STRUCTURAL MATERIALS.

By H. S. SPROULL.

From a few sections of the country reports indicate some falling off in the production of structural materials, but generally there has been a gain for standard descriptions, and occasionally of very decided character. The losses appear to be due to local influences alone, having no further bearing, while the increase may be accepted as a fair reflection from the entire country. The prime factor, leading to a fuller production, was the low ruling cost of material, which presented an attraction for consumption, and led to larger investments in real estate improvements, especially in the larger cities and their suburbs. Some increase in public works and improvements has opened the outlet still wider, and promises additional expansion. Notwithstanding the considerable increase in quantity of material produced in 1885, the value only exceeded that of 1884 in a few instances, and in some cases ran rather behind, as the result of the lower values brought about by various influences, as will be explained farther on. The profits of the manufacturing interest have naturally become somewhat curtailed, yet rarely to a serious extent, and there is very universal testimony to warrant the assertion that no attempt has been made to balance the shrinkage in price by lowering the grade of the product; but, on the contrary, every reasonable effort was put forth to enhance the quality and attractions as an additional stimulant to consumption.

The absence of complete and authentic records of production is strikingly noticeable in respect to all structural material proper. In a few cases the difficulty might be overcome by a systematic and unanimous action of manufacturers, but the scattered location and crude methods of the numerous small concerns engaged in the industry precludes the possibility of giving statistics of actual results, and estimates must therefore be depended upon. No estimates have been accepted, however, until consultation and comparison of views with responsible sources of information confirmed the amounts assumed; and the following reports may be considered quite as near positive records as it is possible to obtain with the means now available. Manufacturers and producers generally, however, are becoming impressed with the value of reliable figures, and through trade organizations or co-operation with the statistical departments of the States concerned in the production, it may become possible to secure a comprehensive record.

In the preparation of this report, statistics have been quoted from the United States Bureau of Statistics; the annual reports of industrial and statistical bureaus of most of the States referred to; from responsible trade journals published in various sections of the country, and from private records of the most reliable character. Information has also been obtained through the courtesy of Mr. Thomas B. Bancroft, chief inspector of mines for the State of Ohio; Messrs. James M. Swank and L. E. Schlauch, of Pennsylvania; Mr. J. B. Speed, of Kentucky; the Buffalo Cement Company; Messrs. George W. White and Jerome A. King, of New York City. The report for the Rocky mountain division has again been furnished by Mr. F. F. Chisolm, and that for California by Mr. C. G. Yale.

BUILDING STONE.

Present status.—The value of the building stone quarried in the United States during the past four years is estimated as follows:

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

Preparatory to making the foregoing estimate for 1885, a wider expanse of territory was brought under investigation and a more thorough form of inquiry adopted than in 1884, with no better results in obtaining positive data. Indeed, the generally ambiguous and evasive replies to requests for actual figures forcibly indicated the absence of method among the majority of producers for compiling and preserving records of their output, and that in conjunction with almost insurmountable difficulties in the way of knowing and reaching all sources of supply, led to an early abandonment of the effort toward exact results by this means. Communication with numerous producers, distributors, and consumers, however, furnished valuable hints and suggestions from which an estimate corresponding with that for 1884 was fairly warranted, and $19,000,000 may be accepted as the nearest approximation to the value of the production for 1885, of which the available sources of information will admit. In adjusting the influences existing during 1885 it was found that on one side must be placed evidences of an increased output in many sections, and especially when tributary to some of the large cities of the interior; the opening up of new quarries; and the fact that a certain amount of surplus production was submitted to as a means for keeping desirable labor busy and contented. In opposition were to be found, several important localities showing a considerable decrease in consumption, and an almost universal admission of a lower value. While

the actual amount of stone quarried may have been larger than in 1884 its value was no greater, according to the best authorities.

Not even an estimate can be ventured upon regarding the proportion of the numerous varieties of stone used, and probably there was no important variation from the previous year, yet granite and some of the harder descriptions of sandstone increased slightly in favor and the brown stones have fallen somewhat further into disrepute. The latter has been most marked in connection with the coarser varieties of brown stone quarried near and used in some of the prominent seaboard cities, where the severity of the weather requires something that will show more positive and longer resistance to defacement and disintegration. An importation of Scotch stone of light color and good promise as to durability has found some favor in that connection, yet quite as desirable and probably a better quality could be obtained from our domestic quarries, especially those located on deposits of refractory sandstone and the highly siliceous limestones, etc., all calculated to develop an extreme degree of durability and maintain a uniform shade. Probably the most reliable returns obtained from the question of production were those given for bluestone. It, in common with the figures for all other stone, is an estimate only, yet the result may be accepted as approximating closely the amount actually quarried. About the entire supply is taken from deposits in the State of New York, with the city of Rochester on the western boundary line of the working field, the Hudson River on the east, and thence running down into the Lehigh and Wyoming sections of Pennsylvania, an area, in connection with a few smaller and unimportant sources of supply, producing in 1885 some 250,000 long tons with a quarry value reaching $2,000,000, quite a falling off from the product of the preceding year, as will be seen in the annexed table. The valuations are included in the general estimate of the production of building stone.

