SLATE.

By A. T. Coons.

PRODUCTION.

Notwithstanding the unsettled conditions of trade, labor, and finance in the United States in 1908, the output of slate as reported to the United States Geological Survey increased in value $297,597—from $6,019,220 in 1907 to $6,316,817 in 1908. This value for 1908 is the largest reported for any year since the beginning of the compilation of slate statistics in 1879, when the output was valued at $1,231,221 and was composed entirely of roofing slate. The value for 1908, however, exceeded by only $59,932 that for 1903, which was $6,256,885. For a number of years previous to 1903 there was a decided and regular yearly increase in the value of the slate output in the United States. Strikes in the building trades during 1903 and 1904 checked the slate industry considerably, and although there has been an increase in output and value for each year since 1904 it has not been until 1908 that the value of output equaled that of 1903. During the last five years, or since the check given in 1903, the slate industry has had to contend with strikes in different quarry sections, the use of tiles, patent roofing processes, shingles, concrete, and cheaper grades of roofing material, and also with high price and scarcity of labor, increased cost of supplies, and a decrease in the slate export trade.

In 1908, as in 1907, nine States reported a commercial output of slate. These States in rank of output were Pennsylvania, Vermont, Maine, Virginia, New York, Maryland, California, New Jersey, and Arkansas. In 1907 the rank of output was Pennsylvania, Vermont, Maine, Virginia, Maryland, New York, California, Arkansas, and New Jersey. New York displaced Maryland and New Jersey displaced Arkansas in 1908.

All of the States except Maryland reported an increased production for roofing slate, both in quantity and value, in 1908. The decrease in Maryland was due largely to a slide in one of the chief quarries, resulting in a decrease of output for that quarry and for the State.

The statistics as given in this report represent the output of slate as reported directly to the survey by the quarrymen, and include the quantity and value of the roofing slate sold by them, the quantity and value of mill stock sold by them, and the value of a quantity of slate sold for other purposes.

As in the report for 1907, the quantity of rough and manufactured mill stock as sold by the quarrymen is given. These statistics for
rough mill stock represent the rough slate sold by the quarrymen to
the slate mills to be made into finished product, and those for manu-
factured mill stock represent the slate worked up by the quarrymen
in their own mills and sold in the finished or partly finished condition.
The values given represent the prices received f. o. b. at point of
shipment for the material as sold by the quarrymen.

Roofing slate.—Of the total value of the slate production in the
United States over 80 per cent represents roofing slate. In 1908 the
production of roofing slate was reported as 1,333,171 squares, valued
at $5,186,167; in 1907 the figures reported were 1,277,554 squares,
valued at $4,817,769, an increase for 1908 of 55,617 squares in quan-
tity and of $368,398 in value. The increase in average value per
square from $3.77 in 1907 to $3.89 in 1908 was 12 cents.

The greater part of the slate quarried in the United States is for
roofing purposes and is put on the market and sold by “squares,” a
square meaning a sufficient number of pieces of slate of any size to
cover 100 square feet of roof, allowing a 3-inch lap. The sizes of
slate in a square vary from 24 by 16 inches to 9 by 7 inches, and the
number of pieces necessary for a square varies from 85 to 686, accord-
ing to the size of the piece. The ordinary thickness of a piece is
from one-eighth to three-sixteenths of an inch. The approximate
weight per square of ordinary roofing slate is 650 pounds, and it is
generally shipped in carload lots from 50 to 100 squares per car,
according to the size of the pieces. The ordinary price per square
of No. 1 slate varies from about $3.50 to $10 per square f. o. b. at
quarries, and depends on the quality, the color, size, thickness, smooth-
ness, straightness, and uniformity of the pieces. Some of the infe-
rior slate, which is mottled or ribboned, sells as low as $2.50 per
square, but specially prepared slate, with pieces carefully selected
with regard to color, extra thickness and size, and extra cutting, sells
as high as $30 per square. The red slate of New York commands the
highest value per square for ordinary slate.

Mill stock.—The value of mill stock, including slate sold for all
purposes other than roofing, decreased from $1,201,451 in 1907 to
$1,130,650 in 1908, a decline of $70,801. The quarries of Pennsyl-
vanian, Vermont, and Maine furnish nearly all of the mill stock. Ver-
mont decreased in quantity of output, and Pennsylvania and Maine
decreased both in quantity and in value. The situation in Vermont
was probably due to loss of trade caused by a strike in the quarries,
which began in May, 1907, and lasted until May, 1908.

