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No. 19

BRICK AND TILE INDUSTRY IN OREGON

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1949

State Governing Board

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FOREWORD

Dating back before recorded history there was brickmaking. It is probably the most ancient and universal of the crafts. Fired brick over 10,000 years old have been found in Egyptian excavations, and evidence of the making and use of brick and tile has been found among the past records of practically all peoples who left any records. The reason for the universal use of brick and tile down through the ages is easily explained. Clay from which brick may be made is widely distributed over the surface of the earth. Clay may be shaped, baked, and put to use with the simplest of facilities, and brick make a durable insulated fireproof structure having a pleasing appearance.

Brickmaking is the oldest industry in the State. Settlement of the Willamette Valley and brickmaking progressed together; and, except for agriculture, brickmaking has been subject to the least fluctuations of any industry. During World War II there was considerable curtailment of brick and tile output because of price control, but since the war's end the industry has flourished.

In 1947 the Department made a field canvass of nonmetallic production in the State and, in this canvass, gathered information concerning brick and tile plants. As a part of the Department's work in cataloging and publicizing mineral industry operations, this information on brick and tile plants is given in the accompanying report.

F. W. Libbey
Director

July 7, 1949

CONTENTS

	<u>Page</u>
Foreword	
Introduction	
Purpose and scope of investigation	1
Previous work	1
History	1
Acknowledgements	1
Statistics	3
Description of clay plants in Oregon	
Corvallis Brick and Tile Company, Benton County	3
Monroe Brick and Tile Company, Benton County	5
Molalla Brick and Tile Company, Clackamas County	7
Needy Brick and Tile Company, Clackamas County	8
McFarlane Brick Plant, Josephine County	9
Klamath Falls Brick and Tile Company, Klamath County	9
Albany Brick and Tile Company, Linn County	10
Oregon Clay Products, Inc., Malheur County	11
Donald Brick and Tile Company, Marion County	12
Columbia Brick Works, Multnomah County	13
Sylvan Brick Company, Multnomah County	14
Pacific Stoneware Company, Multnomah County	15
Monmouth Brick and Tile Company, Polk County	16
Tillamook Clay Works, Tillamook County	17
La Grande Brick Yard, Union County	17
Forest Grove Clay Products Company, Washington County	18
O. K. Brickyard, Washington County	19
Scholls Tile Company, Washington County	20
McMinnville Brick and Tile Factory, Yamhill County	21
Willamina Clay Products Company, Yamhill County	22
Hubbard Clay Works, Clackamas County	24
Results of testing Oregon brick and tile clays	25
Bibliography	27

Illustrations

Figure 1. Index map showing location of clay plants and localities, opposite page 1	
Figure 2. Graphs showing trends in Oregon clay industry 1895-1947, " "	5
Figure 3. Production of brick, building tile, and drain tile in Oregon in 1946	7

Tables

Table 1. List of clay plants in Oregon and products manufactured	2
Table 2. Results of tests made on Oregon commercial clays from 16 producers	25
Table 3. Results of tests made on raw clays from 30 new localities	26

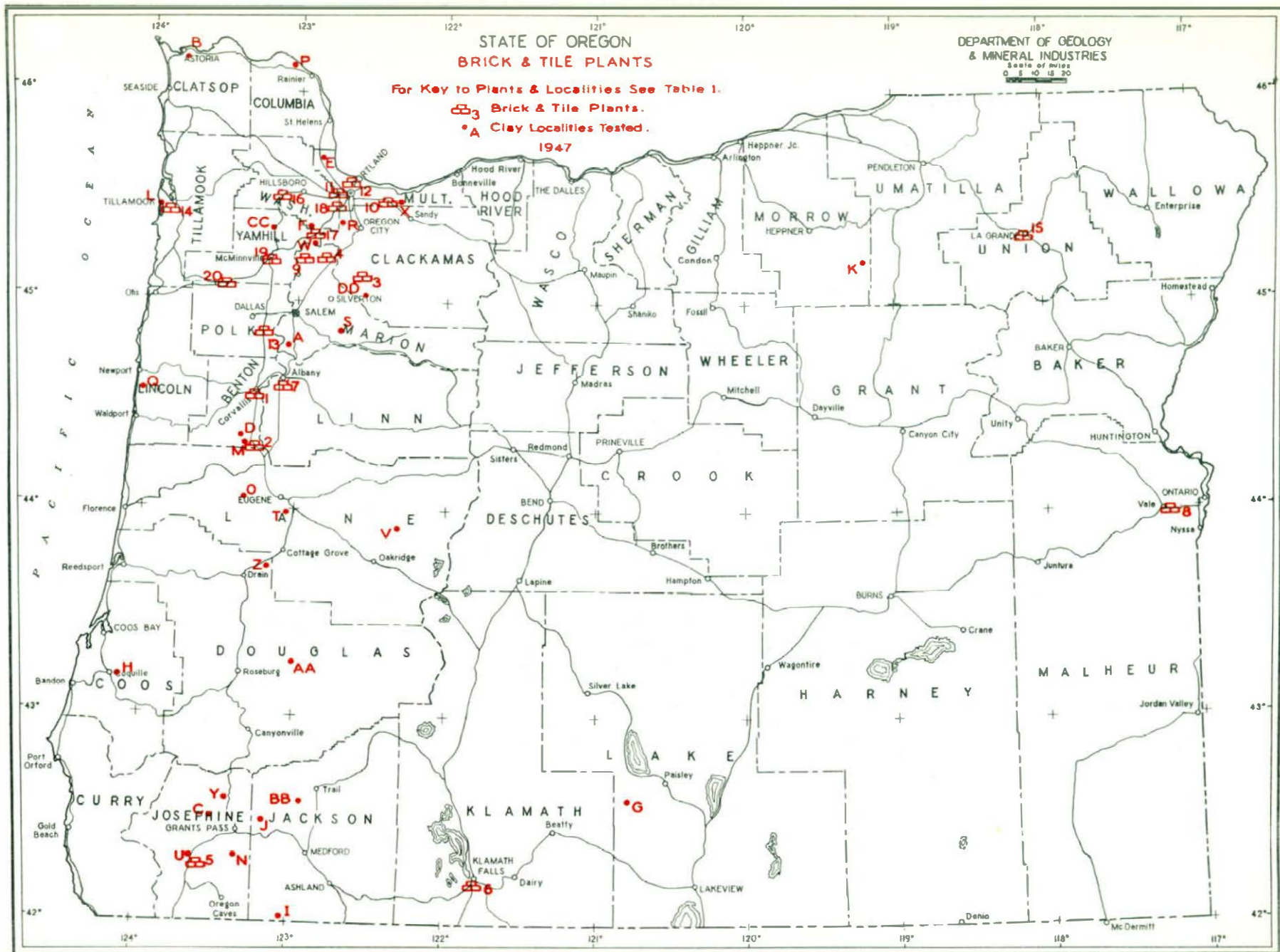


Fig.1 Index Map Showing Location of Clay Plants and Localities.

BRICK AND TILE INDUSTRY OF OREGON

Introduction

Purpose and scope of investigation

The origin of clay, its geology, classification, composition, and other properties have been discussed many times elsewhere (see bibliography at the end of this report) and it is not the purpose of this paper to duplicate this type of information. The clay industry of Oregon, however, has not been previously described in detail. Because this industry is a relatively substantial one, the value of its products amounting to nearly one million dollars a year, the Department has deemed it worthy of special study.

Nineteen brick and tile plants and one stoneware plant (see index map on opposite page and table 1 on page 2) in Oregon were visited, and the description of these operations makes up the bulk of this report. Samples of clays were taken, and later tested, from the plants in operation and also from localities which seemed to have potential economic value as sources of clay.

Previous work

The most comprehensive report on Oregon refractory clays to date is by Wilson and Treasher (1938); it includes a large amount of geologic and economic data, together with numerous chemical and ceramic analyses of several types of clays in western Oregon.

Other reports on Oregon clays are few in number and restricted in treatment. Ries (1900) and Parks (1912) briefly described Oregon clay-working industries. Geisbeek (1913) wrote the first fairly comprehensive outline of the industry. Results of a testing program of brick and tile from thirty Oregon plants were published by Williams in 1914. These tests included crossbreaking, crushing or compression, absorption, and freezing and thawing tests; but no data concerning other characteristics were given. The unpublished thesis of Wilcox (1935) has since that time been a handbook for those interested in clay deposits, as it gives the properties of some Oregon clays. Several localities are listed by Hodge (1938) but no tests other than chemical analyses are given.

History

The clay products industry of Oregon is one of the oldest in the State; indeed it was a pioneer industry. Potteries were active as early as 1855 and substantial brick houses were constructed from locally fired brick prior to 1880. Of the 19 brick and tile plants active in early 1947, 6 were built before 1900, and 8 were built in the 10 or 12 years previous to World War I. Many of the plants have been operated on a family basis, and the art of firing clay has been passed down in some families through three generations.

In recent years the number of plants has decreased (68 operations in 1908; 29 in 1913; 19 in 1946) as larger and more modern plants have been built and as cost of hand labor has increased.

Immediately following World War II the clay products industry experienced intense activity because of "boom" conditions in all kinds of construction. In Oregon many brick and tile plants added to their equipment.

Acknowledgements

The authors are grateful to the brick and tile operators who supplied operating information, and to the several Department staff members who assisted in the preparation of this report.

