```
Absorption tests, 564, 608.
                                          Bain, H. F., cited, 463.
Acknowledgments, 642.
                                          Ball mills, 174.
                                          Barringer, L. E., 219.
Adams county, 415.
Adair county, 415.
                                          Besley Brick Company, 109, 116, 577.
Administrative report, 1.
                                                       tested, 577.
Advantages of hollow blocks, 599.
                                          Beyer, S. W., 4.
               paving brick, 602.
                                                         Clay and clay industries
               the open heater, 365.
                                                           of Iowa, 27.
Alkalis, 66, 336.
                                                         Directory of Iowa clay
Allamakee county.
                                                           workers, 621.
Alluvium, 48.
                                                         Geology of clays, 376.
Aluminum and iron, 335.
                                                         Mineral production for
Alternate specifications for boiler 66" x
                                                           1902, 7.
  18', 358.
                                                         Mineral production for
American Brick and Tile Co., 109, 398.
                                                           1903, 647.
Ames and Kelly brick, 579.
                                                         Technology of clays, 29.
Analyses of clays, 42, 52, 55, 112, 131,
                                          Beidermann, 92.
              219, 220, 223, 224, 226,
                                          Bischof, Dr. Carl, 98, 100, 119.
              228, 229, 231, 232, 233,
                                                             Formula of, 135.
              322, 323, 324, 325, 330,
                                          Bissell, G. W., 262.
              386, 387, 389, 392, 393,
                                                         Clays and clay indus-
              396, 398, 401, 406, 422.
                                                           tries of Iowa, 27.
              426, 431, 437, 438, 445,
                                                         Selection, installation
              465, 468, 471, 472, 473,
                                                           and care of power
              475, 489, 499, 502, 505,
                                                           plants, 347.
              506. 510, 512, 513, 518,
              540, 541, 543, 545, 546,
                                          Calcium, 336.
              548, 549.
                                          Calculation of results, 619.
            coal, 262, 263, 264, 265,
                                          Calhoun county, 509.
              266, 267, 370.
                                          Calorific power of lowa coals, 371.
            fuel gases, 268.
                                          Calvin, S., 6.
            Iowa coals, 370.
                                                    Administrative report, 3.
                                                    Work in Winneshiek county, 6.
Appanoose county, 415.
                                          Campbell Brick and Tile Company, 508.
Arey, M. F., 6.
                                          Capital City Brick and Pipe Company,
Aron, Dr., 97.
                                            109, 116.
Augusta stage, The, 409.
                                                       Tests of clays of, 604.
Automatic clay gatherer, 157.
                                          Carboniferous period, 402.
           indenting brick cutter, 198.
```

Continue of heiless 257	Clara
Castings of boilers, 357.	Clay wares produced in 1902, Value
Centerville Brick and Tile Company, 417.	of, 18. produced in 1903, Value
Cerro Gordo county, 396.	of, 651.
Changes which occur in the burning of	Clayton county, 385.
clays, 274.	Clermont Brick and Tile Company, 109.
Chemical analyses of clays, 330, 333.	Clinton county, 387.
Value of, 339.	Coal, 12.
Chemistry of clays, 319.	produced for 1902, 14.
Chemistry of rock composition, 322.	produced in 1903, 652.
Classes of clays, 325.	Coal Measures, 410.
Classification of clays, 37.	Cold water feeder, 362.
Buckley's, 39.	Colesburg potter's clays, 109.
Ladd's, 37.	Pottery Company, 388.
Orton's, 40.	Combustion of fuel, 261.
Clay county, 549.	Comparison of brick tests, 571, 592.
Clay crusher, 166, 167.	Composition of pholerite, 52.
disintegrators, 168.	Compression tests on brick, 562.
Fire, 44, 325.	Cones Seger, table of fusing points, 141.
Flint, 45.	Construction of boilers, 357.
red, The, 532. Slip, 223.	Construction of open feed-water heat-
Workers, Directory of lowa, 621.	ers, 366. Continuous kiln, 315.
Clays, Bonding power of, 85.	Continuous tunnel drier, 252.
Changes which occur in burn-	Corey Pressed Brick Company, 109,
ing of, 274.	116, 506.
Colors of, 70, 340.	Cratty, R. I., 6.
Composition and chemical prop-	Cream City Brick and Tile Company,
erties of, 52.	401.
Definition of, 35.	Cretaceous period, 509.
deposited from running water,	Crushing tests of brick, 608.
68.	Cutting tables, 197, 201.
deposited in still water, 44.	
Feel of, 72.	Dale Brick Company, 109, 116.
Fineness of grain of, 116.	tested, 578.
Fire, 44.	Dallas county, 424.
Fusibility of, 123. Fusion tests of, 147.	Decatur county, 430.
Physical properties of, 69.	Definition of clays, 35.
Plasticity of, 46, 87.	Dehydration, 275.
Porosity of, 109, 112, 113.	Delaware county, 388, 529. Des Moines county, 403, 429.
Preparation of raw, 163.	Desirable types of boilers, 353.
Shrinkage of, 103.	Determination of alkalis, 336.
Slaking of, 72.	aluminum, 335.
Specific gravity of, 114.	calcium, 336.
Strength of, 74.	clays, 334.
Structure of, 69.	ferris oxide, 338.
Clay wares, Burning of, 261.	magnesium, 336.
Drying of, 234.	sulfur, 339.
Processes in the manufac-	titanic oxide, 339.
ture of, 32.	Devonian period, The, 395.