On account of the peculiar properties of slate it is adapted to various
uses, and the mill stock includes slate used for blackboards, school
slates, flooring, wainscoting, vats, sinks, laundry tubs, vaults, sanita-
tary ware, refrigerator shelves, electrical switchboards; billiard, labo-
atory, and other table tops; mantels, hearths, well caps, etc. This
material is generally sold in the form of slabs from 1 to 3 inches
thick, the price varying from 4 cents to 30 and 40 cents per square
foot, according to the work done on the slab. It is either sold by the
quarryman to the milling companies, or milled and finished by quarr-
ymen operating their own mills. It is noticeable that Lehigh and
Northampton counties, Pa., report the only stock for school slates and
blackboards. This is due to the fine cleavage qualities of the slate
and to the thickness and size of the beds.
The following table shows the value of roofing and mill slate quarried in the United States in 1907 and 1908, by States and uses:

Value of roofing, mill, and other slate produced in the United States in 1907 and 1908, by States.

<table>
<thead>
<tr>
<th>State</th>
<th>Number of squares</th>
<th>Value</th>
<th>Manufactured:</th>
<th>Rough.</th>
<th>Total.</th>
<th>Other.</th>
<th>Total value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Units</td>
<td>Quantity</td>
<td>Sq. feet</td>
<td>Value</td>
<td>Quantity</td>
<td>Value</td>
<td>Quantity</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arkansas</td>
<td>7,000</td>
<td>690,000</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>California</td>
<td>3,000</td>
<td>500,000</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Maine</td>
<td>16,617</td>
<td>113,665</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Maryland</td>
<td>21,815</td>
<td>113,665</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>New Jersey</td>
<td>2,000</td>
<td>8,000</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>New York</td>
<td>11,668</td>
<td>81,555</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>795,969,957,434</td>
<td>47,065</td>
<td>507,714,116,5,220,884</td>
<td>620,733,737,1473,885,440</td>
<td>1,197,811,530,172,660</td>
<td>1,092,070,300,2,089,840</td>
<td>1,277,054,4,187,769,4,563,800</td>
</tr>
<tr>
<td>Vermont</td>
<td>39,127</td>
<td>173,670</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Virginia</td>
<td>38,127</td>
<td>173,670</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
</tbody>
</table>

1908

<table>
<thead>
<tr>
<th>State</th>
<th>Number of squares</th>
<th>Value</th>
<th>Manufactured:</th>
<th>Rough.</th>
<th>Total.</th>
<th>Other.</th>
<th>Total value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Units</td>
<td>Quantity</td>
<td>Sq. feet</td>
<td>Value</td>
<td>Quantity</td>
<td>Value</td>
<td>Quantity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arkansas</td>
<td>7,000</td>
<td>800,000</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>California</td>
<td>3,000</td>
<td>500,000</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Maine</td>
<td>16,617</td>
<td>115,665</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Maryland</td>
<td>21,815</td>
<td>115,665</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>New Jersey</td>
<td>2,000</td>
<td>8,000</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>New York</td>
<td>11,668</td>
<td>81,555</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>825,078,079,000,2,503,493</td>
<td>455,844</td>
<td>971,603</td>
<td>62,994,3,555,435,083</td>
<td>498,198</td>
<td>333,904,5,992,928</td>
<td>1,197,811,530,172,660</td>
</tr>
<tr>
<td>Virginia</td>
<td>41,076</td>
<td>164,265</td>
<td>404,299</td>
<td>144,000</td>
<td>504,000</td>
<td>146,000</td>
<td>38,500</td>
</tr>
<tr>
<td>Totals</td>
<td>1,333,171,5,180,167,2,586,200</td>
<td>702,350</td>
<td>1,907,200</td>
<td>90,964,4,793,812</td>
<td>793,304</td>
<td>373,346,6,316,817</td>
<td>1,345,400,25,042,6,019,220</td>
</tr>
</tbody>
</table>

* Used chiefly for electrical supplies.
* Composed of 5,711,105 school slates, valued at $48,192, and 1,533,530 square feet of blackboard material, valued at $169,385.
* Composed of 5,092,147 school slates, valued at $42,364, and 2,533,836 square feet of blackboard material, valued at $298,500.

The following table shows the total value of the slate production of the United States from 1904 to 1908, inclusive:

Value of slate produced in the United States, 1904-1908, by States.