Table 1.
List of Clay Plants in Oregon and Products Manufactured

Index Map Nos.	County	Name of plant	Owner or operator and address	Common brick	Face brick	Drain tile	Big. tile	Fire brick
1	Benton	Corvallis Brick & Tile Co.	A.M. Woodcock & Esten Winegar Crystal Lake Cemetery road Corvallis, Oregon	X		X	X	
2	"	Monroe Brick & Tile Co.	E. A. Wiedman, Monroe, Oregon	X	X	X	X	
3	Clackamas	Molalla Brick & Tile Co.	C. W. Key, Geo. Wright, & Arnold Shaver, Rt. 3, Molalla, Oregon			X	X	
4	"	Needy Brick & Tile Co.	Edward Kenagy & Kenneth Berkey Hubbard, Oregon	X		X	X	
	"	Hubbard Clay Works	S. D. Hostetler & Roy Kenagy Hubbard, Oregon			X		
5	Josephine	MacFarlane Brick Plant	F. E. MacFarlane, 319 Rogue River Ave., Grants Pass, Oregon	X				
6	Klamath	Klamath Falls Brick & Tile Co.	Ralph Smith, P.O. Box 573 Klamath Falls, Oregon	X			X	
7	Linn	Albany Brick & Tile Co.	L.R. Harrison, Albany, Oregon	X		X	X	
8	Malheur	Oregon Clay Products, Inc.	R.D. Lytle, Pres., Vale, Oregon	X				
9	Marion	Donald Brick & Tile Co.	J.S. Fisher & Son, Donald, Ore.	X		X		
10	Multnomah	Columbia Brick Works	Franze Olbrish, Pres., Gresham, Oregon	X			X	
11	"	Sylvan Brick Company	Charles E. Jensen, Gen. Mgr. Sylvan, Oregon		X			
12	"	Pacific Stoneware Co.*	L.W.M. Scott, 9217 N. Peninsular Ave., Portland, Oregon					
13	Polk	Monmouth Brick & Tile Co.	G.P. Partridge, Monmouth, Ore.	X		X	X	
14	Tillamook	Tillamook Clay Works	R.G. Krebs, Rt. 2, Box 221 Tillamook, Oregon			X		
15	Union	LaGrande Brickyard	N.P. & J.L. Jensen, Box 636 LaGrande, Oregon	X				
16	Washington	Forest Grove Clay Products Co.	Elmer McCormack Forest Grove, Oregon	X				
17	"	O.K. Brickyard	Art Krebs, Operator Sherwood, Oregon	X		X		
18	"	Scholls Tile Co.	Jesse C. Snyder & Son Scholls, Oregon				X	X
19	Yamhill	McMinnville Brick & Tile Factory	S.B. Nicoll & Son McMinnville, Oregon	X		X		
20	"	Willamina Clay Products Co.	O.K. Edwards, Pres., 1020 S.W. Taylor, Portland, Oregon	X	X			

*Manufactures stoneware, flower pots, red ware, etc.

Statistics

The chart (fig. 2, opposite p. 5) gives basic statistics of clay production in Oregon. Federal agencies ceased compilation of detailed statistics on the industry in 1941; later data have been largely collected by this Department. The 1946 value of clay products (\$876,157) was equalled in 1910 and exceeded in 1911, when the value amounted to \$1,081,025. In 1910, however, 64 million brick were produced compared to 28 million brick in 1946 (fig. 3, opposite p. 7)

Description of Clay Plants in Oregon

Corvallis Brick and Tile Company (1)*
(brick and tile)

Benton County

Owner and operator:

Mr. A. M. Woodcock and Mr. Esten Winegar, Corvallis.

Location and area:

South Corvallis across from the Corvallis Sand and Gravel Company on the southwest side of Crystal Lake Cemetery road, $\frac{1}{2}$ mile southeast of the Marys River bridge, in the NE $\frac{1}{4}$ sec. 11, T. 12 S., R. 5 W., at an elevation of about 225 feet. Property owned consists of 10 acres.

History and production:

The plant was built in 1905 by W. C. Corbett and Sons, who operated it for many years, and then sold to George Simmons. It was bought early in 1946 by the present owner who commenced operations on June 1. Production from that date up through 1947 has been as follows:

	1946(6 mos.)	1947
Roman brick (No.)	50,000	----
Common brick (No.)	103,000	27,000
Drain tile (feet)	57,390	161,157
Building tile (tons)	422	190

Geology:

The plant is located upon the natural levee, and the clay deposit is probably of Recent origin, derived from the periodic flooding of the river banks. About six acres of the land has been stripped of a thin soil overburden; no sand or grit is visible in the pits.

Equipment and process:

The clay is mined to a depth of 6 to 8 feet with a $\frac{3}{8}$ -yard shovel, and loaded on a truck which carries it up an inclined ramp to an overhead bin. Recently a Traxcavator has replaced the shovel for this work. A small shed, 30 by 20 feet, permits some winter storage of clay. The clay drops to a large pug mill, and is lifted by inclined belt to a second clay machine. Brick is cut by a hand-operated machine. Brick from the cutters is loaded on pallets and wheeled by barrow and rubber-tired trucks to the drying rooms. A Hyster fork truck has recently facilitated moving the pallets. One part of the drying building is 35 by 100 feet and three stories high, serviced by two elevators. The other portion of the shed is 70 by 90 feet, with an extra shed 40 by 50 feet.

There are two round downdraft kilns, both of them wood fired. The larger kiln with twice the capacity of the other, is about 30 feet in diameter, and is fired from 12 ports. The brick is water-smoked about 36 hours (less in summer) and fired about 50 hours; the smaller kiln (20 feet in diameter) is fired for about 36 hours from 8 ports. From June 1 to December 30, 1946, 19 kilns using 400 cords of wood were fired. The large kiln uses twice as much wood as the smaller.

Fired brick and tile may be loaded directly from the kilns to trucks, as the entrances are level with the raised loading platforms. Four men operate the plant.

*Numbers after clay plant names refer to key numbers on clay plant index map opposite page 1.

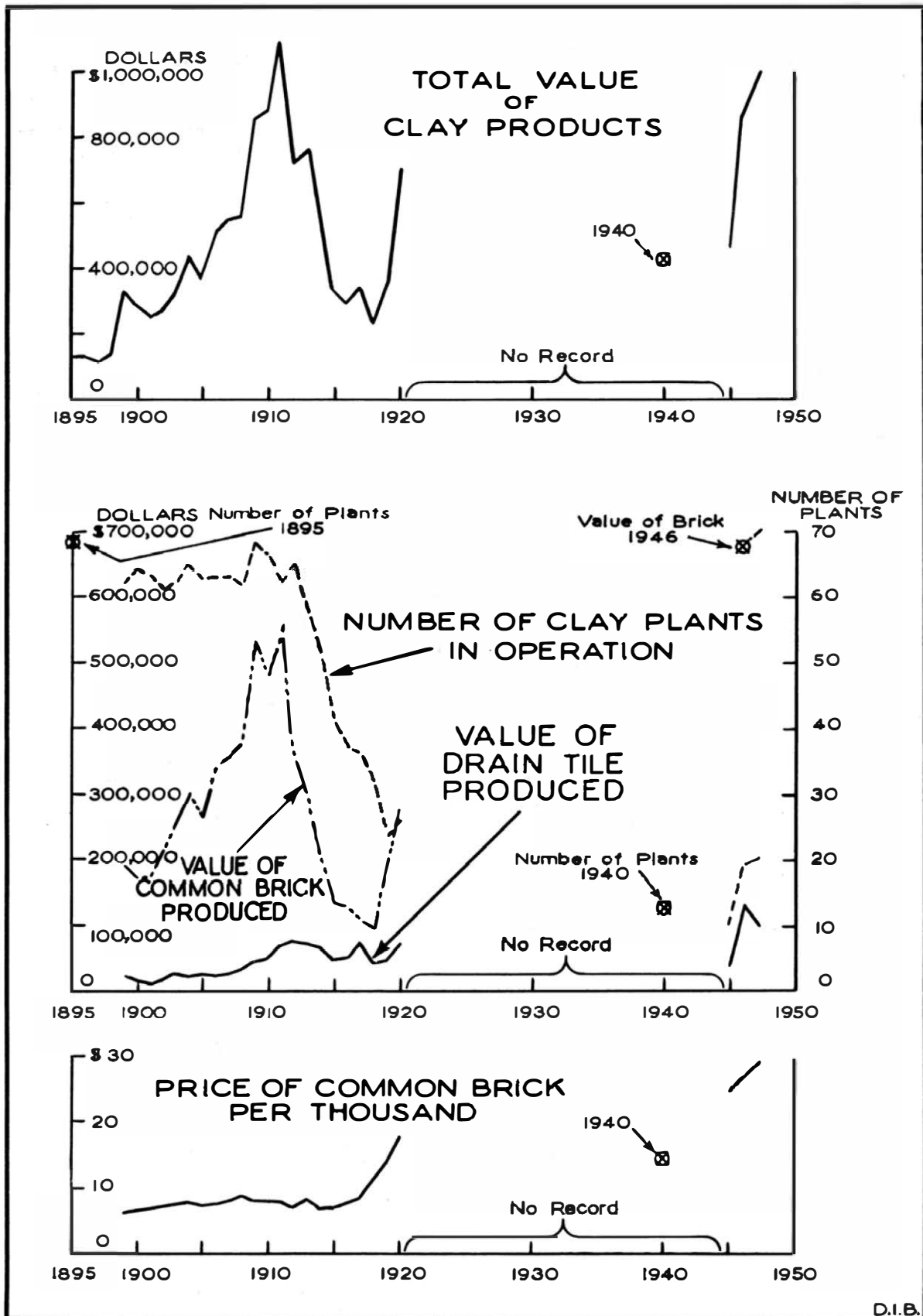


Fig.2 Graphs Showing Trends In Oregon Clay Industry 1895-1947

Monroe Brick and Tile Company (2)
(brick and tile)

Benton County

Owner and operator:

Mr. E. A. Wiedman, Monroe, Oregon.

Location and area:

One-half mile north of Monroe, on the east side of U.S. Highway 99-W, in the E $\frac{1}{2}$ sec. 28, T. 14 S., R. 5 W. The property consists of about 20 acres, of which approximately 8 acres are now occupied by the clay pit, which averages 10 feet in depth.

History and production:

The plant was built in 1912 by Fields and Marks of the Fairmount Brick and Tile Company of Eugene. It was purchased in 1932 by Mr. Wiedman, who has operated it since that time. Recent production is as follows:

	<u>1945</u>	<u>1946</u>	<u>1947</u>
Brick	917,400	1,840,000	3,157,000
Building tile	820 tons	2,028 tons	1,834 tons
Drain tile	192 "	35 "	10,603 feet

Geology:

The clay pit consists of valley alluvium, the surface of which lies at about 290 feet elevation. Thickness of the clay is not known.

Equipment and process:

The clay is dug with a $\frac{1}{4}$ -yard gas shovel, assisted by a D4 'dozer. It is stored in an open shed 60 by 100 feet, and in an enclosed shed 30 by 110 feet. Clay is fed from the shed into a bin with a screw feed to belt conveyor leading to the top floor of the machine room, where it passes through two sets of Steele rolls to the pug mill and extruder. The brick cutter is fully automatic, and all machinery is powered by an electric motor and line shaft. Pallets are loaded on steel cars.

Both open-air and enclosed waste-heated sheds are used. They are 100 feet long and consist of: 21 tracks for air-drying bricks on pallets, a ventilated shed 50 feet wide for drying of tile, and an enclosed and heated shed 55 feet wide (12 tracks). There is a separate "kiln" for drying, in which waste heat from the kilns also is used.

There are three oil-fired rectangular downdraft kilns, of somewhat different sizes, but averaging 20 by 50 feet. The largest will hold 100,000 brick; the other two, 65,000 brick each, or 14,000 6 by 8 by 12-inch tile (equivalent in weight to 65,000 brick). The large kiln requires about 8 cords of wood for water-smoking and 5,000 gallons of oil; the smaller kilns consume less. There are 12 burners on each kiln, 6 on each side. Space for a large scove kiln was being leveled when the plant was last visited. Eight men are employed.

