STRUCTURAL MATERIALS.

By Wm. C. Day.

THE BUILDING INDUSTRY IN GENERAL.(a)

The year 1886 opened with encouraging prospects for the building industry generally throughout the country, but scarcely were active operations fairly under way when the widely-spread labor disturbances which have made the year memorable began, making themselves felt in a number of the largest cities, both in the east and west. As soon as the labor troubles were inaugurated, many building enterprises were abandoned, and many more were postponed until the differences between labor and capital should be smoothed over. The building operations which were carried on during the period of disturbance were in most cases attended by small margins of profit to all concerned, and in some instances by disaster to contractors and to those who supplied material. Business was dull for all branches of trade connected with the building industry; demand for material was low and irregular, and values fell off quite considerably.

This period of general depression was, however, followed by one of the greatest activity, and while it is true that many building enterprises contemplated at the beginning of the year were abandoned and not taken up again during 1886, still the fact remains that at the close of the year the showing made by the principal cities of the country was a large increase in the amount of building done, as compared with 1885.

The kind of buildings most extensively erected during this period of activity consisted of residences, the demand for which, in view of our rapidly increasing population, is naturally at all times imperative.

a In the preparation of this report the sources drawn upon for information have included a large number of quarrymen, producers of all kinds of structural materials, dealers, architects, contractors and builders, building inspectors and commissioners, trade journals, statistical publications from various States, etc. Sincere thanks are due to the large number of correspondents whose replies to inquiries addressed them were so courteously and conscientiously given, and to whom the value of the report is largely due. Information in regard to the Rocky Mountain division was furnished, as in former reports, by Mr. F. F. Chisolm, and that for the Pacific coast by Mr. C. G. Yale. Especial acknowledgments are hereby tendered to Mr. Robert H. Dalby and also to Mr. L. E. Schlauch, both of Slatington, Pennsylvania, for valuable information in regard to slate; to Mr. S. L. Merchant, of New York, for aid in preparing the report on cement; to Dr. J. M. Safford, State geologist of Tennessee; Prof. Thomas B. Bancroft, chief inspector of mines in Ohio; Mr. O. C. S. Carter, of Philadelphia, and to Mr. Henry J. Biddle, of Philadelphia.

Only a few cities show positive evidence to the effect that building operations for the entire year were curtailed owing to the influence of labor troubles, although, of course, the frequently-propounded question, "What would have been the amount and value of building done in 1886 had there been no serious interruption?" is one which no one can satisfactorily answer.

The following table has been constructed on the basis of statistics furnished by the building inspectors and commissioners of the various cities considered. The figures represent in general the number of permits issued during the year and the estimated values of the buildings for which permits were given. Although all the buildings for which permits are issued are not completed during the same year, still this fact does not diminish the value of the figures as showing the comparative condition of the industry in different years:

Number and value of the buildings for which permits were issued in twenty cities during the years 1884, 1885, *and* 1886.

Cities.	Frame buildings.		Brick buildings.		Total for year.	
	Number.	Value.	Number.	Value.	All buildings.	Value.
1884.						
Portland, Maine	56		25		81	$210,000
Boston, Massachusetts (*a*)	1,123	$3,078,145	(*b*) 312	$5,400,775	1,435	8,478,920
Fall River, Massachusetts	416		7		423	866,450
Providence, Rhode Island	393	1,145,840	16	239,400	409	1,385,240
Bridgeport, Connecticut	249	360,000	20	100,000	269	460,000
Brooklyn, New York	1,304		1,435		2,739	12,672,334
New York City, New York					2,897	41,401,208
Wilmington, Delaware			226	730,225		
Washington, Dist. Columbia	151	94,784	1,042	3,293,070	1,193	3,387,854
Richmond, Virginia	186	154,200	226	733,200	412	887,400
Saint Paul, Minnesota (*c*)	2,075	1,667,035	269	2,387,490	2,344	4,054,525
Saint Louis, Missouri	620	371,136	1,989	6,393,655	2,609	6,764,791
Topeka, Kansas	603		68		671	406,671
1885.						
Portland, Maine	67		14		81	250,000
Boston, Massachusetts (*a*)	1,372	4,552,538	(*b*) 348	6,218,800	1,720	10,771,338
Fall River, Massachusetts	209		10		(*d*) 212	330,975
Providence, Rhode Island	452	1,273,745	13	364,700	465	1,638,445
Bridgeport, Connecticut	280	420,000	25	125,000	305	545,000
Brooklyn, New York	1,261		1,377		2,638	11,465,795
New York City, New York					3,368	45,374,013
Wilmington, Delaware			280	668,500		
Philadelphia, Pennsylvania					6,326	
Pittsburgh, Pennsylvania	795		647		1,442	3,030,429
Baltimore, Maryland					2,970	3,500,000
Washington, Dist. Columbia	325	195,255	1,336	3,297,252	1,658	3,492,507
Richmond, Virginia	244	124,900	238	873,400	(*e*) 483	(*f*) 1,021,300
Galveston, Texas	116	177,630	7	123,500	123	301,130
Detroit, Michigan	1,328	1,437,819	563	2,040,500	1,891	3,478,319
Chicago, Illinois					4,638	24,330,125
Saint Paul, Minnesota (*c*)	2,964	2,238,026	385	1,921,182	3,349	4,159,208
Saint Louis, Missouri	510	456,825	2,169	6,400,779	2,679	6,857,604
Omaha, Nebraska	600	957,318	60	1,788,145	(*d*) 662	(*g*) 2,865,463
Topeka, Kansas	696		75		771	494,291

a Values estimated for completed buildings.
b Number of brick, stone, and iron buildings for which permits were issued.
c The total values for Saint Paul include "additions, alterations, and repairs."
d Includes 2 stone buildings.
e Includes 1 stone building.
f Includes value of 1 stone building, $23,000.
g Includes value of 2 stone buildings, $120,000.

Number and value of the buildings for which permits were issued, &c.—Continued.

Cities.	Frame buildings.		Brick buildings.		Total for year.	
	Number.	Value.	Number.	Value.	All buildings.	Value.
1886.						
Portland, Maine	91	.....	32	.....	123	$300,000
Boston, Massachusetts (*a*)	1,353	$3,992,792	(*b*) 346	$8,813,100	1,699	12,805,892
Fall River, Massachusetts	205	.....	22	.....	(*c*) 230	666,750
Providence, Rhode Island	407	1,194,607	12	168,750	419	1,363,357
Bridgeport, Connecticut	350	630,000	34	170,000	384	800,000
Brooklyn, New York	1,774	.....	2,215	.....	(*d*) 3,990	20,318,485
New York City, New York	.....	.....	.....	.....	4,095	58,750,733
Wilmington, Delaware	.....	.....	192	622,983	.....	.....
Philadelphia, Pennsylvania	.....	.....	.....	.....	7,561	.....
Pittsburgh, Pennsylvania	847	.....	568	.....	1,415	2,401,809
Baltimore, Maryland	.....	.....	.....	.....	2,632	3,100,500
Washington, Dist. Columbia	392	295,689	1,802	4,412,240	2,194	4,707,929
Richmond, Virginia	137	125,000	204	528,600	341	653,600
Galveston, Texas	181	394,400	5	104,000	(*e*) 187	(*f*) 623,400
Detroit, Michigan	1,533	1,561,864	520	2,335,350	2,053	3,897,214
Chicago, Illinois	.....	.....	.....	.....	4,664	26,868,375
Saint Paul, Minnesota (*c*)	3,017	2,488,271	553	3,567,571	3,570	6,055,842
Saint Louis, Missouri	491	405,892	1,732	5,916,978	2,223	6,322,870
Omaha, Nebraska	1,150	2,224,390	145	2,950,750	1,295	5,175,140
Topeka, Kansas	576	.....	69	.....	645	621,596

a Values estimated for completed buildings.
b Number of brick, stone, and iron buildings for which permits were issued.
c Includes 3 stone buildings.
d Includes 1 iron building.
e Includes 1 stone buildings.
f Includes value of 1 stone building, $125,000.

Adding together the figures for the values of "all buildings" for all cities except Wilmington and Philadelphia, data for which are wanting, the total $124,105,942 is the result for 1885, while for 1886 the corresponding total is $155,433,492. An increase during 1886 of $31,327,550, or 25.2 per cent., over 1885 is evident. Omitting New York city from the calculation, the totals are $78,731,929 for 1885, and $96,682,759 for 1886, an increase for the latter year of $17,950,830, or 22.8 per cent.

In order to convey a general idea of the condition of the building industry in the United States during 1886, the following information relative to a number of the more or less important cities and towns in the country is presented.

MAINE.

Bangor.—This city is the center of a large lumber-producing district, and this product is naturally much more extensively used than brick, stone, or other building materials. Comparatively few of the finer or more expensive buildings are erected. During 1886, dwellings of moderate cost formed the class of structures most largely built. There being a number of slate quarries near the city, slate for roofing purposes is cheap and is freely used. Ornamental building materials find little favor and it does not seem likely that there will be any great demand for them in the near future.

Portland.—The following table shows the progress made in building during the last three years:

Number and value of buildings erected in Portland, Maine, 1884 to 1886.

Kinds of buildings.	1884.		1885.		1886.	
	Number.	Value.	Number.	Value.	Number.	Value.
Frame buildings	56	.....	67	.....	91	.....
Brick buildings	25	.....	14	.....	32	.....
Total	81	$210,000	81	$250,000	123	$300,000

The building stone used in Portland consists chiefly of red and buff sandstone quarried at Long Meadow, Massachusetts, and granite taken from quarries at Biddeford, Red Beach, and Hallowell, Maine, and Conway, New Hampshire. For roofing purposes slate is quite freely used, and the demand for it is increasing; tiles are not much employed, the climate being unfavorable to their adoption.

As shown in the foregoing table, frame structures formed the large majority of buildings erected during 1886; brick is manufactured from local clay deposits; the use of ornamental brick and tile is gradually increasing.

VERMONT.

Burlington.—Stone for foundations is quarried within the city limits. Buildings of the better class are of brick, trimmed with brown stone. During the past year dwellings of an average cost of $3,000 formed the class most largely constructed.

Slate, on account of its cheapness, is the roofing material commonly used even on unpretentious structures; demand for it is increasing. For flat roofs tin is employed; roofing tiles are not known. The use of ornamental brick is not increasing, stone trimmings being preferred in the best buildings.

NEW HAMPSHIRE.

Manchester.—For the better class of buildings in this city, red brick, with granite trimmings for exterior work, is generally used. The stone in common use is granite, quarried locally and at Concord, New Hampshire. During 1886 dwellings formed the class of buildings most largely erected. Slate for steep roofs is freely used, with increasing demand; tin and asphalt composition on flat roofs.

MASSACHUSETTS.

Boston.—The following table shows the comparative condition of the building industry in this city for the past five years:

Number of wooden, brick, stone, and iron buildings for which permits were issued.

Kinds of buildings.	1882.	1883.	1884.	1885.	1886.
Wooden buildings	841	1,005	1,123	1,372	1,353
Stone and iron buildings	235	236	312	348	346
Total	1,076	1,241	1,435	1,720	1,699

Estimated cost of completed buildings.

Kinds of buildings.	1882.	1883.	1884.	1885.	1886.
Wooden and frame buildings	$2,379,278	$1,670,806	$3,078,145	$4,552,538	$3,992,792
Completed brick buildings	4,932,640	5,864,577	5,400,775	6,218,800	8,813,100
Total	7,311,918	7,535,383	8,478,920	10,771,338	12,805,892

From this table it is evident that while there has been a decrease in the number of buildings erected in 1886 as compared with 1885, the total value is over $2,000,000 greater for 1886 than for 1885, showing, of course, a decidedly higher average value for the buildings of 1886.

The foundations of buildings are usually granite; for superstructures and for ornamental trimmings in brick buildings, etc., sandstones from Nova Scotia, Long Meadow, Massachusetts, and from Ohio are quite extensively employed. For roofing purposes, slate, tin, composition of tar and gravel, and, recently, copper are used.

No increase over the present consumption of ornamental brick and tile is anticipated since the present tendency is towards the use of stone for ornamental work, and toward greater simplicity in construction.

Fall River.—The following table gives an idea of the progress made in building during the past three years:

Kinds of buildings.	1884.		1885.		1886.	
	Number erected.	Value.	Number erected.	Value.	Number erected.	Value.
Frame buildings	416	.....	200	.....	205	.....
Brick buildings	7	.....	10	.....	22	.....
Stone buildings	...	.....	2	.....	3	.....
Total	423	$866,450	212	$330,975	230	$666,750

A considerable falling off for 1885 and 1886, as compared with 1884, is evident, although a marked gain for 1886 over 1885 is also apparent.

CONNECTICUT.

Bridgeport.—The following table gives a statement of the building industry for the past three years:

Kinds of buildings.	1884.		1885.		1886	
	Number erected.	Value.	Number erected.	Value.	Number erected.	Value.
Frame buildings	240	$360,000	280	$420,000	350	$630,000
Brick buildings	20	100,000	25	125,000	34	170,000
Total	260	460,000	305	545,000	384	800,000

As is evident from this table, frame buildings formed a large majority of the buildings erected during 1886. The building stone consumed consists of gneissoid rock of good quality quarried locally, Connecticut River brownstone, and also brown sandstone from quarries at Springfield, Massachusetts, and Portland, Connecticut.

Dwelling houses were in greatest demand during 1886, although some factories were erected. Slate is the favorite roofing material for large buildings, and the demand for it is always good, although it cannot be said to increase rapidly; that from Bangor, Pennsylvania, seems to be preferred, although some from Vermont is also used. The use of ornamental brick and tile has increased markedly during the past few years.

Hartford.—For buildings of the better class, brick with brownstone trimmings is largely used. Brown sandstone from Portland, Connecticut, is very popular for trimmings and ornamental stonework; granite from various places on the coast of Connecticut, Massachusetts, and Rhode Island is employed to some extent. For roofing purposes, slate, the demand for which is gradually increasing, is in common use for the better class of buildings; tin and gravel and tar composition are used for flat roofs. The use of ornamental brick and tile is reported as increasing.

New Haven.—In this city, for all ordinary brick work, brick manufactured at North Haven, Connecticut, is extensively employed, while in the best brick buildings pressed brick from Philadelphia and Trenton is liberally made use of for facings; black mortar in brick work is frequently used. Terra cotta has as yet been but sparingly introduced, but ornamental brick is quite popular. The stone employed consists of brown sandstone from Portland, Connecticut, bluestone from the North River quarries, and granite from quarries in Maine, New Hampshire, and Rhode Island. During 1886 small private dwellings and flats took the lead among the various classes of buildings erected. Slate is the favorite roofing material, that from Pennsylvania being preferred; tile is not used; no shingles are allowed on roofs within the city.

RHODE ISLAND.

Providence.—The state of the building industry is indicated by the following table:

Kinds of buildings.	1884.		1885.		1886.	
	Number erected.	Value.	Number erected.	Value.	Number erected.	Value.
Frame buildings	393	$1,145,840	452	$1,273,745	407	$1,194,607
Brick buildings	16	239,400	13	364,700	12	168,750
Total	409	1,385,240	465	1,638,445	419	1,363,357

Quite a marked falling off both in number and value of buildings for 1886 is evident. This is ascribed by local authorities to the influence of strikes and other labor troubles occurring between May and the early part of July.

For buildings of the better class, brick, with brown-stone trimmings, is generally employed, while granite from Westerly, Rhode Island, and Oneco, Connecticut, is used to some extent. The popular roofing materials are slate and tin, with increasing demand for slate. Ornamental brick is favorably regarded, but tile is not so freely used.

NEW YORK.

Albany.—Brick, with pressed brick and Long Meadow sandstone trimmings and facings, is the favorite building material for the finer structures in this city.

Besides the Long Meadow stone, bluestone, from Schenectady, New York, sandstone from Connecticut and New Jersey, and granite from Maine are used.

The class of buildings in greatest demand seems to have been, during 1886, flats for no more than three families, and two-story basement houses for single families.

Slate and tin are the favorite roofing materials. The demand for slate is decidedly increasing, as is also that for ornamental brick and tile.

Brooklyn.—The following table shows the progress in building for the past three years:

Kinds of buildings.	1884.		1885.		1886.	
	Number erected.	Value.	Number erected.	Value.	Number erected.	Value.
Frame buildings	1,304	.....	1,261	.....	1,774	.....
Brick buildings	1,435	.....	1,377	.....	(a)2,216	.....
Total	2,739	$12,672,334	2,638	$11,465,795	3,990	$20,318,485

a Includes one iron building.

A heavy gain over 1885, both in number of buildings and in value, is apparent from this table.

The stone used in combination with brick is chiefly brownstone from quarries in Connecticut, Wyoming Valley bluestone, and granite from Quincy. Tenement flats and small dwellings were most largely erected during the year. Slate and tin are the chief roofing materials, but tile is said to be in considerable demand. The use of ornamental brick, tile, and terra cotta is said to have increased very largely.

New York.—The following table will serve to show the extent and the kind of building done in New York during 1886:

Plans and specifications for new buildings filed and acted upon in New York during the year ending December 31, 1886.

Kinds of buildings.	Number.	Estimated cost.
Dwelling houses:		
Estimated cost over $50,000	5	$395,000
Estimated cost between $20,000 and $50,000	163	3,816,500
Estimated cost less than $20,000	1,144	13,089,700
Flats, estimated cost over $15,000	1,174	23,481,400
Tenement houses, estimated cost less than $15,000	448	5,415,900
Hotels and boarding houses	5	523,900
Stores:		
Estimated cost over $30,000	28	2,066,000
Estimated cost between $15,000 and $30,000	18	402,000
Estimated cost less than $15,000	90	280,848
Office buildings	26	1,389,100
Manufactories and workshops	160	2,608,400
School houses	8	705,000
Churches	19	804,950
Public buildings:		
Municipal	14	1,009,500
Places of amusement	12	593,000
Stables	131	663,800
Frame buildings in twenty-third and twenty-fourth wards	557	1,353,480
Other frame structures	93	152,255
Total	4,095	$58,750,733

In 1886, 3,750 buildings were commenced, and 3,250 were completed; 2,677 were in progress on January 1, 1887.

