of the little ones at La Beneficencia, one of the orphan asylums of Mexico. Mats are laid on the red-tiled floor of a cool corridor for this purpose

Photo from A. W. Cutler

TRAVELING IN STATE: A SCENE IN THE QUAINT OLD INDIAN TOWN OF TEHUANTEPEC, MEXICO

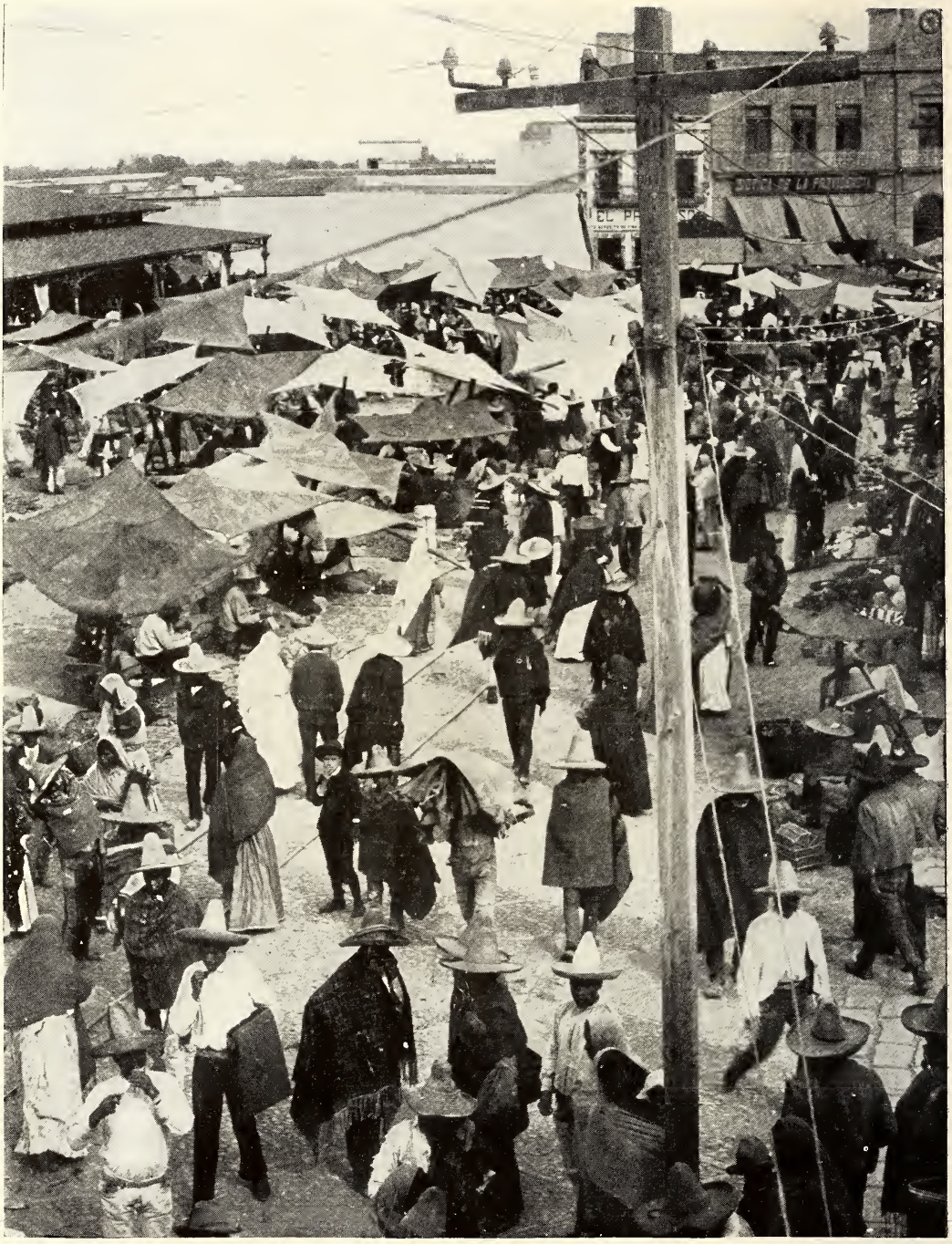


Photo and copyright by Underwood & Underwood

A BUSY MART: A SCENE IN THE MARKET SQUARE IN MEXICO CITY ON AN ORDINARY MORNING

Most of the foodstuffs, such as vegetables, butter, fruit, and poultry, were brought to this market by farmers to supply the city. Note the high-crowned straw hats and the blankets used as overcoats.

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THE NATIONAL GEOGRAPHIC MAGAZINE

CASTLES IN THE AIR

Experiences and Journeys in Unknown Bhutan

BY JOHN CLAUDE WHITE, C. I. E.

LATE POLITICAL OFFICER IN CHARGE OF SIKKIM, BHUTAN, AND SUCH PARTS OF TIBET AS FELL WITHIN THE SPHERE OF BRITISH INFLUENCE.
AUTHOR OF "SIKKIM AND BHUTAN"

With Photographs by the Author

IT HAS been my good fortune to have had exceptional facilities for exploring the hitherto very little known, but most interesting, native state of Bhutan, which lies in the heart of the Himalaya Mountains, on their southern slopes, about 250 miles northeast of Calcutta (for map see page 457).

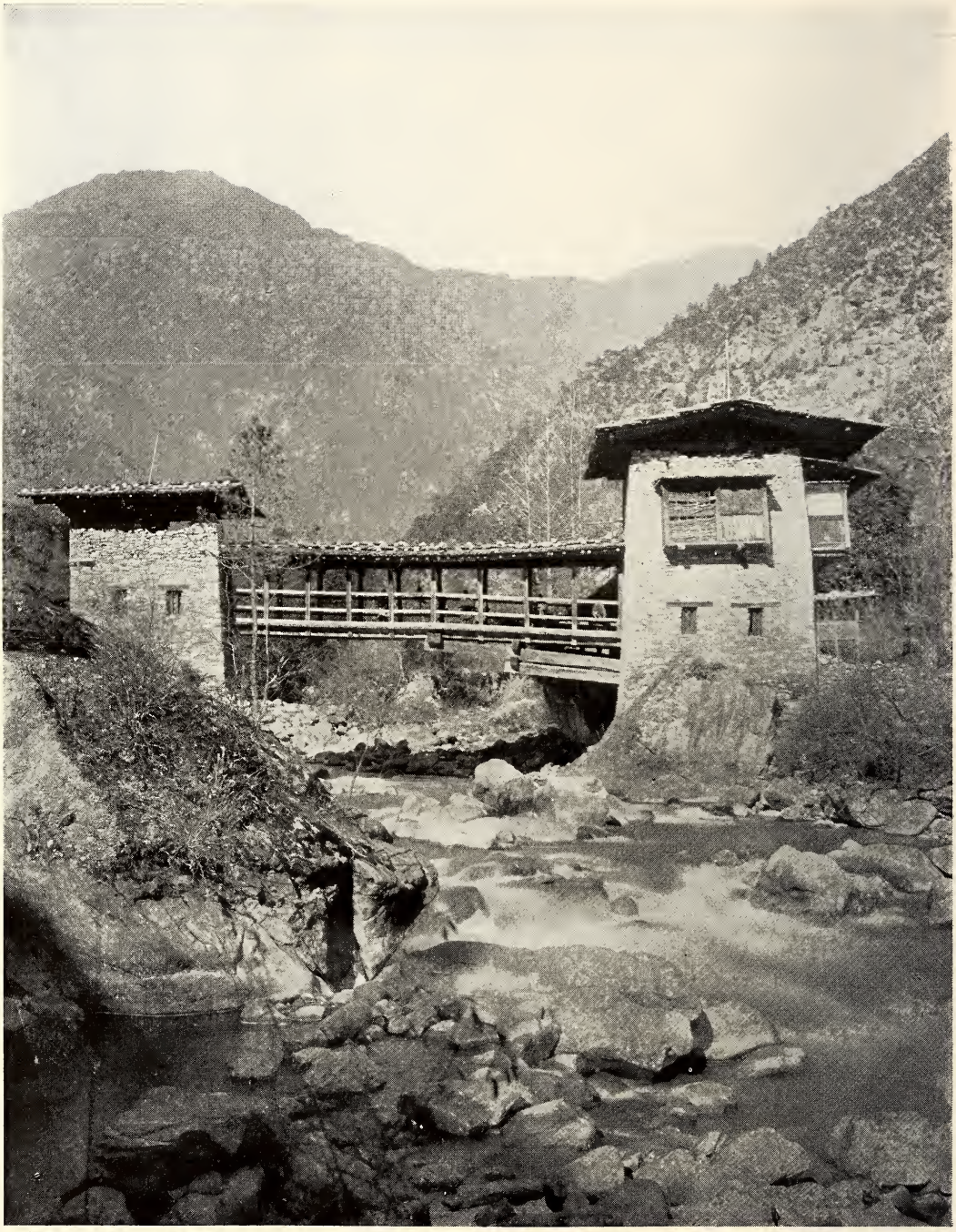
Though naturally an unruly and turbulent country, there had been no raids into British territory for many years, owing to the good government and strength of character of the present ruler, now Maharaja Sir Ugyen Wang-chuk, K. C. S. I., K. C. I. E. By correspondence I had kept up the friendly intercourse begun by my predecessor and friend, the late Mr. A. W. Paul, and on meeting Sir Ugyen for the first time in the Chumbi Valley, at time of the Lhasa Expedition, our acquaintance ripened into firm friendship on both sides.

He extended to me a most pressing invitation to visit his country, and when I was able to do so, a little later on, he gave me every possible assistance, and consequently during the several journeys I made there I was enabled to see everything of interest and to gather information otherwise impossible to procure. Sir Ugyen, his council, the Deb Raja, and all the lamas (monks) combined to make my visits both most interesting and enjoyable and treated me royally throughout.*

*The first of my journeys into Bhutan was toward the end of 1905, when I made my way down the Am-mo-chu Valley from Chumbi to the plains of India. In the following spring I was sent by the government of India to present the insignia of a Knight Commander of the Indian Empire to the Tongsa Penlop, and to do this I traveled from my headquarters, the residency at Gangtok, in Sikkim, crossing the Natu-la Pass to Chumbi via Hah, Paro, Tashi-cho-jong to Poonakha, and on to Tongsa and Byagha, and on my return journey from Tashi-cho-jong northward up the valley of the Tchin-chu into Tibet.

On another occasion I marched along the boundary between British India and Bhutan and from Dorunga across the Dangna-chu to Kanga and up the Kuru River. In the same year I also traveled from Dewangiri through Chungkar, Tashi-gong, Tashiyangtsi, across the Dong-la to Lhuntsi; Pangkha, Singhi-jong, and across the Bad-la into Tibet.

In 1907 a formal intimation was conveyed to the government of India that Sir Ugyen Wang-chuk, K. C. I. E., the Tongsa Penlop, was about to be installed as *gyalpo* (king), or Maharaja of Bhutan, and this was accompanied by a pressing invitation that I should personally be present, and to my great gratification I was deputed head of a mission representing the government of India at the ceremony. The mission traveled through Phari, in the Chumbi Valley, across the Temo-la to Paro, and by my old route to Poonakha, and then leaving my escort and companions I returned by a new and unknown route via Bite Jong and Dungna-Jong to Jaigoan, in the plains of India (see map, page 457).



THE FIRST LARGE BRIDGE WE CROSSED AFTER ENTERING BHUTAN

It is built of squared pine logs, on the cantilever principle. A wooden shingle roof protects the timber from the elements and the ends are guarded by blockhouses. The cold was so great that this rushing torrent was frozen in a single night (see text, page 370).

A FROZEN WATERFALL NEAR GOUTSA: ELEVATION, 13,000 FEET, AND ABOVE TREE-LEVEL

This shows how intense the cold can be in these mountains. The surrounding hills are a favorite haunt of Burhel Ovis Nahura. Note yaks grazing in the foreground

THE FORTRESS OF DUG-GYE JONG, MAGNIFICENTLY SITUATED AMONG IDEAL SCENERY, ON A SPUR RUNNING INTO AND COMMANDING THE VALLEY. IT WAS ORIGINALLY BUILT TO PROTECT THIS ROUTE FROM POSSIBLE TIBETAN RAIDS (SEE PAGE 370)

It is impossible to find words to express adequately the wonderful beauty and variety of scenery I met with during my journeys, the grandeur of the magnificent snow peaks, and the picturesqueness and charm of the many wonderful jongs, or forts, and other buildings I came across; but I hope my photographs may give my readers some idea of what I saw.

A SPLENDID RACE

The Bhutanese are fine, tall, well-developed men, with an open, honest cast of face, and the women are comely, clean, and well dressed and excellent housekeepers and managers. Their religion is Buddhism and their language a dialect of Tibetan. The population of Bhutan is about 400,000.

My experience of the people is that they are universally polite, civil, and clean, and during the whole time I spent in the country I only saw one drunken man. I had every opportunity of judging, as I entered numerous houses and temples in all parts of the country, and invariably found them clean and tidy. In many of the houses the floors were washed and polished, and the refreshments they hospitably pressed on me were served in spotlessly clean dishes.

The clothes of the higher officials were always immaculate, their brocades and silks fresh and unstained in any way, and even the coolies were a great contrast to the usual Tibetan or Darjeeling coolie.

The amount of labor expended on their irrigation channels shows that they are an industrious and ingenious people (see pages 401 and 428). Their houses are all large and substantially built.

In the courtyards we found retainers busily occupied in various trades, while the women of the household spin and weave and make clothes for the men-folk in addition to their ordinary duties. A great part of the country is under cultivation, and they raise sufficient crops to support the whole population, including the lamas, who are a great burden to the State (see also page 394).

The men were cheery and jovial, always ready, at the end of a day's march, when we had settled into camp, for a game at quoits, shooting at a target with arrows, jumping, etc. They are fond of their beer, but there is no great harm in that, and small wonder they are thirsty after toiling up the hills with their loads. I have drunk many a choonga (bamboo mug) full of the mild ale myself and been none the worse for it.

WHAT BHUTAN IS LIKE

Bhutan lies between 26° 30′ and 28° 30′ north latitude and 88° 45′ and 92° 15′ east longitude, and is bounded by British India on the south, the native state of Tawang, subject to Tibet, on the east, Tibet on the north, and Sikkim and the British district of Darjeeling on the west.

The mountain system may be most easily described as a series of parallel ranges running approximately in a southerly direction from the main ridge of the Himalayan range, where the peaks attain altitudes up to 24,000 and 25,000 feet. The principal rivers are the Am-mo-chu, Wang-chu, Mo-chu, and Kuru, or Lobrak-chu.

In climate it varies enormously from the ice and snow of the higher altitudes to the damp, overpowering heat in the deep valleys, and in vegetation from the magnificent grazing grounds in the higher regions, covered with alpine flowers, surrounded by snow peaks, high pine forests, rhododendrons, magnolias, chestnuts, and oaks, to luxuriant tropical palms, ferns, and bamboos.

On my second journey I came across quantities of *Cypripedium fairianum* growing in masses on the magnesium limestone hills. This is the orchid of which one specimen reached England about 1860 in a consignment sent from Sikkim by Sir Joseph Hooker, but had since become extinct, and for which $5,000 was offered by orchid-growers. I had been on the lookout for it for several years, and now, when I did find it, I was just too late, as it had been discovered during the survey of the Am-mo-chu Valley a few months before.

There are magnificent forests of *Pinus excelsa, Abies brunoniana*, and silver fir, many of the trees exceeding in size anything I have ever seen. If these forests, with the water power at hand on all sides,

were properly worked, they ought to supply all the tea districts in India with boxes, and would then soon bring in some of the much-needed revenue to Bhutan; but European capital and supervision are absolutely necessary or otherwise the forests will be destroyed.

In eastern Bhutan the hills are densely clothed with forests, but with practically no population, as it is too fever-stricken to allow of any one living there. They are, however, the haunt of almost every kind of wild animal — elephant, rhino, tiger, leopard, bison, mythun, sambur, cheetah, hog-deer, barking deer, etc. The river beds are full of runs leading to the various salt-licks which occur in the hills.

On one of my visits in this section a magnificent tusker went up the valley ahead of me, and Ugyen Kazi, who pitched his camp higher up the valley, was obliged to move his tents, owing to the numbers of wild elephants making it too unpleasant for him to stay.

While I was examining some coal deposits a large tigress, with her cub, walked down the valley, and on my return I found her pugs (footprints), with the little one's pug inside one of her own. It is an ideal place for shooting, but not easy to follow game, owing to the extreme steepness of the sandstone cliffs. The elephant in its wild state can go over or down nearly anything, and the tusker I mentioned I found had gone up a precipice 30 feet high at an angle very little short of perpendicular.

A TORRENT FROZEN SOLID IN ONE NIGHT

My second journey opened with an experience of what bad weather can be at these altitudes, for on leaving Chumbi early in December we came upon an exceptionally severe blizzard. The wind rapidly became a veritable hurricane and the temperature dropped to — 26° Fahrenheit. A roaring torrent close to our halting place, which at first kept us awake, gradually became more and more silent as the cold increased, and by morning it was frozen solid (see page 366).

I had marched on to a small bungalow at a place called Goutsa, where although everything, even the tea and milk, froze solid, I could at least have a fire and some protection from the storm; but two of my party had camped out in the hope of shooting a "shau" (*Cervus sinencis*), news of which had been brought in. The stag was reported to have a magnificent head, and as I have seen specimens with antlers measuring 64 inches, he was a trophy worth trying for. They, however, saw nothing of him and, greatly to my relief, came in the next day none the worse for their rough experience.

The following morning was brilliant and we went on to Phari, where there is a fine old weather-beaten fort built by the Tibetans, the headquarters of a jongpen, a Tibetan military official. The town is very dirty, the dirtiest I have come across, and the people living in it are also dirty; but it is difficult to keep clean at an elevation of over 15,000 feet, in such a climate, with no fuel except yak's dung, with its accompaniment of acrid smoke.

We had now reached Bhutan and, crossing the Temo-la (16,500 feet), we entered it in glorious weather. We traveled through wonderful scenery, crossing and recrossing torrents and surrounded by pine forests.

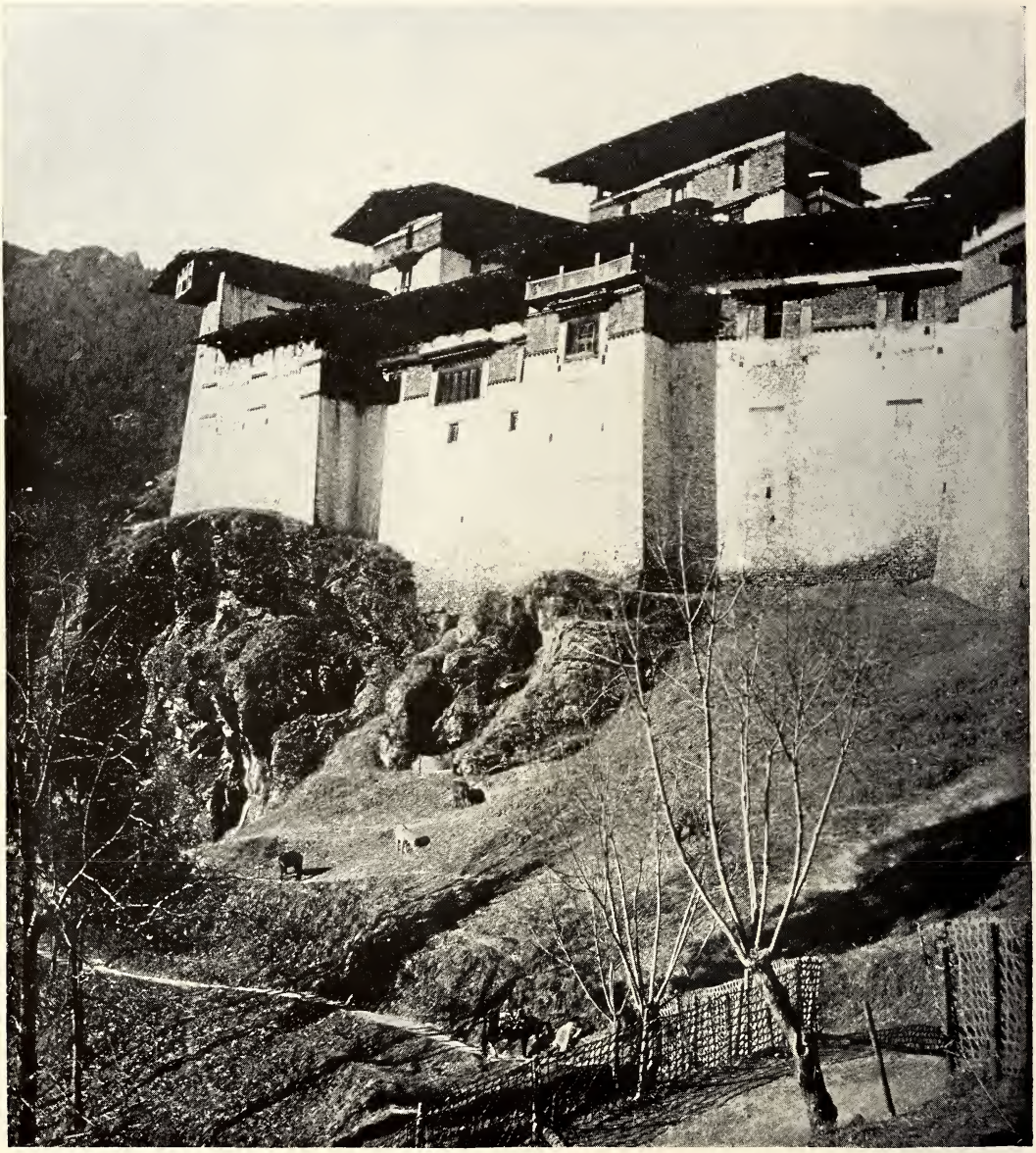
THE CASTLE OF DUG-GYE

The first place of interest we came to was Dug-gye Jong (see page 368), a fort built to protect this route from a possible raid by Tibet. The fort is magnificently situated on a projecting spur in the middle of the valley, with high snow peaks on either side and lovely views looking down the valley. The jongpen (or general) had sent out gaily caparisoned mules to meet us.

I cannot describe Dug-gye better than Captain Turner, who had visited it 120 years before; the scene does not seem to have altered in the least.

"The approach to the only entrance is defended by three round towers, placed between the castle and the foot of the hill and connected together by a double wall, so that a safe communication between them is preserved even in times of the greatest peril. Around each of these towers, near the top, a broad ledge projects, the edges of which are fortified by a mud wall, with loop-holes adapted to

ANOTHER VIEW OF DUG-GYE JONG, SHOWING OUR CAMP IN THE FOREGROUND AND TERRACED RICE FIELDS. ALTHOUGH 9,000 FEET IN ELEVATION, VERY GOOD CROPS OF RICE RIPEN HERE



ANOTHER VIEW OF DUG-GYE

This view gives a very good idea of the sloping architecture of the walls and the projecting roofs, made of split pine. The railing in the foreground is split bamboo

A VIEW OF THE INTERIOR OF DUG-GYE JONG, SHOWING SHINGLE ROOFS KEPT IN PLACE BY LARGE STONES

In the yard are stacks of long split shingles ready for renewing the roof. The roofs are reshingled every fifth year and are weighed down with tons of stones to withstand the fierce winds in these high altitudes (see also page 431).

DUG-GYE: THIS VIEW SHOWS THE ROUND TOWERS BUILT TO PROTECT THE COVERED WAY TO THE SPRING UNDERNEATH THE LOWEST TOWER. IN CASE OF SIEGE THE INMATES CAN REACH THE WATER SUPPLY UNDER COVER

the use of the bow and arrow or of muskets. On the north of the castle are two round towers that command the road from Tibet. On the east side the rock is rough and steep, and close under the walls on the west is a large basin of water, the only reservoir I had seen in Bhutan.

"The castle of Dug-gye-jong is a very substantial stone building, with high walls; but so irregular is its figure that it is evident no other design was followed in its construction than to cover all the level space on the top of the hill on which it stands. Having ascended to the gateway at the foot of the walls, we had still to mount about a dozen steps through a narrow passage, after which we landed upon a semicircular platform edged with a strong wall pierced with loop-holes. Turning to the right, we passed through a second gateway and went along a wide lane with stables for horses on each side. The third gateway conducted us to the interior of the fortress, being a large square, the angles of which had three suites of rooms. In the center of the square was a temple dedicated to Mahamoonie and his concomitant idols."

I found the whole of the premises very clean. The jongpen, who was appointed by, and is a staunch adherent of, the Tongsa Penlop, Sir Ugyen, and had been to Lhasa in the latter's suite, received us cordially, and entertained us with a Bhutanese lunch of scrambled eggs and sweet rice, colored with saffron, accompanied by *murwah* (beer) and *chang* (spirit), also colored with saffron, fresh milk, and a desert of walnuts and dried fruits. His wife, who prepared the meal, was one of the cleanest and best-looking women I have seen in Bhutan; and her little boy, wearing an exact copy, in miniature, of his father's dress, was a nice little chap.

The Dug-gye armory is said to be the best in the country, and is contained in a fine room, with a large bow window facing south and looking down the valley—in the Tongsa Penlop's opinion the best balcony in Bhutan (see pages 372, 431).

In the outer courtyard men were making gunpowder. A silversmith and a wood-turner were also at work, and in the inner courtyard were piles of shingles (pieces of flat wood) ready for reroofing the castle, which has to be entirely redone every five years. Altogether there was an air of bustling activity which was pleasant to meet with.

A MONASTERY BUILT OVER A PRECIPICE

We remained as guests of the jongpen for two days in order to visit the famous Monastery of Paro Ta-tshang, which is situated on the opposite side of the valley, about 3,000 feet up. The road was reported to be very bad, and it certainly was, and I was glad I had not brought my own animals, but had borrowed mules from the jongpen for all our party. The road to the top of the spur was very steep, with frozen, slippery patches, where it was shady and very hot in the sun. It ran in one place in a narrow path across a precipice, with a tremendous drop below, and in another became a series of steep stone steps (see page 430).

On reaching the top of the ridge we first came in sight of the monastery buildings, grouped on an almost perpendicular hillside in the most picturesque manner. The main temple is erected on what is practically a crack in a perpendicular rock over 2,000 feet in height, and along the crack there are a few more subsidiary buildings.

Each building is two stories high and is painted, like all monasteries, a dull light gray on the lower story, with a broad band of madder red above, and shingle roofs, on the top of which are gilded canopies. It was unquestionably the most picturesque group of buildings I had seen. Every natural feature in the landscape had been taken advantage of, and beautiful old trees clinging to the rocks were in just the right position and, combined with the sheer precipices, made a magnificent picture.

We appeared to be quite close, but were really separated from the buildings by an almost inaccessible gorge. The only approach was by a narrow path or series of steps, where a foot misplaced would precipitate you to the bottom, 1,000 feet below, then across a plank bridge, and up another series of little steps cut in the rock. The native hospital assistant had

SANG-TOG-PERI, THE HIGHEST BUILDING IN THE GROUP OF THE PARO-TA-SHANG MONASTERY

The entrance, the surroundings, the way the trees are grown, is much more like a Japanese temple than anything I have seen elsewhere in Bhutan (see text, pages 375-377, and picture, page 430)

accompanied our party so far, but this was too much for him. He said he had been in many bad places, but never such a bad one as this, and he turned back to where the mules were waiting. Natives, as a rule, have good heads and do not mind bad roads, so that speaks for itself.

Across the gorge a rope of little colored prayer-flags was stretched, which fluttered out prayers for the benefit of those who had put them up, and this added to the picturesqueness of the scene.

On reaching the top of our ladder-like path a monk presented us each with a draught of beautifully ice-cold water in a gourd from a holy spring, and I can imagine it being much appreciated on a hot day.

The most holy shrine, the sanctuary round which all the other buildings have sprung up, was situated in a cave. The cave is not large, and in it was a gilded chorten filled with small images of Buddha in copper gilt, each seated on a lotus and many of very good design. The other buildings were for the most part ordinary temples, with frescoed walls and altars, with butter-lamps and incense burning, and in the principal one there was a very fine brass Buddha of more than life size, surrounded by his satellites. There were also some unusually good specimens of *dorjes* (thunderbolts) and *purpas* (daggers), both of which are used in the temple services.

They were supposed to be of holy origin and to be found among the solid rocks near the shrine; but I could see none, although the Bya-gha Jongpen's son, a nephew of the Tongsa, had taken one away a few weeks previously. My servants were very anxious to secure one of these treasures, and climbed to an almost inaccessible point in the rocks in search of them, but without success.

In the center of the gorge, perched upon a tiny ledge, there was a hermit's dwelling, which could only be reached by climbing a perpendicular notched pole about 40 feet high. It looked diminutive against the enormous precipice (p. 378) and dreary and uninviting, with long icicles hanging from the roof, and we did not attempt to visit it. We, however, climbed to the top of the precipice to visit the monastery of Sang-tog-peri, which was most picturesquely situated on a projecting spur, with a fine old oak overhanging the entrance. It reminded me of some of the Japanese temples in Kioto, in the way the natural features of the ground had been utilized to beautify the entrance.

There was a lovely view from this point. Around us on all sides were spurs, with other monasteries and nunneries, but they were all more or less difficult of access and our time would not admit of further delay; so we were obliged to return, leaving them unvisited. It was a place that would take days to explore and would well repay the trouble, especially to an artist in search of the beautiful and unusual.

FEEDING MULES WITH EGGS

From Dug-gye the route to Paro ran down the valley, with monasteries perched on every prominent hill. On reaching Paro we found our camp, as usual, ready pitched for us (see page 384).

In the afternoon, while wandering round the camp, which was very well laid out, I watched the curious Bhutanese custom of feeding mules with eggs, which I had never come across elsewhere. All our mules, as well as those belonging to Ugyen Kazi and to the penlops, each had a ration of two or three raw eggs. The eggs were broken into a horn, the mule's head held up, and the contents of the horn poured down the animal's throat; and, strange to say, they seemed to like the unnatural food. The Bhutanese always give this to their animals when they have any extra hard work to do, and say it keeps them in excellent condition; and certainly all their mules were in first-rate condition.

Paro is a very large and striking building, protected on the one side by the River Pa-chu, spanned by a substantial bridge on the cantilever principle, covered with a roof to protect the timber (see pages 385-387). The only entrance is from the hillside above the third story, the lower stories being used entirely as storehouses for grain, etc.

A HERMIT'S HOUSE

On the most precipitous part of the road through the gorge leading to Paro-ta-tshang, on an almost perpendicular face of the cliff, and actually under the overhanging cliff on the right. The streak of white in the left-hand bottom corner is a string of printed prayers stretched across the gorge (see pages 375-379).

GOLDEN TEMPLE ROOFS OF THE PRINCIPAL SHRINE AT PARO-TA-TSHANG

The upper portion is carved in high relief and the top is of copper gilt. The balcony window is painted and ornamented with sacred scrolls

GORINA MONASTERY, SURROUNDED BY LAMAS' HOUSES, SITUATED ON A SPUR RUNNING INTO THE PARO VALLEY. PRAYER FLAGS ARE DOTTED ABOUT ON POLES, AND TO THE RIGHT OF THE MAIN BUILDING IS A "GYANTSIN," OR CIRCULAR SACRED HANGING

The chapel was gaily decorated with fresco paintings in good taste, while the hangings round the altar were overlaid with wrought brass open-work superior to anything that I had seen in Lhasa; but in sharp contrast the side altars were adorned with four gaudy green porcelain parrots. On the ridge below we were greeted with salvos of artillery, fired from iron tubes bound with leather, and I wondered whether these could be the leather cannon of which we heard so much in the Chinese-Gurkha war.

IN A BHUTANESE FORTRESS

Crossing the foss, which separates the outer courts from the fort by a heavy drawbridge, we passed through a huge gateway and found ourselves in the eastern courtyard, in the center of which is the smaller of two citadels, equal in height and occupied by petty officials (see page 388). A series of rooms and verandas overlooking the river is built against the inside of the east and north outer walls, and a covered veranda, one story in height, occupies nearly the whole western front.

The penlop's rooms are situated in the southeast corner, on the floor above, and we entered through a long, low room filled with retainers seated in four rows, two on each side, facing each other—a scene which made one think of the old baronial halls in bygone English days. To add to this impression, the reception-room was large and handsomely decorated, and the walls were hung with arms of all descriptions—shields, spears, matchlocks, guns, bows and arrows of every imaginable kind—all well kept and ready for use.

The penlop, or governor, received us in a large bay-window looking down the valley, but the visit was dull and uninteresting, as he seemed to know little of the history of his country, and what little information we did extract was vague and inaccurate. According to the usual custom, I made him some presents, and shortly after took my leave, receiving permission to inspect the fort and to pay a visit to his private house across the valley (see page 391).

The fort is said to have been built toward the end of the sixteenth century, and does not seem to have suffered from the earthquake of 1897, which shattered Tashi-cho-jong and Poonakha. On the first floor is the temple, the *gompa,* or public chapel, of which is a very finely proportioned hall, well lighted, and with galleries running round the main building.

It is a much larger room than the one in the Potala at Lhasa, where the Tibetan Treaty was signed, and all its decorations are good, a hanging lattice-work of pierced brass in front of the altar especially being very fine and quite unusual. At the other end of the west veranda is the private chapel of the Ta-tshangs, or state lamas, and there we were received by their head, the Abbot Lama Kun-yang Namgyel, who went to Lhasa with the Tibet Mission and exercised a good influence among the monks there. He gladly showed us all there was to be seen.

The larger of the two citadels is in the center of the western courtyard, at the northwest angle of the building, and I noticed old catapults for throwing great stones, carefully stored in the rafters of the veranda. In the northeast corner are the rooms for distinguished guests, and there is a guard-house in the parade ground beyond the drawbridge. The fort is protected on the side away from the river by several small outlying block-houses (see page 385).

The penlop's (governor's) private house, where he passes some part of his time, lies on the other side of the river and is the residence of his wives (see page 390). No female is allowed to enter the fort, and at night the gates are closed and opened for no one. In this house the jongpen lives amicably with two wives, the younger one being the daughter of the elder woman by a former husband. The elder woman was intelligent and had a great deal to say, but the younger one was shy and very silent.

THE HEADQUARTERS OF THE GOVERNMENT

Three marches brought us to Tashi-cho-jong, the summer quarters of the Bhutan government. En route we camped under an immense "weeping cypress," 51 feet in girth at 4 feet from the ground, and the latter part of the march before reaching the castle was most interesting, as we passed through country replete with historic interest connected with the different battles which had taken place between rival clans for its possession, fortunately now things of the past.

Tashi-cho-jong is an imposing edifice, in the form of a parallelogram, the sides parallel to the river being twice the length of the other two. It differs from other forts in one particular. Instead of only one gate, it possesses two large gateways on the south, and another to the east, on

A FINE EXAMPLE OF CHORTEN, OR SHRINE, AT GORINA MONASTERY, SURROUNDED BY PRAYER FLAGS

In front a venerable lama is telling his beads. The carving and decoration on this was good and the images well modeled

the river face. It is protected on the west and north by a wide foss filled with water (see pages 392-397).

Unlike Paro and Poonakha, the bridge across the Thimbu Chu was not connected with the castle, and below the bridge was a wooden contrivance cleverly constructed to catch the timber floated down the river for the use of the castle.

The interior of the castle is divided into two unequal portions by a high wall, the larger section to the south containing the usual square tower, measuring about 85 feet each way, and in this are situated the chapel and private apartments of the Dharma Raja, the spiritual head of the nation.

The original tower was destroyed by the earthquake of 1897 and the present structure was finished about 1902; but it has been badly built and the main walls are already cracked, while the interior showed signs of unequal subsidence. The decorations are, of course, quite modern.

In the southeast angle of the courtyard beyond are the public or living quarters of the Dharma Raja, and on the west front those of the Thimbu Jongpen, where we were hospitably entertained. The northern and smaller portion of the castle is occupied entirely by the Ta-tshang lamas and is not usually open to laymen. The dividing wall is surmounted by a row of white *chortens,* or shrines, protected from the weather by a double roof (see pages 395 and 441).

A THOUSAND BUDDHAS

In the center of the inner courtyard is an extremely fine hall of audience or worship, 120 feet square and at least 50 feet high. It is well lighted and finely decorated with fresco paintings, and when the silken ceiling cloths and embroidered curtains and banners are hung it must look extremely well; but the lamas were absent at Poonakha, their summer quarters, and all the decorations were either carefully put away or taken with them.

A succession of chapels was built on the west side. One of these was a splendid example of good Bhutanese art; its door-handles, of pierced iron-work inlaid with gold, were exceptionally beautiful. It was said to contain 1,000 images of Buddha, and the number is very likely correct, as I counted over 600, while the pair of elephant's tusks supporting the altar, which I have remarked as an essential ornament to the chief altar in every Bhutanese chapel I have visited, were larger than usual (see page 441).

THE BUDDHIST RITUAL

To my readers who wish to study the subject of Buddhist religion in this part of the world, I cannot give better advice than to read Waddell's "Lamaism," as I have no intention of entering deeply into it, and will content myself by saying that in both Sikkim and Bhutan the religion is an offshoot of Buddhism, and was introduced into these countries from Tibet by lamas from different monasteries who traveled south and converted the people. Most of the tenets of Buddha have been set aside, and those retained are lost in a mass of ritual; so nothing remains of the original religion but the name.

The form of worship has a curious resemblance in many particulars to that of the Catholic church. On any of their high holy days the intoning of the chief lama conducting the service, the responses chanted by the choir, sometimes voices alone, sometimes to the accompaniment of instruments, where the deep note of the large trumpet strangely resembles the roll of an organ, the ringing of bells, burning of incense, the prostrations before the altar, the telling of beads and burning of candles, the processions of priests in gorgeous vestments, and even the magnificent altars surmounted by images and decorated with gold and silver vessels, with lamps burning before them, even the side chapels with the smaller shrines, where lights burn day and night, add to the feeling that one is present at some high festival in a Catholic place of worship.

I have been present at the services on feast days in the temples in Sikkim, Bhutan, and in Lhasa, and no great stretch of imagination was required to imagine myself in a Catholic cathedral in France or Spain, especially the latter. There is also some resemblance in the dress and vestments of the priests and lamas and even in some of their customs. Many of

A GOOD VIEW OF PARO JONG, WITH AN ENORMOUS WILLOW IN THE FOREGROUND. THE LARGE TREE IN THE CENTER IS A WEEPING CYPRESS. OUR CAMP MAY BE SEEN IN THE DISTANCE (SEE PAGES 377 AND 381)

VIEW OF PARO JONG, SHOWING ONE OF THE OUTLYING PROTECTING FORTS ON THE HILL AND A STONE EMBANKMENT TO KEEP THE RIVER IN ITS PROPER BED AND PREVENT ITS OVERFLOW (SEE PAGE 381)

The forts are painted a dull light gray on the lower stories, with a broad band of madder red above, clearly shown in this photograph

ANOTHER VIEW OF PARO JONG, GIVING SOME IDEA OF ITS HEIGHT ABOVE THE RIVER, AND ALSO SHOWING A SMALL TEMPLE BUILT IN A CLEFT OF THE ROCK ON THE RIVER BANK

Note the round tower, which protects the covered way to the water supply

BRIDGE ACROSS THE PA-CHHU, THE APPROACH TO PARO JONG, A VERY MASSIVE STRUCTURE, PROTECTED BY ROOF AND BLOCKHOUSES. THIS IS THE ONLY MEANS OF CROSSING THE RIVER AND IS DOMINATED BY THE FORT

THIS VIEW SHOWS THE CITADELS OF PARO JONG TO ADVANTAGE, AND ON THE RIGHT THE DRAWBRIDGE TO THE ONLY ENTRANCE

"I noticed old catapults for throwing great stones carefully stored in the rafters of the veranda" (see text, page 381)

THE INTERIOR OF THE PARO JONG

THE PRIVATE HOUSE OF THE GOVERNOR OF PARO ACROSS THE PA-CHHU: HERE THE GOVERNOR (PENLOP) AND HIS FAMILY LIVE, AS NO WOMAN IS ALLOWED TO ENTER THE CASTLE (SEE TEXT, PAGE 38[1])

A GROUP OF BHUTANESE OFFICIALS. THE ONE SEATED IS THE GOVERNOR OF PARO JONG, AND IS COMMONLY CALLED THE PARO PENLOP (SEE PAGES 377 AND 381)

TASHI-CHO-JONG, THE SUMMER HEADQUARTERS OF THE BHUTAN GOVERNMENT (SEE PAGES 381 AND 383)

ANOTHER VIEW OF TASHI-CHO-JONG AND BRIDGE OVER THE THIMBU CHU. THE CRACKS IN THE BLOCKHOUSE WALLS WERE CAUSED BY AN EARTHQUAKE (SEE PAGE 381)

them go entirely into seclusion, and they also have certain periods of time devoted to prayer corresponding to a retreat, during which they see no one.

THE LAMAS ARE DISLIKED AND FEARED

As a class the lamas are disliked, but also feared by the people, on account of the belief that the lamas have the power to do them harm.

As a rule, the lamas are ignorant, idle, and useless, living at the expense of the country, which they are surely dragging down.

As the lamas in Bhutan are fed, clothed, and housed at state expense, and as their numbers have steadily increased, they have become a very heavy burden which cannot long be borne and an evil which I hope may soon be curtailed by the method proposed by Sir Ugyen Wangchuk, namely, the gradual reduction by leaving vacancies, occurring through death and other causes, unfilled and the limitation of the number admitted to each monastery.

There are, of course, exceptions to every rule, and I have met several lamas, notably the Phodong lama of Sikkim, and others like him, men who were thoroughly capable, who acted up to their principles and whom I thoroughly respected; but, I am sorry to say, such men were few and far between. The majority generally lead a worldly life and only enter the priesthood as a lucrative profession and one which entails no trouble to themselves.

The march from Tashi-cho-jong to the Fort of Simtoka was a lovely one, crossing and recrossing a sparkling stream, through glades of oak, chestnut, and rhododendron, while the slopes of the hills were covered with pines (*Pinus excelsa*).

Simtoka-jong (see page 398) is situated on a projecting ridge, with deep gullies separating it from the main hill. It looks old and is not in very good repair.

On the four sides of the central square tower, instead of the usual row of prayer-wheels we found a row of square slabs of dark slate, carved in low relief, with pictures of saints and holy men. It was a wonderful collection of different types, with no monotonous repetition of the same figure, whence derived I cannot imagine, unless indeed of Chinese origin, as the variety reminded me of the 1,000 statues in the temple in Canton, where one figure is pointed out as Marco Polo In Simtoka one face is a very unflattering likeness of the German Emperor In the chapel itself, beneath a magnificent carved canopy, was one of the finest bronze images of Buddha that I have seen; it was supported on either side by a number of standing figures of more than life size.

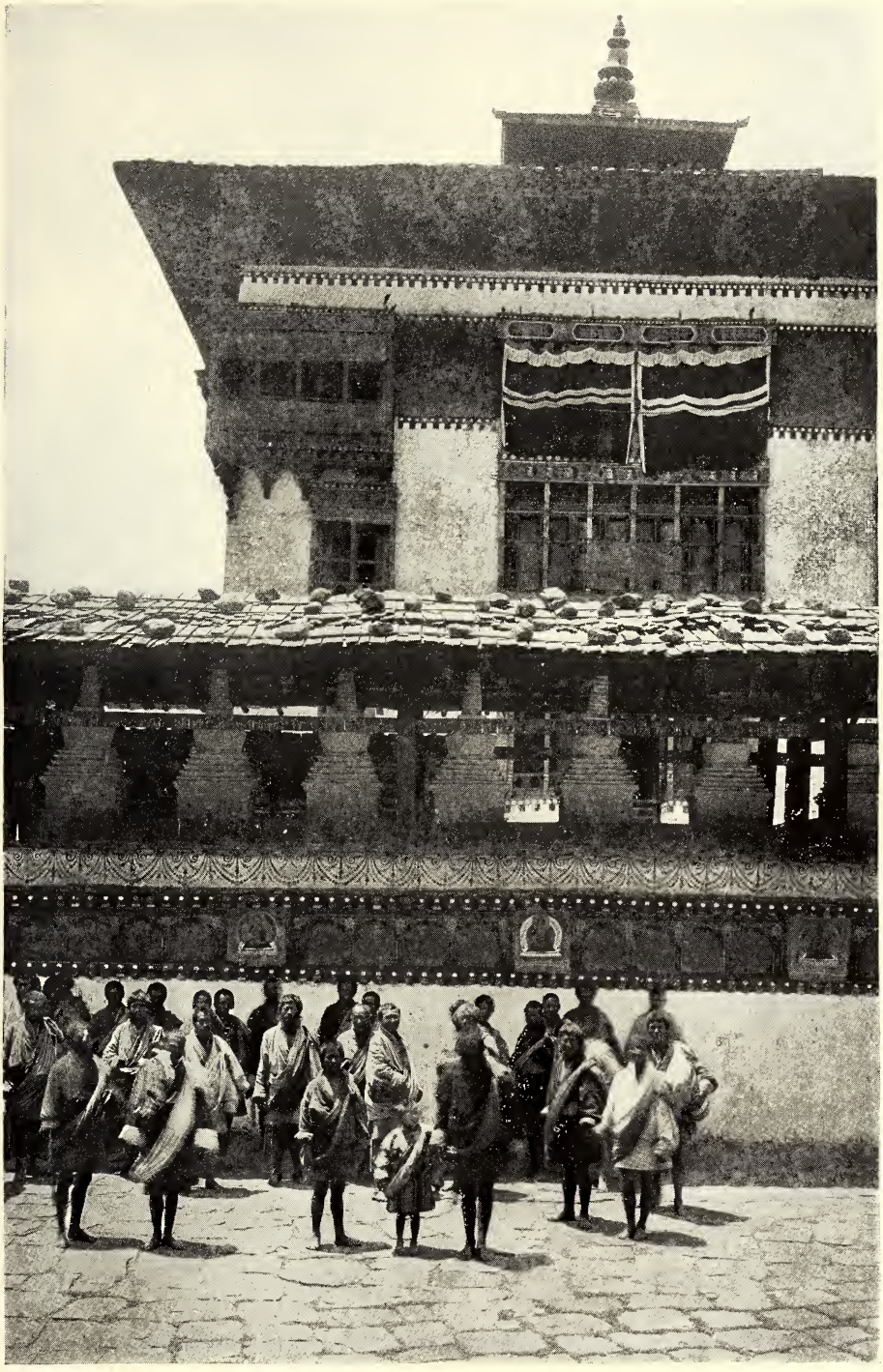
OUR PICTURESQUE RECEPTION AT POONAKHA

The entrance to Poonakha, which is the winter capital of Bhutan (see page 440), was picturesque and interesting in spite of the rain, which came down in torrents.

About four miles out we were met by a deputation from the Tongsa Penlop. He had sent the Ghassa Jongpen, who brought scarfs of welcome and baskets of fruit, oranges, plantains, and persimmons, in addition to sealed wicker-covered bamboos filled with murwa and chang. There were at least five or six gaily caparisoned mules for each of us to ride, sent by the Tongsa, the Poonakha Jongpen, Deb Zimpen, and others; so we had an abundance of choice. The Tongsa had also sent his band, which consisted of six men, two in red, who were the trumpeters, while the remainder, dressed in green, carried drums and gongs. The mass of colors of every hue was most picturesque, and we made a very gay procession as we started off again toward Poonakha.

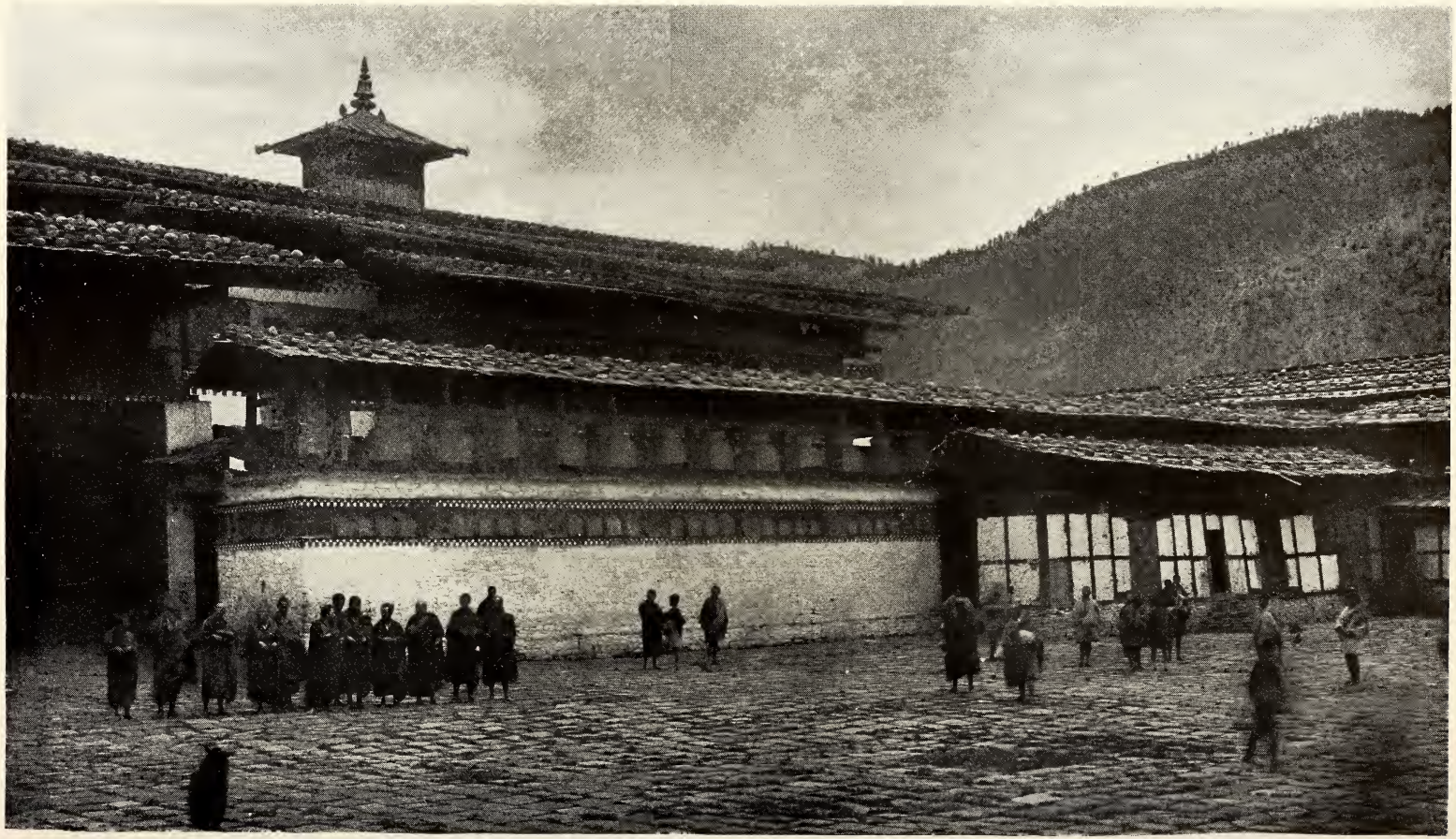
At the point where the jong first comes in view a salute of guns was fired, more retainers met us, and our procession was joined by the dancers. The band and dancers preceded me down the hill, playing a sort of double tambourine and twisting and twirling to the beat as they descended the path. The procession must have extended for quite half a mile along the hillside.

First came the pipes and drums and escort of the 62d Punjabis, followed by some twenty led mules, most of them with magnificent saddle-cloths, with their



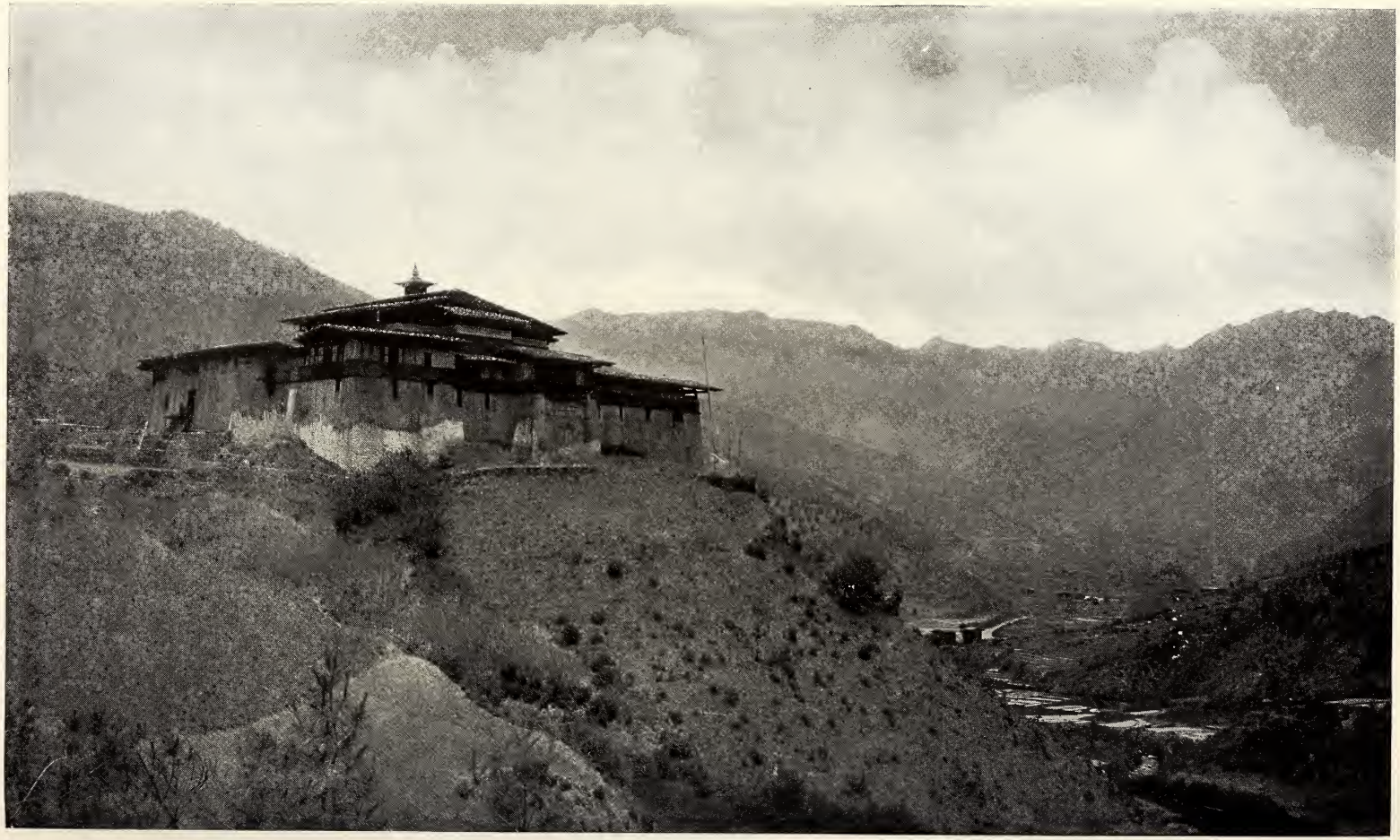
INTERIOR OF TASHI-CHO-JONG, SHOWING THE WALL DIVIDING THE PORTION OCCUPIED BY THE LAYMEN FROM THAT OF THE LAMAS

The citadel in the background and a group of orderlies in front (see also page 441)

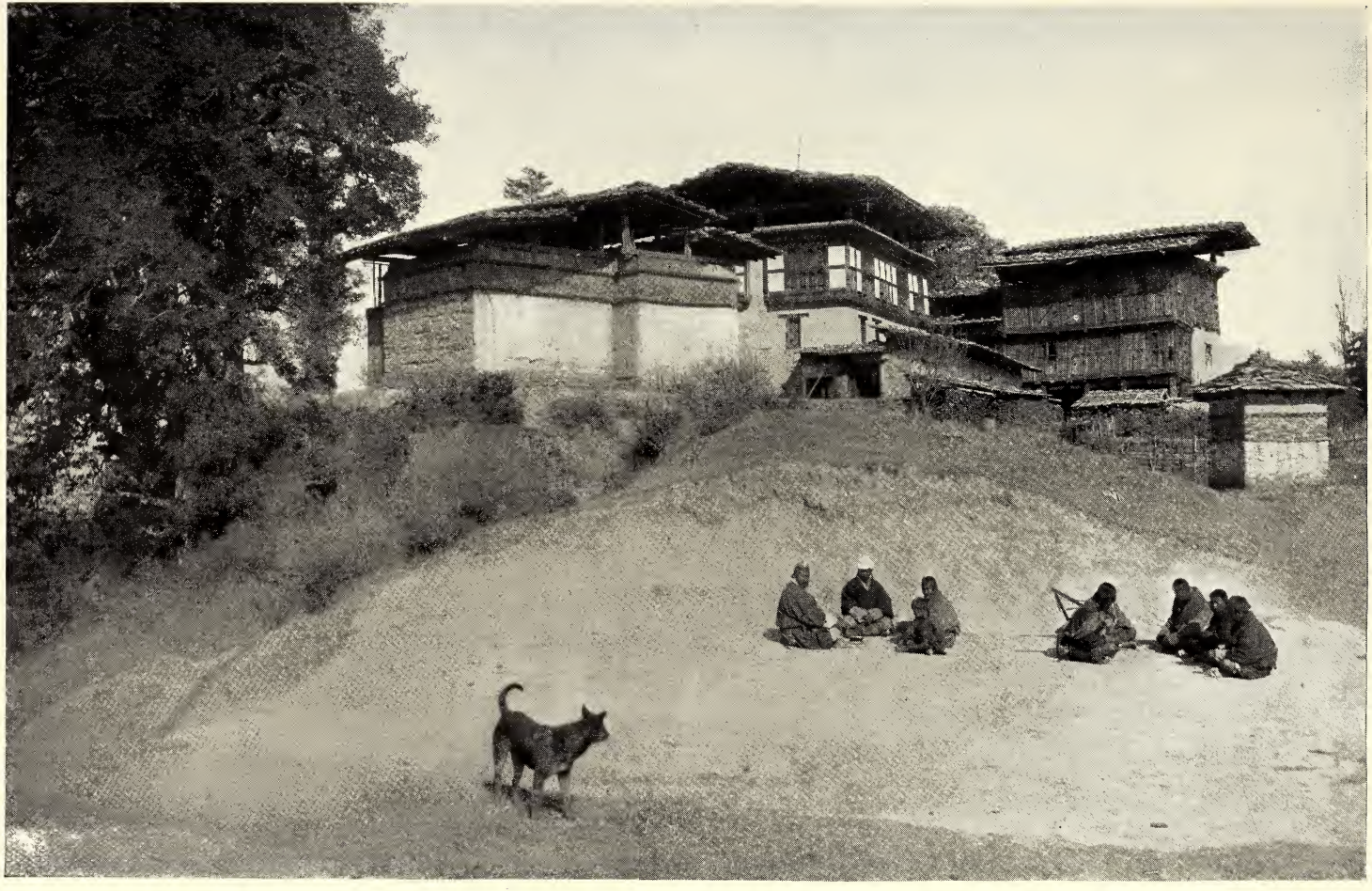


THE INTERIOR OF TASHI-CHO-JONG (SEE PAG 383)

A COURTYARD AT TASHI-CHO-JONG, WITH THE CITADEL ON THE LEFT AND A FINE CHORTEN, OR SHRINE, IN THE CENTER
(SEE PAGE 383)



SIMTOKA JONG, ONE OF THE OLDEST FORTS IN BHUTAN AND ONE FOR THE POSSESSION OF WHICH THERE HAVE BEEN MANY FIGHTS
(SEE PAGE 394)



A FARM-HOUSE OF THE BETTER TYPE IN THE PARO VALLEY: THE HOUSES ARE ALL LARGE AND SUBSTANTIALLY BUILT

A PRETTILY SITUATED BHUTAN VILLAGE, WITH ALPINE SCENERY AND GROUP IN FOREGROUND

"My experience of the people is that they are universally polite, civil, and clean. I had every opportunity of judging, as I entered numerous houses and temples in all parts of the country, and invariably found them clean and tidy. In many of the houses the floors were washed and polished, and the refreshments they hospitably pressed on me were served in spotlessly clean dishes" (see text, page 369).

METHOD OF CARRYING WATER ACROSS A RIVER FOR IRRIGATION PURPOSES BY MEANS OF HOLLOWED-OUT TREE TRUNKS

The Bhutanese are great irrigators and in places their water channels are carried along the hillsides for miles

syces and other retainers; next the body-guard of the Tongsa, about twenty men, dressed in beautiful silks and brocades and each with a yellow scarf. The band and dancers followed immediately in front of myself and my party, and we again were followed by my orderlies and servants, who were all mounted and wearing their scarlet uniforms. On account of the narrow path, the procession had to proceed in single file, and as we gradually wended our way across the bridge we must have made a brave show for the country folk, who had flocked out in thousands to watch our arrival.

In camp waiting to receive me were all the principal Bhutanese officials—the Tongsa Penlop himself (now the king), the Thimbu and Poonakha Jongpens, the Zung Donyer and Deb Zimpon. The first three I had met in Tibet; the last two at Buxar.

They greeted me most cordially and condoled with me on the weather, inquired about our journey, and hoped we had had no great difficulties. Then in a short time, the rain having ceased, they took their departure and left us to settle down in our quarters. For myself a large, comfortable Swiss cottage tent had been pitched; two others with embroidered tops, cook-houses and quarters for the followers, together with my own camp equipage, made a very luxurious encampment.

AN IMPREGNABLE FORTRESS

I also had a great compliment paid me, as the Deb Raja's band played in front of us all through the outer courtyard across the river and right into the camp, an honor not even paid the Tongsa Penlop himself beyond the bridge.

Poonakha, lying between the rivers, is easily supplied with water; but other forts built on a ridge have some difficulty, and are in many cases, as at Dug-gye, obliged to build sunk passages zigzagging down to the valley and protected by towers at each turning to insure a supply of water in the event of a siege. Where a fort is built on the side of a hill, as at Paro and at Tongsa, protecting towers are always built above it.

The plan nearly always followed in the forts is that of a rough parallelogram divided into courts. The main entrance in Poonakha is approached by a steep flight of wooden steps about 20 feet in height, which in time of emergency can be easily removed, leading to the gateway, a massive wooden structure, easily closed and invariably shut at night.

Through the gateway the first court is reached. The main citadel is situated in this, at the south end, a square building, about 40 feet at the base and 80 feet high, and flanking the court on all sides are the two-storied buildings used as residences by the lay officials. Beyond the citadel there is another court, also surrounded by double-storied dwellings, and in the building dividing this court from the next is the larger Durbar Hall, which stretches across the whole width. Next comes another and smaller court, within which, to the south, stands the second and smaller citadel, inclosed by more buildings.

Beyond comes another court, given up entirely to the Ta-tshang lamas, numbering about 3,000, the large temple standing in the center. The lamas' cells occupy two sides of the court, the third side overlooking the junction of the rivers.

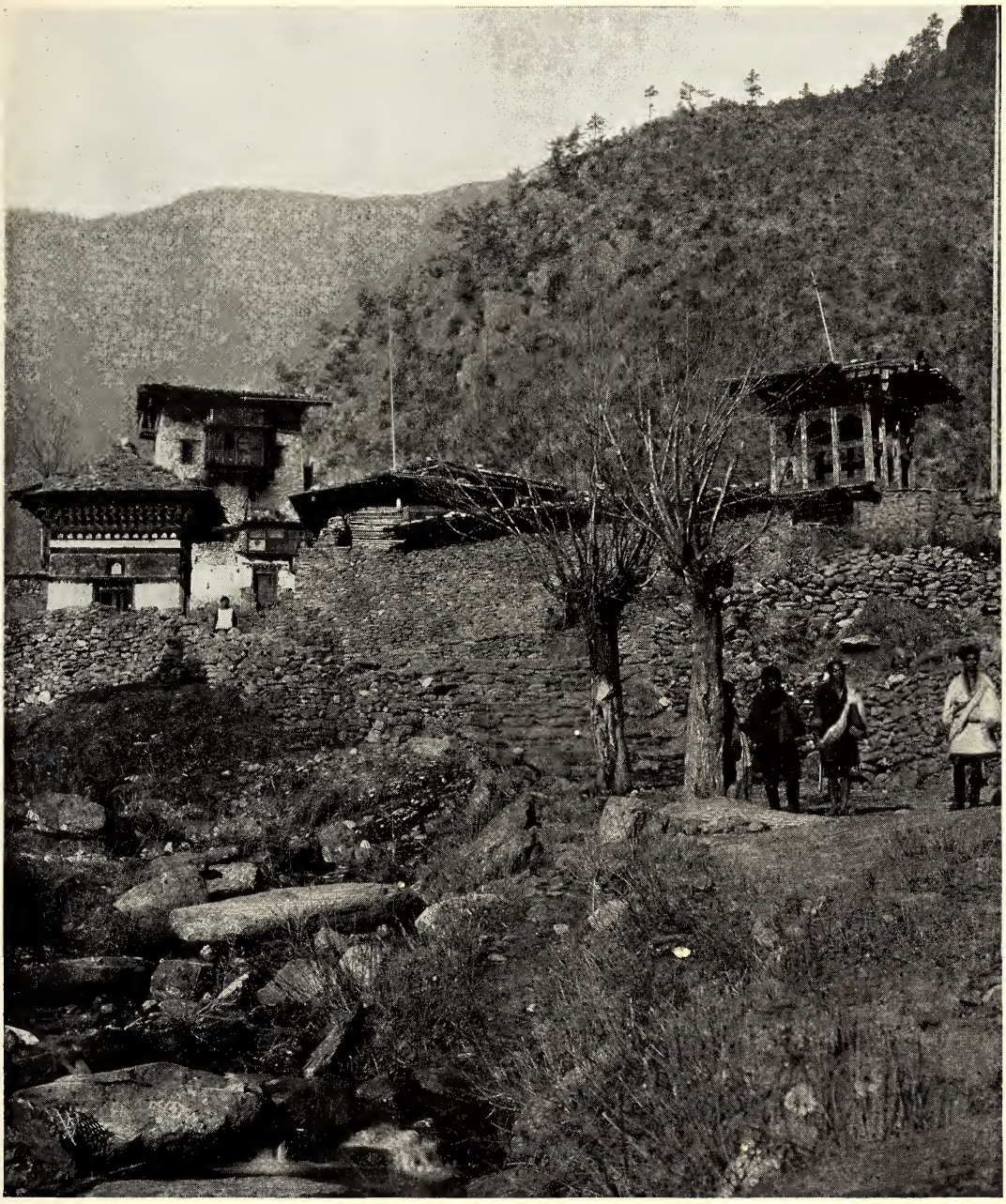
Underneath these courts are a few store-rooms for the housing of grain, but the greater part is filled in with earth and rock.

All the buildings are roofed with shingles made of split wood, and in this the great danger, that of fire, lies, as the shingles are easily set alight; but otherwise, in the days of bows and arrows, such forts were practically impregnable, and this one could, if necessary, house 6,000 souls or even more.

A QUAINT CEREMONY

I spent many days here preparing for the Durbar, which proved of such interest that I give a full account of it. Unfortunately, on the morning of the Durbar it rained heavily, but cleared up before the ceremony began. This took place in the Palace of Poonakha, in the large hall.

When everything was in readiness in the palace, a small procession from camp was formed. Major Rennick and myself, in full-dress uniform, preceded by our



HAH VILLAGE: A GOOD EXAMPLE OF BHUTANESE TIMBERED HOUSES

POONAKHA, SHOWING THE BRIDGE OVER THE MO-CHHU, THE ONLY APPROACH FROM THE WEST

Before the days of cannon and arms of precision this was a very strong position; now it can be dominated from the hills on all sides (see text, pages 394-402, and also page 440)

escort, commanded by Subadar Jehandud Khan, a native officer of the 40th Pathans, proceeded to the fort, where we were ushered with great ceremony into the Durbar Hall. This is a fine, handsome room, with a wide balcony overlooking the Po-chu, and a double row of pillars forming two aisles. The center or nave, a wide span open to the lofty roof, was hung with a canopy of beautifully embroidered Chinese silk.

Between the pillars were suspended "chenzi" and "gyantsen" hangings of brilliantly colored silks, and behind the tongsa's seat hung a fine specimen of needle-work picture, a form of embroidery in which the Bhutanese excel (page 445) and which compares favorably with anything I have seen in other parts of the world, even in Japan or China. At the upper or north end of the room was the high altar and images always to be met with in Bhutanese chapels, and in front of this was a raised dais, on which sat the Deb Raja, a rich yellow silk stole over his red monastic dress, with the Abbot of the Poonakha Ta-tshang lamas, in ordinary canonicals, on his left (see page 406).

To the right of the dais was a row of four scarlet-covered chairs for myself, Major Rennick, Mr. Paul, and the subadar, and in front of each chair was a small table with fruit and refreshments. Close behind me stood my servants with presents.

On the opposite side of the nave, facing me, was a low dais with a magnificent cushion of the richest salmon-colored brocade, on which Sir Ugyen Wang-chuk sat, dressed in a handsome robe of dark-blue Chinese silk, embroidered in gold with the Chinese character "Fu," the emblematic sign of good luck. Below him were ranged the chairs of the officials present in order of their rank.