Dimensions of boilers, 35%.

machines, 618.

Direct radiation, 255.

Directory of Iowa Clay Workers, 621.

Disintegrators, 168.

Down draft kilns, 292.

Drain tile, 213.

and hollow block, 231.

Dry pans, 170.

Dry methods of clay preparation, 163.

Dry pressed brick, 209, 229.

Drying of clays, 234.

Drying by fuel burned for the purpose, 256.

Drying by radiation from heated brick works, 258.

Drying by radiation from heated surfaces, 259.

Drying by waste gases, 257.

Earthenware, 232.

Effect of chemical composition on fusibility of clays, 129.

Effect of physical condition on fusibility of clays, 132,

Effective power calculated in engines, 373.

Eldora Pipe and Tile Company, 473. End-dumping clay car, 161.

Engines, 373.

Fairbanks cement machine, 80.

Fayette county, 393.

Feed-water heaters, 362.

Feldspar, 57.

Ferrous oxide, 338.

Fire clay, 325.

Firing of boilers, 369.

Fittings of boilers, 357.

Flint Brick Company, 109.

Clay tests of, 604.

Floyd county, 400.

Formation of clays, 185.

clay wares, 185.

Foundation for engines, 374.

Franklin county, 402.

Fremont county, 432.

Freezing and thawing tests, 565.

Freezing tests, Results of, 590.

Galena-Trenton limestone, 383.

General consideration of clays, 234.

Geological distribution of clays, 381.

Geology of clays, 378.

Gethmann Bros. Brick Co., 109, 560.

Analysis of clay, 545.

Glazing, Stoneware, 218.

Bristol, 225.

Salt, 219.

Slip, 223.

Temperatures of, 47.

Grand Junction brick tests, 578.

Grand Junction brickyard, 578.

Granite Brick Company, 109, 404.

Test of brick of, 604.

Greene county, 432.

Gumbo, The, 534.

Guthrie county, 433.

Gypsum production in 1902, 26.

production in 1903, 655.

Haigh continuous kiln, 522.

Hamilton county, 435.

Hardin county, 436.

Hatt, W. K., 616.

Haworth, E., 93.

Hedzfeld, 92.

Hollow blocks, 213, 231.

Advantages of, 599.

Tests of, 600.

Holman & Brother brick plant, 517.

Clay pit of, 517.

Honestone quarries, 439.

Horizontal type soft mud brick machine, 190.

Hoskin's muffle furnace, 81.

Hot floor dryer, 249.

Hubinger Brick Works, 410.

Humboldt county, 440.

Illinoian drift, The, 528.

Impurities in clays, 55.

Inclined stationary screen, 179.

Inclined vibrating screen, 180.

Incrustation on brick walls, 341.

Indirect radiation, 255.

Inspection and test of boilers, 357.