Number and estimated cost of proposed new buildings in New York from 1875 *to December* 31, 1886.

Years.	Number.	Estimated cost.
1875	1,406	$18,226,870
1876	1,379	15,903,880
1877	1,432	13,365,114
1878	1,672	15,219,680
1879	2,065	22,567,322
1880	2,252	29,115,335
1881	2,682	43,591,300
1882	2,577	44,793,186
1883	2,623	44,304,638
1884	2,897	41,461,208
1885	3,368	45,374,013
1886	4,095	58,750,733
Total	28,448	$392,473,279

The large increase of 1886 over 1885 and all previous years is very striking, and, moreover, the average value ($14,346) of the buildings for 1886 is greater than that ($13,472) of the buildings for 1885.

Among the building materials used brick is, of course, the important material constructionally. Granite is extensively employed in public buildings and large business houses. The Connecticut brown sandstone, which has been so popular for many years, is still extensively employed, also a red sandstone quarried at Belleville, New Jersey. Other brownstones are used to a moderate degree. Among these may be mentioned that quarried in the Potomac range in the District of Columbia, and also stone of fine quality from North and South Carolina. Among the sandstones of recent adoption in New York may be mentioned the stone imported from Scotland, including two varieties, one known as the "Corsehill freestone," and the other the "Gatelaw bridge sandstone;" both are of a brownish-red color; the former is fine and the latter coarse grained. The "Dorchester freestone" from New Brunswick, and Ohio sandstone, from Berea, have been popular for some years.

The study for strong and effective contrasts indulged in for some ten years past has resulted in the introduction of a considerable variety of stones, chiefly quarried in the South and West. Among these may be mentioned the oolitic limestone from Bedford, Indiana, as well as from Kentucky, Tennessee, and Georgia. Marble from Vermont and Georgia is used to a liberal extent.

A very great variety of roofing materials is employed. Slate and tile are abundantly used, but tin is perhaps most commonly preferred.

Large quantities of ornamental brick and tile are used, but can hardly be said to increase at present in the best class of buildings, for which carved work in stone (largely marble) is becoming popular.

NEW JERSEY.

Elizabeth.—For foundations of buildings, trap rock, from Schooley's mountain, New Jersey, is generally used. The first story of private dwellings is frequently built of brick or stone; the upper stories of wood covered with shingles. Brownstone, from Belleville, New Jersey, is used for trimmings and ornamental work. During 1886 the buildings erected in greatest number consisted of private residences, costing from $5,000 to $10,000.

Shingles, as roofing material, are generally preferred, while slate is used to some extent, with no perceptible increase in demand at present. The use of ornamental brick and tile, while not very extensive, is steadily growing.

Hoboken.—Brick, with brownstone trimmings, is the material most generally employed for the better class of buildings. For foundations, trap rock, quarried on the Palisades immediately west of Hoboken, is the material customarily used.

During 1886 tenement houses, large flats, and small and inexpensive dwellings for one family formed the great majority of buildings erected.

For roofing purposes tin was the material by far most freely employed. Comparatively little slate was used, and the demand for it is not very great, nor is it perceptibly increasing.

Ornamental brick and tile are employed, but for the finest buildings erected there is a growing preference for carved work in stone.

Newark.—New Jersey common brick is the material used for walls and behind the facings in buildings of the better class; North River and Hackensack brick is used for the facing of rear walls, and Trenton brick for facing on street fronts; for trimmings, Trenton and Philadelphia molded brick, Perth Amboy terra cotta, and Belleville and Newark, New Jersey, brown sandstone. Small private dwellings were in greatest demand in 1886, but a number of large factories were in course of erection; a number of handsome private residences were completed. Slate is used on high-pitched roofs of buildings of the better class, shingles on cottages; tin is generally employed for flat roofs. The increase in use of ornamental brick and tile is said to have been quite marked.

Paterson.—The buildings of the better class erected during 1886 consisted of frame structures in greatest number and combinations of brick and stone. The stone used is brown sandstone quarried at Paterson, Belleville, and Little Falls, New Jersey.

Shingle, slate, and, to a very limited extent, tiles were used for roofing purposes. The demand for slate is increasing. Ornamental brick and tile are gradually coming into use.

DELAWARE.

Wilmington.—The state of the building industry for the past three years is indicated by the following table:

Kinds of buildings.	1884.		1885.		1886.	
	Number erected.	Value.	Number erected.	Value.	Number erected.	Value.
Brick buildings	326	$730,225	280	$668,590	192	$622,983
Stone buildings	1					

PENNSYLVANIA.

Philadelphia.—The following table gives the number and kind of buildings erected in 1885 and 1886:

	Stories.	1885.	1886.
Dwelling houses	2	4,113	4,850
	3	1,286	1,669
	4	7	6
Stores and dwellings	2	105	128
	3	157	203
	4	2	1
	5	.....	3
	6	.....	3
Stores	2	17	29
	3	13	7
	4	12	6
	5	5	10
	6	1	4
	7	.....	1
Banking buildings	.....	2	3
Churches and chapels	.....	26	24
College buildings	.....	.....	1
Factories and foundries	.....	71	79
Home buildings	.....	3	4
School-houses	.....	10	15
Other miscellaneous buildings	.....	496	515
Total	.....	6,326	7,561
Alterations and additions	.....	1,638	1,639

No data as to the value of the buildings erected could be obtained, but judging from the much greater number of buildings erected in 1886 and also from their more pretentious character in many cases, it is plain that the value for 1886 must have markedly exceeded that for 1885.

For foundations of buildings Conshohocken limestone is in common use; for superstructures brick is of course the standard material. Among the stones most abundantly used for superstructures and in combination with brick for ornamental purposes may be mentioned, brown sandstone from Hummelstown, Pennsylvania, and from various quarries in New Jersey, Connecticut, and Ohio. Indiana limestone is quite extensively used. Ohio limestone is also used, but to a less extent; granite from Quincy and Cape Ann is frequently employed.

For roofing purposes tin is the material most in demand, as the majority of the roofs are flat; for steep roofs Pennsylvania slate is liberally employed and the demand for it is increasing, while tile for exterior work seems to be losing ground, although largely used for interior ornamentation. Ornamental work in general is not so freely indulged in as formerly, and better taste is displayed.

Pittsburgh.—The state of the building industry for the past two years is indicated by the following table:

Kinds of buildings.	1885.		1886.	
	Number.	Value.	Number.	Value.
Frame buildings	795	.....	847	.....
Brick buildings	647	.....	568	.....
Total	1,442	$3,030,429	1,415	$2,401,809

Dwellings and manufacturing establishments have taken the lead among the buildings erected in 1886. A new court house was begun in 1885 and was nearly completed in 1886. It is built of granite from Worcester, Massachusetts, and its cost is $1,850,000. A new jail of the same material was completed in 1886 at a cost of $400,000. A new post-office is in course of erection.

Among the building stones in common use in Pittsburgh may be mentioned the following: Sandstone from Beaver county, Pennsylvania, and from Cleveland, Ohio.

Slate is the leading material for all steep roofs. Brick and tile, for exterior ornamentation, are being superseded, to some extent, by stone-work. Considerable injury to the building industry was sustained from strikes during the year.

MARYLAND.

Baltimore.—In 1885 permits were issued for the erection of 2,970 and in 1886 for 2,632 buildings. No figures for the detailed value of these buildings could be obtained; from the returns of the assessors it appears that about 70 per cent. of the buildings for which permits were issued were completed during the year; $3,500,000 per year is believed to cover the value of the completed buildings, but for 1886 the actual amount was probably less than this figure.

Most of the buildings erected are of brick. The finer residences are frequently faced with white Maryland marble or brown sandstones, from various localities. Pressed brick of fine quality is used in very large quantity, and ornamental brick and tile are continually increasing in favor. Tin is very largely used as roofing material, as also is slate for steep roofs. Tile is employed to a limited degree.

DISTRICT OF COLUMBIA.

Washington.—The following table shows the state of the building industry for the past three years:

Kinds of buildings.	1884.		1885.		1886.	
	Number.	Value.	Number.	Value.	Number.	Value.
Frame buildings	151	$94,784	325	$195,255	392	$295,689
Brick buildings	1,042	3,293,070	1,333	3,297,252	1,802	4,412,240
Total	1,193	3,387,854	1,658	3,492,507	2,194	4,707,929

The building stones used consist largely of Potomac red sandstone quarried near Washington and brown sandstone from Hummelstown, Pennsylvania. Brick of very fine quality and appearance is used for street facings. Slate is extensively used, and the demand for it is increasing. No increase in use of ornamental brick and tile in the better class of buildings is likely, although both are at present quite liberally used.

VIRGINIA.

Richmond.—The state of building in Richmond is shown by the following table:

Kinds of buildings.	1884.		1885.		1886.	
	Number.	Value.	Number.	Value.	Number.	Value.
Frame buildings	186	$154,200	244	$124,900	137	$125,000
Brick buildings	226	733,200	238	873,400	204	528,600
Stone buildings	.....	.....	1	23,000	.....	.....
Total	412	887,400	483	1,021,300	341	653,600

Granite from quarries near Richmond and from other parts of the State is in use, also brown sandstone from Pennsylvania. Slate quarried in the State is the favorite material for steep roofs; very little tile is used; tin is the common material for flat roofs.

GEORGIA.

Atlanta.—The building stones most used are: granite taken from quarries 16 miles from the city; limestone from Indiana, Bowling Green, Kentucky, and Dickson, Alabama; brown sandstone from North Carolina, and marble from the vicinity of Marietta, Georgia. Frame buildings are mostly in demand. Tile roofing is in use on but one house in the city. Georgia and Virginia slate is used to a limited extent on steep roofs. Within the past five years the use of ornamental brick and tile has been increasing.

Savannah.—The stone now used for building purposes is chiefly Alabama limestone; Connecticut brown stone and Georgia granite have been driven out of use almost entirely.

Small frame residences are the buildings most in demand. Tin is almost exclusively used for roofing; no slate is employed. Very little ornamental material is in use.

TENNESSEE.

Memphis.—The building stone chiefly used includes limestone from Dickson, Alabama, sandstone from Mount Sterling, Kentucky, granite from quarries near Little Rock, Arkansas. The best and finest buildings now erected are mainly of brick, and a comparatively recent increase in the use of brick has been attended with a greater indulgence in ornamental brick, tile, and terra cotta. Tin is more largely used than anything else for roofing purposes; but slate, which thirty years ago was used more than at present, is again coming into use, and the demand for it is increasing, though not rapidly.

TEXAS.

Austin.—In this city frame buildings are much more extensively erected than any other class, but stone in combination with brick is used in the finest buildings. The stone most used is magnesian limestone, quarried locally. Granite is quarried in Burnet county and is used to some extent. The bricks in use are of a yellowish color, but of good quality. Tin is most freely used as roofing material, but slate is also employed, while copper is an experiment and has been used in the new capitol building. There is a steady increase in the use of ornamental brick and tile.

Galveston.—The following table shows quite a marked increase in building during 1886:

Kinds of buildings.	1885.		1886.	
	Number.	Value.	Number.	Value.
Frame buildings	116	$177,630	181	$394,400
Brick buildings	7	123,500	5	104,000
Stone buildings			1	125,000
Total	123	$301,130	187	$623,400

The stone residence included in the above table is not yet completed; it is the only stone building in the city; the stone used in it is a hard and close grained sandstone from quarries in Brown county, central Texas. The trimmings used consist of granite from Burnet county, the same stone as that used in the new capitol.

As the nearest stone suitable for building purposes is more than 200 miles from the city, and freight rates are high, it is not probable that the use of stone will rapidly increase.

A large portion of the residence part of the city was destroyed by fire in November, 1885, and the owners of small houses almost immediately rebuilt structures of the same kind as those destroyed; hence the low average value, $1,530, of the buildings erected in 1885. During 1886 a much better class was put up, and the prospects are good for further improvement in quality as well as in number during the present year.

ARKANSAS.

Little Rock.—In this city limestone from Dickson, Alabama, and oolitic limestone from Kentucky are used chiefly; granite from quarries near the city is also employed, but not to a great extent, owing to cost of cutting. Brick is used for stores and for the best residences. Frame buildings have been in greatest demand.

Tin is used for all flat roofs, but slate quarried near the city will probably be more and more freely used for steep roofs. Ornamental brick and tile have been used only within the past two years; their use is increasing continually, though the quantity now used is not great.

KENTUCKY.

Louisville.—Among the various kinds of stone used in Louisville may be mentioned the following: Oolitic limestone from Bedford, Indiana, also from Salem and Bowling Green, Kentucky. Buena Vista, Ohio, Lake Superior, and Long Meadow sandstones are used to a limited degree. Brick with stone facings or with ornamental brick and tile trimmings is largely used in buildings of the better class. Tin and slate are the favorite roofing materials. It cannot be said that there is a marked increase in the use of slate.

OHIO.

Cincinnati.—For all ordinary works in this city the local limestone is used. For ornamental purposes Buena Vista, Berea, Amherst, and Cleveland sandstones are liberally employed; also Dayton, Ohio, and Bedford, Indiana, limestone. Granite, chiefly from Maine and Missouri, is used to some extent. For roofing purposes the usual varieties of materials used in large cities are employed here. The slate used is taken largely from the Virginia quarries. The use of ornamental brick and tile is extensive and increasing.

Cleveland.—The stone used for building in this city includes a number of the Ohio sandstones, particularly that from Amherst and Berea; also sandstone from the Lake Superior region, and to a small extent from Pennsylvania and Massachusetts. For roofing purposes slate, tin, tar and gravel, and copper are used. Tile for roofing is unpopular. Ornamental brick and tile have not been very largely employed and no marked increase is perceptible.

MICHIGAN.

Detroit.—The following table gives an idea of the state of building in this city for the past two years:

Kinds of buildings.	1885.		1886.	
	Number.	Value.	Number.	Value.
Frame buildings	1,328	$1,437,819	1,533	$1,561,864
Brick buildings	563	2,040,500	520	2,335,350
Total	1,891	3,478,319	2,053	3,897,214

An increase in the total number of buildings erected and in total value is evident, and also a higher average value for the brick buildings, which were not so numerous in 1886 as in 1885.

For the best buildings erected, ordinary brick, with pressed brick fronts in combination with stone trimmings, is generally employed. Kelly Island (Lake Erie) limestone is employed for foundations, while

for facings and trimmings Ohio, Lake Superior, and Ionia, Michigan, sandstones are popular.

For roofing, tin, slate, and asphalt composition are the common materials; tile is only sparingly used. Ornamental brick and tile are being introduced and will probably become quite popular. Terra cotta has been considerably used, but is said to be giving way to stone work.

ILLINOIS.

Chicago.—The following table shows the increase in building in Chicago:

Years.	Number of buildings.	Frontage.		Cost.
		Feet.	Miles.	
1885	4,638	108,850	20.3250	$24,530,125
1886	4,664	112,302	21.1422	26,868,375

For foundations and ordinary work Joliet and Lemont, Illinois, limestone is used; for ornamental work the following are used: Brown sandstone from Connecticut; red sandstone from Long Meadow, Massachusetts; sandstones of all kinds from different sources in Ohio, the Lake Superior region, and, to a less degree and quite recently, from Colorado. Bedford, Indiana, limestone is quite popular. Georgia marble is being introduced with great satisfaction, particularly the pinkish-gray variety. Granite from Maine, Missouri, and Minnesota is largely used.

Brick of all kinds is used in enormous quantities; ornamental materials in general are extensively indulged in.

A great variety of roofing materials is employed, particularly for flat roofs; for steep roofs, slate and tile are liberally used, with, however, considerable opposition to tile from architects.

MINNESOTA.

Minneapolis.—The favorite building stones used in this city include red sandstone from Lake Superior, brown sandstone from Bayfield, Wisconsin, and a drab variety from Cleveland, Ohio. A considerable quantity of pink granite from Saint Cloud, Minnesota, is used. Some of the best buildings of recent erection have been faced with Rasota stone from Le Sueur county, Minnesota.

The pressed brick in use comes chiefly from Chicago and Saint Louis, though a fair grade from Menominee, Wisconsin, is now being employed to a slight extent.

Business houses are said to have been in active demand during the past year. For roofing materials, composition of tar, gravel, etc., is common on flat roofs. Slate does not enjoy great popularity at present, although its use is becoming more general. Tile is in good repute,

but to be efficient in such a cold climate must be laid with extreme care, and thus the cost is made so heavy that extensive use of it, as in many other cities, is not probable.

Saint Paul.—As will appear from a consideration of the following table the building industry in Saint Paul has been quite active during the past three years:

Kinds of buildings.	1884.		1885.		1886.	
	Number.	Value.	Number.	Value.	Number.	Value.
Frame buildings	2,075	$1,667,035	2,964	$2,238,026	3,017	$2,488,271
Brick buildings	269	2,387,490	385	1,921,182	553	3,567,571
Total	2,344	4,054,525	3,349	4,159,208	3,570	6,055,842

The values in this table include "alterations, additions, and repairs," besides the value of the buildings newly erected.

The stone used for ornamental work, trimmings, etc., includes brown sandstone from Bayfield, Wisconsin, and also from various localities in Ohio. Rasota and Kette River sandstones are also popular at present. Brick, with pressed brick facing, is a very popular material for the best buildings. For roofing, tin and composition are used for flat roofs and slate for steep roofs. The demand for slate is decidedly increasing. Ornamental brick and tile, particularly the latter, for interior work are coming more and more into use.

MISSOURI.

Saint Louis.—The following table shows a falling off in the amount of building done in this city during 1886 as compared with 1884 and 1885:

Kinds of buildings.	1884.		1885.		1886.	
	Number.	Value.	Number.	Value.	Number.	Value.
Frame buildings	620	$371,136	510	$456,825	491	$405,892
Brick buildings	1,989	6,393,655	2,160	6,400,779	1,732	5,916,978
Total	2,609	6,764,791	2,670	6,857,604	2,223	6,322,870

It is claimed by local authorities that disastrous strikes reduced the amount of building 35 per cent.

The building stone in use consists of local limestone; sandstone from Warrensburg, Missouri; Lake Superior brown sandstone, and granite from Iron Mountain, Missouri, and from Maine.