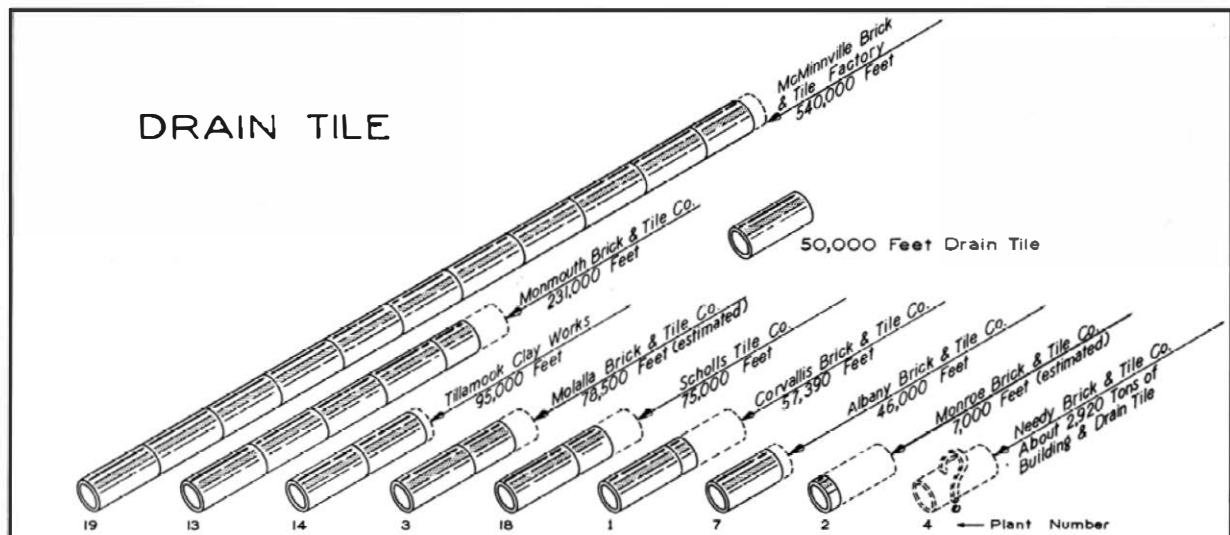
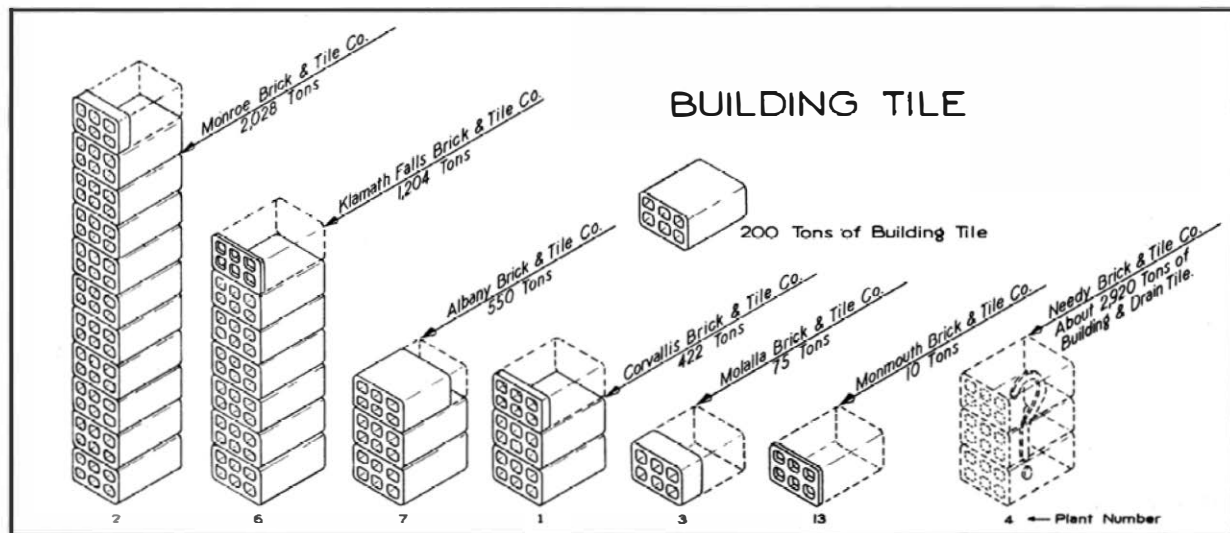
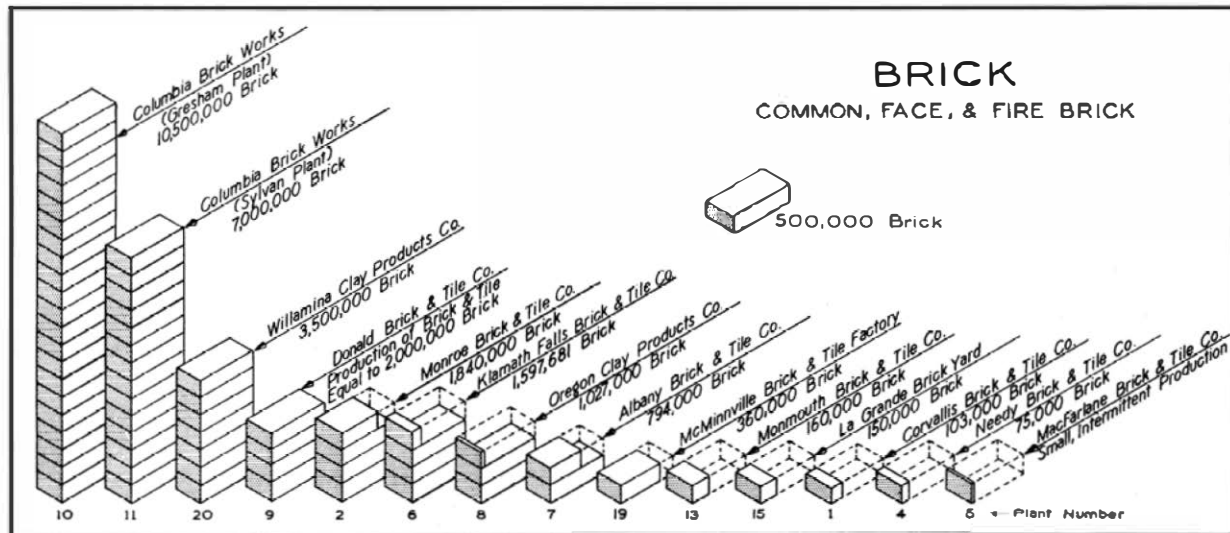


Fig. 3 Production of Brick, Building Tile & Drain Tile in Oregon in 1946

Molalla Brick and Tile Company (3)
(building and drain tile)

Clackamas County

Owners and operators:

C. W. Key, George H. Wright, and Arnold Shaver, Molalla, Oregon.

Location and area:

About 2 miles south of the Molalla River bridge on the west side of State Highway 215, in the NE $\frac{1}{4}$ of the SW $\frac{1}{4}$ sec. 32, T. 4 S., R. 2 E., at an elevation of about 280 feet. The property was formerly a part of the old Barnard Donation Land Claim, 2 $\frac{1}{2}$ miles northwest of the town of Molalla, and comprises 5 acres.

History and production:

The plant was built in 1923 and 1924, and has been in intermittent production since that time. Recently the original operator, Mr. C. W. Key, who ran the plant with his brother, has taken Wright and Shaver into partnership.

Production for the years 1946 to 1947 is as follows:

	<u>1946</u>	<u>1947</u>
Drain tile (feet)	78,500	120,000
Building tile (tons)	----	80

Development:

About 1 $\frac{1}{2}$ of the 5 acres has been mined to a depth of from 6 to 8 feet. Three men operate the plant.

Geology:

The clay deposit was mapped by Harper (1946) as being within the Willamette silt, very close to the edge of the "No. 2 gravels" terrace, and upon the "Molalla alluvial fan," which slopes northwest about 50 feet to the mile.

The section in the pit (which was under water at the time of visit) is said to consist of 6 inches of soil, 6 to 8 feet of very plastic gray clay, with occasional pebbly lenses, underlain by gravel.

Equipment and process:

The clay is mined with a $\frac{1}{4}$ -yard gasoline shovel, and hauled in a small dump truck 100 yards up a ramp to a small storage shed. From the shed it is lifted about 10 feet with a canvas-chain belt to 16-inch disintegrator rolls, from which it drops to a vertical roller pug mill. Equipment is powered by an 8-cylinder Packard automobile engine, connected to the rolls and pug mill by differential gears. A small gas engine pumps water to a 4 by 6-foot radiator tank. After passing through a wire tile cutter (or small home-made wire brick cutter) the tile or brick is set on carts and lifted by elevator to the 3-story air-drying shed (48 by 120 feet) where it is stored on pallets.

The circular, wood-fired kiln has a 24-foot inside diameter, and is loaded from two levels (via a trestle from the drying shed). It has a capacity of about 20,000 4-inch drain tile; but is usually stacked with about 12,000 tile and 6,000 6 by 6 by 12-inch building tile. The normal cycle consists of 2 days to stack, 4 days to fire, 6 days to cool, and 2 days to unstack. With 3 men operating, it is fired once every 3 weeks; but with six men it could probably be fired twice a month. It takes about 20 cords of slabwood (costing from \$5.00 to \$6.00 a cord) to fire the kiln, which is normally operated from April to October.

Needy Brick and Tile Company (4)
(brick and tile)

Clackamas County

Owners and operators:

Edward Kenagy and Kenneth Berkey, Hubbard, Oregon.

Location and area:

The plant is about 2 miles west of Needy, or 5 miles east of Hubbard and 9 miles west of Molalla, on the west bank of Rock Creek, in the NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 6, T. 5 S., R. 1 E., at an elevation of about 140 feet. Plant and quarry are located on a 55-acre tract.

History and production:

The plant was originally built by Isaac Miller previous to 1900. One of the Stewart kilns was built in 1914. A new kiln of the same type and size was built in 1937, doubling the capacity. The plant was operated for many years by D. D. Hostetler, who sold it August 1, 1945, to the present owners, who began operation in April 1946.

During 1946, 67 kilns were fired producing 75,000 brick and 2,920 tons of building and drain tile. At a ratio of 2 $\frac{1}{4}$ tons to 1000 brick, this is the equivalent of nearly 1,300,000 brick.

Development:

The clay pit, which covers about 4 acres adjacent to the creek, was under water when visited. About 6 feet of clay was taken up in mining. The plant employed about 7 men.