In the aisles were double and treble rows of the chief Ta-tshang lamas seated on white carpets, while four flagellants, carrying brass-bound batons of office and formidable double-thonged whips of rhinoceros hide, walked up and down among the rows to maintain order. At the lower end, by which we had entered, were collected the subordinate officials of the court, standing, with my own escort formed up in front of them, facing the Deb. It was altogether a brilliant and imposing scene.

KNIGHTING THE PRESENT KING

After my party and the high officials of state, who had risen on my approach, had taken their seats, there was a short pause for order and silence to be restored. I then rose and directed Rai Lobzang Chöden, my interpreter, to read a short address in Tibetan, and on its conclusion I stepped forward, with Major Rennick carrying the insignia and warrant on a dark-blue cushion fringed with silver, in front of the Deb Raja (see page 436) as the Tongsa Penlop (Sir Ugyen) advanced from his side to meet me.

I placed the ribbon of the order round his neck, pinned on the star, and handed the warrant to Sir Ugyen, who suitably expressed his most grateful thanks for the honor the King-Emperor had conferred on him. I then handed him presents and, placing a white silk scarf in his hands, offered my hearty congratulations and good wishes.

The presentation of gifts by the remainder of my party brought our part of the ceremony to a close. Sir Ugyen Wang-chuk then turned and made his obeisance to the Deb Raja, who, as Chole Tulku, is the head of the Bhutanese Church, awaiting the reincarnation of the Dharma Raja, and received his blessing. In like manner Sir Ugyen also received the blessing of the abbot.

Now began an almost interminable procession of lamas, officials, and retainers, each bringing a scarf and presents, till Sir Ugyen was almost smothered in scarfs, while the whole nave from end to end gradually became filled up with heaps of tea, bags of rice and Indian corn, rolls of fabrics—silk, woolen, and cotton—of all colors and values, with little bags of gold dust and rupees appearing on the top (see page 407).

As each present was placed on the floor the name of the donor was announced. I had no means of verifying, but I should think there were at least 200 donors. It

THE DURBAR AT POONAKHA

From right to left: Thimbu Jongpen; Sir Ugyen, seated, covered with scarfs; behind him is Ugen Dorji; the Ta-tshang abbots seated before the altar, which is covered with offerings of fruit; the author, Major Rennick, and Mr. Paul. Notice the dish of fruit in front of each and the magnificent silk hangings and coverings (see page 405).

AT THE DURBAR, LOOKING DOWN THE ROOM, SHOWING THE LARGE HEAP OF PRESENTS IN THE CENTER OF THE HALL

The officials are writing down the names of the donors, and on the left are seated the Ta-tshang lamas in gorgeous robes, while all round the hall are brilliant brocade silk hangings, and an especially handsome line of circular flags above the Ta-tshangs (see page 405)

THE COURTYARD AT POONAKHA AFTER THE DURBAR, WITH GAILY DECORATED MULES AND PONIES, EACH WITH ITS ATTENDANT

was amusing to watch the emulation among them and the flourishes some of them gave as they dumped the presents with a bang on the floor and whipped out the scarfs to their full length. The presentation of white silk scarfs on the meeting of officials with superiors, equals, or subordinates is a universal custom in Bhutan.

When these congratulations came to an end, tea and refreshments were offered to all the company of guests, including the lamas in the aisles, who at each course intoned a sort of grace. Finally beetel and pan were distributed. (Beetel-nut is the fruit of a palm and pan is an astringent leaf, which, eaten with a small quantity of lime, is much prized by the Bhutanese.)

AN INTERESTING BEER CEREMONY

At the commencement of the feast a large cauldron of *marwa,* or beer of the country, was placed at the lower end of the nave and a curious ceremony was gone through. The Zung Donyer, with a long, bowl-shaped ladle, mixed the liquid three times; then, holding up the bowl full of beer in one hand, raised the other in prayer.

This ceremony he repeated three times and then advanced with the ladle full to the Deb Raja (see page 436), who blessed it; he then turned to the Tongsa, upon whose hands a small portion was poured; and, finally, the Donyer returned and poured the remainder into the cauldron, which was removed doubtless for the refreshment of the crowd of onlookers, who were not of sufficient importance to share the tea and refreshments dispensed in the Durbar Hall.

Next, with great ceremony, a wooden spear, with a piece of red cloth and a white silk scarf fastened to the base of the head, was carried to the Deb and blessed; it was then waved over the Tongsa, who reverently touched the end of the shaft. The spear was then sent to the Tongsa's apartments.

The final act in the ceremonial was a short prayer, led by the Deb and intoned by the lamas, and with this the proceedings ended and we returned to camp.

It was a most interesting ceremony and conducted throughout with the greatest order and reverence and it passed off without a hitch of any kind. It says a good deal for the change in the conduct of affairs in Bhutan and their anxiety to show respect to the British government that they should have made the presentation of the decoration to the penlop the first occasion of so public and elaborate a ceremony, as I understand that hitherto it has been the custom of the recipient of an honor merely to go to the Deb and head lamas to receive their blessing, while congratulations and presents were received at his private dwelling.

THE SPIRITUAL CAPITAL OF THE NATION

While at Poonakha I paid a visit to the Ta-lo Monastery, which was only reached after three hours' hard climbing. This monastic colony is a charming collection of small, well-built, two-storied houses, with carved and painted verandas scattered all over the hillside, each in its little garden of flowers and trees, with here and there a chapel or decorated *chorten,* or shrine, to break the monotony.

The great temple, with its somber background of cypress and pine, dominates the scene, but higher up the beautifully decorated retreat of the late Dharma Raja formed a fitting crown to the whole group of buildings. In the great temple were many chapels, all scrupulously clean and well ventilated, glass window-panes being in great evidence.

The principal objects of interest were two large silver *chortens* containing the ashes of two of the Shabdung Rimpoches. They were highly chased and jeweled, the stones being mostly turquoise. The ceremonial instruments used by the late Dharma Raja were preserved here and were fine examples of the best Bhutanese metal work.

The carving on the pillars and canopies was excellent, but so much overladen by open-work metal scrolls it was difficult to follow in detail. An elephant's tusk before one of the altars measured 8½ feet, and there was a magnificent collection of embroidered and appliqué banners; in fact, the whole building was full of treasures.

I was received with open arms and

THE BHUTAN OFFICIALS ON THEIR WAY TO AUTHOR'S CAMP AFTER THE DURBAR

The three on the left are the Paro Penlop, the Thimbu Jongpen, and Sir Ugyen

BHUTAN ORDERLIES FOLLOWING THEIR OFFICIALS TO AUTHOR'S CAMP, DRESSED IN BRIGHTLY DYED TUSSORE SILK GARMENTS, WEARING STEEL HELMETS, AND EACH CARRYING A SILVER-SHEATHED SWORD

SIR UGYEN AND HIS COUNCILORS

The council were in bright-colored silk robes, each with his crimson shawl of office; standard-bearers in gaily striped bokus; fighting men with swords, leather shields, and brightly polished steel helmets ornamented with colors; archers with bows and arrows; gun-carriers with all kinds of strange weapons, and many others, all quaintly and picturesquely dressed. From left to right: Poonakha Jongpen, Thimbu Jongpen, Sir Ugyen, Zung Donyer, Deb Zimpon, and, standing, Ugen Dorji.

GROUP TAKEN IN AUTHOR'S CAMP AT POONAKHA

The Tongsa and officials were particularly pleased with the magic lantern shown them privately and asked for a second display in the fort. We obliged them a few evenings later to a vast crowd—I should think of at least a thousand people—who, from the remarks I at times overheard, took a keen and intelligent interest in the performance. In addition to slides made from my Tibetan pictures, I had several of India and Europe, and we wetted the screen thoroughly to enable the audience on both sides to see. The four figures in the center, from left to right, are Poonakha Jongpen, Thimbu Jongpen, Sir Ugyen, Paro Penlop and his son, Deb Zimpon, and on the right Ugen Dorji.

FEEDING THE PEOPLE AT POONAKHA, OUTSIDE MY CAMP, AFTER THE DURBAR

We distributed doles to the poor in the neighborhood. More than a thousand turned up, a most quiet and orderly crowd, who waited with the greatest patience each for his turn. I had them marshaled in double lines, sitting on the ground, and Rennick and Campbell passed down the lines, giving each person a four-anna bit. Even the babies were made to hold out their hands, though the parents speedily seized the coin.

every expression of friendliness by the lama, a brother of the late Shabdung Rimpoche, who invited me to look at everything I wanted and broke open seals on boxes and doors in order to allow me to examine his treasures. I fancy this is the first time any European had been allowed to do such a thing, and the treasures were worth seeing, especially the old embroidered banners. Even the late Shabdung's dwelling was opened and I was allowed to enter his private rooms, the greatest honor they could confer on me.

All we required was provided and everything done for our comfort, and the lama (see page 415) was quite hurt that we were unable to stay longer and accept more of his hospitality.

The ladies who had entertained me at Ta-lo later came to Poonakha and paid me a visit. After listening to the gramophone, with which they were much pleased, they went away, taking with them some silks for themselves and toys for their children. With them came the head of Ta-lo, the Tango Lama, a man about 40, and his younger brother, Ninser Talku, about 11 years old. In the evening the lama came back to dine with us, accompanied by the Thimbu Jongpen, but I do not know that on this occasion the dinner itself was an actual success, as the lama was not allowed to eat fowl or mutton, our principal stand-bys, and the Thimbu excused his want of appetite by saying he had already dined.

THE TA-LO LAMA IN CENTER WITH A LARGE GOITER

This disease is very prevalent throughout the Himalayas, and is believed to be caused by drinking snow water

SIMPLE AND KINDLY PEOPLE

I have always found the Bhutanese, as well as the Sikkim people, very appreciative of English food, and as they are Buddhists, with no question of caste, they consider it an honor to be asked to meals, and are most anxious to return any hospitality they receive, in marked contrast to the natives of India, who are defiled and outcasted by such intercourse with strangers. It is a great factor in helping forward friendly relations, and although, out of politeness, they never refuse to taste wine, nearly all the officials are extremely abstemious.

At Poonakha the others jocularly remarked that the Zung Donyer, being so much older, was a seasoned vessel and must drink for the rest of them, and often passed the half-emptied glasses on to him to finish; but at the same time they kept a strict watch to see that the strange spirits whose strength they were unaware of should not overcome him.

After dinner I showed the Tango Lama a stereoscope, with views of Europe, and he so enjoyed it that I gave it to him when he called to take leave. He asked me if I had brought with me any toy animals, mentioning in particular an elephant, as he wanted them to place before a new shrine they were making at Tango. By a great piece of luck I had a toy elephant that waved its trunk and grunted; also a donkey that gravely wagged its head, and a goat that on pressure emitted some weird sounds. He was greatly delighted with them and bore them off in triumph, but whether to assist his worship or amuse his children I do not know.

Next day, on leaving, he asked if I had a model of a cow, but that, unfortunately, was not forthcoming. It was an excellent idea, bringing models of animals and simple mechanical toys among the presents, and they are most popular as gifts, a jumping rabbit being in great demand. It shows the simple nature of

THE LATE SHABDUNG RIMPOCHE'S HOUSE AT TA-LO MONASTERY

The frescoes and carvings under the eaves are good and the whole of the decoration is well carried out. The bells are cast in Bhutan (see page 428)

the people, that they should be interested so easily.

While at Poonakha I procured a specimen of the takin (*Budorcus taxicolor whitei*), a very rare animal, and I succeeded in bringing a live specimen to England, which is now in the Zoölogical Gardens, London (see page 417).

A VISIT TO A BHUTAN HOME

With the conclusion of the Durbar my official duties came to an end, but the Tongsa (now Sir Ugyen Wang-chuk) begged me to accompany him to his official residence, the castle at Tongsa, and thence to his private residence and castle at Byagha; so my party became the private guests of Sir Ugyen. We were entertained by the most charming and thoughtful of hosts, everything that could conduce to our comfort being done—camps pitched, roads mended, even houses built for us to live in; in fact, no host could have done more and few so much.

After four days' marching, passing en route Angduphodong Jong, we reached Tongsa. On nearing the fort a bevy of singing girls met us below the almost perpendicular approach and sang us into the fort. I was obliged to ride up steep zigzag steps, although I would have much preferred to walk; but it would not have been considered etiquette for me to arrive on foot (see page 435).

Sir Ugyen met us in camp with the information that the castle lamas were all ready and eager to finish the dances that on our previous visit had been stopped by rain; so, after a hasty lunch, I went on to the castle. The dance went off very well, with the dancers in gorgeous dresses of every imaginable color, to the accompaniment of weird tom-toms and huge trumpets, flutes, and cymbals,

PHOTOGRAPH OF THE RARE TAKIN, OR BUDORCAS TAXICOLOR WHITEI, TAKEN IN CHUMBI (SEE PAGE 416)

He was being brought to India, but, unfortunately, the next day he was found dead; it is supposed poisoned by eating aconite. Later I succeeded in securing another specimen, which is now in the Zoölogical Garden, London.

ANGDUPHODONG JONG, SITUATED ABOUT TEN MILES BELOW POONAKHA, ON THE MO-CHHU (SEE PAGES 438 AND 443)

which produce a strange and unusual, but rather fascinating, music of their own. But the most interesting objects to me were the masks, which, instead of being carved out of wood, as in Sikkim, were molded from a *papier-mâché* of cloth and clay, and very well molded they were—the heads of the various animals quite recognizable and many with great character (see pages 439 and 444).

The fort is composed of a wonderful collection of buildings. Within its numerous courtyards, temples, and dwellings it contains a population of perhaps 3,000 lamas and laymen and could hold 6,000 (see pages 420-423, 442, and 443).

A distinctive feature which is most striking in Bhutanese architecture is that all the walls have a distinct camber, and that the windows are of peculiar form, with the sides sloping inwards. From whence did this form of architecture come? What is its origin? Did it come into this remote and inaccessible region in the Himalayas through the Akkadians, Babylonians, Assyrians, and Persians from Egypt? Or was the center from which the art spread founded by a race which had its habitat somewhere in Asia? An interesting question, which can only be touched on here, but one which would be worth some systematic study (pages 432 and 433).

BLESSING THE RICE FIELDS

Early one morning the sound of a sweet-toned gong warned us that the spring ceremony of blessing the rice fields was about to begin (see page 420).

A long and picturesque procession of men and women, led by the Donyer, came winding down the hillside until the first rice field, into which water had been running all the day before, was reached. The field below was still dry, and turning in there they all sat down and had some refreshment. Suddenly the men sprang up, throwing off their outer garments; this was the signal for the women to rush to the inundated field and to commence throwing clods of earth and splashes of muddy water on the men below as they tried to climb up.

Then followed a wild and mad, though always good-natured, struggle between the men and the women in the water, the men doing their utmost to take possession of the watery field, the women equally determined to keep them out.

The Donyer, the leader of the men, suffered severely, though the courtesies of war were strictly observed, and if one of the assailants fell his opponents helped him up and gave him a breathing space to recover before a further onslaught was made. But gradually the women drove the men slowly down the whole length of the field until the last stand was made by a very stout and powerful official, who, clinging to an overhanging rock, with his back to his foes, used his feet to scoup up such quantities of mud and water that no one was able to come near him.

However, all the other men having been driven off, he and the Donyer were allowed at last to crawl up on the path and the combat for the year was over. This was looked on as a very propitious ending, as the victory of the women portends, during the coming season, fertility of the soil and increase among the flocks and herds; so they dispersed to their various homes rejoicing.

PRAYER-WHEELS DRIVEN BY WATER

Below the eastern wall of Tonsa in the ravine is the building containing the prayer-wheels, worked by water, from which the palace took its original name of Chu-knor-rab-tsi. In it are two sets of wheels, each axle containing three manis, or cylinders, containing prayers, one above the other, the smallest at the top. They had evidently not been used for some time, so the next day, having nothing better to do, we assisted in putting them in order by clearing out the waterways, which had been blocked with stones and rubbish, and hope it may be placed to our credit as a work of merit.

In Bhutan we often saw these water-driven prayer-wheels, most of them in a state of picturesque decay and only a few still in working order. For the benefit of my readers who are unacquainted with this practice, the following is a short description: A prayer-wheel consists of a hollow cylinder filled with written or printed prayers and fixed to a perpendicular shaft of wood, to the lower end of which horizontal flappers are attached,

GENERAL VIEW OF TONGSA JONG

The flooded rice field on the right-hand corner is the scene of the ceremony of blessing the rice, where the sham fight between the men and women took place (see text, page 419)

ANOTHER VIEW OF TONGSA JONG, SHOWING OUTLYING FORTS, TERRACES, AND IRRIGATING PIPES

against which water is directed from a chute; the end is shod with iron and revolves in an iron socket driven by the force of the stream. With each revolution the prayers are believed to be prayed for the benefit of the builder of that particular wheel and count so much to his credit.

They are very easily kept in order; but probably because only construction and not preservation is a work of merit in the Buddhist religion, no one seems to take the trouble to clear out the watercourses or to mend a broken flapper, and consequently most of them were at a standstill.

It is a delightfully easy method of praying, and some enormous wheels have been erected. One at Lamteng, in the Lachen Valley in Sikkim, contains no less than four tons of printed paper, and measures about 9 feet in height by 4½ feet in diameter; but these very large ones are seldom worked by water-power, and generally have a crank on the lever end of the shaft, which any one anxious to pray has only to turn, while a bell sounding automatically at each revolution records the number of prayers repeated.

THE KING'S PRIVATE HOME

We stayed here a few days and then went on to Byagha. This visit to Byagha, which lasted 12 days, was really the most enjoyable part of the expedition, for we were received as honored guests by Sir Ugyen in his private capacity; and interesting and imposing as the ceremonies had been at Poonakha, these few days at Byagha gave us a much deeper insight into the life and customs of the Bhutanese, as our intercourse with our host was quite free and untrammeled.

An easy descent brought us to an open-

Photo by John Claude White

"Below the eastern wall of Tonsa in the ravine is the building containing the prayer-wheels, worked by water. In it are two sets of wheels, each axle containing three manis, or cylinders, containing prayers, one above the other, the smallest at the top. . . . In Bhutan we often saw these water-driven prayer-wheels, most of them in a state of picturesque decay and only a few still in working order" (see text, pages 419-421)

Photo by John Claude White

ONE OF THE GATES TO TONGSA JONG (SEE PAGES 432 AND 433)

"It is a delightfully easy method of praying, and some enormous wheels have been erected. One at Lamteng, in the Lachen Valley in Sikkim, contains no less than four tons of printed paper, and measures about 9 feet in height by 4½ feet in diameter" (see text, pages 419-421).

ing in the pine forest, from whence we looked down on the broad vale of Byagha, through which a river flowed tranquilly. On the right bank was a large house and chapel, surrounded by trees just bursting into leaf, the home of Sir Ugyen's sister, and close by the site of the old house in which he was born. On a bluff on the central ridge, some 500 feet up, was the castle, entirely rebuilt, though on a smaller scale, after the total destruction of the old one in 1897; while, to crown all, where the ridge widened out into broad glades, edged with pine forests, was the equally new summer house of our host. He had terraced and turfed the slope above the castle (see page 426).

Nothing could have been more picturesque than our camping-ground at Byagha. The view everywhere, both up and down the valley, was lovely. Dr. Griffith 70 years previously had written: "The country was very beautiful, particularly in the higher elevations. And at this season, to add to the beauty, primulas, in flower in myriads, clothed whole glades in delicate violet, while above rhododendrons flamed in gorgeous scarlet." He adds: "We saw scarcely any villages, and but very little cultivation."

In direct contradiction to this, I noticed that whole hillsides were being cultivated up to at least 11,000 feet, and I was so struck by the difference that I

GROUP OF LAMAS AND NOVITIATES AT TONGSA

There is a curious mixture of type among them, due probably to the prevalence of raids into the plains in earlier days and to the fact that they brought back captives both men and women. Note two cases of goiter

GROUP OF WOMEN AT TONGSA JONG

Notice that they are nearly all either telling their beads or turning prayer-wheels, sometimes both. Note curtain of window

SIR UGYEN'S SISTER'S HOUSE AT BYAGHA. A GOOD SPECIMEN OF A PRIVATE HOUSE. THEY ARE VERY LARGE AND ACCOMMODATE AN ENORMOUS FOLLOWING (SEE PAGE 423)

SEWING MAIDS IN OLD COSTUMES, NOW DISCARDED

made inquiries, and found that as recently as 30 years ago, when Sir Ugyen left the valley, a boy of 12, there was nothing but jungle either here or on the slopes opposite. The land had only been brought into cultivation since the internecine quarrels had ceased some 18 years ago. So much for stability of government; but even now poverty reigns, and the valley is only prosperous in comparison with more unlucky ones.

As soon as we had settled down, Sir Ugyen's sister, his two daughters, and a daughter of the Thimbu Jongpen came to add their welcome. The younger ones were rather pretty, unaffected and merry girls, while the sister, although a grandmother, was full of good nature and showed traces of good looks. They all wore their quaint and distinctive dress, which consists of a long piece of Bhutanese cloth, woven in colored stripes, draped round the figure, and fastened on the shoulders and confined at the waist by a band of brighter Bhutanese cloth. They also wore necklaces of large, rough beads of coral, turquoise, and amber, and occasionally gold filigree beads and many bangles of gold and silver (page 434). Their hair was left unornamented and either cut short or worn in two long plaits. The elder daughter brought her little son, to whom I gave a bottle of sweets, which pleased him just as much as it would a little Western boy, and his mother told me later that he ever after loved me for my gift.

Very soon after our arrival Sir Ugyen took me all over his house. On the east front, occupying the whole width of the

building, was a long, well-ventilated factory, where many girls were busy weaving silk and cotton fabrics, chiefly the former. The silk was in the main tussar, obtained from Assam and the northern hills. It was altogether a very charming and home-like dwelling, and evidently managed by an excellent and capable housewife in his eldest daughter, who lives with him and superintends his household (see pages 437 and 446).

On one occasion we breakfasted with him, and were offered several small dishes cooked in Chinese fashion in small cups, with the accompaniment of boiled rice, while in the center of the table was a large dish of various kinds of meat. After breakfast I had to go and witness an archery contest. The distance between the butts was at least 150 yards, and the shooting was much better than what we saw at Poonakha and what Dr. Griffiths writes of. There were two teams, captained respectively by Ugyen Kazi and the Tongsa Donyer, and the former won.

SIR UGYEN'S PERSONALITY

Sir Ugyen took a good deal of trouble to find some books for me, from which I have gathered a fuller account of early Bhutanese history than we have had hitherto.

His own story is a somewhat pathetic one. As a young man he married an exceedingly lovely girl, to whom he was devotedly attached, but after the birth of their second daughter she died very suddenly from some unknown cause. The shock was a terrible one to Sir Ugyen. He became seriously ill, and on his recovery withdrew from all gaiety and found solace in reading and studying the history and legends of his country. As some of his followers described him, he was more than a lama. Sir Ugyen is the only Bhutanese I have come across who takes a real and intelligent interest in general subjects, both foreign and domestic, and he neither drinks nor indulges in other vices. He made a large collection of books, but unfortunately many of them were destroyed when the Dechen-phodang, near Tashi-cho-jong, was burnt down; while the earthquake of 1897, which destroyed all the principal buildings in Bhutan, ruined other archives.

THE LIFE OF THE WOMEN

We were also entertained by the Tongsa's sister and spent several days in an encampment near her house. We here saw what capable housewives the Bhutan ladies are. Everything was done very systematically. In the morning the provisions for the day were given out—no easy task, with some hundreds of retainers to feed—and the store-rooms relocked, orders issued, and tasks appointed in spinning, weaving, etc., to be carried out by the large household of women, and it was interesting to see the deference in which these dames are held.

We were taken to see the Guru Lhakung Monastery and to lunch at a country house; were shown all the industries of weaving in cotton, wool, and silk; the process of casting of metals, chiefly bells and images; the making of swords and gold- and silversmith's work. Many pieces turned out by the latter were of exquisite design and finish. It was all most interesting and instructive.

THE MEN ARE EXCELLENT ARTISANS

The Bhutanese excel in casting bells, and I have seen some excellent specimens with very fine tones. The composition used for the best bells contains a good deal of silver, but they never make them of any great size, the largest I have seen being probably 24 inches in diameter and of about an equal height.

In iron-work they are also good artificers, and many of their sword-blades are of excellent manufacture and finish, and are still made from the charcoal iron. The polish they put on them is wonderful, and the blades almost look as though they had been silvered.

Their swords are very handsome weapons, with finely finished blades, elaborately wrought, silver-handled, inlaid with turquoise and coral, and silver scabbards with gold-washed patterns, attached to handsome leather belts with brightly colored silk cords and tassels. Their daggers are also very fine, many of them with triangular blades and fluted sides,

THE KING OF BHUTAN, SIR UGYEN WANG-CHUK

He is shown standing in the doorway of his residence, wearing the insignia of the Order of the Indian Empire, which was bestowed on him by the British Government before his elevation to the throne. Photo by John Claude White.

A CLIFF-SIDE MONASTERY

This group of buildings forms part of the Paro-ta-tsang monastery, which is perched on the face of a perpendicular cliff thousands of feet above sea-level. Note the prayer flags and shrine in the road in the foreground of the picture. From this point the road descends into an almost impassable gorge by steps cut out of the solid rock where the smallest slip would mean being precipitated down a couple of thousand feet. (See also pages 374–377.) Photo by John Claude White.

IN A BHUTAN FORTRESS

The Dug-gye Jong, or castle of Dug-gye (see pages 368–370) protects one of the entrances to Bhutan from possible raids by the Tibetans. The picture shows the citadel and courtyard. On the steps is the governor of the castle, with his son. "This fort is magnificently situated on a projecting spur in the middle of the valley, with high snow peaks on either side and lovely views looking down the valley." Photo by John Claude White.

THE PICTURESQUE CASTLE AND OFFICIAL RESIDENCE OF THE KING OF BHUTAN: THE TONGSA JONG

Photo by John Claude White.

A CORNER IN THE TONGSA JONG

"The fort is composed of a wonderful collection of buildings. Within its numerous courtyards, temples and dwellings it contains a population of perhaps 3,000 lamas and laymen, and could hold 6,000." Note the beautifully carved windows and the curious overhanging roofs. Photo by John Claude White.

THE ROYAL FAMILY OF BHUTAN

On the top step stands the king, not in his robes of state but in the comfortable attire of private life. Beside him are his sister and her two daughters, and on his right one of his nephews. The three girls in front are serving-maids who wear the modern costume of their class.

THE KING'S SINGING GIRLS

"We were entertained by the most charming and thoughtful of hosts. Everything that could conduce to our comfort was done, camps pitched, roads mended, even houses built for us to live in; in fact, no host could have done more and few so much. . . On nearing the Fort, a bevy of singing girls met us below the almost perpendicular approach and sang us into the Fort (Tongsa Jong)." Photo by John Claude White.

THE LAST OF THE DEB RAJAS

The Deb Raja was formerly the civil ruler of the country, and was also its ecclesiastical head when there was no Dharma Raja. Behind is seen one of the beautiful embroidered banners, his mitre and scarf on the left, the paraphernalia of office on the table, including a double drum and bell. The embroidered cloth in the foreground is in appliqué work in bright colors. Photo by John Claude White.

IN THE PALACE OF THE KING

This fortress—the Byagha Jong—is the family residence of the present king. It shows how interesting and picturesque the buildings in Bhutan are. In the background is the band of musicians which welcomed the author to the castle. In the center of the courtyard is the royal bathroom, consisting of three tree-trunks hollowed out to serve as baths. Photo by John Claude White.

A TYPICAL COURTYARD

The Bhutanese are very clever builders, and their woodwork is always of a high standard of excellence, their doors, windows and panelling being perfect in their way. The houses are of three or four stories, with balconies opening on to courts in the interior. The ornamentation is of carved wood, generally painted. No ironwork is used, and the doors are hung on ingeniously constructed wooden hinges. Photo by John Claude White.

A GROUP OF MASKED DANCERS—TONGSA-JONG

The Bhutanese are, like the Tibetans, Buddhists, and this picture shows a group of lamas, or monks, engaged in one of the religious dances often incorrectly called devil dances. The masked dancers do not represent devils, but virtues and vices and various mythological characters, as in the Miracle Plays of Europe in the Middle Ages. Photo by John Claude White.

THE WINTER QUARTERS OF THE GOVERNMENT

This fortress, known as the Punakha Jong, a typical Bhutanese stronghold, is the headquarters of the government in winter. Bhutan is an independent state, but it has surrendered to the British Government the control of its foreign relations. In fact, though not in name, this step really made it a part of the Indian Empire. (See also pages 400–406.) Photo by John Claude White.

THE MONKS' QUARTERS IN THE TASHI-CHO-JONG

A group of monks are seen in the foreground, where no layman may enter. This fortress contains many beautifully decorated chapels, the door handles of ironwork inlaid with gold being especially beautiful. It is said to possess one thousand images of Buddha. (See pages 392, 393, 395 and 396.) Photo by John Claude White.

A NATIVE BRIDGE

This bridge, below the castle of Angdu-pho-dong, has a span of 130 feet. It is a fine specimen of native work, and is probably very old. An English visitor to Bhutan 120 years ago made a sketch of a bridge at the same site which has an extraordinary resemblance to the present structure. Photo by John Claude White

THE CASTLE OF ANGDU-PHO-DONG

Like all Bhutanese strongholds, the interior of this castle is arranged in a series of courtyards. The houses in the one shown in the picture are assigned to minor officials, and here they live in happy familiarity with the domestic animals that can be seen in the foreground. Photo by John Claude White. (See page 415.)

LAMAS IN THEIR GORGEOUS SILK VESTMENTS—TONGSA JONG

These three lamas have assisted at the "mask dance" (see page 435), and, as it is a religious function, they are attired in their robes of

with sheaths of exquisite open silver and gold work set with turquoise.

Every house of any importance has large workrooms attached in which weaving is carried on, and the stuffs produced, consisting of silks for the chiefs' dress, woolen and cotton goods, are excellent; and a good deal of embroidery is also done.

The monasteries possess an art which, so far as I know, is peculiar to Bhutan. They make most beautiful needlework pictures of the saints on hanging banners. Innumerable pieces of colored silks and brocades are applied in a most artistic manner with elaborate stitches of all kinds. Many of them are veritable works of art (see pages 406-407).

Another industry in which the Bhutanese excel is basket-work and fine matting, made from split cane. The baskets are beautifully woven of very finely split cane and some of the lengths are colored to form a pattern. They are made in two circular pieces, rounded top and bottom, and the two pieces fit so closely and well that they can be used to carry water. They are from 6 to 15 inches in diameter, and the Bhutanese use them principally to carry cooked rice and food. They also make much larger and stronger baskets, very much in the shape of a mule-pannier, and these are used in a similar way for pack animals.

The mats are also very finely woven of the same material, with a certain amount of the split cane dyed to form patterns. They are delightfully fine and soft, so flexible they can be rolled up into quite a small space and very durable, and can be got in almost any size up to about 16 feet square, and even larger if they are required.

Possibly the excellence of the work produced in Bhutan owes much to the feudal system which still prevails there. Each penlop and jongpen has his own workmen among his retainers, men who are not paid by the piece and are not obliged either to work up to time or to work if the spirit is not in them, and consequently they put their souls into what they do, with the result that some pieces of splendid individuality and excellent finish are still made. No two pieces are ever quite alike, and each workman leaves his impress on his work.

The suspension bridges in Bhutan are very interesting and merit description. They consist of four or five chains of wrought iron made of welded links, each 15 to 18 inches in length. The three lower chains are tightened up to one level, and on them a bamboo or plank roadway is placed. The remaining chains, hanging higher up and further apart, act as side supports, and between them and the roadway there is generally a lattice-work of bamboo, or sometimes grass, in order that animals crossing may not put their legs over the side. The roadway is never more than three or four feet wide.

Many of the chains on these bridges are extremely old—many hundreds of years—and appear to be of Chinese workmanship. The links are in excellent order and very little pitted with rust. The other and newer chain bridges have been made in Bhutan.

I should have liked to stay longer in Bhutan, but I could spare no more time and was obliged to turn my face homeward and take leave of my most charming and entertaining hosts, which I did with great reluctance.

MAGNIFICENT GORGES

On the homeward journey we went north from Tashi-cho-jong, traveling up the magnificent gorges of the Tchin-chu, passing the monasteries of Perugri-sampti-guatsa and Tango to the higher grazing grounds.

The gorge of the Tchin-chu is bordered by stupendous cliffs of most weird shapes, among which El Capitano, of the Yosemite Valley, would be dwarfed by the lowest of these monsters. These cliffs appeared to be formed by horizontal strata of sedimentary rocks, consisting of layers of limestone, sandstone, slate or shale of a dark-blue color and quartzites. The towering rocks were cleft in numberless places from top to bottom, leaving narrow slits or fissures, which I was told were often more than a mile long. One which I photographed extends for more than two miles before it opens out in a beautiful basin, and forms one of the Thimbu's best grazing stations.

INTERIOR OF SIR UGYEN'S HOUSE AT BYAGHA, WITH GROUPS OF WEAVING WOMEN: ON RIGHT UPPER STORY ARE THE WEAVING ROOMS
(SEE TEXT, PAGES 427-428, AND PICTURE, PAGE 437)

THE PICTURESQUE SUMMER RESIDENCE OF SIR UGYEN'S SISTER AT SANGACHOILING: SITUATED ABOUT FOUR MILES NORTH OF BYAGHA

Presently we came to Gangyul (13,600 feet), a little village in a narrow, flat valley close under the eastern glaciers of Cho-mo-Lha-ri. While our camp was being got ready, I rode two or three miles up the valley in the hope of seeing a remarkable cave which we were given to understand was in the locality. We soon discovered, however, that our guide was much more anxious to show us a large flat rock of slate situated between two branches of the Tsango-chu, at the head of which was a wooden axle forming a rack.

DEVOURED BY LAMMERGEIERS

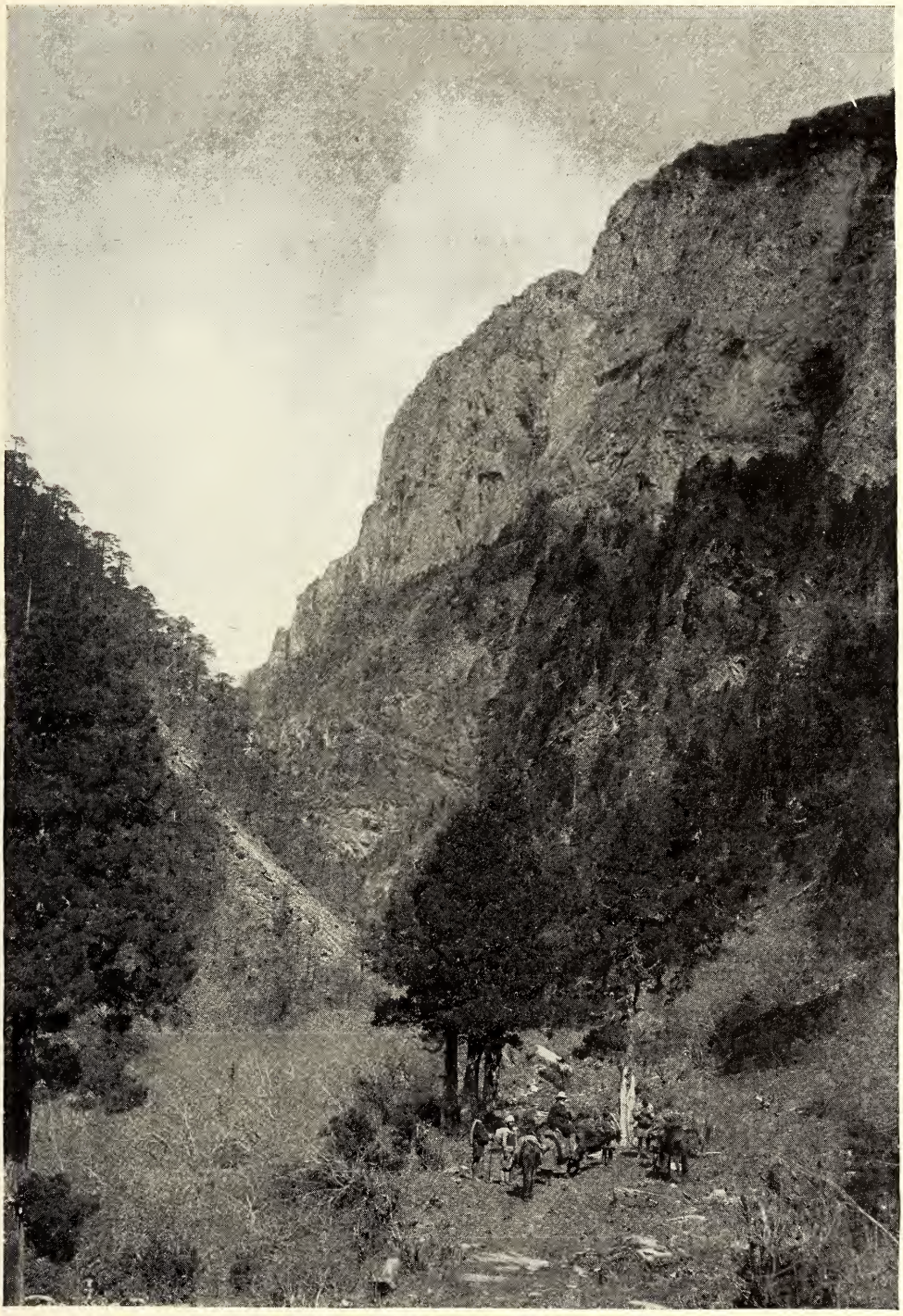
It was carefully explained to us that this was a holy spot on which human corpses, the head and shoulders tied to the axle to keep the body in place, were exposed, to be eaten by lammergeiers and other ravenous birds and beasts of prey. In perfectly solemn and earnest good faith we were told that the birds were fastidious and would not touch low-caste bodies, and that only three families in the valley were entitled to be thus disposed of.

The Thimbu excused himself from accompanying me, as the memories connected with this spot were very painful to him, his daughter only a few years before having been laid on the slab.

One of our guides lay down on the slab, while another lit a smoky fire, devices which, they said, would be sure to attract the lammergeiers from their eyries; but the deception failed and no birds appeared. In another respect the little valley was very remarkable, as the glaciers seemed to completely close in the head, and I saw two avalanches and heard several more, caused by the increasing power of the sun's rays on the snow.

AN OLD LAMA, KNOWN AS THE LHASA DOCTOR

He was quite a character, and posed himself for this picture with his human thigh-bone trumpet and skull drum



A VIEW UP THE TCHIN-CHU GORGE: RIDING YAKS AND MULES IN FOREGROUND

The Bhutanese have a curious habit of feeding their mules with eggs when engaged in a specially difficult journey (see text, page 377)

FEEDING FOLLOWERS AFTER ARRIVAL IN CAMP: BLACK YAKS' HAIR TENTS AND EMBROIDERED TENT BELONGING TO THE HEAD MAN

VIEW LOOKING TOWARD THE BOD-LA PASS, A SMALL TEMPLE SURROUNDED BY PRAYER-FLAGS, AND OUR COOLIES AND THEIR LOADS IN THE FOREGROUND

GROUP TAKEN IN CALCUTTA DURING THE VISIT OF H. R. H., THE PRINCE OF WALES

From left to right: Bhutan Orderly, Mr. R. E. Holland, Foreign Office; Captain Hyslop, 93d Higlanders, on special duty during H. R. H.'s visit; Sir Ugyen, Ugen Dorji, the author, Rai Lobzang Chuden Sahib, Jerung Dewan, H. H. the Maharaja of Sikkim, Barmiak Kazi, H. H. the Maharani of Sikkim, Bhutan Orderly, Sikkim Orderly.

OUTLINE MAP OF BHUTAN, SHOWING JOURNEYS BY JOHN CLAUDE WHITE (SEE PAGE 365)

THE HOME OF THE NATIONAL GEOGRAPHIC SOCIETY

On the right is the Gardiner Greene Hubbard Hall, erected for the Society by the heirs of its first President. In this beautiful building are the Board rooms and Library. The administration building adjoining, which has just been completed, is devoted to the editorial and business offices of the Magazine. The Society's spacious home is located on Sixteenth street, one of Washington's most beautiful boulevards, where many of the foreign embassies are located, and five squares north of the White House. Mr. Arthur B. Heaton is the architect of the new building, which was built by the George A. Fuller Co.

The main glacier was most beautiful, looking like a curious broad staircase of snowy whiteness, leading from where we stood heavenward. There were several fine waterfalls gushing out from holes in the cliffs high above us and disappearing before they reached the path, the rivulets of water oozing out again from the banks of the main stream, showing that the water had resumed a subterranean course. A curious feature about the falls was that as the power of the sun increased so did the waterfalls visibly increase in size. Our camp that night was a cheery one and we relieved the time by learning, to the great amusement of the bystanders, to play Bhutanese backgammon, our implements being two wooden dice, a collection of little wooden sticks of varying length, and a handful of beans.

A short march brought us to the Phewla, or Ling-shi-La, over which pass we crossed into Tibet.

By this time the different kinds of transport I had used during my tours had included, I should think, about every known sort. I had made use of coolies, elephants, mules, ponies, donkeys, yaks, oxen, carts, pony-traps, rail, and steamer, and the only available animal I had not employed was the Tibetan pack-sheep.

I hope I may have interested my readers by my account of this hitherto-unknown country, one so little known that as recently as 1890 a high Indian official wrote most undeservedly, as my explorations proved: "No one wishes to explore that tangle of jungle-clad and fever-stricken hills, infested with leeches and the pipsa-fly, and offering no compensating advantages to the most enterprising pioneer. Adventure looks beyond Bhutan. Science passes it by as a region not sufficiently characteristic to merit special exploration."

And with this quotation I must close for the present, though later I hope to give the readers of the NATIONAL GEOGRAPHIC MAGAZINE some of my impressions of Tibet itself, in which country I have also done a certain amount of traveling.

THE NATIONAL GEOGRAPHIC SOCIETY AND ITS NEW BUILDING

BUILT with the solidity of a government building, planned as a model of what a building may be as the home of a great society and as the quarters of a large office force, the new building of the National Geographic Society combines every feature that modern architecture and sanitary engineering had to suggest toward making it the architectural representation of the ideals of the Society.

Its splendid proportions are typical of the wonderful growth of a great movement for the increase and diffusion of geographic knowledge. That movement began with the founding of the National Geographic Society, "for the increase and diffusion of geographic knowledge," January 27, 1888, by a small band of explorers and scientists.

For some ten years the Society followed the usual course of scientific societies, being a small institution with many ambitions, which the limitations of its funds prevented being fulfilled except in an imperfect way. Then, in 1899, came a new idea. Why not popularize the science of geography and take it into the homes of the people? Why not transform the Society's Magazine from one of cold geographic fact, expressed in hieroglyphic terms which the layman could not understand, into a vehicle for carrying the living, breathing, human-interest facts about this great world of ours to the people? Would not that be the greatest agency of all for the diffusion of geographic knowledge?

A GEOGRAPHIC AWAKENING

With an affirmative answer, a new era in geographic education dawned. The National Geographic Society found the whole world ready to enrich the pages of

GENERAL OFFICE: TO LEFT OF ENTRANCE OF NEW ADMINISTRATION BUILDING

Where visiting members are received. The entrance and Reception-room are finished in Botticini and Tennessee marble

its Magazine with the best things that travel, research, and exploration could bring, and it found the people eager for the knowledge those pages brought them. From that day to this there has been growth, growth, growth—growth that is expressed in the Society's new home, growth that is disclosed in the remarkable contents of the Magazine, growth that is emphasized by the fact that today the National Geographic Society is the largest and most popular scientific society in the world, and its Magazine the most widely circulated non-fiction magazine on earth.

The Society has no endowments; its endowment is the remarkable interest that the Magazine has stimulated throughout the world and the wonderful support it commands. With no other dividends to pay than the dividends of information it carries to its readers, the income derived from the Magazine can be put back into it and into the explorations and research work of the Society.

HUBBARD MEMORIAL HALL

Until 1902 the National Geographic Society was without a home of its own, but that year the heirs of the Hon. Gardiner Greene Hubbard built Hubbard Memorial Hall as a home for the Society and as a memorial for its first President. It looked as if they had discounted the future liberally and had anticipated the day of the greatest growth to which the Society could hope to attain. They little reckoned that within a single decade the rising tide of geographic interest would sweep into the Society a membership such as no other scientific society in the world has enjoyed; that before the ear-marks of newness were off the walls, the Society's management would have to be working and planning for more space.

Long before ten short years had passed Hubbard Memorial Hall was full and overflowing, and two branch offices had to be established in rented quarters. Soon the Board of Managers saw that it was only a question of two or three years until its own quarters would demand enlargement, and made provision for that day by acquiring the land adjoining the Hubbard Memorial Hall, a fine plat of ground 90 by 100 feet; they also began gradually to accumulate a building fund out of the receipts of the Society's business.

The work on the new building, which was designed by Architect Arthur B. Heaton, was begun on March 27, 1913; and, owing to the energy and faithfulness of the contractors, the George A. Fuller Construction Co., was completed in less than seven months. The results of that work are graphically told by the pictures and by the following letter, written by Mr. E. Z. Blagg, vice-president and general manager of the Globe-Wernicke Company, who was in charge of the erection of the new plant of that company, the largest woodworking plant in the world. He says:

A REAL "MODEL PLANT"

"I wish to extend my heartiest congratulations to the National Geographic Society, of which I am proud to be a member, on the completion of its new home. Before the erection of our new building in Cincinnati I made many trips to so-called 'model' plants throughout the country in search of ideas, and I want to say that I have yet to see a large office force more admirably housed than that of the Society.

"I was particularly impressed with the foresight of those who planned the building, in the matter of utilizing the natural light and providing for the last word in hygienic surroundings. There is not a dark corner in the building, and the ventilation system is perfect.

"That the present and future requirements of the Society were kept clearly in mind while the building was being planned is shown by the wonderful facilities throughout for the expeditious handling of the Society's business, particularly that pertaining to the issuance of the NATIONAL GEOGRAPHIC MAGAZINE. Your equipment for taking care of incoming mail is the most complete I have ever seen, and nothing has been left undone to expedite the work of each department.

"One feature of your system in particular impressed itself upon my mind as a model for all business concerns — I

OFFICERS AND MEMBERS OF THE NATIONAL GEOGRAPHIC SOCIETY

The first meeting of Robert E. Peary, discoverer of the North Pole (4), and Roald Amundsen, discoverer of the South Pole (3), at the home of the National Geographic Society, January 11, 1913. The other members in the group include J. J. Jusserand, the French Ambassador (2); Viscount Bryce, then Ambassador from Great Britain (5); George W. Wickersham, at that time the Attorney General (13); the Minister from Norway (14); Hiram Bingham, leader of the Yale-National Geographic Society Expedition to Peru (16). Officers and Board of Managers of the National Geographic Society: President, Henry Gannett (1); Col. Henry F. Blount (6); Dr. Alexander Graham Bell (7); Mr. John Joy Edson, Treasurer (8); Rear Admiral John E. Pillsbury (9); Gilbert H. Grosvenor, Director and Editor National Geographic Society (10); George Otis Smith, Director U. S. Geological Survey (11); Rear Admiral C. M. Chester (12); O. H. Tittmann, Vice-President, and Supt. U. S. Coast and Geodetic Survey (22); L. A. Bauer, Director Department of Terrestrial Magnetism, Carnegie Institution (15); Franklin K. Lane, now Secretary of the Interior (18); Rudolph Kauffmann, Managing Editor, Washington *Evening Star* (20); Brigadier General John M. Wilson, former Chief of Engineers, U. S. A. (21); C. Hart Merriam (29); Charles J. Bell, President American Security and Trust Co. (23); David Fairchild, Agricultural Explorer (24); George Shiras, 3d, former member of Congress and wild-game photographer (25); John Oliver La Gorce, Associate Editor, NATIONAL GEOGRAPHIC MAGAZINE (26); George R. Putnam, U. S. Commissioner of Lighthouses (27); Frederick B. Eichelberger, Assistant Treasurer, National Geographic Society (28); Frederick V. Coville, President Washington Academy of Sciences (31); Dr. S. N. D. North (32); T. L. Macdonald, M. D. (33); Edwin P. Grosvenor, Special Assistant to the Attorney General, member of firm of Cadwalader, Wickersham & Taft (30); Peter Stuyvesant Pillot (17), and Julien A. Ripley (19), of New York.

mean that your business for each day is complete in itself, and a trial balance struck before that day's books are closed. The prompt service received by your members through this system is an important factor in the wonderful growth the Society has enjoyed.

"Your new building adjoining Hubbard Memorial Hall will be a standing monument to represent the good work carried on by the Society."

The style of architecture of the new building is Italian Renaissance, and the material white brick, trimmed with white limestone, making it harmonize in every detail with the Hubbard Memorial Hall, with which it is connected by passages in the basement and in the first two stories. The hallway is paved with white and green marble, while the walls are of rich but plain Italian Batticino marble, which gives a pleasing effect to the eye. The first floor is the only one that covers the entire space of the lot; in the upper stories one-third of the space is occupied by a 20-foot air shaft, inclosed on only three sides. The result is that there is not a dark corner in the entire building, making it lighter on dark days than most modern office buildings are when the sun is shining.

THE SEVERAL DEPARTMENTS

The first floor of the new building is devoted to the reception offices, the office of the Assistant Secretary, and the addressing and mailing rooms. The second floor is occupied by the correspondence department, which receives and answers upward of a thousand letters on the average day. The third floor is devoted to the editorial department.

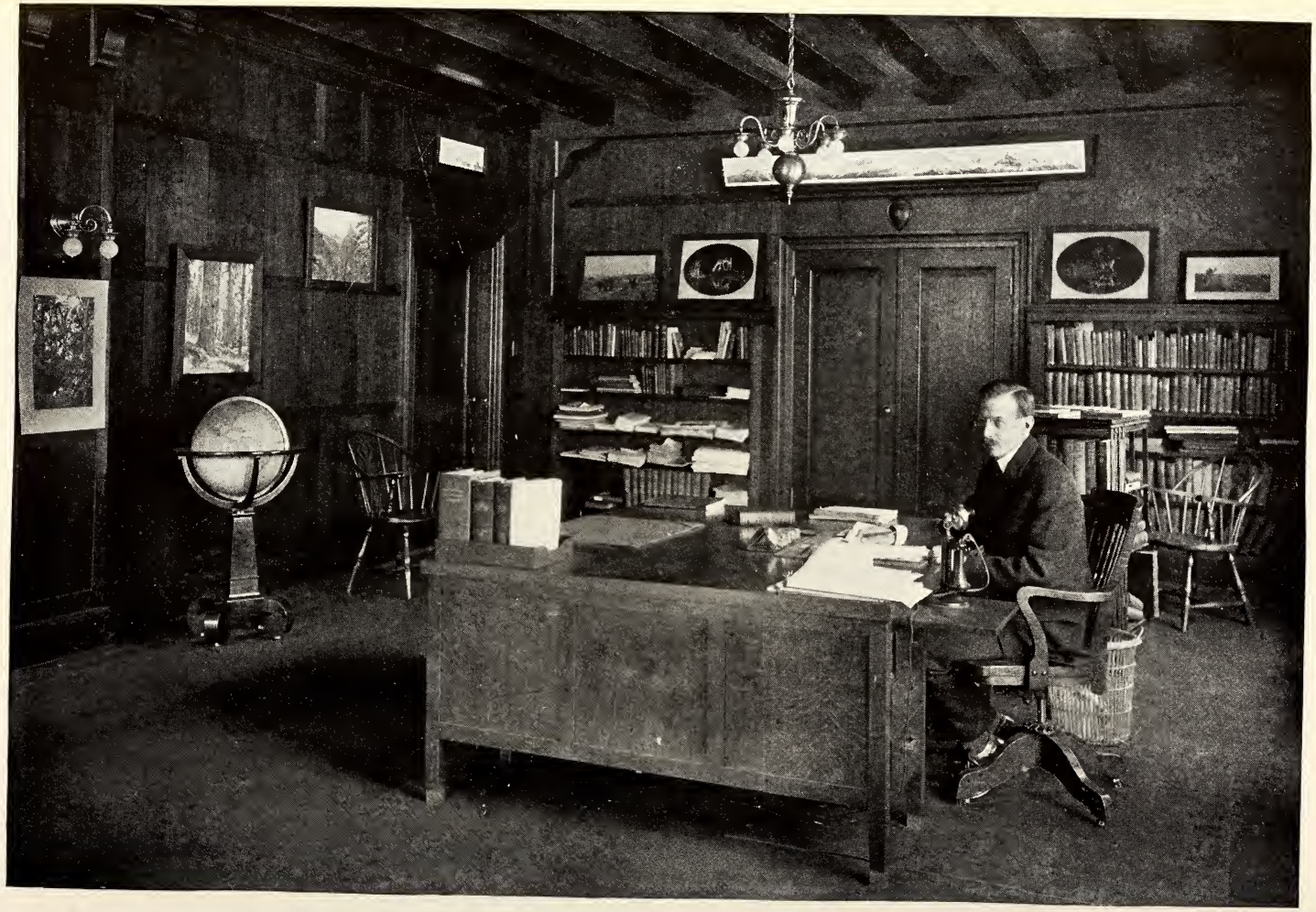
The office of the Director and Editor consists of two rooms, paneled from top to bottom in dark cypress, with an ornamental beamed ceiling. Next to these is the office of the Associate Editor, paneled throughout with Georgia pine. The general editorial room is a spacious one, with perhaps 350 square feet of window space. In this room is the large fireproof vault used for storing the thousands of photographs which have come from all parts of the world, constituting what probably is the greatest collection of geographic pictures to be found anywhere. On the fourth floor the accounting department has its quarters. The remainder of that floor is taken up by the kitchen and employees' dining-room.

With the new building occupied by the business and editorial activities of the Society, it is now possible to devote Hubbard Memorial Hall to its scientific activities. The rooms on the ground floor of this building are used for the meetings of the Board of Managers, the Research Committee, and such other committees of the Society as have occasion to meet for conference. The upper story is given over to the library and an exhibition hall. The library has been renovated and its small but valuable collection of books recatalogued and rearranged.

THE SOCIETY'S WORK

The Society encourages exploration and geographic research by means of such financial grants as its resources will permit. In coöperation with Yale University, it has recently maintained a large expedition in Peru, making geographical, geological, and archeological investigations around Cuzco, in a region which is generally believed to have been the birthplace of the famous and little-known Inca race. It also had an expedition in Alaska investigating the recent eruption of Mt. Katmai, this study being preliminary to a comprehensive investigation of what is perhaps the most stupendous volcanic belt on the earth. The Society has just concluded a series of investigations, extending over three years, of the glaciers of Alaska, one of the most important fields of geographical research in America.

Its earlier expeditions to Alaska did much pioneer work in the exploration of that territory. In 1902 the Society sent an expedition to Mount Pelée and La Soufrière to study the terrible eruptions of these volcanoes. The Society has assisted various Arctic expeditions, notably the last expedition of Robert E. Peary, which discovered the North Pole, April 6, 1909. In 1909 it sent to Sicily a trained geologist to investigate the Messina earthquake. A popular account of



THE PRIVATE OFFICE OF GILBERT H. GROSVENOR, THE EDITOR OF THE NATIONAL GEOGRAPHIC MAGAZINE AND THE DIRECTOR OF THE NATIONAL GEOGRAPHIC SOCIETY

Mr. Grosvenor's beautiful office is paneled in cypress, with rafter ceiling, and finished in soft brown tones throughout. The room is quite a contrast to the quarters occupied by the Society when Mr. Grosvenor was appointed, April, 1899, to develop the Magazine and Society. At that time, 15 years ago, the National Geographic Society shared a small room, 10 x 14 feet, with another scientific organization, and had not sufficient income, with its membership of 900, to provide him with clerical assistance. Then the Editor could carry the entire edition of one month on his back; today one month's edition makes a pile two miles high, and the ink used for printing a single issue is more than ten men can carry.

OFFICE OF JOHN OLIVER LA GORCE, THE ASSOCIATE EDITOR

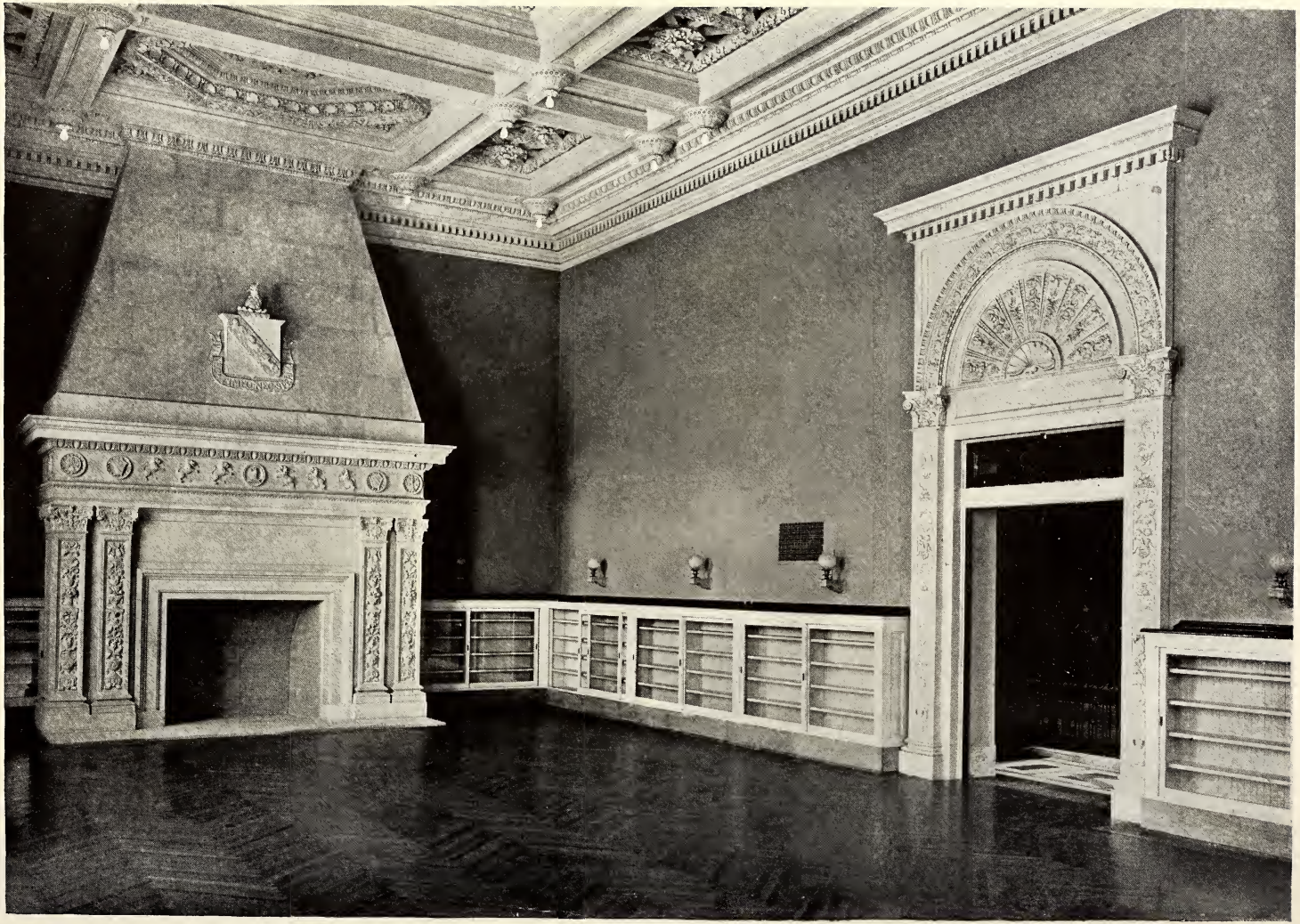
This office, which adjoins that of the Editor, is paneled and raftered in Georgia pine, showing the natural grain

A CORNER OF THE MAIL-ROOM ON THE FIRST FLOOR OF THE SOCIETY'S NEW BUILDING

Here are filed the 300,000 addressograph stencils from which the monthly magazine wrappers are printed. The motor-driven machines in the foreground automatically address the wrappers. There is not a dark corner in the entire building

ONE SECTION OF THE INDEX DEPARTMENT: FOURTH FLOOR, NEW ADMINISTRATION BUILDING

Here the 300,000 membership cards, with duplicate sets, which are in constant use, are filed. The tables were especially designed to facilitate the rapid handling of file cards. The first consideration in the building plans was the utilization of natural light, perfect sanitation, and plenty of fresh air in all departments.



A CORNER OF HUBBARD MEMORIAL HALL

WHERE THE NATIONAL GEOGRAPHIC MAGAZINE IS PRINTED

This new building of Judd & Detweiler, Inc., who have printed the Magazine of the National Geographic Society since 1888, has just been erected by them for the exclusive use of the NATIONAL GEOGRAPHIC MAGAZINE.

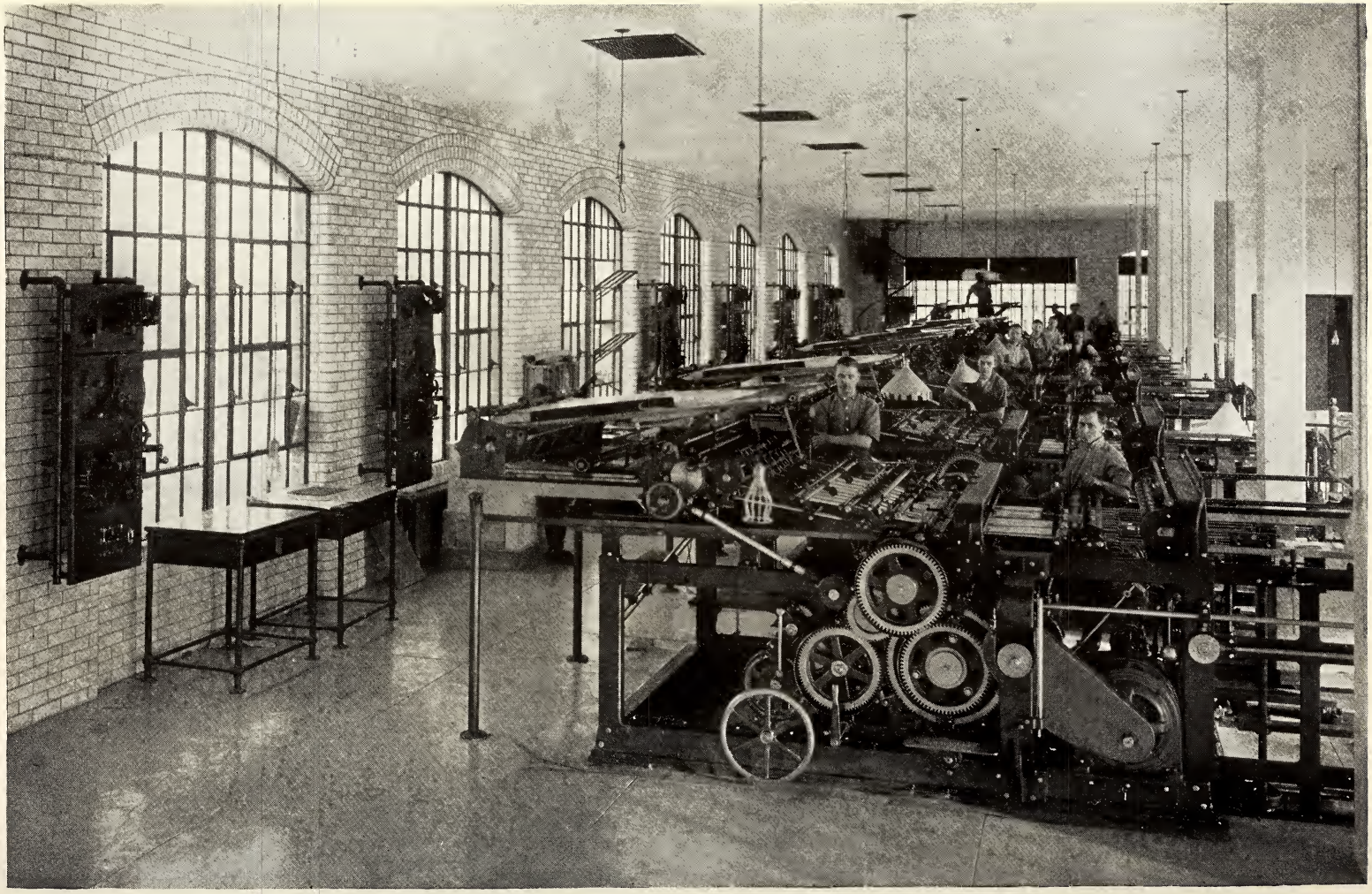
all expeditions is printed in the Magazine, while the technical results appear in separate monographs published by the Society.

ALL KINDS OF QUESTIONS

The correspondence of the National Geographic Society indicates the remarkable range of interest of its members. Here is a letter from a man wanting to know who publishes the best bathymetrical chart; here another inquiring as to the measures of the arcs of parallel south of the Equator; a third asks for precise information upon the rate of movement of glaciers. A New York lawyer has a case in which the crucial events take place in a town with an unpronounceable name in South America; his office atlas and the public library gazetteer alike fail to disclose its location. In despair he writes to the National Geographic Society, and by return mail is put in possession of the town's precise location, with details of the easiest way to reach it. A merchant, called on business to the west coast of South Africa, writes to know what precautions will be necessary to maintain his health and what kind of clothing he should take along. Here is a letter from a man who wonders where gum arabic comes from; another wants to know the height of Mt. McKinley; another seeks to ascertain why afforestation promotes rainfall; another asks the Society why the twilight period in the tropics is so short. All of these hundreds of inquiries must be answered, although some of them require much patient investigation.

The Magazine receives hundreds of comments and suggestions from the members each month. Many of these are helpful and all encouraging. Some of them express so admirably the objects of the GEOGRAPHIC MAGAZINE that several are printed in part below.

"An odd thing happened the other day. I stopped by the public library to get something to take home to read, and decided to take home three of the back numbers of your Magazine. I was intensely interested in them.



THE BATTERY OF EIGHT PRESSES ON WHICH JUDD & DETWEILER, INC., PRINT THE GEOGRAPHIC MAGAZINE

Upon this modern type of very rapid rotary presses the Magazine is printed. In the erection of their new plant, Mr. George H. Judd, President of Judd & Detweiler, Inc., left nothing undone to provide for their employees the maximum of light, air, and pleasant surroundings, and their establishment is considered a model one. Each issue of the National Geographic Magazine requires twelve carloads of paper.

A CORNER OF THE BINDERY DEPARTMENT OF JUDD & DETWEILER, INC., WHO PRINT THE GEOGRAPHIC MAGAZINE

After being printed on other floors, the many 16-page sections of which the magazine is made up are sent here, where they are automatically gathered together by the machines in the foreground, fastened with wire staples, and the covers are also attached by machines. The completed copies are then trimmed and bound in bundles, as seen in the picture, and allowed to remain under pressure for a time, so that the glue may properly set.

"Last night I got so absorbed in reading about that lost city in Peru that I let my fire go out and sat up reading about it till 11 o'clock in the cold. Valuable? Why it is the most valuable thing I have seen in a long time, and a copy of this Magazine ought to be in every school in the United States. As a former school teacher, I see possibilities of instruction and entertainment for the scholars such as I have never seen before. Then, too, the pictures of living things in our back yards is simply wonderful. You will get my hearty coöperation in putting this Magazine before the people, and especially the younger ones. Many of us think in pictures, and most all young people do so, and one of these pictures is more impressive than a dozen pages of scientific explanation.

"A great many people who go into the fields and woods with unseeing eyes can be awakened to the wonderful things all about us and get a vast amount of knowledge in a very direct and lasting way.

"This venture in the Magazine line is simply splendid, splendid, and deserves the help and push of every father and mother, as well as of the educators."

"I cannot see how I should teach geography without this Magazine, and the children look for its coming with eagerness. They love it because they know that what they see is *truth* and not an artist's fancy."

"Through the Magazine I have become an accomplished traveler, am familiar with the wonders of our own country and the strange, out-of-the-way places of the earth, and have taken these perfectly fascinating journeys without discomfort and without expense."

"It does not seem possible to supply such a Magazine to members, considering the small amount of the annual dues."

"I want to say that your conception of popularizing geographic study and the sciences that relate to the earth and its people generally is proving one of the most helpful influences that have come under my observation. I am sure it is proving a vast benefit to our generation."

The Membership of the National Geographic Society in the Various States, Territories, and Insular Possessions.