Quantity and value of bluestone quarried in the United States in 1884 *and* 1885.

Years.	Quantity.	Value.
	Long tons.	
1884	300,000	$2,500,000
1885	250,000	2,000,000

New sources of supply.—Information concerning new sources of supply is not abundant, but the condition of trade in building stone was hardly calculated to stimulate unusual effort toward development. In Virginia the quarrymen have opened up a few new beds of granite contiguous to old working ground and showing no really new qualities. Between Richmond and Lynchburg the available supplies are becoming greater, and during 1885 a very fine quarry of brownstone was opened at Midway Mills. New Hampshire and Connecticut have added some-

what to their productive capacity. The production in Pennsylvania is increasing slightly, and just at the close of the year another granite quarry was opened near French Creek Falls, Chester county. At Rockfield, Kentucky, an oölitic limestone has been further developed, showing stone of exceptionally good quality, comparing favorably with the Portland oölitic stone of England. An extensive plant has been erected and the necessary rail connections made in order to place the stone upon the market. Considerable prospecting has taken place in the western and southern States, and some valuable quarries of building stone located. In Utah attention is turning toward the fine deposits of white and black marble and brownstone, but no active measures have as yet been taken to utilize the supply, partly owing to absence of proper transportation facilities. An excellent building stone is reported in the southeastern part of Minnesota, of bright-red color, and is called "Minnesota redstone," but no detailed description has been forwarded.

Rocky mountain division.—A bed of remarkably fine marble was opened during 1885 on one of the branches of Rock creek, Gunnison county, Colorado. The marble was made the subject of a special examination by the Union Pacific Railway Company, and all tests of its quality proved in the highest degree satisfactory. There is an abundance of the marble, but it is so difficult of access that it was found impracticable to attempt the development of the district. Marble of fair quality is found on the Upper Arkansas, near Grand Junction, and at other western points, but is nowhere mined or worked.

SLATE.

Production.—Slate deposits are known to exist from Maine to Michigan and from the Saint Lawrence to the Gulf States, but actual development is confined to comparatively few localities. Maine, Vermont, and New York produce moderate quantities, and small beds of very good slate are worked in Michigan and Virginia, but the great bulk of the total product of the United States comes from the immense quarries situated in Lehigh and Northampton counties, Pennsylvania. In the latter section over three thousand men were employed in 1885, mostly of Welsh and English nativity, and the result of their labor was a liberal increase in the product. The bulk of the manufacture is in the form of roofing slate, which is distributed over the entire country, and a fair proportion finds a foreign outlet. Various sizes are made, to meet architectural designs and other requirements of the trade. They are sold in "squares." A "square" is 100 square feet, weighs 600 pounds, and covers the same area as 1,000 shingles. The cost, delivered from the quarry, ready for shipment, in 1885, was $2.50 to $3.75 per square, against $3.50 to $4 per square in 1884. The scale of wages paid at quarries, in 1885, was as follows: Splitters, 18 to 20 cents per hour; blockmakers, 15 to 18 cents per hour; laborers, 10 to 13 cents per hour.

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

[Squares of 100 square feet each.]

Sections.	1884.	1885.
Bangor and Pen Argyl region, Pennsylvania	195,505	196,832
Slatington section, Pennsylvania	104,000	108,000
Vermont	85,000	130,000
Maine	41,000	34,000
Chapman's	29,499	26,328
Peach Bottom	10,000	14,500
Virginia	9,000	17,300
Michigan	7,000	10,000
Total	481,004	536,960

Total yearly production of roofing slate from 1879 *to* 1885, *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

Towards the close of the year a fine bed of slate was discovered on Fremont island, Great Salt Lake, Utah, and after a careful examination of the quarry by experts a company was formed to develop and work it. The production will find a western market at a great saving in transportation charges, and no doubt will stimulate consumption.