Geology:

The section in the pit, according to Edward Kenagy, consists of 6 inches of sod, 1 $\frac{1}{2}$ feet of topsoil, 2 feet of gray sticky clay, 1 foot of brown clay, and 1 foot of sand which is mined with the clay.

Rock Creek has cut about 40 feet into the Molalla alluvial fan, which is capped in this area by at least 20 feet of Willamette silt. The clay pit lies on a Recent low bench of Rock Creek, opposite from a steep-walled cliff where the meandering of the stream has cut into the fan surface. It could not be determined whether the clay is a Recent deposit from the present stream or a portion of the fan alluvium.

Equipment and process:

The clay is dug with a small $\frac{1}{4}$ -yard gas shovel mounted on caterpillar tracks, and trucked or bulldozed (depending upon the part of the pit being worked) to a stock pile near the plant, from which it is fed by bulldozer and by hand to a set of 14-inch rolls. A belt conveyor 10 feet long carries the clay to the pug mill, which has a capacity of 20,000 brick per day. The clay is cut by wire tile cutter and hand-operated brick cutter. The machines are run by a large single-cylinder diesel, which has a compressed air-starter engine.

Hand-operated lift-trucks carry the pallets through elevators to the 3 floors of the air-drying shed and to the hog-fuel or kiln-heated shed. The same trucks carry the dried brick to two 25-foot oil-and-steam-fired Stewart circular kilns which have a capacity of 4,500 4-inch drain tile and 20,000 brick or 3,000 6 by 8 by 12-inch building tile. The two kilns are fired once a week, cooling over the weekend, and are emptied and filled on Monday and Tuesday. They are fired with wood (water smoked) for 72 hours, and with oil for 20 hours. Exhaust from the top of the kilns is drawn by blower to the drying house. When the kilns are not in operation a hog-fuel-fed boiler furnishes heat for drying, as well as steam for the oil burners and oil pump.

MacFarlane Brick Plant (5)

Josephine County

Owner and operator:

F. E. MacFarlane, 319 Rogue River Avenue, Grants Pass, Oregon.

Location and area:

E $\frac{1}{2}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 24, T. 37 S., R. 8 W., just south of the summit of Hayes Hill. The area comprises seven placer claims, located March 29, 1939.

History and production:

The plant was erected in 1939. Production at present is limited to common brick. The plant is operated intermittently and is currently producing only enough brick to supply the requirements of Mr. MacFarlane's bricklaying.

Development:

Between two and three acres have been cleared of brush and timber. There is a small clay pit back of the plant.

Geology:

The clay appears to be the deeply weathered slate of the Galice (?) formation. It is interbedded with a decomposed sandstone. Depth of weathered zone is from 10 to 25 feet, and it appears that there is sufficient clay for many years of operation.

Equipment:

Equipment consists almost entirely of the brick plant itself. The machinery was purchased from the old Ashland Brick and Tile Company and is as follows: a 110-h.p. Leroy gas motor for a power plant; disintegrator to break clay; Hummer model brick machine; pug mill; tile cutter which will cut up to 12 by 12 inches; and wire brick cutter. Buildings consist of a 100 by 20-foot drying shed; a 26 by 40-foot powerhouse; machinery plant is 10 by 12 feet; shop is 20 by 50 feet. All buildings have metal roof for fire protection.

Water is obtained from a 40-foot dug well. There is plenty of second-growth timber for firing the kiln.

Klamath Falls Brick and Tile Company (6)

Klamath County

Owner and operators:

Mr. Ralph W. Smith, owner, P.O. Box 573, Klamath Falls, Oregon; Mr. Wendell A. Smith, business manager; and Mr. William R. Smith, plant superintendent.

Location and area:

Montelius Street, Buena Vista Addition, Klamath Falls, Oregon. SW $\frac{1}{4}$ sec. 19, T. 38 S., R. 9 E. Plant and pits located on 40 acres of deeded land.

History and production:

The plant was constructed approximately 25 years ago and has been an active producer since that time. Production in 1946 consisted of 1,026 tons of building tile, and 1,549,978 common brick. In 1947 the plant produced 1,434 tons of tile and 1,320,289 brick.

Development:

Numerous shallow clay pits have been developed in the area adjacent to the plant.

Geology:

The area in which the plant is located has been mapped by Moore (1937) as diatomite with associated tuffs and clays. This formation was questionably assigned to the Pliocene age.

Numerous shallow pits have been developed adjacent to the plant. The "clay" thus exposed is very silty and contains some sizeable pieces of float. Most of these are conglomerates and tuffs.

Equipment and process:

Clay is mined by a P. and H. shovel and trucked to a large storage shed at the plant. Equipment includes a granulator pug mill, rolls, dry pan, screens, pug-mill and auger press. Brick and tile are cut with automatic cutters. Waste heat is used in the drying sheds. There are two oil-fired kilns, a rectangular downdraft holding approximately 67,000 brick, and a circular downdraft holding about 77,000 brick.

All plant machinery is electrically powered. Production is restricted to common brick and building tile.

Clay processed at the plant is composed of a mixture of approximately 75 percent clay mined locally and 25 percent Lincoln clay, which is shipped in by rail from Lincoln, California. The latter is a high-quality clay, which, when combined with the local clay, produces good red brick and tile. Thirteen men are employed.

Albany Brick and Tile Company (7)
(brick and tile)

Linn County

Owner and operator:

Mr. L. R. Harrison, Albany, Oregon.

Location and area:

East Albany, just south of U.S. Highway 99-E, in the SE $\frac{1}{4}$ sec. 5, T. 11 S., R. 3 W. The pits cover about 4 acres.

History and production:

The plant was originally built around 1880 by J. S. Morgan, and the Albany Brick and Tile Company was incorporated in 1912 by Wentworth. Mr. Harrison has been manager and part owner since 1920. Production has been approximately as follows:

	<u>1945</u>	<u>1946</u>	<u>1947</u>
Brick (No.)	70,000	794,000	811,000
Drain tile (feet)	32,000	46,000	69,000
Building tile (tons)	310	550	257

Twenty kilns of brick and ten kilns of tile were fired in 1946.

Development and geology:

The clay pits have been excavated to a depth varying from 6 to 15 feet. The plant lies at an elevation of 220 feet on the wide alluvial fan near the mouth of the Santiam River. The clays were probably deposited originally by floodwaters from the Santiam, or they may have resulted from an early flood stage of the Willamette River.

Equipment and process:

Clay is dug with a Caterpillar tractor and Fresno scraper, and either stored in an open shed or delivered to a belt that feeds the clay machine, which consists of a pug mill above an extruder. Both are run by an electric motor and line shafting. Brick and tile are loaded on pallets and on steel cars to be moved to the drying sheds. The main dry shed is 80 by 100 feet, a half of which (12 tracks) has recently been enclosed and blowers installed for waste heat drying.

There are three rectangular downdraft kilns, two of which are fired by 8 ports and one by 6 ports. The two large kilns hold 45,000 brick; the center kiln holds 40,000 brick. The kilns are water smoked with gas burners to 250° C. and then fired with slabwood; about 20 cords being required per kiln. There are 7 men employed.

Oregon Clay Products, Inc. (8)

Malheur County

Owner and operator:

Oregon Clay Products, Inc., Vale, Oregon. This is an Oregon corporation with Robert Lytle, Vale, Oregon, as president. Manager is Mr. Ed Hendrix and superintendent is Donnis Hon.

Location and area:

Sec. 21, T. 18 S., R. 45 E. The property is on U.S. Highway 28 a half a mile from the Union Pacific Railroad at Vale. Area consists of 16½ acres of deeded land and options on an additional 60 acres.

History and production:

Clay was worked here by individuals about 30 years ago at which time hand-molded, sun-dried brick were made for local consumption. The Oregon Clay Products, Inc., tested the deposits and set up the present plant in the spring of 1946. Production from this plant has been limited to brick only. Production of common and face brick in 1946 totaled 1,600,000. In 1947, 1,321,900 brick were fired.

Geology:

Forty 8-inch test holes were drilled by this company and sank to depths of 10 and 12 feet. One hole went to a depth of 28½ feet. All holes reportedly showed solid, gravel-free clay. The pit dug in the course of subsequent operation of the property has attained a depth of about 11 feet and has disclosed the top 4 feet to be "heavy" clay; the next 4-foot section is classed by the operators as a balanced, fine-grade clay; the lowest section tends to contain an excess of sand. All three types are mixed for plant feed, as the lowest sandy clay tends to balance the heavier surface clay.

Washburne (1914) shows that the clay occurring here is an integral component of the Payette formation. This formation is a fresh-water lacustrine deposit of Tertiary age.

Equipment and process:

A hydraulic lift carry-all tractor is used in the pit for excavation and delivery of clay to a belt conveyor. A processing unit consisting of rolls and a vibrator screen is on this conveyor line. The clay thus processed is discharged into a hopper which feeds directly into a pug mill. The pug-mill charge feeds directly to a Brewer No. 9 brick machine with a capacity of 25,000 brick per 8-hour shift. This produces a stiff-mud type brick which is wire cut to standard size by semi-automatic cutters. All plant machinery is electrically powered. Pallets of raw brick are stacked in the yards for open-air drying, with hand carts used for transportation from the cutters to the kilns. Kilns are all up-draft and fired by slack coal, and include one permanent kiln of 340,000-brick capacity; one semi-permanent kiln of 315,000-brick capacity; and two temporary kilns of 217,000 and 77,000-brick capacities.

General information:

The plant is well situated with respect to transportation. Precipitation is not great in this area, but is sufficient during the winter and spring months to render operations impracticable due to muddiness in the pit.

Donald Brick and Tile Company (9)
(brick and tile)

Marion County

Owners and operators:

J. S. Fisher and Son; Donald, Oregon.

Location and area:

The plant is just south of Donald, 5 miles west of Aurora, in the E $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 17, T. 4 S., R. 1 W., at about 180 feet in elevation. The area consists of 66 acres.

History and production:

The plant was built by Hoekins and Son in 1907, was owned by Goode and Van Hoonissen in 1913, and has been operated by J. S. Fisher since that time. During 1945 only 40 kilns were burned; in 1946 the plant started in April and burned 88 kilns, of about 60 tons each.

Development:

There are 3 pits, located from 30 to 200 yards from the plant, covering a total area of about 15 acres. The pits average slightly over 6 feet deep. The plant was operated by 12 men when visited.

Geology:

The plant is located upon the nearly level alluviated terrace surface of the Pudding River basin, on French Prairie. The Willamette River and Pudding River are incised 100 feet into this surface, the former lying 7 miles to the west and the latter 4 miles to the east. The gentle initial slope to the northeast of the wide surface is shown by the long consequent courses of streams such as Mission, Champoeg, and Mill creeks.