Fine bricks, including ordinary, pressed, and ornamental, are manufactured quite extensively in Saint Louis, and are very largely used. Slate, for which there is an increasing demand, is used for roofing purposes to a considerable extent, but tile does not seem to be at all popular.

NEBRASKA.

Omaha.—A liberal increase in the amount of building done in Omaha is shown by the following table:

Kinds of buildings.	1885.		1886.	
	Number.	Value.	Number.	Value.
Frame buildings	600	$957,318	1,150	$2,224,390
Brick buildings	60	1,788,145	145	2,950,750
Stone buildings	2	120,000	.....	.....
Total	662	2,865,463	1,295	$5,175,140

The buildings erected during these two years were as follows:

Designation of buildings.	1885.	1886.
Schools and churches	$92,600	$214,900
Manufactories	342,750	504,000
Hotels	120,000	190,000
Stores and warehouses	701,000	1,325,000
Residences	1,609,063	2,890,490
Total	2,865,413	5,124,390

KANSAS.

Topeka.—The following is a statement of the building done in the last three years:

Kinds of buildings.	1884.		1885.		1886.	
	Number.	Value.	Number.	Value.	Number.	Value.
Frame buildings	603	.....	696	.....	576	.....
Brick buildings	68	.....	75	.....	69	.....
Total	671	$406,671	771	$494,291	645	$621,596

IOWA.

Des Moines.—For the finest buildings in this city, brick, with pressed brick fronts and stone trimmings, is chiefly used.

Brick is obtained mainly from Saint Louis and Chicago, although there is some local manufacture.

For foundations limestone and brick are used. The former is from Earlham, Madison county, Iowa. For trimmings there are in use the following: Sandstones from Carroll county, Missouri, and Cleveland, Ohio; a comparatively small amount of quartzite from Sioux Falls, Dakota, and artificial stone locally manufactured. During the past year frame dwellings have comprised the bulk of the buildings erected, and

little artistic work has been done. For the finest residences slate is used for roofing; shingles, of course, for cheap frame buildings. Business buildings are about equally divided between gravel-and-tar composition and tin. Tile is not used for roofing. Ornamental brick and tile are coming more and more into use.

WISCONSIN.

Milwaukee.—The materials most used for buildings of the better class are buff brick and limestone, both produced locally. This limestone is quarried 5 miles west of the city and is, for the most part, of the usual drab color, but a pink variety occasionally found is more highly prized, as its effect in buildings is very agreeable. To some extent sandstones from the Lake Superior region, and to a greater extent from Ohio, are used for facings and trimmings. Joliet limestone is used for large flagging and steps. Red brick and terra cotta are increasing in demand, but none are of local manufacture, owing to absence of the proper clay.

For flat roofs, gravel composition ranging from the cheapest coal tar to the best asphaltum is chiefly used; tin is used to a less extent but still quite extensively. For the best buildings having high pitched roofs, slate, which comes chiefly from Maine and Pennsylvania, but also a fine quality from Michigan is used; for the cheap buildings, shingles are of course employed.

Ornamental brick is new, but its use is increasing.

The amount of building done in 1885 has been estimated at $4,000,000, while that done in 1886 is believed to have been less than that amount. The falling off is ascribed to labor troubles.

COLORADO.

Denver.—The building stone used in Denver consists of lava from Castle Rock and Coal Creek sandstone, both quarried near Denver; sandstone from Armago, New Mexico; red sandstone from Morrison, near Denver, and granite from Platte Cañon and Georgetown, Colorado.

During 1886 there was a marked demand for residences. Tile is not used for roofing purposes. Slate has been used only within the past year and the demand for it is not likely to increase greatly, owing to the expense of shipping from the East, which has thus far been the source of supply. Buildings of the better class have used Philadelphia pressed brick to some extent. Quite recently ornamental tile has been introduced.

CALIFORNIA.

Sacramento.—Buildings of the better class consist of frame structures for dwelling houses, but for a few of these and for the best business houses, brick is used, with pressed brick fronts and granite trimmings.

The stone most used is granite, quarried at the Folsom State prison and at Penryn, Placer county.

For roofing purposes tin is chiefly used on business houses; red-wood shingles are used outside the fire limits; they are very durable and seem to be much liked. Slate is very little used, and tile practically not at all. Ornamental brick is very slightly employed, but terra cotta is used to a considerable extent; it is manufactured at Lincoln, in Placer county.

Los Angeles.—Among the better class of buildings frame structures for dwellings and brick for business houses are erected, with adobe structures for the poorer classes. Until the past year granite has been the stone most used for trimmings, etc., but the demand for a cheaper stone has resulted in the development of several quarries of sandstone of a variety of colors in the foothills and cañons near the city.

The buildings erected during the past year consist chiefly of dwelling houses, small hotels, and lodging houses. For roofing purposes red-wood shingles are principally used for dwellings and tin for business houses. Slate is practically unknown. No ornamental brick or tile is used.

BUILDING STONE.

Production.—The value of the building stone quarried in the United States during the past five years is estimated in the following table:

Value of building stone produced in the United States, 1882 to 1886.

Years.	Value.
1882	$21,000,000
1883	20,000,000
1884	19,000,000
1885	19,000,000
1886	19,000,000

As was shown in the report for 1882, the estimate for that year was based upon the census returns of 1880. For the years since 1882 the estimates have been based upon comparisons of the general condition of the industry in the preceding years. The estimate for 1886 was determined as the result of extensive correspondence with quarrymen, architects, builders, dealers, etc., in all parts of the country, and the comparative state of the industry in 1886 and 1885 was thus revealed. While it is true that the total amount of stone quarried was greater in 1886 than in 1885, it is also true that prices in general were lower. The reduction in price was due to a variety of causes, such as naturally increasing competition, efforts to introduce new kinds of stone, or to extend the market to new localities, etc. Another cause was the temporary falling off in demands produced by the labor disturbances from May

to July. Prices fell, and did not in all cases recover when active building operations were resumed in the latter part of the summer. Furthermore, it is probable that many building enterprises involving the use of stone for ornamental purposes were postponed until the season of 1887, in the hope of fewer indications of labor troubles. There are, however, many notable exceptions to the foregoing statements implying reduction in demand and in prices, a number of long established and important quarry regions having held their own in regard to price with a good increase in production over 1885.

GRANITE AND ALLIED ROCKS.

Production.—The depressing influences which have been felt during a part of 1886 by the quarrying industry as a whole have naturally produced their effects upon the production of granite, and although the total output is unquestionably greater than that of 1885, still it has by no means come up to what appeared to be expected at the beginning of the year. Granite is steadily increasing in popularity as a stone for ornamental and decorative purposes. This statement applies particularly to those varieties which admit of a high polish. A statue of granite is now said to cost very little more that one of marble, notwithstanding the much greater hardness of the former. This, however, may be accounted for in part at least by the fact that much less detail is brought out in granite than in marble sculpture. Granite is produced in eighteen different States; the most important of these are in the order named, as follows: Massachusetts, Maine, Rhode Island, Connecticut, Virginia, and New Hampshire. While it is probable that half of the counties in California contain more or less granite, the only localities where the stone is quarried to an extent greater than is required for local use are Penryn, Pino, and Rocklin, in Placer county, and Folsom, in Sacramento county. The quantity quarried and shipped from these several points in 1886 was about as follows: From Penryn, 10,000 tons; from Pino and Rocklin, 5,000 tons; and from Folsom, 7,000 tons.

More than half of this production finds a market in San Francisco, the balance being mostly used by the United States Government in the construction of fortifications, light-houses, and the dry-docks at Mare Island. Between 2,000 and 3,000 tons of granite were quarried at other points in the State during the year. The demand for the stone is quite variable from year to year.

New discoveries and developments.—Late in 1886 three new companies were organized for the purpose of quarrying syenite found in Warwick township, Chester county, Pennsylvania, on the line of the Saint Peter's branch of the Wilmington and Northern railroad, about 40 miles from Philadelphia.

Two or three varieties of fine granite were discovered at the new town of Hinsdale, Minnesota, on the Iron Range railroad. The Hinsdale Granite Company has already begun the shipment of granite to Chicago, in fulfillment of a contract for about 600 car loads.

The Southern Granite Company, of Atlanta, Georgia, has recently made preparations for increased production of granite from its quarries on Stone mountain, near the city, by exploding large quantities of giant powder, with which three shafts of a depth of 60 to 65 feet were charged. One of these shafts was charged with 2,000, the second with 5,000, and the third with 8,000 pounds of the explosive.

Quarries of granite at Henderson, Vance county, North Carolina, have been developed during the past year, but the exact extent of operations has not been reported. There are indications that granite will be quarried at quite a number of localities in the South during 1887. Virginia is the only southern State reported as having produced granite during the last Census year.

In Colorado the production of granite is still largely prospective, but active efforts are being made by those interested in developing the resources of the State to introduce the stone into western markets. Two quarries owned by the Union Pacific Railroad Company are said to yield granite of the very best quality. The stone from one of the quarries is pink in color, while that from the other is gray.

The following table gives the results of tests made by the commissioners appointed to select suitable stone for the Colorado State capitol:

Results of tests of stone for the Colorado State capitol.

Locality.	Color.	Position.	Size of specimens.	Strength of the specimen.	Strength of 1 square inch.	Specific gravity.	Weight of 1 cubic foot.	Ratio of absorption in twenty-four hours.
			Inches.	*Pounds*	*Pounds.*		*Pounds.*	
Grape creek	Pinkish gray (*a*)	Bed	2.03 × 2.04	60,000	14,492	2.603	162.375	.048
		Edge	2.05 × 2.07	73,750	17,352			
Brownsville	Mottled gray	Bed	2.02 × 2.03	62,500	15,244	2.700	168.426	.004
		Edge	2.02 × 2.03	85,000	20,731			
Do	do	Bed	2.07 × 2.08	67,500	15,625	2.713	169.236	.004
		Edge	2.08 × 2.09	90,000	20,694			
Lawson	Light gray	Bed	2.00 × 2.07	72,500	17,512	2.629	163.997	.006
		Edge	1.97 × 2.06	74,000	18,226			
Platte cañon	Pink	Bed	1.97 × 2.08	65,000	14,585	2.625	163.747	.006
		Edge	2.04 × 2.00	60,000	14,634			
Cotopaxi	Mottled gray	Bed	1.99 × 2.00	74,250	18,654	2.667	166.367	.003
		Edge	1.99 × 1.98	92,500	23,358			
Monarch	Dark mottled gray	Bed	2.03 × 2.03	62,500	15,170	2.760	172.168	.012
		Edge	2.00 × 2.02	71,500	17,698			
Gunnison	do	Bed	2.04 × 2.06	52,500	12,976	2.715	169.361	.006
		Edge	2.02 × 2.04	64,250	15,594			

(*a*) Gneiss; the other samples are all granite.

LIMESTONE AND MARBLE.

Production.—The limestone and marble industry may be regarded as in a very satisfactory condition when its present magnitude is compared with that revealed by the census of 1880. There are many good and quite obvious reasons why in times of reasonable prosperity the production both of ordinary, uncrystallized limestone and of the more or less completely metamorphosed variety, marble, should steadily increase from year to year. In the first place, ordinary limestone is very largely used for foundations in the construction of all kinds of buildings, while the better grades are, in many localities, extensively used as the material of superstructures. Furthermore, vast quantities are of course burned for lime and used as a flux in blast furnaces.

Owing to the rapidity with which marble and limestone in general undergo discoloration and disintegration from climatic and local atmospheric conditions, it does not seem improbable that the out-of-door use of these materials in many of our important cities may be considerably reduced in the not distant future. Still, even if this be so, the demand for all the varieties of white and variegated marbles for purposes of interior decoration is becoming sufficient to counterbalance a considerable falling off in the consumption of these materials for external ornamentation.

The returns of the Tenth Census place the product of 615 limestone and marble quarries in the United States at 65,373,965 cubic feet, valued at $6,846,681. The value of the limestone and marble quarried in 1886 is estimated at $8,500,000. This figure would, in all probability, have been somewhat exceeded but for the reduced demand caused by the interruption in building in the early part of the summer.

As compared with 1885, there has been a falling off in many quarry districts in the production of common limestone, and prices generally have been somewhat lower, although from a few quarry regions slight gains, both in production and price, are reported.

Very few strikes on the part of workmen in the quarries of important districts have been reported as occurring during 1886, but a number of the largest quarry regions of Ohio, Indiana, Missouri, Illinois, and Wisconsin experienced considerable loss in trade owing to the strikes in Saint Louis, Cincinnati, Chicago, and Milwaukee.

Considering the discouraging and depressing effect of labor troubles upon the building industry during part of the year, it is somewhat surprising that so few quarries were entirely abandoned, although quite a number suspended or reduced operations during the period of general disturbance. This fact reflects quite favorably upon the general stability of the industry.

The following table, compiled by Mr. Thomas B. Bancroft, chief inspector of mines in Ohio, gives the production of all grades of limestone in that State for 1886:

Production of limestone in the State of Ohio in 1886.

Counties.	Weeks worked.	Men employed.	Burned for lime.	Used for fluxing.	Dimension stone.	Ordinary building stone.	For piers and protection purposes.	Flagging.	Paving.	Curbing.	For ballast and macadam.
			Short tons.	*Short tons.*	*Cubic feet.*	*Cubic yards.*	*Cubic yards.*	*Square feet.*	*Square feet.*	*Linear feet.*	*Cubic yards.*
Allen	24	67	7,969	.....	.....	10,857	310	17,000	.....	3,775	9,831
Adams	9	6	587	.....	.....	.....	.....	.....	.....	.....	.....
Butler	22	42	.....	.....	.....	7,307	730	4,850	.....	8,870	.....
Belmont	....	4	2,450	.....	.....	.....	.....	.....	.....	.....	1,055
Clinton	16	24	1,160	.....	13,000	1,553	280	.....	.....	.....	370
Crawford	28	14	936	.....	.....	1,329	.....	8,640	.....	.....	.....
Clarke	37	126	19,591	23	22,632	17,912	480	2,845	.....	12,788	2,375
Clermont	10	13	.....	.....	.....	2,237	.....	.....	.....	.....	551
Delaware	30	35	23,949	.....	1,600	1,642	.....	2,000	.....	.....	500
Darke	27	9	1,460	.....	.....	.....	.....	.....	.....	.....	.....
Erie	38	101	30,350	28,430	.....	21,095	2,505	200	78,336	.....	1,720
Franklin	37	76	5,516	35,094	17,425	27,759	698	.....	.....	4,588	650
Greene	25	61	18,768	.....	23,077	3,354	740	5,250	.....	100	1,389
Hardin	22	52	315	.....	.....	1,193	140	60	.....	.....	10,762
Holmes	14	14	75	.....	.....	140	24	.....	.....	.....	611
Highland	30	66	11,192	.....	51,583	4,352	.....	21,811	7,200	5,000	61
Hamilton	33	452	11,006	.....	.....	63,972	.....	.....	54,000	.....	25,605
Hancock	32	41	3,406	.....	.....	11,928	926	125	.....	.....	2,453
Jackson	.....	.....	.....	15,879	.....	.....	.....	.....	.....	.....	.....
Lucas	29	39	1,051	.....	12,900	3,843	4,700	426	10,800	.....	2,346
Logan	36	21	.....	.....	.....	5,427	2,000	.....	.....	.....	.....
Lawrence	....	.....	.....	67,669	.....	.....	.....	.....	.....	.....	.....
Mahoning	....	.....	.....	30,823	.....	.....	.....	.....	.....	.....	.....
Muskingum	30	51	3,265	14,344	10,475	1,892	37	.....	.....	1,250	1,116
Montgomery	37	141	4,683	.....	149,100	19,709	2,596	47,496	.....	3,000	392
Marion	44	133	56,400	45,489	4,550	16,866	2,981	14,200	.....	.....	25,742
Miami	35	152	5,813	.....	158,846	34,315	6,232	39,647	300	18,079	5,825
Ottawa	38	269	189,310	34,113	8,417	10,882	32,551	300	.....	2,700	28,736
Perry	5	20	.....	2,022	.....	.....	.....	.....	.....	.....	.....
Preble	22	64	8,342	.....	7,750	5,308	4,267	19,750	.....	.....	1,411
Putnam	4	17	.....	.....	.....	502	.....	.....	.....	.....	.....
Paulding	....	2	.....	.....	.....	355	.....	.....	.....	.....	.....
Seneca	30	67	14,936	.....	71,808	5,243	182	3,300	4,000	.....	32,618
Stark	23	12	3,530	.....	.....	.....	.....	.....	.....	.....	.....
Sandusky	35	65	28,450	.....	4,950	1,203	70	.....	.....	500	3,749
Shelby	28	10	4,620	.....	.....	.....	.....	.....	.....	.....	.....
Scioto	....	.....	.....	52,541	.....	.....	.....	.....	.....	.....	.....
Tuscarawas	....	.....	.....	1,650	.....	.....	.....	.....	.....	.....	.....
Van Wert	26	9	4,310	.....	.....	2,313	277	.....	.....	.....	1,040
Wood	31	86	47,415	.....	7,334	10,586	306	.....	.....	.....	23,351
Wyandot	22	22	7,315	.....	1,250	157	18	.....	.....	.....	2,551
Total	....	2,383	517,270	328,080	563,697	295,231	63,050	187,900	154,636	60,650	186,810

According to the census returns for 1880 Ohio produced 11,098,583 cubic feet of limestone. Reducing the product of 1886 to cubic feet, a figure something more than 15,000,000 cubic feet is the result, thus showing a large gain in production since the census year.

As Ohio stood second in production of limestone in 1880, Illinois taking first place with a production of 13,013,139 cubic feet, a correspondingly large gain may be inferred for other States producing similar material.

The product of the Joliet (Illinois) quarry district for 1886, including 18 quarries, is estimated to be, in round numbers, 5,340,000 cubic feet,

while that of the Lemont quarry region reaches 1,200,000. In view of the fact that labor disturbances very seriously affected these regions these figures are probably decidedly below what might justly be expected for the coming year, although this production is believed to be very slightly, if at all, in advance of that of 1885, when local labor trouble is said to have curtailed the output. The value of the product of the Joliet and Lemont regions is estimated to be $800,000.