State	Rank in population	Members
New York	1	53,391
Pennsylvania	2	26,562
Massachusetts	6	25,319
California	12	24,125
Illinois	3	22,085
Ohio	4	12,991
New Jersey	11	10,824
Connecticut	32	7,896
Missouri	7	7,064
Michigan	8	6,759
Minnesota	19	5,992
Wisconsin	13	4,714
Indiana	9	4,574
District of Columbia	44	4,080
Washington	30	4,477
Colorado	33	4,425
Iowa	15	4,129
Maryland	27	3,960
Maine	35	2,944
Texas	5	2,674
Kentucky	14	2,629
Montana	41	2,500
Virginia	20	2,336
Kansas	22	2,270
Rhode Island	39	2,200
Oregon	36	2,099
Georgia	10	1,835
Tennessee	17	1,812
New Hampshire	40	1,752
Florida	34	1,742
Vermont	43	1,600
West Virginia	28	1,592
Nebraska	29	1,346
North Carolina	16	1,309
Louisiana	24	1,188
Utah	42	1,090
Idaho	46	1,056
Oklahoma	23	990
Alabama	18	976
South Dakota	37	976
Arizona	47	937
North Dakota	38	925
South Carolina	26	929
Delaware	48	858
Arkansas	25	820
Mississippi	21	752
New Mexico	45	726
Wyoming	50	594
Nevada	51	555
Alaska		372
Guam		9
Hawaii		623
Panama (Canal Zone)		382
Philippine Islands		584
Porto Rico		204
Samoa		3
		281,556

Table Showing Membership of the National Geographic Society in Proportion to the Population of Each State.

District of Columbia	1	member to every	97	of the population	
California	1	" "	98	" "	
Massachusetts	1	" "	132	" "	
Connecticut	1	" "	141	" "	
Nevada	1	" "	147	" "	
Montana	1	" "	150	" "	
New York	1	" "	170	" "	
Colorado	1	" "	180	" "	
Arizona	1	" "	218	" "	
Vermont	1	" "	222	" "	
New Jersey	1	" "	234	" "	
Delaware	1	" "	235	" "	
Wyoming	1	" "	245	" "	
New Hampshire	1	" "	245	" "	
Rhode Island	1	" "	246	" "	
Maine	1	" "	252	" "	
Washington	1	" "	255	" "	
Illinois	1	" "	255	" "	
Pennsylvania	1	" "	288	" "	
Idaho	1	" "	308	" "	
Oregon	1	" "	320	" "	
Maryland	1	" "	327	" "	
Utah	1	" "	342	" "	
Minnesota	1	" "	346	" "	
Ohio	1	" "	367	" "	
Michigan	1	" "	417	" "	
Florida	1	" "	436	" "	
New Mexico	1	" "	450	" "	
Missouri	1	" "	466	" "	
Wisconsin	1	" "	496	" "	
Iowa	1	" "	538	" "	
Indiana	1	" "	590	" "	
North Dakota	1	" "	590	" "	
South Dakota	1	" "	597	" "	
Kansas	1	" "	744	" "	
West Virginia	1	" "	766	" "	
Kentucky	1	" "	871	" "	
Virginia	1	" "	882	" "	
Nebraska	1	" "	885	" "	
Tennessee	1	" "	1,205	" "	
Louisiana	1	" "	1,394	" "	
Georgia	1	" "	1,421	" "	
Texas	1	" "	1,457	" "	
South Carolina	1	" "	1,630	" "	
Oklahoma	1	" "	1,673	" "	
North Carolina	1	" "	1,685	" "	
Arkansas	1	" "	1,918	" "	
Alabama	1	" "	2,188	" "	
Mississippi	1	" "	2,388	" "	

"I am very much interested in the Magazine, because it expresses more than any other the healthiest, happiest interest that one can know—NATURE."

"I feel that every adult (over 12 years) should read—and *see*—it every month. I am one of those people who believe that war might be made impossible by acquainting the peoples of the world with one another. Certainly, your splendid Magazine is one of the best means we have of telling the American people about their 'brothers across the seas.'"

Housed in its new building, with additional facilities for work in every one of its departments, with a rising tide of enthusiasm among its membership of 285,000, which is scattered among 15,200 post-offices in continental United States, 222 post-offices in the territories and insular possessions of the United States, and in 1,782 post-offices in the foreign countries of the world, the second quarter-century of the career of the National Geographic Society opens with a prospect without parallel in the history of geographic education.

Table Showing the Number of Towns and Post-offices in Each State and Territory in the United States where the National Geographic Society Has Members.

State	Number of towns and post-offices where the National Geographic Society has members
Alabama	146
Arizona	117
Arkansas	128
California	745
Colorado	264
Connecticut	289
Delaware	36
District of Columbia	1
Florida	254
Georgia	195
Idaho	156
Illinois	665
Indiana	364
Iowa	537
Kansas	366
Kentucky	204
Louisiana	153
Maine	306
Maryland	245
Massachusetts	614
Michigan	456
Minnesota	396
Mississippi	152
Missouri	360
Montana	198
Nebraska	325
Nevada	69
New Hampshire	224
New Jersey	459
New Mexico	125
New York	1,272
North Carolina	217
North Dakota	217
Ohio	639
Oklahoma	221
Oregon	217
Pennsylvania	1,113
Rhode Island	88
South Carolina	122
South Dakota	214
Tennessee	171
Texas	453
Utah	80
Vermont	193
Virginia	377
Washington	314
West Virginia	205
Wisconsin	378
Wyoming	91
Alaska	69
Guam	7
Hawaii	80
Panama (Canal Zone)	24
Philippine Islands	79
Porto Rico	31
Samoa	1
Total number of towns and post-offices in the United States where the National Geographic Society has members	15,422

Membership of the National Geographic Society in Foreign Countries.

Country	Membership	Towns
Africa	75	45
America, Central, and West Indies:		
Bahamas	8	5
Bermuda	24	9
British Honduras	3	2
Costa Rica	34	12
Cuba	284	51
Guatemala	31	5
Haiti	1	1
Honduras	16	11
Jamaica	25	14
Mexico	839	109
Nicaragua	10	6
Nevis	1	1
St. Kitts	1	1
Salvador	3	2
Santo Domingo	13	6
Trinidad	9	5
America, North:		
Canada	3,482	588
Newfoundland	24	8
America, South:		
Argentina	41	13
Bolivia	7	3
Brazil	55	14
Chile	38	14
Colombia	14	7
Ecuador	9	2
Falkland Islands	2	1
Peru	41	12
Uruguay	4	1
Venezuela	10	4
Asia:		
China	201	56
India	69	40
Japan	75	35
Korea	28	13
Persia	7	5
Turkey in Asia	38	15
Miscellaneous Asia	26	16
Australasia:		
Australia	56	15
New Zealand	31	16
South Sea Islands	8	8
Europe:		
Austria-Hungary	43	20
Belgium	22	7
Bulgaria	8	3
Denmark	29	9
Finland	5	4
France	195	36
Germany	286	107
Great Britain:		
England	847	177
Ireland	65	37
Scotland	100	55
Wales	8	7
Greece	3	2
Holland	22	17
Italy	94	28
Malta	1	1
Norway	36	14
Portugal	3	2
Rumania	4	1
Russia	30	13
Spain	32	14
Sweden	33	17
Switzerland	82	36
Turkey in Europe	20	4

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THE NATIONAL GEOGRAPHIC MAGAZINE

MEXICO AND MEXICANS

BY WILLIAM JOSEPH SHOWALTER

Especial attention is called to the map of Mexico published as a supplement to this issue of the NATIONAL GEOGRAPHIC MAGAZINE. *It contains the latest and most accurate information of the geography of the country, and also gives the transportation routes open and in prospect, as well as the contours of altitude. The map is the highest example of the cartographer's art that has been produced with Mexico as its subject. Additional copies of the map may be obtained from the offices of the National Geographic Society. Price, 50 cents each; mounted on linen, $1.*

PERHAPS nowhere else in the world is there a country so full of contrast as Mexico. With a university established before John Harvard, Elihu Yale, or William and Mary were born, the masses of its people are hopelessly ignorant. With a hospital founded before Jamestown was even dreamed of, it is one of the most backward regions of the earth in a medical way. With natural riches greater than those of a thousand Midas's, its masses are just as poor as the proverbial church mouse. With a constitution as perfect as any organic law in the civilized world, it is a nation whose rulers always have been a law unto themselves.

Effigies of Judas Iscariot — to be burned, crunched, exploded, or hanged by the neck until dead—may be bought in the same stores that sell the latest creations of the dressmakers' and the milliners' arts from Paris. A bull ring, built of American steel and concrete, stands within earshot of the Republic's leading hotel, and the sound of the perfervid cheering of the sun-gods as they applaud their favorite matador when he executes a brilliant pass, and the band responds with the Diana, may be wafted into the very precincts of the American Embassy itself.

Here you will see a Mexican half-breed, barefooted, wearing a dollar pair of trousers, a fifty-cent shirt, and a ten-dollar sombrero. There, at a single glance and within the length of a single city block, you may see an Indian *cargador,* a donkey, an ox-cart, a carriage, a railroad train, a street-car, and an automobile—almost every type of locomotion since Adam.

WIDE CLIMATIC RANGE

You may tread the burning sands of a tropical desert with the wet of the perpetual snow of towering mountains still upon your shoes. You may take a single railway journey of 36 hours in which the people you see at the railroad station will be dressed in four different weights of clothing.

Land of the inordinately rich and of the abjectly poor; land of the aboriginal Indian and of the twentieth-century business man; land of perpetual snow and of

MEXICAN TROOPS AT BAUCHE, CHIHUAHUA, DURING THE OROZCO REVOLUTION Photo by Altman and Dorman

"The most conspicuous thing about the male population of Mexico, so far as the masses of half-breeds are concerned, are their hats. These are bought even if their purchase does force the buyer to go hungry for months afterwards, for the peon is not nearly as much a slave to his haciendado as he is to his hat" (see text, page 491).

Photo by Shirley C. Hulse

A VARIETY OF CACTUS WHICH IS A SOURCE OF MUCH ANNOYANCE TO STOCK AND TO RIDERS IN CHIHUAHUA, MEXICO

Any part of the bush will come away freely, and a slight touch will serve to attach almost any amount of such cactus to the person. The process of removal is usually long and painful.

unending summer—everywhere you turn there is contrast, high lights and deep shadows. Fitting indeed is Ober's beautiful apostrophe to this wonderful region:

"Mexico lies at the meeting-place of two zones—the Temperate and the Torrid—and from its geographical position, combined with its altitudes, possesses a greater variety of soil, surface, and vegetation than any equal area of contiguous territory in the world. Basking in the sunshine of the tropics, her head pillowed in the lap of the North, her feet resting at the gateway of the continents, her snowy bosom rising to the clouds, she rests serene in the majesty of her might. She guards vast treasures of gold and silver; emeralds and opals adorn her brow; while the hem of her royal robes, dipped in the seas of two hemispheres, is embroidered in pearls and the riches of the sea.

"Mother of western civilization! Cradle of the American race! A thousand years have been gathered into the sheaf of time since her first cities were built. When the Norsemen coasted our western shores she had villages and towns, white-walled temples, and spreading palaces. When the Pilgrims landed at Plymouth Rock, a hundred years already had passed since the soldiers of Cortés had battled with the hosts of Montezuma. In no country in the world can you pass so rapidly from the blazing shores of the heated tropics to the region of perpetual winter, from the land of the palm and the vine to the land of the lichen and the pine."

ONE-FOURTH AS LARGE AS THE UNITED STATES

Mexico has an area approximately one-fourth of that of the United States, a

THRASHING WHEAT IN A MEXICAN VILLAGE: THE VILLAGE CHURCH IS, AS USUAL, A VERY PROMINENT PART OF THE LANDSCAPE

Photos by Shirley C. Hulse

THIS PICTURE WAS TAKEN ON ACCOUNT OF THE VERY FINE "NOPAL" CACTUS, WHICH STANDS ON THE LEFT: ASIDE FROM THE CACTUS, THE VIEW IS TYPICAL OF THE BACKYARDS IN A SMALL MEXICAN VILLAGE

fourth of whose area once belonged to Mexico. It has a coast-line some 6,000 miles long, although its greatest length is less than 2,000 miles and its greatest breadth only 750 miles. Although its area is only one-fourth that of Brazil, its population is approximately equal to that of the empire of the southern continent.

Some 15 million souls live within its borders, of whom more than two-thirds can neither read nor write.

Of the total population, only 19 per cent are white, 43 per cent are of mixed parentage, while 38 per cent still maintain their Indian blood uncorrupted. The foreign population two years ago numbered 100,000 souls, of whom 30,000 were Americans, 20,000 Spanish, and 5,000 British.

MEXICAN AGRICULTURAL POSSIBILITIES

The agricultural possibilities of Mexico, despite its vast central desert plain, are great. It has millions of acres of the finest grazing land, great bodies of land that will produce two crops of corn a year, large areas of banana lands that can match those of Guatemala and Costa Rica, coffee lands that produce coffee not only fit for the "queen's table," but used on it, rubber lands, and cocao lands—all lying accessible to good railroads and in touch with the world's markets.

Go to Yucatan, go to Colima, go to Chiapas, go to Vera Cruz, and everywhere outside the great desert you will find a soil teeming with possibilities. And portions even of the desert land, if we may judge by what we have done with our own western alkali plains, may yet be made to blossom when the irrigationist and the plant-breeder join hands.

The possibilities of the arid and semi-arid regions of Mexico are disclosed at Saltillo, on the Mexican plateau between Mexico City and Laredo, Texas. The traveler who journeys from the capital to the frontier spends a night and a day traveling over a barren region, with here and there an adobe city, and with nothing but the green of the cacti to relieve the depressing brown of the desert. About twenty hours out of Mexico he comes to Saltillo.

In a moment he passes from the desert into a broad oasis that is wonderful for its vegetation and beautiful for the air of prosperity and well-being that dwells with it. Here land that yesterday was as bare as Mother Hubbard's cupboard today is laden with all the good things that the vegetable kingdom affords. A strange combination of tropical and northern agriculture greets the eye. Most of the things which grow in our own western country flourish alongside of the crops which grow south of the Tropic of Cancer.

A trip along the Pan-American railroad, with its magnificent forests and great ancient estates, among them one on which the cattle still wear the brand of Cortes; over the Isthmus of Tehuantepec, where the tropical jungle rivals that of the Motagua River Valley in Guatemala, pronounced by Frank G. Carpenter the richest in the world, and then on up through the great Atlantic plain of middle Mexico, suggests the immense undeveloped resources of the country.

In the middle and lower altitude belts of the country the banana and the orange flourish. The excellent railroad facilities of Mexico give a good outlet to the ports at Vera Cruz and Tampico, where ships are constantly loading for European and American ports. The orangeries of eastern Mexico are nearer to the eastern part of the United States than are those of southern California, and crop failures among them are unknown. With the same methods of cultivation that are pursued in Florida and southern California, they should be a source of vast wealth to the country.

THE HOME OF CORN AND COTTON

Although the value of the corn produced in Mexico each year is greater than that of any other product, not even excepting gold or silver, the country still has to import a part of its supply. The reason is not far to seek—it is the nation-wide love for the tortilla. There are vast areas where it is easy to produce two crops of corn a year and where each crop grows with an exuberance that would delight the heart of any corn-club contestant in the United States.

It was my good fortune to travel through the region lying between the Mexican highlands and the lowlands,

Photo by Dr. C. William Beebe

This pastoral scene is where two springs—one hot, the other cold—arise close together, near the city of Colima and the active volcano of the same name, in western Mexico. This part of the country is noted for its enormous wild fig trees.

from Santa Lucrecia to Cordoba, and wherever I came across one of those little Mormon settlements which dot the prairie stretches of this region there were fields of corn to be seen the like of which may be met in but few parts of the United States.

Uncounted generations before the United States came into being the Indians of Mexico had their little patches of corn. It was the great staple of Montezuma's court, and to this day it is almost the sole support of the Mexican Indian.

There are few parts of Mexico, either in the hot belt adjoining the sea or on the table-lands between the mountains, where corn is not cultivated with success. How valuable the crop might be made when farmed in the Illinois and the Iowa way is shown by the wonderful success with which the Mormons have met when undisturbed by war.

History does not recall the time when cotton first was cultivated in Mexico. The Spaniards found it there. Indians clothed with cotton garments were first seen by Columbus along the coast of Yucatan at the very dawn of the sixteenth century. The Toltecs wrote in their sacred books that Quetzalcohuatl, god of the air, grew cotton of all colors in his garden and taught them its many uses. In the times of Cortes the Indians quilted armor of cotton, which was proof against arrows.

To this day cotton is cultivated with profit in many parts of the country. In the Laguna region it is perennial and does not require to be planted oftener than once in ten years. Some of the largest cotton factories in the world are to be found in Mexico. The great Rio Blanco mills, in Orizaba, rank with the best in England and America.

REMARKABLE MEXICAN PLANTS

Mexico probably has a greater range of remarkable vegetation than any other country in the world. The parrot fruit tree produces an odd-shaped fruit, bearing a close resemblance to green parrakeets. Evidently mindful of this striking resemblance, when the parrakeet is

frightened it makes a dash for the parrot tree, where it assumes a position which makes it look like the fruit itself. So close is the resemblance that their enemies, the hawks, occasionally fly by a tree on which a dozen or more of these birds are sitting, apparently unaware of their presence.

Another remarkable tree is the "Arbol de Dinamite" — dynamite tree — whose fruit, if kept in a warm place, bursts with considerable force and a loud report, scattering its flat seeds to a surprising distance.

THE PAPAYA TREE

One of the most interesting fruits in Mexico is known as the melon zapote, or papaya. It grows wild and attains a height of as much as 25 feet. The dark-green leaves are from 20 to 30 inches long and grow at the top of an otherwise leafless trunk. The fruit would seem a cross between a cantaloupe, a pumpkin, and a watermelon. The tree begins to bear fruit when a year old, producing from 20 to 100 melons at a time, a single one of which may weigh as much as 20 pounds.

The melons contain considerable pepsin, which reacts against both acid and alkaline conditions of the stomach, and it is said that a diet which includes papaya precludes dyspepsia. Both the fruit and the leaves possess the singular property of rendering tough meat tender. When the pulp of the fruit is rubbed over a piece of tough meat the juice attacks the fiber and softens it.

The trees are well defined as to sex, and where they are cultivated but one male tree is permitted to grow in a grove of fifty or more females.

Mexico abounds in orchids, and some of the most beautiful species known in the plant kingdom are there to be found.

As one journeys through the country from the Tehuantepec Railroad to the Vera Cruz and Mexico City line he sees dozens of species of orchids on the forest trees, some of which would bring top prices in the New York market.

MEXICAN RAILROADS

No other country in the New World, south of the Rio Grande, is so well supplied with railroads as Mexico. Prior to the Madero revolution it had 20,000 miles of up-to-date American railroad. At six different points lines crossed the frontier from the United States, and Laredo, Eagle Pass, and El Paso gateways handled much traffic to and from Mexico. The Mexican railroads carried 11,000,000 passengers annually at that time, and handled about 11 million tons of freight. Their total revenues amounted to about $40,000,000.

The government owns a controlling interest in the major portion of the mileage of the railroads, and is the owner of the Tehuantepec road and of the Vera Cruz and Isthmus line. A plan was on foot a few years ago to extend a branch of the Tehuantepec road to Yucatan, to connect up with the United Railways of that province. This would give every section of the country railroad communication with every other section.

Besides the Tehuantepec route there are two or three other transcontinental lines. The Pan-American Railway extends from the Tehuantepec route to the Guatemalan frontier, and this gives through railroad connection from Canada to Guatemala city. But having traveled over this route, let me advise the sea trip as one far more comfortable, even to those who are not good sailors.

From an American standpoint the Tehuantepec route is by far the most interesting of the Mexican railroads, because it is the principal prospective competitor of the Panama Canal. This road is built on the line of the proposed Eads' ship railway, from Coatzacoalcos to Salina Cruz. It is approximately 200 miles long, and crosses the continental divide above Rincon Antonio.

EADS' DREAM

How Eads could see a ship railway across those mountains is more than I can imagine. When you journey across a mountain on a railroad that is well located, and yet on which the curves have to be so sharp that the rear platform of your car and the headlight of your locomotive point in the same direction, and when this happens not once, but a dozen times, and in a 20-car mixed train, you cannot imagine, in your wildest

Photo by Shirley C. Hulse

"HEELING" A COCK

The Mexicans use a gaff, or heel, up to three inches or more in length. As contrasted to the needle-like heel which is used elsewhere, the Mexican heel is broad and razor-sharp on both edges, except that the top edge is blunted for a little ways back of the point to insure the penetration of the gaff, which might otherwise merely rip instead of cutting deep. The Mexicans sometimes wrangle and haggle for hours while arranging terms of the fights, which are usually over very quickly after they are once started. Not infrequently both cocks fall dead after the first clash.

flights of fancy, how a ship could be hauled over those mountains in a gigantic cradle.

There are many peculiarities about the Tehuantepec Railroad. It is owned by the government, but is operated by a company made up of two equal partners, the Mexican government and the firm of S. Pearson & Son. Each partner contributed half the capital of the firm, and they share the profits, the Pearson firm being the managing director.

The Mexican government owns about one-third of the stock of the American-Hawaiian steamship line, which is the principal freight producer for the Tehuantepec Railroad. Years ago these ships went around South America, from Hawaii to New York, with their cargoes of sugar. When the Mexican government decided to build the Tehuantepec Railroad, it proposed to the steamship line to take a third of its stock, and to handle its cargoes across the Isthmus upon terms that would be more advantageous than the trip around South America. It agreed to handle the business between Salina Cruz and Coatzacoalcos for one-third of the through rate, with the understanding that if this did not afford a profit to the steamship company the railroad would be willing to accept as low as a fourth of the through rate.

COMPETING WITH PANAMA

With the opening of the Panama Canal, the American-Hawaiian line will send its ships through that waterway, in spite of the fact that the Mexican government owns one-third of the line's stock, and took it in order to get the steamships to use the Tehuantepec route.

But although the Tehuantepec officials

Photo by Shirley C. Hulse

MEXICANS WATCHING A COCK FIGHT

concede that on through cargo business they cannot, under any circumstances, compete with the Panama Canal, they still believe that they will not be seriously affected by the opening of the big waterway. They think that the business boom that the canal will bring to tropical America will give enough additional mixed cargo to take the place of the through cargo lost.

To illustrate: On a ship loaded with lumber and bound for New York from Oregon, the Tehuantepec route could not quote a rate that could compete with the canal; but on a ship that left Liverpool with mixed cargo, some bound for California, some for Hawaii, some for Peru, and some for China, the Tehuantepec route could transfer that cargo as advantageously as the Panana Canal.

Mexico spent a fortune in building port works at Salina Cruz and Coatzoalcos for the loading and unloading of the big ships that carry cargo to and from the Isthmus. At the former place a modern harbor has been made where scarcely an indentation in the shore line existed before. The inner harbor is artificial entirely, and ships now ride 30 feet above what once was the old town site of Salina Cruz. Great blocks of concrete make a sea-wall between the inner and the outer harbors. The outer harbor is formed by two great breakwaters which leave an opening about 600 feet wide out to sea. These breakwaters enclose a harbor space of about 20 acres.

Ships are loaded and unloaded with electric cranes, the cars having trap doors in their roofs. The peons often handle as much as 60 tons of sugar each a day. They are paid a standard wage, with a bonus for all above a certain amount they handle, and they certainly do work for that bonus. When the railroad was begun, wages in the Tehuantepec region were 25 cents Mexican a day; they soon reached $1, then $1.50, then $2.00, and finally, $2.25 a day.

An interesting sidelight on the policy of former President Diaz toward the upbuilding of a middle class in Mexico was afforded me by a conversation with the Vice-President and General Manager of the National Railways. He told me that General Diaz wanted to put Mexicans in

FLASHLIGHT PICTURE TAKEN IN THE COALCITE CRYSTAL CAVES AT NAICA, A MINING TOWN NEAR SANTA ROSALIA, CHIHUAHUA

These caves have not been fully explored. Many of the crystals retain water of crystallization, and are sometimes used as hand-levels by the native miners.

every place that they could fill, because it would be good for the country, in the development of a middle, thinking class, to have the employees as well as the ownership of the railroads nationalized. He felt that to have Mexican conductors, engineers, telegraphers, etc., would be to assist in the establishment of a middle class, which he recognized as Mexico's crying need.

The railway manager knew by experience that the Mexican does not make as good a railroad man as the American, but he was gradually carrying out this policy at the time I was in Mexico, which was just before the fall of Diaz. It was Diaz's idea that the establishment of industries in Mexico and the employment of Mexicans in responsible positions in connection with them must eventuate in a middle class worthy of the name.

SOME MEXICAN INDUSTRIES

Mexico has many important industries, and some of the plants are the largest of their kind in the world; for instance, the Bueno Tono Cigarette Factory, of Mexico City, has a daily output of 12 million cigarettes a day. It is the largest factory of the kind in the world, and earns a 12-per-cent dividend on an investment of $3,250,000.

The Mexican Light & Power Company, with a capitalization of $25,000,000, operates the great hydro-electric plant at Necaxa, which is one of the largest on the Western Hemisphere.

A few years ago there were in Mexico 145 cotton mills, with 732,000 live spindles, and employing 35,000 operators. The owners of a single chain of mills at Orizaba employed 5,000 people and turned out products valued at many millions of dollars (see also page 476).

One of the largest glycerine and soap factories in the world, with a daily output of 75,000 boxes of soap, was in operation in the very country where the Federals and the Constitutionalists have been fighting during the past few months.

All of these growing industries were demanding something in the way of intelligence from their employees and were making progress in the direction of establishing a middle class in Mexico.

THE MINES OF MEXICO

Humboldt once pronounced Mexico "the treasure-house of the world." It produces one-third of the world's silver, a considerable percentage of its gold, one-ninth of its lead, and one-twentieth of its copper. The country's mineral production, exclusive of iron, coal, and petroleum, amounted to $158,000,000 in 1910. With the exception of Campeche, Tabasco, and Yucatan, every State in the Mexican republic possesses mines, of which there are 21,000, covering 633,000 acres of mineral lands, and giving employment to half a million men. Yet probably less than one-fourth of the mineral possibilities of the republic have been exploited. Prior to the outbreak of the Madero revolution, upward of 5,000 mining claims were registered each year.

The famous iron mountain at Durango is estimated to contain 600 million tons of iron ore, which is worth seven times the value of all the gold and silver mined in Mexico in two centuries. It is believed that this deposit was formed by the same process that made the Hudson River palisades, near New York city. A big opening was made in the earth's crust, through which this enormous mass of iron was thrust up, and piled high above the surrounding territory. No one knows how deep this iron mass penetrates. It is nearly a mile long, more than a third of a mile wide at the base, and some 700 feet high. An American smelter company has erected works to utilize this iron.

The Santa Maria graphite mines are the largest and most important in the Western World. There are seven beds of graphite deposits, varying in thickness from 9 to 10 feet. They were formed from coal beds by the metamorphic action of intrusive granite. The graphite is transported to Saginaw, Mich., where it is ground up and sold to the pencil and lubricant factories of the world.

The region around the Gulf of Mexico is very rich in petroleum. Some years ago an oil company was engaged in sinking a well near Tampico. At a depth of 1,824 feet a gas explosion blew out the entire installation of machinery, and the well

Photo by Shirley C. Hulse

A TYPICAL REVOLUTIONIST IN MEXICO

This picture was taken at the request of the photographed, and the request was in no uncertain terms

took fire. It burned unchecked for three months, during which time 10 million barrels of oil were consumed (page 490). Hot salt water gradually replaced the oil.

The Mexican Eagle Oil Company, at Potero del Llano, struck a gusher which flowed 100,000 barrels of oil a day. A huge storage reservoir, with a capacity of 3,000,000 barrels, was established to take care of the oil pending its going to market.

It is believed that the oil fields of Yucatan, Vera Cruz, and Tampico, when once peace is established, will go a long way toward meeting the unprecedented demand for gasoline that the automobile has created.

HOME INDUSTRIES

The delicate drawn-work of the Mexican Indian is justly famed throughout the world and deserves to rank with the finest of Spanish and Italian laces. Thousands of Indian women work at a wage of 10 cents a day, from early morning to nightfall, around the drawn-work frames

Photo by Shirley C. Hulse

THE MEXICAN FEDERAL ARMY GOES NOWHERE WITHOUT ITS WOMEN

Soldiers are supposed to be paid daily and to look out for themselves as regards food and supplies of all sorts. The women forage and cook and take the place of a regular organized commissary department. At times they take active part in battle, and they are said to leave nothing of value on the field after the fight.

which are used in Mexico. These frames are made somewhat like curtain-stretchers, and from 5 to 15 girls gather around one of them and work for days and even months on the beautiful drawn-work table-cloths which come from Mexico.

The best drawn-work is made from imported Irish linen, and the prices at which these pieces are sold, considering the work put on them, is ridiculously low. Pieces may be bought in Mexico City for $40 which could not be duplicated in the United States for $200. The designs are in endless variety, and each piece is so finely fashioned that it takes a woman's eye to tell which is the right and which is the wrong side.

The Indians make all sorts of small objects to attract the centavos of the tourist. The little dolls of Cuernavaca, a half-inch tall and dressed in finely embroidered raiment, are the admiration of every one who sees them. The small clay animals, perfectly fashioned and ranging from the peaceful dog to the charging bull and the bucking mule, would do credit to the genius of many a sculptor whose name figures in the art publications of the world.

DRESSED FLEAS

But perhaps most wonderful of all are the tiny dressed fleas which may be bought in Mexico City. They are mounted in little boxes which are a little more than a quarter of an inch each in dimension. Here are a bride and groom, the former with her bridal veil and orange blossoms and the latter with his Prince Albert coat and silk hat; here are two ballet dancers dressed in true Spanish dancing costumes; here a bull fighter in full regalia; here a water-carrier with his water-jug.

Another wonderful work of the Indians is the making of feather pictures from the plumage of humming-birds, now almost a lost art. Several persons are employed on each picture, blending the various colors of the feathers together in a way requiring extraordinary patience and care.

OLD BELLS WHICH WERE MELTED AND CAST INTO CANNON BY THE FORCES OF GENERAL MANUEL CHAO AT PARRAL, CHIHUAHUA, IN 1913

The sketch of the figure to be reproduced is first made, and each artist takes charge of one particular part of the figure or drapery. When each has finished his share all of the different parts are reunited and the picture formed. Then the whole feather picture is placed on a plate of copper and gently pressed together with a sort of paste until the surface became even. Because of the splendor and liveliness of the colors, they appear even more beautiful than the paintings which they imitate.

MEXICAN DYES

The fine and fast colors made by the Indians of Mexico and their mastery of art of hand-weaving has excited the wonder of travelers for many generations. Their multi-colored serapes, in which all of the tints of the rainbow are blended with a rare harmony and a keen appreciation of color values, are perfect specimens of the weaver's art.

Many of the Indian colors are made from Mexican insects, the best known of which is the cochineal. At a time beyond recorded history the Zapotec Indians discovered that the dry bodies of the female cochineal was superior even to the scarlet grain used to impart rich and lasting color to their clothes. Until 1703 it was believed that the cochineal was a seed or bloom of the plant. The insects feed on the leaves of the cochineal fig and other closely allied cacti. They remain attached to the spot on the leaf where they were hatched, and their bodies grow rapidly as they absorb the juice of the cacti, until all of their extremities are indistinguishable to the naked eye. It takes about 70,000 of them, when dried, to weigh a pound. Some are killed in ovens, which causes them to develop a grayish red color, and they are then known as the silver cochineal. The insect bears a close resemblance to the American wood-louse.

TORCHES AND LANTERNS MADE OF FIREFLIES

A remarkable insect found in Mexico is the Elater firefly. Seen by day, it is a large beetle, of a greenish-black color and about an inch long. Behind the eyes are two round transparent nodules about as large as a pin-head and filled with a

CANNON, "EL PADRE," MADE BY MEXICAN REVOLUTIONISTS FROM OLD BELLS SHOWN IN THE PRECEDING PICTURE

luminous substance. When roused, the insect seems perfectly saturated by this luminous secretion.

Four of these fireflies will throw a fairly brilliant light, by which the pages of a newspaper may be read. They fly only after dark, and resemble fiery dragons sweeping through the air, carrying lanterns. The Indians use them as miniature torches; the men fasten them to their ankles in going through the forest, and the women wear them in their hair under a thin gauze veil.

Tiny little cages are constructed in which three or four are kept for lighting purposes. The insects congregate by the thousands in many forest trees, and, as if by a preconcerted agreement, simultaneously flash their lights, then darken them and flash them again.

CURIOUS INDIAN FOODS

The Indians of Mexico eat many curious foods. One of the most remarkable of these is made of the eggs of a species of marsh fly. This fly deposits its eggs in incredible quantities upon flags and rushes. These eggs are gathered and made into cakes which are sold in the markets. These little cakes are somewhat like brickbats, and the Indians enjoy a meal of them with as good a stomach as white people enjoy cheese. They call the eggs water-wheat. They resemble fine fish roe, and when mixed with corn meal and fowl eggs form a staple article of diet, particularly during Lent.

The insects themselves, which are about the size of a house-fly, are captured, pounded into a paste, boiled in corn husks in much the same fashion as tamales, and in this form are eaten.

The Indians have a systematic method of cultivating their water-wheat. They plant bundles of reeds a few feet apart, with their tops sticking out of the water. On these the insects deposit their eggs. The reeds are then removed and the eggs shaken off on a sheet.

MEXICO CITY

In all the world one cannot find a more remarkable capital than Mexico City. Situated in a valley whose floor is a mile and a half above the level of the sea, and

THE POST-OFFICE: MEXICO CITY

Photo from Alberto L. Godoy

"Mexico City is the most complete mixture of the ancient and the modern to be found in the New World. The old city might date anywhere from the tenth century, from its appearance. The new city is ultra modern, and you step from the sixteenth to the twentieth century by walking across the street. In the new part of the city there are miles of streets, with magnificent homes on both sides, that remind one of Massachusetts avenue between Dupont Circle and Sheridan Circle in Washington or of Riverside Drive in New York" (see text, page 489).

Photo by Shirley C. Hulse

THE BURRO—SOMETIMES SPOKEN OF AS THE MEXICAN CANARY

This animal is admirably suited to the needs of the Mexican peon. He is the personificaton of patience. About all that any one ever does for a burro is to make him work or to collect 15 pesos for his remains after he has stolidly permitted himself to be run over on a railroad. The process of making a burro work often entails what might seem to be considerable brutality. If the Mexican has any feeling for animals, he rarely exhibits such feeling in the presence of a foreigner; but the burro never seems to mind. The longer you observe him working or eating, or merely in a trance, the more surely will you wonder whether he is a stoic or whether he, too, is unfeeling as regards animals, until you hear *and see* him burst forth into song. Then you *know* that the burro is neither stoic nor clod. He has great feeling—all the feelings. He simply lacks means of expression excepting that of song, and in song he pours out all his joys and hopes, all his suffering and anguish, his longing, his very soul.

whose borders are surrounded by towering mountains; located where the beautiful volcanoes, Popocatepetl and Ixtaccihuatl, rear their snow-capped heads above the plain and stand eternal guard over it, its situation is one of rare beauty and grandeur. Its climate is mild, the temperature ranging from 35 to 75 degrees, with a mean of 65 degrees. No man sleeps without a blanket in Mexico City, nor needs an overcoat at midday.

Prior to the conquest the lakes of the Mexican Valley were extensive and the barges of the Aztecs sailed uninterruptedly from the gates of Chapultepec to Ixtapalapa. A large number of canals intersected the ancient metropolis of Tenochtitlan and connected with the lakes in the suburbs, making it a sort of new world Venice.

In 1607 the celebrated Portuguese engineer Martinez undertook to drain the Valley of Mexico by cutting a canal through the mountains. From 12,000 to 15,000 Indians were forced to do the work, which was considered complete 11 months after its inception. The work, however, was largely a failure, since it drained only one small lake and an unimportant river, leaving lakes Texcoco and Chalco still perpetual menaces to the city.

In 1879 a huge drainage canal 30 miles long was begun, which was completed in 1900, at a cost of about $8,000,000, American gold. Its completion removed the danger of inundations from Mexico City and solved the problem which occupied the thoughts and engendered the fears of the Aztecs as far back as 1449.

LA PLAZA: VERA CRUZ

Photo from Alberto L. Godoy

Vera Cruz, like every other Mexican city and town, has its principal plaza, where the people come to promenade and to hear the military bands play. In some of the cities unaccompanied women keep to the right and unaccompanied men to the left, promenading in opposite directions.

This great drainage canal starts at a point east of the city and, winding its way between the Guadalupe range and Lake Texcoco, ends near the town of Zumpango, after crossing the Guadalupe River by means of a great aqueduct. The depth at the starting point is 16 feet and at the terminal 65 feet. At one place it was necessary to tunnel the Xalpan Mountain, this tunnel being about 7 miles long.

Mexico City is the most complete mixture of the ancient and the modern to be found in the New World. The old city might date anywhere from the tenth century, from its appearance. The new city is ultra modern, and you step from the sixteenth to the twentieth century by walking across the street. In the new part of the city there are miles of streets, with magnificent homes on both sides, that remind one of Massachusetts avenue between Dupont Circle and Sheridan Circle in Washington or of Riverside Drive in New York.

THE PARADE OF SOCIETY

The parade ground of Mexico City is the Avienda de San Francisco. This short street extends from the Mexican White House to the Alameda, and is only about 24 feet from curb to curb. Here, at the approach of twilight, every smart equipage in the capital comes. Down the one side of the street and up the other side moves the procession at a slow walk, while everybody looks at everybody else.

It is not bad manners to look at the beautiful ladies and their large families of children—rather it would be distinctly bad manners not to, for this is a parade both for seeing and being seen. Even the moving-picture playhouses are provided with balconies, where the patrons may go between reels to watch the passing show.

Once the government, back in the days of Diaz, when no hand dared dispute its authority, ordered the parade to move down Avienda de San Francisco and to return via Cinco de Mayo street, but that took the privilege of seeing the returning crowd away from those going in the opposite direction, and even the firm hand of the law couldn't overrule the order of society; so that even now, in the days of revolution, the parade still goes down one side of Avienda de San Francisco and up the other side.

As Avienda de San Francisco unites the old and the new cities, so does the Cinco de Mayo (Fifth of May) unite the cathedral, stateliest of all the religious edifices on the continent, with the theater, most beautiful, although unfinished, of all the amusement places in America. The Cinco de Mayo is the Wall Street of Mexico, and the buildings which line it are modern in every respect.

The Paseo de la Reforma, extending from Chapultepec to the Avienda de Juarez, a short avenue connecting the Paseo with Avienda de San Francisco, is one of the finest driveways of the world. Passing through the new city, with two driveways divided by a lane of tropical trees and flowers, with here and there a beautiful circle and a splendid monument, there is nothing in the New World or the Old that surpasses it. The most magnificent mornings anywhere to be found smile down on it winter and summer, and no traveler who ever drove up the Paseo de la Reforma in the forenoon can forget that drive, even though he has seen all the famous avenues of the world.

The city is full of interesting places. Whether it be the cathedral, which rears its majestic towers to heaven on the very spot where the sacred temple of the Aztecs stood, and where tens of thousands of human beings were sacrificed to the sun; whether it be the Hospital de Jesus, built on the site where Cortes and Montezuma first met, and supported to this day from the revenues of the estate of Cortes; whether it be the Jockey Club, housed in the beautiful House of Tiles; whether it be the bronze equestrian statue of Charles IV of Spain, declared by Humboldt to be second only to the statue of Marcus Aurelius at Rome, or whether it be Chapultepec, with its memories of the American triumph in Mexico, there is no place with more attractions from a historic standpoint than Mexico City.

A PRACTICAL CHARITY

The national pawn shop is one of the unique institutions of the capital. It was

AN OIL WELL NEAR TAMPICO

One of the most spectacular sights in the world is a great oil gusher on fire. When the second Dos Bocas well was being drilled, without warning the stream was tapped at 1,800 feet, and before the men could put the fire out of the drilling engine the gushing oil spread over the ground and took fire from the engine. It was estimated that from 60,000 to 75,000 barrels of oil were consumed each day for nearly two months. The cost of extinguishing the fire and capping the well was $3,000,000. During the height of the fury of the fire the flames reached an elevation of 1,400 feet and a width of 75 feet. Newspapers could be read at a distance of 17 miles, headlines at 33 miles, and ships could see the fire 100 miles away.

founded by Pedro Jose Romero de Terreros, the owner of the fabulously rich mines at Real del Monte. Here money may be borrowed on chattels at very low rates of interest, and everything is pledged, from a pair of cock's spurs to an automobile and from a silver ring to an iron safe. The smallest loan made is 12 cents and the largest $4,000.

The clerk who makes the loan must repay it out of his own pocket if the pawn is not redeemed or cannot be sold for a sum equivalent to the loan. Unredeemed pledges are marked with prices at which they will be sold, and every five months this price is marked down lower, until it finds a buyer, or until the point is reached where the clerk must pay the loan and take the pawn himself.

About 40,000 articles are pawned each month. The interest on loans amounts to about $20,000 a month. All profits go to the extension of the business.

From the American standpoint burial customs in Mexico are very strange. A grave may be rented in perpetuity or for a term of years. If the latter option is taken and the rent is not paid promptly at each recurring period, the bones of the occupant are ejected and thrown upon a great bone pile. These bones from time to time are cremated.

At Mexico City's great city of the dead, where 160,000 people have been buried, there is a cave which contains hundreds of tons of human ashes. The Mexican law forbids services at the grave since the separation of church and state under Benito Juarez.

Nothing is more heartrending than to witness a funeral of a child among the poor, and infant mortality is terribly high among them. Too poor to buy a coffin, they must content themselves with renting one. They place their own child in it, the husband takes it upon his shoulder, and together the family march to the grave, where the child is removed from the coffin and put into the ground, with nothing to protect it from the cold earth but its little cotton shroud. Those who are better off use a street-car hearse and buy coffins for their dead.

THE MEXICAN PEOPLE

The most conspicuous thing about the male population of Mexico, so far as the masses of half-breeds are concerned, are their hats. These are bought even if their purchase does force the buyer to go hungry for months afterwards, for the peon is not nearly as much a slave to his haciendado as he is to his hat.

At one time the brims of the Mexican sombrero got so wide that the hats had to be tipped sidewise to be gotten into the cars, so the government resorted to a tax of $1 for each 4 inches of brim above a certain width.

Grandiloquent promises and exaggerated courtesy is the characteristic of the people. To be "muy simpatico," heartily congenial, is the first law of their social code. Everybody puts his house at your disposal; it is yours. But nobody means even to entertain you as his guest unless he says so in as many words. If you admire a piano, a watch, a house, or a hacienda, it is yours instantly, although you never get it.

The Mexican loves companionship. When he meets an old friend he hugs him to his heart, figuratively and literally, and with many pats upon his back calls him the friend of his youth. He bows whenever he enters a public place, ostensibly to the person nearest the door, but in reality to the whole crowd.

Beggars flourish everywhere, and of all the woe-begone, bedraggled, miserable-looking creatures on the face of the earth, commend me to the Mexican beggar. "Un centavo, señor," rings in your ear day and night. Begging and looking wretched with them is an art whose mastery they begin to strive for while still babes in arms. They invoke the blessings of the saints and the love of God upon you when asking for alms and when receiving them, and the only way that yet has been discovered to get rid of them is to say "Pardoneme por Dios"—"Pardon me in the name of God." That is even a better way and a much more satisfactory one than calling the police.

Once I was passing through a little town above San Luis Potosi, when I saw a bunch of little half-breeds ranging from

Photo from Alberto L. Godoy

THE PYRAMID OF THE SUN: SAN JUAN, TEOTIHUACAN, NEAR MEXICO CITY

"The monuments left by the Aztecs and their predecessors in Mexico tell of a surprising ancient civilization. . . . The Pyramids of the Sun and Moon, near Mexico City, while not as large as those of Egypt, bear wonderful inscriptions" (see text, page 493).

ten years down to a baby about a year old. I gave the baby a "cinco centavo" piece, and right before my eyes a little scoundrel about eight grabbed it away from the baby and ran. I tried the same experiment in several other places, with about the same result. Mexico is the only place I have ever visited where they steal from the babies.

Mexico is a land of holidays. Counting Sundays, there are 131 on the Mexican calendar, and it is asserted that more than half of the people observe them all. There are 52 saints' days, 15 solemn feast days, 3 holy days, and 6 family feast days. On certain of these days all Mexico takes to the festival, and it usually requires from one to three days for the peons to sober up and get back to regular work again.

A SPLENDID ANCIENT CIVILIZATION

The monuments left by the Aztecs and their predecessors in Mexico tell of a surprising ancient civilization. Where once the Americans and the Mexicans engaged in deadly combat at Churubusco, and where until recently they fraternized at the beautiful Country Club long years before the astronomical observatory at Uranienborg was built, there arose an Aztec astronomical observatory. The Aztecs fixed their year with a determination of the actual time between the equinoxes more accurate than that of the Alexandrian scholars who made the Julian calendar. The latter calendar today is some 13 or 14 days out of accord with the seasons, while the Aztec calendar is only a few hours out of agreement with the equinoxes. They wrote their calendar on a great circular stone 22 feet in diameter, 3 feet thick, and weighing some 24 tons. The inscriptions on it have been worked out and the Aztec system of time reckoning ascertained.

The Sacrificial Stone, containing a carved portrayal of the rights of sacrifice of the Aztecs, is also to be found in the National Museum, and a copy of it is in our own National Museum. Tens of thousands of victims were offered up on this stone to the sun-god of the Aztecs, the principal part of the sacrificial rite being the plucking out of the yet-beating heart of the victim and holding it up to heaven.

The Pyramids of the Sun and Moon, near Mexico City, while not as large as those of Egypt, bear wonderful inscriptions. The Chinese Minister to Mexico declares that one of these inscriptions occurs on the majority of tombs in China.

From the ruins of Palenque, known to have existed before the coming of Columbus, there was taken some years ago a tablet which shows, in bas-relief, two Indians standing in reverential attitude before a cross.

The earliest people who seem to have left any trace of their occupancy of the land in Mexico were the Toltecs. They were followed by the Chicemecs, called the barbarians of the North, and believed by some to have been the progeny of a race of people who came to the American continent either by way of the frozen Bering Straits or were borne across the seas by the Japan current.

Whether viewed from the standpoint of its past, contemplated from the standpoint of its present, or considered from the standpoint of its future, Mexico is now the great question-mark of the Western World. It will be a long, long climb until its population, four-fifths Indians and half-breeds, will reach that point in their national destiny where they can possess a government like our own. It will be years before the tragic days of the present can be wiped out and before the uncounted riches of its wonderful mineral and agricultural resources can be fully capitalized.

But somehow, some day, Mexico will find that peace that is based on a united desire for peace and a united purpose to have it, and then Mexico will go forward as our own country has gone forward in the last fifty years.

BIRDS OF TOWN AND COUNTRY

By Henry W. Henshaw

Chief of the Biological Survey

The 64 colored pictures of common birds of the United States, which illustrate the following article by Dr. Henshaw, were prepared especially for the National Geographic Magazine *by the artist-naturalist, Louis Agassiz Fuertes, and represent many months of work by him and by the engraver and printer. As in the June, 1913, number, the* Geographic *printed a collection of 50 birds in colors, also by Louis Agassiz Fuertes, with text by Dr. Henshaw, it has now given its readers, at the cost of many thousands of dollars, a complete pictorial description of the 114 more common birds of our country.*

The Magazine has received so many requests for separate copies of the article printed last year that arrangements have been made for binding substantially in one volume both of the above articles; also the article by Frederic H. Kennard, "Encouraging Birds Around the Home," with 36 illustrations, which was printed in our March, 1914, number, and the original contribution, "Our Greatest Travelers: Birds that Fly from Pole to Pole; Birds that Make 2,500 Miles in a Single Flight," by Wells W. Cooke, in our April, 1911, issue. A limited number of copies of this valuable collection, substantially bound in cloth, may be obtained at the office of the National Geographic Society at $1.00 each (bound in leather, $2.00).

FROM very ancient times birds have appealed to the interest and imagination of mankind. They have furnished themes for innumerable poets, have appeared in many guises in primitive religions, and by their flight inspired the predictions of the soothsayers of old. In these modern and prosaic times birds still continue to interest mankind, and the last decade has witnessed a marked strengthening of the sentiment toward them.

The present interest is direct and personal, and today hundreds of thousands of men and women in various parts of the country, old as well as young, are employing much of their leisure in familiarizing themselves with the birds of their respective localities. In following birds afield, in studying their habits, and listening to their songs, they bring themselves into close touch and sympathy with nature and add new zest to life—a zest, be it noted, which enriches without harm to any creature.

Would that the same could be said of the sportsman who almost invariably is at heart a nature lover, though the primitive instinct to kill is uppermost. Many sportsmen, however, who formerly followed wild creatures only to kill, have abandoned the use of rifle and shotgun, and today are finding greater pleasure in studying and photographing their former quarry than they did in pursuing it with murderous intent. A real interest in living outdoor wild life leads naturally to a love of nature in all her varied manifestations, and this, in all lands and under all circumstances, remains a source of lasting pleasure.

A love of birds from the esthetic side, however, is of comparatively recent development and had little place among primitive peoples, who utilized birds chiefly in two ways—for food and for ornament. Feathers, especially, appealed to them for purposes of adornment, and this barbaric taste has not only survived among civilized races, but in recent years has developed to an extent which threatens the very existence of many of the most beautiful and notable species of birds in various parts of the world. No region is too remote, no forests too deep, no mountains too high to stay the plume-hunter, stimulated by the golden bribe offered by the tyrant Fashion.

Happily, America has taken the lead in an attempt to restrict this craze for feather adornment, which means nothing less than the death of millions of beautiful and useful creatures. Nor are evidences wanting that other countries as well have recognized the gravity of the situation and are preparing to pass pro-

tective laws similar to those recently enacted in this country.

BIRDS ARE THE FARMERS' MOST EFFICIENT ALLIES

While birds appeal to the regard and interest of man from the esthetic side as no other creatures do, there is another and even more important point of view, and it is no doubt true that of late years interest in birds has been greatly stimulated by the discovery that they possess an economic value. Indeed, so great is their value from a practical standpoint as to lead to the belief that were it not for birds successful agriculture would be impossible.

The study of the economic side of bird life and of the relations of birds to the farmer and horticulturist have been greatly stimulated in the United States by Federal aid and supervision, and in no other country in the world have the activities of birds been so carefully investigated with reference to their practical bearing. Under the Biological Survey of the Department of Agriculture, for instance, is a corps of trained men, who study the food of birds by careful examination of the stomachs of specimens killed for scientific purposes. The information thus gained is supplemented by observations in the field, and the result is a large amount of invaluable data illustrative of the economic relations of many kinds of birds. This storehouse of information has been largely drawn upon in the following pages.

OUR COUNTRY IS PARTICULARLY FORTUNATE IN THE NUMBER AND VARIETY OF ITS BIRDS

It would be strange indeed if our land, with its vast extent of territory, its diversified landscape, its extensive forests, its numerous lakes and streams, with its mountains, prairies, and plains, had not been provided by Nature with an abundant and diversified bird life. As a matter of fact, America has been favored with a great variety of birds famed both for beauty and for song. America also possesses certain families, as the humming-birds and wood-warblers, the like of which exist nowhere else in the world.

In considering the many kinds of birds in the United States from the practical side, they may not inaptly be compared to a police force, the chief duty of which is to restrain within bounds the hordes of insects that if unchecked would devour every green thing. To accomplish this task successfully, the members of the force must be variously equipped, as we find they are. Indeed, while the 1,200 kinds of birds that inhabit the United States can be grouped in families which resemble each other in a general way, yet among the members of the several families are marked variations of form and plumage and still greater variation of habits, which fit them for their diversified duties.

As the bulk of insects spend more or less time on the ground, so we find that more birds are fitted for terrestrial service than for any other. Our largest bird family, the sparrows, is chiefly terrestrial, and although its members depend much upon seeds for subsistence they spend no little share of their time searching for insects. They are ably aided in the good work by the thrushes, wrens, certain of the warblers, and many other birds.

Another group is of arboreal habits, and plays an important part in the conservation of our forests, the true value of which we have only recently learned to appreciate. So many insects burrow into trees that a highly specialized class of birds — the woodpeckers — has been developed to dig them out. The bills, tongues, feet, and even the tails of these birds have been cunningly adapted to this one end, and the manner in which this has been done shows how fertile Nature is in equipping her servants to do her bidding.

The bark of trees also forms a favorite shelter for numerous insects, and behold the wrens, nuthatches, warblers, and creepers, with sharpest of eyes and slenderest of bills, to detect our foes and to dislodge them from crack and cranny.

The air is full of flying insects, and to take care of these there are the swallows, swifts, and night-hawks, whose wings and bodies are so shaped as to endow them with the speed and agility necessary to follow all the turns and windings of their nimble insect prey.

The whippoorwills, swift of wing and with capacious mouths beset with bristles, attend to the night-flying insects when most birds are asleep, while the hawks by day and the owls by night supplement the work of other birds and have a special function of their own, the destruction of noxious rodents.

Thus every family of birds plays its own part in the warfare against insects and other foes to man's industry, and contributes its share to man's welfare.

Birds would fall far short of what they accomplish for man were they not the most active of living things. It is curious that the group of vertebrates which live the fastest—that is, have a higher temperature and a more rapid circulation than any other—should be related by descent to a family of such cold-blooded creatures as the reptiles and lizards, which often go without food and hibernate for considerable periods. Very different is it with birds. Few realize the enormous quantity of food required to sustain the energy of these creatures, most of whose waking hours are spent in a never-ending search for food.

In satisfying their own hunger birds perform an important service to man, for notwithstanding the fact that the acreage under cultivation in the United States is larger than ever before, and that the crops are greater, the cost of foodstuffs continually mounts upward. Meanwhile the destruction of farm and orchard crops by insects and by rodents amounts to many millions each year, and if any part of this loss can be prevented it will be so much clear gain.

The protection of insectivorous and rodent-destroying birds is one of the most effective means of preventing much of this unnecessary loss, and the public is rapidly awakening to the importance of this form of conservation. From the farmers' standpoint, such birds as the bobwhite, prairie-chicken, the upland plover, and the other shore birds are worth very much more as insect eaters than as food or as objects of pursuit by the sportsman. This statement applies with especial force to such species as the prairie-chicken, which everywhere in its old haunts is threatened with extinction.

BIRDS CHECK RAVAGES OF DISEASE-CARRYING INSECTS

The value of birds to the farmer is plain enough, but we do not usually think of birds as having any direct relation to the public health. To prove that they do, however, it is only necessary to state that 500 mosquitoes have been found in the stomach of a single night-hawk; that in a killdeer's stomach hundreds of the larvæ of the salt-marsh mosquito have been found, and that many shore birds greedily devour mosquito larvæ. As mosquitoes are known to carry the germs of such serious diseases as dengue fever and malaria, it is evident that by destroying them birds are conferring an important benefit on man. It may be added that not infrequently ticks are eaten by birds, and that the tick responsible for the spread of Texas fever among cattle has been found in the stomach of the bobwhite.

Since birds perform such invaluable service, every effort should be made to protect the birds we now have and to increase their numbers. This can be done in several ways: (*a*) by furnishing nesting boxes for certain species to nest in, as swallows, martins, wrens, woodpeckers, great-crested flycatchers, and others; (*b*) by planting berry-bearing shrubs about the farm or orchard as food for the birds in winter; (*c*) by the establishment of bird santuaries, where birds may be reasonably safe from their natural enemies and be permitted to live and breed in absolute security as far as man is concerned.

Here, again, the National Government, taking the lead, has set apart no less than 64 bird refuges in various parts of the United States. These for the most part are rocky, barren islands of little or no agricultural value, but of very great usefulness in the cause of bird protection. The example thus set is now being followed by certain States, as Oregon and Wisconsin. Several private citizens also have acquired islands for the purpose of making bird preserves of them; others not only prevent the destruction of wild life on their forested estates, but go much farther, and endeavor in various ways to increase the number of their bird tenants.

Efforts to protect birds on a smaller scale and to attract them about dwellings, with a view to their close companionship, are worthy of all praise, and such efforts should be far more common in this country than they are at present, particularly as the means involve little trouble or expense. The presence of trees and shrubbery near the house is of itself an open invitation to birds which they are eager to accept, particularly if the shrubbery is not too closely pruned. Birds like thick vines and tangles, in the recesses of which they feel safe from their many enemies. Suet, nuts, and other bird foods, if exposed in conspicuous places, can usually be depended on to attract birds in winter, and often avail to save many lives, especially when snow covers the ground. In summer opportunities to drink and bathe are irresistible attractions to birds and largely increase the number resorting to any given neighborhood.

Last but not least important may be mentioned the element of safety from cats. Birds and cats do not thrive in the same neighborhood.

To awaken interest in the study of our bird neighbors is the chief object of this paper. The free use of colored illustrations to facilitate identification precludes the necessity for long and detailed descriptions. As all the birds illustrating the text are from the brush of the well-known artist, Fuertes, they need no commendation, but may be permitted to sing their own praises.*

* The following birds were pictured and described in the June, 1913, number of the NATIONAL GEOGRAPHIC MAGAZINE: Bluebird, robin, russet-backed thrush, ruby-crowned kinglet, chickadee, white-breasted nuthatch, brown creeper, house wren, brown thrasher, catbird, mocking-bird, myrtle warbler, loggerhead shrike, barn-swallow, purple martin, black-headed grosbeak, rose-breasted grosbeak, song-sparrow, chipping sparrow, white-crowned sparrow, English sparrow, crow blackbird, Brewer's blackbird, Bullock's oriole, meadow-larks, red-winged blackbird, bobolink, common crow, California jay, blue jay, horned lark, Arkansas kingbird, kingbird, nighthawk, flicker, yellow-bellied sapsucker, downy woodpecker, yellow-billed cuckoo, screech-owl, barn-owl, sparrow hawk, red-tailed hawk, Cooper's hawk, morning dove, ruffed grouse, bobwhite, killdeer, upland plover, black tern, Franklin's gull.

LIST OF BIRDS DESCRIBED AND INDEX

	Illustration page
Kingfisher	499
Red-headed Woodpecker	499
Red-shafted Flicker	499
California Woodpecker	499
Black and White Warbler	501
Yellow Warbler	501
Audubon's Warbler	501
American Redstart	501
Indigo Bunting	503
Lazuli Bunting	503
White-throated Sparrow	503
Slate-colored Junco	503
Black Flycatcher, or Phainopepla	505
Yellow-throated Vireo	505
Red-eyed Vireo	505
Lark Sparrow	505
Maryland Yellow-throat	507
Yellow-breasted Chat	507
Oven-bird	507
Cedar Waxwing	507
Towhee, or Chewink	509
California Brown Towhee	509
Orchard Oriole	509
Baltimore Oriole	509
Black-billed Magpie	511
Yellow-billed Magpie	511
Phœbe	511
Blue-fronted Jay	511
Wood Pewee	511
Ruby-throated Humming-bird	513
Rufous Humming-bird	513
Whippoorwill	513
Road Runner	513
Varied Thrush	516
Veery	516
Wood-thrush	516
Bush-tit	516
House Finch	518
Purple Finch	518
Arkansas Goldfinch	518
American Goldfinch	518
Vesper Sparrow	520
Blue Grosbeak	520
Cardinal	520
California Quail	520
Tree-swallow	522
Cliff or Eaves Swallow	522
Scarlet Tanager	522
Western Tanager	522
Yellow-headed Blackbird	524
Starling	524
Cowbird	524
Chimney Swift	524
Marsh-hawk	526
Osprey	526
Turkey-buzzard	526
Bald Eagle	526
Black-crowned Night Heron	528
Herring Gull	528
Great Blue Heron	528
Common Tern	528
Great Horned Owl	530
Coot	530
Wood-duck	530
Spotted Sandpiper	530

KINGFISHER (Ceryle alcyon).

Length, about 13 inches. Not to be confused with any other American bird.

Range: Breeds from northwestern Alaska and central Canada south to the southern border of the United States; winters from British Columbia, Nebraska, Illinois, Indiana, Ohio and Virginia south to the West Indies, Colombia and Guiana.

The cry of the kingfisher, which suggests a watchman's rattle in vigorous hands, can be mistaken for the note of no other bird; nor, for that matter, is the bird himself likely to be confused with any other species. Whether flying, perched on a branch over a stream, or diving for small fish, our kingfisher is always himself, borrowing none of his peculiarities from his neighbors. Many of his tropical brothers catch insects for a living; but our bird, early in the history of the development of the kingfisher family, discovered that fish were easier to catch and in the long run more filling than insects, and hence renounced the family habit and assumed the role of fisherman. Instead of using a hollow tree as a nest site, the kingfisher has apparently learned a lesson from the sandswallows and excavates a burrow for himself in some sandbank, usually not far from pond or stream; and you may be sure that any pond chosen by him for a haunt is well stocked with fish. The fish he kills are chiefly minnows and of small value, but the bird sometimes makes a nuisance of himself about fish hatcheries, where his skill in catching young food fish often brings him speedy doom.

RED-HEAD (Melanerpes erythrocephalus).

Length, about $9\frac{3}{4}$ inches. Our only woodpecker with red head and broad white wing patch.

Range: From southern Canada to the Gulf Coast and from central Montana, central Colorado, and central Texas to the Hudson and Delaware. Generally resident, but more or less migratory in the southern parts of its range.

This strikingly marked and readily identified woodpecker is common in some localities and entirely wanting in others which apparently are equally well adapted to the bird's needs. Its habits are a combination of woodpecker, jay and flycatcher, and catching insects on the wing is a common habit. Though in general migratory, the bird is apparently indifferent to cold and other weather conditions, and winters wherever food abounds, especially where beechnuts, of which it is very fond, are plentiful. The red-head eats nearly twice as much vegetable food as it does animal, but the latter includes many destructive insects. For instance, it is greatly to its credit that it eats both species of clover beetles, the corn weevil, cherry scale and 17-year cicada. On the other hand, vigorous accusations are not wanting from various parts of the country of damage done by this species. It eats corn on the ear, and attacks many kinds of small fruits, including strawberries and apples. It is also guilty of robbing the nests of wild birds of both eggs and nestlings. It does some damage to telegraph poles by boring into them to make nests. No doubt some of these charges are well founded. For the most part they represent the occasional acts of individuals, or are local and not characteristic of the species as a whole.

RED-SHAFTED FLICKER (Colaptes cafer collaris).

Length, 12 to 14 inches. To be distinguished from its eastern relative (*C. auratus*) by its red mustache and nuchal band and the red wing and tail shafts.

Range: Rocky mountain region from British Columbia south to Mexico, west to the coast mountains in Oregon and Washington, and through California; largely resident.

Few birds are more widely known than the flicker, as appears from the fact, recorded by Chapman, that in the various parts of the country it appears under no fewer than 124 aliases. Though well known, the flicker is more often heard than seen, its loud call often proclaiming its presence when it is hidden among the trees. As a rule the flicker is shy and in some sections of the country it has good reason to be, since it is accounted a game bird and, as such, pursued for the table.

Though a woodpecker, the red-shaft departs widely from typical members of the tribe both in structure and habits. Notwithstanding the fact that its bill is not well adapted for boring into wood for larvæ, the bird manages to do considerable damage in the west by making holes, in church steeples, school houses and other buildings, to serve as roosting quarters. As it is nowise particular as to its domicile, it is possible materially to increase its numbers by putting up nesting boxes for its accomodation. The bird's subsistence is obtained largely from the ground, where it secures vast quantities of ants, for taking which its tongue is specially adapted; about one half its food in fact consists of these creatures. The flicker also consumes grasshoppers, crickets, and beetles, but it is so much of a vegetarian that the list of berries and seeds it eats is a long one, though it is not accused of taking domestic fruit.

CALIFORNIA WOODPECKER (Melanerpes formicivorus and races).

Length, about $9\frac{1}{2}$ inches. Easily distinguished from its fellows by its general black color, white forehead, throat patch, belly and wing patch.

Range: Breeds from northwestern Oregon, California, Arizona, and New Mexico south through Lower California to Costa Rica.

The California woodpecker is a noisy, frolicsome bird and by all odds the most interesting of our woodpeckers. Its range seems to be determined by that of the oaks upon which it lives and from which it draws a large part of its subsistence. In California the bird is known to many by the Spanish name, *carpintero*, or carpenter, and its shop is the oak, in the dead limbs of which, as in the bark of pines, it bores innumerable holes, each just large enough to receive an acorn. That the birds do not regard the filling of these storehouses as work, but on the contrary take great pleasure in it, is evident from their joyous outcries and from the manner they chase each other in their trips from tree to tree like boys at tag. In California many of the country school houses are unoccupied during the summer and the woodpeckers do serious damage by drilling holes in the window casings and elsewhere with a view to using them as storage places. As long as the acorn crop lasts, so long does the storing work go on. Meanwhile the jays and squirrels slip in and rob the woodpecker's larder. Though this woodpecker eats insects, including some harmful ones, they form less than a third of its entire fare.

Kingfisher
Red-headed Woodpecker

Red-shafted Flicker
California Woodpecker

BLACK AND WHITE WARBLER (Mniotilta varia).

Length, about $4\frac{1}{4}$ inches. Easily known by its streaked black and white plumage.

Range: Eastern North America. Breeds from central Mackenzie, southern Keewatin, northern Ontario, Newfoundland, Nova Scotia and New Brunswick to eastern Texas, Louisiana, central Alabama and northern Georgia, west to South Dakota; winters in Florida and from Colima and Nuevo Leon to Colombia, Ecuador and Venezuela.

A warbler in form and general make-up, a creeper by profession and practice, this readily identified species, in its striped suit of black and white, may be observed in any bit of eastern woodland. Here it flits from tree to tree or climbs over the trunks and branches, scanning every crack and cranny for the insects that constitute its chief food. Though not a lover of open country, it frequently visits the orchard, where it performs its part in the task of keeping insect life within due bounds. It nests on the ground and hides its domicile so skillfully that it is not often found. None of the warblers are noted as songsters, but the black and white creeper, as I like best to call it, emits a series of thin wiry notes which we may call a song by courtesy only. In scrambling over the trunks of trees it finds and devours many long-horned beetles, the parents of the destructive root-borers; it also finds weevils, ants and spiders.

YELLOW WARBLER (Dendroica æstiva and races).

Length, little more than 5 inches. Mostly yellow, breast and belly streaked with reddish brown.

Range: North America, breeding generally throughout its range south to California, New Mexico, Missouri and northern South Carolina; winters in Central and South America.

The "yellow bird," or wild canary, as it is sometimes called, is one of the commonest of the warbler tribe, and ranges over a vast extent of territory, being found here and there from ocean to ocean. Unlike some of its relatives, it prefers open thickets, especially of willows, to thick woodland, and often builds its pretty nest by the roadside or in garden shrubbery. Though not an expert musician, the yellow warbler sings early and often, and in zeal makes up what it lacks in quality of voice. Because its nest is easily found by the initiated, this warbler is often victimized by the infamous cowbird and is forced to bring up one, or even two, young cowbirds in place of its own rightful progeny. It is pleasant to be able to record the fact that sometimes the clever warbler knows enough,—how it knows it is another matter,—to evade the unwelcome responsibilities thus thrust upon it, and builds a platform over the alien egg and then continues its domestic affairs as originally planned. Indeed cases are on record when two cowbirds' eggs have been found in a nest, each covered up by a separate layer of nest material. If this is not intelligence of a high order, how else can we characterize it? The food of this warbler consists almost exclusively of harmful insects, including the black olive scale.

(See Biol. Surv. Bul. 17, p. 20 et seq.; also Bul. 29.)

AUDUBON'S WARBLER (Dendroica auduboni).

Length, about 5 inches. Much like the yellow-rump but with yellow crown and throat patch.

Range: Breeds from central British Columbia, Alberta and southwestern Saskatchewan to our southern border, east to South Dakota and Nebraska; winters from California and Texas, south to Guatemala.

America is particularly favored by the presence of the beautiful wood warbler family, the members of which are excelled by few birds in symmetry of form, pleasing coloration and graceful motions. They are also of highly beneficial habits. No member of the wood warbler family is more characteristic of the group than this beautiful bird. In voice, coloration, and habits it is almost the counterpart of the yellow-rump of the eastern states, for which indeed it might easily be mistaken were it not for its yellow throat, the corresponding area in the yellow-rump being white. It summers in the mountains and shows off to advantage against the dark foliage of the pines. It seems to have little fear of man and in winter frequents orchards, gardens, and dooryards. Wherever it may be it keeps up an incessant hunt for its insect food, in the pursuit of which, like many others of its family, it sometimes essays the role of flycatcher, being very expert and nimble on the wing. This warbler also devours large numbers of ants, flies, scale and plant lice, and various noxious beetles and bugs.

(See Biol. Surv. Bul. 30, pp. 43-46).

REDSTART (Setophaga ruticilla).

Length, nearly $5\frac{1}{2}$ inches. To be distinguished from other warblers by its coloration and its motions. (See below.)

Range: Breeds from central British Columbia and eastern Canada to Washington, Utah, Colorado, Oklahoma and North Carolina; winters in the West Indies and from Mexico to Ecuador.