The pits were full of water when visited, but the section, according to Fisher, consists of 2 feet of soil, 2 feet of gray clay, and 2 feet of sandy subsoil, which is included in mining.

Equipment and process:

Clay is dug by a $\frac{1}{4}$ -yard gas shovel and carried by a 2-yard dump truck to a storage shed which has a 5,000-yard capacity. It is loaded from the shed by a Caterpillar D-2 Traxcavator onto the dump truck, which takes it up a ramp above the bin feeding the disintegrator rolls. A set of 18-inch rolls beneath the disintegrator delivers the clay onto a 50-foot belt to the pug mill. The mill is driven by a 75-h.p. electric motor, the rolls by a 10-h.p. motor. Dry clay and grog are pulverized in a 7-inch Red Devil hammer mill, and elevated by air to another bin above the pug mill. The pug mill is a Steele clayworking machine with a de-airer, operating under 20 pounds vacuum furnished by a 3-h.p. motor and vacuum pump. It has a capacity of 4,000 4-inch tile or 20 to 25,000 brick per day. Tile is cut by a rotary wire tile cutter, and brick is cut by a fully automatic wire brick-cutting machine.

Brick and tile are taken by wheelbarrow and elevator to the 4 floors of the air-drying shed, where they remain 10 days to 2 months; or to two heated dry rooms, each 30 by 100 feet, where they remain for 72 hours. Heat from the top of the kilns and heat from a separate oil burner is drawn by a 30-inch fan operated by a 3-h.p. motor to the dry rooms. The burner takes 6 gallons of oil per hour.

Three circular periodic Stewart oil-fired kilns with an inside diameter of 22 feet are fired once a week. Each has a capacity of 15,000 brick or 9,000 4-inch tile. The kilns are fired by wood (water smoked) for 24 hours through 6 ports, and by oil for 24 hours. They then cool for 3 days, leaving 1 day to unstack and 1 day to stack.

Columbia Brick Works (10)

Multnomah County

(face brick, common brick, and tile)

Operator:

Mr. Franzo Olbrich, president, Gresham, Oregon.

Location and area:

The plant is located on the Portland Electric Power Company Railroad, $1\frac{1}{2}$ miles southeast of Gresham at Hogan Station, in the SW $\frac{1}{4}$ sec. 14, T. 1 S., R. 3 E., just north of Johnson Creek at about 350 feet in elevation. The pit lies 2000 feet to the east. Fifty acres, of which 20 acres has been mined, and 20 acres of clay ground remain.

History and production:

The Columbia Brick Works was founded in 1905, incorporated in 1909, and remained under the same ownership until August 1948. The plant originally consisted of scove kilns; at present there is a bank of 22 Hoffman semi-continuous kilns. Production of tile was almost discontinued during the war years; later the following quantities of brick were produced:

	<u>1945</u>	<u>1946</u>	<u>1947</u>
Brick (No.)	3,800,000	3,500,000	5,247,000
Tile (tons)			8,000

Recent work has been done on a lower terrace at plant level, with about 1 acre stripped. The clay here is reportedly of lower grade than the upper level.

Geology:

The pit is cut to a depth of about 30 feet in the 400-foot or highest terrace stage of Pleistocene alluviation. The present pit face consists of 1 to 2 feet of soil, 10 feet of silty yellow clay, 10 feet of gray clay, and 20 feet of yellow sandy clay. The various grades of clay at the face are mixed in mining. The clay is of transported origin. It was probably deposited in a stagnant backwater which had been ponded during the ice-age flooding and valley-filling stage of the Columbia drainage. Bedrock across Johnson Creek to the southwest consists of Boring lava (Treasher, 1942), and the terrace levels to the southeast at higher elevations consist of glacio-fluvial outwash deposits from the Sandy River drainage.

Equipment and process:

The clay is dug with a $\frac{1}{4}$ -yard dipper electric shovel, which dumps into a 4-yard bottom-dump narrow gauge car, hauled by a small gasoline locomotive over 1500 feet of track to the dry storage shed. Shovel and car are operated by one man, who makes about 30 trips a day, delivering an average of 120 cubic yards of clay.

The dry storage shed was completed in 1946, and is 80 by 125 feet in size. The pit car pumps directly into bins from an overhead trestle. A scoopmobile and bulldozer transfer stored clay into bins.

A 300-foot conveyor belt transports the raw clay to the main plant, where it passes through rolls and pug mill driven by a 150-h.p. electric motor. The semi-automatic, rotary wire brick cutter delivers the brick onto a loading belt. Green brick are stacked on steel drying cars, which are then placed in a tunnel dry shed 93 feet long containing 18 tracks, and heated by hog fuel firing together with waste heat from the kilns.

The kilns are the coal-fired ^{semi-}continuous Hoffman type. There are 22 chambers 10 by 25 feet in size, arranged in a single row about 270 feet long. They are fired progressively by coal fed through openings in the top of the chambers. The heat from the chambers being fired is carried into the next kilns to perform the preliminary drying and heating. Wyoming coal is used. Two blowers supply sufficient draft. Each chamber contains 24,000 brick, and there are about 9 kilns fired per week, giving an average monthly production of about 800,000 brick. The long storage shed parallels the railroad track, and is supplied with two sunken roadways for truck loading.

Unfired brick are crushed and sacked for "Mortar-Mix." There are a number of oar sheds, a change room, oil storage, tool and smithy sheds, and a small office building. Thirty men are employed.

Sylvan Brick Company (11)
(face brick)

Multnomah County

Operators:

H. R. Kreitzer, president; Charles E. Jensen, vice-president and general manager, Sylvan, Oregon.

Location and area:

Just east of Sylvan, and north of State Highway 8 (Canyon Road) on the west boundary of Portland, in the center of the S $\frac{1}{2}$ sec. 6, T. 1 S., R. 1 E., at an elevation of about 750 feet. The area comprises 13 acres.

History and production:

The clay pit at this locality was first opened up by Randles and Kinsey in 1893. It has been known by many names, among them "Standard Brick and Tile Company." It was taken over in 1933 by the Columbia Brick Works, and in August 1948 became the Sylvan Brick Company. Production during the war years has been restricted to face brick, although the plant is equipped to turn out a large variety of tile. Production of brick since 1945 is given as follows: 4,500,000 in 1945, 7,000,000 in 1946, and 7,000,000 in 1947.

Geology:

Fifty feet of clay is exposed in the quarry behind the plant and an additional 187 feet is indicated by a well drilled near the plant. The origin of the thick clay section at Sylvan and of the clays and silts lying upon a weathered surface of Columbia River basalts in the west Portland hills and farther north has been a subject of discussion since it was first described (Diller, 1896). Diller believed that even the deposits as high as 660 feet in elevation were "evidently laid down in water." Darton (1909) described it as a loess; and Treasher (1942) states that it is in part water and in part wind laid. Libbey, Lowry, and Masen (1945) believe that the presence of quartzite pebbles in the clay at Sylvan is conclusive evidence that it was water laid.

Equipment and process:

The clay is excavated with a bulldozer, which moves it into a dry storage shed 100 by 300 feet in size holding several thousand yards. A belt conveyor runs beneath the storage shed, and the raw clay is fed to it by the bulldozer and by hand. It is lifted and dropped through a disintegrator and an 18-inch roll. From there it is carried by a short belt to an American pug mill and auger machine. Power is supplied by a 150-h.p. electric motor. A dry pan crushes dried clay and spoiled green brick for a dry clay source which is carried by bucket elevator to a bin above the pug mill.

The auger machine has a capacity of 40,000 brick per day; the brick pass through a semi-automatic wire cutter. Brick are stacked on steel cars, and enter a 2-story tunnel drier by way of narrow-gauge track and elevator. They remain in the drier about 3 days. The drying house contains 15 tracks, and is 100 feet long.

From the drier house the brick is loaded from both sides into a double row of downdraft kilns, consisting of 11 units (5 on each side and 1 at the end) each unit being 11 by 40 feet in size and 12 feet high, with a capacity of 25,000 brick. The dimensions of the row of kilns are 40 by 230 feet. They are individually fired through 3 ports at each end of each kiln by 6 electric motor-driven Enterprise crude-oil burners. There are 2 electrically driven oil pumps which supply oil from the large storage tank, and maintain a closed circuit movement of the oil while the burners are not in operation. About 35 barrels of oil (about \$1.98 per barrel in 1949) is required to fire each kiln, and almost every day 1 kiln is finished firing (25 kilns during November 1946).

The periodic kilns operate on a 12-day cycle as follows: 3 days stacking and unstacking, 2 days drying and heating, 2 days firing, 4 days cooling, and 1 day for final cooling with blower.

The heat from the downdraft kilns is carried from the duct beneath the kilns into and up through the next kiln, where the brick are given preliminary water smoking, drying, and heating, and is then pulled through a duct to the exhaust fan and stack. Another duct parallel and below this exhaust duct carries the heat from the cooling kilns to the drier house, thus transferring and using much of the waste heat.

A round downdraft or beehive kiln, 32 feet in diameter, is used as an auxiliary for special work.

Brick from the kilns are stacked on pallets which are loaded directly upon trucks by means of 3-wheeled fork trucks. There is a large amount of storage space for finished brick. Other buildings contain a lunch room, small office and show room, a wash room, and a machine shop. Thirty-six men are employed.

Pacific Stoneware Company (12)

Multnomah County

Owners:

Mr. L.W.M. Scott and Messrs. A. J. and R. A. Hable.

Location and area:

Plant occupies 2 acres at 9217 North Peninsular Avenue, Portland, Oregon, near the center of NW $\frac{1}{4}$ sec. 9, T. 1 N., R. 1 E.

History and production:

The plant was established in about 1890, and incorporated on November 10, 1909. The original plant was operated by Borchers and Prale; the present plant was built by T. S. Mann and family. During 1945 there were fired 27 (?) kilns of flowerpot and stoneware material, with 12 men employed; during 1946 there were 45 kilns fired, with 22 men employed. The production during 1946 of machine-pressed flower pots totaled nearly 2 million; of moulded pots about one-eighth that number.

Raw material:

Clay is purchased from Willamina Clay Products Company at a rate of about 700 tons per year; clay is also shipped from deposits at Chester and Image, Washington, and from Mayger, Oregon. Loam for flowerpot body is obtained locally from basement excavations. The rate on clay from Chester (near Spokane) is 21 cents per hundred pounds.* The total amount of clay used in 1945 was 1142 tons; in 1946, 2040 tons.