Condition of the slate industry.—The slate quarrying industry of the country during the years 1884 and 1885 was, through various influences, suffering considerable depression and afforded little profit to the producer. A steady shrinkage in consumption, very active competition to secure such opportunities for the disposal of supplies as could be found, and scarcely any modification in the cost of production, were, in brief, the dominant factors under which the trade labored. There was nothing to indicate that roofing slate had lost favor, except in some of the cities, but accumulations of stock carried over from former seasons and a diminution in the erection of buildings upon which a covering of slate appeared to be an absolute necessity, placed the quarrymen at a decided disadvantage when attempting to dispose of the new output. One of the greatest checks to the demand was caused by general retrenchment in the matter of railway construction, improvement and repairs, since depots, freight sheds, engine stables, etc., during active periods of increase in railroad property, form a most liberal outlet for roofing slate. A curtailment of production was difficult to accomplish, except at the risk of still more disastrous results to the producer.

The labor employed in the quarries must be peculiarly skilled, and cannot readily be replaced, a fact that induced the policy of keeping the men at work, and forcing a sale of the product rather than of shutting down entirely, and this was carried out with no fairly compensating modification in the rate of wages. Thus, without securing much advantage on the cost of production, and being compelled to follow a small decline in the selling price during 1884, the margin of profit to the producer has been exceedingly small. Tile for roofing purposes has been used to some extent, but cannot be considered as a competitor with slate, owing to the non-absorbent qualities of the latter, and general ability to withstand the elements.

Exports.—For many years roofing slate has contributed a fair proportion to the export movement of the United States. During 1876, 1877, 1878, and partially again during 1880, Great Britain and the continent became very liberal customers, not the least remarkable feature of the trade being shown in the shipment of several cargoes direct to Welsh ports, thus practically selling at the very door of England's great base of supplies. Since 1881, however, the European demand has about all disappeared and left shippers dependent upon the custom of South America, the West Indies and Australia, the former two countries requiring small amounts, but the latter affording quite a marked outlet. Indeed, the latter trade increased very rapidly during 1885 as a result of the uncommonly low prices ruling, a large proportion of the stock having been sold and delivered on the pier alongside of vessels at $4 per square, and in some instances at 25 cents per square lower; a basis upon which it was found possible to compete with England in her own colonial market, and also to furnish a vent for the enforced surplus production of this country, to which reference has before been made. No general record of the export movement is obtainable, but probably 90 per cent. is shipped from the port of New York, and as the figures for that point were perfected under careful compilation they afford an excellent index to the foreign movement in roofing slate for a series of years.

Exports of roofing slate from the port of New York from 1876 *to* 1885, *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

Slate is not confined to its use as a roofing material by any means, but, on the contrary, is probably more universally used than any other

stone. In composition and texture it is admirably adapted to the reception of carved and molded designs, is susceptible of a high polish, and possesses great power of resistance to the principal destructive elements, besides having the additional merit of wide range of color, embracing black, dark blue, purple, purple-clouded green, gray-clouded green, light green, and a clear, bright red. The scope of consumption is rapidly expanding, and among the uses to which slate is applied the following may be enumerated: Flagging, flooring, floor tiles, molding for tiles, vestibule trimmings, slabs, etc., wainscoting, mantels, hearthstones, steps, risers, platforms, sills and lintels, turned balusters, laundry and bath tubs, sinks and wash trays, meat and water tanks, refrigerator and cooling-room shelves, cistern linings, brewers' vats, mangers, butchers' and curriers' tables, bar fixtures, billiard table beds, urinals, school slates and blackboards, countertops, vault work, grave linings and covers, and memorial tablets. Of the above no record of production or value can be obtained that would prove at all useful as a basis for estimates. Possibly a faint idea of the proportions devoted to these various uses might be obtained from the production of the Slatington section, where, besides an output of 108,000 squares of roofing slate, there were also made, in round numbers, 39,900 cases of school slates; 31,850 pieces, or 1,430 cases, or 27 carloads of flagging; 5,900 cases blackboards; 30 cases mantels and hearths, and 47 carloads of sawed and shaved slate. The export of manufactured slate has also proved a significant item for several years past, but it is generally understood that the stock handled on foreign orders was composed almost wholly of school slates, with possibly an occasional parcel of mantels and hearths. It is again necessary to rely upon the figures of the port of New York as an indication of the extent and progress of the business with foreign countries, but the annexed tables represent a very large proportion of the entire shipment of the United States.