<table>
<thead>
<tr>
<th>State</th>
<th>1904.</th>
<th>1905.</th>
<th>1906.</th>
<th>1907.</th>
<th>1908.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>$14,300</td>
<td>$10,000</td>
<td>$5,000</td>
<td>$8,500</td>
<td>$2,500</td>
</tr>
<tr>
<td>California</td>
<td>30,200</td>
<td>40,000</td>
<td>50,000</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Maine</td>
<td>181,188</td>
<td>224,254</td>
<td>238,681</td>
<td>236,966</td>
<td>218,767</td>
</tr>
<tr>
<td>Maryland</td>
<td>158,752</td>
<td>154,215</td>
<td>130,929</td>
<td>116,969</td>
<td>102,186</td>
</tr>
<tr>
<td>New Jersey</td>
<td>8,000</td>
<td>5,369</td>
<td>8,000</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>New York</td>
<td>71,543</td>
<td>66,646</td>
<td>73,300</td>
<td>83,485</td>
<td>136,619</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>3,695,246</td>
<td>3,498,903</td>
<td>3,822,149</td>
<td>3,833,648</td>
<td>3,962,405</td>
</tr>
<tr>
<td>Tennessee</td>
<td>697</td>
<td>707</td>
<td>707</td>
<td>707</td>
<td>707</td>
</tr>
<tr>
<td>Utah</td>
<td>880</td>
<td>890</td>
<td>890</td>
<td>890</td>
<td>890</td>
</tr>
<tr>
<td>Vermont</td>
<td>1,436,101</td>
<td>1,182,544</td>
<td>1,441,330</td>
<td>1,477,566</td>
<td>1,710,404</td>
</tr>
<tr>
<td>Virginia</td>
<td>330,208</td>
<td>146,786</td>
<td>172,807</td>
<td>173,870</td>
<td>194,356</td>
</tr>
<tr>
<td>Totals</td>
<td>5,617,195</td>
<td>5,499,297</td>
<td>5,688,345</td>
<td>6,019,220</td>
<td>6,316,817</td>
</tr>
</tbody>
</table>
The following table shows the value of slate for roofing purposes and for mill stock from 1904 to 1908, inclusive:

<table>
<thead>
<tr>
<th>Year</th>
<th>Roofing slate</th>
<th>Value of mill stock</th>
<th>Total value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of squares</td>
<td>Value</td>
<td>Number of squares</td>
</tr>
<tr>
<td>1904</td>
<td>1,233,757</td>
<td>$4,669,289</td>
<td>1,233,757</td>
</tr>
<tr>
<td>1905</td>
<td>1,241,727</td>
<td>4,574,569</td>
<td>1,241,727</td>
</tr>
<tr>
<td>1906</td>
<td>1,214,742</td>
<td>4,446,746</td>
<td>1,214,742</td>
</tr>
<tr>
<td>1907</td>
<td>1,277,564</td>
<td>5,817,760</td>
<td>1,277,564</td>
</tr>
<tr>
<td>1908</td>
<td>1,355,171</td>
<td>6,166,187</td>
<td>1,355,171</td>
</tr>
</tbody>
</table>

The following table shows the average price of roofing slate per square since 1902:

Average annual price per square of roofing slate for the entire country.

<table>
<thead>
<tr>
<th>Year</th>
<th>Price per square</th>
</tr>
</thead>
<tbody>
<tr>
<td>1902</td>
<td>$3.45</td>
</tr>
<tr>
<td>1903</td>
<td>3.88</td>
</tr>
<tr>
<td>1904</td>
<td>3.78</td>
</tr>
<tr>
<td>1905</td>
<td>3.69</td>
</tr>
</tbody>
</table>

**IMPORTS.**

Practically no slate is imported into the United States. In 1907 slate valued at $5,404 was imported in the form of mantels, chimney-pieces, etc., including $208 for roofing slate; in 1908 the importations were valued at $7,227 for chimney-pieces, slates, slabs, mantels, etc.

**EXPORTS.**

In comparison with the total output, the value of roofing slate exported from this country in 1908 was very small, being only $197,216 compared with a value of $220,995 in 1907.

**SLATE INDUSTRY BY STATES AND LOCALITIES.**

The slate production of the United States is practically confined to the northeastern part of the country, the scattered deposits other than in this section being not yet fully developed or not showing an equal commercial output. The localities of the principal deposits, either producing in commercial quantities or in a greater or less state of development, are given below by States. Almost all of these deposits are described in Bulletin No. 275 of the United States Geological Survey.  

**Arizona.**—A deposit of slate occurs about 6 1/2 miles north of Phoenix, Maricopa County. This deposit is owned by the Phoenix Slate Company, of Phoenix, but has not been developed.

**Arkansas.**—Although several companies have done more or less development work in Arkansas, little slate has been marketed, chiefly on account of lack of transportation facilities. The deposits are located in the west central part of the State, and development work...
has been carried on in the counties of Polk, Montgomery, Garland, Salina, and Pulaski. Red slate, which has played such an important part in the New York slate industry, is also found in Arkansas. The slate is now used chiefly for electrical purposes, but it is also well adapted for use as a roofing slate.

**California.**—The slate output of California is confined to Slatington, Eldorado County, although there is a deposit near Merced, Mariposa County. The output was practically the same in 1908 as in 1907, and was used entirely for roofing slate.

**Colorado.**—A deposit of slate near Marble, Gunnison County, has been reported to the Survey, and it is stated that steps are being taken toward the development of the deposit, with a view to putting the slate on the market.

**Georgia.**—No commercial slate was marketed, but a considerable amount of development work was reported as being done on the deposits near Rockmart, Polk County, in 1908.

**Maine.**—The principal Maine slate deposits are in Piscataquis County, near the towns of Monson, Blanchard, and Brownville. Commercial slate, however, occurs near the town of Forks, Somerset County, but as this deposit has been open to the railroad only a short time no slate has been marketed.