Equipment and process:

Clay is unloaded from railroad cars into a covered shed, from which it is shoveled through apertures directly into two circular blungers. After blunging, the slurry goes through lawns (screens) to storage tanks beneath the floor of the shop, from which it is pumped under pressure into two vertical clay tanks. The oakes of clay from two filter presses are taken to the 3 Beard flower pot machines and to the hand-mold room on the next floor above where there are six molding tables. The steam-heated drying rooms on the basement floor are about 30 by 50 feet; on the floor above, about 30 by 100 feet.

Two downdraft beehive kilns, 30 feet in diameter, hold about 45 tons of clay each. They are located in the center of the building and are oil-fired with 6 burners, the oil being pre-heated. From 1800 to 2000 gallons of oil are used for each firing. The kiln cycle takes about 1 week, although each kiln is only fired once in 14 days. Stacking and unstacking time is about 3 days, firing time from 38 to 40 hours, and cooling time about 2 days. Storage of the finished products is in a large room 50 by 130 feet. The entire plant occupies a space 150 feet square.

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* 1947.

Owner and operator:

G. P. Partridge, Monmouth, Oregon.

Location and area:

The plant is located on the east side of U.S. Highway 99-W just north of Monmouth city limits in the SW $\frac{1}{4}$ sec. 24, T. 8 S., R. 5 W., at an elevation of 190 feet. It occupies about 6 acres, of which 4 acres have been stripped.

History and production:

The first kiln was built about 1907 by George F. Shaw, and the father of the present owner purchased the plant in 1917. A new rectangular kiln was built in 1935. During 1945, 1946, and 1947 the plant has produced the following:

	<u>1945</u>	<u>1946</u>	<u>1947</u>
Brick (no.)	30,000	150,000	80,000
Drain tile (ft.)	150,000	280,000	280,000
Building tile (tons)	160	200	200

A total of 70 kilns was fired in this period, with an average of about 30 tons per kiln. Drain tile is made in 4, 5, 6, 8, 10, and 12-inch sizes; building tile is made in 6 by 8 by 12-inch and in 4 by 8 by 12-inch sizes.

Development:

The old pit of about 3 acres lies south of the plant and is from 6 to 10 feet deep. A new pit northeast of the plant has recently been opened.

Geology:

The section exposed in the pit consists of 18 to 20 inches of fine clayey silt, mapped on the soil maps as Willamette silty clay loam. It overlies a tan clay which is at least 10 feet thick and may extend considerably deeper than this. Water wells in the vicinity penetrate a gravelly water-bearing bed at 25 feet. The deposit lies on a portion of the Willamette plain, which in this area slopes eastward from 10 to 25 feet to the mile.

Equipment and process:

The clay is dug from the pits with a small tractor and Fresno scraper, and piled in the storage shed with a bulldozer, which is also used to shove it into a feed bin equipped with an automatic screw-feed disintegrator. This screw does preliminary mixing of the clay as it delivers it to a 30-foot feed belt and lift which supplies the disintegrator rolls. A short belt carries the clay to a J. D. Fate pug mill. The disintegrator and mill are operated by a 30-h.p. motor, the screw by a 15-h.p. motor. After extrusion and cutting, the brick are loaded on 3-wheeled carts and moved to the outside drier shed 30 by 150 feet in size; the tile are placed directly on pallets, and lifted on two elevators to the upper two floors of the main drier shed, 50 by 185 feet, which along with the lower floor, has a capacity of about 450 tons of tile. Tile on pallets are moved with the 3-wheeled carts to raised shelves. At the present time the lower floor of the dry shed is being closed off and will be heated with waste heat from the kiln.

Dried brick and tile are moved to the two kilns by cart and elevator. The rectangular downdraft kiln is 20 by 30 feet in size, and holds about 7,000 drain tile and 20,000 brick. It is fired to 1800°F. with 6 Enterprise oil burners, the firing cycle taking about 1 week. It uses about 1,000 gallons of oil for each firing. The oil storage tank holds 7,000 gallons.

A second kiln is of the beehive type, about 20 feet in diameter. At the present time the kilns are being water smoked with oil, a new procedure.

The plant employs four or five men.

Tillamook Clay Works (14)
(brick and tile)

Tillamook County

Owner and operator: R. G. Krebs, Route 2, Box 221, Tillamook, Oregon.

Location:

About 7 miles southeast of Tillamook and 1 mile northeast of U.S. Highway 101 in the SW $\frac{1}{4}$ sec. 10, T. 2 S., R. 9 W.

History and production:

The plant was built in 1913 by the father of the present operator, E. G. Krebs, and produced fairly steadily at the rate of 5 or 6 kilns per year until the last few years. The present kiln was built in 1937; previous to that time open or clamp kilns were used. The plant did not operate in 1945, but in 1946 5 kilns of 4-inch drain tile, a total of 95,000 feet, were fired. No brick or building tile were produced. In 1947, 85,000 feet of drain tile was fired.

Development and geology:

The plant is located on a low terraced divide between the Trask and Tillamook rivers, at an elevation of about 80 feet. The clay, as exposed in the pit which covers about 1 acre and is mined to a depth of 12 feet, shows the following section:

Sod	$\frac{1}{2}$ foot
Yellow clay	1-2 feet
Gray clay	1-2 feet
Blue clay	4-5 "
Gravel	Below 10 to 12 feet

The clay has a very high drying shrinkage, and must be treated carefully.

Equipment and process:

Clay is dug with a special rotary digger electric-powered. An overhead tramway with bucket delivers clay from the pit to a bin above the pug mill. The clay is not otherwise treated before going to the extruder. The 2-story building contains both machine room and bins, and drying space with elevators. The mill is powered with a gas engine. Tile are transported by wheelbarrow.

The single, circular downdraft kiln is 23 feet in diameter, and can be wood fired at a rate of about 1 kiln per month. Due to the high shrinkage of the clay it takes from $4\frac{1}{2}$ to 5 days to water smoke and $1\frac{1}{2}$ days to fire. Capacity of the kiln is 19,000 4-inch tile. Two men operate the plant.

La Grande Brick Yard (15)
(Formerly Towery Brick & Tile)

Union County

Owners: Niels P. Jensen and Jack L. Jensen, Box 636, La Grande, Oregon.

Location and area:

Sec. 36, T. 2 S., R. 37 E., on the Grande Ronde River on 17 acres of deeded land.

History and production:

The clay here was first utilized for brick manufacture in the 1890's and intermittent operations under various ownerships continued for many years. Between 1921 and 1930 the property was owned and operated by the Towery Brick & Tile Company. The present owners purchased the property in 1941 but because of the war no attempt was made to rehabilitate or operate the plant until the summer of 1946. Production since then has been as follows:

	<u>1946</u>	<u>1947</u>
Common brick	125,000	180,000
Face brick	25,000	30,000

Development:

Two small batches of brick were fired for a yield of 150,000 saleable brick. This was done under a temporary set-up in which the plant was located at a new site on the property. Pit work was accomplished by hand methods and executed so as to level and otherwise prepare the location for a larger and permanent plant installation.

Geology:

The owners report the existence of sufficient reserves for many years of sustained, moderate-scale production. The clay was deposited at the mouth of the Grande Ronde River when the valley was a vast inland lake. Only remnants of the original clay deposit remain, the one at the plant being described as 750 by 30 by 15 feet. Another remnant is reported to exist on the other side of the river.

Equipment and process:

Excavation is accomplished by use of a Caterpillar tractor and plow. A scraper is used for primary transportation to the grizzly where sand is mixed with the clay by hand in a proportion of 1 yard of sand to 2 yards of clay.

From the grizzly trap the mixed feed is elevated by a belt conveyor to a roll crusher. The crushed product is delivered by another belt conveyor to an auger mill. No screens were used during the past season, but it is planned to install a shaker screen ahead of the auger press.

Brick are out by a manually operated wire cutter and stacked 81 to a pallet and hand carted to open air drying tiers where the brick are allowed to dry for a period of approximately 4 weeks.

Firing has been done in temporary kilns of an average capacity of about 70,000 brick. Slabwood has been used for fuel. Approximately 360,000 saleable brick, including the batch to be fired, have been produced at this plant during the two seasons it has operated.

General information:

The climate in the Grande Ronde Valley will permit normal operations for 9 to 10 months out of the year without serious handicap from snow and freezing. Water is abundant and a potential supply of slab and cordwood exists nearby. The plant is situated adjacent to the Union Pacific Railroad and within a few blocks of U.S. Highway 30.

Forest Grove Clay Products Company (16)
(brick and tile)

Washington County

Owner and operators:

Elmer McCormack, Hillsboro, Oregon, owner; S. M. Haney, superintendent; and Robert K. McCormack.

Location and area:

Half a mile south of the center of the town of Forest Grove, just west of State Highway 47, on the north bank of Gales Creek, in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 1 S., R. 4 W., at an elevation of about 160 feet. The property consists of about 12 acres.

History:

The plant was originally located at Beaverton, under the name of Clay Products Company, and was moved to Forest Grove in about 1921. It was operated by Victor Randall and a partner named Martin; later by Jake and Otto Shearer until purchased, after lying idle for 2 years, by McCormack in 1944.

Development and geology:

The clay pit now occupies over 3 acres immediately north of the plant. It is cut into the 175-foot terrace, and the bank consists of 15 feet of micaceous clay silt, overlying 5 feet of blue clay; the 2 layers are mixed in mining.

There are 2 well-defined terraces at 175 and 200 feet in elevation in the Forest Grove area, with Gales and Dairy creeks being maturely incised in the older surface to an elevation of about 150 feet. The period of alluviation, when the clay was deposited, undoubtedly was late Pleistocene, the clay and silt being largely water laid.

Equipment and process:

The clay, formerly excavated by team and Fresno scraper, is now dug with a small 3-wheeled Scoopmobile which picks up a 1-yard load at the face, carries it to a ramp, lifts it up, and drops it into a small bin above the primary pug mill. Clay is also stored for winter use in a 30 by 50-foot shed, from which it is loaded either by the Scoopmobile or by a $\frac{1}{2}$ -yard shovel mounted on a truck chassis.

A large new pug mill and auger machine with de-airer was installed in February 1947, and the clay is delivered from the primary to the secondary mill by means of belt conveyor. All machinery is operated by separate electric motors. The hand-operated wire brick cutter delivers the brick onto a long belt from which they are removed manually and stacked on pallets, which are transferred to a concrete-block, steam-heated drying house by fork truck.

Brick are oil and steam fired through 8 ports of a circular kiln 40 feet in diameter which holds 80,000 to 90,000 brick, and takes 10 to 14 days to fire. Recently most of the brick have been fired in scove kilns 30 feet square built under a moveable shed which runs on tracks 120 feet long. These take about a week to fire. The crude oil is supplied from an oil-storage tank, holding about 12,000 gallons, by steam pumps driven from an oil-fired boiler. Ten men are employed.