Its beauty of form and plumage and its graceful motions place this dainty bird at the head of our list of wood warblers—a place of distinction indeed. The bird appears to be the incarnation of animated motion and fairly dances its way through the forest. Spanish imagination has coined a suggestive and fitting name for the redstart, *candelita*, the little "torch bearer." The full appropriateness of the name appears as the graceful creature flits through the greenery, displaying the salmon-colored body and the bright wing and tail patches. The redstart is not unknown in some parts of the west, but it is essentially a bird of the eastern states, where it is a common inhabitant of open woodland districts. The wood warblers are not our most artful architects, and in this respect the redstart does not depart from the traditions of its kind. While it builds a rather neat and compact structure of strips of bark, plant fibres and the like, placing it in a sapling not far from the ground, the nest is not the thing of beauty one might be led to expect from such a fairy-like creature. Ornamental as the redstart is, it possesses other claims on our gratitude, for it is a most active and untiring hunter of insects, such as spittle insects, tree-hoppers and leaf-hoppers, and both orchard and forest trees are benefited by the unceasing warfare it wages.

(See Biol. Surv. Bull. 17, p. 20 et seq.)

Black and White Warbler
Yellow Warbler

Audubon's Warbler
American Redstart
Female, upper; male, lower

INDIGO BUNTING (Passerina cyanea).

Length, about 5½ inches. The male is easily identified by the rich blue color, with black wings and tail. The female is warm brown.

Range: Breeds from eastern North Dakota, central Minnesota, northwestern Michigan, southern Ontario and southern New Brunswick to central Texas, southern Louisiana, central Alabama and central Georgia; winters from southern Mexico to Panama.

The indigo bird is the brightest colored sparrow that visits the north, but one can hardly believe that the sprightly dandy, clad in his rich blue suit, is the mate of the inconspicuous brown bird that seeks assiduously to conceal herself in the leafy cover, as though a bit ashamed of the contrast between her working suit and the holiday garb of her spouse. The indigo is a frequenter of sprout land, of brushy thickets and of open woodland, and the male is fond of singing his cheerful lay from the topmost twig of a tall shrub or tree, as though challenging the world to produce his equal. For such a dainty bird, the nest is a singularly inartistic structure and very carelessly built. It is placed in the crotch of some low leafy bush and is not at all difficult to find.

The fine feathers of the male are not the only claim of the indigo bird to our interest. Its food consists largely of weed seed, but it eats many insects, including a goodly proportion of grasshoppers and caterpillars.

WHITE-THROATED SPARROW (Zonotrichia albicollis).

Length, about 6¾ inches. The white throat and yellow before the eye are its distinguishing colors.

Range: Over most of eastern North America. Breeds in much of Canada south to southern Montana, central Minnesota, central Wisconsin and in the mountains of northern Pennsylvania, New York and Massachusetts; winters south of the Ohio.

This is one of the bird lovers' favorites, as well it may be. Its beautifully variegated plumage, its jaunty ways, its familiarity and its sweet and plaintive whistle all combine to commend the bird to our interest. In the fall it comes to us in large flocks associated with other species, especially juncos and various other sparrows. The "peabody bird" is singularly prodigal of its sweet song, and the young white-throats begin to try their voices in the fall as if practicing for the more exacting demands of spring. When a number join in the fall chorus the result is singularly sweet and inspiring. Many a camper in the north woods, as he lies in his blanket under the stars, pays tribute to the sweet voices of this songster, as it is borne on the midnight air to his ears from some leafy retreat.

The food habits of this sparrow give it a place among the farmers' friends. It is a great destroyer of weed seed and is especially fond of those of ragweed and bindweed. In the cotton belt, where many white-throats winter, it includes among its insect food the boll weevil.

LAZULI BUNTING (Passerina amœna).

Length, from 5¼ to 5½ inches. Male blue above, breast brownish; wing bars white. Female brownish.

Range: Breeds from southern British Columbia, southern Alberta, southeastern Saskatchewan and western North Dakota to southern California and southwestern Texas; winters in Mexico.

The lazuli finch is a near relative of the indigo bunting and the nonpareil, and its habits are in a general way very similar. There is the same disparity between the dress of the sexes, the color of the female being comparatively dull and homely. The male, however, is a gay plumaged dandy in his suit of turquoise blue, and is likely to surprise the stranger who meets him for the first time, since his colors suggest a tropical setting and are somewhat out of keeping with his surroundings. Notwithstanding his fine feathers, he is not so fond of displaying himself as is his cousin, the indigo bird, but seems to think that the cover of brush and chapparral is essential to his safety. The lazuli finch is a cheerful singer, and its song may be heard at frequent intervals. This song is vivacious and pleasing and the Easterner who hears it for the first time will have no difficulty in guessing at the identity of the chorister, from the resemblance of his lay to the ditty of the indigo bird.

We know comparatively little about the food habits of this finch. It is known, however, that it is a confirmed seed eater and also devours many insects.

SLATE-COLORED JUNCO (Junco hyemalis).

Length, about 6¼ inches. Prevailing color grayish slate, belly white; outer tail feathers tipped with white.

Range: Breeds in much of Alaska and Canada and in the mountains of New York, Pennsylvania and Massachusetts, while a nearly related form (the Carolina Junco) breeds in the southern Alleghenies; winters throughout the eastern states to the Gulf.

Only one junco inhabits the eastern United States, but several species live in the west. All of the members of the group resemble each other in a general way and all have similar habits. Most of us know the junco only in the fall and when, after having summered in the mountains of the more northern districts, the birds gather in large flocks and forsake high altitudes for more congenial surroundings. The junco associates with other sparrows, usually far outnumbering them, but its slate-colored plumage and white tail feathers reveal its presence unmistakably. Its familiar "tsip," may be easily recognized among the medley of notes, but its low sweet song is to be heard at its best only in its alpine home. Nevertheless, as the late migrants shape their course for the northern woods, it is not uncommon to hear the males of a flock burst into song, as if they really could not be content to remain silent any longer. When snow is on the ground the juncos are often hard pushed for food and on such occasions a flock will readily respond to an invitation to visit the dooryard and dine on table crumbs or small seeds of any kind.

The junco is one of our most persistent grass and weed seed eaters and in winter and spring seeds constitute much the greater part of its fare. Taking the year around about one-fourth of its food consists of insects, including leaf beetles, weevils, caterpillars, grasshoppers and many others.

(See Biol. Surv. Bul. 15, pp. 80-82.)

INDIGO BUNTING
Male, upper; female, lower
WHITE-THROATED SPARROW

LAZULI BUNTING
Male, upper; female, lower
SLATE-COLORED JUNCO

BLACK FLYCATCHER; PHAINOPEPLA (Phainopepla nitens).

Length, about 7½ inches. The glossy black color and marked crest of the male and the brownish gray of the female, also crested, distinguish this species.

Range: Breeds from central California, Nevada, Utah, and southwestern Texas southward; winters from southern California southward.

Though a distant relative of the cedar bird, the phainopepla differs markedly from that species both in appearance and habits. It is known to few, for it lives chiefly in the desert country of the southwest, though it is not wholly a stranger in the parks and gardens of that region. When flying the white wing-patch becomes conspicuous and distinguishes the bird from all others. In the fall it is not unusual to find it in loose flocks the members of which are drawn temporarily together, perhaps by the abundance of some favorite food. Like the cedar bird, it is essentially a berry eater, and in California sometimes makes free of the cherry crop. Its chief dependence, however, is the mistletoe, the mucilaginous berries of which delight it, as also do those of the juniper and pepper. Its partiality for mistletoe is probably the bird's worst trait, as it distributes the seeds of this pernicious parasite to the detriment of many fine oaks and sycamores. It eats many insects, principally ants, and has the habit of perching on a tall shrub, from which it sallies forth after flying insects, thus simulating a flycatcher. It is this habit which has given the bird its common name. The phainopepla has a variety of call notes and a very pleasant song.

YELLOW-THROATED VIREO (Lanivireo flavifrons).

Length, about 6 inches. Its green upper parts and bright yellow throat and upper breast are its identification marks.

Range: Breeds from southern Canada south to central Texas, central Louisiana and central Florida; winters from southern Mexico through Central America.

By no means so common as the red-eye, the yellow-throat inhabits the same kind of woodland tracts and like it may often be seen, and still oftener heard, in the trees that shade the village or even the city streets. It is, however, much less common in such places since the advent of the English sparrow, having been driven away by that little pest. Its song is much like that of the red-eye, yet it has a rich throaty quality quite foreign to the notes of that tireless songster and far superior to them. Neither this, nor indeed any of the vireos, ever seem to be in a hurry. They move quietly through the leafy covert, scanning the most likely lurking places for insects, pausing now and then to sing in a meditative manner, then renewing their quest. All of which is as different as possible from the busy, nervous movements of the wood warblers, that seem ever in haste as though time were much too precious to waste.

The food of the yellow-throat consists of a large variety of insects, including caterpillars, moths and beetles, and also those well-known pests, flies and mosquitoes. It also eats the plum curculio.

RED-EYED VIREO (Vireosylva olivacea).

Length, about 6¼ inches. The slaty gray crown enclosed by narrow black lines serves to identify this vireo.

Range: Breeds from central Canada south to southeastern Washington, southern Montana, eastern Wyoming, eastern Colorado, western Texas, and central Florida; winters in South America.

The red-eye is one of the commonest not only of our vireos but also of all our small birds, and inhabits every suitable piece of woodland throughout its territory. Its notes may be frequently heard coming from the village shade trees; city parks and streets also know it. Its most notable trait is its habit of singing almost continuously as it moves slowly through the branches, pausing now and then to pick up a caterpillar or other insect. In woods where these vireos are common its voice may be heard all the livelong day, even during the noon hours when most birds are silently resting. The nest, suspended in a V-shaped fork, is a beautiful specimen of avian architecture, and so indifferent is the bird to its location that the nest of no other bird is so frequently seen by the chance passerby.

Though fond of mulberries and sassafras berries, the red-eye eats insects by preference, and spends most of its time gleaning the branches for plant lice scales and caterpillars of various kinds. It eats such harmful beetles as the long-horned borers and weevils. I once saw a red-eye with a full grown luna moth in its bill. After vigorously beating the helpless moth on a limb to get rid of the wings the bird succeeded in reducing the enormous body to a formless mass and eventually swallowed it.

(See Bull. 17, p. 23.)

LARK SPARROW (Chondestes grammacus and sub-species).

Length, about 6¼ inches. The variegated head markings and white outer tail feathers distinguish this species.

Range: From western Pennsylvania and western Maryland and the Mississippi valley westward; and from southern British Columbia and southern Saskatchewan to central Alabama, northern Louisiana, Texas and south into Mexico; winters from northern California, southern Texas and southern Mississippi to Guatemala.

With some of the habits of the grass finch and, like that species, having the tail feathers tipped with white, the lark sparrow yet possesses distinctive traits of its own and after a little scrutiny can be mistaken for no other species. Its peculiar head markings have suggested the local western name of "snake bird," although the reason is not quite obvious. The lark finch is usually very abundant where found at all, and inhabits the open country, prairie, plain, and desert. It is often to be seen running along the dusty roads or perching on the roadside bushes and fences. It is a really fine songster and the possession of a musical voice has led to its capture and sale as a cage bird.

It has peculiar claims on the interest of the western farmer since it is to be classed in the front rank of sparrows as a destroyer of grasshoppers. These harmful insects and others constitute about a third of its food for the year, while weed seeds of great variety form the other two thirds.

Black Flycatcher or Phainopepla
Female, upper; male, lower
Yellow-throated Vireo

Red-eyed Vireo
Lark Sparrow

MARYLAND YELLOW-THROAT (Geothlypis trichas and variety).

Length, about $5\frac{1}{3}$ inches. Mostly green above, yellow below. Distinguished from other warblers by broad black band across forehead, bordered narrowly with white.

Range: Breeds from southern Canada to southern California, Texas and Florida; winters from the southern United States to Costa Rica.

This little warbler is common throughout the eastern and southern states, frequenting thickets and low bushes on swampy ground. He is not a tree lover, but spends most of his time on or very near the ground, where he hunts assiduously for caterpillars, beetles and various other small insects. Among the pests that he devours are the western cucumber beetle and the black olive scale. He has a cheery song of which he is not a bit ashamed and, when one happens to be near the particular thicket a pair of yellow-throats have chosen for their own, one has not long to wait for vocal proof that the male, at least, is at home. The yellow-throat has the bump of curiosity well developed and if you desire a close acquaintance with a pair you have only to "squeak" a few times, when you will have the pleasure of seeing at least one of the couple venture out from the retreat far enough to make sure of the character of the visitor.

YELLOW-BREASTED CHAT (Icteria virens and sub-species).

Length, about $7\frac{1}{2}$ inches. Its size, olive-green upper parts and bright yellow throat, breast, and upper belly distinguish this bird at a glance.

Range: Breeds from British Columbia, Montana, Wisconsin, Ontario and southern New England south to the Gulf States and Mexico; winters from Mexico to Costa Rica.

The chat is one of our largest and most notable warblers. It is a frequenter of brushy thickets and swampy new growth and, while not averse to showing itself, relies more upon its voice to announce its presence than upon its green and yellow plumage. Not infrequently the chat sings during the night. The song, for song we must call it, is an odd jumble of chucks and whistles which is likely to bring to mind the quip current in the West, "don't shoot the musician; he is doing his best;" in this same charitable spirit we must accept the song of the chat at the bird's own valuation, which, we may be sure, is not low. Its nest is a rather bulky structure of grasses, leaves and strips of bark and is often so conspicuously placed in a low bush as to cause one to wonder how it ever escapes the notice of marauders fond of birds' eggs and nestlings.

The chat does no harm to agricultural interests but on the contrary, like most of the warbler family, lives largely on insects, and among them are many weevils, including the alfalfa weevil, and the boll weevil so destructive to cotton.

(See Biol. Surv. Bul. 17, p. 18 et seq.; also Circular 64, p. 5.)

OVEN-BIRD (Seiurus aurocapillus).

Length, a little over 6 inches. Above mostly olive green; below white, breast and sides streaked with black.

Range: Breeds from southern Mackenzie, Ontario, southern Labrador and Newfoundland south to Wyoming, Kansas, southern Missouri, Ohio Valley and Virginia; also in mountains of Georgia and South Carolina; winters in southern Florida, southern Louisiana, Bahamas, West Indies, and southern Mexico to Colombia.

The oven-bird is one of our best known birds and one the woodland stroller is sure to get acquainted with, whether he will or no, so common is it and so generally distributed. In moments of ecstacy it has a flight song which has been highly extolled, but this is only for the initiated, its insistent repetition of "teacher, teacher, teacher," as Burroughs happily phases it, is all the bird vouchsafes for the ears of ordinary mortals. Its curious domed-over grass nest is placed on the ground and is not hard to find. The food of the oven-bird does not differ greatly from that of other warblers, notwithstanding the fact that the bird is strictly terrestrial in habits. It consists almost exclusively of insects, including ants, beetles, moths, span worms and other caterpillars, with a few spiders, millepods and weevils.

(See Biol. Surv. Bul. 17; also yearbook for 1900, p. 416.)

CEDAR WAXWING (Bombycilla cedrorum).

Length, about $7\frac{1}{4}$ inches. Known from every other American bird, except its larger cousin, the Bohemian waxwing, by its crest, grayish brown upper parts, yellow tail band and sealing wax-like tips to secondaries and, sometimes, to tail feathers.

Range: Breeds from central British Columbia, Alberta, southern Keewatin, northern Ontario and northwestern Quebec south to southern Oregon, northern New Mexico, Kansas, northern Arkansas, and North Carolina; winters over most of United States and southward to Mexico and Panama.

In clothing the cedar bird, Mother Nature essayed her very best and reached the limit of quiet elegance. As if aware of the distinction conferred by its smooth delicately tinted plumage, the waxwing has the air of a well-bred aristocrat, and comports itself with a dignity that is very impressive. Why this beautiful creature should be denied a voice is a mystery but, with the exception of the faintest kind of a whistle and a few low notes, seldom heard, the bird is silent. But its beauty and the good it does should insure it careful protection.

Except during the nesting season, which is very late, the bird is a wanderer, moving about the country in flocks and remaining a shorter or longer time in a given locality according to the abundance of food. The waxwing is a berry eater and its local name of "cherry bird" indicates that it by no means disdains cultivated varieties. Fortunately the bulk of the fruit it takes consists of wild species, especially in winter, when cedar berries are greedily devoured. In the west it includes in its bill of fare mulberries and pepper berries. While insects constitute only a comparatively small percentage of its diet, those eaten include some very destructive species such as scales and the dreaded elm beetle.

(See Farmers' Bul. 54 (rev.), pp. 38-39.)

Maryland Yellow-throat
Female, upper; male, lower
Yellow-breasted Chat

Oven-bird
Cedar Waxwing

TOWHEE (Pipilo erythrophthalmus).

Length, about $8\frac{1}{4}$ inches. Male mostly black, belly white. Female brown. Outer tail feathers white tipped.

Range: Breeds in the United States from Saskatchewan and southeastern Canada south to Central Kansas and northern Georgia; winters from southeastern Nebraska and the Ohio and Potomac southward.

The towhee is a frequenter of second-growth and of scrub, and when the visitor enters such precincts he is pretty sure to hear the challenging cry, "chewink," and to catch sight of the bird as it hurriedly dashes into some brushy thicket as if in mortal terror. The flight is hurried, jerky and heavy, as though the bird was accustomed to use its wings only in emergencies. This is not far from being the case, as the towhee sticks close to mother earth and uses its great strength and long claws to advantage in making the leaves and rubbish fly in its vigorous efforts to uncover the seeds and insects upon which it relies for food. The towhee thus literally scratches for a living as no other of our birds does, except possibly the brown thrush, and the lazy man may well pass by the industrious ant and go to the towhee for inspiration. No one waxes enthusiastic over its musical ability, but the song is given with such right good will that it is sure to satisfy the hearer as, no doubt, it does the bird himself. Seton interprets it to a nicety with the phrase "chuck-burr, pill-a-will-a-will-a." The towhee includes in its bill of fare beetles and their larvæ, ants, moths, caterpillars, grasshoppers and flies, and also in Texas the boll weevil. Wild fruit and berries complete the list.

ORCHARD ORIOLE (Icterus spurius).

Length, about $7\frac{1}{4}$ inches. Our only oriole with black and chestnut markings. Female grayish olive green.

Range: Confined to eastern North America. Breeds from North Dakota, Minnesota, Wisconsin, Michigan, southern Ontario, central New York and Massachusetts south to northern Florida, the Gulf Coast and southern Mexico, west to central Nebraska and western Kansas; winters from southern Mexico to northern Colombia.

Though clad in modest garb (for an oriole) and in no respect a rival of the Baltimore, the orchard oriole has merits of his own. As his name implies, he is a lover of orchards, and I have always associated him with the glory of apple orchards in full bloom and with the delicious perfume with which the air is heavy. Amidst such surroundings, the black and chestnut livery of the orchard oriole marks him as one of the princes of our bird world. Gardens and parks also know him well, and he is not averse to swinging his nest from the trees that shade the farmer's house. His nest betrays his connection with the family of weavers, but his skill does not equal that of the Baltimore and he is content with a smaller pensile basket made chiefly of grasses. His song, like his dress, is modest, but it is exceedingly sweet, and one who hears it is sure to pause in his walk and wish that it were longer and given more frequently.

The orchard oriole is chiefly insectivorous, as indeed are all of our species.

CALIFORNIA BROWN TOWHEE (Pipilo crissalis and varieties).

Length, about 9 inches. The long tail and brown plumage with white belly distinguish these ground- and thicket-loving birds.

Range: Southwestern Oregon, through California to northern Lower California.

The brown towhees, of which the California form is a good type, are characteristic of the brushy canyons of the far west, where they skulk and hide among the shrubbery and cactus much as do the common eastern towhees. Their powers of wing are not great and their long tails and heavy bodies render their flight awkward in the extreme. On the ground, however, they run with great ease and speed. In California brown towhees are common in the parks and gardens, and in every way are very much more familiar than the related towhee of the east. Like its eastern cousin, it is much addicted to scratching among leaves and rubbish, for which work its stout legs and claws are particularly adapted. The thin "tchip," which is the call note, seems out of all proportion coming from such a stout, vigorous body. The birds of this group are not fine songsters, but their simple ditties are pleasant to hear in the waste places where they are generally found.

The brown towhee is much more of a vegetarian than an insect eater, and in California Professor Beal found that 85 per cent. of its yearly food consists of fruit, grain and weed seeds.

BALTIMORE ORIOLE (Icterus galbula).

Length, about $7\frac{1}{2}$ inches. The combination of black and orange marks this bird from its fellows.

Range: Breeds from central Saskatchewan and the southeastern provinces of Canada south to northern Texas, Louisiana and northern Georgia, west to Montana, Wyoming and eastern Colorado; winters from southern Mexico to Colombia.

Lord Baltimore was signally honored when one of our finest birds was christened with his name because it chanced to carry the family colors, black and yellow. Orioles are a tropical group and the luxuriant tropical forests are bright with the gleaming colors of many species of these beautiful birds. Only a few have found their way into the temperate zone, but not one of the tropical species is garbed in more tasteful dress than this exotic which has adopted the elms and sycamores of the temperate zone for its summer home. When chill November winds have stripped our shade trees of their foliage then are revealed the long, pendant nests, wrought with so much skill and patience by Madame Oriole, and we begin to realize how many of these birds summer with us. Suitable material for the oriole nest is none too easily found, and the weaver is not so fastidious that she will not accept strings and yarn of any color which are hung out for her convenience; so that at the end of the oriole season the bird lover who is willing to co-operate with a pair of Nature's weavers may fall heir to a nest made to order, so to speak.

The oriole is as useful as it is tuneful and ornamental. Caterpillars constitute the largest item of its fare, including many not touched by other birds. It eats also beetles, bugs, ants, grasshoppers and spiders. Particular mention must be made of the boll weevil, of which the oriole is a determined foe. The small amount of fruit taken by the oriole, including cherries, is insignificant when compared with the long list of harmful insects it destroys.

Towhee or Chewink
Male, upper; female, lower
Orchard Oriole
Male, upper; female, lower

California Brown Towhee
Baltimore Oriole
Male, upper; female, lower

MAGPIE (Pica pica hudsonia).

Length, from about 18 to 21 inches. The black head and body and the white belly, white wing patches, and long tail are distinguishing features. The yellow-billed magpie is smaller with a yellow bill.

Range: A characteristic western species. Breeds from Aleutian Islands and Alaska, central Alberta, southern Saskatchewan and Winnipeg Lake south to northern Arizona and New Mexico, and from the Cascades and Sierra to western North Dakota and western Texas; resident.

There are two species of magpies, the yellow-billed being confined to California, where it is very local. In general the habits of the two are similar. "Maggie," as this bird is familiarly known in the west, possesses dual traits. He is beautiful of plumage and adds much to the interest of the landscape as he flies from field to field, his long tail extending behind like a rudder.

Of eminently sociable disposition, this bird is rarely seen alone. He prefers flocks of family size to 50 and upwards. In more ways than one the magpie is like the crow and his sagacity has developed along much the same lines. In most localities he is suspicious and wary, as he has good cause to be, for he is not a favorite with either farmer or ranchman. He is eminently carnivorous, a carrion feeder by preference, an insect eater by necessity, and he performs good service in the latter role. He eats also many wild fruits and berries, but he is an incorrigible thief and well he knows his way to the poultry yard. No sound is sweeter in "Maggie's" ears than the cackle of the exultant hen that has just laid an egg, and the hen house must be well protected that keeps him from his plunder. Perhaps his worst trait, however, is his fondness for the eggs and nestlings of small birds.

PHŒBE (Sayornis phœbe).

Length, about 7 inches. Distinguishing marks are the dusky brown color, dark brown cap and white margined outer tail feathers.

Range: Lives mainly in the east. Breeds from about middle Canada south to northeastern New Mexico, central Texas, northern Mississippi and mountains of Georgia; winters from south of latitude 37° to southern Mexico.

Few of our birds have won a more secure place in our hearts than plain little phœbe, who has no pretentions to beauty of plumage or excellence of song. For this its confiding disposition and trusting ways are responsible, and many a farmer listens for its familiar voice in early spring and welcomes it back to its accustomed haunts under the old barn. Originally building its nest on the face of cliffs, the phœbe soon forsook the wilds for man's neighborhood, and year after year apparently the same pair returns to the identical rafter in the barn, the shelter of the porch, or the same nook under the foot bridge, which they have claimed for their own for many seasons. The insistent call of "phœbe—phœbe" is as familiar as the pipe of the robin.

The phœbe has further claims to the favor of man since it is one of the most useful of birds, living almost wholly on insects, among which are many noxious kinds, as May beetles, click beetles, and several species of weevils, including the boll weevil and the strawberry weevil. As if reluctant to leave their northern home, many phœbes remain with us till late fall, and individuals may be seen lingering in sheltered places in the woods long after other flycatchers have started for the tropics.

BLUE-FRONTED JAY (Cyanocitta stelleri and sub-species).

Length, $11\frac{3}{4}$ to 13 inches. Easily distinguished from its fellows by its high crest, brownish slaty fore-parts, dark blue wings and tail and blue or whitish streaks on forehead.

Range: Resident in western North America from southern Alaska and Montana to Mexico.

The blue-fronted jays, of which the Steller jay may be taken as the type, are common inhabitants of the piny woods of both the Rocky Mountain and the Sierra Nevada States. They are among the handsomest of the family, the beauty of their plumage, their long erectile crests, and their insistent voices compelling the attention of any who invade their retreats. Not being residents of cultivated districts, although they eat grain and small fruits, they do comparatively little damage. On the other hand, they do not do much good, for, although they are insect eaters, insects do not constitute a large part of their food, nor are the kinds they eat very important economically. Probably their most serious fault is a fondness for the eggs and young of small insectivorous birds of which they destroy many in the course of the year. They share this failing with all other members of the family, and bird lovers must deem it a pity that such bold, dashing, handsome birds as the jays should be so destructive to small but useful birds. This habit is all the more to be deplored inasmuch as when unmolested jays readily respond to invitations to be neighborly, and willingly take up their abode near houses, where they never fail to excite admiration and interest.

WOOD PEWEE (Myiochanes virens).

Length, about $6\frac{1}{2}$ inches. Not readily distinguished by color, though darker than most other small flycatchers, and with wing longer than tail.

Range: Breeds from Manitoba and southeastern Canada to southern Texas and central Florida; winters in Central and South America.

The wood pewee is clad in such modest garb and is of such retiring disposition that, were it not for its voice, it would often be passed unnoticed even by the most observant, especially as its home is in shaded glens or deep woods. Here the wood pewee pursues its vocation with a vigor worthy of all praise, and the snap of its mandibles as they close over some luckless flying insect is often the only sound heard in the depths of the quiet forest. There is little about the habits and make-up of this, or indeed of any of the flycatchers, to suggest great constructive skill, but the nest of the wood pewee is a marvel of taste and ingenuity and, though much larger, suggests the dainty architecture of our hummingbirds. Like their fairy creations the wood pewees' nest is covered with lichens and saddled neatly across a limb.

The food of this flycatcher consists almost exclusively of insects and includes among others crane flies, beetles, dragon flies, ants, grasshoppers, caterpillars and moths of many kinds. It also devours such pests as the clover weevil, the plum curculio, the corn weevil, the rice weevil, and others nearly as harmful, and many flies, including the house fly.

Black-billed Magpie
Yellow-billed Magpie
Phœbe

Blue-fronted Jay
Wood Pewee

RUBY-THROAT (Archilochus colubris).

Length, about $3\frac{3}{4}$ inches. Needs no description as it is the only hummer living in the eastern states.

Range: Breeds from southeastern Saskatchewan and central Quebec south to Gulf Coast, west to North Dakota, Nebraska, Kansas and central Texas; winters from middle Florida and Louisiana through southern Mexico and Central America to Panama.

Of the five hundred or more species of this strictly American family, the eastern United States is favored by the presence of only one, the ruby-throat, nor is this species as common as might be desired. Compared to the abundance of its kind in the far west it is rare indeed. As if afraid of being too prodigal of her gifts, Nature has denied the hummingbird song, and the harsh squeaks of these tiny sprites are far better adapted to making war than love. Truth is, the hummer has a sharp temper and not only engages in warfare with its own kind but attacks any bird, however large, that ventures to dispute its territorial rights. These are not small, for in its own estimation it is literally "Lord of all it surveys." The male is an inconstant swain and no sooner is the nest made—and in the making he takes no part—and the eggs laid than he departs, leaving the joys and cares of housekeeping to his erstwhile mate. While the nectar of flowers is eaten in large quantities, a creature so vivacious as the hummer could hardly sustain life on diet so thin, and the bird adds to its bill of fare a liberal supply of minute insects and spiders of various sorts.

WHIP-POOR-WILL (Antrostomus vociferus).

Length, about 10 inches. Not to be confused with the nighthawk, which flies by day and has white wing bars, while the whip-poor-will is crepuscular and nocturnal.

Range: Breeds from the Atlantic to the plains, and from Manitoba and the eastern Canadian Provinces south to northern parts of Louisiana, Mississippi and Georgia; winters from South Carolina and the Gulf States to Central America.

This bird of the night, whose day begins with the going down of the sun when the nighthawk's ends, is common throughout the east in open woodlands, on the edges of which it likes to hunt. It dozes away the hours of daylight squatting on the ground among the leaves where its marvelous protective coloration affords it safety. No sooner have the shadows lengthened, however, than it becomes active and its characteristic note resounds through the forest glades. So plaintive is its cry and so mysterious its comings and goings, that in the minds of many its notes are associated with misfortune, as a death in the house near which it persistently calls. Its two eggs are laid among the leaves, needing no other protection than the cover of the mother's body. The whip-poor-will may be accounted one of our most efficient insect destroyers, as its immensely capacious mouth beset with bristles, a regular insect trap, would suggest. Among its prey it includes May beetles and moths. These two form the principal articles of food and as they are parents respectively of the white grub worm and an innumerable host of caterpillars their destruction is of marked benefit to agriculture.

RUFOUS HUMMINGBIRD (Selasphorus rufus).

Length, from $3\frac{1}{4}$ to $3\frac{3}{4}$ inches. The reddish brown body color, red and green gorget, and the notch in tail feathers serve to distinguish this species from our other hummers.

Range: Breeds from the Alaskan coast, east central British Columbia, and southern Alberta south to the mountains of central California, and southern Idaho.

One can but wonder at the hardihood of this little wanderer from the tropics in including in its summer itinerary a journey to distant Alaska. It reaches a latitude of 61°, much farther north than any other of its kind. In favored glades of the forests in the Rocky Mountains and the Sierras during the migration this and other species of hummers are to be seen literally by hundreds. The rufous hummer has temper and courage to match its fiery hues, and spends no small part of its time doing battle with its fellows. The contestants after several fierce rounds fly away not only fit but eager for another fray on the first occasion. In addition to the nectar of flowers, its standard fare, this hummer includes in its diet "honey dew," the sugary secretion of plant lice which is deposited on vegetation. Like all other hummers it eats large numbers of minute insects which it finds inside the flowers. It is interesting to note that hummingbirds discover the flowers they frequent by sight alone and any bit of bright color in the distance is sure to attract their notice, as a bright red handkerchief on a bush or about the neck. More than once I have observed them poising within a few inches of my head evidently endeavoring to ascertain the nature of the red handkerchief I wore.

ROAD RUNNER (Geococcyx californianus).

Length, 20 to 24 inches, mostly tail. Quite unlike any other North American bird in form and color.

Range: From the upper Sacramento Valley south through California and the peninsula and from Colorado, Kansas, middle and western Texas, Arizona and New Mexico southward; resident.

The name "road runner" when applied to a cuckoo may seem an anomaly to those who know only our eastern cuckoos, but in truth the road runner is anomalous in many ways. It is distinguished by curiously marked plumage, the possession of a long bill and a disproportionally long tail. As a result of its strange appearance, and stranger antics, the road runner is made the hero of many a fable. Among other wonders it is claimed that it can outrun the swiftest horse and kill the biggest rattlesnake. It is said to accomplish the latter feat by surrounding the reptile while asleep with a rampart of cactus spines on which the enraged reptile accommodatingly impales itself.

The truth is that when in a hurry this ground cuckoo can run with great speed, though as yet no official record of its best time has been made. Its food consists of a great variety of harmful insects, among which the snout beetles or weevils are conspicuous. It devours also mice, horned lizards, centipedes, land shells and small snakes; probably a young rattlesnake would fare no better than any other small snake. Its notes are difficult to interpret with words, but are not likely to be forgotten when once heard, and they are frequently uttered in the early morning from the topmost bough of a mesquite or other tree.

RUBY-THROATED HUMMINGBIRD
Male, upper; female, lower
WHIP-POOR-WILL

RUFOUS HUMMINGBIRD
Male, upper; female, lower
ROADRUNNER

Photo by Robert E. Coker

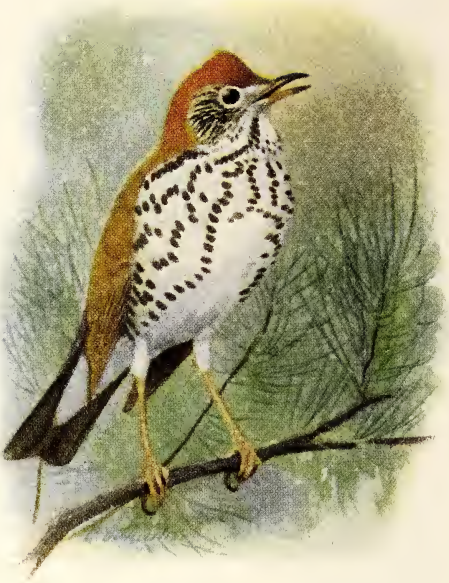
PELICANS ON THE LOBOS DE AFUEVA ISLANDS, PERU

It was estimated by Mr. Coker that there were upward of 100,000 pelicans, all told, on the eastward island of the Lobos de Afuevas. At the time of the writer's next visit there he saw scarcely any birds near the old rookery. It is one of the tragedies of the guano industry that this important bird has received so little consideration. (See the article, "Wealth of a Rainless Coast," by Robert E. Coker, printed elsewhere in this number.)

Photo by Robert E. Coker

ONE HUNDRED THOUSAND PELICANS

Such an array of big gray birds makes a more showy effect than a vastly greater number of smaller birds. Unfortunately, this great and valuable rookery, unmolested for several years, was not permitted to remain undisturbed. (See the article, "Wealth of a Rainless Coast," by Robert E. Coker, printed elsewhere in this number.)



Varied Thrush
Veery

Wood Thrush
Bush-tit

VARIED THRUSH (Ixoreus nævius).

Length, about 10 inches. Its large size and dark slate-colored upper parts, black breast collar, orange brown stripe over eye and orange brown under parts mark this thrush apart from all others.

Range: Breeds on the Pacific coast from Yakutat Bay, Alaska, south to Humboldt County, California; winters from southern Alaska to northern California.

This, one of our largest and finest thrushes, is limited to the west coast, where it finds a congenial summer home in the depths of the coniferous forests, the mystery and loneliness of which seem reflected in its nature. Although the varied thrush somewhat suggests our robin, it is much shyer, and its habits and notes are very different, making it more nearly akin to the small olive thrushes. It nests in the conifers, and its eggs, unlike those of the robin, are heavily blotched with brown. Its song, a single long-drawn note, has been greatly praised, and seems entirely in harmony with the bird's surroundings, being weird and inspiring. In winter the varied thrush abandons the forest and with it many of the habits of the recluse, and visits more open districts, including ravines and even gardens, where it becomes quite familiar.

This thrush, like its smaller brethren, feeds chiefly on the ground, and its food is largely of vegetable nature, but includes a fair proportion of insects, with millepeds and snails. Unless its habits are greatly modified by the encroachment of civilization on its domain it is not likely to be much of a factor in agricultural affairs, but it will continue to make itself useful by destroying the insect enemies of forest trees.

VEERY (Hylocichla fuscescens fuscescens).

Length, about 7½ inches. To be known from the other small thrushes by its uniform cinnamon brown upper parts and its faint brown breast markings.

Range: Breeds from northern Michigan, central Ontario and Newfoundland south to northern Illinois, northern Indiana, northern Ohio and New Jersey; and in the Alleghenies south to North Carolina and northern Georgia; winters in South America.

Far more retiring than either the wood thrush or the hermit, the veery must be sought in the seclusion of the swamp or swampy woodland, far from the recesses of which he rarely ventures. Much of his time he spends on the ground, for on or near it he finds his chosen fare. Though trim in form and clad in a garb of modest color as befits his nature, the veery appeals less to the bird lover's eye than to his ear. Though some of his relatives are classed among the most famous of American songsters, the veery may fairly claim place in the front rank, and his wild, mysterious and all-pervading notes touch certain chords in the human breast which respond to the song of no other of our birds.

The food of the veery does not differ essentially from that of the other small thrushes and includes a great variety of small wild fruits and insects. As it rarely visits the orchard or farm its insect-eating habits have little direct bearing on the farmer's interest, although indirectly the bird contributes its share to the beneficial work of staying the superabundant tide of insect life. It does, however, eat many weevils, and among them the notorious plum curculio.

WOOD THRUSH (Hylocichla mustelina).

Length, about 8¼ inches. To be distinguished among its fellows by its more bulky form, by the golden brown head, bright cinnamon upper parts, and the large round black spots beneath, sharply contrasting with the pure white.

Range: Breeds from southern South Dakota, central Minnesota, central Wisconsin, southern Ontario and southern New Hampshire south to eastern Texas, Louisiana and northern Florida; winters from southern Mexico to Central America.

The wood thrush finds its way to our hearts and sympathies more through its voice than its presence, and whoever has failed to hear its clear flute-like tones rising from the woodland depths as the mists of evening gather has missed a rich treat. It is no doubt true that the Hermit Thrush is a more finished performer, but that chorister reserves his music chiefly for the northern wilds while our wood thrush favors more southern lands. Moreover, the hermit is a true recluse and must be sought in the deeper forest, its chosen home, while its more southern cousin lives in comparatively open woodland and does not disdain to take up its summer residence in parks and gardens. The music of the one is for the favored few, while the song of the other is almost as well known as that of the brown thrasher.

Like most of the tribe, the wood thrush obtains its food chiefly from the ground, where it spends much of its time searching among the leaves. Insects with a small percentage of fruit, chiefly wild varieties, compose its fare. Among the insects are cutworms and other caterpillars, ants, grasshoppers and beetles, including the Colorado potato beetle. Thus the bird deserves a high place in our esteem for both esthetic and economic reasons.

BUSH-TIT (Psaltriparus minimus and sub-species).

Length, from 4 to 4½ inches.

Range: Pacific coast from southern British Columbia to the Cape Region of Lower California, and eastward to the interior of Oregon and California; nests generally throughout its range.

This pigmy among birds has many of the characteristic habits of the chickadee family, of which it is the smallest member. Extremely sociable, bush-tits move about in large flocks, occasionally in company with other birds, generally without. One moment you are alone, the next moment the trees and bushes are full of these diminutive little busybodies that scan you with their curious bead-like eyes as they hurry on in quest of food, keeping up the while a constant calling and twittering. Their pendant nests, often attached to oak trees, suggest the well-known structure of our hang-bird or Baltimore oriole, and are excellent specimens of bird architecture.

The few western states favored by the presence of this bird are to be congratulated, as more than half its animal food consists of insects and spiders, nearly all of which are harmful. Among the insects are many tree bugs, *Hemiptera*, which contain our most dreaded insect pests, such as the black olive scale and other scales equally destructive. The bush-tit is also a persistent foe of the codling moth in all its stages.

(See Farmers' Bul. 54, p. 44; also Bul. 30, pp.

House Finch
Female, upper; male, lower

Arkansas Goldfinch
Male, upper; female, lower

Purple Finch
Male, upper; female, lower

American Goldfinch
Male, upper; female, lower

HOUSE FINCH (Carpodacus mexicanus frontalis).

Length, about 6 inches. Grayish brown above, many feathers tinged with red. Below dull white, crown, rump, and throat crimson.

Range: Resident in Oregon, Idaho and southeastern Wyoming south to Lower California and Mexico.

The pretty little house finch of the far west is among the most domestic of American birds, and exhibits a predilection for the neighborhood of houses almost as strong as that of the English sparrow. It carols its sprightly lay from the tops of buildings in villages and even cities, and from the shrubbery of lawn and park. So confiding has the bird become that it places its nest in any crack or cranny of house or outbuilding that is large enough for its housekeeping operations. When such convenient and safe retreats are not to be had it builds a bulky nest in a tree or bush.

It is fond of fruit, including pears, cherries, and small fruit, which its strong conical bill enables it to break open with ease. Locally, therefore, it is a good deal of a pest and does much damage to fruit crops, especially where it is numerous. Much, however, can be said in mitigation of its offenses. The seeds of plants, a large proportion of those of noxious weeds, constitute seven-eighths of its food for the year. Plant lice which are notoriously harmful to many trees and plants, also are a favorite diet. So too are caterpillars and beetles; therefore, the balance is decidedly in the bird's favor.

This attractive songster was carried to the Hawaiian Islands years ago and now is numerous in Honolulu and also in the forest on the island of Hawaii where amid brighter and more tropical neighbors it seems curiously out of place, though it sings as often and as joyously as it ever did in its old haunts across the Pacific.

ARKANSAS GOLDFINCH (Astragalinus psaltria and sub-species).

Length, about 4½ inches. Upper parts olive green, more or less mixed with black in the sub-species; under parts yellow.

Range: Breeds from southern Oregon, Utah and northern Colorado to southern Lower California and into Mexico.

In the far west this goldfinch takes the place of the eastern goldfinch which in a general way it much resembles in habits. Like that bird it is rarely seen, save in the breeding season, except in small parties, the members of which seem to be on terms of the utmost familiarity and accord. The flight of this species, as of its kindred, is exceedingly characteristic. It disdains to cleave the air in straight lines but progresses in a series of graceful sinuous curves, which, however, take the little aeronaut rapidly from point to point. This flight is a sure mark of identification. The bird has a sweet warbling song and even its call notes are plaintive and pleasing. It abounds in orchards and gardens and is often to be seen by the roadside gleaning its food from the tall stems of thistle, sunflowers, groundsel and other seed-bearing plants and weeds, all of them either useless or positively harmful. It is by no means wholly a vegetarian, however, and eats many plant lice, sometimes filling the stomach with these minute creatures to the exclusion of all other food. As a weevil eater it is peerless, and it does no harm to any product of husbandry. Altogether this pretty little goldfinch deserves protection at the hands of man.

PURPLE FINCH (Carpodacus purpureus).

Length, about 6 to 6¼ inches. Unlike any other eastern finch, the crimson head of the male sufficiently distinguishes it.

Range: Breeds in southern Canada and southward to North Dakota, Minnesota, Illinois, Pennsylvania mountains, and northern New Jersey; winters from somewhat north of the southern boundary of its breeding range to the Gulf States.

Considering that it is common and widely distributed, the purple finch is not so well known as it should be. For one thing it has a marked liking for the tops of trees, particularly elms, and when in a tree top and more or less screened by foliage it requires the aid of a good glass to make its identity sure. Its warbling song is sweet and melodious but is all too brief for perfect enjoyment, though in spring the bird is prodigal enough of its carols, and not infrequently a dozen males may be heard singing at once in the same or in contiguous trees. It frequently nests around houses and for a site is very partial to the Virginia Juniper.

The purple finch lives almost entirely on the seeds of various plants, including those of false buckwheat and ragweed, with some wild berries. It is accused, not without reason, of being a confirmed budder of fruit and other trees, but the damage it inflicts on eastern orchards appears to be very slight, if indeed the modest budding it does is an injury at all.

AMERICAN GOLDFINCH (Astragalinus tristis and sub-species).

Length, about 5 inches. Easily distinguished by its rich yellow plumage and black crown and tail.

Range: Breeds from southern Canada south to southern California, southern Colorado, Arkansas and northern Georgia.

The thistle bird is one of our best known finches, being not only common but very sociable. It usually goes in small flocks, or family parties, and sometimes the tall thistles on which it likes to feed bend with the united weight of several of the gay plumaged little goldfinches. It is a law unto itself as regards its nesting period, and begins to think seriously about housekeeping when other birds are feeding full grown youngsters, or are debating the propriety of a second brood. The goldfinch has a pretty and plaintive call note, and its full song is well worth listening to. It is much like that of the canary, so much alike, in fact, that the bird is often called the wild canary.

Throughout the year the goldfinch is a seed eater, especially of weed seeds, and it eats also many insects, including canker worms, plant lice, and beetles. Our goldfinch sometimes annoys the farmer by attacking the lettuce seeds which have been left to mature for next season's planting, but the damage in this way is slight, and Prof. Beal has been told that even on the large seed farms of California it is never serious enough to call for protective measures.

(See Biol. Surv. Bul. 17 and Bul. 34, pp. 71-73.)

Vesper Sparrow
Blue Grosbeak
Male, upper; female, lower

Cardinal
Male, upper; female, lower
California Quail

VESPER SPARROW (Pooecetes gramineus and sub-species).

Length, about 6 inches. Its white tipped outer tail feathers distinguish this individual from its brown liveried fellows.

Range: Breeds from southern Canada south to Oregon, Arizona, Texas, Kentucky, Virginia and North Carolina; winters from southern California, Texas, Missouri and North Carolina, south to the Gulf coast and southern Mexico.

There is little about this brown streaked sparrow to attract attention and, until it flies and displays the white tipped tail feathers, you might mistake the bird for any one of a half dozen of the sparrow family. Indeed if one catches merely a glimpse of a vesper sparrow crouched low and running swiftly through the grass one may be forgiven for mistaking the bird for a mouse. It frequents open pastures and when singing likes to mount a rocky boulder so common in New England and other parts of the east. We are perhaps justified in calling its song its most notable characteristic. Though not a pretentious effort the voice of the vesper sparrow is sweet and plaintive beyond expression, and harmonizes with the dying day as does the song of no other bird.

Prof. Beal records the fact that in winter the food of this sparrow consists wholly of vegetable matter, while in summer it consists of little else than insects. The vesper sparrow cares less for grass seed than any other of its fellows but consumes great quantities of weed seeds. It eats also large numbers of grasshoppers, caterpillars and weevils. A number of these sparrows taken in Utah where the newly imported alfalfa weevil is doing much damage were found to have eaten these weevils to the average extent of more than half their food. Thus the value of this bird to the farmer cannot be questioned.

BLUE GROSBEAK (Guiraca cærulea and sub-species).

Length, about 7 inches. Distinguished by its larger size from the indigo bird which alone resembles it.

Range: Breeds in the southern United States north to northern California, Colorado, Nebraska, southern Illinois and Maryland and south to southern Mexico; winters in Mexico and Central America.

One seldom sees the blue grosbeak at short range or under circumstances which make identification easy, as the bird is rather shy and frequents brushy thickets and viny tangles much as does the indigo bird. The low warbling song of this grosbeak may be compared with that of the purple finch but it is neither so loud nor so well sustained. Under the name of "blue pap" the grosbeak used to be a favorite cage bird in Louisiana and other southern states, and no doubt is so today, despite protective laws. In the matter of diet it shows a marked preference for insect food over vegetable, the proportion being about 67 to 33 per cent. The vegetable matter includes many weed seeds, as foxtail and bindweed, also corn, the taking of which makes a black mark against its record. As, however, the bird consumes twice as much animal matter as vegetable, the balance is much in its favor and it accordingly earns protection as well by its economic service as by its beauty and song.

CARDINAL (Cardinalis cardinalis and sub-species).

Length, about $8\frac{1}{4}$ inches. Its size, crest and bright red color serve for instant identification.

Range: Southern United States generally, west to Texas and southern Arizona, north to lower Hudson, northern Ohio, northern Indiana, southern Iowa and southeastern South Dakota; resident.

The cardinal is a notable bird and any locality he chooses for his residence must be considered highly favored. His bright colors, trim form and erectile crest, his clear whistling call, and his fine song are all to his credit. He is a resident of thickets and tangled undergrowth with hanging vines, and, when these are provided and he feels safe from the prowling cat and marauding hawk, he will take up his abode in your garden or back yard as readily as anywhere else. Favor him further by supplying him food and water in winter and you make him your friend indeed. Practically he is a resident wherever found and the sight of his flashing red suit amidst snow covered bushes is a memorable picture. The cardinal used to be a favorite cage bird in the Southern States and the business of trapping him for market, especially about the large southern cities, was common. The bird is now protected by law as it should be, and the sight of a cardinal behind prison bars has become rare indeed. How many thousands were sacrificed for hat gear we shall never know but happily this practice too is fast disappearing.

By preference the cardinal is a vegetarian, and about seven-tenths of its food consists of vegetable matter in the form of seeds, berries, etc. But it also eats many insects, potato beetles, cotton worms, boll worms, cotton-boll weevils, codling moths and many other scarcely less note worthy. Mr. McAtee in attempting to sum up all the economic facts, declares that the bird does at least fifteen times as much good as harm, which is a record to be proud of.

CALIFORNIA QUAIL (Lophortyx californica and varieties).

Length, about $9\frac{1}{2}$ inches. Distinguished from Gambels' quail by the reddish instead of black belly.

Range: Resident in the Pacific Coast region from southwestern Oregon and western Nevada through California and Lower California.

The California quail is one of our most beautiful game birds and the sight of a large covey running daintily along, with crests nodding and fine plumage gleaming in the sun is a sight to remember. Before quail were so much persecuted, covies were common in the gardens of Oakland and other California towns, seemingly as much at home among calla lilies and rosebushes as in the stubble field. The numerous families in the fall associate in bands of three or four hundred, or even more. The California quail has learned one lesson never acquired by our bob-white—to roost in trees and bushes instead of on the ground, and no doubt the safety thus obtained during the hours of darkness is one reason for its great abundance.

This quail is the greatest vegetarian of any of our game birds, the vegetable food eaten by over 600 individuals examined amounting to 95 per cent of the total food consumed. Unfortunately the California quail consumes much grain when germinating and thus damages the growing crop; it also attacks grapes and, while it does not eat a great many, it seriously damages bunches by puncturing a few grapes here and there, so ruining the fruit for market.

Tree Swallow
Scarlet Tanager
Male, upper; female, lower

Cliff or Eaves Swallow
Western Tanager
Male, upper; female, lower

TREE SWALLOW (Iridoprocne bicolor).

Length, about 6 inches. The steel blue upper parts and pure white under parts are distinguishing characteristics.

Range: Breeds from northwestern Alaska and northern Canada south to southern California, Colorado, Kansas, Missouri, and Virginia; winters in central California, southern Texas and Gulf States and south to Guatemala.

In its primitive state the tree swallow used to nest in hollow trees, and in some parts of the country it still continues to do so. Early in the settlement of the country it saw the advantage of putting itself under man's protection, and now no bird is quicker to respond to an invitation to nest in a box dedicated to its use. The bird lover within the range of the species may secure an interesting tenant or two by the expenditure of a little trouble and labor, since the bird is not a bit fastidious as to its domicile, providing it is weather tight. Tree swallows arrive from the south early in April and soon begin to nest. In the fall they gather in great flocks preparatory to their departure, and may then be seen by hundreds perched on telegraph wires. As is the habit with swallows generally, tree swallows migrate by day feeding as they go, and a flock passing swiftly south presents to the casual observer an every day appearance well calculated to deceive. Watch the flock as it crosses the road and passes from field to field and you will notice that while the line of flight has many a twist and turn it trends steadily to the south and that no individual takes the back track.

The tree swallow consumes vast numbers of gnats, flying ants, beetles, mosquitoes and other flying insects. It exhibits a rather curious departure from the traditions of its kind in that it appears to be very fond of the berries of the bayberry or wax myrtle. It also often chooses these bushes for a roosting place at night.

SCARLET TANAGER (Piranga erythromelas).

Length, about $7\frac{1}{4}$ inches. The scarlet coat and black wings and tail mark this bird out from all others.

Range: Breeds from southern Canada south to southern Kansas, northern Arkansas, Tennessee, northern Georgia and mountains of Virginia and South Carolina; winters from Colombia to Bolivia and Peru.

The tanagers are strictly an American family, and as their bright colors might seem to suggest, they originated in the Tropics to which most of the numerous species are confined. In fact the gleam of scarlet from the coat of this tanager in our somber woods always seems a little out of place as though the bird were an alien. But it is wholly at home with us, and, indeed, does not hesitate to make its summer residence still farther north in Canada. Curiously enough the nearest relatives of the brilliant tanagers in the bird world are the plainly colored sparrows. The chirp-churr of the tanager is a familiar call note in our northern woods, while its song is one of the sweetest; so that altogether this species is to be classed as a notable member of our bird world.

In some localities it is accused of eating honey bees, but to offset this local habit it devours the potato-beetle and many other beetles and a great variety of caterpillars. Blueberries and other small berries also form an important part of its food.

CLIFF SWALLOW (Petrochelidon lunifrons and sub-species).

Length, about 6 inches. The rufous upper tail coverts serve to distinguish this swallow from other species.

Range: Breeds from central Alaska and northern Canada south over the United States (except Florida) and to Guatemala; winters in South America.

The cliff and the barn swallow are members in good standing of the original guild of masons, and their clever constructive work in nest building with mud pellets will bear the severest professional inspection. Through much of the west the cliff swallow still attaches its mud house to the faces of cliffs as from time immemorial, and it was not until the farmers' house and barn offered a satisfactory substitute for granite and sandstone bluffs, that the bird became really numerous in our eastern States. In some localities this swallow is not a welcome guest about the homestead as its nest is apt to contain parasites which the good housekeeper fears. Such parasites, however, are not to be dreaded as they will live only on birds. The cliff swallow performs invaluable service to man since its food consists wholly of insects, and among them are many pestiferous kinds, such as leaf bugs, leaf-hoppers and the boll weevil. Whoever then protects this and other species of swallows and encourages their presence on their premises does good and patriotic service and can moreover be sure of adequate reward.

WESTERN TANAGER (Piranga ludoviciana).

Length, about 7 inches. The combination of orange-red head, black back, and yellow under parts are distinctive.

Range: Breeds from northeastern British Columbia, southwestern Mackenzie and southwestern South Dakota to the mountains of southern California and New Mexico; winters from central Mexico to Guatemala.

Discovered in Idaho by Lewis and Clarke in 1806, this tanager has thus been known more than a hundred years in which time it has become one of the most familiar of western birds. It is a common inhabitant of both the western Rocky Mountains and the Sierra Nevada, and is very much at home among the pine woods of which it is the brightest ornament. In general its habits are like those of its scarlet cousin, and it also has a sweet song very similar in general effect. In California this tanager has acquired an evil reputation by attacks on the cherry crop, and there is no doubt that when it assembles in large numbers in the fruit districts it is the cause of heavy loss to small fruit growers. Under ordinary circumstances, however, the greater part of its food consists of insects, many of them harmful, and it is only fair to balance the good the bird does against the harm. Two very harmful families of beetles, whose larvæ are wood borers and do much damage to trees and other plants, are represented in the food. The planting of berry bearing trees near the orchard would no doubt prevent much of the loss, occasioned by this bird, which by no means occurs every year. For the rest the fruit grower must be allowed to protect his fruit in the best and most effective way.

YELLOW-HEADED BLACKBIRD
Male, upper; female, lower
STARLING

COWBIRD
Male, upper; female, lower
CHIMNEY SWIFT

YELLOWHEAD (Xanthocephalus xanthocephalus).

Length, about 10 inches. Our only blackbird with a yellow head.

Range: Confined to western North America. Breeds from southern British Columbia, southern Mackenzie, southwestern Keewatin, and northern Minnesota to southern California and Arizona, east to southern Wisconsin, Illinois and Indiana; winters from southwestern California, southern Arizona, southeastern Texas, and southwestern Louisiana south into Mexico.

Apparently Nature started out with the intention of making an oriole but decided to make a blackbird instead—and behold the yellowhead. He is a sociable chap and nests in great companies in the tule swamps of the west. The yellowhead's voice is harsh and guttural and his vocal efforts have been well characterized as a maximum of earnest effort with a minimum of harmony. Late in midsummer when the young are on the wing, old and young betake themselves to the uplands, grain fields, pastures and corrals, associating as often as not with redwings and Brewer's blackbirds. The yellowhead feeds principally upon insects, grain and weed seed, and does not attack fruit or garden produce; but it does much good by eating noxious insects and troublesome weeds; where too abundant it is likely to be injurious to grain.

(See Biol. Surv. Bul. No. 13, 1900, p. 32.)

STARLING (Sturnus vulgaris).

Length, about 8½ inches. General color dark purple or green with reflections; feathers above tipped with creamy buff. In flight and general appearance unlike any native species.

Range: At present most numerous near New York City. Has spread to Massachusetts, Connecticut, New Jersey, Pennsylvania, Maryland, Virginia and recently to the District of Columbia; resident where found, though wandering southward in winter in search of food.

The Old World has sent us two bird pests, the English sparrow and the starling. Although, up to the present time, we cannot convict the starling of having done any great damage he has proclivities which make him potentially very dangerous. Introduced into New York in 1890, the original sixty have multiplied many fold and spread in all directions till now they occupy territory hundreds of miles square, and are multiplying and spreading faster than ever. On the north they have entered Massachusetts and Connecticut, and on the south they have reached Richmond, though only in migration. Even as I write the calls of a flock of 200 or more can be heard coming from a neighboring park, but as yet the bird has not elected to summer in the National Capital. The starling is a hardy, prolific bird and is also aggressive. Like the English sparrow it associates in flocks, which is a great advantage in bird disputes. There is little doubt that the effect of its increase and spread over our country will prove disastrous to native species such as the bluebirds, crested flycatchers, swallows, wrens and flickers, all valuable economic species, which nest in cavities as does the starling. Then too the starling has a taste for grain and small fruits, especially cherries, which will not commend it to our farmers and orchardists.

COWBIRD (Molothrus ater).

Length, about 8 inches. Male glossy black, head, neck and breast brown. Female brownish gray.

Range: Breeds from southern British Columbia, southern Mackenzie and southeastern Canada south to northern California, Nevada, northern New Mexico, Texas, Louisiana and North Carolina; winters from southeastern California and the Ohio and Potomac Valleys to the Gulf and to central Mexico.

Chapman calls the cowbird a villain—but is not the villain in the piece often the most interesting character on the stage? Thus our cowbird, short as he is of manners and morals, cannot fail to interest the bird lover. He is full of idiosyncrasies that keep one guessing. Why for instance his close association with the peaceful cow? Why his ludicrous attempts to sing, he who has not a thread of music in his whole make-up? How did Madame Cowbird come to lapse from the paths of virtue and, in place of building a nest of her own, foist her eggs and the care of her offspring on smaller and better principled birds to their detriment? Leaving these conundrums for wiser heads to solve, I must say that the cowbird seems to have chosen the smooth path to prosperity. It makes an easy livelihood, having no parental cares or worries, and is common and widely distributed. The farmer seems to have little to complain of in respect to the bird's food habits.

(See Biol. Surv. Bul. 13, p. 29, 1900.)

CHIMNEY SWIFT (Chætura pelagica).

Length, rather less than 5½ inches. Too well known by its peculiar flight and habits to need describing.

Range: Known only in eastern North America. Breeds from southeastern Saskatchewan, Manitoba, Quebec, and Newfoundland south to Gulf Coast; west to Plains from eastern Montana to eastern Texas; winters south of the United States.

The popular name of this bird, chimney swallow, embodies an error since the bird not only is not a swallow but is not even distantly related to the swallow family. Unlike the humming birds as the chimney swift is in appearance and habits, it is structurally not far removed from them. Like the swallows it is an indefatigable skimmer of the air and like them it earns a debt of gratitude by destroying vast numbers of our winged enemies, which its unsurpassed powers of flight enable it to capture. Indeed, chimney swifts eat nothing but insects, and no insect that flies is safe from them, unless it be too large for them to swallow. In June swifts may be seen gathering twigs for nest material. They disdain to pick these up from the ground but seize the coveted twig with their strong feet and break it off from the terminal branch when in full flight. By means of a sticky saliva secreted for the purpose the swift glues these twigs to the sides of the chimney in the form of a shallow nest. Although not generally known, swifts roost in chimneys and cling to the walls by using the sharp pointed tail as a prop, as do many woodpeckers in ascending trees. Any bird lover may secure distinction by solving an ornithological riddle and telling us where our chimney swifts spend the winter. They come in spring, they go in fall and at present that is about all we know of the matter, save that they do not hibernate in hollow trees, as many have believed.

Marsh Hawk
Osprey

Turkey Buzzard
Bald Eagle
Male, upper; immature, lower

MARSH HAWK (Circus hudsonius).

Length, about 19 inches. The ashy upper parts, white rump and long tail of the adult male sufficiently distinguish this hawk; while the fuscous upper parts and buff under parts much streaked with brown distinguish the female and young.

Range: Breeds through much of Canada, south to the middle United States; winters in the United States, especially in the south.

Though not exclusively a marsh frequenter, as its name might seem to imply, this hawk prefers open country, and its favorite hunting grounds are meadow and marsh, in which it nests on the ground. It flies rather low, the better to see and drop suddenly upon the luckless meadow mice—its favorite food. Unfortunately small birds form part of its fare, and there are localities, like Cape Cod and Martha's Vineyard, in Massachusetts, where this hawk has earned a bad reputation as a destroyer of poultry and game. However, over much the larger part of the vast territory it inhabits, the marsh hawk is a rodent eater, and the debt of gratitude it lays upon the farmer is large. This debt should be fully discharged by preserving the bird and encouraging its presence unless it is caught committing overt acts. In other words, as this hawk is very beneficial over most of its range, individual hawks should be presumed to be innocent unless detected in transgression.

OSPREY (Pandion haliætus carolinensis).

Length, about 23 inches. The great size, brown upper parts and white under parts are distinguishing features.

Range: Breeds from northwestern Alaska, and central Canada south to the Gulf Coast, western Mexico and Lower California; winters from the southern United States, Lower California and Mexico to Central America.

A thin, high pitched whistle, the alarm as well as the call note of the osprey, frequently directs the attention of the passer by to this fine hawk as he circles high in air on the watch for fish. The bird is common along our coast and to some extent along our rivers, and his bulky nest of twigs, often in low trees or sometimes on the ground, frequently attests his former presence when he is wintering elsewhere. When unmolested, ospreys return to their own strip of territory year after year, and they and their descendants probably rear their young in the same nest for generations, repairing it from season to season as necessity requires. The osprey lives solely on fish which he catches himself—he disdains carrion—diving from mid air upon his quarry and often burying himself in the water momentarily by the force of his descent. He often fastens his talons in the back of a large fish, which proves too heavy, and he has to abandon it; but usually he succeeds in carrying his prey to his nest, though his slow and labored wing-beats often prove how heavy is his load. Notwithstanding the fact that the osprey makes no direct return for the fish he eats, no one can doubt that indirectly he renders a full equivalent. Visitors to the seashore, and even old residents, never tire of watching his superb flight and interesting habits, and his plunge, after his quarry, whether successful or unsuccessful, is a sight to be remembered.

TURKEY BUZZARD (Cathartes aura septentrionalis).

Length, about 30 inches. The naked head and neck and glossy black plumage are distinctive.

Range: Extends from southwestern Canada, northern Minnesota, southern New York and south into northern Mexico and Lower California.

This buzzard displays superb powers of flight which even the eagle cannot surpass, and no small part of its time is spent in the upper air, describing great circles on motionless wings as if for the mere pleasure of flight. Let another buzzard, however, discover a carcass, and the movements of our æronaut as he hastens to the feast are at once noted by his next neighbor, and his by a third, till the carrion feeders of a wide territory are assembled. Sight and not smell, then, is depended on by the buzzard to guide him to his food. Though of great strength and provided with a formidable bill, the buzzard rarely, if ever, attacks living animals, unless they are disabled, but depends upon death to provide for his wants. No doubt his ability to fast is as great as his capacity for gorging himself when occasion offers, and he must often go for days without food. As a scavenger the buzzard does good service and no sound reason exists for destroying him, notwithstanding the fact that occasionally the bird may be instrumental in spreading hog cholera by transporting the germs on his feet and bill. This disease, however, may be, and no doubt often is, transmitted by the feet of so many other birds, especially the English sparrow, and of so many mammals, especially rats, and even on the footwear of man himself as to lead to the belief that if every buzzard in the hog cholera districts were to be sacrificed no perceptible diminution of the disease would follow. The bird should continue to enjoy the protection which is at present accorded it in nearly every state of the Union.

BALD EAGLE (Haliætus leucocephalus and sub-species).

Length, about 33 inches. The white head (adult) and naked tarsus distinguish this species from the golden eagle.

Range: A resident of Alaska, much of Canada, and the whole of the United States in suitable localities.

Though a fisherman by profession, the white head is by no means the master of his craft that the osprey is. In fact he never fishes for himself so long as he can rob the more skilful and more industrious fish hawk. When necessity compels, however, he fishes to some purpose, and much after the manner of his erstwhile victim, the fish hawk. He is far less fastidious in his food habits than that bird, however, and often gorges himself until he cannot fly on dead fish gathered along shore, especially on the great salmon rivers of the northwest. When fish are scarce and waterfowl are plentiful, the white head has little difficulty in living off them. Complaint is made in Alaska, where the bald eagle is numerous, that he sometimes interferes with blue fox farming by killing the animals for food. Though the blue fox is not a large animal he is by no means a pigmy, and the bird who would make him his quarry must needs possess both strength and determination. As this eagle has been taken for our National emblem it would seem to be the part of patriotism to condone his faults and remember only his virtues, among which are a magnificent presence, superb powers of flight, and his devoted care of his family.

Black-crowned Night Heron
Male, upper; young bird, lower

Herring Gull
Adult in winter, upper
Adult in summer, lower

Great Blue Heron

Common Tern

BLACK-CROWNED NIGHT HERON (Nycticorax nævius nævius).

Length, about 24 inches. The black crown distinguishes it from its relative, the yellow-crowned night heron.

Range: Breeds from northern Oregon, southern Wyoming, southern Manitoba, and central Quebec south to Patagonia; winters from northern California and Gulf States southward.

Given for a roosting place a suitable stand of leafy trees, especially evergreens, conveniently near a stream or pond that harbors fish, frogs and tadpoles, and any locality may have its colony of night herons. As its name implies, this heron is a bird of the night, not leaving its roost till dusk when, with frequent iteration of its hoarse quawk, it wings its way in the gathering gloom straight to its feeding place. So rarely is the bird about in daylight that a large colony may exist for years near a town or large city, and not above a dozen individuals have an inkling of its existence. True to its sociable instincts, the night heron by preference nests in colonies, and several pairs often place their rude nests of sticks in the same tree; or, in the absence of trees, as in the extensive tule swamps of the far west, where other conditions are ideal for herons, they nest on the ground or on the prostrate tules, hundreds of pairs being associated together.

This heron sometimes feeds on field mice, but it eats too many fish to please the fishculturist, and after it has once learned the way to a hatchery strong measures are needed to discourage its activities.

HERRING GULL (Larus argentatus).

Length, about 24 inches. Deep pearl gray above; much of rest of plumage white. Not readily distinguished in life from its allies.

Range: Breeds in Alaska and in Arctic regions south to southern British Columbia, southern Alberta, northern North Dakota, central Wisconsin, southern Ontario, northern New York, and Maine; winters from southern British Columbia to Lower California and western Mexico, and from Gulf of St. Lawrence and Great Lakes south to Bahamas, Yucatan, and coast of Texas.

All things considered, the herring gull is probably the best known of the family by reason of its abundance and wide distribution. Moreover, this is the gull most frequently noticed by passengers as it follows in the wake of our ocean and trans-Atlantic steamers. It breeds no farther south than the coast of Maine, but in winter it is very numerous along the Atlantic coast and in many of our inland ponds. It does excellent service as a scavenger in our harbors, venturing fearlessly among the shipping to secure anything edible that may find its way overboard. The services of this and other gulls in such a capacity are so valuable that their destruction under any pretense is to be deprecated. When the craze for feathered hat gear was at its height thousands of gulls, without regard to species, were killed for millinery purposes, but it is to be hoped that, now the sale of their feathers is illegal practically everywhere in the United States, the gulls will rapidly increase.

(See Biol. Surv. Bul. 17, pp. 53, 80.)

GREAT BLUE HERON (Ardea herodias and sub-species).

Length, from 42 to 50 inches.

Range: Breeds from the southern Canadian provinces south to southern Lower California, southern Mexico and South Atlantic States; winters from Oregon, the Ohio Valley and Middle States south to the West Indies, Panama and Venezuela.

When one sees a large bluish bird, with long neck and stilt-like legs, standing motionless by river, pond or lake, or slowly wading in the shallows, he may be sure he has before him the great blue heron, and a notable bird he is in many ways. Wary as this heron is and keen to scent danger, he offers so tempting a mark as he wings his way slowly along, with head and neck drawn in against the body and long legs trailing behind, or as he stands motionless watching for game, that he is frequently shot "just for the fun of it." This wanton taking of life is never justifiable, but when the life cut short represents so much beauty and grace as are embodied in this stately bird, the crime seems doubly heinous. Naturally this heron is much less common than he used to be.

Small fish, frogs, tadpoles, and snakes form the bulk of his food, and in some regions he is a determined foe of mice and gophers, and the sight of a heron in the midst of a dry pasture or in a stubble field watching for a gopher to emerge from his hole is very common.

(See Biol. Surv. Bul. 31, p. 52; also Bul. 17, p. 217.)