The production of limestone in Missouri during the census year was 4,419,300 cubic feet, valued at $421,211. Of the 27 quarries at that time operated in the entire State 20 were in the vicinity of Saint Louis. The product of the Saint Louis region for 1886 is estimated at 2,500,000 cubic feet, valued at $150,000. The product of this region is devoted almost entirely to local consumption, and the effect of strikes in Saint Louis is said to have been very severely felt, one authority claiming that the output of 1886 was about one-half that of 1885, and that labor troubles were largely responsible for this considerable falling off. Three quarries in this region were abandoned during the year.

The limestones of Indiana are becoming yearly more and more popular, particularly the oolitic stone of the sub-Carboniferous age. Statistics from this State are too meager to admit of a reliable estimate of production, but it is certain that large quantities are shipped out of the State to many of the larger cities, both east and west, Chicago, Cincinnati, and Philadelphia being among the most important markets.

Production of marble.—As has already been indicated the marble industry as a whole is in a thrifty condition. Although the labor troubles of the year have had their depressing effect upon this as well as upon other quarrying industries, still the effect has been far less marked and, as will be shown later in detail, a number of new and important discoveries and developments have been made.

The following table gives for the census year the value of the marble quarried in the States which at that time were the only ones producing fine marble in any considerable quantity. This table has lately been compiled by Mr. George P. Merrill from the original data on limestone, furnished for the Tenth Census.

Value, by States, of marble quarried in 1880.

States.	Value.
Vermont	$1,340,000
New York	224,500
Massachusetts	238,125
Maryland	65,000
Tennessee	173,600
Total	2,041,225

The value of the marble produced in Vermont during 1886 is estimated at $1,500,000. Accurate returns from Tennessee give 269,486 as the number of cubic feet of all kinds of marble shipped from the

State during 1886. This is valued at $1.50 per cubic foot, giving $404,229 as the total value of the year's production.

The marble quarries of Georgia yielded an output of 100,000 cubic feet, valued at $100,000.

The total value of the marble produced in the United States during 1886 is probably very nearly $2,400,000.

New discoveries and developments of common limestone.—The limestone of the Joliet (Illinois) quarry region has until the last year been recognized as being in general unfit for use as a flux in blast furnaces. The discovery in this region, during 1886, of a bed of quite pure limestone, well suited for use as a flux, is therefore of particular interest. The location of this newly discovered bed is at Gravel Bank about 10 miles below Joliet. The following analysis shows the composition of the stone.

Analysis of limestone from Gravel Bank, near Joliet, Illinois.

	Per cent.
Calcium carbonate	92.14
Magnesium carbonate	1.75
Alumina	2.50
Silica	3.70
Total	100.09

The use of this stone as a flux in this region is said to be interfering decidedly with the shipment of limestone to this locality from Indiana.

In the various important limestone-producing States the opening of quite a number of new quarries has been reported, but as such developments are, in the majority of cases, mere additional operations of beds already worked by existing companies, they are not of especial interest.

New discoveries and developments of marble quarries.—The active quarrying of marble in Georgia was commenced only within the last few years, the census report making no mention of any limestone production whatever in this State during 1880.

The Georgian Marble Company, of Atlanta, is operating extensive marble quarries near Tate Station, Pickens county, Georgia. The deposit is of great thickness, very free from joints, and of uniform quality. The marble consists chiefly of the following descriptions: The most of it is white, with a few gray streaks. Light gray and white mottled, dark gray and white mottled, and flesh color with occasional greenish streaks, are also found. Diamond drills and channelers are in use, and the quarries are supplied throughout with the best machinery for quarrying and handling the product.

Considering the recent appearance of the Georgia marble upon the market, the demand for it is exceedingly good and is quite rapidly increasing, particularly in Chicago, Cincinnati, and other western cities.

It is not so well known in the East, although used in New York and Philadelphia to some extent. The coarsely crystalline character of this marble is somewhat against it for the finest kinds of decoration, but its attractive colors will secure for it an increasing popularity.

Alabama.—Toward the close of 1886, a company known as the Alabama Marble Company, with a capital stock of $100,000, was organized to develop and operate a quarry situated 16 miles from Florence and 1 mile from the Nashville and Florence railroad, in Lauderdale county. The officers of this company are W. J. Kernachan, president; C. B. Eldred, vice-president; J. B. White, secretary and treasurer.

Tennessee.—The already celebrated marbles of this State are rapidly increasing in popularity, and unquestionably they are at present the finest in the country for general decorative work.

The building of the South Atlantic and Ohio railroad, now in progress, from Bristol, Tennessee, to the Kentucky State line, is having the effect of stimulating the investigation and development of marble beds known to exist along its line. The next volume of this series will probably record encouraging results.

The Grayson Marble Company was organized in November, 1886, for the operation of quarries to be opened in a tract of about 70 acres of marble land owned by the company and situated in Monroe county.

In the early part of the present year a company known as the "Middle Tennessee Marble and Manufacturing Company," with a capital stock of $200,000, was organized for the purpose of operating a marble quarry in the vicinity of Kelso, on the Nashville and Chattanooga railroad, in Lincoln county. The marble has been tested and is said to be of fine quality, while the quantity is large. The officers of the company are R. L. Bright, president; Dr. W. C. Bright, vice-president; H. R. Shepard, secretary and general manager; Hugh Francis, treasurer.

There is some prospect of the development during the present year of a quarry near Athens, McMinn county.

The Crescent Marble Company, of Knoxville, is making preparations for doubling the output of 1886 during 1887. The following is a statement of the results of an analysis of the marbles quarried by this company:

Analysis of marble from Knoxville, Tennessee.

	Per cent.
Moisture	0.13
Silica	0.125
Sesquioxide of iron	0.26
Alumina	trace.
Lime	55.32
Magnesia	0.02
Carbonic acid	43.51
Sulphur	0.005
Organic matter and loss	0.63
Total	100.00

The analysis was made at the Columbia College School of Mines, New York. This marble broke under a crushing strain of 12,340 pounds to the square inch.

The Knoxville Marble Company reports a more flourishing condition of its business during the past year than in any previous year. The following are results of tests applied to the marble products from the quarries of this company. A cube $3\frac{1}{8}$ by $3\frac{3}{16}$, by $3\frac{3}{16}$ inches broke under a pressure of 12,550 pounds to the square inch. A slab of this marble, 2 feet $5\frac{1}{2}$ inches wide and 3 inches thick, on supports 4 feet $8\frac{1}{2}$ inches apart, was loaded at the center until it broke; the breaking load was 4,638 pounds. These tests were made by Henry Flad & Co., civil engineers, of Saint Louis.

Some four or five new quarries are said to have been opened near Concord, Knox county, but no particulars in regard to these developments were received.

Altogether the condition of the marble industry in Tennessee is most encouraging, and, in view of the enterprising spirit which is rapidly developing, some interesting results of the current year's progress may be expected in the next report. Improvement in transportation facilities is much needed in nearly all the quarry regions, of this State.

Virginia.—The Virginia Marble Company was reorganized late in 1886 by ex-Mayor Grace, Joseph S. Spenny, J. B. Hill, of New York city, and a number of Virginia gentlemen, for the purpose of operating a quarry near Mountsville, in Loudoun county. The capital stock of the company is $500,000.

Colorado.—The establishment by the Union Pacific Railroad Company of a "stone department," for the purpose of quarrying and transporting to consumers all kinds of building stone found in the "Great Hog Back" elevations of Colorado, and the liberal policy pursued by the company toward private quarry enterprises, have done a great deal, particularly during the past year, toward putting the building stone industry of the State in a promising condition. The following statements serve to indicate that the production of marble in Colorado may be looked for in the near future:

The Midland Railroad Company has made surveys of its marble deposits, and has located a railroad running directly to the beds. The Osgood Company has made investigations of the thickness of its marble deposits with a view to subsequent development.

The beds at Marble Glen, 10 miles northwest of Fort Collins, are said to consist of very fine material and to be of vast extent. Governor Routt has made preparations for opening up these deposits.

Some of the Colorado marbles are said to be fully equal in quality to those of Vermont and Tennessee. Inasmuch as investigations thus far have been of a preliminary character, definite statements in regard to both quality and quantity must be left for a future report.

PACIFIC COAST.

California.—The recent discoveries of marble in California have been the subject of considerable comment during the past year.

In September, 1885, Mr. Israel Luce, now superintendent of the Inyo Marble Company, at the request of members of the Carson and Colorado Railroad Company, visited the marble deposits known to exist in Owen's valley, 1½ miles from Owen's lake, 5 miles north of Keeler, and ½ mile from the Carson and Colorado railroad. At that time a company was organized for the purpose of developing the beds, but in May, 1886, it abandoned the project and sold out all equipments, etc., to the present owners, the Inyo Marble Company, which since that time has been developing the ledge and putting up a mill for sawing; sand suitable for this purpose being found in the neighborhood. The first car-load of sawed marble was shipped early in the present year.

The stone is said to be pure dolomite and the greater part of it is white, but a great variety of colored products is also found, including the variety known as moss agate. According to the reports of all experts who have examined this marble it is of very superior quality, being adapted not only for structural purposes, but also for the finest kinds of work.

The stone appears to exist in three layers; the upper one is from 15 to 20 feet thick, is considerably shattered and strained, and its present position is believed to have been the result of a slide from the mountain above.

The second layer is 3½ to 4 feet thick, apparently, in its original bed, but is also somewhat strained. The third layer has not been disturbed from its original position; its thickness is not yet known, but it has been penetrated to a depth of 6 feet. This stone is the only California marble that has proved acceptable to local cutters and dealers. The officers of the Inyo Marble Company are J. M. Keeler, president; H. B. Keesing, vice-president; O. F. von Rhein, secretary, and Israel Luce, superintendent.

In Antelope valley, Mono county, another marble deposit was discovered. This bed is said to be extensive, and to include all colors, from white to black; some of it has a strong resemblance to onyx. It takes a fine polish and is believed to be of great value. Blocks of any required size can be quarried, some weighing as much as 25 tons having been taken out. Shipments to the owners' works in Reno have already been made.

In the autumn of 1886 a deposit of marble, represented as covering an area of 600 acres, was discovered in the Mojave desert, San Bernardino county, 3 miles from Victor station, on the California Southern railroad. Nothing is yet known in regard to the depth of the bed. As both stone and lumber fit for building purposes are scarce in south-

ern California, this discovery is likely to prove a valuable one for Los Angeles, where it is calculated the stone can be laid down for $1 per cubic foot. At present, adobe, or unburnt brick, and lumber, are almost the only building materials extensively used in the town. The railroad company expects to build a track connecting the marble beds with Victor station.

The variety of marble known as onyx has been found in quantity at two places on the Pacific coast, one being the Kesseler quarry, in San Luis Obispo county, and the other near Suisun City, Solano county. A considerable quantity of stone has been taken from the former during the last three or four years; it has been manufactured into mantels, table tops, pedestals, vases, and other articles, which are readily sold at high prices, the mantels selling for $300 to $400 each. The onyx from the Kesseler quarry is indeed a magnificent stone, and has been very enthusiastically described by those familiar with it.

About 200 tons of the Suisun stone were shipped to Eastern markets last year; being situated near a railroad, a larger quantity is shipped from the Suisun than from the Kesseler quarry, the latter being at a considerable distance from the railroad.

Idaho.—A recent discovery of marble is reported in Cassia county, near the place at which the old stage road crosses the summit of the Goose Creek mountains. The deposit is said to be large, covering the mountain side over an area of 1 mile in width and 4 miles in length. Being 30 miles from a railroad, there is not much likelihood that the stone will be utilized in the near future.

Utah.—Several marble deposits are known to occur in Utah, but no very valuable stone has been quarried; this may, perhaps, be due to the fact that most of the marble investigated has been taken from near the surface, while that which is to be found at a greater depth may turn out to be of finer quality.

Marble has been found on Snake creek, east of Park City, Summit county, near Spanish Fork, and near Frisco.

SANDSTONE.

Production.—The output and the price of sandstone for 1886 were quite noticeably affected by the strikes of the early part of the year. The total falling off was, however, much less than was expected at the time of the general labor disturbances. This was due to the quite rapid and vigorous revival of building enterprises which took place toward the end of the year.

According to the last census report, the total production of sandstone for the entire country amounted to 24,776,930 cubic feet; of this quantity Ohio produced 8,574,726 cubic feet, or more than one-third; Pennsylvania came next with a yield of 6,229,110 cubic feet; New York and

New Jersey followed in the order named with productions of 2,980,353 and 2,384,791 cubic feet, respectively.

Ohio still stands at the head of the list of sandstone-producing States and its lead appears to be continually increasing.

Owing to insufficient data it is impossible to give an estimate of the total output for the year, but it is probable that the output was but little greater in 1886 than in 1885. Of all the different quarry regions in the eastern division from which information was received, a majority reported production as "about the same" as in 1885; a smaller number reported a curtailment, owing chiefly to strikes; while a still smaller number report an increase of business, although in no case is this very considerable.

In the Rocky Mountain division, and particularly in Colorado, the general condition of the quarrying industry has been good. This prosperity is largely due to the efforts of the Union Pacific Railway Company to develop the quarries which abound along the Great Hog Back in Colorado, and to create a demand for the stone in the important cities of the Missouri valley. No separate figures for sandstone production alone have been furnished, but the amounts of stone of all kinds quarried and shipped by the Union Pacific Company during 1886 have already been given.

The composition of the most popular sandstones of this region are shown by the following analyses:

Analyses of sandstone.

	Stout quarry.	Buckhorn quarry.
	Per cent.	*Per cent.*
Silica	95.50	96.45
Iron and alumina	0.78	1.90
Calcium oxide	0.88	1.06
Magnesia	1.45	0.64
Carbonic acid and water	1.18	.....
Total	99.79	100.05

When engaged in making a selection of the stone to be used in building the Colorado State capitol the board of commissioners having the matter in charge made tests of quite a number of different kinds of stone chiefly from Colorado, but also from other States.

The following table gives the results for sandstone:

Results of tests of sandstone for the State Capitol, Colorado.

Number of specimen.	Locality.	Color.	Position.	Size.	Strength of the specimens.	Strength of one square inch.	Specific gravity.	Weight of one cubic foot.	Ratio of absorption in 10 minutes.	Ratio of absorption in 24 hours.
				Inches.	*Lbs.*	*Lbs.*		*Lbs.*		
50	Buck Horn	Grayish white	Bed	2.05×2.07	78,750	18,573	2.379	168.402	.011	.040
			Edge	2.04×2.06	72,500	17,261				
51	Thistle, Utah	Dark reddish brown.	Bed	2.06×2.06	35,000	8,254	2.407	150.211	.024	.063
			Edge	2.02×2.04	38,750	9,405				
52	Trinidad	Drab	Bed	2.01×2.03	41,250	10,110	2.339	145.906	.009	.069
			Edge	1.94×2.00	37,500	9,665				
53	Manitou (Snider)	White	Bed	2.01×2.05	53,750	13,046	2.207	137.672	.071	.094
			Edge	2.06×2.07	48,750	11,442				
54	Ralston	Red	Bed	2.04×2.04	46,250	11,118	2.245	140.043	.062	.080
			Edge	1.99×2.02	39,000	9,701				
55	Left Hand	Pink	Bed	1.98×2.00	45,000	11,278	2.240	139.731	.023	.042
			Edge	2.03×2.03	56,250	13,653				
56	Saint Vrains	Light red	Bed	2.00×2.01	46,250	11,505	2.393	149.275	.012	.061
			Edge	2.00×2.04	71,500	17,187				
57	Douglas county	Red	Bed	2.04×2.01	14,250	3,544	2.191	136.674	.088	.134
			Edge	2.02×2.02	14,250	3,492				
58	Fort Collins	Gray	Bed	2.03×2.05	48,750	11,707	2.252	40.679	.013	.072
			Edge	2.00×2.04	44,000	10,784				
59	do	Light red	Bed	2.00×2.01	51,250	12,740	2.432	151.648	.011	.051
			Edge	1.99×1.99	69,250	17,487				
60	Stout	Dark gray	Bed	2.07×2.07	45,000	10,514	2.263	141.165	.040	.066
			Edge	2.08×2.10	55,000	12,585				
61	Coal Creek	Greenish gray	Bed	2.02×2.02	11,750	2,879	2.033	126.818	.053	.167
			Edge	1.96×2.01	9,500	2,411				
62	Oak Creek	Yellowish gray	Bed	2.03×2.04	11,000	2,657	1.953	121.828	.076	.193
			Edge	2.02×2.03	10,000	2,475				
63	Coal Creek	Greenish gray	Bed	2.05×2.05	15,000	3,570	2.067	128.939	.055	.158
			Edge	2.03×2.04	14,000	3,381				
64	Gunnison	Brownish gray, speckled.	Bed	2.02×2.02	25,000	6,127	2.066	138.877	.128	.146
			Edge	2.00×2.01	21,000	5,224				
70	Cañon City	Cloudy blue	Bed	1.99×2.00	22,750	5,716	2.301	143.536	.061	.100
			Edge	1.95×1.91	14,250	3,820				
71	Manitou (Emerins).	White	Bed	1.97×2.03	37,000	9,250	2.233	139.294	.077	.120
			Edge	2.01×1.96	40,000	10,152				
72	Gunnison	do	Bed	1.98×2.02	21,000	5,250	2.204	137.485	.087	.090
			Edge	2.02×1.96	21,750	5,492				
73	La Porte, Colorado.	Pink	Bed	2.03×2.04	43,750	10,567	2.235	145.033	.031	.079
			Edge	2.03×2.00	35,000	8,620				
74	Brandford	Greenish gray	Bed	2.01×2.02	13,500	3,308	2.004	125.009	.071	.189
			Edge	2.02×2.01	11,750	2,894				
75	Wyoming	Gray	Bed	2.06×2.02	45,500	10,833	2.021	126.069	.102	.217
			Edge	2.01×2.03	38,750	9,544				
76	Left Hand	Cream gray	Bed	1.99×2.04	50,000	11,848	2.394	149.237	.011	.049
			Edge	2.04×1.95	52,000	13,056				
77	do	Light pink	Bed	2.02×1.97	54,000	13,200	2.290	142.850	.026	.054
			Edge	2.01×2.04	36,250	8,841				

Although granite, slate, jasper, marble, limestone, as well as sandstone, are found in Dakota, the last-mentioned stone is the only one as yet quarried. During 1886 about 5,000 perches were shipped from Buffalo Gap to O'Neal City, Norfolk, Fremont, and Omaha, Nebraska; 12,000 perches were used in 1886 for building purposes in Rapid City.