O. K. Brickyard (17)

Washington County

Owner and operator: Fred Krebs, owner, and Art Krebs, Sherwood, Oregon, operator.

Location and area:

Just south of Six Corners on west side of U.S. Highway 99-W. The property consists of about $1\frac{1}{2}$ acres.

History and production:

The plant was built about 1921 by Otto Krebs and operated by him until 1942. It was idle during World War II. In January 1947 Art Krebs leased the brickworks from Fred Krebs and reopened the plant. Production was confined to 4 months from May through August during which time 170,000 common brick were fired.

Development:

A clay pit, with a 4-foot face, measuring 200 by 400 feet has been dug into the surface of a flat several acres in extent. The brick plant has been erected on the level floor of the bench a short distance west of the highway. Plant operation is normally suspended during the winter months when the pit becomes too wet to work.

Geology:

The pit is in the Pleistocene terrace deposit which covers a large area along the Tualatin River. Beneath the top 4 feet of usable clay the deposit becomes too sandy to use.

Equipment and process:

The top 4 inches of soil in the pit is stripped off, uncovering a 4-foot layer of silty clay which is used. The pit clay is loaded by hand-shovelling into a dump truck and hauled to the pug mill which has a capacity of from 5,000 to 6,000 brick per day. Here it is mixed with "gumbo" obtained from Cedar Creek, which flows just south of the plant. Clay and gumbo are mixed at a ratio of 5 to 1.

The brick are cut with a manually operated wire cutter and hauled on rubber-tired carts to the 25 by 75-foot air-drying shed.

After drying for at least a week the brick are stacked in a scove kiln having a capacity of about 90,000 brick. The kiln is fired with slabwood for 10 days. A shed 25 by 50 feet protects the kiln from the weather. A 1-ton Hyster fork truck is used to transfer the fired brick to trucks for delivery.

A 20-h.p. electric motor supplies power to the pug mill. An average of 4 men were employed during the 4 summer months in 1947.

Scholls Tile Company (18)

Washington County

(Groner-Rowell Company, previous to 1926)

Owners and operators: Jesse C. Snyder and Son, Scholls, Oregon.

Location and area:

Just west of State Highway 210, about $\frac{1}{4}$ mile north of North Scholls, in the NW $\frac{1}{4}$ sec. 10, T. 2 S., R. 2 W. The plant and pit are just north of the Tualatin River. The plant is at an elevation of about 135 feet, and the floor of the pit is about 15 to 20 feet lower in elevation. The property comprises 21 acres.

History and production:

The plant was first established in 1902 under the name of Groner-Rowell Company, which was sold to Jesse C. Snyder in 1926, who has operated it since that time and recently has taken his son into partnership. During the 1946 season the plant produced 75,000 feet of drain tile; in 1947, 210,000 feet of drain tile and 2,500 building tile. Prewar production was about 500,000 feet of drain tile per year.

Development:

The clay pit has been excavated to a depth of from 15 to 20 feet in the terrace surface, over an area of about 6 acres. Six men operate the plant.

Geology:

The deposit is located on the lowermost, or floodplain, terrace of the Tualatin River; the present bottom of the pit being within 4 feet of the normal water level. The plant is on the second terrace, about 10 feet above the lower terrace, which has been slightly incised since late Pleistocene time by the meandering course of the Tualatin River. Clay in the pit face consists of about 6 feet of silty clay overlying an equal amount of cleaner clay. The two are mixed when mined. The deposit probably originated as a transported clay, laid down during temporary ponding of the drainage, and may underlie a large portion of the wide and relatively flat terrace north of the river. Similar deposits undoubtedly could be found along the river between Scholls and Hillsboro to the north. Depth to basalt bedrock, which outcrops in Cooper Mountain to the north and Chehalem Mountain to the south, is unknown but may be several hundred feet.

Equipment and process:

Clay was formerly loaded by Fresno scraper and ramp into a small car, which was pulled by cable up the narrow gauge track 150 yards to the plant. A small bulldozer loads the clay, and a trestle delivers it to an elevated bin and to a storage shed with a capacity of 1,500 cubic yards of raw clay. This permits winter operation of the plant.

Machinery in present operation consists of rolls, pug mill, and wire-cutting machine, run by a 50-h.p. electric motor. New machinery has been installed to make tile from 3 to 13 inches in diameter, the larger 14 and 16-inch sizes are made on the old machine.

Tile are transported from the machine to the 3-story drying houses (40 by 60 and 60 by 90 feet) by wheelbarrow and elevators, where they are air dried from 10 days to a month. The drying space handles enough tile for 6 kilns, that is from 45,000 to 75,000 tile (of 4-inch and 6-inch size).

After drying, the tile are moved by elevator and wheelbarrow and stacked in two round kilns, about 20 feet in diameter, which have a collective capacity of 15,000 4-inch tile or 25,000 6-inch tile.

After loading and sealing, the kilns are wood fired through 6 ports for 24 hours, oil-and-steam fired with heavy oil for 36 hours, and then allowed to cool for 5 days. The oil is pumped to the burners from an 87-barrel storage tank by means of a steam-operated oil pump. On an average, each kiln makes $2\frac{1}{2}$ firings a month, and requires from 60 to 65 barrels of oil per firing.

McMinnville Brick and Tile Factory (19)

Yamhill County

Owners and operators: Mr. S. B. Nicoll and Son, McMinnville, Oregon.

Location and area:

The plant is located near the southeast city limits of McMinnville, beside the Southern Pacific tracks, at the north edge of the NW $\frac{1}{4}$ sec. 28, T. 4 S., R. 4 W. One pit is located $\frac{1}{4}$ mile east on the west bank of the Yamhill River; another is also on the bank of the river about half a mile south of the first pit; and a third site is located just southwest of the center of sec. 28 in an open field. The terrace surface upon which the plant and pits are situated lies at an elevation varying from 125 to 150 feet. There are 12 acres in the plant area, and 15 acres farther east and south on which the clay pits are located.

History and production:

The plant was established in 1888 by Jacob Seitters, and is thus one of the oldest in Oregon. During the last few years of World War II the plant was not in operation. It started again in June 1946; during the remainder of that year, it burned 40 kilns, averaging from 20,000 to 25,000 brick or brick-equivalent per kiln. Actual production ran about 40 percent red rug brick and 60 percent drain tile, the latter being mostly 4-inch, although some other sizes (5, 6, 7, 8, 10, and 12-inch) were made. The products were a light red in color, unless given a heavy firing.

Development:

At the time the plant was visited (January 1947), the original clay pit, located north and east of the plant, had been dug over an area of several acres to a depth of 5 to 8 feet, and was no longer in use. The second pit farther east was 10 to 14 feet deep on the edge of the main terrace, and covered about half an acre. The pit farther south was about the same depth, but less than 50 feet across. The new pit site south of the plant had not yet been opened up.

Geology:

The remarkably level Dayton Prairie, which lies north of the Amity Hills at an elevation averaging about 155 feet, is incised to a depth of 75 feet by the meandering course of the Yamhill River, which lies in a narrow canyon, with occasional terrace areas at about 110 feet. This Dayton surface, according to the map,* is composed in its upper elevations of Amity silt loam, the remainder being Willamette silt loam. In the clay pits, bands about 6 inches thick of plastic silty clay alternate with much less plastic fine micaceous silt. A few small granite erratics have been found in the pit. The deposit is clearly water lain, probably of upper Pleistocene age, and was deposited in the "Willamette Sound" during flooding of the valley.

Equipment and process:

Clay is excavated with a $3\frac{3}{8}$ -yard Bucyrus-Erie shovel and trucked to the plant. The clay is delivered to a granulator pug mill on the upper level, then dropped to a vertical Brandeis-Brewer brick machine. The former is run by a 40-h.p. motor, the latter by a separate 75-h.p. motor. The wire brick cutter is hand operated; there are several tile cutters for the different sizes.

* -----
Soil survey of Yamhill County, Oregon: U.S. Dept. Agr., Bur. Soils, 1920.

Brick are loaded on pallets and carried by means of 3-wheeled trucks to the lower level of the air drier. Tile are either taken by wheelbarrow to the lower levels of the 3 driers, or lifted by chain elevator to the upper floor of the sheds. The driers consist of the main shed, 35 by 110 feet; a smaller shed parallel to it 25 by 100 feet; and a shed 30 by 40 feet, the second floor of which extends out over the machine room. Ramps extend to the upper floor of the sheds. The lower floor of the main shed is partitioned off so that it can be heated by waste heat drawn by 2 blowers from the kilns.

Brick and tile are moved from the driers by hand truck and wheelbarrow to the kilns, which consist of 2 downdraft beehives, and 1 double-chambered kiln 40 feet square. Each kiln requires about $1\frac{1}{2}$ cords of slabwood for water smoking, and then is fired with oil burners using about 1,000 gallons of oil per firing. One of the beehives has 6 burner ports; the other, 9. The square kiln has 3 ports at the ends of each chamber, 12 in all, of which only 6 are used for oil firing. An oil pump keeps the heavy oil in circulation from the 7,000-gallon storage tank. The total firing cycle amounts to about 1 week.

Brick are removed from the kilns and stacked with a Hyster lift truck and pallets; tile are removed by wheelbarrow and stacked by hand. An 80 by 300-foot building for storage and machine shop is also a part of the plant. Five men are employed.

Willamina Clay Products Company (20)
(formerly Pacific Face Brick Company)

Yamhill County

Owners:

Willamina Clay Products Company, 1020 S.W. Taylor Street, Portland, Oregon;
O. K. Edwards, president; G. J. Edwards, vice-president and treasurer; and H. K. Hadley, superintendent and secretary.

Location and area:

The quarry is located on the east side of Willamina Creek, 0.8 mile northwest of the town of Willamina, in the SE $\frac{1}{4}$ sec. 36, T. 5 S., R. 7 W. The property is at the end of a spur of the Southern Pacific Railroad, with a siding at the plant. It is half a mile from State Highway 18, about 40 miles northwest of Salem and 56 miles southwest of Portland. The property covers 53.33 acres.

The company also has 140 acres (7 claims) on the northeast portion of Hobart Butte, 15 miles south of Cottage Grove, Lane County, in the SW $\frac{1}{4}$ sec. 31, T. 22 S., R. 3 W.

History:

The Willamina quarry was first opened in 1907 and was operated until 1917 by O. K. Edwards, under the name of Pacific Face Brick Company. During the period between 1917 and 1924 production was intermittent, but operation has been continuous since 1924. A fire destroyed much of the plant in 1938. Previous to that time tile and hollow ware, now no longer made, had been part of the output. In 1945 production consisted entirely of face, fire, and common brick.