The roofing slate production in this State increased somewhat in 1908, from 16,879 squares, valued at $91,583, in 1907 to 20,151 squares, valued at $115,682, in 1908, an increase of 3,272 squares in quantity and of $24,099 in value. The producers in general reported an increase in roofing slate, with better prices. Mill stock demand was, however, reported very dull, and this is evident from the decrease in production of 119,530 square feet in quantity and of $46,998 in value—from 404,829 square feet, valued at $145,023 in 1907 to 285,299 square feet, valued at $98,025 in 1908.

**Maryland.**—Only a very small part of the slate quarried in Maryland is used for purposes other than roofing, and while a good demand was reported for the slate, the output was less than in 1907, and the financial depression was seriously felt. A “slide” or “cave in” in one of the principal quarries curtailed the output to some extent. The roofing slate produced in 1908 amounted to 18,521 squares, valued at $101,204, a decrease of 3,294 squares and of $12,461, as compared with the output of 21,815 squares, valued at $113,665 in 1907. The average price per square was $5.46 in 1908 and $5.21 in 1907, an increase of $0.25 per square in 1908. The entire output was obtained from the Peach Bottom region at Cardiff, Harford County. Other deposits also occur in Montgomery and Frederick counties, but these have not been operated recently.

**Nevada.**—A deposit of black slate has recently been reported from near Winnemucca, Humboldt County, Nev., and a brief description of this slate is made a part of this report.

**New Jersey.**—The slate deposits of Sussex County, N. J., are a continuation of the Bangor-Slatington slate belt of Pennsylvania, and are worked in two localities, Newton and Lafayette, the old quarries at the latter place having recently been reopened and enlarged. Demand was reported good, and the output was larger than in 1907. The average price per square was $4 in 1907 and $4.05 in 1908. Besides the Sussex County locality there are also deposits in Warren County, but these have not recently been worked.
New York.—The slate deposits of Washington County, N. Y., are a continuation of the belt in Rutland County, Vt. The red slates of New York, which have contributed so much to the value of the New York slate output, are the only red slates now on the market, the red-slate deposits of Arkansas being not yet developed. Besides the red-slate deposits there are also the purple and green slates which mark the Vermont deposit. The average value of New York slate is particularly high on account of these red slates, whose price for ordinary slate is $11 per square; the price is often much higher on account of extra thickness and extra cutting of sizes made to order, which are sold up to $30 and sometimes up to $200 per square. The average price in 1908 was $8.10 against $6.85 in 1907, an increase of $1.25. The output in New York in 1908 increased both in quantity and value of output, and is confined almost entirely to roofing slate. The demand was reported very good, and several new operations were reported.

Pennsylvania.—The output of slate from this State was valued at $3,902,958 in 1908 and at $3,855,640 in 1907, showing the small increase of $47,318 for 1908. Notwithstanding this small increase the total output in 1908 amounted to 61.79 per cent of the total value of the slate produced in the United States. The roofing slate of this State represented 59.21 per cent of the value of the roofing slate produced in the United States, and the other slate represented 73.59 per cent of the value of all the other slate produced in the country.

The roofing-slate production increased from 793,466 squares, valued at $2,987,740 in 1907, to 825,078 squares, valued at $3,070,906 in 1908, a gain of $83,166. The average price per square was $3.72 in 1908 and $3.77 in 1907, a decrease of 5 cents per square. Almost all of the producers reported the demand for roofing slate about the same as in 1907, with the general prices lower, although there was a larger demand with higher prices for small-sized slate.

The roofing slate in Pennsylvania comes from York, Lehigh, and Northampton counties. In 1908 Pennsylvania produced 61.89 per cent of the quantity of the roofing slate produced in the United States, and Northampton County produced 74.05 per cent of the Pennsylvania output and 45.83 per cent of the total quantity for the United States. Lehigh County represented 24.08 per cent of the Pennsylvania output and 14.90 per cent of the total quantity for the United States. Northampton and Lehigh slate is also used for mill stock and is the only slate and blackboard slate in the United States. York County produces the so-called Peach Bottom slate. This slate is the same as that of Harford County, Md., and in 1908 the value of the output from York County was but little less than from the Maryland Peach Bottom region.

Besides roofing slate, Pennsylvania has a larger output of mill stock than any other State, and as before stated is the only State whose slate is fitted by its special properties for use as blackboards and school slates. The slate used for these purposes has been reported separately in 1907 and 1908.

The total value of mill stock, exclusive of school slates and blackboards, was $498,188; the value reported for 1907 was $620,753—a decrease of $122,565 for 1908. The quantity also decreased from 4,597,884 square feet in 1907 to 3,565,083 square feet in 1908—a
decrease of 1,032,801 square feet. This is in accordance with reports of the producers, who state that there was much less demand for this material in 1908 than in 1907. They also state that the demand for blackboards increased, as is shown by the output of 2,838,886 square feet of blackboard material, valued at $291,500 in 1908, compared with 1,531,330 square feet, valued at $198,965 in 1907, an increase in 1908 of $87,556 square feet and of $92,505.