The Dakota sandstone is from 250 to 400 feet in thickness and forms the foot hills which completely encircle the Black Hills. It is generally to be found in good seams varying in thickness from a few inches to several feet; its hardness is quite variable, as also are its colors, which include brown, white, pink, yellow, brick-red, and variegated; the last is much admired locally, and is in common use for window sills, keystones, etc.

New discoveries and developments.—Under this heading there is comparatively little to be said for the Eastern division, owing to the unfavorable conditions which prevailed during the early part of the year.

In November of 1886 steps were taken to open a new sandstone quarry at the mouth of the Salmon Trout river near Marquette, Michigan. The stone lies in three distinct beds; the first one, consisting of a variegated stone similar to that of the Marquette quarries, is about 6 feet thick. The second bed is 7 feet thick and resembles the Portage Entry stone, though darker in color, more compact, and of finer grain. The third bed is the most valuable; it is about 5 feet thick, and its color is about the same as that of the Marquette brownstone; its quality is said to be very fine and great popularity is predicted for it. It will be known as the Newport and Lake Superior quarry, and from present indications the output during 1887 will be abundantly sufficient to demonstrate satisfactorily the quality and extent of the deposit. Considerable activity in developing other quarries of Lake Superior sandstone is being manifested and encouraging results may be anticipated for the current year.

Quarries of red sandstone at Wadesboro', Anson county, North Carolina, are being actively worked, but no full account of operations thus far conducted at this point have been received.

About the end of the year a new quarry of sandstone was opened 2 miles east of Warrensburgh, Johnson county, Missouri.

A marked increase in activity in the quarrying of sandstone near Thistle Station, on the Denver and Rio Grande Western railroad, in Utah, has been revealed during the past year, and this point is becoming quite noted locally for the extensive shipments made.

Near Buffalo Gap, Custer county, Dakota, a large bed of rock, which promises to be of considerable value for use as whetstones and hones, was discovered in July, 1886.

SLATE.

Production.—The year 1886 opened with quite encouraging prospects for the slate industry, prices being maintained at nearly the same figures as for the early part of the preceding year, while the outlook for a brisk demand was fairly good. Hardly had the season fairly opened, however, when the labor troubles made themselves immediately felt by curtailing demand in a number of districts which had previously been reliable markets. Large enterprises, which would have been carried out forthwith, were either abandoned entirely or indefinitely postponed until the times should present fewer elements of doubt and uncertainty. Furthermore, a number of the prominent slate regions were burdened with the overproduction of two or three years previous, it having been the policy of large producers to continue operations undiminished in spite of slack demand rather than, by reducing output, to throw out of employment the peculiarly skilled laborers whose places it might afterwards be difficult to fill.

In view of the above facts, the production of slate in 1886, although falling considerably behind expectations, and also, for the principal districts, slightly behind the production of 1885, may be regarded as by no means unsatisfactory.

Production of roofing slate in all sections during the years 1884, 1885, *and* 1886.

[Squares of 100 square feet each.]

Sections.	1884.	1885.	1886.
Bangor and Pen Argyl region, Pennsylvania	195,505	196,832	215,341
Slatington section, Pennsylvania	104,000	108,000	109,000
Vermont	85,000	130,000	111,385
Maine	41,000	34,000	36,000
Chapman's	29,499	26,328	24,464
Peach Bottom	10,000	14,500	12,000
Virginia	9,000	17,300	16,600
Michigan	7,000	10,000	12,000
Total	481,004	536,960	536,790

Total yearly production of roofing slate from 1879 *to* 1886 *inclusive.*

Years.	Number of squares.	Average price per square, delivered on cars.	Value.
1879	367,857	.....	.....
1880	382,867	.....	.....
1881	454,070	.....	.....
1882	501,000	.....	.....
1883	506,200	.....	.....
1884	481,004	$3.85	$1,851,865
1885	536,960	3.07	1,648,467
1886	536,790	3.00	1,610,370

Prices.—The prices of slate in New York for different times are shown in the following table:

Comparative prices of roofing slate at New York, January 1.

	1885.	1886.	1887.
Purple	$6.00 to $7.00	$6.00 to $7.00	$5.00 to $6.00
Green	6.00 7.00	6.00 7.00	5.00 6.00
Red	15.00	15.00	10.00
Black	4.50 5.00	4.50 5.00	3.50 4.00

Quite a marked falling off is apparent for the early part of the present year; according to some slate producers this decline may be, in part at least, accounted for by the lack of harmony between operators and the failure of a number to adhere rigidly to the scale of prices agreed upon. There is no reliable evidence to show that the use of roofing slate is at all falling into disrepute; but on the contrary, home demand, particularly in the West, has increased during the past year, and the

indications for still further increase during the present year are decidedly good.

In so far as information has been received, there have been no serious disturbances between employers and workmen at any of the quarrying centers during 1886. The following is the scale of wages paid at the Slatington section:

	Cents per hour.
Splitters	15 to 18
Blockmakers	15 18
Laborers	10 13

This differs from the scale of last year only in being less for splitters, who were at that time paid 18 to 20 cents per hour.

The following is the scale of prices for roofing slate on board cars, adopted February 8, 1887, by the Slatington Slate Exchange:

Prices of roofing slate at Slatington, Pennsylvania.

	Per square.
24's and 22's	$3.75
20's, 18's, and 16's	4.00
14's	3.75

Exports.—The exports of roofing slate from New York City during 1886 show a decided falling off. As the following table shows, no roofing slate was shipped from New York to European ports, as was the case some years ago, when several cargoes of slate were shipped direct to Welsh ports.

Exports of roofing slate from New York for 1886.

	Pieces.	Value.
British West Indies	30,100	$1,330
British Australia	2,577,576	71,671
New Zealand and Tasmania	217,570	6,063
Total	2,825,246	79,064

Exports of roofing slate from the port of New York from 1876 *to* 1886 *inclusive.*

Years.	Tons.	Pieces.	Value.
1876	19,475	646,985	$377,233
1877	25,565	2,895,428	646,272
1878	12,320	1,834,225	308,852
1879	4,792	3,085,124	166,220
1880	11,267	1,698,522	220,292
1881	2,927	3,522,527	138,904
1882	864	4,337,801	153,318
1883	187	1,488,226	54,063
1884	50	2,776,236	90,262
1885	.....	4,113,204	115,206
1886	.....	2,825,246	79,064

The export trade to Australia increased quite rapidly during 1885, with the ultimate effect, however, of overstocking the market there to such an extent that it is said that some lots were sold in Australia for less than it cost to put them on board ship here. Welsh producers have been shipping considerable quantities to the same Australian ports, and since they undoubtedly have the advantage of American producers in matters of cost and transportation facilities, successful competition with them can no longer at present be maintained.

The use of slate for other purposes than as a roofing material appears to be increasing. During 1886 business has been fully as good as in previous years for some of these slate products, such as mantels, blackboards, flagging, etc.; prices were quite well sustained during the year. The following table for the Slatington section will serve to give some idea of the comparative condition of trade in these products for 1885 and 1886:

Comparative table of the annual sales in the Slatington section.

Articles.		1885.	1886.
Roofing squares		108,000	109,000
School slates	cases	36,872	42,388
Flagging	pieces	31,849	58,713
	cases	1,429	1,673
	cars	27	21½
Blackboards	cases	5,882	6,791
Mantels	pieces	8	.....
	cases	24	21
Hearth slate	do	2	1
Rough, sawed, and shaved	do	46¾	32

The exports of manufactured slate still consist almost entirely of school slates. The following tables give the shipments from New York; the figures represent a large proportion of the entire exports for the year:

Exports of manufactured slate from the port of New York 1876 to 1886 inclusive.

Years.	Cases.	Value.	Years.	Cases.	Value.
1876	10,612	$87,500	1881	14,414	$62,109
1877	8,675	68,437	1882	14,625	68,150
1878	13,274	88,215	1883	8,943	40,674
1879	17,505	74,251	1884	12,189	53,021
1880	15,674	76,709	1885	10,573	49,965
			1886	9,498	40,804

Exports of all kinds of slate from the port of New York, 1876 to 1886 inclusive.

Years.	Value.	Years.	Value.
1876	$464,733	1881	$201,013
1877	714,709	1882	221,468
1878	397,067	1883	94,737
1879	240,471	1884	143,283
1880	297,001	1885	165,171
		1886	119,868

New discoveries and developments.—In the latter part of 1886 a large bed of slate was discovered on Abram's creek, 1½ miles from the Little Tennessee river, in Blount county, Tennessee. Some very encouraging statements in regard to both the quality and the extent of the rock have been made, and inasmuch as a company known as the Abram's Creek Roofing Slate Company, capital stock $125,000, was organized early in 1887 for the purpose of quarrying and manufacturing the slate, interesting items in regard to developments may be looked for in the next volume of this series.

A new company, known as the Washington Red Slate Company, with a capital stock of $30,000, was recently incorporated at Middle Granville, New York, for the purpose of operating slate quarries in that region.

Slate of a quality sufficiently good for roofing purposes is reported by Mr. F. F. Chisolm as occurring on Pennington and Slate creeks, Dakota.

In the latter part of 1886 operations for the purposes of developing a slate quarry 8 miles southwest of Little Rock, Arkansas, were instituted. The slate as indicated by samples submitted is of good quality, and exists in apparently unlimited quantity. None seems to have been quarried during 1886 at this place, but there are indications of a liberal production during 1887. The quarry is owned by Mr. Alonzo Hull, of Little Rock, Arkansas.

Utilization of slate débris.—In view of the rapid accumulation of slate refuse in the neighborhood of all actively-worked quarries, the question of its disposal has always been one of considerable interest to slate producers. The following facts, abstracted from the London *Machinery Market*, seem to indicate that the disposal of this refuse may become a source of profit. In 1878 Thomas Evans took out a patent for the manufacture of slate refuse into bricks. He had demonstrated that, by subjecting a mixture of the finely-powdered slate débris and water to sufficient pressure in molds, the consistence of the mixture being about that of mortar, the product was a superior quality of brick.

The patent was purchased by Messrs. Coley, Bromfield, and Davis, who subsequently sold it to a company known as the Patent Slate Brick and Sanitary Tube Company, limited. This company erected an expensive plant and commenced manufacturing the new product. The cost of manufacture has been found to be 1*s.* 1*d.* per 1,000 bricks. The bricks thus made are said to resist extremes of temperature well, and to withstand crushing force up to the limit 1,056 tons to the square foot. Owing to the fact that sewage acids have no deleterious effect upon this material, it is well adapted to the manufacture of sanitary tubes, which have already been made up to 3 and 4 feet in diameter.

An investigation of this subject might well repay slate producers in this country, where so many thousands of tons of slate are constantly being thrown aside as waste.

Imports and exports of building stone.—The following tables show the extent of the foreign commerce of the United States in marble and other stone:

Marble imported and entered for consumption in the United States, 1867 to 1883 inclusive.

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches in thickness.	Sawed, dressed, etc., over 2 and not over 3 inches in thickness.	Sawed, dressed, etc., over 3 and not over 4 inches in thickness.	Sawed, dressed, etc., over 4 and not over 5 inches in thickness.	Sawed, dressed, etc., over 5 and not over 6 inches in thickness.	Veined and all other in blocks, etc.	White, statuary, Brocatella, etc.	Not otherwise specified.	Total.
1867	.....	.....	.....	.....	.....	$192,514	$2,540	$51,978	$247,032
1868	.....	.....	.....	.....	.....	309,750	4,403	85,783	399,936
1869	.....	.....	.....	.....	.....	359,881	3,898	101,309	465,088
1870	.....	.....	.....	.....	.....	332,839	3,713	142,785	479,337
1871	$5,973	$168	$77	$44	$28	400,158	1,134	118,016	525,598
1872	3,499	1,081	452	.....	318	475,718	4,017	54,539	539,624
1873	3,124	21	.....	.....	.....	396,671	4,148	69,991	473,955
1874	1,837	.....	.....	.....	.....	474,680	2,863	51,699	531,079
1875	1,456	427	96	.....	.....	527,628	1,623	72,389	603,619
1876	595	126	204	87	.....	529,126	1,151	60,596	591,885
1877	2,124	.....	.....	.....	.....	349,590	1,404	77,293	430,411
1878	198	11	8	.....	.....	376,936	592	43,915	421,660
1879	184	.....	.....	.....	.....	329,155	427	54,857	384,623
1880	.....	.....	.....	.....	.....	531,908	7,239	62,715	601,862
1881	339	.....	.....	.....	.....	470,047	1,468	82,046	553,900
1882	655	.....	.....	.....	.....	486,331	3,582	84,577	575,145
1883	619	.....	.....	.....	.....	533,096	2,011	71,905	607,631

During the last three fiscal years the classification has been as follows:

Classification.	1884.	1885.	1886.
Marble:			
In blocks, rough or squared, of all kinds	$511,287	$429,186	$410,843
Veined marble, sawed, dressed, or otherwise, including marble slabs and marble paving tiles	12,941	43,923	81,497
All manufactures of, not specially enumerated	67,829	54,772	34,546
Total	592,057	527,881	526,886

Building stone (exclusive of marble), paving stone, and stone ballast imported and entered for consumption in the United States, 1867 to 1886 inclusive.

Fiscal years ending June 30—	Building stone, dressed.	Building stone, rough.		Sandstone.	Slate chimney pieces, mantels, etc.	Roofing slate.	Limestone.	Paving stones.	Ballast.	Total value.
		Quantity.	Value.							
		Long tons.								
1867	.....	.....	.....	.....	$37,510	$85,204	.....	.....	.....	.....
1868	$59,081	.....	.....	.....	16,045	118,776	.....	$5,718	.....	.....
1869	61,408	.....	$8,237	$4,171	10,602	85,364	.....	467	$3,987	.....
1870	150,619	.....	.....	3,201	19,870	107,521	.....	2,034	10,518	.....
1871	145,759	1,455	16,982	3,660	21,381	117,484	.....	.....	34,703	.....
1872	162,614	10,723	39,515	7,680	25,925	107,192	$2,459	5,529	11,303	$362,217
1873	218,236	20,226	73,889	6,160	26,643	91,503	1,486	3,788	17,143	438,848
1874	238,680	19,658	81,645	8,534	27,519	80,519	1,639	7,246	21,882	467,664
1875	275,633	15,748	67,357	10,986	42,022	16,342	2,023	2,017	9,025	425,405
1876	316,404	8,199	34,124	7,174	44,266	2,051	1,938	1,005	9,350	416,312
1877	201,034	7,584	25,571	5,492	34,479	4	1,705	485	6,272	275,042
1878	153,693	10,197	37,878	7,136	38,935	275	2,614	1,950	6,989	250,470
1879	125,493	6,845	24,531	13,056	46,260	620	1,456	2,943	2,305	217,624
1880	75,501	11,035	43,907	10,220	51,165	72	2,560	2,383	7,572	193,470
1881	76,741	15,867	65,950	15,115	46,862	2	1,990	3,799	5,401	215,860
1882	104,296	16,778	75,309	.....	45,774	154	2,710	16,599	8,792	253,694
1883	127,476	14,324	64,767	.....	44,375	2,813	1,841	2,629	5,745	249,646
1884	122,463	12,198	50,860	.....	34,640	16,099	143	2,576	2,551	229,332
1885	145,344	13,183	64,680	.....	56,913	5,196	.....	.....	4,056	276,189
1886	171,840	13,084	65,459	.....	60,512	4,366	.....	.....	3,759	305,936

Marble and stone of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Rough.	Manufactured.	Total.	Fiscal years ending June 30—	Rough.	Manufactured.	Total.
1826	.....	$13,303	$13,303	1857	.....	$111,403	$111,403
1827	.....	3,505	3,505	1858	.....	138,590	138,590
1828	.....	3,122	3,122	1859	.....	112,214	112,214
1829	.....	2,647	2,647	1860	.....	176,239	176,239
1830	.....	4,655	4,655	1861	.....	185,267	185,267
1831	.....	3,588	3,588	1862	.....	195,442	195,442
1832	.....	3,455	3,455	1863	.....	138,428	138,428
1833	.....	5,087	5,087	1864	$57,715	144,647	202,362
1834	.....	7,359	7,359	1865	74,261	183,782	258,043
1835	.....	8,687	8,687	1866	89,703	112,830	202,533
1836	.....	4,414	4,414	1867	53,983	138,558	192,541
1837	.....	5,374	5,374	1868	60,399	105,046	165,445
1838	.....	5,199	5,199	1869	62,266	87,135	149,401
1839	.....	7,661	7,661	1870	42,227	138,046	180,273
1840	.....	35,794	35,794	1871	135,672	137,613	273,285
1841	.....	33,546	33,546	1872	156,976	165,311	322,287
1842	.....	18,921	18,921	1873	96,735	189,795	286,530
1843 (nine months)	.....	8,545	8,545	1874	126,669	168,977	295,646
1844	.....	19,135	19,135	1875	125,968	254,356	380,324
1845	.....	17,626	17,626	1876	95,480	236,255	331,735
1846	.....	14,234	14,234	1877	131,716	917,937	1,049,653
1847	.....	11,220	11,220	1878	142,661	597,356	740,017
1848	.....	22,466	22,466	1879	143,457	430,848	574,305
1849	.....	20,282	20,282	1880	199,051	453,912	652,963
1850	.....	34,510	34,510	1881	220,362	409,433	629,795
1851	.....	41,449	41,449	1882	180,774	433,656	614,430
1852	.....	57,240	57,240	1883	152,182	389,371	541,553
1853	.....	47,628	47,628	1884	188,245	415,015	603,260
1854	.....	88,327	88,327	1885	182,719	(a)330,786	513,505
1855	.....	168,546	168,546	1886	159,553	(a)445,708	605,261
1856	.....	162,376	162,376				

a Includes roofing slate.