	L = .
Iowa Brick Company, 468.	Limestone production in 1902, 23.
Clay analysis of, 471.	in 1903, 654.
Clay pit of, 470.	Loam, 49.
Clay tests of, 604.	Loess, 529.
Iowa coals, Study of, 262.	Analysis of, 545, 546.
Iowan drift, The, 528.	deposited by winds, 51.
Iowan loess, The, 538.	The Iowan, 538.
Iron in glaze, 58, 335, 548.	Lucas county, 447.
	Macbride, T. H., 6.
Jasper county, 440.	Machinery of power plants, 352.
Jaw type of rock crusher, 164.	Madison county, 447.
Jefferson county, 441.	Magnesium, 65, 336.
Jester, B. B. Fire clay of, 113, 116.	sulfate, (6.
Johnson, J. B, 616.	Mahaska county, 450.
Jolly, Potter's, 216.	Manner of testing brick, 575.
Jony, Potter 3, 210.	Manufacture of brick, 185, 212.
	drain tile, 185, 212.
Kansan drift, The, 526.	hollow block, 212.
Kaolinite, Composition of, 35.	pottery, 185, 215.
Origin of, 36.	sewer pipe, 214.
Kelly Brick and Tile Works, Pit of, 539.	Maquoketa shales, 384.
Clay of 579.	Marion county, 452.
Tests of brick	Marston, A., 27, 555, 616.
of, 583, 593,	Mason City Brick and Tile Co., 400.
595.	Analysis of clay of, 396.
Keokuk county, 444.	Pit section of, 396.
Key to kinds of brick, 559.	Tests of brick of, 578, 579,
Kilns, Types of, 288.	583, 586, 587, 595.
Continuous, 314.	McBirney, J. F., 574.
Downdraft, 292.	Merrill Brick Co., Plant of, 476.
Direct rectangular, 309.	Pit section of, 475.
Direct round, 292.	Tests of brick of, 604,
Muffle, 313.	608, 612, 617, 620.
Up-draft, 289.	Methods of expressing fusibility, 133.
American scove, 289.	firing, 372.
English clamp, 289.	measuring fusibility, 136.
Pottery, 290.	plasticity, 96.
Muffle, 291.	preparing clay for fusion
Kinderhook stage, The, 403.	tests, 144.
	used in rational analysis, 327.
Ladd, G. E., 99.	Mica in clays, 57.
Lagging of steam pipes, 374.	Minter, J. E., 214.
Langenbeck, 99, 329.	Mineral production of lowa for 1901,9.
Lead production in 1902, 26.	for 1902,9.
in 1903, 655.	for 1903, 647.
	Moisture in clays, 334.
Lee county, 407, 446. Leonard, A. G. 6.	Monroe Brick and Tile Company, 441.
Lime in clays, 62.	Monroe county, 451.
	Montgomery county, 457, 511.
production in 1902, 22.	Muffle down drafit kilns, 313,
in 1903, 653.	and the country of th

Multiple stack kiins, 312. Muscatine county, 459.

National Brick Man'f's. Association, 208, 613, 614, 617.

Nichols, F. I., 574.

Northwestern Sewer Pipe and Tile Company, 520.

Pit section of, 520.

Norton, W. H., 4.

Number of producers of minerals in 1902, 11.

Number of producers of minerals in 1903, 648.

Object of analyses of clays, 326. of rational analysis, 326.

of ultimate analysis, 326.

Oneota limestone, 382.

Open air drying of clays, 247.

Open feed-water heaters, 364.

Advantages of, 365.

Construction of, 366.

Requirements of, 367.

Origin of clays, 35.

Orton, Edw., Jr., cited, 40, 41, 77, 91, 223, 606.

Page county, 461.

Percentage of fuel saved by heating feed-water, 364.

Periodic or chamber dryer, 250.

kiln, 314.

Physical properties of clay, 69.

Plastic clay, 325.

Plasticity of clays, 87.

Platt Pressed and Fire Brick Company, 424.

Analyses of clay of, 426.

Pit sections of, 425.

Tests of brick of, 559.

Pleistocene period, The, 525.

Plymouth county, 512.

Pocahontas county, 550.

Polk county, 463.

Porcelain clay, 325.

Porosity of clays, 109.

Portland cement, 5.

Post-Wisconsin, 552.

Pottawattamie county, 513.

Potteries at Sioux City and Sargents Bluff. 522.

Pottery, Manufacture of, 215.

Power house, The, 351.

Power plants, Selection of, 349.