The school-slate production decreased from 5,711,105 slates, valued at $48,152 in 1907, to 5,036,147 slates, valued at $42,364 in 1908, a decrease of 674,958 slates and of $5,788 in value.

The following table shows in detail the production of slate in Pennsylvania, by counties and uses, in 1907 and 1908:

<table>
<thead>
<tr>
<th>County</th>
<th>Roofing slate</th>
<th>Manufactured</th>
<th>Rough</th>
<th>Blackboards</th>
<th>School slates</th>
<th>Total value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of square feet</td>
<td>Value</td>
<td>Sq. ft.</td>
<td>Value</td>
<td>Sq. ft.</td>
<td>Value</td>
</tr>
<tr>
<td>1907. York</td>
<td>14,790</td>
<td>$82,280</td>
<td>2,046,600</td>
<td>2,377,337</td>
<td>279,892</td>
<td>2,027,388</td>
</tr>
<tr>
<td>Lehigh</td>
<td>222,746</td>
<td>841,386</td>
<td>2,676,600</td>
<td>2,827,337</td>
<td>276,010</td>
<td>2,727,388</td>
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<tr>
<td>Northampton</td>
<td>1,325,405</td>
<td>3,064,096</td>
<td>3,109,704</td>
<td>3,309,377</td>
<td>871,138</td>
<td>33,651</td>
</tr>
<tr>
<td></td>
<td>735,406</td>
<td>2,967,600</td>
<td>7,805,600</td>
<td>8,447,600</td>
<td>1,150,250</td>
<td>63,639</td>
</tr>
<tr>
<td>1908. York</td>
<td>15,456</td>
<td>82,500</td>
<td>2,046,600</td>
<td>2,377,337</td>
<td>279,892</td>
<td>2,027,388</td>
</tr>
<tr>
<td>Lehigh</td>
<td>108,036</td>
<td>756,553</td>
<td>100,196</td>
<td>26,286</td>
<td>339,185</td>
<td>34,796,614</td>
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<tr>
<td>Northampton</td>
<td>300,975,373</td>
<td>2,327,700</td>
<td>244,254,400</td>
<td>438,968</td>
<td>506</td>
<td>898</td>
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<tr>
<td></td>
<td>623,078,3,070,903</td>
<td>583,430</td>
<td>435,884</td>
<td>97,653</td>
<td>62,304</td>
<td>2,386,365</td>
</tr>
</tbody>
</table>

The quantity and value of blackboard and school slates given in this table does not necessarily represent the entire quantity and value of these articles made in 1908, but the quantity and value of the material sold as such by the quarriers. It is possible that some of the rough mill stock sold to the slate mills by the quarriers was used for these purposes. This office collects slate statistics from quarrymen and not from manufacturers. Were figures from dealers and slate-mill operators included, it would be almost impossible to avoid duplication. On the other hand, it is impossible to obtain the value of the rough slate stock from the quarryman who mills his own slate, as the only value the material has to him is its value at the completion of his work.

_Tennessee._ Slate deposits more or less developed for commercial enterprise are found at Chilhowie, Blount County, Tellico Plains, Monroe County, and Johnson City, Washington County.

_Utah._ A company has recently been formed to work the slate deposit near Provo City, Utah County, and it is possible that this slate may be put upon the market within a short time.

_Vermont._ Vermont comes next to Pennsylvania in rank of slate production, and in 1908 produced 27.08 per cent of the value of the output of the United States as compared with 61.79 per cent produced by Pennsylvania. The principal slate belt of Vermont is in
Rutland County and adjoins the slate region of Washington County, N. Y. Slate is, however, also quarried near Northfield, Washington County, but not largely.

In May, 1907, a strike started among the quarrymen in Rutland County and lasted until May, 1908, and the production for both 1907 and 1908 was somewhat curtailed on this account. In 1907 the total value of the output was $1,477,259; in 1908 it was $1,710,491, a gain of $233,232. The increase was chiefly in the roofing-slate output which was reported as 385,314 squares, valued at $1,301,576 in 1907, and as 402,258 squares, valued at $1,513,580 in 1908, an increase of 16,944 squares and of $212,004. The average price per square in 1907 was $3.38; in 1908 it was $3.76. The increase in price per square was due to the making of a large number of squares of slate of extra thickness and with much additional cutting.

The output of mill stock increased in value in 1908 but decreased in quantity of output. In 1907 there were reported 963,911 square feet, valued at $175,683, and in 1908, 941,930 square feet, valued at $196,911, a decrease in quantity of 21,981 square feet and an increase in value of $21,228.

The operators in Vermont report more varied trade conditions than in any other State. Those affected by the strike report business as very badly crippled, both by the strike and by financial conditions; other quarrymen report good demand and increased production despite financial difficulties.