COMMON TERN (Sterna hirundo).

Length, about 15 inches. The pearl-gray breast and belly distinguish the adult of this tern from its relatives. The outer web of the outer tail feathers is darker than the inner web; the reverse is true of Forster's Tern, its nearest ally.

Range: Breeds from Great Slave Lake, central Keewatin and southern Quebec south to southwestern Saskatchewan, northern North Dakota, southern Wisconsin, northern Ohio and North Carolina; winters from Florida to Brazil.

Our common tern is, alas, common no longer. The Atlantic coast is peculiarly fitted to be the home of the terns by reason of the extensive shallows and the great number of sandy islands on which terns and gulls used to breed in absolute safety. At the bidding of fashion, however, thousands of these beautiful creatures were slaughtered till the sand was red with their blood and island colonies that used to number thousands were exterminated. No excuse serves to palliate the crime of the wholesale murder of these graceful sea swallows, as they are aptly termed, which used to make our shores so attractive by their presence. But the tide seems to have turned, partly at least. The Government has set aside islands as breeding resorts and places of refuge and, through the activity of Audubon Societies and of individual workers, a certain measure of safety seems now assured to these persecuted birds. It may even prove possible, by the bird sanctuary plan, to increase their numbers again and make them a familiar sight along our deserted shores. Could the sentiment of the women of the United States be united for their protection, all doubt as to the future of these beautiful creatures would be removed, but so long as the arbiter of Fashion decrees feathers on hats, so long will the eternal vigilance of their friends be needed to assure the safety of the small remnant of this species and its kindred.

Great Horned Owl
Coot

Wood Duck
Male, upper; female, lower
Spotted Sandpiper

GREAT HORNED OWL (Bubo virginianus and sub-species).

Length, about 22 inches. The great size and long ear tufts sufficiently distinguish this owl.

Range: Resident over the greater part of North and South America.

This, our largest owl, inhabits heavily forested and unsettled regions and is becoming more and more rare in thickly populated areas. It is well known by its far reaching call—"hoo-hoo-hoo-hoo"—which is heard best in the still small hours of the night, when it echoes across the expanse of canyon and forest in the far west.

This owl destroys many partridges and other game birds, and unhoused poultry is never safe from its nocturnal attacks. Its deeds are those of darkness, since usually it hunts only at night, though when disturbed in the daytime it can see well enough to take good care of itself. Its bill of fare is a long one and includes many kinds of mammals and birds. It is one of the few creatures which when hungry do not hesitate to attack the skunk, and it appears to have no great difficulty in killing this rather formidable little beast. That it does not always do so with entire impunity is evident from the odor frequently attaching to its feathers. Its destruction of rodents entitles it to our gratitude, especially when it kills pocket gophers, rats, mice, ground squirrels and rabbits. In some parts of the west rabbits are responsible for much damage to orchards and crops and consequently their reduction is a blessing. Nevertheless the protection of this big and fierce owl cannot be recommended on sound economic grounds.

COOT (Fulica americana).

Length, about 15 inches. The slate-colored plumage, with blackish head and neck, white bill, and scalloped toes mark this bird apart from all others.

Range: Breeds from southern Canada south to Lower California, Texas, Tennessee and New Jersey; also in southern Mexico and Guatemala; winters from southern British Columbia, Nevada, Utah, Ohio Valley and Virginia south to Panama.

The coot, or mud-hen, is a sort of combination of duck, gallinule and rail, and withal is a very interesting bird. Fortunately for the coot, its flesh is little esteemed, and by many, indeed, is considered unfit for human consumption. The coot is thus passed by in contempt by most sportsmen, and in some regions it is as tame as can well be imagined, swimming within a few feet of the observer with entire unconcern. Under other circumstances, however, as in Louisiana, where it is shot for food under the name *poule d'eau*, it becomes as wild as the most wary of ducks. It frequents both salt and fresh water, preferably the latter. The mud-hen is one of the few American birds that occasionally visits the distant Hawaiian Islands in fall and winter. Finding conditions there to their liking, some of the immigrants, probably centuries ago, elected to remain and found a new colony, and there, in the fresh water ponds of the island archipelago, their descendants still live and thrive.

The food of the coot consists almost entirely of water plants of no use to man. There would seem, therefore, to be no excuse for killing or disturbing the bird in any way.

WOOD DUCK (Aix sponsa).

Length, about 19 inches. The elongated crest of feathers and variegated plumage of white and brown, spotted with chestnut, ochraceous and steel blue are characteristic.

Range: Breeds from Washington to middle California, and from Manitoba and southeastern Canada to Texas and Florida; winters chiefly in the United States.

It can be said of this duck, as of no other, that it is our very own, since most of the breeding area it occupies is within our territory, and by far the greater number of the species winter within the United States. The story of its former abundance on our ponds and streams and of its present scarcity is a sad commentary on our improvidence and a warning for the future. Happily, it is not yet too late to save this most beautiful of our ducks, and under proper regulations it may be expected not only to hold its own, but to increase until it is once more a proper object for the skill of sportsmen. Under present conditions all true sportsmen should refrain from its further pursuit.

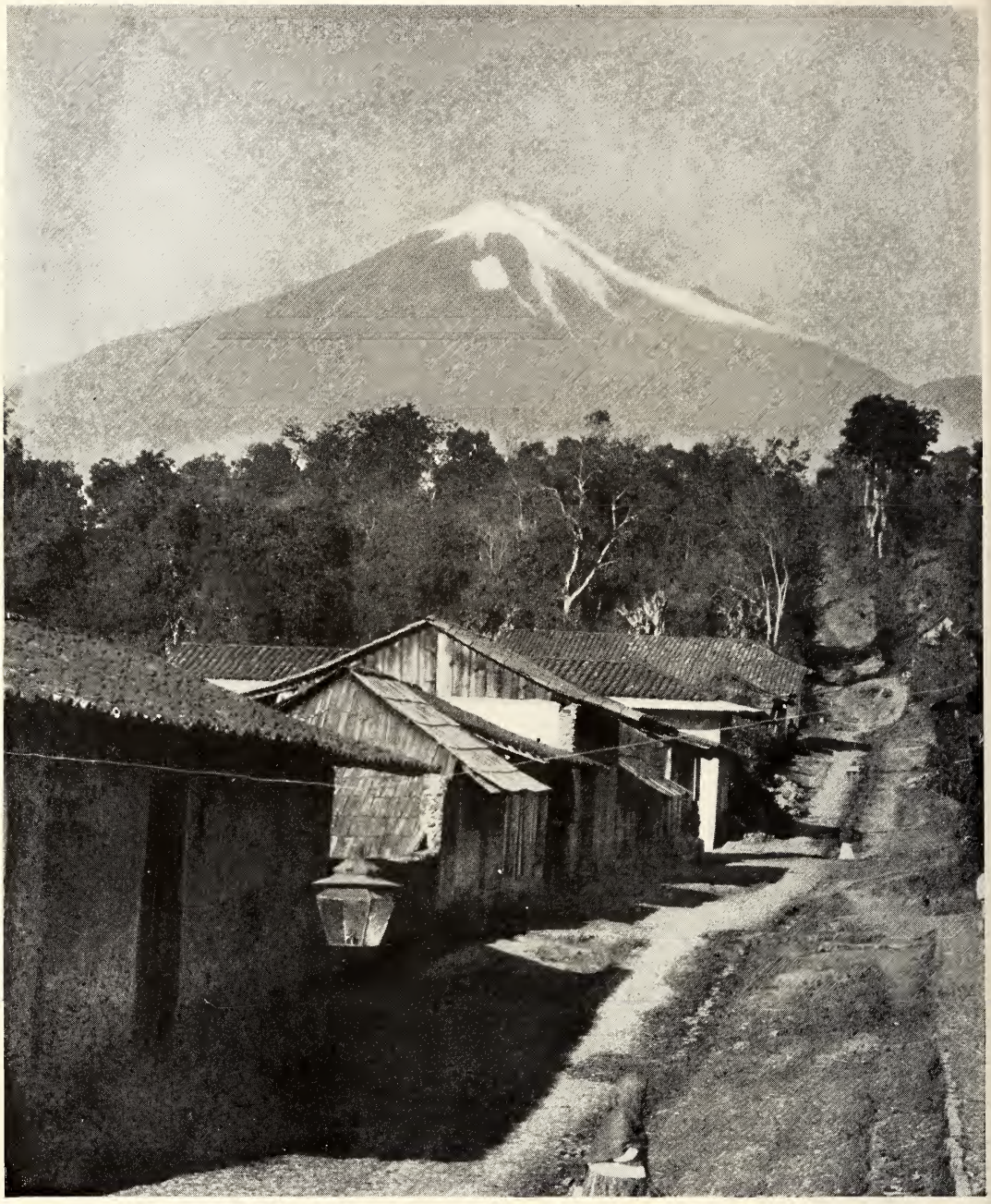
As is well known, the wood duck is one of the few wildfowl that builds its nest in hollow trees, and the security thus provided for the young is one of the factors to be relied upon for the increase of the species. North, south, east and west, the States of every section are, or should be, interested in the preservation of this distinctively American duck, and should make suitable regulations for its welfare and see to their enforcement.

SPOTTED SANDPIPER (Actitis macularia).

Length, about 6 inches. The "tip up," with its brownish gray upper parts and white under parts and its teetering motion, is too well known to need description.

Range: Breeds in northwestern Alaska and in much of northern Canada south to southern California, Arizona, southern Texas, southern Louisiana and northern South Carolina; winters from California, Louisiana and South Carolina to southern Brazil and Peru.

The little "tip up," as it is appropriately named, from its quaint nodding motion, unduly favors no one section or community but elects to dwell in every region suited to its needs from Alaska to Florida. It is doubtless more widely known than any other of our shore birds, and as it takes wing when disturbed, its "wit, wit" comes to us from beach, river side, and mill pond, from one end of the land to the other. It is the only shore bird that habitually nests in cornfields and pastures, and its handsome buff eggs spotted with chocolate are well known to the farmer's boy everywhere. Much is to be said in favor of the food habits of the little tip up, as the bird includes in its diet army worms, squash bugs, cabbage worms, grasshoppers, green flies and crayfishes. Having thus earned a right to be numbered among the farmers' friends, the bird should be exempt from persecution. The tiny morsel of flesh afforded by its plump little body, when the bird has been shot, is in no sense an adequate return for its services when alive and active in our behalf.



THE SNOW-CROWNED MT. ORIZABA Photo by Frank M. Chapman

"The country lying between the cities of Vera Cruz and Mexico City possesses more varied natural attractions than any other area of similar extent in the world" (see text, page 533). "The summit of Orizaba can be reached without great difficulty. One may travel to an altitude of 15,000 feet by mule, and the remaining 3,000 odd feet are traversed on foot. No physical obstacles are encountered, and the walk to the top is merely a matter of legs, lungs, and heart" (see text, page 548).

A NATURALIST'S JOURNEY AROUND VERA CRUZ AND TAMPICO

By Frank M. Chapman

Curator of Ornithology in the American Museum of Natural History

With Photographs by the Author

WHILE fully aware of the high percentage of error most sweeping assertions contain, I nevertheless venture to claim that the country lying between the cities of Vera Cruz and Mexico City possesses more varied natural attractions than any other area of similar extent in the world.

From the moment when, on the Gulf, one sights the still distant Sierra, until one reaches the site of Tenochtitlan itself, one's attention is held by a variety of interests which make the trip from coast to table-land, and the snow-peaks rising from it, an epitome of a journey from equatorial to boreal regions.

If one is in search of supremely beautiful scenery, it is here to and beyond the limit of human appreciation. If one would test the climates of the world, he may go in a day from perpetual summer to everlasting snow, and at the same time pass from belts where rain falls almost daily to others where it is rarely known. With these extremes of temperature and humidity there is, of course, a corresponding diversity in flora and fauna, which makes the region of exceptional interest to the botanist and zoölogist, and particularly, as I shall endeavor shortly to show, to the student of the distribution of life.

For the archeologist there are ruins which evince a high degree of aboriginal culture; and for the ethnologist, natives who, in retaining their tribal customs, offer problems of fundamental importance in connecting the present with the past.

The historic period opens with the incomparable romance of Cortez and Montezuma, of Aztecan and Tlaxcalan, and passes through three centuries of Spanish government, the war of independence, the short-lived empire of Maximilian, and the campaign of Scott, to the astonishing era of material development under Diaz, and the no less disastrous years of disintegration once his iron grip was loosened.

Thus, omitting all reference to natural resources and commercial possibilities, whether one be a student of nature or of man, or merely a tourist in search of the novel and beautiful, this portion of Mexico will appeal to him with a force and fascination which makes a journey through it one of the memorable experiences in a lifetime of travel.

ENTER FROM THE GULF

Be one student or tourist, there can be no question that one should enter Mexico from the Gulf. Were it not for customs-house formalities, the northern boundary might be crossed unawares at many points; but to follow for days in the wake of the Conquistadores produces a mental condition which prepares one properly to enjoy a definite arrival in Mexico near the landfall of Cortez. A journey from the coast to the capital follows a natural succession of climatic zones as well as the sequence of early historic events.

Furthermore, steamers so arrange their schedules that they reach Vera Cruz in the morning, and we begin our day, therefore, alert and eager for the experiences incident to travel in a land where the eye is greeted by strange sights, the ear by unfamiliar sounds.

The day, indeed, should begin at sunrise, some hours before disembarking at Vera Cruz, with a hope that one may have the rare good fortune to see the first rays of the sun touch the summit of Mt. Orizaba, the first, as it will be among the most lasting, of one's impressions of

Mexico. The shore is still some 30 miles distant, the mountain itself about 100 miles, and one is with difficulty convinced that the gleaming pink cloud high above the horizon is part of the still invisible earth beneath it. Doubtless the Aztecs were not familiar with this view of Mt. Orizaba, but from no other place is their name for it—Citlaltapetl, the Star Mountain—so applicable.

On only one of three voyages to Mexico have I had this thrilling view of Orizaba's snow-crown, but in default of it there is still the sunrise over the Gulf, and if this be obscured, there is always the Gulf itself, usually calm at this hour, and the half-speed at which the steamer is moving to prevent too early an arrival at Vera Cruz, gives one an exceptional opportunity to see the surface life from her deck.

SCHOOLS OF FLYING FISH

Nearly every little raft of gulf-weed shelters a swarm of small fish; near the Arcos keys the black and white gannets, which evidently live there, are abundant, and occasional herring gulls, sooty or bridled terns, and frigate birds are seen, while at frequent intervals flying fish, flushed by the steamer, spring from beneath the bow and scale away. One exceptionally calm morning, when the Gulf was glassy smooth, we could see them from the bow of our ship, swimming ahead a foot or two beneath the surface.

As the steamer bore down on them they darted right and left, or at our too close approach took to the air. For 20 to 40 feet they touched the surface when the tail and long, wing-like pectoral fins were in rapid motion, the latter being moved up and down. The body was held at an angle and apparently only the lower lobe of the tail touched the water, making, when it struck, a series of connected circles. Sufficient headway being thus gained, the fins became rigid and the creature scaled or sailed, a true aëroplane, until momentum was lost, when it plunged abruptly into the water. When the tail struck the crest of a swell the "wings" also vibrated, and fresh force was thus acquired, but the calmness of the sea afforded few opportunities for this method of prolonging the sail. This varied from a few feet to 150 yards, with frequent changes of direction.

March 4, 1910, as the steamer passed the island fortress of San Juan de Ulloa and glided inside the breakwater to the substantial customs pier, our preparations for immediate landing were halted by the tardiness of the health officer, who, after keeping us impatiently waiting for an hour, conducted his inspection with exasperating deliberation; nor were we declared free until the last steerage passenger had been examined.

CONQUERING PEACEFUL BANDITS

In the meantime, on the pier below, a horde of *cargadors* had gathered behind the rope before which the baggage had been piled. As we descended the gangway the rope was dropped, and we were charged by a mob of shouting, gesticulating porters, five or six of whom shoved their badges into one's face at the same moment, grabbed our hand baggage, and all but tore us into fragments. It was a scene of riotous confusion, with two or three score bandits pulling, shoving, swearing, dodging, fighting for the privilege of taking our luggage to hotel or railway station, and I emerged from the fray with all our 14 trunks, 14 valises, and the exultation of a conqueror.

Time was when Vera Cruz was dreaded as a pest-hole, and trains at once took one from the steamer up the Sierra on the way to Mexico City, usually as far as Orizaba. Now, however, sanitary conditions and hotel accommodations have been so improved that one may stay here without danger or discomfort. At least, one should remain over night to begin the trip toward the table-land early in the morning, and thus be able to see every foot of this remarkable journey.

Fellow-travelers with whom we had shared a common interest in the events of the voyage now separated, each to his appointed task or tour. A newly appointed ambassador went to his post at the capital with small realization that out of the apparently peaceful present would soon arise a period of devastation ruinous to the interests of the country and presenting critical situations for diplomatic

Photo by Frank M. Chapman

A VIEW OF MT. ORIZABA FROM THE TRAIL, AT 9,500 FEET

Photo by Frank M. Chapman

MULES LOADED WITH COFFEE: MT. ORIZABA IN THE DISTANCE

RIVER FRONT OF TAMPICO, MEXICO Photo by Frank M. Chapman

treatment; a rubber planter went south to the Isthmus, an oil-man north to the petroleum deposits near Tuxpam, and an archeologist left for the ruins on the table-land.

Some came to buy, others to sell, and in more settled lands we might have had small interest in them or their calling, but your commercial man in the tropics is often an adventurer at heart and an explorer in practice, and if his reports to his "house" never reach the pages of a geographic magazine, we may admit that they not infrequently contain more novel information than many reports that do. Gratefully do I acknowledge my debt to these Knights of Trade, whose intimate knowledge of little-known trails and places has been of no small value in solving problems of transportation and subsistence.

WE PASS THROUGH TROPICAL, TEMPERATE, AND BOREAL ZONES IN 75 MILES

My own mission in Mexico was to make field studies and collect specimens and accessories for an American Museum Habitat Group, designed to illustrate the effect of altitude on the distribution of life; and the fact that nowhere on the American hemisphere can this be done so effectively as in the country lying between sea-level and snow-line on Mt. Orizaba, is in direct support of the claims made for the diverse interests of this truly wonderful region.

Reference to a map of the natural life areas of North America shows the tropic region stretching up two narrow arms on the Gulf and Pacific coasts of Mexico which, in places on the higher Sierras, are paralleled by southern extensions of the Canadian Zone of the north. Between the two lie bands of the Temperate Zone.

Thus, in our journey from the Gulf to the summit of the Sierra, we pass through Tropical, Temperate, and Boreal zones—the Tierras Caliente, Templada, and Fria, of the native. Our actual journey, in passing from sea-level to snow-line, may be a matter of 75 miles, our change of altitude approximately three miles; but if we were to seek the Canadian Zone not on mountain top but on the coast, it would be necessary for us to travel to Maine or Nova Scotia. In other words, a journey of some 1,500 miles would be required to reach conditions which are here distant but three altitudinal miles.

Photo by Frank M. Chapman

A "FIG" TREE ON THE TAMESI RIVER, MEXICO

FROM PARROTS TO CROSSBILLS

It follows, then, that one can actually stand in a tropical jungle, where parrots, trogons, toucans, and other equatorial birds are calling from the liana-draped trees, and look upward to forests of pines and spruce, where crossbills, juncos, pine siskins, and evening grosbeaks are among the common permanently resident species.

Later, we may ascend to the snows on Orizaba to discover at approximately what altitude the palms of the Tierra Caliente give way to the oaks of the Tierra Templada, to be in turn replaced by the spruces of the Tierra Fria. As a preliminary to this journey let us first see something of the Tropical Zone.*

Circumstances led me to make studies in this zone near Tampico, and from this town of many dugouts we embarked at 6.15 on an April morning, bound for Paso del Haba, a small sugar plantation on the banks of the Tamesi River distant 75 miles by water, 35 by land. In addition to our host, who proved a host indeed, our party consisted of George Shiras, 3d, Louis Agassiz Fuertes, Chapman Grant, and the writer—a company with sufficiently diverse aims to insure a many-pointed contact with nature.

Sacrificing the picturesque to the practical, we embarked in a launch with a four-horse-power engine, rather than a tolda-covered canoe of four-paddle power, and consequently reached our destination in twelve hours rather than in thirty-six. But what we gained in speed we lost in opportunity for observation.

ENCROACHING CIVILIZATION

An intrusively vulgar, tuff-tuffing motor-boat is about the most effective agent for destroying the charm and alarming the life of a quiet, remote tropical river that man has devised; but we argued that opportunities missed on the water might

*As a matter of fact, on this particular trip, the tropics were visited last, but the narrative follows the more natural order.

Photo by Frank M. Chapman

A TREE LOADED WITH PARASITES

"In our journey from the Gulf to the summit of the Sierra we passed through Temperate, Tropical, and Boreal zones. . . . To reach conditions which are here distant but three altitudinal miles we should have to make a journey of some 1,500 miles" (see text, page 536).

Photo by Frank M. Chapman

PARASITE VEGETATION ON LIMB OF A TREE

be found on the shore. Furthermore, on the lagoons which mark the entrance of the Tamesi into Panuco, the birds seemed to have become in a measure accustomed to the steady, even cough of our kind of craft, and we passed within gunshot of numerous coots, many species of ducks, and even a small flock of roseate spoonbills, a bird with which we hoped to become more familiar later.

Soon the Tamesi narrowed to 150 or 200 feet, a width it held with surprisingly little variation throughout the day. For a time it wound through a grazing country, which is overflowed in the rainy season, where cattle were numerous and trees almost wanting; then for miles we passed through plantations of bananas. This moisture-loving plant can be grown here only in the narrow strip formerly occupied by the original forest on the banks of the river. With the forest had gone most of the wild life; but man himself was here sufficiently primitive to be a part of the fauna, and his picturesque thatched cabins and log-hewn canoes, and the passing glimpses of his way of life on land and water, afforded interesting illustrations of the manner in which he meets his environment.

About 60 miles from Tampico we first encountered primeval forest, which in this low, comparatively arid coastal zone is restricted to the river banks, and the immediate increase in the number and variety of birds seen, stimulated a somewhat flagging faith in the accuracy of statements concerning the bird life about the plantation which, be it confessed, we had received with more or less incredulity.

It was 5.30 when we arrived, with just enough daylight left to pitch our tents in the ranch-house clearing on the banks of the river. The brown stream flowed silently by some 20 feet below us, with no hint of the loss to life and property it had caused only the preceding season, when it flooded the country for miles.

It is commonly believed that to see

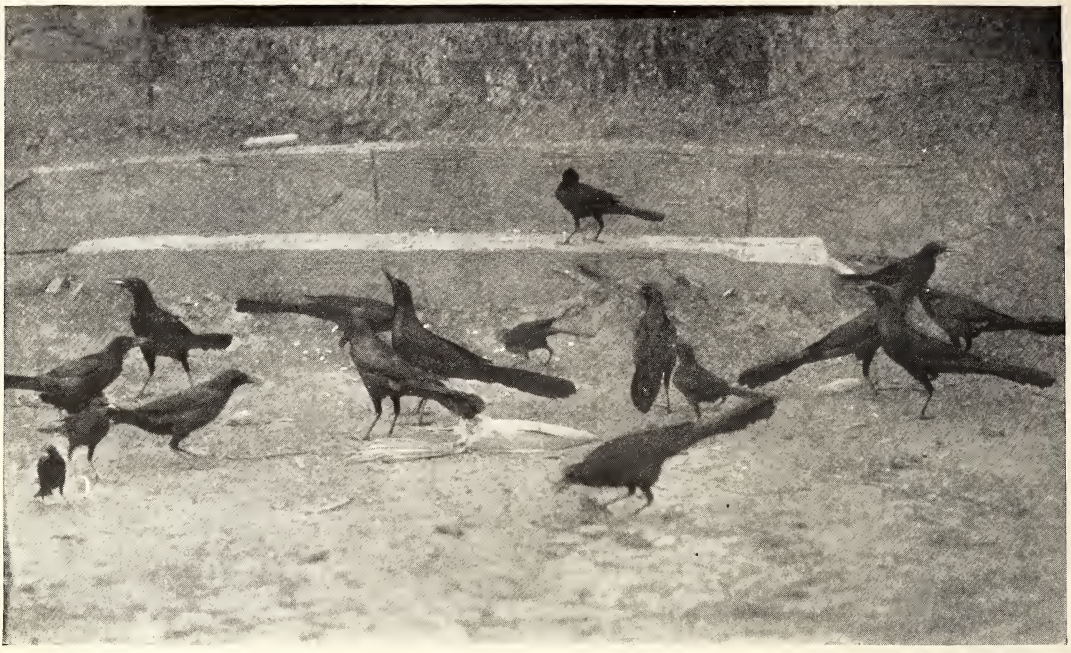


Photo by Frank M. Chapman

GREAT-TAILED GRACKLES, NEAR VERA CRUZ, MEXICO

tropical birds in abundance one must go at least to South America; but I have yet to find, in a somewhat extended experience, any place where certain eminently characteristic tropical species are more abundant than we found them at this camp on the Tamesi River distant less than four days from Chicago!

A BIRDLAND BABEL

We were awakened by the loud calls of flying parrots, not passing over at a great height, *en route* to some distant feeding-ground, as one usually sees them, but stopping, with much conversational chatter, to join scores which were breakfasting in the trees overhanging our tents.

At once we recognized the "double yellow-head" (*Amazona oratrix*) of the bird stores, rated by dealers as second only to the gray, red-tailed African parrot in its power of speech, and second to none as a whistler. With it was a slightly smaller, red-capped parrot (*Amazona viridiginalis*), which, whatever it may be in a cage, is vocal enough in nature. Parrakeets of two species, with darting, dove-like flight, shot through the clearing, uttering their sharp, rolling cry, or, entering a tree-top, disappeared with incomprehensible completeness until, assured of the safety of their surroundings, they began slowly to move about in search of food.

Red-billed pigeons (*Columba flavirostris*) nearly as large as our domestic bird, shouted their emphatic "hurrah," and the dainty little scaled doves filled in the gaps with their quaint *put-a-coo, put-a-coo;* ground doves mourned gently, if inconsolably, and the pygmy owl (*Glaucidium*) whistled with clock-like regularity from the top of a leafless tree—a perch which this diurnal, light-loving midget prefers.

Great-tailed grackles creaked, sniffled, whistled, choked, and rattled; queer little Mexican crows, looking not much larger than blackbirds, perched in flocks in the leafless trees, snoring and grunting; flycatchers (*Myiozetetes texensis* and *Tyrannus melancholicus*) twittered excitedly; Derby flycatchers (*Pitangus*) cried *hip, hip, hurray;* gold and black orioles whistled like school-boys homeward bound; anis whined; golden-fronted woodpeckers coughed; and ever and again the big Mexican pileated woodpecker sprang his thumping, reverberating rattle with astonishing effect.

A DREAM COME TRUE

It was such a scene as one might well have dreamed of, but scarcely expect to find when waking; nor did it altogether fade with the rising sun. These birds were not only feeding, but living, near us, and when their early morning hunger was satisfied many of them were found to be nesting, or preparing to nest, within sight of our tent.

A ground dove sat calmly on her two white eggs in the heart of a small orange tree at the ranch-house door; a red-billed pigeon, for some reason dissatisfied with the site in which its nest was built, was moving it twig by twig to a new situation in a limb above our tent; a pair of pileated woodpeckers had taken possession of a dead trunk about 150 feet from camp, making the entrance to their nest directly beneath a large projecting fungus, which served as an admirable hood to their doorway; yellow-headed parrots were prospecting for a homestead in a dead tree on the river shore, and appeared and disappeared in its hollow limbs in a manner which seemed to indicate they felt at home; while a pair of red-capped parrots were evidently much annoyed to find that a cavity which appeared to be acceptable was already occupied by a lizard about 2 feet in length, who refused to be dislodged, but continued to bask quietly at his threshold with, no doubt, irritating calmness.

Three factors accounted for the abundance and familiarity of the birds about our camp in the ranch-house clearing: First, the larger forest trees had been left standing and only the undergrowth cut out; second, many of these trees, locally known as "otaheite," were bearing fruit of which parrots and some other birds were particularly fond; third, the birds were not molested.

To see the species which required either undergrowth or wholly primeval conditions, it was necessary only to climb the corral fence, 200 yards away, and enter the forest on its farther side. The trees were not high, but the growth was dense, and in places the ground was covered with wild pines having leaves bordered by a series of strong hooks, which, set in both directions, were more productive of eloquence than progress when one attempted to leave the forest path.

BOLD AND TIMID BIRDS

Here, if one could avoid the big brown jays (*Psilorhinus*), which, with jerky flight and raucous calls, followed one with maddening persistence, he might find the copper-tailed trogon and hear its flicker-like *coo* or detect the elusive, echo-like *hoot* of the mot-mot; and in the early morning the air vibrated with the soft, conch-like cooing of the semi-terrestrial white-fronted dove (*Leptotilla*), while chachalaccas rattled, woodhewers (*Dendrornis*) piped, wrens of several species called or sang from the lower growth, and overhead there were warblers, tanagers, and vireos, some on their way north, others preparing to nest.

The banks of the river were too high and too continuously wooded to be suitable for water-loving birds, and the river is memorable to us chiefly as a fly-way of the splendid Muscovy duck, wild ancestor of a much degraded barn-yard descendant.

No one lacked for occupation at Paso del Haba. Shiras hunted with camera by sunlight and flashlight, securing photographs of birds by day and of beasts by night, and left, no doubt, a more vivid and lasting impression on the minds of two natives who unwittingly sprang one of his flashlight camera-traps than even his dry plate recorded.*

The naturalists added to their store of notes and specimens, while the keen, discriminating ear of Fuertes led to the discovery of a surprising new species of oriole, possibly the ancestral form of our familiar orchard oriole.

ORNITHOLOGIST'S PARADISE

Given the same considerate host who made our stay at his home so care-free, and hence productive as well as enjoyable, and somewhat more stable governmental conditions than have lately prevailed in this vicinity, and I know of no place where an ornithologist might hope to learn more of the habits of many tropi-

* See the article by Mr. Shiras in NATIONAL GEOGRAPHIC MAGAZINE, July, 1913, "Wild animals that took their own pictures by day and by night," page 807.

cal species concerning whose home lives we know as yet little or nothing. Of the 88 species recorded by us during the week of our stay, no less than 36 are tropical forms, which are here at, or near, the northern limit of their range.

This fact in distribution, together with the specimens to confirm it, filled our present wants, and we returned to Tampico to continue our reconnaissance in the tropical fauna among the water birds of the Tamiahua lagoon to the southward.

A canal which had lately been completed from the Panuco River to the northern end of the Tamiahua lagoon gave easy access to that large body of water. Having now to supply our own launch, several days were lost in overcoming the numberless obstacles which invariably confront the hurried traveler in the tropics, but the importance of actually starting induced us to leave Tampico at 3.30 in the afternoon of April 11 rather than wait until the following morning.

Sunset found us still in the canal and we were forced to camp for the night on the lately erected mud-bank which formed its shores—a site fully demonstrating the importance of a tent with a permanently attached water-proof floor-cloth. There were a few ducks in the bordering mangrove swamps. Fuertes killed three blue-winged teal soon after we landed, and a pair of gadwalls, which took wing as he fired, were dropped, if not literally in our pot, at least in the fireplace.

The spot was a good one to leave, and we were off early in the morning on our run to the southern end of the lagoon. Great brown rail (*Aramides*), Muscovy ducks, and black-necked stilts were among the noteworthy birds about us, while an astonishing number of coots (*Fulica*) were found resting on the long jetty-like arms which carry the canal to deep water in the lagoon. With explosive, protesting *cucks* they pushed off into the water, forming, finally, a solid black raft seemingly several acres in extent. Along the shore there were a few canvasback, gadwall, and shovelers; but most of the ducks had evidently left for the north, and birds as a whole were far from common.

With anticipations of better things beyond, we puffed along as rapidly as a head wind and two towed row-boats laden with gasoline, provisions, and camp equipment would permit. Our objective point was the home of a certain Indian hunter whom Charles Sheldon had told me could give us all needed information about bird life in general and roseate spoonbills in particular; but it must be admitted that the fact I had forgotten the man's name and mislaid the notebook in which it was recorded rather clouded our immediate future.

However, when we landed on the eastern shore of the lagoon for the night we learned from a troop of small Indian boys, who gravely shook hands with each one of us as we stepped ashore, that a thatched hut on a near-by bluff was the home of the man we had been blindly seeking. "Maclodeo" was the name to which a dormant memory instantly responded.

A JUNGLE VISITING CARD

Maclodeo proved to be absent hunting alligators, but when, the following morning, I introduced myself to his wife as a friend of "el Americano Don Carlos" a flash of comprehension illumined her previously puzzled features, and hurrying into the dimness of her thatch she quickly returned with a small, still white and evidently precious bit of cardboard, on which was engraved "Charles Sheldon, Madison avenue, New York City," a treasured memento which completed the identification of Maclodeo!

Information now came readily, and we learned that not only spoonbills, but several other species of birds were nesting on a group of small islets about 10 miles farther south. In spite of our ardent desire to see these birds, our surroundings were too attractive to leave without at least a casual exploration.

The peninsula is here about 10 miles in width, and in place of a growth of acacias, cacti, and other xerophytic plants, such as characterize the coastal plain to the north and to the south, it is for the greater part covered with a forest of surprising luxuriance. The common occurrence of fresh water at a depth of not more than two feet indicates that

Photo by Frank M. Chapman

PELICANS IN BLACK MANGROVES IN TAMIAHUA LAGOON, MEXICO

this forest has appeared in response to a natural subsurface irrigation. However this may be, the fact remains that at this point luxuriant tropical forest growth reaches its northern limit at sea-level, a circumstance which implies that one may expect to find here many species of plants, birds, and mammals heretofore known only from farther south, as well possibly as some local forms.

AN UNEXPLORED REGION

The region is practically unexplored zoölogically, and offers an attractive as well as a readily accessible field to the faunal naturalist. Purely as a bit of pertinent information, it may be added that no one should attack it who is not proof against mosquitoes and the small ticks, locally known as "pinaleas."

A day near Maclodeo's added to our list of purely tropical species a third parrot, a tinamou (*Tinamus*), a great cacique (*Gymnostinops*), a hawk (*Rupornis*), a falcon (*Falco albigularis*), a toucan (*Ramphastos*), a flycatcher (*Megarhynchus*), blackbirds of the genera *Amblycercus* and *Dives*, tanagers of the genera *Saltator* and *Phœnicothraupis*, and flycatcher-like birds of the genera *Lathria* and *Platypsaris*.

Even this encouraging and suggestive showing could not induce us longer to postpone our visit to the bird islands. Possibly, too, our departure was in a measure hastened by the ticks and mosquitoes, and on the morning of April 14 we continued our voyage, and two hours later landed on Pajaro Island in a tiny cove, with a sand beach overhung by black mangroves—a most attractive camp site. The beach, some 50 feet wide, was bordered by lower, grass-grown, evidently at times marshy, but now dry, ground, and on the other side of this lay a still lower area several acres in extent, covered with black mangroves and other low trees and bushes growing in water.

Up to this time few birds and no spoonbills had been seen; but giving no expression to our disappointment or to our rapidly changing estimate of Señora Maclodeo's veracity, we crossed the narrow marsh and entered the wall of vegetation on its farther side.

Photo by Frank M. Chapman

A REDDISH EGRET, NOT PHOTOGRAPHED BEFORE

A BIRD PARADISE

If we had suddenly opened the door of an overcrowded hen-house and thrown a bomb within, the change could not have been greater or the effect more surprising. Hundreds of birds which had been quietly resting at mid-day, with squawks of alarm, sprang into the air, and for a moment we were dazed by the confusion about us. But among the numberless herons of several species we could see dozens of delicately colored pink forms, while in nearly every tree was one or more nests holding young nearly as large and as pink as the parents which had just left them. We had at last reached the home of the spoonbill (see pp. 548-550).

Further exploration revealed a surprising number of birds on the island. There were Louisiana and little blue herons in great abundance, a few reddish and American egrets, black-crowned and little green herons, wood ibis and black-necked stilts, snowy banks of white ibis, and probably 200 pairs of roseate spoonbills. Nearly all were nesting, and it was obvious that we had before us an unusual opportunity to record photographically, both with motion film and fixed plate cameras, the appearance and habits of some little-known birds.

We first directed our attention toward the spoonbills, the most difficult, as well as the most valuable, subjects before us. Satisfactory studies could not be made from below, and the trees were generally too small to furnish support at the desired height, and before a proper location was found and the umbrella blind and cinematograph placed in position our strength, if not patience, was fully spent.

SACRIFICED TO FASHION

The odor from the decaying bodies of white egrets which, stripped of their plumes by hunters, had been thrown into the semi-liquid mud of the rookery, of their dead young in the nests above and water below, of the fragments of food and sundry débris of a great gathering of birds, the extreme heat—the mercury reached 99°—and the abundance of mos-

WHITE IBIS AND YOUNG

Photo by Frank M. Chapman

In the right foreground an ibis is feeding its young, which are, however, protectively colored and almost invisible in the photograph (see text below)

quitoes furnished as many elements of discomfort as one often encounters at one time, and all were intensified within the blind; nevertheless I can recall only one other experience in bird study which has afforded me keener pleasure or more lasting satisfaction.

To go into detail is not possible at this time, and it may simply be stated that a series of plates and motion films were made illustrating the home life of the roseate spoonbill, valuable not only because they had not been made before, but even more valuable because, owing to the diminishing numbers of this rare bird, they may possibly never be made again.

The white ibises were nesting in low bushes under conditions which made photography as easy with them as it was difficult with the spoonbills. One had only to erect one's blind in the open spaces their nests faced and enter it, when forthwith the routine of ibis life was resumed.

The young ibis were almost ready to fly and in their wood-brown plumage were as invisible as their parents were conspicuous. In photographs containing dozens of them only one or two can be clearly distinguished, and even in the motion pictures obtained they can be discovered with difficulty.

AFTER THE IGUANA

I had exposed my last plate on them one day when I observed a heavy-bodied iguana, about 4 feet in length, with his armor of plates and spikes fully developed, slowly climbing about among the nests, pausing here and there to eat leaves. The birds paid no attention to him and he was at least not an unwelcome guest. Being unable to photograph this venerable-appearing reptile, I determined to catch him, and before he realized my presence I was almost within grasping distance (see also page 558).

At that moment he took in the situa-

Photo by Frank M. Chapman

A FLOCK OF IBISES: TAMIAHUA LAGOON, MEXICO (SEE PAGE 545)

tion, half fell, half jumped to the ground, and at top speed galloped over the mud to the lagoon, 50 yards away, and plunged into the water not 2 feet ahead of me. I have not yet made up my mind what I should have done with the formidable-looking reptile if his speed had not outrun my discretion. Iguanas were, in truth, surprisingly common on the little island. The track of their dragging trail was everywhere visible along the beach, and we were frequently startled by having them drop from the limbs overhead and scurry into the water.

DIRIGIBLE AND AËROPLANE

On some neighboring islets brown pelicans and man-of-war-birds were nesting in the black mangroves. The latter were so wholly devoid of fear that in order to secure motion pictures of them in flight it was necessary to shake the limbs on which they were sitting. The mating season was past and the birds were incubating their single white egg, and but one bird in the colony of several hundred was seen to inflate its throat pouch.

This form of sexual display is practiced only by the male, who expands his pouch until in form, color, and appearance it exactly resembles a red toy balloon. This striking appendage is exhibited not only when the bird is at rest, but also when it is in the air, and we secured photographs of a flying bird with this great scarlet bladder hanging beneath its bill—a unique combination of dirigible and aëroplane in bird life (see page 551).

Without further describing our search for land and water birds at sea-level in eastern Mexico, or summarizing what I have briefly written about them, at least enough has been said to show that in its general aspects the avifauna is here highly tropical. Accepting this fact as established, we may now return to Vera Cruz and begin our journey toward snow-line.

Remarkable as is the railway journey from Vera Cruz to the table-land, it must be remembered that the region has been settled for centuries and that the original forest has long since disappeared. To find primeval conditions one must therefore go some distance from the long-established railways. In my opinion the whole region may best be seen from Cordoba as a base. The city itself is unusually interesting, the accommodations good,

WHITE IBIS: TAMIAHUA LAGOON Photo by Frank M. Chapman

the climate agreeable, the surroundings picturesque, the vegetation luxuriant, the inhabitants thoroughly Mexican, and the views of Mt. Orizaba of surpassing beauty. A railroad leads not only toward both coast and table-land, but another line goes south, and still another goes north. Cordoba, with an elevation of 2,700 feet, is near the upper edge of the humid Tropical Zone, and in an hour or two one may go by train to the heart of the tropics below or to the Temperate Zone above.

BEAUTIFUL ORIZABA

But Cordoba deserves chiefly to be known as the place from which Mt. Orizaba may best be seen. From no other spot known to me is one more impressed by the dominating majesty of this great mountain. Towering more than 15,000 feet above one, its superb, sweeping, symmetrical outlines can be seen from flank to flank, from foothill to summit. A single view of this great volcanic cone will enrich the remaining years of one's life with a precious memory. To be long enough with Orizaba to experience the ever-changing but never failing demands it makes on one's love of the beautiful and sublime, and to realize its power to stimulate one's spiritual nature, is an abiding inspiration.

Further studies of the life of the Tropical Zone were made at Motzorongo, 30 miles to the south, on the lately opened railway to the Isthmus of Tehuantepec. Here we found as highly developed tropical forest as I have ever encountered, and, in addition to many forms of tropical birds, tapirs and monkeys are said to inhabit it. Finally, our work in the Tropical Zone completed, we turned our faces toward the snows of Orizaba or, to be more exact, toward the clouds of Orizaba, for in consequence of a norther which had prevailed for a week we had been surrounded by fog and drizzling rain, and the mountain had been invisible.

The summit of Orizaba can be reached

Photo by Frank M. Chapman

SPOONBILLS: NOTE THE PECULIAR BILL, WHICH GIVES THE BIRD ITS NAME

without great difficulty from the edge of the table-land through San Andres and Chalchicomula. One may travel to an altitude of 15,000 feet by mule, and the remaining 3,000 odd feet are traversed on foot. No physical obstacles are encountered, and the walk to the top is merely a matter of legs, lungs, and heart. To accomplish our purpose of determining the approximate limits of the life zones through which one passes in traveling from sea-level to snow-line, a less frequented and more direct route was desirable, and we determined, therefore, to begin our ascent at Coscomatepec, a quaint and but little-known town at the bottom of the foothills lying at the eastern base of the mountain.

Coscomatepec is 2,200 feet above Cordoba, at the terminus of a railway 20 miles in length. The journey is made in three hours, the train leaving Cordoba at 7 a. m. and Coscomatepec at 12.30 on the return trip.

"DOCE" AND "DOS"

Mistaking "*doce y media*" (12.30) for *dos y media* (2.30), our prospecting party missed the train for Cordoba by nearly two hours and we were forced to spend the night at Coscomatepec. With an outfit of lenses, guns, etc., worth several hundred dollars, our cash assets barely sufficed to buy us the humblest board and lodging and second-class passage to Cordoba in a freight car overcrowded with

FEEDING UNDER DIFFICULTIES Photo by Frank M. Chapman

"We could see dozens of delicately colored pink forms, while in nearly every tree was one or more nests holding young nearly as large and as pink as the parents which had just left them. We had at last reached the home of the spoonbill" (see text, page 544).

natives. This last circumstance so shocked an English salesman that with difficulty we prevented him from buying us first-class tickets.

Several days later Fuertes and I, with W. F. Patterson, a fellow-member of the Explorers' Club, who, finding us at Cordoba vainly searching for a cook, had volunteered to fill the position (which, I may interpolate, is now permanently open to him!), left Coscomatepec with three saddle and two pack animals. Mist and clouds obscured all but the near-by landscape. The trail was good, but as slippery as though soaped, and the animals fell with discouraging frequency. We were now in the Temperate Zone, a region favorable alike for man and maize, and hence so populated and cultivated that the original growth has long disappeared.

The last mango trees and coffee plantations were left at 4,700 to 4,900 feet, and at 5,000 feet the trail was bordered by great sycamores. Within the succeeding 500 feet we saw hawthorn blooming, wild ("rum") cherry trees with green fruit, poplars, and oaks; and these trees, with willows, peaches, pears, apples, elderberries, huckleberries, and lupines, were characteristic of the zone through which we were traveling.

Few birds were or could be seen, but the presence of robins and flickers (both

Photo by Frank M. Chapman

SPOONBILL AND YOUNG IN NEST: TAMIAHUA LAGOON (SEE PAGE 544)

of the western variety) told us that the fauna as well as flora had changed.

Toward mid-day the trail took the crest of the thin ridge between the deep Jamapa and Tlacotiopa barrancas. Dense clouds were below as well as above us. We seemed to be climbing a knife-edge through space. Reaching level ground on what might have been another planet, we camped for the night. Shortly we were visited by a group of seemingly pure-blooded Indian boys from neighboring cabins or jacales, who appeared as much excited by our presence as though we had come from another planet. Particularly were they interested in Patterson's masterly handling of flapjacks, doubtless to them a kind of glorified tortilla, and we ourselves were not without admiration of his skill, and especially its productiveness.

WAKING IN THE CLOUDS

We awoke in the clouds, and all day they hung closely about us. Huts of hewn boards roofed with split shingles, without windows, and with an unhinged door leaning against their one opening, were passed at intervals. At our approach their owners promptly disappeared within, and although our passing greeting was usually answered, the speaker was unseen, but we could almost feel the questioning look of at least one pair of eyes. They were rather an attractive-looking people, with the ruddy olive complexion one finds among the Indians of high altitudes.

At about 9,000 feet we reached the upper limit of corn, and in consequence the upper limit of human habitation. Beyond this point only goatherds and iceminers were encountered. At the same time we entered the outskirts of the coniferous forests of the Boreal Zone.

PERPETUAL TROPICAL WINTER

A few outlying short-leaved pines (*Pinus montezumæ*) had been seen as low as 5,700 feet, and the pine forests descended at least as low as 8,000 feet. At 9,300 feet we encountered the first spruce (*Abies religiosa*), convincing evidence of the boreal character of our sur-

Photo by Frank M. Chapman

AN UNUSUALLY RARE PHOTOGRAPH: IT SHOWS A MAN-O'-WAR BIRD WITH POUCH INFLATED (SEE PAGE 546)

roundings, and at 9,500 feet we camped in a superb primeval forest of pines, spruce, and oak. The pines (*Pinus montezumæ* and *P. liophylla*) compared favorably in size with those of the California Sierras, while some of the oaks, locally termed *"encimos,"* we estimated to be 130 feet in height, with a basal diameter of 6 feet.

A singularly incongruous tropical note in this Alpine forest was the presence of Spanish "moss" (*Tillandsia*), which in places heavily draped the trees, and crimson-spiked "wild pines," which in abundance grew from favorable root-holds on their branches. The high degree of moisture prevailing in this zone of clouds evidently creates such favorable conditions of humidity for these epiphytes that they have adapted themselves to a much lower temperature than they could endure under dryer conditions.

At night, enshrouded by the now chilly mist, we sat closely around our camp-fire discussing the prospects of better weather, when, doubtless through a change in the direction of the wind, by us unnoticed, the clouds with surprising suddenness disappeared, and almost as quickly as one would turn on a light the once ghostly forest was brightly illumined by the rays of a full moon! The effect was thrilling, but when we looked upward through the pines and saw, impressively near, the

snow-crown of Orizaba gleaming brilliantly, serenely in the moonlight, we were overpowered by an emotion which for a moment left us speechless.

The weather had cleared and in a manner which made the experience the most memorable one of our journey. The following morning was cloudless, and as a reminder that we were in the Tierra Fria the mercury stood at 31° and ice formed in pools left by the rain.

When contemplation of Orizaba permitted we could now take some account of our surroundings. The ridge between the barrancas had narrowed again and on each side we could hear the roar of the over-filled streams tearing down their rocky bottoms, 1,500 feet below us.

BIRDS OF THE NORTH

Birds were common, easily observed, and of absorbing interest. One may read of the occurrence of such typically boreal species as evening grosbeaks and crossbills in the latitude of Mexico City without discounting the impression created by actually seeing them there. Brown creepers (*Certhia*), nuthatches (*Sitta pygmæa* and *S. carolinensis mexicana*), chickadees (*Penthestes meridionalis*), water ousels, juncos (*Junco phæonotus*), siskins, ravens, and hairy woodpeckers were other birds of northern origin seen about or near our camp, while robins, bluebirds, and flickers served further to remind us of higher latitudes. More strictly indigenous forms were olive, and red-faced warblers and the large striped sparrows (*Plagiospiza*).

At an altitude of 10,000 feet we passed a group of buildings locally known as El Jacal, the home of a patriarchal goatherd whose family appeared to be almost as numerous as his flocks. Here the traveler from Coscomatepec to San Andres on the table-land could lodge for the night. The trip therefore may readily be made without other equipment than one could carry on his saddle, and I commend it to every one who would leave the tourist trail and come into closer contact with Mexico than is possible near the line of a railway.

At 11,500 feet the last spruces were observed. At their "timber-line" they were still large, vigorous trees and there was no apparent reason why they should not have continued to appear for at least another thousand feet; but, if unseen, the law that controls their distribution was not the less potent. Shortly they were followed by the long-leaved pine (*Pinus liophylla*), and only the short-leaved pine reached the upper limit of tree-growth.

Camp was made at 12,600 feet, in an ill-selected spot, where, after sunset, the wind swept down off the great snow-fields above us and we could actually see the mercury in our thermometer fall. In 30 minutes it dropped 28°—from 48° to 20°—and at 6 o'clock the following morning it registered 12°. Lack of suitable clothing, though we had prepared for reasonably cold weather, and the suddenness of the change gave us, in spite of a camp-fire, a realizing sense of what it means actually to suffer with cold. Six hours later the sun temperature was 112°, and, suffering now from the heat, we endeavored to adjust ourselves to a variation of 100 degrees in six hours.

MASTER OF THE MOUNTAIN

Long before daylight, on this wakeful night, we heard the tread of sandaled feet and the sound of surprisingly cheerful, laughing voices pass on the trail which led up the mountain. Who these people were and where they were going was later explained to us by a visitor, who, armed with an ancient rifle, politely introduced himself as "el dueno de la montaña"—the master of the mountain—and intimated that in the performance of his duty he would be grateful if we could explain to him the object of our visit to this region in which strangers were rarely seen. Were we Germans? he asked. No; from the United States, we said. "Ah, Englishmen," he replied, and we let it go at that.

He was the handsomest, most attractive specimen of native manhood I have ever set eyes on. I had an absurd desire in some way to "collect" him, and only a realization of how sadly out of place he would be far from his own habitat restrained me from the attempt.

His conquest was completed by Patter-

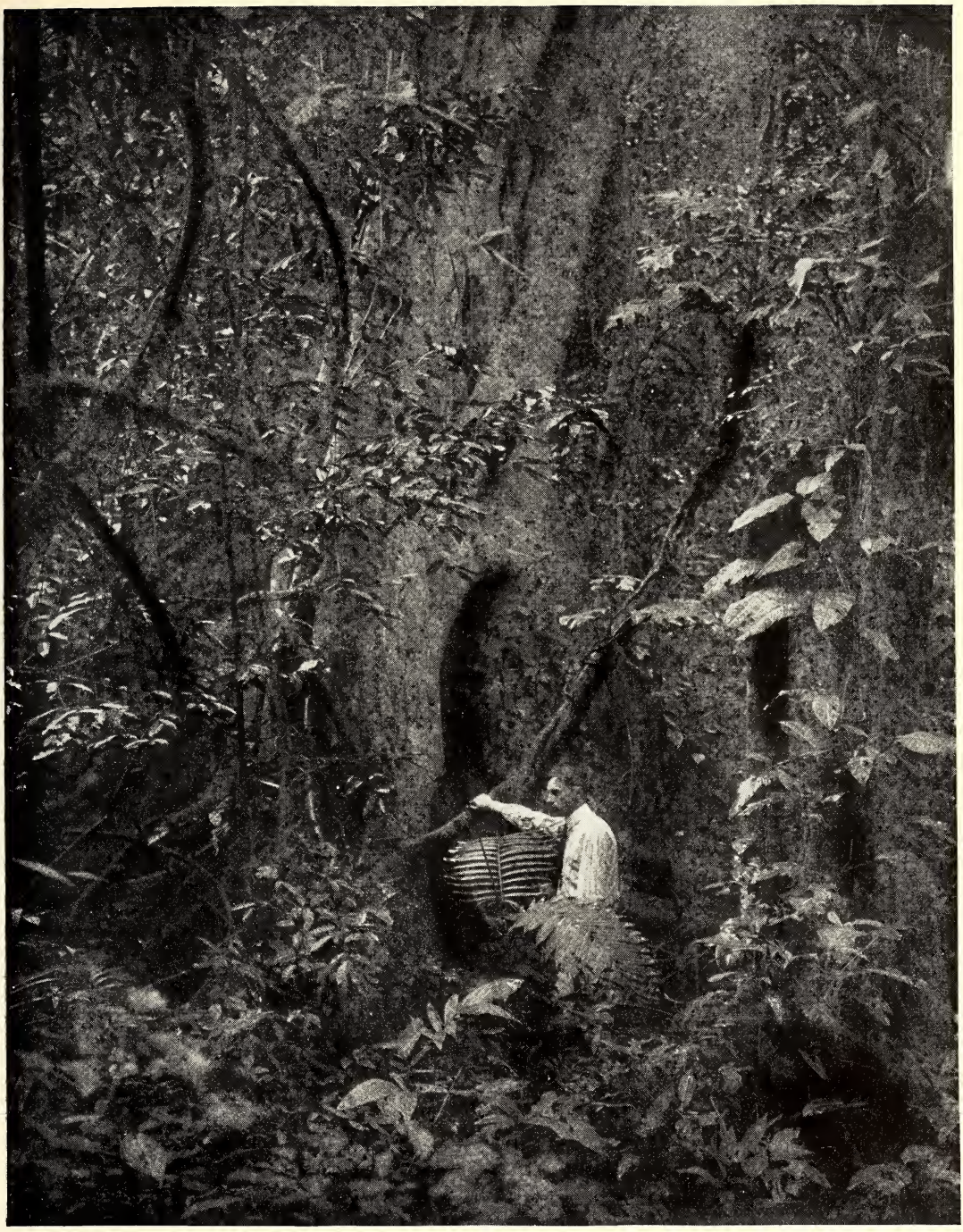


Photo by Frank M. Chapman

SCENE IN THE TROPICAL FOREST NEAR VERA CRUZ AT AN ELEVATION OF 800 FEET

"One can actually stand in a tropical jungle, where parrots, trogons, toucans, and other equatorial birds are calling from the liana-draped trees, and look upward to forests of pines and spruce, where crossbills, juncos, pine siskins, and evening grosbeaks are among the common permanently resident species" (see text, pages 537 and 552).

Photo by Frank M. Chapman

A MOUNTAIN OAK (ALTITUDE, 9,500 FEET) UNDER WHICH WE CAMPED

"We camped in a superb primeval forest of pines, spruce, and oak. The pines (*Pinus montezumæ* and *P. liophylla*) compared favorably in size with those of the California Sierras, while some of the oaks, locally termed '*encimos*,' we estimated to be 130 feet in height, with a basal diameter of 6 feet" (see text, page 551).

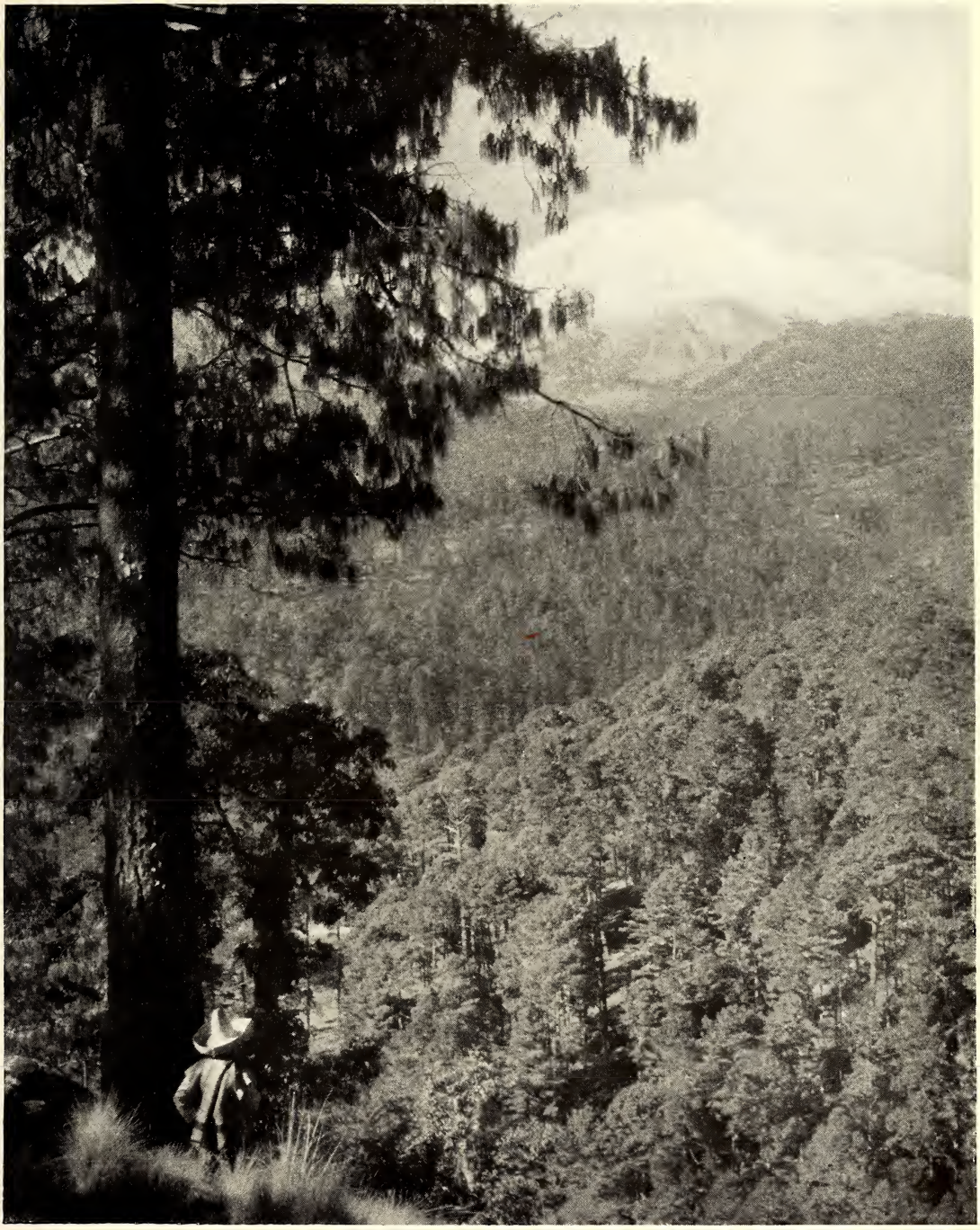


Photo by Frank M. Chapman

IN THE PINES AND HEMLOCKS ON THE SLOPES OF ORIZABA

"The clouds with surprising suddenness disappeared, and almost as quickly as one would turn on a light the once ghostly forest was brightly illumined by the rays of a full moon! The effect was thrilling, but when we looked upward through the pines and saw, impressively near, the snow-crown of Orizaba gleaming brilliantly, serenely in the moonlight, we were overpowered by an emotion which for a moment left us speechless" (see text, pages 551 and 552).

Photo by Frank M. Chapman

ICE MINERS ON ORIZABA: 13,200 FEET

son's flapjacks, and we learned that, representing the owner of the region, his duties were to permit only those to cut wood or mine ice who paid for the privilege. The men who had passed our trail, it appeared, were on their way to the ice deposits near the head of the Jamapa barranca. This cutting of ice near the summit of Orizaba to take to the hot lands at its base is a primitive industry which appeals to one as an eminently practical demonstration of the effects of altitude on climate, and to see it practiced we followed the trail of the cheerful little men from the tropics

Crossing rock-slides where pikas would have been at home, we passed timberline, which on the northern slope of the barranca was at 13,000 feet, but on the southern slope appeared to be at least 800 feet higher. The short-leaved pine was the only tree occurring here, and to the last it stood erect, was symmetrical, and attained a height of about 30 or 40 feet, or about one-half its maximum size.

A CITY'S ICE SUPPLY

Where the barranca narrowed until it seemed a mere crack in the mountain we found a burro staked, and a short distance farther heard voices and the musical sound of cutting ice. We had traced to its source the original "nieve" which a thousand times itinerant peddlers had nasally invited us to "*tome*" (take) in the streets of Cordoba. Cordoba, it is true, is now supplied with artificial "nieve," but Huatusco and other towns to the north not reached by rail still draw on the deposits of Orizaba.

The men were working at an isolated pocket of clear, crystal ice about 100 feet above us. With serapes thrown over their heads for protection from the rays of the sun, and apparently not affected by the altitude, which made us avoid unnecessary exertion, they vigorously chopped out blocks weighing about 75 pounds. With the aid of a lariat these were carefully lowered down the steep

Photo by Frank M. Chapman

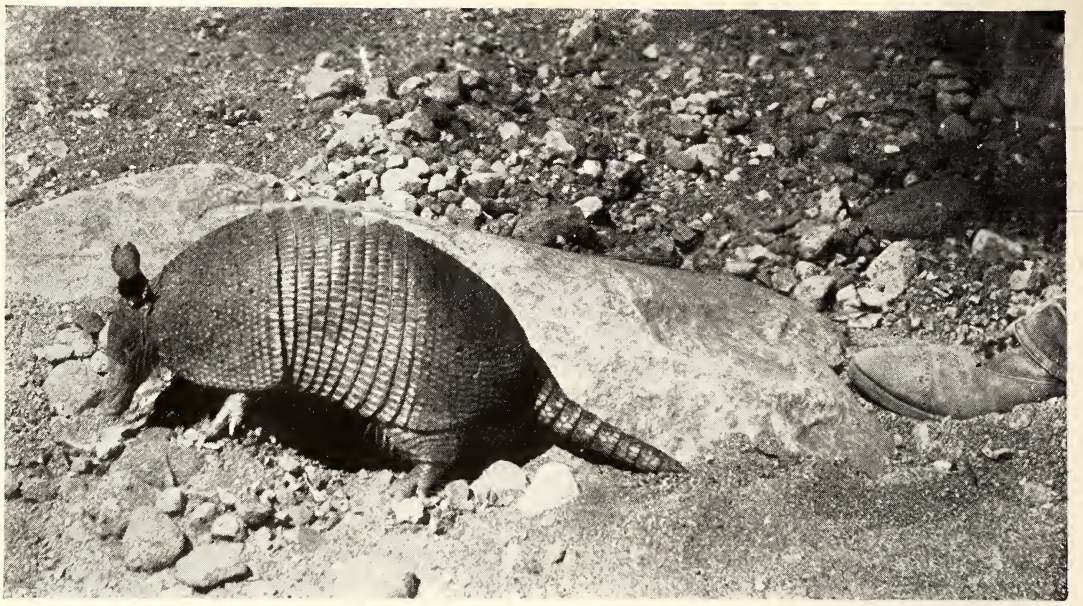
PACKING ICE FROM ORIZABA: A CLOUD-FILLED CANYON BEHIND

decline to the floor of the barranca, there to be wrapped in saccate grass and old serapes.

Late that afternoon these men trotted past our camp, now at 10,000 feet, on their way to the tropics. Each one carried a great cake of ice on his back, and the burro had two. Mentally we followed them in their journey, and the experience was properly rounded when several days later the first sound that greeted us as we stepped off the train at Cordoba was the familiar "tome nieve" of the ice-cream vender.

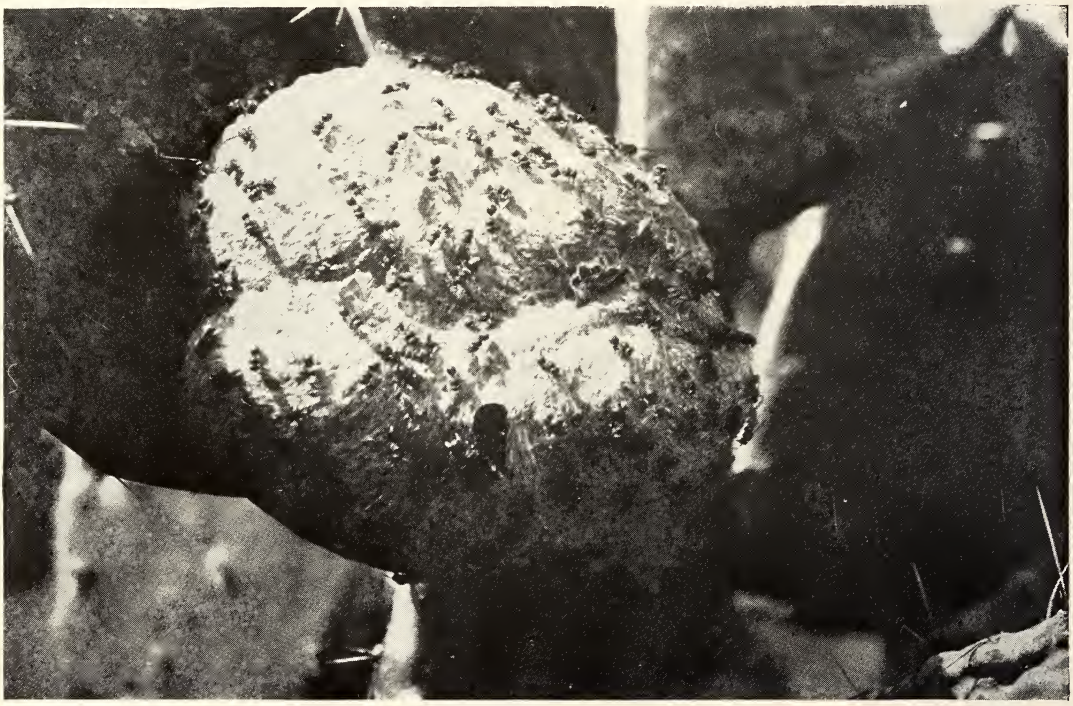
The *dueno de la montaña* assured us that El Pico had never been ascended from this side, thereby quickly extinguishing whatever ambition we may have had to climb to the summit. Our task indeed was finished when we reached the upper limit of life, and with the collections made below we now had specimens of birds, trees, and plants, paintings, photographs, and data with which to construct our proposed Habitat Group of Mt. Orizaba as seen from the Tropical Zone at its base.

In due time this group was completed, and it stands, let us hope, for all time as a not inadequate representation of a mountain which, whether seen from the sea as a sun-kissed cloud, from the lowlands as a sky-piercing cone, or from the pine forests as a massive, glittering dome, always compels the homage we render a great personality.



THE NINE-BANDED ARMADILLO IS COMMON IN MOST PARTS OF MEXICO

Its bony armor is rather a protection against the thorns of the dry country in which it lives than against the attack of large carnivores, which can readily bite through the joints



Photos by Dr. C. William Beebe

PAPER NEST OF MEXICAN WASPS BUILT ON A CACTUS PAD

The insects are small, but very savage, and with exceedingly venomous stings, and if disturbed by a lizard running past will attack one without further provocation

Photo by Dr. C. William Beebe

THE RING-TAILED CAT, OR BASSARISCUS, WHICH PROWLS AT NIGHT ABOUT ONE'S TENT IN THE ARROYOS OF MEXICO

It is somewhat related to the raccoons, but shows close affinity to fossil dog-like creatures which lived in the Oligocene. The tail can be fluffed up until it is as large around as the body.

Photo by Dr. C. William Beebe

THE LONG-TAILED MEXICAN OPOSSUMS ARE MOST ARRANT COWARDS

When cornered, they fall over in what appears to be the extremity of death—limbs stiffened, eyes glazed—and recover only when they think danger is past

Photos by Dr. C. William Beebe

Iguanas in Mexico can be approached closely by a person on horseback, from which position this was photographed. They show how flight may have been initiated in birds by leaping, sprawled out flat, from high trees. Their flesh is more tender and sweet than chicken meat (see also page 545).

The nests of giant tropical orioles, or caciques, in Mexico are pendant structures 3 and 4 feet in length. They are usually built out on the very tips of slender branches, so that they are protected from the attacks of arboreal beasts of prey. Often, as in the above photograph, there is a little subsidiary chamber at the summit, which is used by the male bird as a roosting place when his mate is sitting on the eggs below.

Photo by Dr. C. William Beebe

THE DANDY AMONG BIRDS

The Mexican mot-mot is perhaps the only bird in which the tail-feathers are mutilated by the bird for purposes of decoration after they are full-grown. A portion of the shafts is denuded by the bird, leaving the web at the tips to form a conspicuous racket.

Photo by Dr. C. William Beebe

THE LONG-TAILED CRESTED JAY

Next to the parrots, the long-tailed crested jays of Mexico are the most conspicuous birds at the edge of the table-land. They live in flocks of about twenty and are very noisy. Small birds fear them as they do hawks and for much the same reason, as they are inveterate robbers of nests.