Poweshiek county, 477

Practical consideration in drying clays,

Pre-Kansan or Albertan stage, 526.

Preparation of raw clays, 163.

Primary or residual clays, 40.

Processes in the manufacture of clay wares, 148.

Production of clay goods in 1902, 17.

in 1903, 651.

of coal in 1902, 12.

in 1903, 650.

of gypsum in 1902, 26.

in 1903, 655.

of lead and zinc in 1902, 26.

in 1903,655.

of stone in 1902, 22.

in 1903, 653.

Properties of clays used in manufacture, 226.

> to be observed in selection of engines, 373.

Pug mill, 176.

Pyrometer, La Chatelier's, 139, 146.

Quarries, Honestone, 439. Quarrying, 152.

Raney Bros Brick and Tile Plant, 443. Section of clay pit of, 443.

Rating formula, 595.

Rational analysis of clays, 327,344,345. Object of, 326.

Rattler test of paving brick, 613.

Specifications for, 617.

Table of, 620.

Rectangular down draft kiln, 309.

Red clay, 532.

Report of State Geologist, 3.

Repressing, 202.

Advantages of, 208.

Effects 61, 206.

Requirements of open heater, 367. of power plants, 350.

Results of observation tests 590	Section at Coal graph 453
Results of absorption tests, 589. freezing tests, 590.	Section at Coal creek, 453.  Coalville, 449, 503.
rattler tests, 613.	Competine creek, 444.
transverse tests, 587.	Cottonwood Mills, 427.
tests of Ames brick, 597.	Danville, 430.
tests of Council Bluffs brick,	Davenport Brick and Paving
588.	Company, 479.
tests of Goodwin brick, 590.	De Kalb, 429.
tests of Grand Junction	Delta, 445.
brick, 591.	Des Moines, 463.
tests of Kelly brick, 593.	Douds Station, 483.
tests of Mason City brick, 586.	Eldora, 436.
tests of Webster City brick,	Elrick Junction, 408.
588.	Fate Quarry, 459.
Revolving screen, 183.	Flint brickyards, 470.
Riveting boilers, 356.	Ft. Dodge Clay Works, 497.
Robinson, W. S., 426.	Ft. Dodge Brick and Tile
Rolls for clay crushing, 165.	Company, 496.
Rotary screens, 181.	Gifford, 439.
Round down draft kilns, 292.	Glendon, 435.
round down draft sinds, 200.	Graf, 391.
Sac county, 514.	Granite Brick Company, 404.
Saint Croix sandstone, 383.	Grant City, 510.
Saint Louis limestone, 410.	Greenbush, 493.
Saint Peter sandstone, 383.	Guilford township, 456.
Salt glazing, 219.	Hackberry Grove, 396.
Savage, T. E., 6.	Hamburg, 432.
Scott county, 479.	Hanging Rock, 428.
Screens, 179.	Hawarden, 515.
Duplap, The, 184.	High Bridge, 429.
Inclined stationary, 179.	Indian creek, 482.
Inclined vibrating, 180.	Iowa Falls, 440.
Rotary, 181.	Iowa Pipe and Tile Co., 477.
Secondary clays, 44.	Keokuk, 409.
Section at Ackworth, 491	Kime brickyard, 495.
Barber Asphalt Co., 473.	Lake creek, 510.
Bear creek, 484.	Le Claire Brick and Tile
Bevington, 449.	Company, 481.
Big Spring, 388.	Lehigh, 508.
Birch creek, 441.	Lehigh Brick and Tile Com-
Bluff creek, 454.	pany, 505.
Boone Clay Works, 420.	Liberty township, 443.
Booneville, 424.	Linden, 428, 434.
Burlington Junction, 462.	Lynville, 441.
Butlerville, 461.	Manchester, 529.
Carlisle, 492.	Martinsburg, 446.
Cedar creek, 442.	Mason City Brick and Tile
Centerville, 415.	Company, 396.
Chariton creek, 448.	Merrill Brick Plant, 476.
Clermont, 391.	Middle Raccoon, 428,