In 1932 O. K. Edwards located mineral claims on Hobart Butte, and subsequently opened a quarry and excavated pits.

Development and production:

Annual totals have varied from 1 to $4\frac{1}{2}$ million brick a year. About 350 to 400 tons of clay per year is shipped to the Pacific Stoneware Company.

Between 1932 and 1945 about 15,000 tons of fire clay from Hobart Butte was shipped to the plant.

Geology:

The valley of Willamina Creek north and west of Willamina is out in well-bedded dark-gray clay shales, which appear to be folded gently in at least one anticline along an axis trending east of north. The quarry is located on the east limb of the anticline, where the shale is overlain by medium- to fine-grained amygdaloidal basalts which are interbedded towards the base with tuffaceous shale and coarse tuffs. The basalt, which forms the crest of the ridge, is usually weathered throughout, but occasionally it is fresh and shows columnar structure.

A section of the east wall of the quarry (the north wall is disturbed and duplicated by landsliding) is as follows:

Dark red soil	1-3 feet
Massive, amygdaloidal basalt, mostly deeply weathered . . .	40 "
Thin-bedded platy shale with a few 6-inch layers of massive shale	20 "
Medium-grained shale with large nodules	2 "
Massive, fine-grained blue-green tuffaceous sandstone, grades below into	4 "
Coarse-grained angular tuff, which lies with disconformable contact upon	2 "
Blocky and conchoidally fracturing dark gray carbonaceous shale, with some included shale conglomerate and breccia . . .	30 " plus

The lowest shale bed is at least 50 feet thick, and is the one being mined for clay. The upper basalt is mined for base for brick, which is made up of 25 percent clay and 75 percent weathered basalt. The shale is very fine grained, sheared in places, and both pyrite and gypsum are occasionally present.

The Willamina clay is unusual in having both light-fired colors and low fusion. Clays from this quarry have been described in some detail by Wilson (1923), Wilcox (1935), and Wilson and Treasher (1938).

Hobart Butte is composed chiefly of hydrothermally altered volcanic tuff and breccia through which realgar and stibnite are distributed in minor amounts. The clay which has been quarried came from a capping layer, of unknown depth and extent, which has been altered to a composition similar to that of kaolinite. The formation is considered to be a part of the Calapocoya of upper Eocene on the basis of the contained fossil leaves (Wells and Waters, 1934).

Equipment and process:

Clay at Willamina is dug by a small power shovel during the summer season, when 7 bins with a capacity of 250 tons each are filled for use during the rainy season. Altered basalt may be mined all year, and makes up 70 to 75 percent of the raw material used for face and common brick. The clay is transported by trucks and delivered dry into the bins by way of an 18-inch belt 175 feet long, with a rise of over 30 feet. During the summer season both the bins and the loading belt are by-passed, and the clay is put directly into a set of 3 mixing bins which contain the 3 different materials for the different types of brick made. From the mixer (a Williams hammer mill) the clay goes to the dry pan, where it is crushed by 2 large rotary mullers, and thence to 2 plano-wire screens by way of bucket elevator. A fourth very fine vibrating screen is used for fire clay. The screen oversize returns to the mixer. The blended and ground clay is then carried by belt to 8 storage bins, which hold sufficient material for about 90,000 brick.

The prepared clay is drawn from the bins by several belts that feed a master belt supplying the pug mill, where water is added. The clay then goes through the presses and to the off-bearing belts. Fire clay is reground in 2 wet pans before it goes to the pug mill, and also passes through 2 represses for shaping, channeling, and stamping.

The green brick are loaded into steel cars, which are kept moving by a chain belt, and are then loaded into 12 drying ovens 100 feet long, taking about 36 to 40 hours to pass through. The ovens are heated by a large sawdust furnace, with one 12-foot fan for forced draft and a smaller 6-foot exhaust fan. From the drying ovens they are stacked in the kiln, which is made up of 18 chambers, set in 2 rows. Each chamber is 35 feet long and about 10 feet wide. They are heated by sawdust, fed from above by small cars. Portable heaters are used to heat the outer ends of each chamber as it is started up. The chambers are fired in rotation, the draft from each chamber, as it is fired, passing into the next. Each chamber holds 25,000 brick, and 1 chamber a day is an average rate of operation.

The finished brick are handled by means of an elevating machine loader and truck, which moves piles of over a thousand brick at a time without rehandling, and can stack the piles 3 high. Brick are shipped in railroad cars and by truck to Willamette Valley and Portland markets. Twenty men are employed.

Hubbard Clay Works*
(tile)

Clackamas County

Owner and operator:

S. D. Hostetler and Roy Kenagy, Hubbard, Oregon.

Location:

The plant is located approximately 3 miles east of Hubbard on the south side of the Hubbard to Molalla road and on the west bank of Rook Creek.

History, production, and equipment:

The Hubbard Clay Works has been in operation since the latter part of 1947. Production is reported as 320,589 feet of 4-inch drain tile in 1947. One kiln will hold about 13,000 4-inch tile.

Equipment consists of a $\frac{1}{4}$ -yard quick-way shovel for quarrying purposes, one truck to transport the clay, a J. C. Steele clay-working machine (clay press), and a cutting machine. One oil-fired kiln is in operation and another will be completed soon. The drying room is heated from the same source that fires the kiln.

Geology:

The quarry which supplies the raw materials for the plant is located on Rook Creek immediately east of the plant. A gray silt, which is most probably Willamette silt of Pleistocene age, is the material mined.

* Plant visited in 1949. Located on index map in same general area as No. 4 (Needy Brick and Tile Company).

Results of Testing Oregon Brick and Tile Clays

A good brick and tile clay should have not more than 7 percent firing shrinkage and 7 percent drying shrinkage. It should not bloat, check, warp, or show scumming (uneven surface bleaching). The color should be even. Tables 2 and 3, which follow, show the relative physical properties of some of the Oregon clays that were tested by the Department. Table 2 shows results of tests on clays from commercial plants. Table 3 shows results of similar tests on raw clays of various grades from new localities. These tabulations represent only a small fraction of the total number of clay samples tested by the Department during the study.

Table 2.
Results of Tests Made on Oregon Commercial Clays from 16 Producers

Index map no.	Name of plant	Clay no.	Water of plasticity*	Drying*	Shrinkage		Fired color	
					1800°±	2100°±	1800°±	2100°±
7	Albany Brick & Tile Co.	C-125	30.5%	7.5%	10.7%	11.3%	Dark red	Dark red
11	Sylvan Brick Co.	C-57	22.8	5.3	1.1	6.7	Red	Brown
10	Columbia Brick Works	C-105	23.2	6.9	2.7	3.6	Red	Dark red
1	Corvallis Brick & Tile	C-127	35.0	9.9	7.0	8.3	Red	Dark red
9	Donald Brick & Tile Co.	C-109	23.7	6.4	4.5	6.1	Red	Dark red
16	Forest Grove Clay Products Co.	C-107	23.0	5.3	6.1	6.9	Dark red	Dark red
19	McMinnville Brick & Tile Factory	C-116	32.1	8.7	3.4	8.2	Brick red	Dark red
3	Molalla Brick & Tile	C-111	18.5	7.5	5.2	6.7	Dark red	Dark red
13	Monmouth Brick & Tile	C-112 113	35.7	8.7	2.2	11.0	Brick red	Dark choc.
2	Monroe Brick & Tile	C-126	31.9	7.5	8.1	9.4	Choc. red	Dark "
4	Needy Brick & Tile Co.	C-110	29.3	8.7	3.5	4.4	Brick red	Dark red
17	O. K. Brickyard	C-187	32.6	5.9	6.4	8.5	Red brown	Red brown
8	Oregon Clay Products	C-76	28.1	6.4	1.1	4.4	Brick red	----
18	Scholls Tile Co.	C-106	19.0	9.3	3.5	4.3	Dark red	Dark red
14	Tillamook Clay Works	C-124	46.0	13.6	7.3	7.3	Light red	Red
20	Willamina Clay Products (red brick)	C-114	28.0	6.4	2.2	6.8	Brick red	Choc. red
	(fire clay)	C-115	23.0	3.1	4.1	6.3	White	Yellow
	(black clay)	C-118	36.8	6.4	6.0	9.3	Gray	Gray

* Average of 2 samples.

Table 3.
Results of Tests Made on Raw Clays from 30 New Localities

Key to map	Clay numbers	Water of plasticity*	Drying*	<u>Shrinkage</u>		<u>Fired color</u>	
				1800°±	2100°±	1800°±	2100°±
I	A-12	Nonplastic		High			Buff
G	A-15	High	Low				Brown
U	A-18	Nonplastic	Low				Ivory
C	A-20	Plastic					Buff
BB	A-30	Plastic					White
V	A-33	Nonplastic	Low				White
B	A-42	Plastic	Medium				Ivory
DD	A-45	High	Low				Brown
K	C-11	37.1%	3.1%	3.2%	11.5%	Ivory	Ivory
AA	C-12	Plastic	12.0	1.1		Red	---
AA	C-17	Plastic	11.0	1.1		Brown	---
S	C-45	44.1	9.3	2.3	13.6	Cream	Cream
T	C-47	41.8	7.1	16.0	22.1	Brown	Gray
P	C-58	22.9	6.4	0.0	3.2	Buff	Salmon
W	C-59	32.0	10.5	2.3	8.3	Light red	Dark red
H	C-65	31.0	8.7	2.2	7.0	Buff	Reddish buff
X	C-78	22.4	8.7	0.0	1.1	Buff	Red
E	C-84	29.7	8.7	1.1	9.8	Red	Red
Q	C-85	34.2	11.1	2.3		Red	---
R	C-129	39.0	12.4	3.5	4.7	Light red	Dark red
S	C-131	21.0	7.0	5.7	9.3	Brick red	Choc. brown
Y	C-135	34.0	8.0	1.1	5.7	Light red	Dark red
J	C-138	30.8	9.9	1.1	1.1	Light red	Dark red
CC	C-145	38.6	8.7	1.1	12.2	Light red	Dark red
A	C-152	30.0	7.5	0.0	11.0	Light red	Dark red
D	C-156	39.0	11.1	1.1	3.5	Pink	Red
M	C-158	56.0	12.4	1.2	11.3	Pink	Yellow
O	C-159	55.3	17.6	2.4	7.7	Buff	Salmon
N	C-174	42.8	9.9	0.0	3.4	Brick red	Dark red
L	C-176		7.5	1.1	4.5	Cream	Buff
L	C-177	34.0	7.5	0.0	3.4	Pale salmon	Med. salmon
F	C-178	36.4	11.1	2.3	6.0	Brick red	Dark red
J	C-179	42.0	12.4	1.2	2.3	Brick red	Dark red

* Average of 2 samples.

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