Marble and stone, and manufactures of marble and stone, of foreign production exported from the United States, 1872 to 1886 inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1872	$1,229	1880	$6,816
1873	4,571	1881	709
1874	1,928	1882	4,848
1875	3,428	1883	490
1876	13,371	1884	8,420
1877	8,475	1885	14,406
1878	3,448	1886	4,617
1879	6,364		

Summarizing the foregoing statistics, the movement during the fiscal years 1882 to 1886 may be stated thus:

Balance of trade in marble and stone.

Fiscal years ending June 30—	Imports.	Exports.			Excess of imports over exports.
		Of domestic production.	Re-exports of foreign production.	Total exports.	
1882	$828,839	$614,430	$4,848	$619,278	$209,561
1883	1,475,658	541,553	490	542,043	933,615
1884	821,389	603,260	8,420	611,680	209,709
1885	804,670	513,505	14,406	527,911	276,159
1886	832,822	605,261	4,617	609,878	222,944

CEMENT.

Production.—The following table shows the production of the natural rock cements in the leading districts during 1886:

Production of cement in the leading districts in 1886.

	Barrels of 300 pounds.
Rosendale district, Ulster county, New York	2,050,856
Buffalo and Akron districts, New York	550,000
Williamsville, Erie county, New York	20,000
Louisville, Kentucky	925,210
Utica, Illinois	226,000
Mankato, Minnesota	114,086
Milwaukee, Wisconsin	300,000
Total	4,186,152

The total production for 1886 of all kinds of cement, including the artificial Portland cement, is estimated to have been 4,500,000 barrels, valued at $3,990,000.

The total amount of cement manufactured from natural rock during 1886 is estimated at 4,350,000 barrels, estimated at $3,697,500.

The total amount of American Portland cement manufactured during 1886 is estimated at a maximum of 150,000 barrels, valued at $292,500.

The following tables show the production in the past five years:

Production of cement made from natural rock in the United States from 1882 *to* 1886.

Years.	Barrels of 300 pounds.	Average price per barrel.	Total value.
1882	3,165,000	$1.10	$3,481,500
1883	4,100,000	1.00	4,100,000
1884	3,900,000	.90	3,510,000
1885	4,000,000	.80	3,200,000
1886	4,350,000	.85	3,697,500

Estimated production of American Portland cement from 1882 *to* 1886.

Years.	Barrels of 400 pounds.	Average price per barrel.	Total value.
1882	85,000	$2.25	$191,250
1883	90,000	2.15	193,500
1884	100,000	2.10	210,000
1885	150,000	1.95	292,500
1886	150,000	1.95	292,500

The total production of all kinds of cement during the past five years was about as follows:

Total production of all kinds of cement in the United States from 1882 *to* 1886.

Years.	Barrels.	Value.
1882	3,250,000	$3,672,750
1883	4,190,000	4,293,500
1884	4,000,000	3,720,000
1885	4,150,000	3,492,500
1886	4,500,000	3,990,000

As the foregoing tables show, the production of cement in the United States has increased quite markedly over that of 1885, prices generally have been steadier, and from the first of June until the close of the season producers have been kept busy to supply a good demand. The average cost of production has been higher than in 1885; greater care has been taken in selecting the natural rock and in manufacture, and, generally speaking, an excellent product has been the result. The margin of profit to producers has been small, but the volume of business has in a measure compensated for this.

The production of American Portland cement, while it has thus far been comparatively small, is increasing, and particularly within the past few years considerable interest has been shown in improving methods of manufacture and machinery, so that competition with foreign producers is becoming more and more favorable to the American manufacturers.

Most of the cost of producing Portland cement being that of labor, when the processes of manufacture are the same, the foreign producers have of course a great advantage in cheap labor, but there are indications that this advantage will be offset in this country by signal improvements in methods, whereby workmen are replaced by machinery, which is expected to effect a great saving of time, space, and interest on capital. Judging from all present indications the manufacture of American Portland cement, now in its initial stages, will increase with rapid strides during the next few years.

The demand for the best mortar to be used in buildings rapidly erected is becoming more and more pronounced. Lime mortar, requiring external influences in the setting process, does not contract uniformly on both sides of walls, one of which is freely exposed to the atmosphere and the other more or less protected from it. Cement, on the other hand, containing within itself all the elements necessary to the setting process, is not open to the above objection, and can be used without danger of settling and sliding due to unequal hardness in different parts of the walls even when the superimposed weight is rapidly added without allowing time for chemical or physical changes in mortar.

The scientific investigation of cements of all kinds is at present claiming considerable attention, and its results are to some extent becoming manifest in the care shown by manufacturers to maintain and, if possible to improve, the quality of their products.

The subject of properly testing and comparing the different kinds of cement in use is, however, one to which more attention might well be given by competent and unprejudiced authorities.

Imports.—The following table gives the imports of cement at New York since 1877. The statement for New York was taken from the *Record and Guide:*

Imports of cement at New York, in casks of 400 pounds.

Years.	From Great Britain.	From European continent.	Total casks.	Cost on pier per cask.	Total value.
1877	47,632	10,818	58,450	.....	.....
1878	51,477	19,040	70,517	.....	.....
1879	80,834	25,212	106,046	.....	.....
1880	120,833	45,080	165,913	.....	.....
1881	149,486	73,186	222,672	.....	.....
1882	171,202	190,924	362,126	$2.60	$941,528
1883	158,602	143,363	301,965	2.70	815,306
1884	155,477	201,085	356,562	2.50	891,405
1885	187,955	250,860	438,815	2.05	899,571
1886	261,464	301,887	563,351	.....	.....

The total imports (classed as "Roman" cement at the custom-houses) into the United States since 1868 have been:

Roman cement imported and entered for consumption in the United States, 1868 to 1886 inclusive.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
				Barrels.	
1868		$10,168	1878		$184,086
1869		9,853	1879		212,719
1870		18,057	1880		373,264
1871		52,103	1881		441,512
1872		172,339	1882	370,406	663,684
1873		209,067	1883	456,418	802,294
1874		286,429	1884	(a)585,768	825,095
1875		261,741	1885	554,396	874,076
1876		247,200	1886	650,032	732,297
1877		201,074			

a Classed simply as cement; kind not specified since 1883.

Imports of cement at San Francisco.

Years.	Barrels.	Years.	Barrels.
1864	13,322	1876	66,988
1865	26,270	1877	45,469
1866	34,360	1878	57,258
1867	31,666	1879	15,068
1868	31,954	1880	62,417
1869	54,097	1881	65,695
1870	42,377	1882	99,208
1871	32,602	1883	151,807
1872	54,746	1884	152,500
1873	61,911	1885	167,000
1874	79,435	1886	158,000
1875	73,814		

It is evident from the table for total imports that while the quantity imported in 1886 is decidedly greater than in 1885, its value is less.

Comparative prices per barrel of cement in New York January 1, 1884 to 1887.

	1884.	1885.	1886.	1887.
Rosendale	$1.10 to $1.20	$1.00	$1.10 to $1.25	$1.20 to $1.25
Portland	2.40 2.75	$2.50 to 3.00	2.25 2.50	2.00 2.25
Roman	2.75 3.50	2.75 3.50	2.75 3.25	2.65 2.85
Keene's common	5.00 6.00	5.00 6.00	4.50 6.00	4.50 5.50
Keene's fine	9.25 9.75	9.50 10.00	9.00 10.00	7.50 8.50

From this table it is plain that while the domestic (Rosendale) has risen the imported Portland has fallen in price. A reaction for the better has taken place since the latter part of 1886 in the cement trade of England and Germany.

As compared with the imported Portland cement, the American Portland may be said to be far superior to a large number of imported

brands; but it is also true that a considerable number of the imported articles are in turn superior to the American.

The works at South Bend, Indiana, manufacturing Portland cement, have been obliged to add to their facilities in order to supply the increased demand for their product, which seems to have steadily maintained its good standard of quality.

A considerable variation existing at present in the modes of testing cements is unfortunate, and makes it very difficult to arrive at a correct conclusion in all cases as to the comparative merits of different articles.

The following description of the process of manufacture used by the American Improved Cement Company at their works at Egypt, Pennsylvania, is taken from a paper by Mr. R. W. Lesley, and read before the Engineers' Club, at Philadelphia:

"The material used in the manufacture is a hydraulic limestone or cement rock containing the proper chemical ingredients. The process is briefly as follows: The raw rock is crushed and ground dry. The powder thus formed is run into a mixer, when a small proportion of pitch and water is added. The moistened powder is then passed through a pair of heavy rolls, having matched egg-shaped cavities, which mold it into small eggs and deliver these latter in front of the kilns, avoiding all handling. These eggs can be used the same day in the kilns if necessary, whereas under the old process the same stage of manufacture required weeks, a manifest advantage, to say nothing of the immense saving in labor, land, and interest. The form of the material, its uniformity in density, porosity, and size make it more easily burned, handled, crushed, and ground, and make it a saving at every stage of the process; while the addition of the pitch aids the uniform burning, and, moreover, by forming pores, through which the moisture in the eggs escapes, prevents them from falling away in the kiln, which they would otherwise do, owing to the generation of steam within them and the formation of a crust on their outer surfaces. This is the point which in the old processes prevented placing the wet paste in the kilns promptly, and which is here overcome by the use of a combustible. By this process the foreign brands are fairly met in point of price, and repeated tests by leading authorities here and in Europe show that the quality of the cement made is equal to the foreign Portland."

An article by R. J. Friswell, in the London *Engineer*, March 4, 1887, gives an an account of "Ransome's improvements in the manufacture of Portland cement." After describing the old process of manufacture and pointing out its lack of economy and various other disadvantages and defects, the author says:

"It will be seen from the above that the processes of burning and grinding the cement are by far the most costly of all the operations involved in its manufacture, and that they are beset with defects, both scientific and practical, of a very serious nature. It is evident that if

any great improvement is to be effected in the manufacture, the most serious attention must be directed to those portions of the process. It is, therefore, to this part of the work that Mr. Ransome has directed his attention. Taking as his guiding principles economy of fuel, space, and labor, he has devised the following process:

"The 'slurry,' prepared by any one of the methods now in use, is dried on a floor heated as usual, or by waste gas from subsequent processes. The soft, friable, and easily crushed blocks are now reduced to coarse powder, and are then ready for burning. The old kiln is totally abolished, and in its place a cylinder of boiler plate is used. This is lined with good refractory fire-brick set in fire-clay, and about every fourth row the bricks are set up on end, thus producing a number of parallel longitudinal feathers or ridges extending completely through the cylinder from end to end. The outside of the cylinder is provided with two smooth rings or rails of iron. In the center a third rail is wrought into teeth, in which a worm is rotated at a slow speed. The two rails rest on friction rollers, and the whole cylinder being set at an angle with the horizon, is caused to rotate slowly. This construction, though appearing somewhat formidable, is in practice extremely simple, and similar machines, known as 'black-ash revolvers' or 'revolving black-ash furnaces,' have long been and are now in daily use in alkali works. The cylinder is mounted on the top of a brick-work chamber divided by interior walls of bricks. The two outer chambers are filled with bricks piled in loosely, chequerwise, so as to present a large surface. Supposing a cylinder to be started, the operations will be described. A gas-producer being in working order and delivering its gas at a regular rate, it is lighted and the flame passes through the cylinder, which, in the course of a few hours, attains a white heat. The waste heat from the revolver has also passed through and heated the right-hand division of the generator to a bright cherry red. A shunt valve is now opened, causing the waste gases to pass through the left-hand regenerator, while the gas from the producer is caused to flow through the heated right-hand chamber, and thus arrives at the mouth of the revolver already intensely heated. The result of this is that an immediate economy of fuel is produced, and to avoid overheat it will be necessary to reduce the gas supply. During the whole operation the air necessary for combustion is also heated by passing down a separate division of the regenerator, where it receives heat from the walls of the outer compartments. As soon as the right-hand chamber begins to cool, the furnace-man reverses his shunt valve, and the fresh gas is turned through the hot regenerator, while the waste combustion products are heating that which has cooled down. The effect of this method of working is to return into the furnace the heat which in ordinary methods of work goes up the chimney. No startling innovation occurs save in the application of the method to cement making. Regenerative

furnaces are in use all over the world, and an intelligent furnace man will learn how to manage one in a few hours.

"We have now to turn our attention to the cement, which, taken from the drying floor, we described as crushed to a coarse powder. The powder is lifted by any convenient mechanical arrangement to a hopper, placed at the upper end of the revolver; from this it falls in a steady shower *through the flame* to the lower side of the cylinder, and lodges between the feathers. As the advancing side of the cylinder rises it is lifted until the feather attains such an inclination as to shoot it off again through the flame to the bottom once more, but, owing to the incline, several inches nearer to the lower end. As the revolver moves on, this operation continues again and again, the powder is constantly lifted and shot through the flame in showers, gradually getting nearer and nearer to the lower and hotter end of the cylinder, until at last it falls out into a receptacle at the lower end. In practice it is found desirable to rotate the cylinder at such a rate that any given particle of cement takes about thirty minutes to travel from one end to the other, during which time it has been lifted and shot through the flame about fifty times.

"The powder has now arrived at the outside of the furnace, and having been delivered onto a floor to cool, is at once ready for grinding; that is, it is in the same state as the clinker after being seven days in the kiln. Unlike cement clinker, however, it does not consist of lumps weighing from 14 pounds downward, and as hard as granite, but of a coarse sand. Nor does it consist of an overburnt skin, a properly burnt inner portion, and a possibly underburnt center; but if the operation has been properly carried out, each fragment has been heated to exactly the proper degree. Again, the fuel used is gaseous; consequently no mixture of coke ash has taken place, and the cement is really what it professes to be.

"The next question to be considered is the economy of fuel effected by the use of gas-producers. Instead of consuming coke, these require only to be fed with slack, coal dust, or anything that will burn, fed in at intervals through a hopper. A two-cylinder works would require for its daily service probably one gas-producer capable of converting about 6 hundredweight of slack per hour into gas.

"These producers are chambers of brick-work in which a portion of the fuel burning converts the rest into gas, a small jet of steam being blown in.

"The results derived from this plan of gas firing are: (1) Possibility of working with regenerative furnaces, thus saving all heat passing from the revolver; (2) use of about 3 hundredweight of cheap slack per ton of cement instead of 7 hundred weight of coke; (3) complete combustion of all fuel, the steam injected being decomposed by the red-hot cinders, and producing carbonic oxide and hydrogen; (4) the cement is kept entirely free from fuel ash.

"In addition the revolver gives us the following advantages:

"(1) Economy of space, two revolvers with their appurtenances, and one in reserve covering 900 square feet, turning out the same weight of cement as eleven kilns covering 4,400 square feet;

"(2) Continuous working day and night;

"(3) Economy of repairs which are simple and cheap;

"(4) Less frequent need of repairs, as the continuous heat involves no racking like the alternate heating and cooling;

"(5) Economy in first cost;

"(6) Economy in grinding, a granular sand being produced instead of lumps of clinker, whereby crushers are quite abolished, and the wear and tear of the millstones greatly reduced;

"(7) Economy of hand labor. Revolver cement can be handled on the American elevator system;

"(8) Improved quality from (*a*) non-mixture with fuel ash; (*b*) neither over burning nor under burning;

"(9) Increased control over the quality of cement, it being possible to stop, increase, or diminish the flow of crushed slurry and to vary its quality at any time;

(10) Fewer losses by accident. The ordinary kiln once charged and fired must burn out, whether charged wrongly or rightly, while, as before stated, any error in material can be rectified in a revolver as soon as discovered.

"(11) Perfect control of temperature;

"And, lastly, power of varying the temperature according to the nature of the material.

"In addition to the method of burning just described, Mr. Ransome has introduced another improvement, which, however, is available only in certain districts. This is the introduction of a new material in cement-making in the form of blast-furnace slag."

Mr. Ransome's experimental furnace is at Grays, Essex, England.

A new cement, known by the name "Cement de Paris," has been introduced in France, the inventor and manufacturer of which is M. Vallin, the director of a French cement works, the Gypsine de la Gare. M. Vallin, instead of crushing the material after burning, does so before placing it in the kiln. A crushing mill breaks it into small pieces, which are automatically conveyed to a vertical-cylinder mill, whence they issue ground to powder. This is in turn again automatically placed on sieves, which sift it into pans or kilns heated by gas. A series of inclined plates, having a gyrating motion, agitate the powder in each of the pans, and thus render every particle of it amenable to the action of heat. Finally a mechanical arrangement conveys it to sacks, which a man fills as the powder arrives. The whole operation is thus continuous and automatic, which of itself is a great advantage. But still more important is the fact that all the particles of the cement are thoroughly burnt.

Rocky Mountain division.—Hydraulic cement of fair quality is made in Denver, Colorado, from materials obtained in the Great Hog Back, near Morrison. The Denver company sells all its product to the Denver and Rio Grande and Denver, Texas and Gulf railways where its use is perfectly satisfactory.

The capacity of the works was enlarged during 1886, and the sale of the cement will be extended as much as possible. Cement has also been manufactured to a small extent at Cañon City.

Pacific coast.—No cement was made in 1886 in the Pacific coast division, the small production in California having ceased altogether. The imports at San Francisco for the year were 159,000 barrels, having been the largest in the history of the trade. The consumption of this article on the Pacific coast, confined mostly to the city of San Francisco and vicinity, has largely increased of late, owing to the construction there of numerous cable railroads. Prices in San Francisco at the beginning of 1887 ruled as follows:

Prices of cement in San Francisco January 1, 1887.

	Per barrel.
Rosendale	$2.00 to $2.25
Portland	3.00 to 3.75
Dyckerhoff Portland	3.60
German	3.25

The imports of cement at San Francisco have been as follows:

Imports of cement at San Francisco.

Years.	Barrels.	Years.	Barrels.
1864	13,322	1876	66,988
1865	26,270	1877	45,469
1866	34,360	1878	57,258
1867	31,666	1879	15,668
1868	31,954	1880	62,417
1869	54,697	1881	65,695
1870	42,377	1882	99,208
1871	32,602	1883	151,807
1872	54,746	1884	152,500
1873	61,911	1885	167,000
1874	79,435	1886	159,000
1875	73,814		

New developments.—Most of the well-established cement works have been preparing for an increased output during the present year by enlarging to a greater or less extent their facilities for production. New works have been established at Erin, Tennessee, for the manufacture of natural rock cement, and at Birmingham, Alabama, $100,000 have been invested in a project for the manufacture of cement from blast-furnace slag.