Virginia.—There was a small increase in the slate output of Virginia, which is all used for roofing slate, from 39,172 squares, valued at $173,670, in 1907, to 41,678 squares, valued at $194,356, in 1908, an increase of 2,506 squares and of $20,686 in value. The price per square was $4.66 in 1908 and $4.43 in 1907, an increase of $0.23 in 1908. All the producers report better demand, better labor conditions, and increased price per square, especially for the smaller sizes of slate. The output is from Esmont, Albemarle County; Snowden, Amherst County; and Arvonia, Buckingham County.

West Virginia.—The deposits of black slate near Martinsburg, Berkeley County, have never been worked.

**GENERAL NOTE ON SLATE.**

By T. Nelson Dale.

A general interest has been shown during 1908 in the slate industry and the different characteristics of slate in the United States. This interest has made it advisable to publish with the statistics of production two short extracts from Bulletin No. 275, of the United States Geological Survey, on the slate deposits and slate industry of the United States, showing the classification and the comparative characteristics of slate, and also a few general notes on the uses of the various kinds of slates.

**CLASSIFICATION.**

The term slate, in ordinary usage, denotes a rock which has more or less perfect cleavage, adapting it to various commercial uses, and in which the constituent particles, with very few exceptions, can not be distinguished except in thin section under

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a microscope. In contradistinction, a schist is a rock of sometimes identical chemical and mineralogical composition, but is either made up of coarser particles or possesses a wavy structure, or else is marked by both of these features. Both slates and schists may have originated in deposits of identical character, but they have undergone different processes.

Slates as above defined vary greatly in color—from black through various shades of gray to greens, reds, and purples of different hues. They vary also in luster—from having none to being almost as bright as mica itself. They vary greatly, not only in grade of fissility, but in surface texture, as seen by the unaided eye or determined by touch, and still more in microscopic texture, as seen in thin section. They differ also in mineralogical and chemical composition and in physical properties.

Slates divide themselves naturally into: (1) Those derived from aqueous sediments, and (2) those of igneous origin. The latter, however, are very exceptional. For commercial purposes the basis of classification of the aqueous sedimentary slates must be: First, structural, for the cost of their production and the degree of their strength depend primarily upon that; secondly, it must be mineralogical, for their durability depends upon their content of certain mineral constituents.

Those slates in which the particles have been merely compressed by weight or pressure and cemented by carbonates of lime and magnesia, by kaolin or different combinations of iron, and whose grade of fissility, strength, and elasticity are therefore low, must be distinguished from those in which, under metamorphic processes, the kaolin and feldspar have passed into mica, forming a more or less dense and regular crystalline fabric of overlapping scales and fibers inclosing any remaining sedimentary particles. Such slates necessarily possess a high grade of fissility and considerable strength and elasticity. The first group includes clay slates, the second micas slates or phyllite slates. Those in which the micaceous matrix is but partially formed, and which represent a transition from clay slate to mica slate, are more conveniently put into the clay-slate group. Thus, the dark-purple ("red") roofing slate of Penrhyn, in Wales, is a clay slate, and so also is the black slate of Martinsburg, W. Va.; but the French Ardennes slate, the Welsh Festiniog, and the Peach Bottom of Pennsylvania and Maryland, are all mica slates.

But mica slate includes slates of very different composition and structure, and therefore of properties and value. The first distinction to be made is based upon the amount of ferrous carbonate—which or not it is sufficient to produce discoloration on continued exposure to the weather—for this is an important factor in the value of slates used for roofing. This distinction gives a group of fading and one of unfading slates, each of which can be further subdivided as to color. But each of these colors of fading and unfading mica slate embraces a wide range of texture. Some, like the Arkansas black and light-greenish slates, have a matrix of extremely fine sericite fibers, while the black slates of Arvonia, Va., and the Peach Bottom slates have a texture approaching that of a schist. Such differences in texture can not but result in difference of physical properties. The grades of texture are sufficiently designated by the words very fine, fine, medium, and coarse. There are also distinctions in the grade of fissility which do not always correspond to the grade of texture. These are conveniently numbered from 1 to 4, beginning with those of the best fissility. Finally there are differences in luster and amount of magnetite—differences which are purely specific. The general distinctions are formulated in the following table:

**CLASSIFICATION OF SLATE.**

(I) **Aqueous sedimentary.**

(A) **Clay slates:** Matrix without any or with but very faint aggregate polarization.

(B) **Mica slates:** Matrix with marked aggregate polarization.

1. Fading: With sufficient FeCO₃ to discolor considerably on prolonged exposure.
   (a) Carbonaceous or graphitic.
   (b) Chloritic (greenish).
   (c) Hematitic and chloritic (purplish).

2. Unfading: Without sufficient FeCO₃ to produce any but very slight discoloration on prolonged exposure.
   (a) Graphitic.
   (b) Hematitic (reddish).
   (c) Chloritic (greenish).
   (d) Hematitic and chloritic (purplish).