Section at Muchakinock, 451. Muscatine, 461. Nevada, 482. Northwestern Sewer Pipe and Tile Company, 520. Oak Park, 466. Oskaloosa, 451, 452. Ottumwa, 485. Panora, 434. Parish, 430. Pleasant township, 454. Prospect Hill, 404. Raccoon, 424. Raccoon River, 473. Rand park, 446. Red creek, 407. Red Oak, 511. Riverside mine, 433. Rockford, 401. Sargents Bluff, 516. Sheffield, 402. Sioux City Paving Brick Co., Sioux township, 511. Spring Hill, 493. St. Charles, 448. Sugar creek, 487, 488. Summit, 492. Sweetland township, 460. Union township, 490. Villisca, 459. Walnut creek, 419. Whitebreast creek, 447, 453. Seger's formulæ, 242. Seger volumeter, 115. Selection, installation and care of power plants, 347. of power plants, 350. Self-oiling bearings, 374. Semi-muffle furnace, 291. Sewer pipe, 232. Manufacture of, 214. Sewer pipe or slatted floor drying, 249. Shale pit of Mason City Brick and Tile Company, 397. Shaking grate, 353. Shrinkage in clays, 103. Side-dumping clay car, 160. Silica in clays, 55. Silurian period, The, 395.

Single stack kilns, 293, 310. Sioux City Brick and Tile Co., 522. Sioux county, 514. Sioux Paving Brick Company, 520. Slaking of clays, 72. Slip glazing, 223. Smith, George A., 574. Smith's method of determining alkalis, 337. Soaking pit, 177. Soaking pit and wooden pug mill, 186. Soft mud brick, 185, 227, Specifications for horizontal return of tubular boiler, 356. for standard method of conducting rattler tests, Specific gravity of clays, 114. Stewart, J. E., 574. Stiff mud brick, 185, 228. Stiff mud, 192. Stone produced in 1902, 22. in 1903, 653. Stoneware, 233. glazing, 218. Storm Lake Brick and Tile Company, 109. Story county 481. Strength of clays, 74. Structure of brick tested, 580. of clays, 69. Sulphur, 339. Summary of clays, 260. of brick tests, 573. Surface digging, 151. Table of Seger's cones, 141. showing comparative results of brick tests, 595. showing fusion temperatures of Iowa clays, 147. showing numerical value of rattler tests, 620. Talbot, A. N., 614, 615. Taylor county, 482. Technology of clays, 29. Temperature of fusion of clays, 147. Tensile strength of clays, 83. Tests of clay products, 557. dry press building brick, 558,

Tests of hollow blocks, (00. Valve dampers, 305. Iowa common brick, 574. Van Buren county, 483. Iowa paving brick, 601. Ventilation, 376. Titanic oxides, 338. Vertical type of soft mud machine, 189. Topographic work of the U.S. Survey, of stiff mud machine, 193. 4, 5. Villisca Brick and Tile Company, 459. Transmission belts, 375. Vitrification of clays, 283. Transportation of raw clay to works, Wapello county, 484. Transverse tests of lowa brick, 563. Warren county, 490. Tubes and braces of boilers, 356. Washington county, 408. Types of kilns, 288. Wayne county, 494. Webster City Brick and Tile Company, Udden, J. A., 6. 435. Udden, Jan Andreas, 6. Webster City brick tested, 577. Ultimate analyses of clays, 344. Webster county, 494. Object of, 326. Weems, J. B., 319, 642. Uncommon constituents in clays, 68. Wet method of clay preparation, 175. Union county, 483. Wet pan, 175. Up draft kilns, 289. Wheeler, cited, 52, 90, 93. Use of exhaust steam in heating drying Wheeler's formula, 136. room, 375. Whitney, Professor, cited, 90, 119, Uses of limestone, 22. William's disintegrator and pulverizer, Value of chemical analyses, 339. 169. Williams, I. A., 6. of clay products 1902, 18. Clays and clay industries of 1903, 651. lowa, 27. of coal products 1902, 14. 1903, 650. Directory of Iowa clay workof gypsum 1902, 26. ers, 621. 1903, 655. Geology of clays, 376. of lead and zinc 1902, 26. Technology of clays, 29. 1903, 655. Winneshiek county, 394. of stone 1902, 22. Winning of raw clays, 148. 1903, 653. Wisconsin drift, The, 547. of total mineral production Woodbury county, 515. 1902, 9, 11. Work in Winneshiek county, 6. 1903, 647, 648.