VIEW FROM IXTACCIHUATL, WITH POPOCATEPTL IN THE DISTANCE

Photo from Alberto L. Godoy

Standing guard over Mexico City are the great volcanoes, Popocateptl and Ixtaccihuatl, their summits perpetually covered with snow. From their heights, "the most imposing spectacle of all is the formation of the clouds below you"

A MEXICAN HACIENDA

Life on one of the Baronial Estates of our Southern Neighbor

By J. E. Kirkwood

Professor of Botany in the University of Montana

EXTENDING southeastward from the Rio Grande, between high sierras on the east and west, is the Mexican plateau. About 250 miles in width, this area extends from Juarez to its southern extremity, about a thousand miles. Throughout an arid land, it lies under a clear sky and has few streams and little rain.

Its extensive plains are traversed at intervals by more or less isolated mountain ranges, mostly trending in parallel course with the Sierra Madre, which form its eastern and western walls. The mountains rise from 8,000 to 10,000 feet, but in the interior of the country they appear much lower, owing to the elevation of the plain itself, which increases in altitude from about 3,700 feet at Juarez to over 8,000 feet near the City of Mexico. The topography of this region is very similar to much of that of Arizona, New Mexico, and western Texas.

Though seemingly desolate, the land abounds in life, and the representatives of its fauna and flora occupy places in widely differing families of animals and plants. The country supports, however, a meager and scattered population, which, outside the cities, is concerned chiefly with mining and stock-raising. While physically capable of a larger development agriculturally, this has not been possible under the system of land tenure which now obtains and has existed in Mexico from the early times of the Spanish occupation. The creation of enormous private estates, devoted to mining or grazing, and the domination of large sections of the country by the interests of a single individual or family have greatly hindered the growth of agricultural industry.

FEUDAL AND ARISTOCRATIC

The Mexican estate known as a hacienda is in some respects a remarkable institution. Feudal in its traditions and aristocratic in its management, it reminds one of the old-world baronies of the middle ages. Consistent with political conditions in a country little more than nominally democratic, it is, nevertheless, so at variance with American ideals of liberty and equality that not the least of the interest in the system lies in the fact that such medievalism has flourished at our own doors up to the present time.

The story of the haciendas is one of romantic interest. Each, largely a law unto itself, developed its own institutions, had its life and activities apart from the rest of the State, and to all intents and purposes constituted a distinct social and economic unit.

The writer, not long ago, enjoyed the opportunity of a year's sojourn upon one of these haciendas. This estate, the Hacienda of the Cedars, is 70 miles long by 60 wide, a domain about equal in area to the State of Connecticut. Although much smaller than some of the other haciendas, it nevertheless constitutes a considerable property, being 2½ million acres in extent. From center to circumference is a day's journey or more, and the proprietor, when he visits the outlying portions of his estate, prepares for a journey of days or weeks with coach-and-six and attendants and much of the air of a petty ruler.

The Hacienda de Cedros, or, in more exact terms, the Hacienda de San Juan Bautista de los Cedros (the Hacienda of St. John the Baptist of the Cedars), lies in the northwestern corner of the State of Zacatecas. Mr. Charles T. Andrews, writing of life on a Mexican hacienda, says of this place: "There are several traditions in regard to the early history of the Cedros hacienda. One is that the original grantee obtained the land as a sort of subsidy for a missionary propaganda for 'the conversion of the Indians

Photo by J. E. Kirkwood

PEONS SHELLING CORN ON THE HACIENDA DE CEDROS

Ears are rubbed on blocks made by binding together corn-cobs. "One observing their farming in the outlying districts might imagine himself living in the days of the Pharaohs. The field is plowed with a crooked stick drawn by oxen, with the yoke tied to the horns. Grain is cut with sickle and threshed by the hoofs of cattle, and corn is planted and shelled by hand. Rough and heavy home-made carts or the backs of men or burros are the most common modes of conveyance. The people seem to have no appreciation of improved farming implements. Often when improved implements are provided the laborers they discard them for more primitive methods" (see text, page 573).

and the glory of the church.' There still remains indeed in the archives at Mexico a map of the hacienda with a sketch of the church building he proposed to erect. According to these plans, the sacred edifice would cover about five acres. The result was like some modern schemes for public aid to private enterprise. The promoter got 2½ million acres of land and the church got a building 40 by 60 feet.

"With less pious pretense, but by equally dishonest methods, a second purchaser obtained the property at a later period. For some reason, either through escheat or confiscation, the crown again came into possession of the hacienda and offered it for sale. An official in Mexico, taking advantage of the ignorance of the home government, represented the property as simply a desert waste, very undesirable; but, 'in order to relieve the crown of an unsalable asset,' he magnanimously offered to pay 6,000 Spanish dollars for it as a virtual contribution to the support of the throne, and thereupon received a deed, with the thanks of the monarch for his loyal zeal!"

Some one who knew of the facts as they then were later endorsed the following on a blank page of the deed itself:

"This reprobate son of a degenerate father, . . . knew that besides rich deposits of minerals and large flocks of sheep and goats, the hacienda had at that time 30,000 head of beef cattle, which, to say nothing of the rest, the unmitigated scoundrel got for 20 cents apiece by outright and deliberate lying to his Most Catholic Majesty, the King of Spain."

THE OLD SMELTER AT CEDROS — Photo by J. E. Kirkwood

The slag piles in the foreground and the distance cover several acres. These piles are said to be of considerable value because of the large amount of mineral which the original process failed to extract (see page 577).

The Mexican Central Railroad crosses a corner of this estate at some distance south of Torreon. The station of Camacho, a sun-scorched and wind-swept row of adobe structures, is upon the hacienda, and eastward, over a distant range of mountains, lies the village of Cedros, the capital of this principality. Some 60 miles intervene, however, and to visit it one must proceed thither by horseback or wagon.

Cedros lies on the high border of a plain that reaches leagues long and wide to the west, north, and south. Eastward rises the range of the Potrero. On the horizon to the northeast are the furrowed slopes of the Zuloagas and to the west and southwest the Sierras de Zapoca and Guadalupe.

Thirty miles to the west the Zapocas rise as a mountain barrier along the whole horizon.

ENTRANCE TO CEDROS

Entering the hacienda from the east, this splendid panorama is gradually unfolded to view. When the afternoon sun is low and shadows are mounting the slopes, the slanting rays sweep the wide expanse with a glow of changing color. Rising out of the mountain chain, high above its fellows, stands a lofty peak, with its rugged crest outlined against the glowing sky. Clouds that rest upon it are tinged with gold and crimson and all the brilliant colors of a sunset such as no other land knows. This eminence, known as Pico Teirra, commands the whole of the surrounding country. Dark and rugged to its summit, which lies above 10,000 feet, its somber shadows are deepened by the thin growth of oaks and pines which clothe its higher slopes.

As the morning light strikes across the landscape, the watcher at Cedros may catch the glimmer of white at the base of Teirra, making faintly visible the hamlet of San Rafael. Half way to the peak across the intervening plain two small mountains stand as detached members of a lesser range at its southern extremity. Here a few dwellings comprise the village of Tecolotes, which, with a fortified inclosure and a water reservoir, marks a

station on the wagon road and is 17 miles away, though seeming but three or four.

Far to the northeast the plain reaches level to the horizon. Where the ranges converge in the distance the shifting mirage raises phantom hills which change in the glimmering heat, and *remolinos*—tall, slender columns of dust-laden whirlwinds — glide across the landscape and dissolve from view.

A SMALL CITY

Many small assemblages of huts or houses are scattered over the place and are the homes of small ranchers or herdsmen. In all, about 2,000 people live upon the Hacienda de Cedros. These are distributed about in small groups here and there, where springs may be found or wells dug, or where the configuration of the land makes possible the gathering of the rainfall into reservoirs.

Water is precious, and its relative abundance determines the size of the village and often the nature of its operations. Issuing from the limestone at the western end of the Potreros are a number of fine springs, some warm and others cold, providing for irrigation of the gardens, for the baths, and for household uses. Some supply the long, stone troughs where the herds come to drink. About these springs has grown up the little town of Cedros, and the cottonwoods have grown with it, until across the country their spreading tops are visible afar and almost obscure the white walls of the buildings they overshadow. It is a rare oasis in a wide desert, and grateful shade here beckons the traveler to its restful shelter.

Here all roads lead to Cedros. Tenuous threads of white, cutting the dull green of the distant plain, can be seen converging to this point like the spokes of a wheel. The site, well chosen for strategic reasons, commands its approaches on three sides, while the rough slopes of the mountain lie to the rear. Precautions against Indians and others were necessary in the early days, and parapet and loophole are still visible in the construction of the larger buildings. Though such occasions are less to be expected now, the place is still well adapted to withstand a siege of small arms. The defenses here have somewhat fallen to decay; but at outlying stations some are yet well preserved, as where Cañada Blanca, with wall and battlement, furnishes a place of refuge in the grazing country two days' journey to the west.

The village of Cedros consists of the casa grande, or manor house, with its associated structures, and the church, the dwellings of the peons, a rope-walk (see pages 574 and 575), an old smelter (see page 565) and ore mills, and corrals. Aside from the casa grande and its grounds, the village does not cover more than the space of three or four city blocks.

HOMES OF THE PEONS

The homes of peons are either huddled in groups or scattered about the outskirts, and, though mostly permanent structures built of adobe, they are arranged in no definite order, but are set up wherever chance or the convenience of the builder dictated. Many of the dwellings have small adjoining inclosures formed by a paling constructed of the wand-like branches of the candlewood, serving for garden lots or corrals.

Cheer and comfort are scarcely known to the peons' habitations. They are usually without the luxury of windows, the door serving to admit all the light that enters. The poorer huts have merely a hole in the wall as a means of entrance and exit; sometimes a room adjoining has no exterior opening, but is reached by a hole in the partition.

In these hovels some live, begrimed and hungry, in hopeless poverty. Others of the dwellings are much better. Such may boast some coarse matting and rude home-made furniture and decorations of colored picture-cards and tinsel. In these the dwellers have some regard for cleanliness and a measure of self-respect.

The old church near the center of the village rises prominently above the surrounding structures. Standing upon an eminence, it gives prospect of the country far and near, and is itself first beheld by the approaching traveler. Its portal, shaded by graceful pepper trees, looks

A LANDSCAPE ON THE HACIENDA DE CEDROS Photo by J. E. Kirkwood

The *palma* from which fiber is obtained. "This estate, the Hacienda of the Cedars, is 70 miles long by 60 wide, a domain about equal in area to the State of Connecticut. Although much smaller than some of the other haciendas, it nevertheless constitutes a considerable property, being 2½ million acres in extent. From center to circumference is a day's journey or more, and the proprietor, when he visits the outlying portions of his estate, prepares for a journey of days or weeks with coach-and-six and attendants and much of the air of a petty ruler" (see text, page 563).

out upon the little plaza, witness of its people's life, at work or play. Rugged in its strength and severe in its architectural simplicity, it stands a refuge, spiritual and temporal.

The arched and cemented roof, walled round by a crumbling parapet, the loopholes of which still show, is reached by a flight of steep and narrow steps leading up on the outside. The walls of stone, 4 feet in thickness, are pierced by deep embrasured windows, which, being few and small, light but dimly the appropriately decorated interior. Guarding the entrance to this sanctuary are ponderous doors, whose mortised timbers are studded with huge wrought nails having heads the size of one's palm.

Through the center of the yard a walk of flat stones leads up to the door, where the hollow-worn threshold speaks of the generations of devout people who have come and gone these 200 years. Within a large mural painting depicts the life and death of the martyred priest who long ago ministered to the charcoal-burners at Mazapil. Protesting against the oppression of these poor people, who then were slaves at the hands of their Spanish taskmasters, he aroused the anger of those whose greed he sought to check and lost his life at the hands of hired assassins.

THE MANOR HOUSE

Across the open plaza stands the casa grande. This relic of manorial pretensions of more prosperous days, with the buildings adjoining and appertaining to

A STREET IN THE VILLAGE OF CEDROS Photo by J. E. Kirkwood

On the left the peons' quarters, on the right the garden wall. "The homes of peons are either huddled in groups or scattered about the outskirts, and, though mostly permanent structures built of adobe, they are arranged in no definite order, but are set up wherever chance or the convenience of the builder dictated" (see text, page 566).

it, rambles over several acres of ground. Its front elevation, like that of many other mansions of the land, is innocent of any suggestion of artistic effort, and rises a plain, white-washed wall, broken only by the deep-set and securely grated windows and the heavy doors. It rises 30 feet to the parapet, providing two stories in the main building, though its adjoining structures have but one. Before recent improvements substituted a stronger wall for the old parapet, loopholes were still visible here and there. The doors of the main entrance, like those of the church, are ponderously built of hewn timbers and, being barred, offer effectual resistance to any seeking entrance by force.

There seem to be no available records of the building of this house. A date legible upon one of the beams within is 1731, which appears to be the date of certain repairs. The building, however, in essential respects seems as good as when first built. The lower walls are nearly 4 feet in diameter, though 2 feet, the usual thickness of adobe walls, afford ample protection against the burning heat of summer.

Notwithstanding the prejudice which might naturally arise against sun-dried brick as a desirable or durable building material, they have been immensely useful in many forms of construction over a large part of the North American continent. They came extensively into service, probably, through the force of necessity, where other materials were scarce or difficult to work, but they have abundantly demonstrated their usefulness. It would be difficult to imagine houses better adapted to the hot, dry climate of the plateau than the adobe, properly constructed, which, when well finished, is clean and may be even beautiful in design.

A PRETENTIOUS HOME

Entering the mansion by the main door, a portal large enough to admit a load of hay, one finds himself in a tunnel-like passage leading through to the inner court, or patio. On either side of this passage are doors, and farther on a stairway leads to the upper rooms, though originally they were reached through a trap-door by means of a ladder, which was drawn up at night.

The patio itself, some 60 or 70 feet square, is designed on the simple lines of some of the more primitive and isolated places, and from this court, after the usual fashion, doors open into various rooms. In the center of the patio a well furnishes water for the household, a flower bed occupies a cement basin of ample size, and a grape vine scrambles over an arbor of rude poles.

Entering a door from the passageway, one finds himself in a large *sala*, or parlor, with tinted walls and tiled floor. The tiles, perhaps at one time level, are now uneven after nearly 200 years of use. They are about 8 inches square, hard and smooth of surface. Such formed the chief flooring material in this and other houses of the time. Hewn timbers extend from wall to wall, supporting the floor above. The origin of these and much larger timbers in the construction of the buildings is a matter of some conjecture. Although it is reported that originally a cedar grove of considerable size grew here about the springs, there is at present no evidence that such a stand of timber formerly existed, except the few aged and decrepit junipers scattered along the feeble watercourses.

MUNITIONS OF WAR

A smaller room opening off the *sala* is an arsenal. Rows of Winchesters are stacked along the wall, some of recent, others of older, models; also some ancient muzzle-loading pieces of ponderous weight. Revolvers and pistols of ancient pattern complete the assortment, along with a small supply of drugs and medicines.

Passing out at the other end of the *sala*, one enters a corridor, at the far end of which glazed doors give access to the *huerta*, or garden. Off this corridor rooms open to the right and left, but, as none of these are of special interest, attention may now be turned to the kitchen, entrance to which may be gained from the patio. This room, 20 feet square, is lighted during the day through the open door.

In the center of the room was originally a circular, altar-like structure of stone or adobe, 6 feet across, from which arose a huge conical chimney, supported by several legs forming the sides of as many arches. Upon this bench, prior to the advent of the modern range, cooking was done by the open fire. From the kitchen food was carried by an out-of-door route to the dining-room, there being no connecting passage.

Adjoining the main building a long row of lower structures flanks the plaza. Among the several doors along this row two are noteworthy—one gives entrance to the jail, the other to the wine cellar. The juxtaposition of these two institutions probably was not meant to convey any idea of their logical association, but that one of these sometimes contributed to the other there can be no doubt.

A GREAT WINE CELLAR

The commodious vault of the wine cellar is reached through several outer rooms containing the various appurtenances concerned with the manufacture of wine. Huge fermenting vats built of adobe and lined with cement, each capable of holding several cartloads of grapes, stand close by the press in one of the outer rooms, and in another a still was built close by the steps which lead under a high and heavy archway down to the cellar. The cellar itself, about 100 by 40 feet, is divided lengthwise by supporting arches of the same masonry which figures in the construction of all the buildings.

Along the walls stand rows of huge casks, most of them now empty, but some containing a few gallons of the more recent vintages. Midway of the cellar a well reaches down to a flowing spring, whence water was drawn for uses in connection with the winery. As indicated above, not only fermented, but also distilled, liquors were manufactured here,

Photo by J. E. Kirkwood

LECHUGUILLA PLANTS (THOSE HAVING NARROW LEAVES) AND CACTUS ON THE HACIENDA DE CEDROS

This and page 567 show the typical vegetation of the region. The *lechuguilla* is about 18 inches high. "Two kinds of fiber are produced in large quantities. One is from the leaves of a yucca-like tree commonly called by the natives *palma*, and the other goes usually by the name *lechuguilla*, and is derived from a small relative of the century plant, exceedingly abundant throughout the northern half of the Republic. The fiber is soft, pliable, and strong and is much used for cordage, matting, bags, etc. Some of the fiber is manufactured locally, but the most of it finds a market in New York and other foreign ports" (see text, page 577).

wine and *aguardiente*, a kind of brandy, being the chief products.

From the wine cellar one may enter the garden pertaining to the casa grande. This garden, about 40 acres in extent, is surrounded by an adobe wall 10 feet in height, forbidding entrance to those not of the casa. Given somewhat to arbors in the vicinity of the house and to walks roughly paved with cobblestones, where are also fig and pomegranate trees, cottonwoods and pecans, the larger part of this extensive garden was formerly utilized in the growing of grapes.

MOVING A GARDEN

We are told that the earth of this garden is not its original soil, but was carted onto the area to provide the necessary conditions for the growing of crops, and the story has at least the appearance of truth, inasmuch as the soil within is different from that immediately without the garden wall and resembles the alluvium of the plain below. This light and dusty soil is heaped into ridges inclosing small areas for the purpose of irrigation, made possible by the presence of a small stream which enters the inclosure and supplies a small reservoir surrounded by tall canes. The overflow from this tank never goes very far, but is quickly absorbed by the thirsty ground; only when the gate is opened does the stream suffice to reach the most remote limits of the vineyard.

Following one of the rudely paved walks leading from the casa, one descends a gentle slope to a high-walled inclosure. A low gate, swinging on rusty hinges, admits to a wide hall extending to right and left, from which, opposite the entrance, steps lead down to a large bath. Through an arched portal at the foot of the steps one may pass out into 5 or 6 feet of water in a pool about 30 by 50 feet. A ledge 2 or 3 feet wide surrounds

Photo by J. E. Kirkwood

UNLOADING FIBER AT THE HEADQUARTERS OF THE HACIENDA DE CEDROS

Peons work for months at distant stations on the property and are paid per kilogram when the fiber is delivered

the basin and connects with the broader landing on the side of the entrance. This bath is supplied by the same spring that passes beneath the wine cellar, the waters of which are led thither by a tunnel 100 yards long under 15 feet of earth and stone. This bath is cold, but another at some distance is warm and was a favorite resort. It also is inclosed by high walls and barred doors.

The village of Cedros holds about 500 souls and the casa grande is the center of its life. The "Large House" has always been the center of hacienda life. The establishment of the old haciendas upon the lines of a feudal barony was doubtless agreeable to the owners; but there were then, and also until recent years, conditions throughout the country which not only justified such a scheme of social organization, but made it a practical necessity. Unsettled and lawless as the land then was, infested by Indians and marauding bands of thieves, possession of the land was not only nine points in favor of the contestant, but the whole of the argument. It then behooved the proprietor of an estate to fortify himself and to secure his property against all who would wrest it from him.

MASTER AND SERVANT

To such, therefore, as he could offer protection and employment he came to be in the nature of a master, and such as enjoyed his favor and protection became identified with the property and attached to it as vassals. The law prohibiting a peon's leaving an estate while in debt to it practically made him a fixture, and this law, being still in force, makes his condition today little different from that of former times, though peonage has nominally been abolished.

Wages of the Mexican peon are about 37 cents a day, Mexican currency. Such wages practically insure his perpetual dependency and make it difficult or impossible for him ever to become independent of the property upon which he was born. This condition, which may be regarded as typical of a large section, if not of the

Photo by J. E. Kirkwood

STRIPPING PALMA FIBER

The central leaves of the cluster are soft and useless; such are rejected, as seen in the foreground. "The fiber is stripped from the leaves of the plants by hand. The leaves are long and narrow and the fibers extend from end to end. A workman seizes a leaf, lays it across a block of wood under a heavy dull knife, which is pressed upon the leaf as it is drawn through, and thus parts the fiber from the pulpy tissue. The leaves of the *palma* must be softened by steaming before they are stripped, but those of the *lechuguilla* may be cleaned at once" (see text, page 579).

Photo by J. E. Kirkwood

A GROUP OF LARGE CACTI ON THE HACIENDA DE CEDROS, 4 TO 5 FEET IN HEIGHT

whole of the country, is not compensated for by the fact that his wants are few and easily satisfied.

The peon is not ambitious; he is apathetic. But he has known no better life, and the lack of incentive to effort renders his mental and moral elevation a matter of greater difficulty than it otherwise might be. Taking into account the generations of servitude to which he has been subject, it is not strange that he evinces no regard for the morrow, except as a time to which all disagreeable things should be postponed, and no concern for any interests other than those of the immediate present.

THE CHILDISH PEON

He is essentially a child and is to be treated as such. His salvation is not in higher wages, which would soon be squandered, leaving him in worse condition than before, but first in education of the right sort, which will give him an outlook upon life and an incentive to effort. At the time when the writer knew Cedros it had just passed from the control of its Mexican owners into the hands of an American company, whose interest in the property was mainly in the exploitation of guayule, a small rubber-bearing tree of the desert. With the advent of the new management an effort was made to improve the condition of the peon and the quality of his service by the payment of higher wages, with the result that he worked less than he did before and no more often than was necessary to eke out a subsistence.

The people of the hacienda have little opportunity for education and rarely receive any instruction worthy of the name. A little teaching of the merest rudiments by instructors whose own education is exceedingly meager, with a dearth of books and a dark hovel for a schoolroom, is a fair representation of their educational opportunity; yet many of these people have large capacity for education and are eager to learn.

That the interests of the country would be better served if they were given reasonable educational opportunity seems obvious; but the status of the peon, historic and economic, militates against his receiving the consideration which he deserves.

Mixture of Spanish and Indian blood is common among the peon population. Many of these people are clean, intelligent, and industrious, but the reverse is more frequently true. In the small community at Cedros, where both extremes and many intermediate conditions obtain, it is pleasant to remember an acquaintance with a family of the better sort.

It would be difficult to find more genuine courtesy and refined taste than was habitually shown by the members of this household. They were comparatively uneducated, but their spirit and manners were apparently actuated by an innate sense of delicacy and propriety. And we found others of the same sort whose manners would put to shame many boasting higher education and culture.

DIVISION MANAGERS

For business management the large hacienda is divided into fractions (this hacienda into seven *fracciones*), over each of which an officer, *caporal,* presides, who administers his district and is responsible to the owner, or representative of the owner, the *administrador.* The peon labor is in charge of a *mayordomo,* who assigns the men their tasks, supervises their work, and gives account to his chief.

It is hardly necessary to say that the operations of a hacienda in their character and extent are controlled very largely by the natural resources of the region occupied. Mining, farming, and stock-raising are the principal enterprises of the haciendas on the plateau, while exploitation of native plants yielding fiber, rubber, liquors, etc., are also operations of importance in many places.

In most instances where the management of such business is in the hands of the Mexican and has not passed under the control of more progressive people, the methods employed are of the crudest sort. One observing their farming in the outlying districts might imagine himself living in the days of the Pharaohs. The field is plowed with a crooked stick drawn by oxen, with the yoke tied to the horns. Grain is cut with sickle and

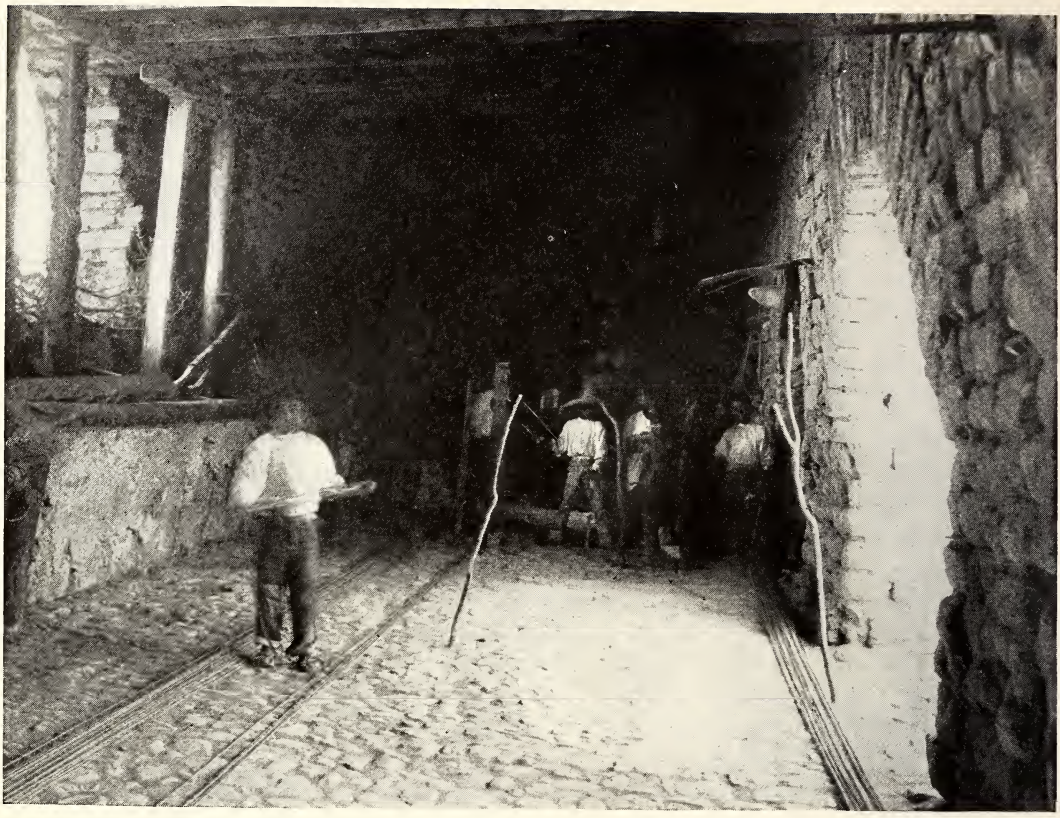


Photo by J. E. Kirkwood

ONE END OF THE ROPE-WALK AT CEDROS (SEE PAGE 584)

In this first picture the boys are in position to manipulate the spinning apparatus. One is winding a bobbin. In the picture on page 575 the spinners, the rope yarns, and the loom are seen.

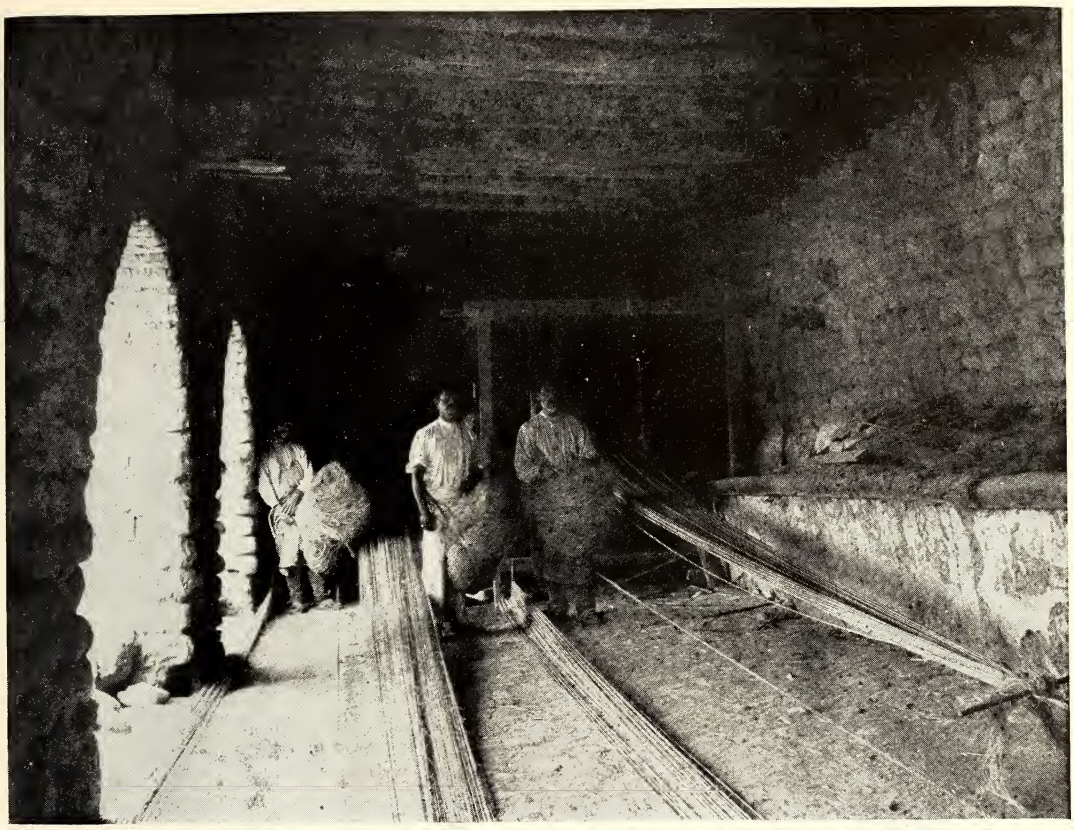
threshed by the hoofs of cattle, and corn is planted and shelled by hand. Rough and heavy home-made carts or the backs of men or burros are the most common modes of conveyance. The people seem to have no appreciation of improved farming implements. Often when improved implements are provided the laborers they discard them for more primitive methods.

The principal agricultural crop of the region is corn, but small grains, beans, squashes, and a few vegetables are also raised. Corn is the staple cereal for the poorer classes, furnishing material for tortillas and tamales; beans, chilis, and onions are easily grown and form some of the chief elements of the Mexican's diet.

MEXICAN CROPS

All of these crops are matured in the short season of the summer rains. July and August can usually be depended upon for heavy showers at not distant intervals, and the drainage of the uncultivated ground is so managed that the run-off is directed over the fields, which thus receive not only the rain which falls upon them, but also that which falls upon a considerable area of the adjacent land. Plowing and seeding are done mostly in July, and October is the month of harvest.

The fruits produced in this region from the few trees growing in the better-watered situations are the fig, pomegranate, avocado, grape, quince, and some inferior apples. One of the most common of the fruits of the country is the *tuna,* the fruits of the cactus of the prickly-pear kind, which grows to immense size and is a feature of almost every well-ordered garden and door-yard. There are a number of varieties of this fruit, most of them being larger than a hen's egg and



THE OTHER END OF THE ROPE-WALK Photo by J. E. Kirkwood

"By means of a string passed over the wheels a boy keeps them in rapid revolution, while the spinner, carrying a bundle of fiber suspended at his waist, backs away toward the other end of the walk, feeding out the fiber slowly to form the rope yarn, a hundred feet or more in length. These yarns may then be twisted into ropes or fed into a rude wooden loom, operated by foot power, and woven into matting" (see text, page 584).

purple, red, or yellow in color. This fruit is largely a food of the poorer class of people, who use it fresh or preserved. Pecans are largely planted for their nuts and for the ample shade which their crowns afford.

THESE DESERTS SUPPORT VAST HERDS OF CATTLE

On the haciendas of the plateau the business of stock-raising is one of the most important and one to which the natural features of the country are best adapted. Though semi-desert in its character and with few springs and fewer streams, yet large herds of animals are raised on these vast plains.

At the time of the transfer of Cedros to its American owners it was estimated that the hacienda supported a half million head of live stock of various kinds. So scant is the growth of grass in this land, however, that one is not impressed with it at sight as a stock range, but the stock get much of their forage from leaves and twigs of many species of woody plants in which the place abounds.

The problem of water supply is a serious one and is solved by the construction of numerous *represas*, or *tanques*, in which the drainage of the surrounding slopes is collected in the rainy season. These tanks are often many acres in extent and the water fills the shallow basin to the depth of 15 or 20 feet. A tank is formed by throwing a dam of earth or masonry across a valley at a convenient point, thus forming a reservoir into which are gathered the waters drained from a considerable area. In this way the herdsman makes good the lack of streams, for there is usually water retained in these

Photo by Shirley C. Hulse

MAIN DAM OF THE MEXICAN NORTHERN POWER COMPANY PROJECT AT BOQUILLA, NEAR SANTA ROSALIA, CHIHUAHUA

This huge project was forced to shut down in September, 1913. because of interrupted railroad communication and the impossibility of bringing supplies to the work. It had for a long time previously been the one construction work of size going forward in Mexico. This project will ultimately deliver electric power to the rich mining district of Parral, 50 miles to the south.

tanks throughout the dry season. If the tanks are located in the vicinity of steep drainage areas, they are likely to become silted up in a few years, thus necessitating an increase in the height of the dam or the selection of another site for a new one.

MINING PROPERTIES OF GREAT VALUE

Many of the haciendas are mining properties of great value. Copper, silver, and lead are the most abundant products. The mountains of the region are richly mineralized, and here and there on a high crest may be seen the outward evidence of the more or less extensive operations going on within the mountain. Some of these mines were worked by the early Spaniards and are still productive. On the Naranjéra property, at San Pedro Ocampo, the hill is honeycombed with pits and galleries from which in the early days ore was taken without science or system, except as the richness of the rock indicated the most profitable direction for the expenditure of effort. The work is now carried on under modern methods.

In the village of Cedros stands an old smelter, typical of the methods formerly in use. It was built of adobe and the fuel used was charcoal, probably produced at Mazapil. Huge piles containing a half million tons of slag are close at hand, and contain, it is said, precious metals abundantly sufficient for a resmelting, so crude was the process then employed. The plant was also equipped for crushing the ore, as indicated by the presence of two large overshot wheels, supplied with water from the hillsides by means of a high aqueduct, the arches of which are still standing.

The ore was brought for miles on the backs of burros or in carts from the 150 mines formerly in operation on the hacienda. As no mines of any consequence, however, occur within 10 miles of this site the amount of labor involved in these operations was enormous.

On the opposite side of the village is a large inclosure, with extensive buildings, concerned with mining operations of a different sort. Though long in disuse, some of the old arrastras, or rude mills of stone for crushing ore, still stand, and the paved court and the old furnaces bear witness to the extraction of silver in former days.

EXTRACTING SILVER

An early traveler in Mexico cites the method then in use as involving first a thorough crushing of the ore by means of a heavy rolling stone, water being added in the meantime to form a thick paste. The paste was finally removed to an open square and deposited in circular beds about 10 feet in diameter. Salt or salt earth was then sprinkled over it, with a little pulverized pine bark or manure, and it was then thoroughly mixed by treading with horses or mules and allowed to stand three or four days. It then received a mixture of magistral and quicksilver in considerable quantities, was trampled as before, left for a day and trampled again, and so on from day to day until the metals were fully amalgamated. The mass was then transferred to an elevated vat and the water drained off. Water was afterward added in large quantities and the whole mixed until the amalgam settled, when it was filtered through canvas and made into triangular bricks, which were set up with spaces between under a copper bell. Charcoal was then heaped upon the bell and ignited. After 12 hours of heating the mercury and silver were separated and the latter removed pure.

FIBER PLANTS

But Cedros is no longer a mining hacienda. Other interests have superseded, and in late years the Campania Ganadera y Textil de Cedros represented stock and fiber as its chief sources of revenue. Fiber-bearing plants are one of the natural resources of the country, and the amount of fiber shipped from this hacienda alone amounts to over 90 tons annually.

Two kinds of fiber are produced in large quantities. One is from the leaves of a yucca-like tree commonly called by the natives *palma,* and the other goes usually by the name *lechuguilla,* and is derived from a small relative of the century plant, exceedingly abundant throughout the northern half of the Re-

LABORERS ON THE BOQUILLA PROJECT

Photo by Shirley C. Hulse

With the exception of about 100 foreigners, the population of Boquilla was entirely Mexican, and the Mexican village numbered at times 7,000 people, of whom half or more were employed on the work

AN AMERICAN GIRL IN MEXICO Photo by Shirley C. Hulse

Peggy loved to jump "Rosey" over anything in the way of ditches or arroyos that he could be made to tackle

public. The fiber is soft, pliable, and strong and is much used for cordage, matting, bags, etc. Some of the fiber is manufactured locally, but the most of it finds a market in New York and other foreign ports.

The fiber is stripped from the leaves of the plants by hand. The leaves are long and narrow and the fibers extend from end to end. A workman seizes a leaf, lays it across a block of wood under a heavy dull knife, which is pressed upon the leaf as it is drawn through, and thus parts the fiber from the pulpy tissue. The leaves of the palma must be softened by steaming before they are stripped, but those of the *lechuguilla* may be cleaned at once. It is a common sight to see great cartloads of this pale yellow fiber drawn into Cedros, where it is weighed out and the men paid according to the amount produced.

The articles made from these fibers are strong, firm, and compact, though somewhat coarse and rough. They are such articles as one sees everywhere in Mexico—articles very well adapted to the purpose for which they are intended. A kind of heavy matting, much used for floor covering in offices and similar places, serves its purpose well. Besides these articles, the fiber is used in the manufacture of various kinds of cordage, and much of it finds its way into brushes, of which a great variety may be found, both of home and of foreign manufacture.

THE ROPE-WALK

In one of the long buildings at Cedros is an old rope-walk. Here a part of the fiber of local extraction is manufactured. The machinery consists of three wooden posts, in which are set small wooden

Photos by Shirley C. Hulse

The company had, from Boquilla to the neighborhood of Santa Rosalia, a private railroad, and, owing to the conditions, it was impossible to restrict the riding of the people on this line. The Mexican peon rides on a railroad, should the opportunity offer, in much the same spirit that a six-year-old child rides in an elevator, and at times the company's traffic was seriously interfered with by the number of the passengers.

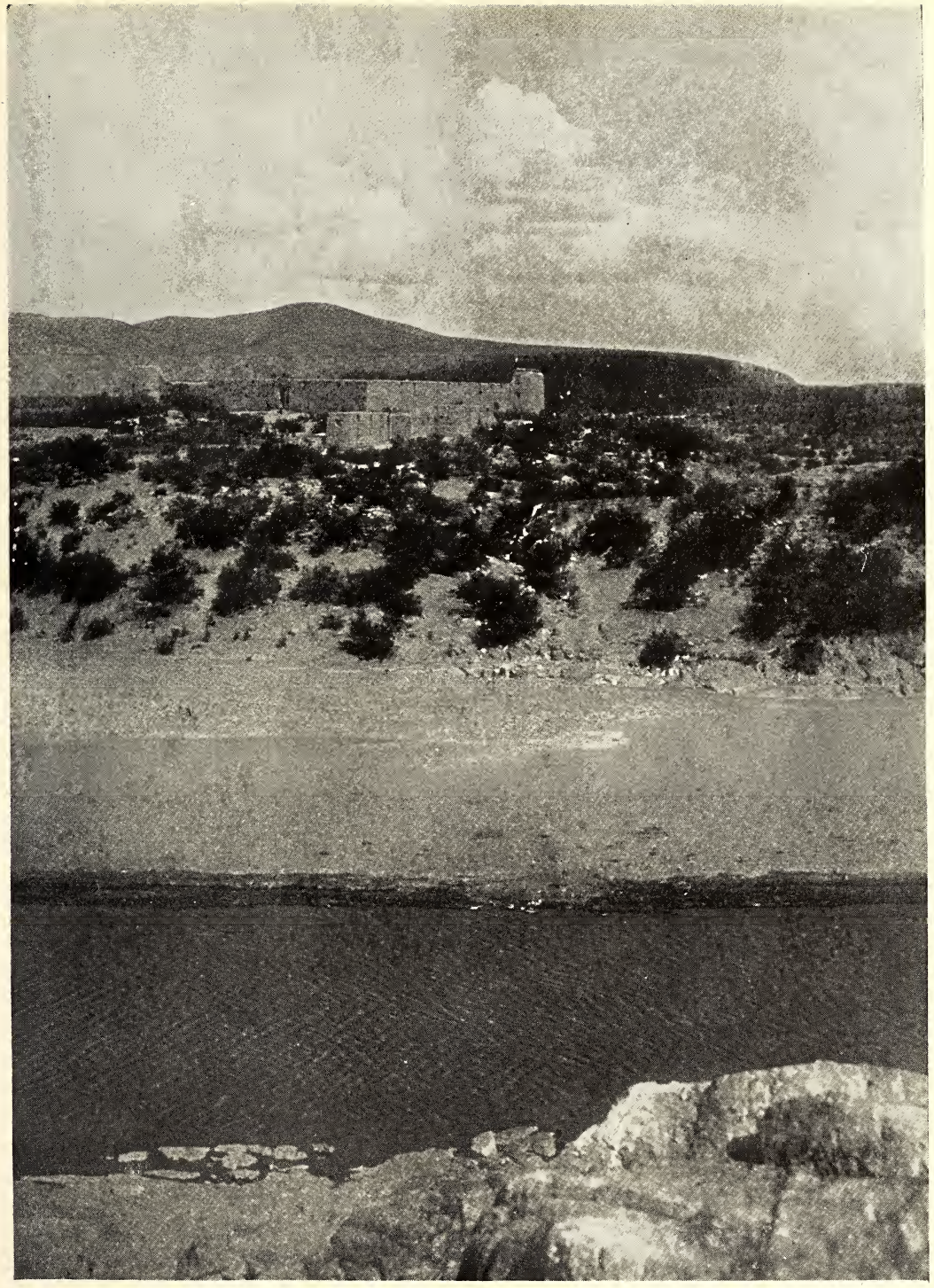


Photo by Shirley C. Hulse

AN OLD MEXICAN RANCH AND FORT NEAR SANTA ROSALIA, CHIHUAHUA

This ranch, which has lately been submerged by the waters of Lake Conchos above the dam at Boquilla, is said to have had a very stirring history as an Indian fort. The patriarch of this ranch had never heard of a camera nor a photograph and he was utterly at a loss when permission was asked to take his picture. At first he was made very nervous by the presence of the camera, but after everything had been explained to his satisfaction he was quite willing to pose for his picture, and his final comment on photography was, "Who could do such wonderful things but God or an American."

Photo by Shirley C. Hulse

CHARACTERISTIC SCENE IN THE MEXICAN STATE OF CHIHUAHUA, WHICH IS DIRECTLY SOUTH OF EL PASO, TEXAS

Goats are raised in very great numbers all through the barren parts of Chihuahua, and they thrive where nothing else, except possibly a burro, could pick up a living. They are valued for their milk and for their skins, which go by thousands into glove leather. The holes along the foot of the bank have been made by the goats licking at a salty stratum in the earth.

Photo by Shirley C. Hulse

THIS MEXICAN GIRL WAS FOR SEVERAL YEARS NURSE AND DOCTOR'S ASSISTANT AT BOQUILLA

She attracted the doctor's attention by her interest in the affairs of the hospital, and, from an ignorant, untrained beginning, she came in time to take full charge of the doctor's work during his illness or absence. She has upon occasion successfully performed surgical operations, herself giving the anesthetic, with no help but that of a mozo. She was absolutely cold-blooded and unfeeling in her handling of patients, perhaps to their ultimate benefit, and she has been suspected of slyly working off personal grudges upon the persons of certain sufferers on the operating table. This was, however, merely in a spirit of mischief and consisted only in getting an occasional harmless yelp and wriggle from the victim. In common with many of the Mexicans, she was exceedingly clever with her pencil, and she copied from American fashion-plates and made for herself clothes which would have done her credit on Fifth avenue itself. Also, she was the personification of meekness and industry, and it is to be hoped that she is a fair illustration of Mexican possibilities, granted the opportunity to learn and to advance

wheels revolving at right angles to the direction of the walk. The posts are set at one end of the walk, with the axle of one of the wheels in each post projecting through in the direction of the walk, so that a wisp of the fiber may be attached to it.

By means of a string passed over the wheels a boy keeps them in rapid revolution, while the spinner, carrying a bundle of fiber suspended at his waist, backs away toward the other end of the walk, feeding out the fiber slowly to form the rope yarn, a hundred feet or more in length. These yarns may then be twisted into ropes or fed into a rude wooden loom, operated by foot power, and woven into matting.

There grows extensively over the tableland a small desert tree, less than 4 feet in height, with silvery, grayish leaves. It grows often as the dominant plant over considerable areas of the calcareous foothills, where it gives an aspect to the vegetation similar to that of the sage-brush areas of our western plains. This plant is widely known as the *guayule*, and its product, a kind of rubber, has been an item of large commercial interest in central Mexico during the last decade.

Although it was known long ago that the plant produced rubber, its profitable extraction has been a matter of only recent years, and now on many of the haciendas the cutting of *guayule* is a thriving and remunerative business. The plant is generally uprooted, regardless of conservation principles, bound into bales, and shipped to factories in the cities. About 10 per cent of the dry weight of the tree is gum, which is separated from the tissue by grinding and extraction by solvents or by mechanical agencies.

THE DAYS OF THE HACIENDA ARE NUMBERED

Various other activities of greater or less magnitude and importance are features of the hacienda life, much as they have been since the first settlement of the country. Where the railroads have penetrated and foreign capital has entered, they feel to some extent the influence of the world's progress and the march of events. At the best, however, they are isolated and provincial, living in the distant past, preferring old customs, manners, and dress, and tenacious of indolent habits, the rich and the poor alike.

The days of the old haciendas are numbered. Such institutions cannot long resist the pressure of the times. Capital is insistent for opportunity where there is profitable investment. Colonization enterprises in different parts of the country have already secured large areas and divided them into small tracts. Revolutions can only temporarily delay such development.

The best leaders of the Mexican people are realizing that one of the great needs of the nation is the free use of the land and the building of homes. Whatever the outcome of the present strife, there awaits a period of reconstruction in which the disposition of the hacienda must have a large share.

Mr. Robert E. Coker's article, "Wealth of a Rainless Coast," noted on pages 514 and 515, was originally scheduled for this month's issue, and the pictures given to the engraver some months ago, to be printed with the bird series in colors. In view of the great demand for information about Mexico, it has been deemed expedient to temporarily withhold Mr. Coker's interesting article to admit the Mexican material.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE HOME OF A FORGOTTEN RACE

Mysterious Chichen Itza, in Yucatan, Mexico

BY EDWARD H. THOMPSON

FORMERLY U. S. CONSUL AT MÉRIDA, YUCATAN

THE ruined group of Chichen Itza, on the Peninsula of Yucatan, Mexico, covers a space of fully 3 square miles. Over all this wide territory are scattered carved and squared stones in countless thousands, and fallen columns by the hundreds, while the formless remains and outlined walls of huge structures fallen into ruin are seen on every side.

Seven massive structures of carved stone and adamantine mortar still tower erect and almost habitable. Their façades, though gray and haggard with age and seamed by time, sustain the claim that Chichen Itza, in the Americas, is one of the world's greatest monuments of antiquity.

The heart of most of the cities of antiquity was a castle or temple; in this great American monument the heart was a castle and a temple—both in one.

As this is a popular descriptive article, rather than a technical one, I shall try to restrain my always present desire and inject only enough figures to give adequate conceptions of size and distance.

A terrace as broad and level as a plain is raised 10 feet or more above the surrounding surface, built up with rubble and finished with a lime cement—hard, white, and durable. On this man-made plain was built, among other structures, a pyramid of nine terraces (see page 586), each faced with inlaid paneled stonework and well finished.

On each of the four inclined faces of this pyramid a stairway was built 111 feet long and 28.7 feet wide, with 104 steps rising from the base-level up to the crowning platform.

Each of the four angles of the pyramid is formed by the undulating body of a great stone serpent. Descending from the crowning platform, each undulation of the body marks a gradient, a terrace plane, while on each side of the northern stairway a serpent head, with wide-open jaws, carved from a single mass of limestone, rests on the plane beneath. A strong man cannot hope to lift the smallest stone that goes into the making of this serpent body.

THE CASTLE TEMPLE

All this is simply of the base, the preparation for and the leading up to the building proper, the Castle Temple (see page 586). This temple is not large, measured by the standards of the present day, or even by that of those ancient builders. Like the heart of the human body, it was not large but important.

Built on the level platform that crowned the pyramid, it is itself only 43 feet by 29 feet, with a narrow level space around it on the platform's outer edge barely wide enough for two to walk abreast in safety.

Photo by Edward H. Thompson

THE GREAT PYRAMID TEMPLE OF CHICHEN ITZA, IN YUCATAN, MEXICO

"On the roof are ornaments of carved stone cut in curious angles and placed like battlements. These probably served as shelters to the fighting men and protection to the priestly watchers of the stars and planets as they traced the celestial orbits and read the omens this revealed" (see text, pages 585 and 587).

On the north, facing a few degrees east of north, is the Ceremonial Stairway, with its two great serpent heads leading up the pyramid to the entrance of the sanctuary.

Thick stone pillars, fashioned always in the conventionalized serpent form, sustain the carved and paneled façade above the entrance to the outer corridor and inner chamber, the sanctuary of the temple. In the semi-gloom of this sanctuary are two square pillars of stone, each supporting massive twin beams of thick sapote wood richly carved. These in their turn help to support the strange triple-vaulted roof of the chamber (see page 588). Sapote wood, like the East Indian teak, is as strong and almost as durable as stone.

Wooden beams, stone pillars, and entrance posts are all carved in low relief (see page 589). Symbols and human figures, some in mask and bearded, and all clothed in ornate regalia, with strange weapons and the flowing plumes of the quetzal, cover their paneled surfaces.

The symbol of the feathered serpent—the body of the rattlesnake, covered with the plumage of the quetzal bird—was to this old civilization what the Cross was to the Christian and the Crescent to the Saracen.

Under this symbol the culture hero *Kuk-ul-can* (Feathered Serpent) of Yucatan, *Quetzacoatl* of the Aztecs and earlier people, was first reverenced, then deified and worshipped.

Most of the carvings on stone surface were painted, but the wooden lintels, carved or plain, were apparently dull finished in their own natural color—a rich red brown.

On the south, east, and west a single high-vaulted but narrow chamber was formed [-shaped, with sapote lintels and carved doorways facing each of the stairways.

Large serpent masks, each flanked by sunken paneled squares, are the only ornaments of these three façades, and, except that on the western façade, are placed directly over the entrances. The mask of this western façade is several feet to the south of the entrance.

This was not a random work, neither did the conformation of the structure make this lack of symmetry a necessary fault.

Is it true that the ancient builders of the East were wont to leave one stone missing or one carving misplaced in an otherwise perfect work because only the Supreme One should produce perfection?

On the roof are ornaments of carved stone cut in curious angles and placed like battlements. These probably served as shelters to the fighting men and protection to the priestly watchers of the stars and planets as they traced the celestial orbits and read the omens thus revealed.

THE HOUR OF SUNRISE

The writer stood upon the roof of this temple one morning last December just as the first rays of the sun reddened the distant horizon. The morning stillness was profound. The noises of the night had ceased and those of the day were not yet begun. All the sky above and the earth below seemed to be breathlessly waiting for something—just waiting. Then the great round sun came up flaming splendidly, and instantly the whole world sang and hummed. The birds in the trees and the insects on the ground sang in a grand Te Deum.

Nature herself taught primal man to be a sun-worshipper, and man in his heart of hearts still follows the ancient teachings.

A gentle breeze sprang up, and then he seemed to be upon a sea-bound rocky promontory, high above all things. The calm sea surface stretched away to where the sky-line met it, and there they fused into an opalescent something, seemingly born of the union of a rainbow with the white sea-foam.

The sun rose higher and the sea of mist dissolved into nothingness. In its place was an ocean of verdure, with a foam of bright blue flowers, the bloom of the jungle morning glory. As he descended the steps worn by the sandal tread of a thousand years, he thought: "Can this world show a more beautiful sight?"

From the northern edge of the level terrace at the base of the temple pyra-

Photo by Edward H. Thompson

IN THE SEMI-GLOOM OF THIS SANCTUARY ARE TWO SQUARE PILLARS OF STONE, EACH SUPPORTING MASSIVE TWIN BEAMS OF THICK SAPOTE WOOD, RICHLY CARVED

Sapote wood, like the East Indian teak, is almost as strong and durable as stone. Note the warrior with his elaborate head-dress carved on the column (see page 587)

Photo by Edward H. Thompson

WOODEN BEAMS AND ENTRANCE POSTS ARE ALL CARVED IN LOW RELIEF

"Wooden beams, stone pillars, and entrance posts are all carved in low relief. Symbols and human figures, some in mask and bearded, and all clothed in ornate regalia, with strange weapons and the flowing plumes of the quetzal, cover their paneled surfaces" (see page 587).

mid a raised causeway, 25 feet wide and macadamized, extends northward 300 yards or more to the Sacred Well.

THE SACRED WELL INTO WHICH PRISONERS AND MAIDENS WERE THROWN

This was the Sacred Way, and in times of pestilence and drought solemn processions of priests, devotees with offerings, and victims for the sacrifice wound between the snake-head columns down the long, steep stairway of the temple and along the Sacred Way to the dreadful Sacred Well (see page 591). The weird music of the flute and the shrill notes of the whistle mingled with the droning boom of the sacred drum as the priests, the devotees with their offerings, and the nobles grouped themselves on the brink of the well.

Then from the platform beside the shrine the offerings from far and near were tossed in, and finally the prisoners of war and beautiful maidens, drugged with the sacred ambrosia Balche, were thrown into the jade-colored waters as expiatory offering to an offended deity.

Could this deep old limestone water-pit, the Sacred Well, be given a tongue and made to tell what it had seen, what world romance could equal it!

Several hundred feet to the west of the Castle Temple, and on the same terrace with it, rest two great parallel moles of solid masonry (see page 592), each 275 feet long, 34 feet wide, and 25 feet high.

Between these moles is the Ceremonial Court. This level cemented space was probably the theater for the performance of certain rites and games of a ceremonial character, like the Aztec game dedicated to Tlaloc.

This belief is borne out by the fact that at a distance of 6 feet from the level upper surface of the mole two great rings of stone were firmly fixed by means of tongues into the perpendicular wall surface directly opposite each other.

One of these rings had either fallen out of its place by its own weight, or more probably was dug out by native honey seekers, and now lies prostrate, but whole, on the ground beneath. The other yet stands out boldly from the sheer wall surface, and the entwined serpents carved on its annular faces are still clearly visible.

To the north and south of these great moles are the half-ruined remains of two small temple structures (see page 594). Shrine-like, they seem to guard the entrance to the Ceremonial Court; but they themselves, their carved walls and columns time worn and beaten, are fully exposed to the wear of the elements.

THE TEMPLE OF THE TIGERS

On the southern end of the eastern mole rests an edifice, like a casket holding jewels, that in time, as the fact becomes known, will be in itself the object of distant pilgrimages.

It is known as the Temple of the Tigers (see page 595) from the zone band of handsomely designed, artistically executed jaguars that, alternating with shields, ornaments the southern face.

Of course, it is understood that the term "tiger" is a misnomer as applied to the great Felidæ in America; the jaguar and not the tiger is meant. The term "tigre," meaning tiger, was probably first carelessly given by Spanish adventurers to the jaguar from Asia, and the name was thus wrongly perpetuated in America.

The entire front of the Temple of the Tigers has disappeared. Fractured and wedged apart by the growing tree roots at the apex of the roof, the overweight of the richly carved façade toppled it over into the space beneath, where it still lies in a formless mass.

Two large serpent columns, with open jaws and bulbous teeth, are still in place. These once helped to sustain the fallen façade, and probably served as the massive fulcrum that tossed the mass of stone and lime free from the platform in front down on the level floor of the Ceremonial Court. These, like all the other serpent columns, are carved in the conventionalized crotalid shape and covered with the conventional quetzal plumes.

The square end pilasters of the outer entrance to the inner chamber are entirely covered with sculptures in low relief. Like those upon the pilasters and columns of the Castle Temple, the prin-

Photo by Edward H. Thompson

THE SACRED WELL INTO WHICH PRISONERS OF WAR AND BEAUTIFUL MAIDENS WERE THROWN

Could this old limestone water-pit, the sacred well, be given a tongue and made to tell what it has seen, what world romance could equal it!

Photo by Edward H. Thompson

THE GREAT PARALLEL MOLES OF SOLID MASONRY WHICH FLANK THE CEREMONIAL COURT

"This level, cemented space was probably the theater for the performance of certain rites and games of a ceremonial character, like the Aztec game dedicated to Tlaloc" (see text, page 590)

cipal motive on each panel is a human figure elaborately costumed and brilliantly painted.

MAYAN MURAL PAINTINGS

The wall surface of both chambers bear traces of having been once covered with mural paintings. Those on the walls of the outer chamber have become entirely obliterated by the erosive action of the elements. Those on the walls of the inner chamber are in part obliterated by the excreta of bats, and still more by the vandal hand of man.

Enough yet remains to make this little chamber the repository of the best-preserved examples of the mural paintings of this ancient Maya race at present known.

The best-preserved portion represents a battle scene. The attacking party, with atlatls, spears, and shields, are seemingly assaulting a city or some large center. Above the battlefield can be seen tier upon tier of houses, and amid them are women in agonized postures, looking down upon the fighting warriors.

To one side is the symbolical figure of *Kuk-ul-can*, with lightning-like yellow flames issuing from his mouth, the sign of defiance and also of war. Many other scenes and portions of figures are depicted, but the battle scene is the clearest of them all at present. The figures are done in a clear, easy style, vigorous and true.

Belonging to this same temple, but on a lower level and built against the eastern wall, is a chamber 22 feet long by 10 feet wide and 15 feet high.

The front of this chamber also is destroyed, and in practically the same way as that of the upper chamber. A portion of the end walls and a large part of the rear still remain upright (see page 596), and the superb wall sculptures they hold upon their surface are fortunately still left for study and comparison.

Clear-cut features, well-worked details, artistically executed and well carried out, show the skill and spirit of these ancient artists. The carvings clearly represent the performance of some religious rite or ceremonial dance. Entwined about the series of masked and conventional figures are the serpent symbol, that of the sun and apparently that of rain and water.

Description is nearly useless in such cases as this; only photographs or drawings can adequately represent the work.

The figures were originally painted in the conventional colors, with the ever-present deep red background.

Portions of the two richly carved square pillars that once helped to sustain the fallen front, and between them a rigid conventionalized "tiger," seemingly a kind of ceremonial seat, complete all that is now visible of this chamber.

Half ruined as it is, the Temple of the Tigers is a treasure and a boon to students of the Maya civilization.

A MAYAN PRISON

South of the Temple of the Tigers lies the beautiful little structure known to the natives as the Chichen Chob, the Prison (see page 598), probably the most perfect existing unit of ancient Maya architecture. The pyramid supporting and the stairway leading up to it are almost intact, the angles and faces of the edifice itself almost perfect.

Within the chambers some of the wooden cross-beams are still in place, the mural paintings on the hard-finished walls are evident, although nearly effaced; but the long band of well-carved hieroglyphics that extend entirely across the wall opposite the doors is as perfect and delicately clear as if carved but yesterday.

To the southeast lies the Round Tower (see page 600), a strange structure, unique in plan and outline. This edifice rises like a turret, 40 feet and of equal diameter, from near the center of a terrace, 20 feet high, 220 feet long by 150 feet wide.

HUMBOLDT'S SURPRISE

Its purpose is at present unknown; but from its construction, annular chambers, winding stairway, and the position of its outlooks and outlets I believe it to have been an observatory, an edifice devoted to the study of the celestial bodies. It is known that the ancient American calendar system was so accurately developed

Photo by Edward H. Thompson

ONE OF THE TWO SMALL TEMPLES WHICH SEEM TO GUARD THE ENTRANCE TO THE CEREMONIAL COURT (SEE PAGE 590)

Photo by Edward H. Thompson

THE TEMPLE OF THE TIGERS

The band of handsomely carved jaguars, alternating with shields, can be discerned near the top of the building (see page 590). "Half ruined as it is, the Temple of the Tigers is a treasure and a boon to students of the Maya civilization" (see text, page 593).

Photo by Edward H. Thompson

THESE SUPERB WALL SCULPTURES REPRESENT THE PERFORMANCE OF SOME RELIGIOUS RITE OR CEREMONIAL DANCE

that Alexander Von Humboldt was for a time incredulous of its native origin.

The learned ones, the wise men among these people, were astronomers, not mere star-gazers, and there are those among the Mayas at the present day that have a surprising native knowledge of the celestial geography, as well as of curious properties of certain roots and herbs on the earth beneath.

The present conical form of this edifice, the shape of its chambers, and above all the peculiar inner stairway winding around a solid center, have caused the natives to call it, in their vernacular, "The House of the Snail," and this name in its Spanish dress clings to it now. As the *Caracol* (Snail) it is best known to the people of the region, and under this name it is shown to the curious and the visitors from afar.

THE "NUNNERY"

Nearly half a mile to the south of the Castle Temple rises the majestic pile of the "Nunnery" (see page 602). How far this name accurately indicates the original purpose of the edifice is not known; but we do know that among these ancient people a certain social organization existed, resembling in a modified form the societies of monks and nuns.

How much or how little of truth is in the name we may not know, but the edifice itself is probably the most ancient of all the structures now standing. How old no one knows; but the fact is evident that the central portion of the structure was old and time worn before the pitted surface and dulled angles were buried in the plastic mass of the newer masonry. Then in time this, too, was hidden under the present walls, new and clear lined then, but now gray and seamed by time and the elements, and this is a land where the ice never forms, the frost never rises, and dryness is more evident than dampness or moisture.

The façades of these later portions of the great mass of stone and lime are wonderful examples of carved stonework and ancient American symbolism. I doubt if, taken as a whole, their equal exists. The photographic views show this in a measure, and only in a measure.

The true beauty of the carvings and the perfect proportions of the structure can never be fitly shown until the debris that now hides the base and destroys the true symmetry of the edifice is removed. This work should be done by competent direction under supervision of the government.

Two small one-storied edifices, in the nature of detached wings, are on the right and left of the building proper.

One, known as "La Iglesia" Church, is still quite perfect, and the symbolical figures encrusted on its richly worked façade have long been objects of study to the student and of curiosity to the profane.

The other is a still smaller structure of ordinary design and no apparent points of special interest.

A wide, steep stairway, with the very narrow steps and risers common to the work of sandal-wearing people, leads up to the important second story. This portion of the structure sets back from the face of the lower one, thus leaving an open level space of some 30 feet wide, broken in front half way by the stairway leading up to the third story.

The lateral northern face of this upper second story has two true entrances into perfect chambers and four large recesses in the front walls that are either blind doorways or once true entrances into chambers formerly existing in the original structure, but later filled up to make a solid foundation for a third story directly above. When this was done the doorways remained as simple niches, and over these a flying buttress (see page 603) was thrown as a stairway to the newer structure above. This is my hypothesis, subject to modifications that future investigations may make necessary.

The stone lintels over every entrance, existing or blind, built into this face of the end walls are covered with handsome, still legible glyphs. Clearly legible indeed, but as unreadable as a sealed book.

Undeciphered and mysterious, they are the pleasure and despair of those who seek to solve the problems that they hold.

Photo by Edward H. Thompson

THE PRISON OR CHICHEN CHOB, PROBABLY THE MOST PERFECT EXISTING UNIT OF ANCIENT MAYA ARCHITECTURE (SEE PAGE 593)

All the chambers within this second story of the edifice have within the wall spaces opposite the entrances various niches about the height of the entrances, but narrower. None, even the smaller chambers, have less than two, and the long, narrow middle chamber on the south face has five.

These may have been doorways, originally giving entrance into the primitive structure, closed when the central portion was made into a solid core; but various circumstances, among them being the presence and position of the recesses in the walls of the end chamber, cause me to throw aside this hypothesis. To me they have all the appearances of having been true niches.

THE RECORDS OF THIS ANCIENT PEOPLE WERE DESTROYED BY THE SPANIARDS

They give, in the mind of the student of these old structures, the appearance of having been repositories. Perhaps within these niches were stored the rolls of parchment, the folded books on deerskin and agave paper, the plans and records, and all the written lore of this city of the Maya wise men, the "Itzaes."

Who knows but their contents formed part of that funereal pyre of ancient Maya literature made by the zealot, Bishop de Landa, on the Mani common.

De Landa, seeing on these old rolls of deerskin and volumes of maguey paper signs that he could not read and symbols that he could not understand, concluded that they were cabalistic signs of a diabolical nature, and caused them, together with many other objects of inestimable value to science, to be destroyed by fire on the public square in the Pueblo de Mani.

At that time the old chroniclers tell us there were destroyed 5,000 idols of distinct forms and sizes, 13 altar stones, 22 stones, carved and of small sizes; 27 rolls of ancient hieroglyphics on deerskin, 197 vases of all sizes and patterns, and many other unrecorded objects.

An ancient Spanish chronicler states naïvely that the natives who witnessed the destruction by fire were much afflicted and made a great outcry of woe.

Is it to be wondered that they made a great outcry of woe? They saw not only the sacred things calcining in the fervent heat, but also the written lore, accumulated knowledge of their race, going up in smoke and red cinders. Naturally the thinking ones among them "made great outcry."

Around the corners and on the unbroken portions of the smooth, hard finish in the recesses are traces of broad red, blue, and green bands forming the paneled outlines for the detail figures within. On the ceiling in places are still the fragmentary outlines of houses, trees, city walls, and nondescript animals.

On the inner walls of the eastern end chamber can be clearly seen the impress of the "red hand," another of the unsolved problems.

The third upper story is small and presents the idea of incompleteness, although its state of ruin prevents the last word being said until excavation and investigation have taken place under some competent person.

The last and least important of the seven structures yet standing is the so-called "House of the Dark Writings." The structure is a huge one-story edifice. Large forest trees grow over its flat roof, and were it not for its vertical wall faces of well-carved stone one could easily believe that he was treading the primeval forest floor.

The name, *Akab tzib*, House of the Dark Writing, was given to it by the natives because in the gloom of an inner chamber can be seen a lintel of stone, covered with glyphs and having on its under surface a seated figure in the act, apparently, of offering up some kind of burnt sacrifice.

This ends the list of the still existing structures; but the wonders to be seen prostrate and those hidden have not yet been mentioned.

We have not mentioned the sepulchers of the high priests, 90 feet beneath the crown of the pyramid, 50 feet in the solid rock; the rock carvings; jaguars carved on the ledge surface; the great natural well from whence this ancient city received its water supply; the caves, with their prehistoric defenses, stalactites, grottoes, and pools of clear, cool

Photo by Edward H. Thompson

THE ROUND TOWER WHICH WAS PROBABLY THE ASTRONOMICAL OBSERVATORY

"From its construction, annular chambers, winding stairway, and the position of its outlooks and outlets, I believe it to have been an observatory, an edifice devoted to the study of the celestial bodies. It is known that the ancient American calendar system was so accurately developed

water—these and many other things we have the desire to depict and describe, but time and space forbid.

WHEN WAS THIS CITY FOUNDED?

How old is this great city of stone-built temples and myriad carvings? For years we have sought among its fallen columns and toppled walls for that which would tell us clearly of its age.

To a certain extent the search has not been in vain. We have found a tablet of stone covered with hieroglyphs, and among them are signs that fix a date, an epoch. Keen minds and trained are now at work on the tablet, and the time may not be far distant when we shall know whether it be 2,000 years old or less, as some students claim, or over 11,500 years, as claimed by Le Plongeon.

The margin between the two "guesses" is certainly wide enough.

Meanwhile, like the Sphynx in the East, the gray, old human faces carved high on the massive walls gaze down unchangingly, unmindful of modern man and his futile guesses.

We have perhaps more information on the early history of this ancient group than we have of any other center of the Maya civilization.

But as that keen scholar, the lamented Dr. Thompson, was fond of impressing upon his pupils, "Gentlemen, information may or may not be facts, and unless it be of proven facts is not knowledge." Even "information" concerning these ancient builders and their buildings is only too scanty, and actual proven facts still more so.

THE LEGEND OF CHICHEN ITZA

The earliest information concerning Chichen Itza is given in a curious document found by Don Juan Pio Perez, a Yucatan scholar and antiquarian, among the dusty old records and archives in the Town Hall of Mani.

The document commences thus: "Lai u tzolan katun lukci ti cab ti yotoch Nonoual"—I might continue on in this way for some time, but all might not understand the text as clearly as could be wished. In fact, the fear of a sudden rupture of relations between writer and reader induces me to forego, and in place give a broad interpretation of the ancient writings in those parts where allusion is made to Chichen Itza.

Translated, the document commences thus, the brackets being my interpolations:

"This is the series of epochs that elapsed from the time of their departure from the house of Nonoual in the land of Tulapan.

"Then took place the discovery of Bacalar. Sixty years they ruled in Bacalar, when they came here.

"During these years of their government of this province of Bacalar occurred the discovery of Chichen Itza. 120 years they ruled in Chichen Itza, when they left it and went to Champutun, where the Itzaes, holy men, had houses.