(II) **Igneous.**

(A) **Ash slates.**

(B) **Dike slates.**

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The scientific basis for these subdivisions will be seen in the table showing the microscopic and chemical analyses of the slates there named, and the application of this scheme to 13 kinds of American slates is also shown later.

COMPARATIVE CHARACTERISTICS.

The following table shows the principal mineralogical, chemical, and physical characteristics of 38 kinds of slate described by the writer in Bulletin 275 as far as these manifestly bear upon their economic value. These slates are from Arkansas, California, Maine, Maryland, New York, Pennsylvania, Vermont, Virginia, and West Virginia. For full particulars and for scientific details the descriptions in Bulletin 275 should be consulted. The columns headed "strength" and "toughness" refer to the tests by Merriman, whose methods of experimentation are described on page 47 of Bulletin 275. Microscopic texture refers primarily to the matrix or body of the slate. By "crystalline" is meant that the matrix consists of interlacing and overlapping scales and fibers of micaovite, and is, therefore, a mica-slate or technically a phyllite-slate, although it may inclose unaltered particles of sedimentary origin. Such a slate should have, other things being equal, greater elasticity (toughness) and strength than one in which there is no such texture, or in which it is only incipient. The fineness or coarseness of this crystalline texture probably has a bearing upon the strength and toughness of the slate, but physical data are not sufficient to show this. The coarse-textured Peach Bottom slates, which really approach a mica schist, are the strongest of the 12 kinds of American slates tested, but they are less flexible than all the other kinds tested. In the grade of facility 1 signifies a perfect slaty cleavage, 4 a very imperfect one. The column of chief mineral constituents includes only the 4 or 5 principal ones seen under the microscope, or whose presence has been otherwise determined, and these are given in the descending order of their probable abundance. To these comparative data should be added the results of a few tests not easily tabulated.

Merriman's later corrosion tests show the following percentages of loss after immersion in acid solution for 360 hours: Pennsylvania slates, 1.88 to 2.76; Peach Bottom, 1.11 to 1.29; red of New York and Vermont, 0.25. During this test the Pennsylvania slates become a grayish white, some of the Peach Bottom slates change but slightly; others are almost unaffected; the red slates likewise remain almost unaffected.

E. H. S. Bailey's tests of porosity give these indices of porosity: "Hard Vein" Pennsylvania Chapman, 0.11-0.14; Daniels quarry, 0.14; Belfast quarry, 0.23; red of New York and Vermont, 0.21.

J. F. Williams's tests of the compression of columns of slate 10 inches long by an inch in section with the cleavage vertical, show that the purplish of the unfading green series of Vermont stands 20,000 pounds; the unfading green, 16,020 pounds, and the red of New York and Vermont, 17,730 pounds.

The following results of various tests of Maine (Monson) slate made at the United States Arsenal at Watertown, Mass., were republished from the War Department reports in the Twentieth Annual Report of the United States Geological Survey, Part VI (continued), 1899, page 595:

| Pounds. | Maximum fiber stress per square inch | 7,671 | Shearing test per square inch | 2,192 | Ultimate compressive strength per square inch | 19,510 |

Coefficient of expansion, 0.000005.

The relative commercial value of several slates is an index of their physical characteristics. Mathews, in 1898, gave these prices for slates 14 by 7 inches, three-sixteenths thick, per square: Peach Bottom, $4.85; Northampton County, Pa., $3.50; Lehigh County, Pa., $3.40-3.95; Maine (No. 1), $6.40; Arvonita, Va., $3.60; unfading green, Vermont, $4.50; red, New York, $11.

The following prices per square for slates, No. 1 quality, 16 by 8 inches, f. o. b., were obtained by Doctor Day from producers for January, 1905: Peach Bottom, $6.35; Monson, Me., $7.20; red, New York, $11; Bangor, Pa., $6.75; Albion, Pa., $5; Pen Argyl, Pa., $4.75; Chapman, Pa., hard vein, $3.25; Slattington, Pa., $4.50 to $5; unfading green, Vermont, $4.50 to $5.25; sea green, Vermont, $3.50; Virginia, $3 to $5.50.

In accordance with the scheme of classification of slates given previously, most of the slates whose characteristics are given on the preceding table are here arranged systematically:

(A) Clay slates (fading), Martinsburg, W. Va.

(a) Carbonaceous or graphitic (blackish).

(b) Chloritic (greenish). "Sea green," Vermont.

(c) Hematitic and chloritic (purplish). Purplish of Pawlet and Poultney, Vt.

Lehigh and Northampton Counties, Pa.; Benson, Vt.

(B) Mica slates.

(a) Graphitic or carbonaceous (blackish).

(b) Hematitic (reddish).

(c) Chloritic (greenish). "Unfading green," Vermont.

(d) Hematitic and chloritic (purplish).

Purplish of Fair Haven, Vt., Thurston, Md.

Peach Bottom, Pa., and Md.

Arvonia, Va.

Northfield, Vt.

Brownville, Monson, Me.

North Blanchard, Me.

West Monson, Me.