LIME.

The production of lime in the United States during 1886 is estimated at 42,500,000 barrels, valued at $21,250,000.

For comparison with the production of previous years the following table is presented:

Estimated production of lime in the United States from 1882 to 1886.

Years.	Barrels of 200 pounds.	Average value at kiln.	Total value.
1882	31,000,000	$0.70	$21,700,000
1883	32,000,000	.60	19,200,000
1884	37,000,000	.50	18,500,000
1885	40,000,000	.50	20,000,000
1886	42,500,000	.50	21,250,000

The *Record and Guide* states that "according to estimates made by some of the principal receivers, the arrivals of Rockland lime at New York were, in round numbers, about 900,000 barrels in 1886, against 800,000 barrels in 1885 and 700,000 barrels in 1884. The imports from St. John, New Brunswick, were in 1886 about 40,000 barrels, against 15,500 barrels in 1885, showing quite an important increase."

Comparative prices per barrel of eastern lime at New York on January 1, 1878 to 1887.

Years.	Common.	Fine.	Years.	Common.	Fine.
1878	$0.80	$1.00	1883	$1.10	$1.40
1879	.80	.90	1884	1.00	1.20
1880	.85	1.00	1885	1.00	1.20
1881	.90	1.00	1886	1.00	1.20
1882	1.25	1.40	1887	1.00	1.20

Particularly in the last few years the attention of architects and builders has been turning more and more to the use of cement instead of lime mortar in the erection of high buildings as well as of buildings of the better class generally. Although of course the amount of lime mortar thus displaced by cement is very insignificant at the present time, and although it may be many years before a perceptible inroad upon the consumption of lime mortar may be expected, still it is interesting to note a tendency, however slight, toward such a change, which, in so far as the quality of buildings is concerned, would be a great improvement.

In the States and Territories west of the Rocky mountains lime sufficient for the demand continues to be made. The quantity of lime burned in California last year amounted to 230,000 barrels, the receipt

at San Francisco being 152,006 barrels. Receipts for the past ten years in this city have been as follows:

Receipts of lime in San Francisco from 1877 to 1886.

Years.	Barrels.	Years.	Barrels.
1877	155,113	1882	133,309
1878	144,072	1883	158,036
1879	104,405	1884	150,526
1880	133,007	1885	154,375
1881	123,779	1886	152,006

The price of lime in San Francisco at the beginning of 1887 ranged from $1.50 to $1.75 per barrel.

Lime imported and entered for consumption in the United States.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1869		$10,800	1878		$14,344
1870		9,063	1879		13,196
1871		11,315	1880		15,852
1872		11,014	1881		24,968
1873		8,260	1882	73,093	36,879
1874		10,964	1883	76,889	41,224
1875		7,328	1884	53,505	26,370
1876		7,367	1885	54,676	28,270
1877		12,823	1886	82,855	41,307

Lime and cement of domestic production exported from the United States, 1864 to 1886.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1864		$86,386	1878	82,507	$98,334
1865		94,606	1879	60,657	74,097
1870	31,175	61,490	1880	41,989	52,584
1871	21,575	51,585	1881	57,555	83,598
1872	39,686	69,218	1882	67,030	100,169
1873	27,873	52,848	1883	74,687	120,156
1874	41,349	69,080	1884	65,768	108,437
1875	64,087	98,630	1885	79,627	127,523
1876	53,827	77,568	1886	81,465	123,103
1877	78,341	97,923			

BRICK.

Production.—The year 1886 has been an active one for the brick industry generally. The total production of bricks in the United States for 1886 is estimated at 5,135,000,000, valued at $27,500,000—*i. e.*, an increase of 12 per cent. in number and 10 per cent. in value over 1885.

The increase in production was most marked towards the close of the season and was due not only to greater activity on the part of brick yards in existence prior to 1886, but also, and to no inconsiderable extent, to the product of yards newly established within the year. These

additions to old facilities were most numerous in the west and south, and in the latter section especially much greater advances may be confidently expected during the year 1887.

The use of machinery for brick manufacture is extending quite rapidly and from all indications will increase markedly more in 1887 than it has done in 1886.

Strong competition in brick manufacture and an increasing tendency on the part of consumers to investigate, test, and compare the various products in general use act as keen stimuli to manufacturers in putting forth their best efforts to maintain and to improve if possible the quality of the articles put upon the market. It is gratifying for those interested in this industry to note the progress made not only in the improvement of processes of manufacture, but in the increased knowledge of crude materials which is rapidly being gained, and in the care taken in selecting and handling these materials so as to secure the best results.

The use of ornamental brick and tile is generally on the increase, but in a few building centers there is a tendency toward the substitution of carved work in stone for a free use of manufactured clay products. The latter statement applies of course only to the finest edifices in the erection of which expense is not a controlling factor.

The percentage increase in the production of pressed brick is about the same as that of common brick, and the production for 1886 is estimated at 258,000,000. The sources for the best products remain as heretofore reported, but in a number of localities south and west there are indications that the production of pressed brick of very fair quality may be expected during 1887.

Philadelphia and Trenton pressed brick are sold all over the country and their popularity seems to be markedly on the increase. The products of Baltimore and Washington are extensively used in the principal cities of the east; their great hardness and beautiful cherry-red color securing for them an unfailing demand at prices so high as to admit of their use only in the finest buildings.

For the finest grades of ornamental or molded and enameled brick, Ohio is in the lead, the principal center of production being, as heretofore, Zanesville. At this point a great variety of forms of molded brick, some of them quite intricate, are produced and shipped to all parts of the country west of Pittsburgh. Enameled brick of various shades are produced and their general use is extending rapidly. A new yard for the manufacture of red pressed brick was established in Zanesville during the year, and the production for 1887 is expected to be double that of 1886.

The following information in regard to the production of a number of brick manufacturing localities, while quite incomplete, may nevertheless be found of interest inasmuch as it gives some idea of the brick industry in 1886, as compared with 1885, besides indicating to some extent what may be expected for the current year.

Résumé of brick production in 1886.

	Estimated production during 1886.	Increase over 1885.
		Per cent.
New York	962,000,000	13
According to the *Record and Guide* the production of brick at points from which the New York market draws its supply was 962,000,000. The area included in this estimate covered the Hudson River district, Long Island, Staten Island, and New Jersey, including Hackensack.		
Galveston, Texas	8,000,000	.....
New Orleans	25,000,000	.....
The production in this city in 1886 did not exceed that of 1885 by any considerable amount, but the outlook for 1887 is unquestionably encouraging.		
Columbus, Georgia	5,000,000	
The brick produced in this city are used locally to the extent of about two-thirds of the entire amount, the balance being shipped to various points. The production was very little in advance of 1885.		
Macon, Georgia	20,000,000	.....
The production of this city is chiefly shipped to Florida.		
Atlanta, Georgia	40,000,000	.....
About two-thirds of the entire production is used in Georgia, the balance being shipped to Florida chiefly, but also to a less degree to Alabama and Tennessee.		
Birmingham, Alabama	10,000,000	.....
The production of brick in this city largely exceeded that of 1885, having been estimated by some authorities as double the amount produced in the previous year. Preparations for a still larger output during 1887 were active during the latter part of 1886.		
Montgomery, Alabama	11,500,000	.....
A fair proportion of this product was shipped to Florida. One new yard was established during the year.		
Selma, Alabama	2,500,000	50
Lexington, Kentucky	5,500,000	10
Chicago, Illinois	400,000,000	11
During 1886, 9 new yards were established and the outlook for 1887 is most encouraging.		
Urbana, Illinois	3,000,000	12.5
In addition to the brick produced during 1886 must be added 10,000,000 tiles.		
Joliet, Illinois	3,000,000	.....
2,500,000 tiles were also produced during 1886.		
Vincennes, Indiana	4,000,000	.....
150,000 tiles were also produced.		
Aurora, Indiana	8,500,000	.....
The brick produced here are used chiefly in Cincinnati.		
Elkhart, Indiana	4,000,000	.....
The product here is for the most part locally used.		
Cincinnati, Ohio	90,000,000	.....
The strikes which occurred during the year are said to have seriously curtailed the output for the year. Two new yards were established.		
Zanesville, Ohio	12,000,000	.....
A variety of brick is manufactured here, including common brick as well as the very fine pressed ornamental and enameled brick, discussed in another place in this report. One new yard for the manufacture of red pressed brick was established during the year, and the output for 1887 will be much larger.		
Omaha, Nebraska	75,000,000	33
The brick industry has been very active during 1886, and a large business is anticipated for 1887. The brick is used locally. Three new yards were started during 1886.		
Lincoln, Nebraska	10,000,000	33
The product is used locally.		
Menominee, Wisconsin	15,000,000	100
The manufacture of brick has been in a flourishing condition during the year, the amount produced being about double that of 1885. Three new yards were established during the year. The principal markets are Saint Paul and Minneapolis, and in these cities the demand for Menominee pressed brick is decidedly increasing.		
Milwaukee, Wisconsin	35,000,000	.....

Firebrick.—The demand for firebrick during 1886 has been generally better than during 1885. To meet this increased demand many of the larger producing establishments have been obliged to force old facilities and in some cases to enlarge them. Furthermore a considerable number of entirely new plants has been erected.

The activity in the erection of iron furnaces at a number of places in the South is doubtless one of the causes for the increase in demand for firebrick, and this cause will probably be felt more in 1887 than it has been during the past year.

Estimated production of firebrick for 1883, 1884, 1885, *and* 1886.

	1883.	1884.	1885.	1886.
Ohio	23,000,000	25,000,000	25,000,000	25,000,000
Pennsylvania	55,000,000	50,000,000	50,000,000	52,000,000
New Jersey	21,000,000	20,000,000	20,000,000	22,000,000
Scattering	7,000,000	8,000,000	10,000,000	11,000,000
Total	106,000,000	103,000,000	105,000,000	110,000,000

Production of fireclay in Ohio in 1886.

Counties.	Number of weeks worked.	Number of miners.	Number employed in manufacture.	Production—short tons.
Columbiana	40	51	499	56,233
Hocking	40	7	50	13,802
Jackson	47	20	92	12,218
Jefferson	49	60	469	115,024
Lawrence	46	20	76	17,150
Muskingum	.....	3	.....	751
Mahoning	27	1	4	600
Stark	29	8	12	17,250
Scioto	35	19	132	23,075
Tuscarawas	37	33	98	10,666
Totals and average	39	222	1,432	266,769

The increase in importations in 1886 was not so great as in 1885. The imports for the years in question are as follows: In 1884, 1,524,000 bricks; in 1885, 3,401,449; in 1886, 3,463,002.

The following table shows the relative prices of fire-brick in New York on January 1 for the past four years, including January 1, 1887:

Prices of firebrick in the New York market per thousand.

Kinds.	1884.	1885.	1886.	1887.
Welsh	$30.00 to $35.00	$25.00 to $50.00	$24.50 to $30.00	$21.50 to $24.00
English	25.00 30.00	25.00 30.00	22.00 30.00	22.00 24.00
American No. 1	33.00 35.00	30.00 35.00	30.00 35.00	30.00 31.00
American No. 2	25.00 30.00	25.00 30.00	25.00 30.00	23.00 28.00

A general falling away in price has evidently taken place since 1884 and during the past year manufacturers have had to accept a small margin of profit.

New discoveries of fireclay.—There is at present no great incentive toward activity in the discovery of new deposits of fireclay, as the beds now extensively worked are in most cases ample to supply the demand, and numerous deposits not worked are known to exist. How-

ever, the following account of a bed discovered at Socorro, New Mexico, is interesting on account of its situation and the ease with which the clay, which is of very fine quality, is taken out.

This deposit is about 5 miles east of Socorro. A road of easy down grade leads from the bed to the town and also to the main line of the Atchison, Topeka and Santa Fé railroad.

The deposit is in the form of a uniform vein from 7 to 15 feet in thickness inclosed between walls of hard siliceous rock in places. It crops out in section for about 1,000 feet of surface. Its main inclination, as exhibited by a sectional view of the outcrop from the highest to the lowest point of the same on the surface of the ground, consists of about 1 foot in 20. It is now being developed by a tunnel starting from the lowest point on the vein and running on an up grade into the hill. The product is run out onto the dump by gravity, requiring therefore no hoisting power. Direct entry can be made into the body of the vein at any or all points along the outcrop. The vein could hardly have been formed by nature more advantageously for economical development and mining. The clay is semi-plastic, refractory, and very similar to the celebrated Stourbridge clay of England. It contains no free silica, and is remarkably free from the impurities usually found in the purest and best fireclays. Aside from a small percentage of organic matter and moisture, it is virtually pure silicate of alumina. It is claimed to be good compared to other American fireclays for extreme refractoriness to the action of the metals and their oxides under high temperatures.

When first mined it is soft, waxy, and of a black color, but after weathering a few days it becomes bluish gray in color and can then be reduced to an impalpable powder readily and cheaply in almost any grinding mill, and as it contains nothing of a gritty character it effects little or no wear of the grinding parts.

Colorado.—During the year 1886 the manufacture and sale of fireclay and its products did not very materially increase. The clay produced near Denver is of the most satisfactory character, and is generally used in preference to foreign manufactures. As stated in previous volumes of this series, the clay is mined near Golden, 14 miles west of Denver. The quantity is practically inexhaustible, and as it is as good, if not better, than any clay found elsewhere in the Rocky mountains, there is little prospect of opening other beds.

The principal manufacturers of fireclay products are the Denver Fireclay Company and the Denver Firebrick Company. These companies report the following production in 1886:

Production of fireclay in Denver, Colorado, in 1886.

	Quantity.
Denver Fireclay Company:	*Short tons.*
Total tonnage	2,600
Firebrick	1,950
Ground clay	520
Assay and furnace goods	130
Denver Firebrick Company	*Pounds.*
Firebrick	837,000
Tiles	1,386,000
Retorts (number, 85)	160,000
Muffles	1,185
Glass-house pots, 30	30,000
	Short tons.
Ground clay	540
Calcined firebrick	160
Total tons of clay mined	3,685
Plastic clay mined	473

The amount of fireclay mined from 1880 to 1885 was about as follows:

Fireclay used by the Colorado works.

Works.	Location.	1880.	1881.	1882.	1883.	1884.	1885.
		Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Cambria Brick and Tile Company	Golden	.....	2,000	3,000	3,000	500	.....
G. A. Duncan and Company	do	4,000	6,000	9,000	10,000	12,000	15,000
Golden Brick and Coal Company	do	5,000	4,500	950	750	1,200	800
Denver Fireclay Company	Denver	1,200	1,200	1,500	1,200	3,200	4,500
Denver Firebrick Company	do	.....	.....	4,000	1,600	.....	.....
Total		10,200	13,700	18,450	16,550	16,900	20,300

Fireclay of good quality is found between the Dakota sandstone and the rocks of the Jurassic period. No works have been established to utilize it in manufacture, although it has been thoroughly tested and found first class.

Pottery.—The representatives of the pottery industry in the United States have been steadily gaining ground in their active competition with foreign producers; this statement is made not only with reference to the plainer wares, but also to the fine decorated articles of England and the French or German china.

The following is a statement of the imports of earthenware and china entered for consumption in the United States during the fiscal year ending June 30, 1886:

Value of imports of earthenware and china in the fiscal year 1886.

Brown earthen and common stone ware	$39,154
China and porcelain not decorated	807,645
China and porcelain decorated	2,967,058
Other earthen stone or crockery, glazed, etc	1,024,235
Total	4,838,092

From the above table it is evident that the total value of the staple white goods imported is $1,024,235; for the same period the value of

the same class of goods manufactured in this country was, in round numbers, $5,000,000; the value of the decorated ware produced amounted to $3,000,000.

A comparison of the figures for production in this country with those representing total consumption shows that about 80 per cent. of the total consumption of staple white goods is supplied by the American producers, while a little more than 40 per cent. of the total consumption of china and porcelain, decorated and not decorated, is the result of home production.

The following table gives the imports of pottery products since 1880:

Earthenware and china imported and entered for consumption in the United States, 1880 to 1886 inclusive.

Fiscal years ending June 30—	Brown earthen and common stone-ware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen stone, or crockery, glazed, etc.	Total.
1880	$31,504	$334,371	$1,188,847	$3,945,666	$5,500,388
1881	27,586	321,259	1,621,112	4,413,369	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	8,686,061
1884	50,172	982,499	2,664,231	666,595	4,363,497
1885	44,701	823,334	2,834,718	963,422	4,666,175
1886	39,154	807,645	2,967,058	1,024,235	4,838,092

An examination of this table shows that while the figures for china and porcelain, decorated and not decorated, have decidedly increased since 1880, the figures for "other earthen stone," etc., *i. e.*, staple white goods, show a falling off since that time, the decline being most marked in 1884. In other words, the bulk of the ware imported up to 1880 consisted of plain goods, while at the present time about three-fourths of the imports are French or German china and English decorated ware.

These facts indicate not only an advance on the part of the American producers, but also markedly improved taste on the part of consumers in the United States. This disposition to use the finer grades of pottery ware dates back to 1876, and is believed to be a result of the Centennial Exposition. English manufacturers, discovering that there was little profit in competition with American potters in the production of plain white ware for consumption in the United States, made special efforts to create a demand for the various grades of fine decorated pottery. The American producers are now endeavoring to keep pace with the new departure, and their efforts are becoming more and more successful.

No serious labor troubles in the pottery industry have occurred during the year, and workmen have been kept in most instances fully employed, producing an output probably exceeding that of average years.

In improvements of machinery, a little has been done during the year, but it has not been one of marked advances in this branch of the industry.

Kaolin.—The amount of kaolin produced in the United States during 1886 was 23,900 long tons, valued, after washing at the mines, at an average of $14 per ton, or in all $334,600. Crude kaolin, as it occurs in the natural deposits, is a mixture, consisting chiefly of quartz sand and china clay or pure kaolin. The latter is separated by washing. There is no demand for the crude mixture above described.

During the fiscal year ending June 30, 1886, the amount of kaolin imported was 14,183 tons, a gain of 3,557 tons over 1885.