Exports of manufactured slate from the port of New York, 1876 to 1885, 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

Exports of all kinds of slate from the port of New York, 1876 to 1885, 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

Imports and exports of building stone.—The following tables show the extent of the for 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, Broccatella, etc.	Not otherwise specified.	Total.
1867	.....	.....	.....	.....	.....	$192,514	$2,540	$51,978	$247,033
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 two fiscal years the classification has been as follows:

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

Building stone (exclusive of marble), paving stone, and stone ballast imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Building stone, dressed.	Building stone, rough.		Sandstone.	Slate chimney pieces, mantles, 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	19,602	85,364	.....	467	$3,987	.....
1870	150,619	.....	.....	3,201	19,879	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	89,519	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	1,765	485	6,272	275,042
1878	153,693	10,197	37,878	7,136	39,965	275	2,614	1,950	6,989	250,470
1879	125,493	6,845	24,531	13,956	46,260	620	1,456	2,943	2,365	217,624
1880	75,501	11,035	43,997	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	75,369	.....	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

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	1856	.....	$162,376	$162,376
1827	.....	3,505	3,505	1857	.....	111,403	111,403
1828	.....	3,122	3,122	1858	.....	138,590	138,590
1829	.....	2,647	2,647	1859	.....	112,214	112,214
1830	.....	4,655	4,655	1860	.....	176,239	176,239
1831	.....	3,588	3,588	1861	.....	185,267	185,267
1832	.....	3,455	3,455	1862	.....	195,442	195,442
1833	.....	5,087	5,087	1863	.....	138,428	138,428
1834	.....	7,359	7,359	1864	$57,715	144,647	202,362
1835	.....	8,687	8,687	1865	74,261	183,782	258,043
1836	.....	4,414	4,414	1866	89,703	112,830	202,533
1837	.....	5,374	5,374	1867	53,983	138,558	192,541
1838	.....	5,199	5,199	1868	60,399	105,046	165,445
1839	.....	7,661	7,661	1869	62,266	87,135	149,401
1840	.....	35,794	35,794	1870	42,227	138,046	180,273
1841	.....	33,546	33,546	1871	133,672	137,613	273,285
1842	.....	18,921	18,921	1872	156,976	165,311	322,287
1843 (nine months)	.....	8,545	8,545	1873	96,735	189,795	286,530
1844	.....	19,135	19,135	1874	126,669	168,977	295,646
1845	.....	17,626	17,626	1875	125,968	254,356	380,324
1846	.....	14,234	14,234	1876	95,480	236,255	331,735
1847	.....	11,220	11,220	1877	131,716	917,937	1,049,653
1848	.....	22,466	22,466	1878	142,661	597,356	740,017
1849	.....	20,282	20,282	1879	143,457	430,848	574,305
1850	.....	34,510	34,510	1880	199,051	453,912	652,963
1851	.....	41,449	41,449	1881	220,302	409,433	629,795
1852	.....	57,240	57,240	1882	180,774	433,656	614,430
1853	.....	47,628	47,628	1883	152,182	389,371	541,553
1854	.....	88,327	88,327	1884	188,245	415,015	603,260
1855	.....	168,546	168,546	1885	182,719	(a)330,786	513,505

a Includes roofing slate.

Marble and stone, and manufactures of marble and stone, of foreign production exported from the United States, 1872 to 1885, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1872	$1,929	1879	$5,364
1873	4,571	1880	6,816
1874	1,928	1881	709
1875	3,428	1882	4,848
1876	13,371	1883	490
1877	8,475	1884	8,420
1878	3,448	1885	14,406

Summarizing the foregoing statistics, the movement during the fiscal years 1882, 1883, 1884, and 1885 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	603,200	8,420	611,680	209,709
1885	804,070	513,505	14,406	527,911	276,159

BUILDING SAND.

Much has been written upon the proper theoretical proportions and qualities of building sand to be used in the preparation of mortar, etc. In actual mixing, however, the average consumer simply handles supplies according to his very practical ideas of cost and convenience, and quality is too frequently a secondary consideration. Cost as usual varies greatly, and while in the great cities 50 to 75 cents per ton might be named, those figures are far above the average, contractors in some localities even finding it necessary to pay for the privilege of disposing of the amount they excavate. Equally uncertain is the production; an approximation to the quantity of sand used simply as a constructive material may be reached by using the totals of other cohesive articles as a basis, and calculating the natural relative proportions used in the preparation of mortars as commonly made; deductions drawn from such suggestions indicate 52,116,000 long tons of sand worked up for building purposes during 1885. This estimate does not cover the supply used for paving and kindred purposes, nor the vast quantities of sand yearly removed from original beds and transferred to railway embankments, harbor and river improvements, etc. Of course supplies are inexhaustible, and outside of city limits can generally be found about where they are wanted.