Granville, Hamptons, N. Y.; Polk County, Ark.

As will be seen by consulting the foregoing tables, the slates in the United States include a very wide range of varieties dependent upon color, texture, fissility, composition, etc. While nearly all of them possess one or two excellent features, few possess many such features, and none possess them all. Several are so conspicuous for their well-nigh perfect adaptation to certain uses that the demand for these slates is likely to increase with the growth of the country. Such are: The blackboard slates of the "soft vein" region in Pennsylvania, which owe their fitness not only to their dark shade, but also to their fine cleavage and the thickness of the beds, which makes it possible to split off large slabs of half inch thickness; the red roofing slates of New York and Arkansas, which owe their bright durable color to hematite; the "unfading green" slate of Vermont, which owes the durability of its color to its very small content of the triple carbonate of lime, iron, and magnesia; the very dark gray unfading roofing slates of the Peach Bottom district in Maryland and Pennsylvania, of Arvonia in Virginia, and of Brownville and Monson in Maine, which owe the durability of their shade to sparseness of carbonate and in cases to the presence of graphite, and their general qualities to a very high degree of metamorphism; the very dark gray mill-stock slates of Northfield in Vermont and of Monson in Maine, and the greenish and purplish mill-stock slates of Vermont; and lastly the "sea green" roofing slates of Vermont, and the very dark gray roofing slates of Northampton and Lehigh counties in Pennsylvania, which, owing to their abundant carbonate, fade more or less, sooner or later, but are less expensive. These Pennsylvania and Vermont slates will always be in demand on account of their cheapness, which is largely due to their great fissility.

The selection of a slate should manifestly be governed mainly by its adaptation for the purpose in view, as well as by considerations of cost and transportation. An increasing quantity of mill-stock slate is being used for electric switchboards, but for this use those varieties with a minimum amount of magnetite are necessarily chosen. It were well if the better qualities of slate were more widely used for inexpensive memorial tablets and gravestones, instead of marble, which in our climate is far less adapted to withstand the acids of the
atmosphere. A comparison of half-century or century old exposed inscriptions on slate and marble will suffice to justify this suggestion. Some chemical process for the utilization of the large percentage of waste in slate quarrying is still being sought for, and more rational methods of prospecting for slate are coming into use.

The relation of the varied usefulness of slate to the character of its geologic history is quite as remarkable as that of coal or any other of the great nonmetallic products. Notwithstanding the intricacy of the chemical and mineral composition of slate, the controlling elements in the history of nearly all of it reduce themselves to the erosive and sedimentary action of rivers and seas, and the metamorphism, crystallization, and rearrangement of the resulting sediments under lateral crustal compression.

NOTE ON A “BLACK” ROOFING SLATE FROM NEVADA.

By T. NELSON DARE.

A dark blue gray, commercially “black” roofing slate has been recently reported to the United States Geological Survey from the Blue Mountains in Humboldt County, Nev., about 21 miles northwest of Winnemucca, and specimens of it said to have been collected from more or less weathered outcrops have been examined by the writer with the following result:

The slate is of dark bluish-gray color. To the unaided eye it has an extremely fine texture and very smooth, slightly lustrous cleavage surface. It contains some carbonaceous or graphitic matter and, as shown by magnet, a little magnetite. The sawn edges show neither pyrite nor magnetite. It does not effervesce with cold, dilute hydrochloric acid. It is sonorous, and has a very high grade of fissility. The cleavage face shows traces of “grain,” but the slate breaks usually at angles of 50° to 70° and 30° to the apparent grain.

Under the microscope this slate shows a matrix of muscovite (sericite) with well-defined aggregate polarization, and is thus a mica slate. The cleavage is fine, although showing some minor irregularities in the size of particles. The quartz particles measure up to 0.06 millimeter in diameter; one plagioclase feldspar measured 0.04 millimeter. No pyrite was detected. The dark particles are nonmetallic and probably carbonaceous. Rather abundant scales of chlorite and of interleaved chlorite and muscovite measure up to 0.14 millimeter in length and to 0.05 millimeter in width. Rutile is very abundant both in single needles and more in net-shaped groups of twinned needles (agenite) measuring to 0.02 millimeter across. There is a little limonite proceeding possibly from the magnetite and due to incipient weathering. No carbonate could be found.

The fissility of this slate is as great as that of the Northampton and Lehigh, Pa., slates, but its freedom from carbonate indicates that its color is more durable. This Nevada slate is of aqueous sedimentary origin, but has undergone metamorphism. Its characteristics, denoted like those in the table on a preceding page, are thus as follows:

**Color:** Dark bluish gray. **Cleavage surface:** Very fine. **Luster:** Slight. **Magnetite:** A little. **Microscopic texture:** Crystalline fine. **Grade of fissility:** 1. **Châef minerals:** Muscovite, quartz, chlorite, carbon, rutile. **Carbonate:** None detected. **Remarks:** A large block should be tested by an experienced slate workman for grain and false cleavage.