New discoveries.—At Lima, Delaware county, Pennsylvania, a bed of kaolin was discovered in October, 1886. The deposit is reached after removing about 10 feet of material above it, and extends, according to examinations thus far made, to a depth greater than 31 feet from the surface of the ground; the exact depth is not known. The investigations of this deposit which have been made are not sufficient to justify any definite statements as to quality or extent, but during the summer of 1887 thorough tests are to be made.

About 1½ miles south of Bodie, California, there is a bed of what is called kaolin, but whether it is sufficiently pure for pottery use, tests thus far made do not show. The deposit was discovered in 1884, but nothing was done towards testing or utilizing it until 1886, and even as yet the tests made are insufficient to admit of any very promising statements in regard to it, although it would probably well repay thorough investigation.

At Leakey, Edwards county, Texas, a company was formed for the development of kaolin deposits in that region.

The Allen kaolin mines at Valley Head, Alabama, were recently sold to a new company, which proposes to erect a mill for washing the product. The exact character of the clay at this point has not been reported.

"*Porous earthenwares.*"—The products included under the name porous earthenwares are severally as follows: Terra cotta lumber, brick wood, cellular pottery, and holtzstein.

They are the products obtained by mixing with water, pressing, drying, and firing different combinations of earthy matters with vegetable materials. The nature of the ingredients used and the methods of treating their mixture secure products of exceedingly porous character, and which possess in general the properties of both brick and wood.

Terra cotta lumber was the first in order of discovery, and is manufactured by mixing together fictile clays with resinous sawdust, and ultimately burning the mixture. The resulting product is susceptible of treatment with carpenters' tools, and may be sawed, planed, and nailed with facility.

The expense connected with firing such refractory clays as those used in terra cotta lumber is quite considerable, and, moreover, they are not sufficiently widely distributed for extensive use. These facts led to further experiment and investigation for a cheaper material, and one that

is as widely distributed as possible. The product "brick-wood" resulting from these experiments is made from surface clays, with or without grit, mixed homogenously with sawdust of any kind, and fired in the up-draft kiln of the brickmaker. The expensive heavy-power grinding mills and costly down-draft kilns, necessary to the working of fictile clays, are done away with in this product. It was found that the vegetable matters contained in the dried, pressed material were adequate as a fuel, after ignition, to bake the clay residue. This product was put upon the market in Saint Paul in 1884.

The substitution for sawdust of straw or hay, cut into short lengths, gave rise to a third product, known as "cellular pottery." It is claimed that in this material the lengths of straw used arrange themselves parallel with each other, and in the direction of motion of the plastic mass through the dies while under the action of the press. The effect of this arrangement of the straw was to produce a fibrous character in the manufactured article, and to render possible the production of pieces in the shape of slabs, joists, and scantlings 10 or 12 feet in length.

The fourth product, "holtzstein," is the result of bringing together, with proper subsequent treatment and firing, clay, sawdust, and cut straw; and therefore it includes within itself the materials and the properties of "brick-wood" and "cellular pottery."

The valuable properties and the advantages claimed for porous earthenwares are their incombustibility, their non-conducting power as regards heat and sound, resistance to chemical agencies and indifference to sudden changes of temperature, light weight with ample strength, susceptibility to the action of edged tools, etc.

Factories for the manufacture of these materials are in operation in several cities and their number is increasing. Reports from some of these individual factories indicate marked demand for these products chiefly as fireproofing material in large buildings. One report showed an increase of the original manufacturing plant, to three times the capacity at first provided for.

The use of these materials in dwelling houses is at present very slight indeed, and comparatively little is known of them by architects whose practice consists mainly of residence construction. Most architects who have any knowledge of "porous earthenwares" speak favorably of them, and predict an extensive use for them in buildings of all kinds.

Roofing tiles.—The use of tiles for roofing purposes is not very extensive, and while many architects denounce them strongly as being unsatisfactory, many others are favorable to their use, if very carefully and skillfully applied to roofs, which must be abundantly strong enough to sustain their considerable weight. The proper use of tile in roofing involves, therefore, a number of items of expense, in addition to the cost of the material itself, which do not so necessarily present themselves with other roofing materials.

In quite a number of cities where tiles have been tried for roofing the climate has been found too severe to admit of their successful use,

but their expense and the skill and care required in applying them are probably the causes which are most powerful in restricting demands, and the consequent production, which for 1886 has probably been little greater than for 1885.

The value of the roofing and paving tiles imported during 1885 was $99,258; for 1886, $80,420; *i. e.*, a decline of $18,838. Unfortunately no distinction between roofing and paving tiles is made in the valuation.

Terra cotta.—The production of terra cotta is increasing, both on account of increase in consumption in cities where its use is comparatively old and well established, and because of a rapidly increasing area in which it is comparatively new but is rapidly gaining in popularity. In the West, particularly, many new establishments have been erected during 1886, and still greater activity in the industry may be expected during 1887 At a number of cities in the South, particularly in Alabama and Tennessee, new establishments were either actually started during 1886 or were contemplated for the early part of 1887. Clay products generally in the South are receiving much more attention at present than has been devoted to them for thirty years past.

Drain tile.—Increase in the production of drain tile in a number of the Western States, particularly Ohio, Indiana, Illinois, and Michigan, is steady and quite rapid. During the past year a considerable number of new factories has been added to those already existing, and, moreover, the tendency to establish yards intended to supply strictly local demands extending over small areas is increasing. Manufacturers are now sending out perfected brick and tile machines, with directions and instructions for use so explicit and definite, that persons previously unskilled in such manufacture may in a comparatively short time become able to produce articles good enough to answer their own purposes and those of their neighbors. As was remarked in the last report, it happens that in many regions requiring drain tile the clay suitable for its manufacture is also found, and this fact, of course, explains the tendency to manufacture for local use only. In some single counties in the States above mentioned there are as many as twenty tile factories, most of them engaged in supplying local demand. The increase in value of lands supplied with a good system of underground drainage in the States mentioned is such, that property owners can ill afford to ignore such improvements when they are at all called for.

Production of drain tile in Indiana.

Years.	Number of establishments.	Capital employed.	Value of product.	Hands employed.
1879	297	$456,489	$623,720	948
1880 (a)	486	700,000	900,000	2,187
1882	261	491,130	764,345	1,086
1883	387	759,562	1,133,515	1,517
1884	513	958,920	1,659,820	1,880

a Estimated; evidently too high.

Sewer pipe.—The annual product of Ohio has been valued at $3,000,000, that of New York at $1,500,000, while the product of New Jersey amounts to about $400,000. It is probable that the value of sewer pipe produced in 1886 is not far from $5,000,000, although this estimate must be regarded as only approximative, owing to a lack of returns full enough to justify a positive and definite statement.

IMPORTS AND EXPORTS.

As will be seen from the following tables, there is a considerable importation of clay and its products, especially china, porcelain, etc., and a small export trade:

Clay imported and entered for consumption in the United States, 1867 *to* 1883 *inclusive.*

Fiscal years ending June 30—	Fuller's earth.		Kaolin.		Unwrought pipeclay and fireclay.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		*Long tons.*		
1867	280.25	$3,113	.....	.....	6,383.75	$72,204	$75,317
1868	211.00	2,522	.....	.....	8,384.75	66,958	69,480
1869	324.10	3,587	.....	.....	12,963.75	84,645	88,232
1870	239.10	2,619	.....	.....	8,014.15	76,057	78,676
1871	290.20	3,383	.....	.....	10,900.48	103,144	106,527
1872	274.00	3,358	.....	.....	13,081.20	128,130	131,488
1873	251.18	2,978	1,378.39	$13,091	12,883.82	141,927	157,996
1874	277.20	3,440	89.21	1,378	12,909.14	147,782	152,600
1875	300.06	3,694	130.47	1,977	10,374.65	116,307	121,978
1876	246.73	3,007	142.00	2,152	11,799.12	126,738	131,987
1877	400.00	4,460	204.26	3,109	11,680.14	129,016	136,485
1878	335.07	4,095	3,499.30	38,899	9,406.74	95,877	138,871
1879	361.21	4,269	4,774.60	45,272	8,477.80	87,948	137,489
1880	578.00	6,925	7,823.66	67,740	11,896.80	117,350	192,015
1881	267.55	3,207	6,887.37	66,654	12,444.28	123,545	193,406
1882	908.27	11,444	13,954.85	135,448	12,181.39	119,620	266,512
1883	1,241.27	14,309	12,870.60	115,492	7,841.32	74,673	204,474

Classified imports of clay during the fiscal years 1884, 1885, *and* 1886.

Kinds.	1884.		1885.		1886.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	16,112	$131,063	10,626	$83,722	14,183	$110,452
All other:						
Unwrought	11,021	85,990	9,736	76,899	11,807	89,626
Wrought	2,149	16,158	3,554	29,839	3,908	34,129
Total	29,282	233,211	23,916	190,460	29,898	234,207

Building brick imported and entered for consumption in the United States, 1868 *to* 1886.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
1868	.....	$44,453	1878	25,170	$166
1869	.....	59,359	1879	918,840	4,534
1870	.....	46,892	1880	349,000	1,662
1871	.....	52,997	1881	539,600	3,002
1872	.....	5,275	1882	711,150	9,168
1873	993,500	6,982	1883	764,700	7,958
1874	594,330	4,929	1884 (a)	531,820	9,985
1875	495,500	3,278	1885	1,220,000	12,905
1876	411,530	3,147	1886	6,219,441	10,461
1877	129,970	897			

a Classed as "brick other than firebrick."

Bathbrick and firebrick imported and entered for consumption in the United States, 1868 to 1886 inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1868	$8,763	1878	$36,670
1869	86	1879	44,681
1870	19,112	1880	60,589
1871	18,215	1881	82,581
1872	47,502	1882	69,575
1873	60,442	1883	124,948
1874	66,428	1884	(a)103,309
1875	50,325	1885	35,616
1876	62,063	1886	43,371
1877	43,548		

a Firebrick only, since 1883.

Firebrick imported since 1877.

Fiscal years ending June 30—	Imports.	Fiscal years ending June 30—	Imports.
	Number.		*Number.*
1877	303,870	1882	2,831,033
1878	244,614	1883	1,250,135
1879	690,954	1884	1,524,000
1880	1,504,462	1885	3,401,449
1881	1,968,230	1886	3,463,002

Earthenware and china imported and entered for consumption in the United States, 1867 to 1886 inclusive.

Fiscal years ending June 30—	Brown earthen and common stone ware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen, stone, or crockery, glazed, etc.	Total.
1867	$48,618	$418,493	$439,824	$4,280,924	$5,187,859
1868	47,208	309,960	403,555	3,244,989	4,005,712
1869	34,260	400,894	555,425	3,468,970	4,459,549
1870	47,457	420,442	530,805	3,461,524	4,460,228
1871	96,695	391,374	571,032	3,573,254	4,632,355
1872	127,346	470,749	814,134	3,896,664	5,308,893
1873	115,253	479,617	867,206	4,289,868	5,751,944
1874	70,544	397,730	676,656	3,686,794	4,831,724
1875	68,501	436,883	654,965	3,280,867	4,441,216
1876	36,744	409,539	718,156	2,948,517	4,112,956
1877	30,403	326,956	668,514	2,746,186	3,772,059
1878	18,714	289,133	657,485	3,031,393	3,996,725
1879	19,868	296,591	813,850	2,914,567	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	8,686,061
1884	50,172	982,499	2,664,231	666,595	4,363,497
1885	44,701	823,334	2,834,718	963,422	4,666,175
1886	39,154	807,645	2,967,058	1,024,235	4,838,092

Value of tiles imported for consumption in the United States, 1868 to 1886 inclusive.

Fiscal years ending June 30—	Encaustic.	Roofing and paving.	Total.
1868	$11,422	.....	$11,423
1869	7,599	$1,443	9,042
1870	8,549	875	9,424
1871	4,771	884	5,655
1872	8,083	31,453	39,536
1873	18,717	51,772	70,489
1874	14,193	51,010	65,203
1875	15,401	45,360	60,761
1876	15,267	29,903	45,170
1877	16,787	42,143	58,930
1878	13,112	41,032	54,144
1879	17,355	31,177	48,532
1880	16,896	34,063	50,959
1881	21,106	43,717	64,823
1882	27,729	46,562	74,291
1883	16,459	83,777	100,236
1884	16,011	115,770	131,781
1885	10,312	99,258	109,570
1886	7,719	80,420	88,139

Value of clay exported from the United States, 1865 to 1886 inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1865	$29,975	1878	$8,384
1869	5,065	1879	6,314
1870	2,354	1880	8,355
1871	10,904	1881	8,762
1872	5,275	1882	17,458
1873	4,970	1883	17,790
1874	8,146	1884	7,725
1875	13,933	1885	8,225
1876	4,325	1886	9,978
1877	5,493		

Value of brick, etc., of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Brick and lime.	Brick, lime, and cement.	Firebrick and firetile.	Brick, other than fire.	Total.
1826	$6,075	.....	.....	.....	$6,075
1827	3,365	.....	.....	.....	3,365
1828	4,573	.....	.....	.....	4,573
1829	3,717	.....	.....	.....	3,717
1830	2,482	.....	.....	.....	2,482
1831	4,412	.....	.....	.....	4,412
1832	3,502	.....	.....	.....	3,502
1833	3,866	.....	.....	.....	3,866
1834	4,294	.....	.....	.....	4,294
1835	4,133	.....	.....	.....	4,133
1836	6,829	.....	.....	.....	6,829
1837	29,626	.....	.....	.....	29,626
1838	31,322	.....	.....	.....	31,322
1839	16,298	.....	.....	.....	16,298
1840	16,949	.....	.....	.....	16,949
1841	14,064	.....	.....	.....	14,064
1842	5,728	.....	.....	.....	5,728
1843 (nine months)	3,883	.....	.....	.....	3,883
1844	12,833	.....	.....	.....	12,833
1845	8,701	.....	.....	.....	8,701
1846	12,578	.....	.....	.....	12,578
1847	17,623	.....	.....	.....	17,623
1848	24,174	.....	.....	.....	24,174
1849	8,671	.....	.....	.....	8,671
1850	16,348	.....	.....	.....	16,348
1851	22,045	.....	.....	.....	22,045
1852	13,539	.....	.....	.....	13,539
1853	32,625	.....	.....	.....	32,625
1854	33,194	.....	.....	.....	33,194

Value of brick, etc., of domestic production exported from the United States—Continued.

Fiscal years ending September 30, until 1842, and June 30 since.	Brick and lime.	Brick, lime, and cement.	Firebrick and firetile.	Brick, other than fire.	Total.
1855	.....	$57,393	.....	.....	$57,393
1856	.....	64,297	.....	.....	64,297
1857	.....	68,002	.....	.....	68,002
1858	.....	103,821	.....	.....	103,821
1859	.....	160,611	.....	.....	160,611
1860	.....	154,045	.....	.....	154,045
1861	.....	93,292	.....	.....	93,292
1862	.....	83,385	.....	.....	83,385
1863	.....	99,313	.....	.....	99,313
1864	.....	49,106	.....	.....	49,106
1865	.....	64,105	.....	.....	64,105
1866	.....	146,874	.....	.....	146,874
1867	.....	102,324	.....	.....	102,324
1868	.....	140,338	.....	.....	140,338
1869	.....	83,229	.....	.....	83,229
1870	.....	.....	$4,483	$25,091	29,574
1871	.....	.....	18,471	9,279	27,750
1872	.....	.....	10,233	14,305	24,538
1873	.....	.....	14,651	10,632	25,283
1874	.....	.....	22,365	11,290	33,655
1875	.....	.....	14,476	12,120	26,596
1876	.....	.....	20,348	18,035	38,383
1877	.....	.....	9,892	25,571	35,463
1878	.....	.....	13,900	254,446	268,346
1879	.....	.....	11,096	51,714	62,810
1880	.....	.....	12,027	36,299	48,326
1881	.....	.....	12,290	27,989	40,279
1882	.....	.....	30,649	50,870	81,519
1883	.....	.....	47,120	56,227	103,347
1884	.....	.....	41,012	60,702	101,714
1885	.....	.....	31,058	41,181	72,239
1886	.....	.....	41,343	35,579	76,922

During the years given there were exported from the port of New York the following numbers of brick:

Building brick and firebrick exported from New York.

Calendar years.	Building brick.		Firebrick.	
	Number.	Value.	Number.	Value.
1877	13, 603, 475	$70, 629	45, 000	$2, 185
1878	4, 471, 980	29, 457	118, 994	3, 148
1879	1, 381, 775	9, 371	94, 976	6, 867
1880	921, 654	7, 486	80, 000	3, 208
1881	971, 500	8, 663	181, 359	8, 361
1882	778, 000	7, 026	269, 810	9, 843
1883	2, 642, 625	21, 737	358, 616	11, 029
1884	1, 702, 850	14, 148	300, 100	9, 042
1885	973, 000	8, 894	.....	12, 059
1886	977, 500	9, 075	223, 010	7, 838

Value of earthenware and stoneware of domestic manufacture exported from the United States.

Fiscal years ending September 30, until 1842, and June 30, since.	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1790	$1, 990	1845	$7, 393	1866	$31, 616
1791	1, 984	1846	6, 521	1867	29, 308
1826	1, 958	1847	4, 758	1868	29, 528
1827	6, 492	1848	8, 512	1869	19, 213
1828	5, 595	1849	10, 632	1870	42, 120
1829	5, 592	1850	15, 644	1871	37, 383
1830	2, 773	1851	23, 096	1872	48, 941
1831	7, 378	1852	18, 310	1873	53, 909
1832	6, 333	1853	53, 685	1874	59, 494
1833	12, 159	1854	33, 867	1875	92, 253
1834	12, 745	1855	32, 119	1876	73, 846
1835	16, 427	1856	66, 696	1877	87, 355
1836	13, 391	1857	34, 256	1878	98, 035
1837	14, 249	1858	36, 783	1879	80, 898
1838	12, 019	1859	47, 261	1880	106, 724
1839	11, 645	1860	65, 086	1881	123, 177
1840	10, 959	1861	40, 524	1882	180, 773
1841	6, 737	1862	32, 108	1883	227, 547
1842	7, 618	1863	88, 244	1884	236, 247
1843 (nine months)	2, 907	1864	67, 591	1885	135, 385
1844	4, 884	1865	93, 258	1886	150, 272