"260 years reigned the Itzaes in Champutun, when they abandoned it and returned in search of their homes.

"For several epochs they lived in the woods and the caves, under the uninhabited hills.

"After forty years they returned to their homes (Chichen Itza) once more, and Champutun knew them no more.

"Two hundred years they reigned in Uxmal, Chichen Itza, Mayapan. The governor of Chichen Itza (Chac xib chac) was deposed because he murmured disrespectfully against Tunac-eel, the governor of Mayapan. Ninety years had elapsed, but the tenth of the 8th Ahau was the year in which he was overthrown."

The unknown native writer keeps on; but I will stop, as he mentions Chichen Itza no more.

Neither the name nor the history of its writer is known; but from the perfect command of both the native vernacular and the Spanish letters it would seem to have been the work of an educated native and written within a few decades after the conquest. This would not be strange, for many bright young natives, sons of the nobles and of the reigning families, were taken by the church or by high lay officials and educated in Spanish learning.

Thus Caspar Antonio Xiu, the lineal

THE MAJESTIC PILE OF THE NUNNERY

Photo by Edward H. Thompson

"The true beauty of the carvings and the perfect proportions of the structure can never be fitly shown until the debris that now hides the base and destroys the true symmetry of the edifice is removed. . . . The stone lintels over every entrance, existing or blind, built into this face of the end walls are covered with handsome, still legible, glyphs. Clearly legible indeed, but as unreadable as a sealed book. Undeciphered and mysterious, they are the pleasure and despair of those who seek to solve the problems that they hold" (see text, page 597).

Photo by Edward H. Thompson

OVER THESE A FLYING BUTTRESS WAS THROWN AS STAIRWAY TO THE NEWER STRUCTURE ABOVE (SEE PAGE 597)

descendant of the last king of Mayapan, was taken, baptized, and educated by Montejo, the conqueror of Yucatan and its first governor.

THE ANCIENT MAYAS HAD THEIR BARDS AND STORY-TELLERS

The ancient Mayas, like most other races, had their bards and story-tellers, who interwove into their songs and tales the history of their people.

Thus, I repeat, it is not strange if some educated native filled, like the gifted Tescucan Ixtlilxochitl, prince and writer, with the desire to perpetuate the fading history of his people, had recourse to the device of writing out, as his memory served, their early wanderings and ancient history, and then, with native subtlety, to hide the documents under those longest filed away and in archives likely to be safe and undisturbed until times far later.

There is a legend of Chichen Itza that has seemingly more of the material of true history in its making than legends are usually thought to have. At all events, it is genuinely romantic and worth repeating.

THE LEGEND OF CANEK

Canek, the impetuous young ruler of Chichen Itza, was deeply in love with a beautiful maiden, daughter of the ruler of a distant province. No longer were his thoughts on the coming hunt of the jaguar; the wild boar passed grunting and unharmed, even unnoticed, as the young ruler sat musing on a fallen log. A fawn, chased by the hunters, became

entangled in a snare close beside him as he sat motionless, happily musing. Seeing that its big, soft eyes were like those of the maiden he loved, he loosed its bonds and set it free.

In the midst of his amorous musings, as he sat in his chamber one day, a dust-covered runner came up to the palace entrance and rattled the sounding shells before the curtains for instant entrance on the ruler's service.

The news he brought drove the young ruler to desperation.

The Batab of a neighboring province, and one far more powerful than he of Chichen Itza, had married the maiden that Canek was to take to wife.

For a while no raging jaguar robbed of his mate was more furious than young Canek; then of a sudden he grew quiet, cool, and seemingly calm.

So his warriors remembered to have seen him when they fought an old-time enemy, killed his fighting men, and defaced his temple, and they patiently waited.

The night came and with it a brooding norther. Darkness as black as the hate in the heart of Canek was all around the silent ranks of the swiftly moving warriors. The lightning flashes, as sharp and hot as the anger that flamed in the Canek's breast, played over the glinting points of crystal on the moving forest of lances as they neared the enemy's city.

The ever-burning flames on the top of the distant temple gleamed redly, and black smoke went heavenward in increasing volume as the priests burnt great baskets of copal in honor of their ruler's marriage.

Canek and his silent warriors came swiftly onward, melting into the darkness of the shadows, hiding from the lightning flash, leaping ahead like deer when chance offered. Revelry had taken the city with all that was in it and held it hard and fast. Even the watchers were drunkenly grumbling over the fate that kept them out of the carousals and in the darkness. As the black and moving shadows reached them swiftly they soon were quiet and out of the darkness for evermore.

THE INTERRUPTED MARRIAGE

And the deer-eyed woman—a wife, yet still a maiden—was she happy? Oh, who knows! It may be that her eyes were not pain shadowed; that it was but the dim light of the wild wax tapers in the narrow vaulted chamber, and it may be that which glistened on her drooping lashes was but the flashing of stray light beams from between the entrance curtains. Who knows?

Merry were the wedding guests and well drunken most of them. More than merry was the bridegroom, who drank the deepest of them all. His brain was sodden, his limbs rebellious, but his tongue, though thick and clumsy, still responded to his call.

Sodden brain and clumsy tongue worked together as he mumbled loudly:

"As for the Lord of Chichen Itza—poor lean dog—let him take his pleasure howling at the moon tonight! Before I seek my wife's caresses in her many-curtained chamber, I must hear a lively song. Ehen! Holcanes! Tupiles! lift your voices and rattle out the battle song."

Drunkenly mumbling, stupidly fumbling, he rolled on his side and fell asleep.

At the holcanes' call the tupiles started the great war song of the Mayas—"Conex. Conex Paleche" ("Come on, come on, ye warriors").

The voices that commenced it were well known, though drunken and quavering; the voices that joined in it and ended it were strong, full, and shrilly menacing. Abruptly the drunken voices ceased and some ended with a groan.

The deer-eyed woman, alone in her curtained chamber, heard the voices and the singing, and then the strangeness of the tumult drove her to the carved stone entrance. Before she reached it the shells were rattled and the curtains parted swiftly. "Star of the night! Star of my life!" said Canek.

"My Lord Canek," said the maiden, with startled eyes, but star lit.

Dead men, live men, and the live men dead in drunken stupor, what could the few with senses unbenumbed do against

Photo by Edward H. Thompson

A PAGE OF STONE THAT NO MAN MAY YET READ

"How old is this great city of stone-built temples and myriad carvings? For years we have sought among its fallen columns and toppled walls for that which would tell us clearly of its age. To a certain extent the search has not been in vain. We have found a tablet of stone covered with hieroglyphs, and among them are signs that fix a date, an epoch. Keen minds and trained are now at work on the tablet, and the time may not be far distant when we shall know whether it be 2,000 years old or less, as some students claim, or over 11,500 years, as claimed by Le Plongeon" (see text, page 601).

Photo by Edward H. Thompson

PHOTOGRAPH OF A HUMAN HEAD CARVED IN STONE: PORTION OF A RICHLY CARVED WALL SURFACE RECENTLY DISCOVERED AT CHICHEN ITZA

All the rolls of parchment and books on deerskin and agave paper, all the plans and records and the written lore of the mysterious city, Chichen Itza, were burned by the Spanish zealot, Bishop de Landa. When he saw the Maya symbols that he could not understand, he concluded that they were signs of a diabolical nature and caused them, together with many other objects containing Maya records, to be destroyed by fire on the public square of the city (see page 599).

the silent fury of Canek and his fighting men?

Never again did Chichen Itza know its Lord Canek, nor any of his band of fighting men. In the passing of a night they vanished, the Lord Canek and the soft-eyed maiden, the stolen bride of the drunken one.

Time passed. The lord who won a bride, but did not learn to keep her, lived his life, died, and was forgotten.

The memory of Lord Canek lived on in song and story and became a part of the legends of Chichen Itza.

THE LOST IS FOUND

One day, long after, a hunting band from Chichen Itza went toward the south—some days' journey. Young men they were and full of rashness, so they kept on the chase until the lane grew hilly and higher, and at last rose into the very clouds. Wonderingly, they turned homeward, journeying over a strange country, until they reached a lake of shining water, and in the lake an island city, with houses and temples and the carved fronts of many buildings like their own Chichen Itza.

From this island city warriors came and met them and led them to the waiting ruler and his aged wise men.

"Who are you, presumptuous ones, that you dare to come unbidden on our land and unwanted to our city?" asked the Batab in stern menace.

The young man spoke bravely, coolly: "We came from our home, Chichen Itza, and have wandered here unbidden because in the chasing of the deer we went farther than we knew; and, finding pathways right before us, we kept on, thinking to find old friends or make new ones."

The ruler turned and took counsel with his wise men, then said to the waiting hunters: "If your tale be true, that you are of Chichen Itza *and not of another province,* you will indeed find here old friends new made—old friends and new as well.

"This is the city of Tayasal, whose lord is Canek, who once was lord of your own Chichen Itza, the City of the Sacred Well."

This is the legend. The substance is as told by the good old, but very dry, chronicler, Padre Cogolucco. I confess to have taken this skeleton and put a little flesh on here and there, just to round out the form—a little brown and red, just to give a local coloring, and so produce the true general effect; that is all. But perhaps I had better have left it as the ancient priestly scribe tells it; "quien sabe"—who knows?

Not all of the tales of Chichen Itza are prehistoric or legendary.

Far later, chronologically, than the legend of Canek, a proven fact, with only a small portion of "information" embedded in it, is furnished us, and brings us down to the historic times of the early Spanish conquerors, when they were in deadly struggle with the fearless Mayas.

MONTEJO WELCOMED

In 1525-1526 Montejo was weary with his long and seemingly fruitless struggles against the native Mayas. Constantly buffeted by his countless enemies and having no place of refuge, he found himself in imminent danger.

The overlords of the provinces near the coast, known by the name of *Cheles* (bluebirds), were in a way friendly to the Spaniards, and Montejo found his way toward them. The other Indians, seeing that the Spaniards were headed coastward and thinking that they were seeking to return from whence they came, did not seek to fight or in any way annoy them; thus the Spaniards arrived safely at the home of the *Batabs Cheles.*

These received them hospitably and, in response to the petition of Montejo, allowed them to find a safe asylum at Chichen Itza, then governed by a vassal chief, Cupul.

Upon their arrival, Cupul, according to a native document, "The Narrative of Nahum Peck," said to them:

"Stranger lords, take your rest in these halls," and they did; they made themselves very much at home, after the manner of the Spanish conquerors of those days, even before they had fairly earned the proud title.

For a time the Indians bore the burdens that their guests put upon them with meekness, but at last they rebelled at

having to be the providers and burden-bearers for such lusty feeders and poor paymasters, and then their actions soon put the Spaniards in a serious plight.

Finally, besieged and almost without provisions, they took advantage of a stormy night after a brave sortie to deceive the Indians. One by one they deserted the edifice used as their garrison and stole away in the darkness, to unite and make for a more friendly haven.

DOG, ROPE, AND BELL

It is said that to deceive the Mayas into thinking that they were there they tied a dog to the rope of a bell and placed food in front, just beyond his reach. His frantic efforts to get at the food rang the bell at frequent intervals, while the constant bark aided the supposed deception of the Mayas, and when at last the ruse was discovered the little band of Spanish soldiery was nearly out of the enemy's reach.

Thus runs the chronicle, and the story may be true; but, knowing, as the writer does, the character and customs of the direct descendants of these same old Maya warriors, he does not believe it. It is far more probable that these Mayas, desiring to be quickly and peacefully rid of their burdensome guests, shut their eyes to the going of the Spaniards and would have been the more obliged to them if they had taken the bell and the dog along with them as well, and so left the besiegers to enjoy their early slumbers undisturbed. The discreetly dropped eyelid, that is almost a wink, and quickly changes into a blindness, is an artful act as ancient as the human race. In many respects the logic of the native Maya is peculiarly his own, but in many other ways his acts and artifices are as old as man himself.

ELOQUENT SILENCE

The writer has often been asked, "After one has visited the ruins of the Old World, is it worth while to visit those of the New World?"

He has had as visiting guests scientists of other lands, men with the wonders of Italy, of Egypt, and India fresh in their memory, inquisitive, incredulous, but desiring to see what there was to see.

As these great, lonely monuments loomed up before their vision, he has noted the quick, surprised intake of the breath, the change of color even, and then—a speaking silence far more eloquent than any words could be.

The American people should awaken to the fact that they have right at home, at their very doors, architecture essentially American, as it were, ruined structures every whit as interesting, as massive, and possibly as old as those of other lands, whose boast it is that the Americans must come to them, for "America has no ruins."

Within these mysterious ruins—American ruins—are great books, with pages of stone, writ in characters that no man may yet read. Are the mysteries they hold, the wonderful facts, that certainly lie sealed and mute within them, hidden from us, less interesting to Americans than are the tales of Egyptian dynasties, the rites of Druids, Roman campings, or Saxon raidings? I think not.

Photo by B. F. Langland

STONE SAILS AT GUADALUPE, MEXICO

Tradition has it that certain sailors who thought themselves lost in a storm vowed to the Virgin that if she would deliver them they would drag their mast to the top of the hill at Guadalupe and set it up as a memorial to her protecting power. They were delivered and fulfilled their vow, building sails of stone around the mast to protect it.

Photo by B. F. Langland

THE CHAPEL OF THE WELL AT GUADALUPE

When, according to tradition, the Virgin appeared before the Indian, Juan Diego, and ordered him to gather flowers on the desert Tepeyac Hill to carry to the Archbishop as evidence of the apparition, a bubbling spring burst forth beneath her feet. This chapel is over that well. It was built by the devout people, the women of the best families serving alongside the peons in the construction work. It is said that whoever drinks from this well must perforce return to Mexico.

Photo by B. F. Langland

A MEXICAN BEGGAR

The beggar population of Mexico has always been a numerous one, in spite of rather sternly enforced laws against begging

Photo by J. Langland

THE SARAPE AND THE BLACK SHAWL

Wherever you go you meet the Indian man wearing his sarape and the Indian woman her black shawl. These serve as clothing by day and as bedding by night.

Photo by J. Langland

SELLING FOOD TO PASSENGERS ON A RAILROAD TRAIN: MEXICO

No traveler ever needed to go hungry in Mexico, provided he had a few centavos and an ability to forget the maxim of his childhood, that "cleanliness is next to godliness."

Photo by J. Langland

MEXICAN BOYS AT CUERNAVACA, MEXICO

The peon does not make much money and he does not need a great deal. His boys wear cotton trousers, cotton shirts, and straw hats; so his clothing bill is small,

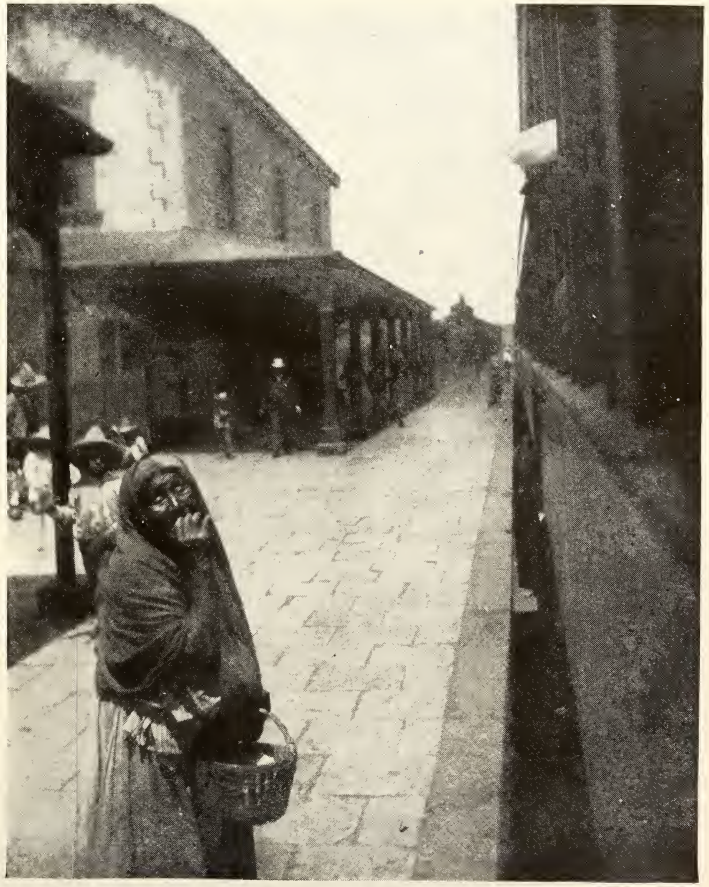


Photo by J. Langland

BEGGAR WOMAN AT RAILROAD STATION: GUADALUPE

From the Guatemalan frontier to the Rio Grande, "Un centavo, señor," rings in your ears, and you reply "Pardonne me por Dios" so often that you feel like carrying a talking-machine with you to say it for you every minute of the day.

A WAYSIDE INN IN MEXICO

Photo from Alberto L. Godoy

At such places they know about as much about the germ theory of disease as a new-born babe knows about the fourth dimension, and they care less. Their systems seem to become as calloused to germs as their horny palms are to blisters

THE TOWN AND HARBOR OF GUAYMAS, MEXICO

Photo by Charles Jenkinson

The city of Guaymas is one of the principal seaports of the Gulf of California. Several railroads find their outlet here

GUAYMAS, SONORA: MEXICO

Photo from Charles F. Holder

The outlying waters of Guaymas Bay are to the people of Mexico what the neighborhood of Catalina Island is to those of the United States. In years gone by fishermen from all points of the compass visited the fishing grounds of Guaymas. The Colorado River salmon, the jewfish, the Spanish mackerel, and the *boca dulce* are there in abundance.

THE MEXICAN MILK-WAGON

Photo from A. H. Blackiston

Nearly everybody who uses milk in Mexico boils it; and when one sees the conditions under which it is produced and marketed, he is a convert to pasteurization

A COUNTRY SCENE: SINALOA

Photo from A. H. Blackiston

The solid-wheeled ox-cart, the razor-backed hog, and the indifferent donkey are as much a part of the rural scene in Mexico as the self-binder, the herd of fat cattle, and the team of fine horses are in the United States

OLD INDIAN WOMAN IN THE MARKET-PLACE: CITY OF MEXICO

Photo by J. Langland

The Indian women come from far and near to the market day. It is no unusual sight to see one of them with a baby tied to her breast with a shawl, a load of wood in each hand, and a basketful of produce on her head

THE PYRAMID OF THE SUN: SAN JUAN TEOTIHUACAN

Photo from Alberto L. Godoy

On this pyramid the Chinese Minister to Mexico, in 1911, found an inscription which is common on the burial places of China. Skirting the west base is the Path of the Dead, flanking either side of which are tumuli, which, when opened, were found to contain wrought stone sarcophagi, inclosing human bones, obsidian knives, and terra-cotta heads, the latter supposed to be the effigies of buried priests and kings (see also page 636)

Photo from Alberto L. Godoy

ON THE ROAD TO PACHUCA, DECORATED HERE AND THERE WITH RUINS OF EARLY SPANISH TIMES

The Conquistadores were great builders, and in addition to the fortresses in and around Pachuca, one finds here the ruins of one of the three most celebrated aqueducts in Mexico, built by the Franciscan Friar Francisco Tembleque.

AN OLD MEXICAN HIGHWAY

Photo by Alberto L. Godoy

The highways of Mexico wind in and out of mountain passes as they cross from one valley to another, and strings of burros and files of Indians going to market or returning are a familiar sight. Pachuca may be seen in the distance.

Photo by D. Basil W. Alexander

A FOREST OF CACTI IN THE UPPER END OF SAN VICENTE CAÑON IN LOWER CALIFORNIA, MEXICO

Millions of acres of the highland region of Mexico are too arid for other vegetation than the cacti and the sage-brush. The above scene is characteristic of the panorama that unfolds itself before the car window for hundreds of miles in the mainland highlands, as well as characteristic of the northern part of the Lower California Peninsula.

Photo by D. Basil W. Alexander

ANOTHER VIEW OF THE CACTI IN SAN VICENTE CAÑON, LOWER CALIFORNIA, MEXICO, SHOWING THEIR IMMENSE SIZE

Mexico has a majority of the more than 500 species of cacti, ranging from the *candelabra*, with its great branches, which give it its name, and the *organ*, with its fluted pipes and thorns with saw-tooth edges, to the creeping kinds that scarcely rise above the ground.

Photo by A. W. Cutler

A QUEER HEAD-DRESS

A Tehuana Indian beggar at Tehuantepec, Mexico. Her hat consists of half a cocoanut cleaned out and polished. A whole cocoanut can be purchased for something less than a penny.

Photo by A. W. Cutler

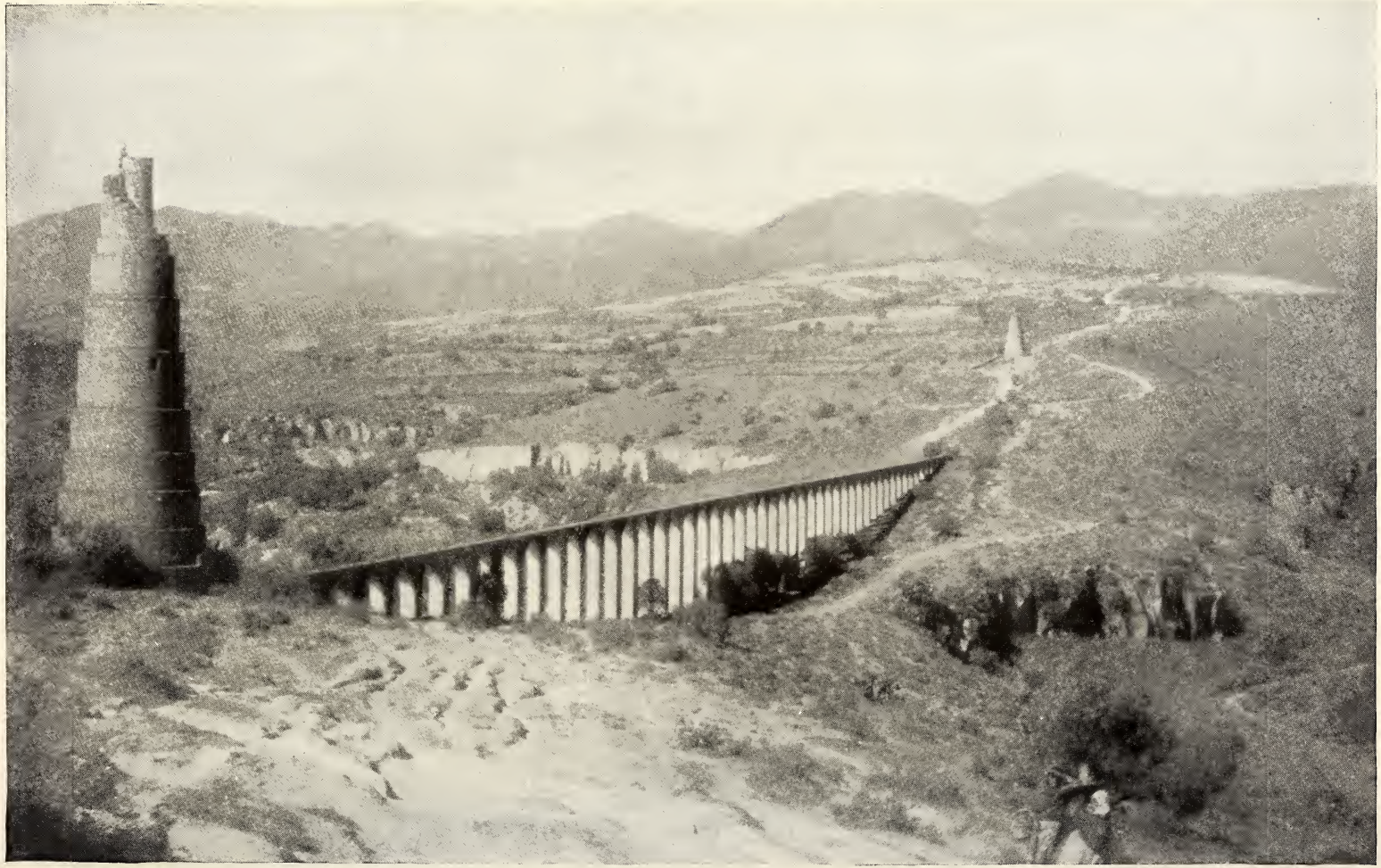
THE WATER-CARRIER

One of the many methods of carrying water adopted by the Tehuana Indians of Tehuantepec, Mexico

IN THE SAN PABLO REGION, MEXICO

Photo from Alberto L. Godoy

The small farmer of the semi-arid regions of Mexico has a rather disheartening fight for existence. His crops are limited in range, being mainly corn and beans, and they are usually short, affording him and his family only the barest necessities of life. Note the fences of cactus.



WATCH-TOWERS OF THE AQUEDUCT OF THE REMEDIES

Photo from Alberto L. Godoy

Highland Mexico abounds in aqueducts which carry water long distances. Some of them have watch-towers, where sentries are stationed to protect them

THEY LOVE THE SUN

Photo by Carl Bergmann

In the highland cities of Mexico the poor congregate in the small plazas and contentedly sun themselves, getting the chill of the cold and coverless nights out of their bodies. The quick-lunch counter is always there to cater to their wants, even though they have very little money to spend.

Photo by C. M. Tozzer

LACANDONE WOMAN SPINNING THE NATIVE COTTON

The spindle rests in a gourd and the mass of crude cotton rests on the shoulder: Yucatan

Photo by C. M. Tozzer

A MAYA WOMAN GRINDING CORN WITH A STONE METATE

She is the descendant of a proud race that is said to have been the only one of the Western World that made any progress toward a phonetic system of writing. They were conquered by the Spanish in the great battle of Merida, in 1540, and every possible remnant of their civilization put to the torch (see page 606).

A HAPPY QUARTETTE: SAN BARTOLITO

Photo from Alberto L. Godoy

For a care-free existence, the children of the Mexican peons match the birds. They may be as dirty as the pigs that share their quarters, as ignorant as the dogs that are their playmates, but nevertheless they are apparently a happy and contented lot

Photo from Alberto L. Godoy

POPOCATEPETL'S CRATER

This crater is bell-shaped instead of conical. Many thousands of tons of sulphur have been taken out of it and the supply seems inexhaustible. The sulphur is carried up 500 feet by peons, who climb "chicken ladders." A windlass takes it the remainder of the distance to the top. Here the peons put it on mats and slide to the lower edge of the snow-line with it. The peak of this famous mountain is shown on page 641.

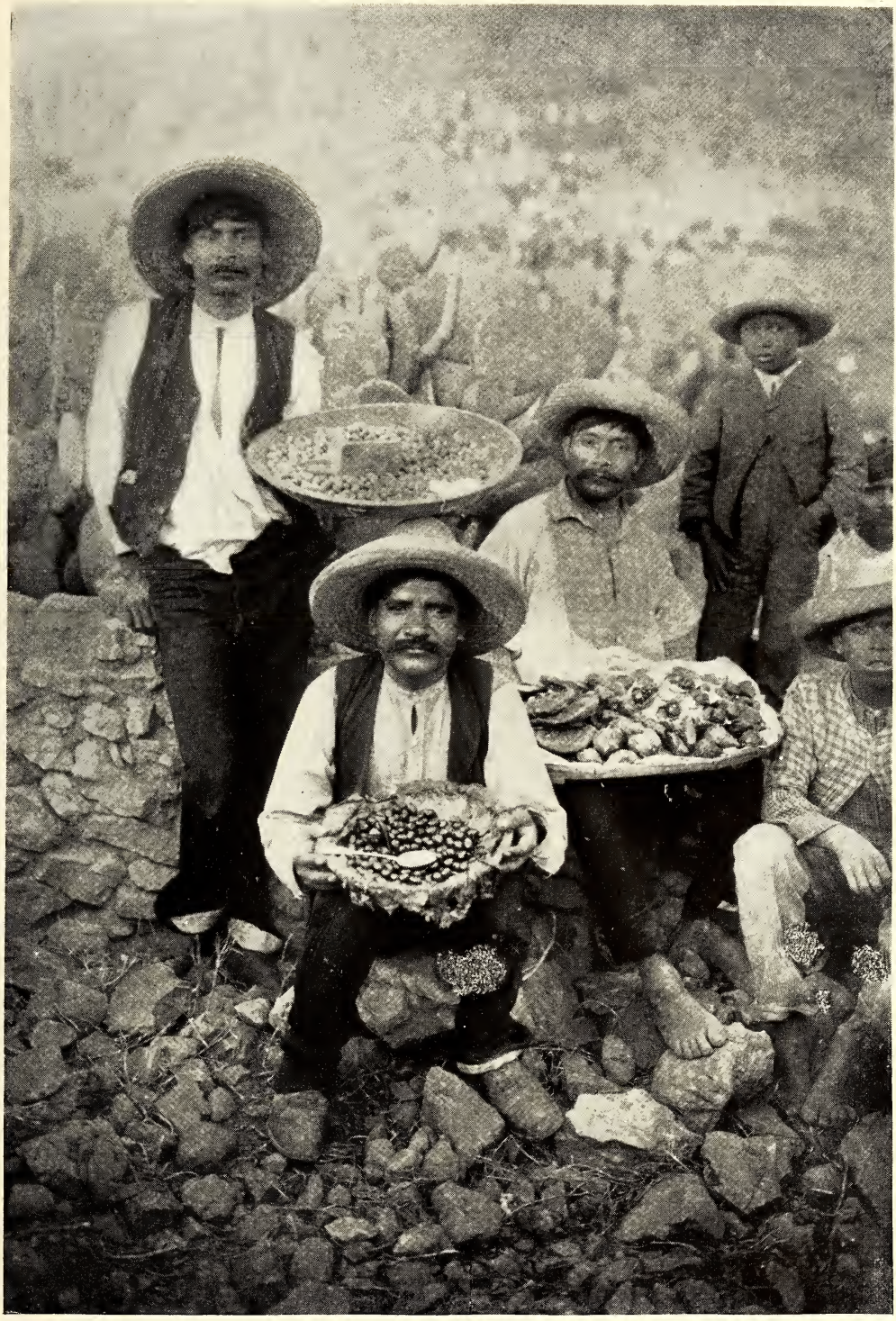


Photo from Alberto L. Godoy

PEANUT AND SWEETMEAT VENDERS

Nature's "original sealed-package" goods find favor with the traveler after seeing the indifference of the sweetmeat venders to flies and dust, which have free access to their offerings.

Photo and copyright by Underwood & Underwood

WASHING AND BATHING IN THE STREAM FED BY THE HOT SPRINGS: AGUASCALIENTES, MEXICO

There is one phrase a traveler always remembers in Mexico—"agua caliente." It means "hot water," a boon that can be had only at a hot spring or through the aid of an alcohol lamp.

MEXICAN CHARRO AND HIS HAT

Photo from H. Ravell

What leather breeches and "chaps" with their elaborate fringes mean to the American cowboy of the old school, the big sombrero means to the "man on horseback" in Mexico. His hat may cost half as much as his horse, and his sarape may match the rainbow for colors. When the elder Diaz attired his "rurales" in such a uniform there was always a waiting list.

ON LAKE PATZCUARO, IN THE STATE OF MICHOACAN, MEXICO

Photo from Alberto L. Godoy

With its surface a mile and a quarter above the sea, and with a circumference of thirty miles, Lake Patzcuaro is one of the most beautiful inland lakes in the world. It abounds in water fowl, and many fishing and hunting expeditions are made to it by the Tarascan Indians.

A RURAL KITCHEN IN MEXICO

Photo from A. H. Blackiston

The kitchens of rural Mexico may not measure up to the standard of those of the rural American housewife, but the Mexican would not trade his hot tamales, chili concarne, frijoles, and tortillas for the best chicken, ham, asparagus on toast and light rolls that the American housewife can prepare.

THE PYRAMID OF THE SUN

Photo from Alberto L. Godoy

What Cheops is to Egypt, such is the Pyramid of the Sun to Mexico. Its base is about as large as that of Cheops, and it is 216 feet high. All we know of its origin is that it was built before the Toltecs occupied the Valley of Mexico. According to tradition, a splendid temple once crowned its summit, and contained a great monument to the sun made from a single block of porphyry. Excavations have revealed galleries and vaults like those of Cheops, and Senor Garcias Cubas, the eminent archeologist, says that a gallery in the companion pyramid, that of the moon, coincides exactly with the magnetic meridian.

A RURAL GUARD ON DUTY

Photo from Alberto L. Godoy

When Porfirio Diaz came into power the country was infested with robbers from the mountains to the sea. He selected the best and made a rural guard out of them. They justified his hopes, and after a while it became as safe to travel in Mexico as it is to travel in the United States. The prolonged civil strife has sadly thinned their ranks, however.

Photo from Alberto L. Godoy

CHILDREN BOATING ON XOCHIMILCO

The vicinity of Mexico City is famous for its lakes, and one of the most beautiful of them is Xochimilco. Some of these lakes were drained in the days of Diaz to prevent the inundation of the Capital in flood time.

THE HAPPY MEXICAN INDIAN

Photo from Carl Bergmann

Left to himself and not forced to comply with the trammelling conditions of civilization, the Mexican Indian worries neither about the past, the present or the future. He finds that "sufficient unto the day is the evil thereof," and so he eats when he can, drinks when he pleases, and is merry when it suits him to be.

IXTACCIHUATL AND THE SLEEPING WOMAN

Photo from H. Ravell

The "man on the mountain" in the Catskills is matched by "the sleeping woman on the volcano" in Mexico. As seen from Tlalpa n the hair of the sleeping woman seems to be streaming down the one end of the mountain.

Photo from Alberto L. Godoy

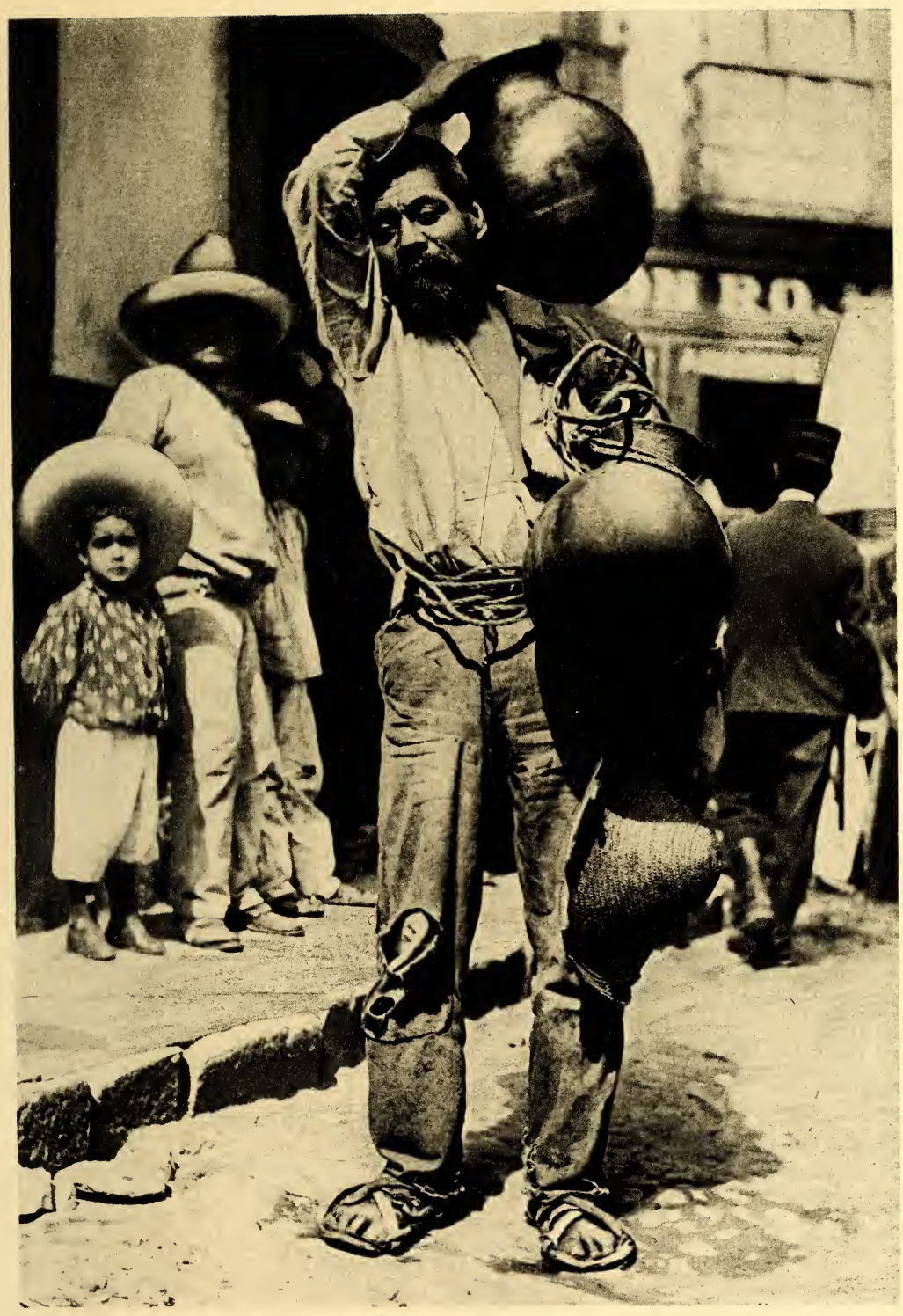
THE SUMMIT OF IXTACCIHUATL

The two majestic volcanoes, Popocatepetl and Ixtaccihuatl, with their caps of perpetual snow, stir the heart of him who beholds them. From the summit of Ixta, 16,200 feet above the sea, one sees Popo, Orizaba, Xiantecatl and Matlacueyatl lifting their lofty cones above the clouds. Across the saddle between Popo and Ixta Cortez built the military road that led him to the capital of Montezuma.

IN QUAINT URUAPAN, IN THE STATE OF MICHOACAN, MEXICO

Photo from Alberto L. Godoy

Where once the Indians of Uruapan fashioned the famous Uruapan lacquer ware, today the people are engaged in growing silkworms. Many of the sunny patios of the small houses are brilliant with the scarlet blossoms of the shepherd's flower. The Spaniards call the



THE WATER CARRIER

Photo by John H. Hall

In every part of Mexico the water carrier flourishes. He gets the water from some spring or clear stream, and the people seem never to inquire about the presence of colon bacilli and only a few of them ever boil the water, which helps to account in a measure for the high death rate in Mexico.

A TYPICAL STREET IN A TYPICAL TOWN

Photo from Carl Bergmann

Except in the larger cities of Mexico where the business quarter is the architectural handiwork of foreign interests, street scenes are distressingly similar. There seems to be no imagination in the mind of the Mexican architect.

A MEXICAN HAT STORE

Photo from Alberto L. Godoy

The lower class Mexican is fastidious about only one thing in the world—his hat. And the Mexican hat store carries a line that gives him plenty of room to exercise his fancy and to deplete his already slim pocketbook.

A MEXICAN HIGHWAY

Photo from Alberto L. Godoy

The people of Mexico do not go to any great trouble in building their country roads, and when they fence them they simply put cacti sprouts into the ground, and the fence grows.

SOLDIERS BEING TRANSPORTED ON XOCHIMILCO RIVER

Photo from Alberto L. Godoy

The Mexican peon fights because he has to, but with all that, given good generalship and enough to eat, he makes a good soldier. "Volunteers" are usually brought to camp tied with ropes or handcuffed.

THE SPAN OF AN AQUEDUCT

Photo from Alberto L. Godoy

Most of the great mining centres of Mexico are located in the highlands where rain seldom falls and where the water supply must be brought for dozens of miles from the mountains.

DISCOVERY AND INVENTION*

By Alexander Graham Bell

I AM going to begin tonight by asking you a rather startling question: Did you ever put your head under water and chuck two stones together to see what the sound is like? If you have never done that, try it, and you'll get a new sensation. I did it once, and it sounded as if a man were hammering for all he was worth at my very ear.

I then took two tiny little pebbles and tapped them together quite lightly under water, and it sounded like a man knocking at the door. It was rather startling to hear such a loud noise from such a slight cause.

Of course, the question at once arose in the mind: How far off could we hear the sound? So I sent a boy a hundred feet up the beach with a couple of stones, directing him to strike them together under water. I then submerged my head, and I could hear the sound about as readily as before.

Well, I determined to test the maximum possible distance, and sent the boy across the bay in a boat to the other side, to a point at least a mile away from the place where I stood, and I followed him with field glasses to see that he carried out my instructions. I saw him land on the other side, take off his coat, roll up his sleeves, and go down to a little plank wharf on the shore rising only a few inches out of water. He lay down upon the wharf, face downward, and put his hands into the water, and I then knew he was making signals with these stones.

Now, the question was: Could I hear him? Quietly and gently I went into the water at my side of the bay, submerged my head, and listened for all I was worth. Well, you know, the signals came perfectly clear and distinct, through more than a mile of water, to my ear. It was one of the most astonishing revelations of what could be done with water.

You know if you look away in the distance at a man firing a gun you can see the flash, and after a time you get the report; the sound takes time to travel through the air. It goes about 1,100 feet per second; but in the water it goes five times as fast as that—over 5,000 feet per second. Water is a much better conductor of sound than air.

DO FISH SIGNAL TO ONE ANOTHER BY SOUNDS?

Reflecting upon these various experiments, the thought occurred: If two little stones tapped together can be heard under water, why, every tiny lobster that snaps his claws must make an audible click. I wonder if there are creatures in the water that signal to one another by sound.

Well, I had occasion to try it once. Bathing in the Grand River in Ontario a great many years ago, I put my head very gently under water and listened, and, sure enough, "tick, tick," came a sound like a grasshopper's chirrup, and a little while after that a chirrup on the other side. There were creatures under the water that were calling to one another.

I don't know whether all fish make sounds or not, but there are some fish that certainly do. The drumfish on our coast drums away in the water so loudly that you can hear him while you are walking on the shore.

It is also a significant fact that all fish have ears. Why should they have ears if there is nothing for them to hear?

Of this we may be certain—that *there is a whole world of sound beneath the waves waiting to be explored,* perhaps by some of you.

I have wanted you to see how one observation leads to another. Starting with a very small thing—the chucking together of two pebbles under water, and following this up by other observations—we broaden our field of knowledge and reach generalizations of considerable magnitude as the resultant of numerous small thoughts brought together in the mind and carefully considered.

*An address to the graduating class of the Friends' School, Washington, D. C., delivered May 22, 1914.

OUT OF THE BEATEN TRACK

I was walking along the road one day in my country place in Nova Scotia, when the idea occurred to leave the beaten track and dive into the woods. Well, I had not gone 50 feet before I came upon a gully, and down at the bottom was a beautiful little stream. I never knew of it before.

Of course, I was not satisfied with the mere discovery, but went down into the gully and explored it right and left. I followed it up to its source. I followed it downward for half a mile, through a beautiful moss-grown valley, until at last the little streamlet discharged into a pond, and away in the distance I could see a sea beach with the open water beyond.

Now, just think of that! Here was a beautiful gorge, half a mile long, right on my own place, and coming at one point within 50 feet of a well-trodden road, and I never knew of its existence before. We are all too much inclined, I think, to walk through life with our eyes shut. There are things all round us and right at our very feet that we have never seen, because we have never really looked.

Don't keep forever on the public road, going only where others have gone and following one after the other like a flock of sheep. Leave the beaten track occasionally and dive into the woods. Every time you do so you will be certain to find something that you have never seen before. Of course it will be a little thing, but do not ignore it. Follow it up, explore all round it; one discovery will lead to another, and before you know it you will have something worth thinking about to occupy your mind. All really big discoveries are the results of thought.

THE BEGINNINGS OF INVENTION

I dare say you have all heard of that celebrated painter who would never allow any one to mix his colors for him. He always insisted on doing that himself, and at last one of his students, whose curiosity had been aroused, said: "Professor, what do you mix your colors with?" "With brains, sir," said the professor. Now, that is what we have to do with our observations.

I think I left you with your head under water listening to the clicking of two stones. Now, let us see whether we cannot use our brains to get you out of so awkward a predicament. We will then have entered the realm of invention, as distinct from discovery.

Why should we not simply put the ear to the water instead of submerging the whole head?

Why should we not ring a bell under water instead of clicking stones together to make a noise. An ordinary dinner bell would do. Empty it of air and ring it under water, and the sound can be heard by a submerged ear at a great distance away.

It is a little awkward, however, to keep the ear continuously submerged on account of the movements of the surface water. Every now and then a little wave will slap you in the face, and you are apt to choke if you are caught unprepared.

Why would it not be better to transmit the sound vibrations from the water to the ear through some intervening mechanism, and thus obviate the necessity of submerging the ear at all?

I have tried submerged hearing tubes of various kinds and planks of wood partially submerged, with the ear applied to the part out of water.

If you put your ear to the bottom of a boat—inside, of course, not outside—you can hear a bell at a distance quite readily. It still is a little awkward, however, to get your ear against the planks of the boat; but brains will help you out. Just fix a telephone transmitter to the planks of the boat, and you can sit at ease with the telephone receiver at your ear.

You may even put the telephone transmitter overboard. It then becomes a submerged ear and will listen for you under water.

FISHING WITH TELEPHONES

I have often thought I should like to go on the banks of Newfoundland and fish with a telephone. If you were to send the transmitter down among the codfish with the bait, perhaps you would find something there to hear. I have never tried it. I will leave that to you.

We now have numbers of steamers

upon the Atlantic fitted with telephone transmitters attached to the thin iron skin of the hull, away down in the hold, and the receiving telephone on the bridge.

On shore there are huge bells at lighthouse stations making fog-signals under water, and each steamer as it approaches the coast can pick up these submarine sounds at a distance of 10 miles.

Here is a completed invention which some patient observer has evolved from just such little beginnings as those I have described.

I doubt whether you could hear a fog-signal through the air at any such distance as that. The air is at best but a poor conductor of sound, and many illusions of hearing are possible.

It is difficult in any case to tell the exact direction of a sound in a fog. It is possible, too, that you might have an echo from the sails of a vessel, and you would then be entirely misled as to the direction of the signal station.

Then, again, an island anywhere near casts a sound-shadow upon the water. The sound-wave striking the island is deflected up into the sky, and you would have to go up in a balloon to hear it, and it may not come down again to the surface for a mile or two beyond the island. A ship quite close to the island might not hear the sound. The captain, knowing that the fog-horn should be heard at least a mile or two away, imagines himself to be much farther off than he really is, and in the midst of the fog he may become conscious of the presence of the land only by actual contact with it.

Then the transmitting qualities of the air are subject to variations on account of unusual atmospheric conditions. You may be quite near a fog-signal station and yet hear the sound so faintly that you imagine it to be far away. You may even get an echo from the clouds; but then you know you are subject to an illusion, for the sound seems to come from the sky.

Now, sounds can be transmitted through the water to far greater distances than through the air, and atmospheric conditions have no effect.

I don't want to confine your attention to inventions that already have been made. I want to show you also that there is room for something new. We don't know everything yet and the list of possible inventions is not yet closed. Take, for example, the case we have been talking about, the transmission of sound through water.

EXPLORING UNDER THE SEA

Three-quarters of the earth's surface is under water and has not yet been explored, at least to any great degree. The only way we have of reaching the mountains and valleys at the bottom of the sea is by sending down a sounding line and bringing up a specimen of the bottom attached to the sinker. It is no joke, however, to reach the bottom of the deep, blue sea through one mile or even two miles of water, and it takes several hours to make a single sounding. Just think of all the time and labor involved in merely ascertaining the depth.

Why should we not send down a sound instead and listen for an echo from the bottom. Knowing the velocity of sound in water and the time taken for the echo to reach the ear, we should be able to ascertain the depth of the deepest part of the ocean in less than four seconds instead of more than four hours. Here is something worth doing. It has never been tried. I have suggested it a number of times, and I will now pass on the thought to you in the hope that some of you may care to take it up.

Suppose you are on one of those steamers provided with transmitter hulls and telephone ear-pieces, and you send down a little piece of gun-cotton or other explosive material to a safe distance below your ship and then explode it by an electrical contact. The sound-wave from the explosion will, of course, go down to the bottom and then be reflected up again, so that after a certain length of time you should get an echo from the bottom.

Not only should you be able to tell the depth of the ocean by an echo from the bottom, but you might perhaps learn something of the nature of the bottom itself. A flat bottom should yield a single sharp return, whereas an undulating bottom should yield a multiple echo, like that heard when you fire a pistol among hills.

Then, as you approach the shore you should get resonance effects, like those perceived when you shout out loudly in an empty cave.

However, I must not take up your time in speaking upon only one subject. What I want to direct your attention to is that both discovery and invention are not things that come all at once. They arise from very simple beginnings. A small observation, patiently followed up by other observations equally small, leads gradually to a big conclusion. Do not ignore little things; life itself is made up of them, and there is a good old Scotch saying that bears upon the point:

"Mony a mickle maks a muckle."

A great many small things make a big one. Any one, if he will only observe, can find some little thing he does not understand as a starter for an investigation.

AN EXPERIMENT AT HOME

I had rather a curious illustration of this the other day in my own house. I told a lad who was waiting upon me that I wanted to make some experiments with a bottle of water, and told him to bring a bottle of very hot water from the kitchen, and be sure that it was quite full. He soon returned with a big-bodied bottle provided with a long and narrow neck, filled to the brim, and put it on the mantelpiece and went downstairs. After the water had cooled, I rang the bell for John.

"John," I said, "I thought I told you to fill that bottle quite full."

"So I did, sir," he replied.

"Well, look at it now; it's not nearly full; the neck is quite empty."

John assured me that he had not touched the bottle since he first put it up, and I assured him that I had not poured any of the water out.

"Well," I said, "what has become of the water?"

He was quite nonplussed at first, and then he began to—to—ratiocinate, and said: "The water was quite hot when I put it in; there was steam coming from it. The water must have evaporated."

I made no comment, but looked at him and said: "Let's try it again. You fill that bottle chock full of hot water this time, and then *cork it* so that no steam can escape."

He did so; and by and by I rang the bell again, and up came John.

"John," I said, "I thought you filled that bottle quite full."

"So I did, sir," he replied.

"Well, look at it now; it's not nearly full." John assured me that he had not touched the cork, and I replied: "Well, what has become of the water?" John said he didn't know. He admitted that some of it had evidently gone, but where it had gone he couldn't for the life of him conceive, and he hasn't found out yet.

I am sorry now I didn't think of telling John to weigh the bottle when he first brought it up, for by weighing it again he could have found out exactly how much had disappeared.

If John hadn't given up he might have arrived by degrees at a realization of the principle upon which a thermometer works.

A thermometer is an instrument for measuring heat, and whenever you can measure a phenomenon you have a basis upon which may be built a science; in fact, all science is dependent upon measurement.

When you measure heat you get the science of thermo-dynamics, and thermo-this and thermo-that. When you measure the pressure of the atmosphere by a barometer you lay the basis for the science of meteorology and a whole lot of sciences dependent upon atmospheric measurements. So you have sciences based upon the measurement of sound and light; but you have no science of odor.

MEASURING AN ODOR

Did you ever try to measure a smell? Can you tell whether one smell is just twice as strong as another. Can you measure the difference between one kind of smell and another. It is very obvious that we have very many different kinds of smells, all the way from the odor of violets and roses up to asafetida. But until you can measure their likenesses and differences you can have no science of odor. If you are ambitious to found a new science, measure a smell.

What is an odor? Is it an emanation of material particles into the air, or is it a form of vibration like sound? If you can decide that, it might be the starting point for a new investigation. If it is an emanation, you might be able to weigh it; and if it is a vibration, you should be able to reflect it from a mirror. You can reflect sound and light and heat, and I have even warmed my hands at the reflection of a fire in a mirror. Not a glass mirror, for glass is opaque to radiant heat. A sheet of transparent glass makes a fine fire-screen. You can see the fire through it, but it cuts off the heat. When you try to reflect it from an ordinary looking-glass, the heat has to go through the glass in order to reach the reflecting surface behind and then pass through the glass a second time in order to get out. Take a sheet of polished metal—tin-foil will do—or any metal with a bright and shiny surface and you can reflect heat from it with ease.

Can you reflect a smell or measure its velocity of transmission? If you can do those things you will be well advanced on the road to the discovery of a new science.

THE SMELL OF TELLURIUM

Well, that reminds me of a discovery that started with a smell. We have a very rare elementary substance known as tellurium, and when you melt it with a blow-pipe it gives off a smell. We can't measure it, nor even describe it; but if you have ever smelled it you will know it ever after. There is nothing in heaven or on earth that smells like that.

Now, you know it is the object of many chemists and scientific men to turn their discoveries to some practical use. They try, through chemical and other means, to convert waste products, for example, into useful things. Indeed, the utilization of waste products is a characteristic of the age in which we live.

Just think what they have done. Here is a gas manufactory consuming coal. After the gas has been produced we have left upon our hands ashes and clinkers and a lot of evil-smelling tar. Well, the chemists go to work and out of that tar they make the most delightful perfumes for scenting handkerchiefs, and nice sweet essences for flavoring puddings, and the most beautifully colored dyes, all made from coal-tar.

Now, there was a distinguished chemist who thought he saw a chance of making something valuable out of the waste products obtained in the manufacture of sulphuric acid. Some of the powder he obtained he heated with a blow-pipe, and at once perceived the characteristic smell of tellurium. Here, he thought, was a rare and valuable element contained in a common and cheap by-product and it might pay to extract it. He then applied various chemical tests, but could get no other indication of the presence of tellurium excepting the smell. All the reactions declared there was no tellurium there.

He did not stop with this observation, but followed it up and began reasoning about it. If, he thought, there is no tellurium here, there is certainly something that has a smell very like it, and I know of no other substance on earth that has a smell like that. Perhaps there may be a new substance here, not yet discovered, which resembles tellurium, at least in the smell.

He knew that he was working with a regular conglomerate or mixture of all sorts of materials, many of which he could identify. He then extracted from the mass all the materials he knew were there to see if there was anything left; and, sure enough, a residue appeared which turned out to be, as he had suspected, a new elementary substance not heretofore known to man.

SELENIUM FOUND

He termed this substance *selenium* because it resembled tellurium. The word selenium, you know, is derived from a Greek word meaning the moon, and tellurium comes from the Latin—tellus, the earth. The two substances were not identical, but were related to one another as the moon is to the earth.

Selenium was found to resemble black sealing-wax in appearance. It had a beautiful, black, glossy surface, and in thin films was transparent, showing ruby red by transmitted light. In this, its vit-

reous form, it was a non-conductor of electricity, thus differing in a remarkable degree from tellurium, which was a good conductor.

When, however, selenium was heated almost to the fusing point and then allowed to cool very slowly, it completely changed its appearance. It acquired a dull metallic look, like lead; and in this, its crystalline condition, was also found to be a conductor of electricity, but of extremely high resistance. A little pencil of crystalline selenium not much more than an inch in length offered as much resistance to the passage of an electrical current as 96 millions of miles of wire, enough to reach from here to the sun, and yet it was a conductor. That was a discovery. Now comes an invention.

Willoughby Smith, in laying the Atlantic cable, found it advisable to balance the electrical resistance of the cable during the process of submersion by tremendous coils of well-insulated wire. Why, thought he, should not a little bit of selenium balance the whole cable and enable us to get rid of all this complication of wire.

He succeeded in doing this, but found the electrical resistance very variable. At times the selenium would balance the whole cable and at other times not one-half of it.

He did not stop with this observation, but sought the cause of the variation. He multiplied observations, and his assistant, Mr. May, soon discovered that the resistance of the selenium was greater at night than in the day.

This at once suggested to Willoughby Smith the thought that perhaps the electrical resistance of selenium was affected by light, and he proceeded to put his idea to the test of experiment. He shut up the selenium in a dark box near a bright light, and found that when the lid was open the resistance went down and when it was closed it rose again. Even a shadow falling upon the selenium affected its electrical resistance.

SPEECH FROM A SUNBEAM

Then other scientific men took the matter up. Professor Adams, of King's College, England, discovered that the resistance varied directly with the intensity of the light that fell upon the selenium. Then I came along with some speculations concerning the possibilities of telephoning without wires by varying the intensity of a beam of light by the action of the voice, and allowing the light to fall upon a piece of crystalline selenium. In this way I thought it would be possible to get speech from a sunbeam.

Well, I need not go into the details, but it was true. I produced the *photophone,* an instrument for talking along a beam of light instead of a telegraph wire. It is interesting to remember that all these things resulted from the observation of a smell.

When I was invited to talk to you tonight I had no idea of what to say. I thought of all the good maxims for your future conduct in life; but giving advice to young people is out of my line, and it seemed to be better to choose some subject with which I was a little familiar myself.

How discoveries and inventions arise from the observation of little things is surely a topic worthy of your consideration. I also thought it would be interesting for you to know how many apparently impossible results have been actually achieved by the patient multiplication of little observations.

It was only a short time ago that if you wished to express the idea that anything was utterly impossible you would say, "I could no more do that than I could fly." I don't think there is any one here who is too young to have heard that expression. It was the height of impossibility that we should fly, and here men are flying in the air today.

It is only a few years since the first man flew, and we are only at the beginning of aviation. What a delightful idea it is to go sailing through the air. The only trouble is that you must come down, and we have altogether too many fatalities connected with the work. Here, then, is a subject for you to explore: How to improve the safety of the flying machine. How to produce flying machines that any one can fly.

We know perfectly well that the time is coming, and is almost here, when it will

be an every-day thing to go from place to place through the air. Perhaps some of you may find a field of occupation in bringing this about.

FLYING ACROSS THE ATLANTIC

Even today we have startling propositions to do things that are apparently impossible. A man proposes to try this summer to fly across the Atlantic Ocean in a heavier-than-air flying machine. The strange thing about the matter is that experts who have examined into the possibilities find that he really has a fighting chance.

You see the distance is less than 2,000 miles from Newfoundland to Ireland. This means that if you could go at 100 miles an hour you would cross the Atlantic in 20 hours—less than a day. Just think of that. Well, we have flying machines that go at a greater speed than that. We already have machines that could cross the ocean if their engines can keep going for 20 hours.

Of course, these are exceptional machines; but even the ordinary machines of today make 50 miles an hour with ease. Now, a flying machine flies faster as you go higher up, because the rarer air offers less resistance to the motion, while the propeller gives the same push with the same power, whatever the elevation. As you get into rarer air the propeller simply spins round faster.

A 50-mile-an-hour machine flying two miles high in the air—and we have machines that have gone twice as high as that—will fly much faster than 50 miles an hour.

Then at an elevation of two miles high in the air there is a constant wind blowing in the general direction of Europe having a velocity anywhere from 25 to 50 miles an hour.

As the net result of all these things, there can be little doubt that any ordinary machine that is able to support itself in the air at an elevation of two miles high will attain a speed of at least 100 miles an hour in the direction of Europe, and that means going from America to Europe in a single day.

Calculation shows that, taking all these circumstances into consideration, our best machines should be able to cross the Atlantic in 13 hours. I hardly dare to say it aloud for publication. It is sufficiently startling to know that it is not only possible, but probable, that the passage may be made in a single day. But if, as I imagine, it can be done in 13 hours, you may take an early breakfast in Newfoundland and a late dinner in Ireland the same night.

Now, I will not take up any more of your time. My idea has been to point out to you how great discoveries and inventions have originated from very little things, and to impress upon your minds the importance of observing closely every little thing you come across and of reasoning upon it.

Indeed, as Smiles very happily puts it, "The close observation of little things is *the secret of success* in business, in art, in science, and in every pursuit in life."

OUR GUARDIANS ON THE DEEP

By William Joseph Showalter

IN A very general way the people of the United States know that there is a government bureau in Washington called "The United States Coast and Geodetic Survey." Yet little indeed do they appreciate its many activities—activities which touch them, even though they are unconscious of the contact, almost every hour of every day of their lives.

Do they or their friends go down to the sea in ships, the Coast and Geodetic Survey stands between them and the perils of the deep, by furnishing the sailing directions that preserve those ships from harm. Do they live on lots that have been surveyed and on streets that have been laid out by a civil engineer, the Survey has contributed to the accuracy of the work. Do they drink water from city water mains, the fundamental

THE SWEEP WITH WHICH THE COAST SURVEY FINDS SUNKEN ROCKS

This is the most reliable apparatus yet devised for discovering the dangers to navigation that lurk beneath the surface of the sea. It is known as the wire sweep, and consists of a wire of any desired length, supported at intervals by buoys so arranged that the wire can be lowered to any given depth. The sweep is then attached to two or three small power-boats, depending on its length, and is towed slowly along. The wire catches upon any obstacle that it encounters. This obstacle is then further investigated by means of lead soundings. These wire sweeps vary in size from 100 feet to over a mile in length, and have been used to a depth of 45 feet (see page 660).

RUNNING A LINE OF SOUNDINGS (SEE PAGE 659)

This picture shows a sounding party in Baltimore harbor. The two observers are seen determining the position of the boat by sighting with their sextants upon beacons on the shore. In the bow the leadsman stands ready to cast the lead, while amidships is the recorder, all ready to note down the observations.

leveling work of the Survey enters into the consideration. In a hundred ways the work of the Coast and Geodetic Survey comes home to every one, and behind the curtain of its somewhat puzzling name it is engaging in a wide range of wonderfully interesting as well as useful activities.

WE HAVE 40,000 MILES OF SHORE-LINE TO BE CHARTED

In these days of great steamships and vast commerce it is necessary that minute information concerning our coastal waters be in the hands of navigators. A single sunken rock in the path of water traffic may send hundreds of souls to the bottom of the sea; a single point of shifting sands carried hither or thither by river or ocean current may ground a steamer; a single unplotted wreck on the bottom of a harbor may do millions of dollars' worth of damage.

For 96 years the work of charting our coasts and making safe the water roads along our shores and within our harbors has been going on. Rather a long task it has been; but then we have rather a long coast-line to survey. According to trend, it is 16,000 miles long; but when it is measured so as to include the shore-line of all large islands, bays, sounds, and estuaries within tidal range, it becomes upward of 40,000 miles long.

Furthermore, that coast-line is never the same. Its main features may be as fixed as the eternal hills, but many of its smaller features are as unstable as the shifting sands of the desert; and these affect every ship that sails its waters. Between 1835 and 1908 Rockaway Beach, near New York, grew to the westward at the rate of nearly 8 inches a day. In 73 years Coney Island's western end has shoved itself farther westward about 1,000 feet. When Vancouver explored Columbia River he found a single straight channel there. By 1851 Sand Island had

appeared, creating a second channel. Since that time it has moved two miles in a northwesterly direction, and finally has closed up the northern channel.

OWING TO WINDS, TIDES, AND RIVERS, THE WORK IS NEVER COMPLETED

It is obvious therefore that the work of surveying our coast-line can never be finished, because the winds, the tides, and the rivers continually alter its minor details, thereby making new investigations necessary. These changes must be kept track of and charted and the mariners warned against them, else, confiding in the accuracy of the charts, they would literally be led into unsuspected traps. The location of all lighthouses, buoys, artificial and natural objects on the shore must be charted, and every other aid to navigation that will tell the skipper of any ship exactly "where he is at" and keep that information at hand all the time. Piers and deepened channels change the conformation of a harbor, and sand-bars rise up or disappear with considerable frequency. Without a proper notation of these things, navigation would be unsafe and insurance rates would be high.

Nor is this all. Marine architecture is progressing, and with that progress ships are growing longer, their waist-lines are getting broader, and their drafts are becoming deeper. In 1848 the loaded draft of the 20 largest ships in the world averaged 19 feet. In 1873 the average of the 20 largest ships was 24 feet, while even in 1898 the average of the 20 largest was only 29 feet. The length of the 20 largest ships in the world rose from an average of 390 feet in 1873 to 640 feet in 1903. It is obvious that a survey thorough enough to meet conditions in 1873 would be wholly insufficient to meet conditions in 1914.

Once a rock that was 25 feet below mean low water was of no interest to navigators; today three-fourths of our navy and half of our shipping would be in danger with such rocks uncharted. There are thousands of rocks dotting the under-water sections of our harbors and shore-lines that could be neglected 20 years ago, but which today are great menaces to navigation until they are located and marked on the sailing charts. For instance, the new super-dreadnought *New York* today would run aground in a thousand places along the Atlantic coast where the *Oregon* could navigate with impunity in the day when it was the crack ship of the American navy; thus the Coast and Geodetic Survey must always go deeper with its investigation of the bottom of navigable waters as the draft of ships increases.

A MARINER'S PICTURE-BOOK

In short, the object of the coast survey is to make a series of map pictures by which navigators may read every detail of coastal or harbor conditions that will enable them to steer clear of all dangers. These pictures must carry to the eye of the mariner every feature of the shore-line, every important feature of the bottom over which his ship has occasion to pass, as well as that over which dangers forbid it to pass, and every detail of current, tide, and compass behavior that enables the mariner to keep in safe waters and out of dangerous channels.

On the map are located all the physical features of the neighborhood — its high-water line, its low-water line, its off-lying rocks, its streams, the elevations of its hills, its towns, roads, lighthouses, aids to navigation, church spires, tall chimneys, peculiar rocks and trees, and the like.

MAKING THE SOUNDINGS

In ascertaining the depth of the water and locating all the under-water obstructions to navigation, a careful record of the fluctuations of the tide while the soundings are being made must be kept. It would not suffice to measure the depth of the water if its height above mean low sea-level were unknown for the moment of measurement. To determine this a registering tide gauge is used—a sort of float attached to a mechanism in which a pen traces the rise and the fall of the water on a roll of paper which a clock causes to revolve under the pen.

Two methods of sounding are used, the one employing the lead line and the other the wire sweep. In lead-line soundings

AN AUTOMATIC TIDAL INDICATOR

This purely American aid to navigation automatically shows the height of the water at any moment. When the arrows point upward the tide is rising; when downward, it is falling. The index on the scale shows that at the moment when the photograph was taken there was an excess of 1½ feet above the normal level of the water.

the process is about as follows: A party goes out in a rowboat or launch, among its members being two observers with sextants and a map showing the shoreline and the objects whose positions have been determined by triangulation; a recorder with a clock and record book; a leadsman and a steersman. The officer in charge directs the recorder to make a note of the position of the boat, which is determined by the observers, and the leadsman casts his line and calls out the depth in feet or fathoms as he draws it up. The recorder makes a note of this and also of the course along which the boat is headed. At intervals of a minute or more the leadsman casts his lead, while every three or four minutes the observers take observations until the end of the course is reached, where a final set of observations locate the end of the line. The boat then turns and runs other lines in the same way, until the entire bottom of the surveyed area has been sounded (see page 657).

The resulting figures must be corrected so that they will all apply to what is known as "mean low water." This is fixed by taking the sum of the low-water readings for perhaps thirty days and finding their average. In fixing the depth of a sounding, the time the sounding was taken is noted and deductions or additions are made to conform with the state of the tide at that hour, as shown on the tide gauge sheets, so that all soundings are recorded on the chart as if made at "mean low water." On

ONE OF THE JOYS OF SURVEYING

Using a sled and four bullocks to transport instruments to the triangulation station at White Rock, Virginia, which was situated in the mountains, miles from the railroad and approached by no road.

the Pacific coast, and in Hawaii, the Philippines, and Alaska the datum is lower, being "mean lower low water."

THE WIRE DRAG

The lead-line method of sounding suffices to record the lay of the bottom with sufficient accuracy where there are no extraordinary obstructions; but in a region like the coast of Maine and that of Alaska, where there are many isolated pinnacle rocks and ledges under water, or along shores like those of Florida, Porto Rico, and the Philippines, where coral reefs abound and coral heads fringe the coast, special investigations have to be made. The lead line might be cast all around a pinnacle rock—might even strike it a glancing blow—and still fail to discover it.

An instance of this kind occurred in Buzzard's Bay, Massachusetts, in 1902. Although more than 91,000 soundings had been made, more than 16,000 angles observed, and 1,462 miles of sounding lines run, a rock whose head was 18 feet below the surface was run upon by the cruiser *Brooklyn* during the naval maneuvers of that year.

In order to discover such obstructions in much frequented waters a new instrument, the wire drag, has been devised. It consists of a long wire, sometimes more than a mile long, weighted down at intervals with sinkers and supported at any desired depth by surface buoys. Several power-boats are hitched to it, usually one at each end and one in the middle, and with these it is drawn around a harbor much as a farmer drives his binder around his field of standing wheat. If it strikes no obstruction the hydrographers know that the harbor bottom is clear to the depth of the drag (see page 656).

Another line of information the mariner must have is about the movement of currents, so that his ship may not be

A PLANE-TABLE SURVEYOR MAPPING A SECTION OF SHORE-LINE

In making a survey of a harbor or section of shore-line, it is necessary to prepare a topographic map of the surrounding territory, showing all objects in the landscape that will help the navigator to fix his position (see page 658).

carried around by currents whose presence he does not suspect. Information concerning them is gathered by means of current rods, as a rule. A current rod is an instrument made to float vertically beneath the water, with only its tip showing above the surface, so that it is not disturbed by the wind. Its movement is observed, and the observations give definite information concerning the currents.

MAKING THE CHART

When all the work in the field has been finished, including observations which show the deflection of the magnetic needle, the force goes back to headquarters and begins the task of "writing up" its notes. And a bunch of notes they are to be written up! To make a single chart of a single harbor may require as many as 12 sheets of field hydrographic drawings, 16 sheets of field topographic drawings, 57 volumes of soundings, 22 volumes of tidal records, 20 volumes of trigonometric records, 7 volumes of altitude records, and 8 volumes of magnetic records.

Obviously the proposed chart cannot be as big as the area it is to represent, so the first thing to be determined is the scale to which it is to be drawn. In representing a harbor the usual scale is approximately half a foot to the mile, or exactly one foot to ten thousand feet. For ordinary navigation along the shore, where ships keep outside the 100-fathom line, a foot on the chart may represent nearly 80 miles, or, to be exact, 400,000 feet. On charts used to approach the coast the usual scale is about a foot to 16 miles, or one foot to 80,000, to be exact again. In all cases a foot on the chart represents just as great a distance on the land or on the water as a clear exposition of the facts to be placed on the chart will permit.

After the map is drawn it is reproduced either on copper plates or on aluminum plates. By photography a copy is made from the drawing, and this is laid down on the copper to fit the latitude and

MEASURING A BASE-LINE

In all Coast and Geodetic Survey work the accurately fixed and measured base-line is the foundation upon which everything else rests. It is measured by the use of invar tapes, which are almost wholly unaffected by heat or cold. The tape is stretched under a uniform tension, hence the spring balance in the picture. The marks for each tape-length are made in hardwood posts firmly set in the ground (see page 665).

longitude marks. The impression is then chemically fixed on the plate, and the engraver, who must have a high degree of skill and accuracy, proceeds to work. The figures showing the depth of the water at each point are put on the plates by a machine, one man being able to do with the machine the work of several by hand, cutting uniform figures and putting them in with mechanical accuracy.

Printing from copper plates is a laborious process. The ink is first placed on the plate and then wiped off with the palms of the hands of the operator and his assistant, leaving only a tiny bit adhering in the engraved lines. It is then run through the press, in contact with wetted paper, after which the prints are calendered by being subjected to a pressure of 600 tons in a hydraulic press.

For cheaper and more rapid work aluminum plates, coupled with the lithographic process, are used. A drawing is made on tracing vellum and then photographed on a sensitized glass plate. Positive plates are made from these negatives, and from these are transferred to the aluminum plates, which have been substituted for stones in the lithographic process. One of the old stones weighed 640 pounds and cost $185; the aluminum plates weigh 5 pounds and cost $4.50.

All the original information upon which every chart is made is filed away, and if one little detail were found wrong 10 years' later the very man who made the error could be located.

100,000 CHARTS ARE DISTRIBUTED EACH YEAR

The vast importance of the hydrographic work of the Coast and Geodetic Survey is illustrated by insurance rates in harbors where it has done its work and in those in which it has done nothing. In Nome, Alaska, for instance, the marine insurance rate is five-eighths of one per cent, the harbor being surveyed. At Kuskokwin, Alaska, the rate is from 1½ per cent to 5 per cent, with the agents not eager for business even at such rates.

The charts of the Survey are kept on sale at all times, and are sold at a price which covers only the cost of the paper and the actual printing. They are furnished to all the ships of the American navy, and the chart-room of one of the big superdreadnoughts contains a series of cabinets where the charts are always kept, ready for reference at a moment's notice. The Hydrographic Office furnishes the same kind of charts for foreign coasts that the Coast and Geodetic Survey furnishes for home coasts.

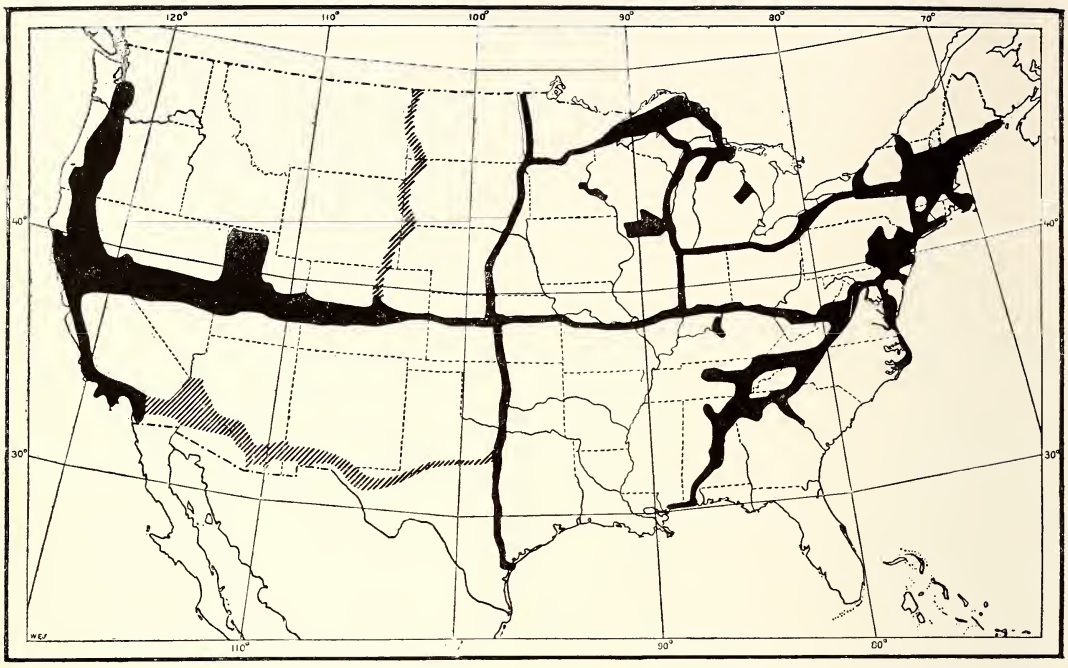
Nearly a thousand different charts have been prepared of the coasts of the United States and its outlying possessions since the Coast Survey was organized. These range in importance from the great charts of New York harbor, where billions of dollars worth of commerce and millions of lives are safeguarded every year, to the charts of places in Alaska, where a ship may not be seen more than once a week, or even once a month. The charts are in great demand by navigators at home and abroad, and the annual sale amounts to more than a hundred thousand copies.

ASTONISHING PRECISION

The geodetic work of the Coast and Geodetic Survey forms a fascinating part of its activities when one looks behind the mathematics involved. It deals with conditions that very many people do not know exist, and requires measurements of a refinement that must eliminate even the personal equation.

When work must be so accurate that it requires the elimination of the difference of the speed with which the eye telegraphs to the brain and the brain to the hand, in two men; when it must be so exact that a line a mile long may turn to the one hand or to the other no more than 1/33 of an inch; when it must reach that standard when the average error is less than one inch in 500 miles in leveling work, it is apparent that the most delicate instruments and the most refined measurements are required. Yet such is the standard set by the Coast and Geodetic Survey for its finest surveys.

It determines the longitude of a place by use of a transit instrument and the telegraph—the transit instrument showing to 1/500 of a second the exact moment at which certain stars cross the meridian of the place, and the telegraph



MAP SHOWING THE NETWORK OF PRIMARY TRIANGULATION IN THE UNITED STATES, ABOUT 10,000 LINEAR MILES BY THE COAST AND GEODETIC SURVEY AND ABOUT 2,000 MILES BY THE LAKE SURVEY

The Texas-California arc, indicated by shading in the lower left-hand portion of the illustration, and the one hundred and fourth meridian arc, similarly shown in the upper portion of the illustration, between the one hundredth and one hundred and tenth meridians, are the most recently completed of the larger arc. The former extends from central Texas to the Pacific coast, is 1,220 miles in length, covers an area of approximately 48,400 square miles, and determines the geographic positions of more than two hundred monumented stations and permanent objects. Connections were made with monuments of the international boundary between this country and Mexico and stations of detached triangulation by the United States Geological Survey.

Primary triangulation is necessary as a framework for coördinating and placing on a single basis all maps and charts made by the Federal and State governments. Monuments of a number of State boundaries are already connected with the triangulation net, and should they and all other evidence of the boundaries be destroyed, it is possible to replace them within a very few feet. It is planned to extend this triangulation until no place in the country is more than one or two hundred miles from a station. Intermediate areas will be controlled by triangulation of a lower order. In addition to the primary, there are many thousands of miles of secondary and tertiary triangulation along the coasts and inland, which furnish the immediate control of charts and maps (see also pages 663–665).

showing the time when they cross the meridian of a place of known longitude. A simple calculation, then, shows the difference of longitude of known and the unknown positions.

The latitude of a place is fixed also by observing the stars, when the Survey does its finest work. With a zenith telescope it notes the exact time when a pair of stars culminate, and after making allowances for refraction, temperature, and the like the determination becomes merely a mathematical one.

In making a survey, after the longitude and latitude of the starting point has been ascertained, a base-line is laid out. Its direction, with reference to the meridian of its starting point, is fixed with great accuracy; the line must not turn to the one side or to the other more than 1/33 of an inch to the mile. The instrument with which this determination is made is known as the theodolite, and consists of a small telescope mounted on a horizontal graduated circle. The lines on this circle are so finely engraved as to be invisible to the naked eye, and the operator reads each measurement by three different microscopes of high power, each of which must tell him identically the same story. Furthermore, he repeats this process of measuring and reading many times, so as to make sure he has avoided mistakes.

The length of the base-line is fixed as accurately as its direction, else all the work that follows would have no value of exactness. In the past these lines were measured with various kinds of apparatus, their accuracy being checked by comparison with a five-meter bar. This bar was a little more than five meters long, but the measuring part of it was the distance between two lines, invisible to the unaided eye, engraved upon iridium plugs inset in its surface. While in use, the bar was kept at a constant temperature by melting ice packed around it. The trough supporting the bar was mounted on a carriage moving upon a track built for the purpose. The successive positions of the ends of the bar were determined by high-powered microscopes firmly attached to heavy posts solidly planted in the ground.

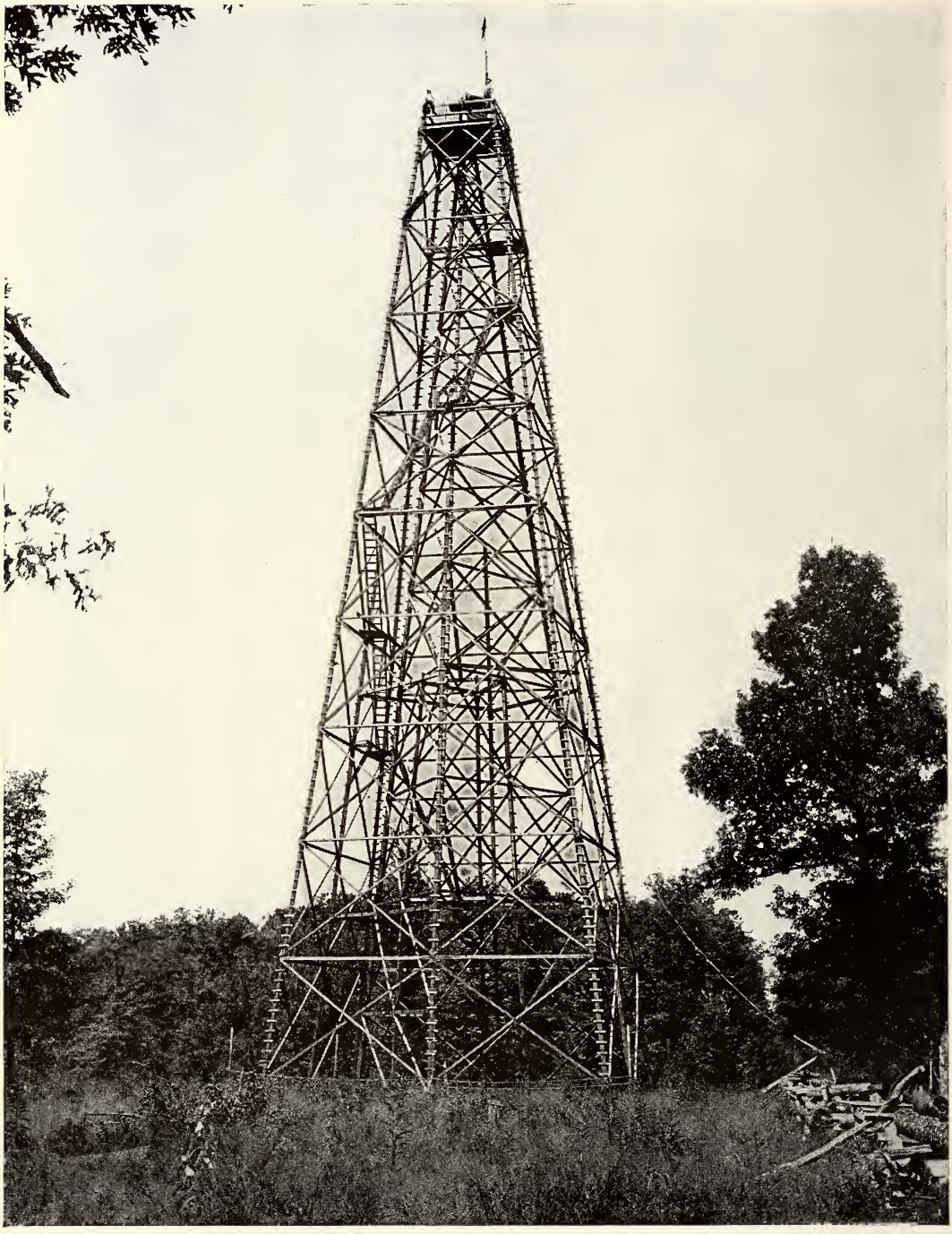
This method, slow and expensive, even when used to check the work of simpler apparatus, has in late years given place to the invar-tape method. Invar tapes are made of an alloy of nickel and steel, and their lengths are practically exempt from the influences of heat and cold. They are used in connection with spring balances, which determine the amount of tension on the tape at the moment of measurement. This method is as cheap as it is accurate and permits much more frequent base-lines, and therefore there is less liability to error (see page 662).

DIFFICULTIES OF THE WORK

The position of the starting point determined, the length and direction of the base-line measured, the distances between hundreds of other points are fixed by triangulation. The surveyors take one line of known length, and from its two ends observe two other directions to a common meeting point, thus making a triangle. By measuring the angles of the triangle they can determine the distance between the two ends of the base-line and the third point more rapidly than if they had taken a standard meter-bar packed in melting ice and laboriously measured the entire distance up hill and down dale, across river and over mountain peak.

In some of the triangulation in mountainous country the lines joining adjacent stations are frequently as much as a hundred miles long, and for such distances special signals have been devised. In daylight observations are made on the heliotrope, a reflecting mirror which reflects the rays of the sun to great distances. The most satisfactory signal, however, is a high-powered automobile headlight used at night. Some of these lamps in the atmosphere of Arizona have shown distinctly through the telescope of the theodolite over a distance of 120 miles (see page 669).

In triangulation work high mountains are desirable, as they more than atone for the difficulty involved in scaling them by the great area of country they spread before the observer. When work is done on level or nearly level ground or in heavily wooded country, it is necessary



A TRIANGULATION STATION

When doing triangulation work in a level or wooded country, it is sometimes necessary to build a high tower that will bring the observers above the trees and buildings of the neighborhood and afford them an unobstructed view of other towers or natural objects in the distant landscape. On the coast of Washington a crow's-nest was built on a tree-top and an elevation of 215 feet was secured.

to build high towers if the distance be long and to overtop the trees if they interfere. In a perfectly level country, with a line of 20 miles, the towers must be 60 feet high to overcome the curvature of the earth and to make the line clear between the light and the theodolite.

THE GREAT ARCS OF TRIANGULATION

The progress of the Coast and Geodetic Survey is graphically shown in the map on page 664, which reveals the fact that a band of triangulation has been stretched from the frontier of Maine along the coast to the mouth of the Rio Grande. Here a line has been run due north to the Canadian border, where it intersects with the boundary between North Dakota and Minnesota. From this arc, at a point not far west of Fort Worth, a line swings westward to the California coast and thence to Puget Sound, and thence along the Canadian boundary to the line extending north from the mouth of the Rio Grande.

Another great line cuts across the country from San Francisco due east to the Blue Ridge and Allegheny Mountains, where it intersects another line running from the Maryland line to Mobile, Alabama. This latter line has a greatly extended area in the vicinity of the approximate juncture of the boundaries of Tennessee, North Carolina, Alabama, and Georgia. A short-line has also been run across the northern neck of Florida, one up the Mississippi, one from a point south of Denver to the Canadian line, and one from the North Dakota-South Dakota-Minnesota intersection to the western shore of Lake Superior.

In addition to these, there are a number of disconnected surveys here and there over the country and a number of reconnaissances or preliminary surveys. Upon these lines of triangulation are based all the exact knowledge we have concerning the exact location of surface of the United States as a geographic entity.

THE GREAT CASPAR SIGNAL

When surveying in Mendocino County, California, a signal tower was built round a great tree, the trunk of which was used to support the top of the tower, and in this way the instruments were elevated to the height of 135 feet above the ground.

THE METAL DISCS WITH WHICH THE COAST AND GEODETIC SURVEY MARKS ITS TRIANGULATION STATIONS

Each triangulation is marked by brass and iron discs as shown in the picture. These marks are useful not only to members of the Survey who desire to relocate positions, but also to private surveyors who desire to connect their survey with one of these control points.

Every survey must have a beginning, and the beginning point of the great national triangulation survey is a point in Kansas formerly known as the United States Datum, but now as the North American Datum. All surveyors' lines in the United States eventually will lead from here, as all roads led to Rome in a bygone civilization. Canada and Mexico have adopted the North American Datum, so that practically the whole of North America which has been connected trigonometrically is hitched to this point.

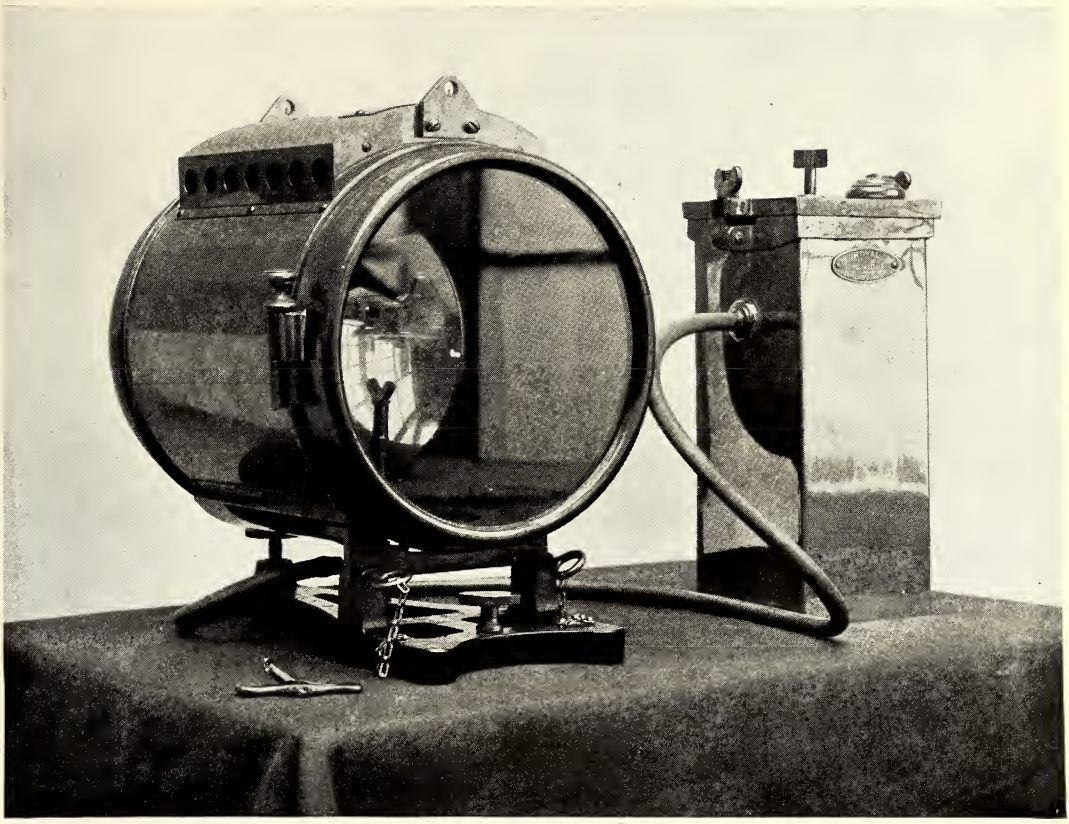
So carefully have all the different surveys been made that they may all be put together and the lines fit perfectly. Any one familiar with surveys made on each side of a river, and how hard it is to get them to fit together, in ordinary practice, can understand what accuracy has been required to bring all the different surveys of North America into such harmony that from every point already fixed a skilled man from the Coast and Geodetic Survey could run his line right back to the North American Datum, in Kansas.

Of late years many cities have found it necessary to order a triangulation of their territory, in order to connect their surveys with those of the Coast and Geodetic Survey. There was much confusion encountered in the offices of city surveyors in trying to connect their layouts of streets, lots, parks, and other works and areas with the big federal survey. These triangulations cover such cities as New York, St. Louis, and Boston, and are now in progress in San Francisco and Cincinnati. Maryland has had all her oyster beds located by the United States triangulation surveys and their positions fixed with reference to the United States Datum and the stars.

DETERMINING THE EARTH'S SHAPE

The work of the Survey in measuring with great accuracy the surface of the United States has not only had its practical uses, but its scientific uses as well. The diameter of the earth is the primary yardstick by which all celestial distances are measured, and the exact length of this astronomical yardstick cannot be known until the shape of the earth is determined with great accuracy. So important is this work that 21 nations are linked together in an international agreement for the support of the International Geodetic Association and the promotion of its work of earth-measurement. A central bureau is maintained at Telegraphenberg, Prussia, and triennial conferences of the science of geodesy are held.

The work of the Coast and Geodetic



ONE OF THE POWERFUL LIGHTS WHICH FLASH SIGNALS 100 MILES

These signals are used to flash from one triangulation station to another making observations at night. The lamps are lighted by acetylene gas, and the reflectors are so powerful that the light has been seen through the telescope of a theodolite for a distance of over 100 miles (see page 665).

Survey has proven so accurate that the world now recognizes the figure of the earth determined by it as the best available, and for that reason it was adopted as the standard by the International Convention of Astronomers, recently held at Paris.

MAPPING WITH CAMERAS

In recent years the Survey has been employing the camera in making its topographic surveys, thus being able in some instances to do away with the plane table. This method of topographic surveying is especially useful in such regions as Alaska, where difficult country and bad weather conspire against the successful use of the plane table. The cameras are specially prepared, cross wires being fixed to the lens and the scale being so arranged that they appear with the view upon the photographic plate. The chief precaution necessary is that each prominent topographic object shall be photographed from at least two points (see page 674).

The work of triangulation and precise leveling sometimes requires the endurance of great hardships and affords many adventures. These involve all the dangers and experiences that go with scaling the Alps or climbing a Mt. McKinley. Tugging instruments up a mountain-side, where the slightest misstep would carry the bearer to the bottom of some terrible chasm or precipitate him into some madly rushing, ice-cold mountain stream, is no summer-evening picnic at best.

Now one of the Survey engineers may be heading a party on the 141st meridian that divides Alaska from Canada, where today they scale a great mountain peak within the Arctic Circle, tomorrow battle

SURVEYING FROM A MOUNTAIN TOP

In making a geodetic survey, absolutely flat country is a much greater obstacle to the surveyor than a range of mountains. Indeed, a high mountain, commanding extensive views in all directions, is often a godsend, as it may serve as the apex for triangles drawn in all directions. Here is such a mountain, Uncompahgre Peak, on the summit of which, 14,289 feet above the sea, a triangulation station was erected when surveying the Colorado arc (see page 665).

with an epidemic of smallpox among the Eskimos, and a few days later are down in a little valley where the mosquitoes are so thick that even a horse cannot graze unless it be protected by nets. Now one of them is at work with a party in the Rocky Mountains, fording streams that are bordered with quicksands, shooting down rapids that threaten every moment to swamp canoe, party and all.

But whatever the task of the men, they learn to live with the thought uppermost in their minds that he who is willing to bear the heaviest burden will find every other member of the party ready to help him bear it.

Men go to Africa to hunt big game; they go to South America to explore new rivers; they go to Switzerland to climb high mountains; they go to the heart of Africa and the interior of Tibet to find strange people; but the men who make the basic surveys upon which our knowledge of the shape of the earth and our maps are based get all the thrills and all the experiences that come to them all, and get back to Washington safe and sound and ready for the prosaic work of writing up their notes.

A MAGNETIC SURVEY

Accurate surveying such as is involved in the triangulation work of the Coast and Geodetic Survey would not boot much on land or sea were definite information not at hand concerning the behavior of the magnetic needle. The magnetic needle refuses to stay put anywhere, and varies from the true north in different degrees in different parts of the earth. For instance, in London it changed its direction 35 degrees in the 232 years preceding the outbreak of the War of 1812. Then it began to swing back again, and up to the present time has moved east nearly 10 degrees. The change is by no means as rapid in the United States as it is in London, but at the same time it is enough to interfere with every survey if the rate of change were not known. As the rate varies between London and Washington, so it varies in different parts of the United States.

In order to determine the declination of the magnetic needle innumerable observations have been made all over the United States, and the exact declination for each place has been ascertained. In the section east of the Rocky Mountain States there is scarcely an area 50 miles square where the variation of the needle has not been measured and passed on to the State and local surveyors, and in few places are these points of needle observation more than 20 or 30 miles apart. The method by which the variation at a given point is found is to compare the north of the compass needle with the true north revealed by the theodolite. The difference is the variation of the needle.

THE MAGNETIC NEEDLE IS NEVER STILL

If the behavior of the needle is important on land, it is even more so on the sea. A boundary a mile long fixed by the compass in Maryland in 1802 would now have its one end some 525 feet away from the original location if the survey now did not allow for the change in the variation of the compass since 1802. But on land points can be located without the use of the compass. On sea the compass is yet indispensable, and the navigator must constantly allow for its continual changes, else some fine night he would find himself high and dry on a reef when he thought he was miles away from it. For instance, the declination of the compass at Key West is 2 degrees east, while at New York it is 10 degrees west. Did a skipper steer through his voyage from Key West to New York on the assumption that the declination was the same at New York as at Key West, he would run into the coast somewhere south of a point 19 miles west of New York.

The Survey maintains observatories at Cheltenham, Maryland; Baldwin, Kansas; Sitka, Alaska; Vieques, Porto Rico, and near Honolulu, Hawaii, where the behavior of the magnetic needle is under constant observation and study. There are places where the compass needle varies from forenoon to afternoon enough to make a difference of from 5 to 20 feet in a mile-long line, and places where there have been sudden and unaccountable changes such as occurred

SURVEYING UNDER DIFFICULTIES IN ALASKA

This picture gives an idea of some of the difficulties encountered by the surveyor. To obtain the necessary elevation the instrument had to be taken to the top of a snow-clad mountain peak, which was so small that it hardly afforded room for the instrument and the two observers

at Los Angeles during a violent storm, when the needle shifted more than 1½ degrees in a few hours. All these phenomena are carefully studied in the hope of discovering ultimately the secrets of magnetism.

A magnetic map of the United States is made showing the lines of equal magnetic declination and those of equal dip. For instance, the map for 1905 shows that 5 degrees east declination runs almost due north and south, while 10 degrees east crosses the Canadian boundary near the Lake of the Woods, Minnesota, and swings around to the southwest, reaching the Pacific Ocean across Lower California. The 70-degree line starts in in the neighborhood of the southern Delaware boundary, and sweeps through northern Virginia, southern Ohio, and middle Nebraska, reaching the Pacific through southern Washington.

The magnetic map is always changing, but the information is carried with it which enables the mariner or the surveyor to make the necessary corrections at any given point.

PRECISE LEVELING

The United States Coast and Geodetic Survey has established precise levels in every section of the United States, marking the altitude at convenient points by means of bench-marks. These marks are the beginning points of all local surveys, such as are necessary in railroad location, water-works planning, and the like. The maximum error allowed in this work is one-fifth of an inch to the mile. In recent years a large number of long circuits have been made, and where these are closed the maximum error has been about one five-hundredths of an inch to the mile. This applies to the precise leveling of over 4,000 miles of line.

Precise leveling is now done with a spirit-level attached to a telescope designed and made by the Survey itself. By the use of a nickel-iron alloy changes due to temperature conditions are practically eliminated. One of the officers of the Survey declared that he could take one of these levels, put it into the hands of the youngest engineer in the Survey, and get better results than the best engineer the American Society of Civil Engineers could get with any other level. After inspecting the Coast and Geodetic level the challenge was not accepted. Many other countries have adopted this instrument in all their leveling operations (see page 675).

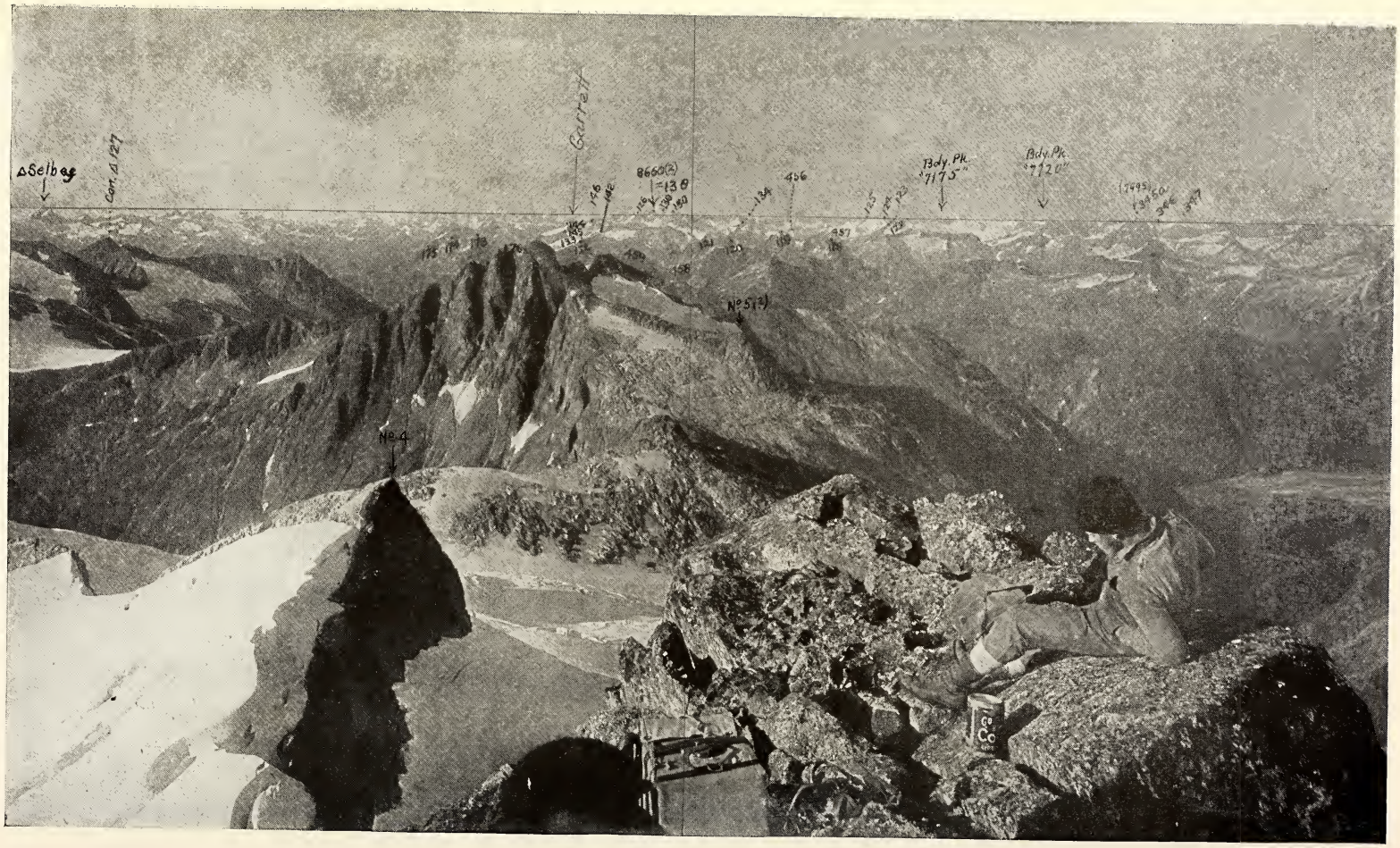
Some leveling is done by the measurement of vertical angles, although this system is not regarded as accurate enough for the finest work of the Survey.

THE TIDES

In addition to its other work the Coast and Geodetic Survey keeps the records of the tides, and furnishes tables which show the fluctuations for every hour and every day for as much as a year ahead. The Survey has made a great mechanical prophet that can predict the recurrence of tides as accurately and as unerringly as an astronomer can predict the coming of a solar eclipse. Its brain of brass can, with the aid of one man, calculate the recurring tides as rapidly as a hundred brains of flesh and blood can do it (see page 676).

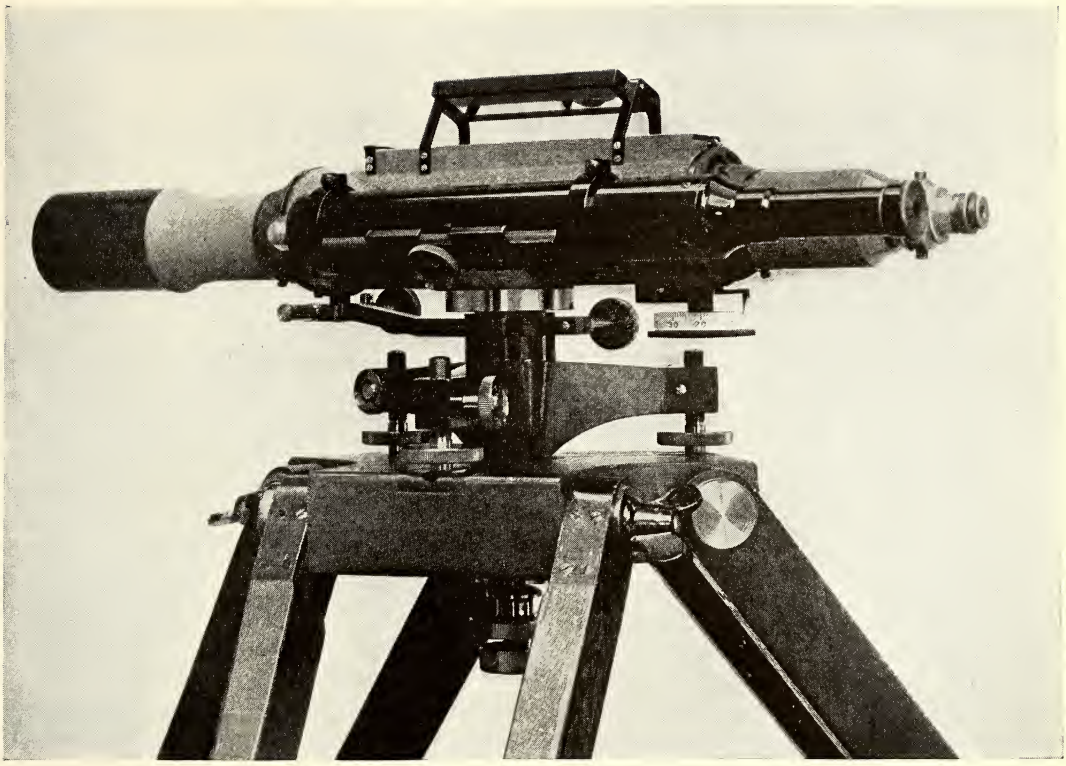
The machine is known as "United States Tide Predicting Machine No. 2." The operator turns a crank until it stops. He then copies the readings on a number of dials and removes from the machine a roll of paper on which is plotted a tidal curve. This process is repeated until tide-tables have been prepared, showing the height to the nearest tenth of a foot of every high and every low tide at a given seaport for every day in the year. This is repeated for some seventy big seaports and in less complete form for 3,000 others.

There are 37 factors in the making of tides, sometimes all of them entering into the process and sometimes fewer of them. We know that they are produced by the force of gravity between the earth, the sun, and the moon, and the tide-predicting machine is simply a mechanism that brings these bodies into their proper relations for every hour and every day of the year, and automatically computes the effect of these relations on the tides and registers it on the dials.



MAP-MAKING FROM PHOTOGRAPHS

This photograph was taken by a camera specially designed for photo-topographic work (see page 669). The rear frame of the inner camera box is supplied with notches to mark the horizon and the principal lines. All these notches print on the edges of the negatives, giving ready means for checking distortions in the prints, and at the same time showing the scale in conjunction with the cross-lines. In this picture, reading from left to right, two triangulation stations are shown, then a camera point (marked No. 4), then the height (in meters) of four peaks, etc. From such photographs it is possible to construct an accurate map of the region within the field of vision.



THE MOST PERFECT PRECISE LEVEL IN THE WORLD

This level was designed and made by the Coast and Geodetic Survey and is recognized by engineers as being superior to every other known make. It can produce more rapid and efficient work for a less cost than any other type. It has been officially adopted not only by the government of the United States, but also by those of India, Mexico, Canada, and Egypt (see page 673).

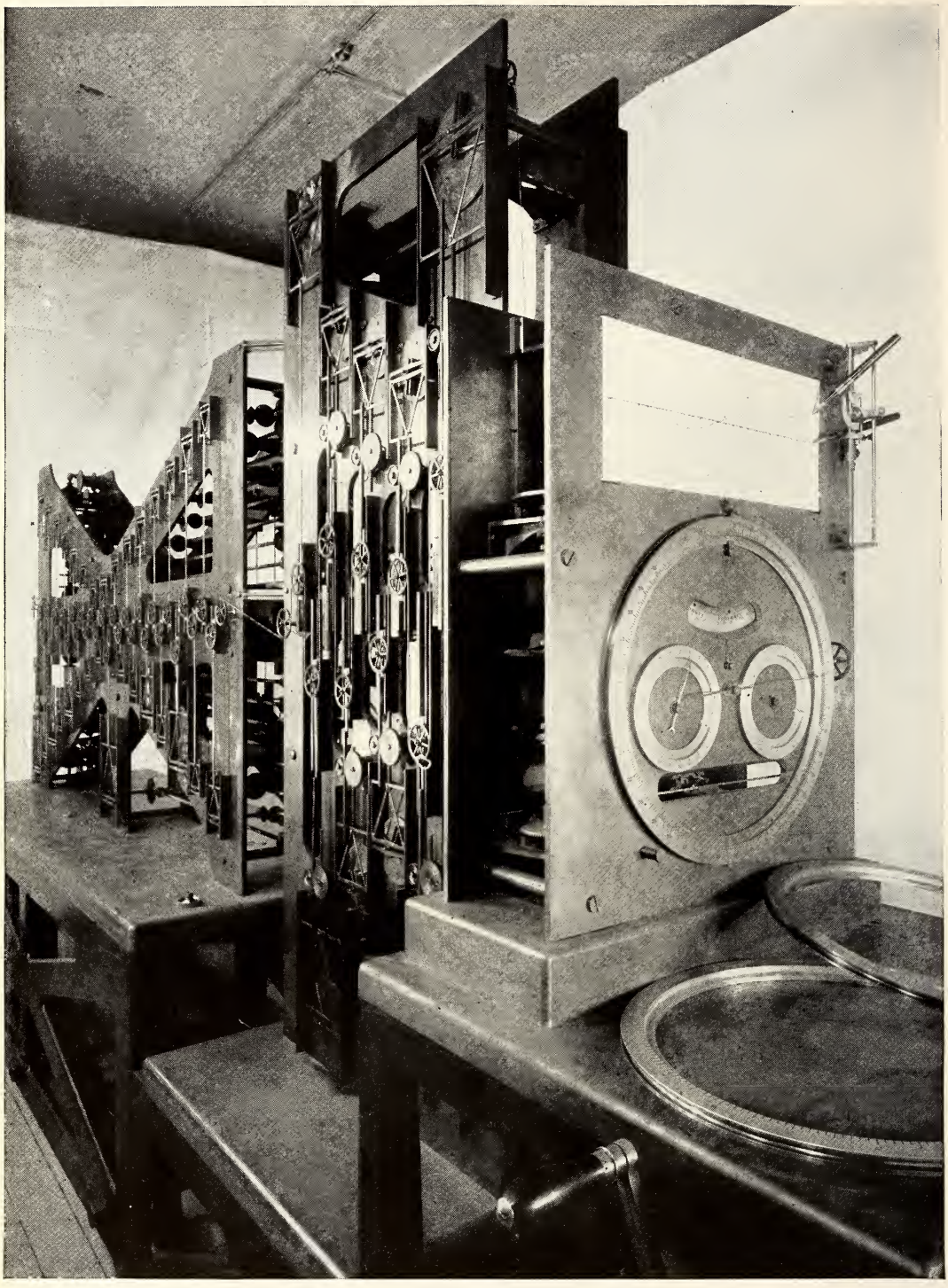
We say that it is simply a mechanism that does these things; but when it is remembered that the machine has 15,000 parts, and that 15 years of careful work were required in its construction, we understand that it is not very simple after all.

The records made by this machine are used wherever men sail the seas, and as the question of a foot or two in depth on a dangerous shoal may involve the lives and the property on a passing ship, while the commercial prosperity of a port may depend upon information about the tides, this great machine serves more than a theoretical purpose. Its tabulations do for the waters what the American Ephemeris and Nautical Almanac does for the stars in aiding navigators.

THE WONDER OF THE TIDES

The tides are among the most remarkable phenomena in the world of nature, and they give rise to many peculiar notions concerning the level of the oceans. The tide at Panama, for instance, rises much higher than the tide at Colon, and this leads many people to think that the Pacific has a higher level than the Atlantic. As a matter of fact, however, while the tidal fluctuations on the Atlantic side have a range about 2 feet and those on the Pacific side a range of about 20 feet, the level of the oceans is the same. The difference is caused by the narrowing shoreline of Panama Bay, which takes a broad expanse of water as it enters the bay and narrows it down as it sweeps into the V-shaped entrance. What it loses in breadth it must make up in depth, and hence the higher tides on the Pacific side of the Isthmus at Panama.

The same phenomenon is witnessed in the Bay of Fundy, where at the head of



A MACHINE THAT PROPHESIES

This machine—the only one of its kind in the world—will predict the tides at any seaport as much as 100 years in advance. It is used in the compilation of the tide tables issued each year by the Coast and Geodetic Survey. A simple turn of the handle will record on the dials the time and height of the water at high or low tide for each day in the year at any selected port, and at the same time trace a tide curve which forms a permanent record of its predictions. The machine—an improvement of Lord Kelvin's tide-curve machine—was designed and constructed by the Coast and Geodetic Survey and is a triumph of applied science.

the bay the rise is 55 feet above sea-level. At spring tides the water in the Bay of Fundy is 19 feet higher than in the Bay of Verte, only 15 miles distant.

The mechanical division of the Survey is a wonderful place to visit, as may be inferred from the fact that it can make theodolites so accurate that in the triangulation between the Maryland and Georgia base-lines the discrepancy was less than half an inch in 30 miles, and that it can make precise levels so accurate that the maximum error is an inch to 500 miles. In addition to the marvelous tide-predicting machine, it has a circular dividing engine with which it constructs the scales on the graduated circles. This engine has a spindle 4 inches in diameter, tapering three-quarters of an inch to the foot. This spindle must fit into its bearing so nicely that it has less than 1/10,000 of an inch play. Before the dividing engine can be set to work the room must have been subjected to a uniform heat for several days, in order that every part of the walls may be uniformly warm, so as to prevent air-currents from interfering with the accuracy of the work. The room is kept at blood heat, so that the presence of the supervisors of the engine's operations do not interfere with its accuracy.

The Coast and Geodetic Survey was founded in 1807 under President Jefferson, and was then known as the Coast Survey. Its greatest work dates from 1878, when it was broadened to its present scope. Today it employs 700 men, and has become one of the Federal government's most important bureaus, serving well the practical needs of every-day life, and at the same time pioneering in paths of science in a way that has added and is adding to the fund of human knowledge on the subjects with which its investigations deal.

HONORS TO COLONEL GOETHALS

The Presentation, by President Woodrow Wilson, of the National Geographic Society Special Gold Medal, and Addresses by Secretary of State Bryan, the French Ambassador, the German Ambassador, and Congressman James R. Mann

THE ninth annual banquet of the National Geographic Society was held at the New Willard Hotel, Washington, D. C., on the evening of March 3, 1914, and was made the occasion of the Society's formal recognition of the eminent services of Col. George W. Goethals, U. S. A., to geography and to the world as the builder of the Panama Canal.

Among the members of the Society and guests present, numbering more than 800, were the President of the United States, with a majority of the members of his Cabinet—Secretary of State Bryan, Secretary of the Interior Lane, Secretary of the Treasury McAdoo, Secretary of Agriculture Houston, Secretary of the Navy Daniels, Secretary of War Garrison, Secretary of Labor Wilson; members of the Supreme Court, Senators and Representatives from nearly every State, diplomatic representatives of every great foreign nation, officers of the Army and Navy, and men and women prominent in the world of science and letters.

The tables were arranged in the form of a huge gridiron and the banquet hall beautifully decorated with flowers and flags. Behind the speakers' table, high overhead, there was a great blaze of electric lights spelling the union of the oceans and the completion of the canal in the words

ATLANTIC—GOETHALS—PACIFIC

The tributes which were paid to the guest of honor by the speakers of the evening were enthusiastically received by the vast audience. Colonel Goethals was accorded an honor which has been achieved by few men—the distinction of receiving at the hands of the President of the United States a gold medal in

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"A, B, C" IN SPANISH—FLOWERS, BIRDS, AND VISITORS AT A PRIMARY SCHOOL: JALAPA, MEXICO

While the children of the peons seldom go to school, either because of indifference to the advantages of education or lack of school facilities, the children of the well-to-do enjoy educational advantages equal to those of other countries.

recognition of his services to his country and the world.

President Wilson's presentation speech conveyed to the great engineer the thanks of the nation, and when he said that the name of Goethals was now written where only the wiping out of our present civilization could cause it to be forgotten, and called upon him to rise and receive the highest honor in the gift of the National Geographic Society, the outburst of applause which swept over the vast audience almost drowned the voice of Colonel Goethals as he tried to find words in which to voice his appreciation of the honor done him.

It was plain that he felt more at home "dividing the land and uniting the world" at Panama than he did in receiving a medal in recognition of his work.

Every speaker of the evening lauded the work of the Americans at Panama and praised the men to whom the world owes the canal.

Before presenting the French Ambassador, Mr. J. J. Jusserand, the Toastmaster, Secretary Bryan, announced his election as an Honorary Member of the National Geographic Society, "for the double reason that his nation deserves a part in this great undertaking, and because of the personal interest that he has always manifested in the work of this Society."

At the end of the speaking Secretary Bryan, the Toastmaster, proposed a toast to the wife who had stood by her husband so loyally during the long and trying siege of work that had been his lot at Panama.

The special medal of the Society is made of heavy Roman gold and bears the following inscription:

"This special medal of the National Geographic Society is awarded to George Washington Goethals, to whose ability and patriotism the world owes the construction of the Panama Canal, March 3, 1914."

A special medal of the National Geographic Society has been awarded only twice before—to Robert E. Peary, December 15, 1909, "for the discovery of the North Pole, April 6, 1909," and to Roald Amundsen, January 11, 1913, "for his Antarctic achievements, resulting in the attainment of the South Pole, December 14, 1911."

ADDRESS BY DIRECTOR GROSVENOR

Mr. President, Members of the National Geographic Society:

Owing to the sudden, but not serious, illness of our learned and loved President, Dr. Henry Gannett, and also to the illness of our Vice-President, Dr. Tittmann, the duty of welcoming you here this evening has unexpectedly come to me at the last moment.

On behalf of the Society, I express our very deep appreciation of the fact that the President of the United States, Hon. Woodrow Wilson, whom we all most devotedly serve, has by his presence honored the tribute which we are giving to the man whose genius built the Panama Canal.

Before introducing the Toastmaster of the evening, I ask your indulgence for a few moments while I read a few statistics about the work of the National Geographic Society. The 12 months since we last met in this hall have made the most successful year in the history of the National Geographic Society. Seventy-four thousand new members have been added to the enrollment, making the total present membership of the society two hundred and sixty-one thousand.*

These are distributed in sixteen thousand towns, villages, and hamlets in the United States and in two thousand cities in foreign countries. California in proportion to its population is our banner State, with a membership of twenty-five thousand. New York City leads our cities, with an enrollment of nineteen thousand. There is not a community of one hundred white people in the United States where a member of our Society cannot be found.

The explorations and educational work of the Society during the past year have kept pace with the increase in membership. We have been continuing our researches in Alaska, in Peru, and elsewhere.

Our Magazine has become perhaps the greatest educational journal in the world.

*The membership on June 15, 1914, is 289,000.

It reaches thousands of schools and libraries and is inducing more than one million people each month to read of geographic matters. One month's edition, if the copies were placed one above another, would make fifteen piles as high as the Washington Monument, or, if placed on a book-shelf, would reach from the White House to the Capitol and back again. The Magazine yields the funds to pay for our exploration; for, unlike other scientific societies, our Magazine supports the Society instead of being a drain upon the organization.

These figures are given that all here may appreciate that the ambition of the Society to increase and diffuse geographic knowledge and help the cause of international good-will is being realized.

Through our Magazine we are bringing our citizens nearer to other peoples and also bringing other peoples nearer to us.

It is now my privilege to present one of the most distinguished members of our Society, Hon. William Jennings Bryan, the Secretary of State, who will direct the proceedings of the evening.

THE TOASTMASTER, WILLIAM JENNINGS BRYAN, SECRETARY OF STATE

The task of a Toastmaster is always the easiest on the program and easier tonight than it usually is, because those who are to speak to you do not require to be presented with an elaborate explanation. Especially is that true of those who appear as the first and second.

A medal given by this Society will be presented to the guest of the evening, and when the greatest Geographic Society of the world is to honor the most illustrious member of his professon on the globe, because of the successful completion of the most gigantic engineering feat in history, there is but one person to present the medal, the President of the United States.

ADDRESS BY PRESIDENT WOODROW WILSON

I am now so unaccustomed to public speaking that it was with genuine hesitation on my own account that I accepted the invitation of this evening. But I accepted it as a matter of course when the great compliment was paid me of extending it to me, because it seemed to me that it was not only a personal privilege which was offered, but a duty encumbent upon me as a representative of the government of the United States. It seemed to me that, speaking for that government, as well as for the distinguished Society in whose name I am now presenting this medal, it was my duty as it was my privilege to be here.

I am here to do what I suppose is an unusual thing for a Society of this sort. It generally confers its honors upon those who have disclosed geography rather than upon those who have altered it. It is a sort of advertiser and custodian of the globe, and it is now about to honor a gentleman who has had the audacity to change the globe.

The engineering profession is one of the few creative professions. Those of us who have attempted to be literary men conceive that we have created conceptions of the mind, but we never can produce them in court. They are never visibly upon exhibition. But the magic of the engineer is that he can change the face of nature and show the work of his hands, and that it is in some deep sense creative in character. The life of mankind on the globe is altered, for example, by the cutting and the use of the Panama Canal.

It fails the imagination to think what this work will accomplish. It will create new neighbors. It will generate new friendships; it will make a new atmosphere of rivalry and of generous association. The whole tendency of the routes of trade will be changed, and the routes of trade are the routes of enlightenment. Only when nations touch one another do they cease to be provincial and look out upon the great tasks of humanity, instead of confining themselves to the relatively selfish tasks of their own domestic development, and it is only as we export and import ideas that civilization becomes thoroughly established.

We have, therefore, to honor tonight the greatest living representative of this extraordinary profession.

It seems to me natural, if I may say so with apologies to some of our friends present, that the greatest engineer living should come from the United States.

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SELLING "HOT" PEPPERS—THE MEXICAN'S CHOICEST DELICACY: MARKET AT CORDOBA, MEXICO

"Hot food" with the Mexicans is more a matter of seasoning than of exposure to heat. Chili con carne and hot tamales have come with their fame to our own shores, but they are only two of the more than 57 varieties of "hot" things the Mexicans eat with evident relish and coming appetites. And "hot" peppers form the keynote of them all.

Photo and copyright by Underwood & Underwood

A SPLENDIDLY EQUIPPED CARPET FACTORY OF SANTA GERTRUDE, NEAR ORIZABA, MEXICO

During the rule of Porfirio Diaz textile factories, employing thousands of laboring people, came into existence in Mexico. They were mostly owned by foreign capital, and through them a middle class was gradually being developed.

The United States has made the world very uncomfortable, but it has at least done so by the exercise of extraordinary dynamic qualities. It is not one of the statical nations of the world. It is one of the nations which has disturbed equilibriums, which has cut new paths for the thought and action of mankind.

And now there is to be elevated and kept always on high at this new gate, upon which men are to enter the roads of new experience, a name which will not be blotted out until and unless the whole civilization of the world should change, the name of Colonel Goethals.

The government of the United States lent him to the world, and he has done this thing for the world, for it is our proud boast that we have cut this highway for all the sea-going ships of the world.

GAILLARD, GORGAS, SIBERT, HODGES

I take it for granted that we do not tonight forget that distinguished group of men who have been associated with Colonel Goethals; that gallant and devoted soldier, Colonel Gaillard, who gave his very life to see that a great work was done at the Culebra Cut; that man who made so much of this work possible, Surgeon General Gorgas, by knowing how to hold disease off at arm's length while these men were given leave to work; also Colonel Sibert, who built the Gatun Dam and created the Gatun Lake, making it look to the eyes of the uninitiated as if nature had done the work over which he himself presided, and also Colonel Hodges, who made the locks and the machinery by which these great things are administered.

But we are merely tonight acknowledging the presiding character and genius which drew all the elements of this work together, which made it a work done by colaborers, not by rivals; work done as if it were the conception of a single mind; work done in the spirit of service and self-effacement which belongs to a great servant of a great government. There is nothing selfish in the eminence of Colonel Goethals. It is representative of a great profession. It is representative of a great government. It is representative of a great spirit.

I am glad that this thing was not done by private enterprise, and that there is no thought of private profit anywhere in it, but that a government put itself at the service of the world and used a great man to do a great thing. That is the ideal of the modern world, that the services to mankind shall be commonly shared.

And so I esteem it a real privilege, acting on behalf of this Society, to present to you, Colonel Goethals, this very beautiful medal. It is made of mere gold, and gold is of no consequence in this connection, sir; but it speaks, in the most precious metal we know, the gratitude and the admiration of the nation.

RESPONSE BY COL. GEORGE W. GOETHALS, U. S. ARMY

Mr. President, it is an easier task to build the Panama Canal than it is for me to find words to express appreciation of the honor conferred upon me by the National Geographic Society and the distinguished manner in which the presentation of the medal has been made. This medal represents the satisfaction of the National Geographic Society at the practical completion of the canal and its approval of the services rendered. Those services are not only individual services, but national services. The French were the pioneers in the undertaking. But for the work that they did on the Isthmus we could not today regard the canal as practically completed. But for the English we probably would not have known the means of eradicating malaria; the death rate would have been great. Among individuals we have national representatives in the Spanish and the English in our laboring force.

The canal has been the work of many, and it has been the pride of the Americans who have visited the canal to find the spirit which animated the forces. Every man was doing the particular part of the work that was necessary to make it a success. No chief of any enterprise ever commanded an army that was so loyal, so faithful, that gave its strength and its blood to the successful completion of its task as the canal forces.

And so in accepting the medal and thanking the National Geographic So-

ciety for it, I accept it and thank them in the name of every member of the canal army.

SECRETARY BRYAN

The Isthmian Canal is an international work. It connects the oceans that wash the shores of every land, and through it will pass the commerce of all the nations. It is fitting, therefore, that we shall have as participants in the program of this evening those who in an eminent way represent the nations which will take conspicuous advantage of the opportunities which this canal will offer, and at our table tonight we have as one of the speakers the representative of one of the great nations of Europe, one of the nations whose growing fleets are known in all the corners of the earth. I have the honor to call upon His Excellency, the Ambassador from Germany, to give his testimony to the greatness of this undertaking and pay his respects to the genius under whose guidance the work has been accomplished.

ADDRESS BY THE GERMAN AMBASSADOR, AMBASSADOR VON BERNSTORFF

When I received the kind invitation to attend this splendid banquet, I accepted with the greatest pleasure because it afforded me the occasion to renew my friendly relations with Colonel Goethals, the greatest engineer of these days, who has presented to the world an engineering feat which in ancient days would have been called one of the Seven—I do not know how many wonders of the world we have now.

I had also wished to meet the charming wife of Colonel Goethals, with whom I had formerly spent a very pleasant week on the ocean. I was not disappointed in that, as I had the pleasure of sitting next to her at dinner.

In one way, however, I must confess that I was very much disappointed this evening, because I had been told that I was to have a very good time tonight and a night off from speaking. A quarter of an hour ago, however, I was asked to say a few words to you, and I am very glad to have this opportunity to thank you for the splendid hospitality afforded me.

The presiding officer of your Society told me before that this Society was carrying on an investigation—one of the many investigations of these days—which was to result in finding a way by which people should work only two weeks in the year and live in happiness and plenty all the rest of the time. Now, if your Society manages to achieve this wonderful result I hope it will be applied to the foreign ambassadors to the United States, because that would mean only fourteen speeches a year instead of about one hundred or more.

These diplomats always feel at home in a society of geographers, because we are what I might perhaps call practical geographers. Without knowing where we are going or whence we come, we are sent all over the globe and we regard the whole universe as our home. It is not always so pleasant as it is here, and we are therefore very glad when on this large globe we find such a pleasant and hospitable home as we all find in the United States.

As a German, I would like to remind you of an incident in the life of perhaps the greatest of my compatriots, Goethe, who a hundred years ago, shortly before his death, was sitting among his most intimate friends, and had just received a book written by Alexander von Humboldt, a name which is familiar to geographers all over the world. It gave a description of Mexico and the surrounding countries, and after having read this book Goethe said to his friends, "I am a very old man, and I have only one wish: that is that I could live long enough to see the Panama Canal built."

He added that he was sure this canal would be built by the people of the United States, because he saw by the energy and enterprise with which they colonized the whole west of this great country that they would surely not miss the opportunity of building this canal. I wish I could evoke his spirit to be among us today. He might find it a queer coincidence that his name is so much like the name of the great man who built this canal.

Before sitting down I wish to thank you once more for your kind hospitality and for the great pleasure you have afforded me tonight.

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THE CATHEDRAL—THE GREATEST OF MEXICAN CHURCHES: NORTHWEST FROM THE NATIONAL PALACE ROOF, CITY OF MEXICO

The cathedral of Mexico City is said to be the largest church in the Western World. It stands on the site of the great temple of the Aztecs, where tens of thousands of prisoners were sacrificed to the sun. Its foundations are composed almost entirely of Aztec images. Its inside dimensions are: length, 387 feet; width, 177 feet, and height, 179 feet. It is estimated that it cost some $2,000,000.

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THE MAGNIFICENT POPOCATEPETL FROM THE LARGEST OF THE ANCIENT AZTEC PYRAMIDS AT CHOLULA, MEXICO

The landscapes on the great Mexican plateau are always filled with interest. A dozen cities surround each of the great Mexican volcanoes, and whether Popo is viewed from Puebla, Mexico City, Amocameca, Cholula, or Cuautla, it is always the same graceful mountain (see also pages 630 and 641).

SECRETARY BRYAN

To build this canal it was not only necessary that some should dream of it, but it was necessary that some one should finance it, and whenever in this country the government needs money it must go to Congress, which controls the nation's purse. We have gone to Congress and Congress has supplied us liberally. All bills have been paid thus far. But it is appropriate that as we are not quite through we should keep on good terms with those who must furnish the balance. And so tonight, with the wisdom that has characterized it in so many ways, the National Geographic Society has taken care to provide that a representative of the House of Representatives should be here to receive your thanks for the money already given and your supplication for that which is needed. I have the honor of introducing to you Congressman Mann, of Illinois.

ADDRESS BY HON. JAMES R. MANN

I can assure the Toastmaster and those who are here that there never has been and that there never will be any difficulty in obtaining all the money that is necessary for the construction and the operation of the Panama Canal, and that is especially true while the Committee on Appropriations is presided over by the genial and handsome gentleman from New York, Mr. Fitzgerald.

I served in the House of Representatives on the committee having jurisdiction in regard to the Isthmian Canal when it was first proposed by Col. William P. Hepburn, of Iowa, the chairman of that committee, that the Isthmian Canal should be constructed not by a private corporation, not by a private enterprise, but should be constructed and owned by the United States itself. We owe a debt of gratitude to him for that proposition, the result of which was the negotiation of a new treaty between the United States and England and the final undertaking of this government by the government itself to construct the greatest civil engineering enterprise which the world has ever known.

The dream of ages was about to come true, the longing of the centuries was to be realized, the hope of the navigators for those years in the past was soon to become a reality, and the two oceans were to be united. There stood the work in contemplation; it only needed the man. Others retired; others despaired. This man retained his confidence; others quit. He kept his commission; others failed; he succeeded. The man and the work came together when Colonel Goethals was placed in charge of this great undertaking.

No one who has visited the Canal Zone and watched the operations of the force there will be surprised to know that that force idolizes the Chief Engineer. He spoke a moment ago of how each man in the work performed his duty with a single eye to true devotion; but you would not know from that that all along the line of the canal, from ocean to ocean, as the Chief Engineer passes by every employee there speaks lovingly, "There goes the old man." And "the old man," as they lovingly call him, tips his hat to every employee, from switchman to his chief lieutenant. He has made them love him; he has made them devoted to the cause. He, with those under him, has made this great undertaking reflect credit upon government, upon national enterprise, upon the American people, upon humanity, upon our own government, because he has succeeded in doing that which no one dared to really hope could be done; that the government in this manner would be able to spend hundreds of millions of dollars in the construction of the great work by direct employment of government officials and employees without serious scandal. It never has been done before on such an enterprise on such a scale, and I hope that our country will recognize that peace may have its victories as well as war.

The heroes of the past have been made in war. Here is a hero whom we ought to put upon a pedestal as an inspiration to our children and those who live now and who come after, that those who do their full duty in time of peace may enjoy the same lofty ideals as those who win in war; and I hope that the title "Colonel" Goethals will soon be gone, and that we will salute him as "General" Goethals.

SECRETARY BRYAN

It might be expected that all Americans sharing in the honor which Colonel Goethals has brought to the nation would be glad to pay tribute to him. It is to be expected that when there is the conjunction, the preparedness and opportunity which constitute success, that we should all rejoice. It is to be expected that we shall all behold with joy and admire the flower that springs from the place where great preparedness and great work meet. But I am glad that on this occasion we can have as a representative of the outside world one whose people began the work which our people completed. This meeting tonight would not be what it ought to be if we did not hear from one of that great nation which first called the world's attention to the fact that it was possible for man to unite these two oceans in perpetual wedlock, and we are fortunate in having as the spokesman of that nation one who can speak so sympathetically to our people, while with such fidelity he represents his own.

The National Geographic Society has asked me to present a certificate of honorary membership to the gentleman whom I am about to call upon. It is presented to him for the double reason that his nation deserves a part in this great undertaking and because of the personal interest that he has always manifested in the work of this Society. Therefore it is my pleasure as it is my honor to present this certificate of membership to His Excellency, J. J. Jusserand, the French Ambassador, and to ask him to represent the nation that gave the initiative to the canal to which we give the completion.

ADDRESS BY THE FRENCH AMBASSADOR, J. J. JUSSERAND

I lack appropriate words to express my gratitude for the signal honor that has just been bestowed on me, especially when I think that it comes from this great National Geographic Society, whose members are as numerous as the sands of the sea—or nearly so, and in which American science is represented by a man like Dr. Graham Bell, the American Army by such an explorer, a pioneer, an early discoverer as General Greely; the American Navy by the man who reached the goal at which so many had aimed and planted the flag of the United States at the North Pole, Admiral Peary.

It is a very great and important thing to hold a record, and on the present occasion, among your honorary members, I certainly hold one—the record of undeservedness. I have no doubt—and in saying so I am acting as a well-wisher of your Society—that I shall hold it long.

I feel in a way guilty in not having better titles, when I think of my youthful preparation and of having been early taught many of the arts useful to explorers: to ride, swim, jump, climb, and even walk. Thus, when small boys, carrying all our luggage on our backs, we did a good deal of exploring in, it is true, not very remote countries; some, however, with whose language we became familiar only in after-life. We were very proud to be able to address at need a priest in Latin and get from him directions as to our way. But I shall blushingly confess, in the presence of my German colleague, that we were once confronted with the terrible fact that, being in a small out-of-the-way place in his country, none between us four could remember more than half the word railway. *Eisen* came to the mind of one of us, and nothing further. We missed our train, and shall never forget that the whole word is *Eisenhahn*.

Of real explorations, I have none to my credit. I set foot on four of the five parts of the world, but from the Nile to Seattle, or Petersburg to Panama, I saw nothing but what others had seen. My chief journeys to far-off lands have been through a medium greatly to be commended, and which consists neither in railroad, steamer, horse, nor camel, but in the National Geographic Society's Magazine. Through it you can visit all the world and know the secrets of the most remote places. Happier than Mahomet, who ordered the mountain to come, but it would not, so that he had to go to the mountain, we beckon to lake and peak, ruins, icebergs, cities, and deserts, and behold, here they come in their true shape and colors!

In my undeservedness one thing pleases

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WONDERFUL WITNESS TO AZTEC ENLIGHTENMENT: CALENDAR STONE DISCOVERED IN 1790 AND NOW IN THE NATIONAL MUSEUM, MEXICO CITY

This stone is of basaltic porphyry, 22 feet in diameter and 3 feet thick, and weighing about 24 tons. It was first found in the subsoil of the present cathedral square of Mexico City about the middle of the seventeenth century, but Archbishop Montufar, fearful that it would influence the Indians to revert to idol worship, caused it to be reburied. The central figure of the carving represents the sun. Within the first ring are the names of the Aztec years; within the second ring the Aztec days of the month. Prescott says that the accuracy with which they adjusted their festivals to the movements of the stars and fixed the length of the tropical year was with a precision unknown to any of the great philosophers of antiquity.

me—that which has made up for my lack of merit—namely, your friendly disposition toward me, and, I feel confident, your consideration for my country. If I have done little, my country has done much. Since our republic has been established a renewal has been apparent of the exploring spirit of the sixteenth and seventeenth centuries.

France has produced new Laudonières, new Cartiers, new La Salles, new Champlains. We have built in Asia and Africa the largest colonial empire France ever possessed, and we have done so more by discovery than by war. The French are "harborous to strangers," said Sir Thomas Overbury. That characteristic has been a great help.

The first thing we did wherever we got was to build a road, then a school, and in that school we had the natives taught not only, nor even chiefly, our language, but theirs, and even in many places their own theology. Our officers have acted at need, in large numbers, under various skies, as instructors, builders, agriculturists, archeologists, artesian-well drillers, trying not to destroy, but to improve; to which many American travelers have borne a testimony in which we take pride.

The value of the diploma you have bestowed on me is enhanced by the fact that I receive it on an occasion the hero of which is Colonel Goethals. I have long known him, and I may say that it was, on my side, a case of friendship at first sight. It is difficult to meet him and not understand the cause of that great influence he has over his fellow-men; one feels at once that he cannot ask any one to do anything but what is right, proper, wise. Any man in his senses acts as he is bidden by him. I have seen him, so to say, in action on that great canal along whose banks so many of my compatriots have found their last resting place; where I saw, with some pride, the white line, not so very near the summit, where we stopped in the Culebra, and I raised my hat to some of our dredges and machinery, still at work after so many years and still contributing to the mighty task.

I had the honor of visiting the canal in the President of the Commission's yellow car, familiarly called "Goethals' yellow peril," because people who prowl about the tracks must move rapidly when it comes, if they do not want to change from this world to another. In the Zone one single man was all-powerful, and his chief strength did not lie in the regulations which had defined his office, but in his moral influence and the respect with which he was surrounded.

We left the canal not knowing which to admire most, the Babylonic grandeur of the material work then nearing completion or the strength of character in one man's breast, which set in motion and regulated the forces used in the perfecting of the enterprise.

I am thankful to you for having given me this occasion to add to American good wishes and congratulations for the work and for the man, French good wishes and congratulations.

SECRETARY BRYAN

While the program as printed is completed, we are not quite through. No one will be called upon for a speech, although there is one subject that has not yet been presented—the happy coincidence of name and accomplishment. How appropriate that it should have been George Washington Goethals who did this work. Who will say that there is no inspiration in a patriotic name?

But I am not willing that this meeting shall conclude until I have performed a task laid upon me by this Society. We have heard from representatives of our own and other countries, and the President has spoken for all the people of the United States in presenting this medal of honor. I am sure that you desire to express yourselves, each one for himself or herself, and I am sure that you will welcome the opportunity that I am asked to give you. While the name of the man will be inscribed upon all the monuments that are erected at Panama, the name of the wife who has stood by him in his work and shared the dangers and the trials of the task will not be forgotten. As a fitting conclusion of this most appropriate occasion, I ask you to rise and drink to the life, health, and prosperity of Colonel and Mrs. Goethals.

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