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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 142

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1909

BY

D. H. NEWLAND

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STATE OF NEW YORK

EDUCATION DEPARTMENT

New York State Education Department
Science Division, May 17, 1910

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I beg to communicate herewith and recommend for publication as heretofore, in the form of a bulletin of the State Museum, the accompanying report on the *Mining and Quarry Industry of the State of New York* for the calendar year 1909, prepared by David H. Newland, Assistant State Geologist.

Very respectfully
JOHN M. CLARKE
Director

State of New York
Education Department
COMMISSIONER'S ROOM

Approved for publication this 19*th day of May* 1910

Commissioner of Education

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REPORT OF OPERATIONS AND PRODUCTION DURING 1909

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PREFACE

The present report follows the general plan of the preceding issues which have been compiled each year since 1904, its aim being to furnish a timely record of progress in the various mineral industries represented in New York State. The statistics of production, as well as much of the information relating to new discoveries and other matters of interest, have been supplied by the individual enterprises engaged in the exploitation of the local resources, and it is desired to express grateful acknowledgment for their cooperation.

INTRODUCTION

The mining and quarry enterprises of the State felt the stimulus of the improved business conditions last year and made good progress toward recovery from the depression that followed the 1907 panic. The value of the mineral production, as calculated from reports rendered by the individual enterprises, amounted in all to

$34,914,034, a gain of more than $5,000,000 over the total for 1908. The upturn was not sufficient to establish a new record for the industries, but it reflected their strong position and capacity for continued growth.

The valuation, it should be noted, has been based, so far as practicable, on crude materials, and though serviceable for comparing the course of the related industries from year to year it affords only a small measure of the contribution made by the general class of mineral activities that are represented in the State. The metallurgical and chemical products of mineral nature are among the largest items of local manufactures. The inclusion of pig iron alone in the list of products for last year would nearly have doubled the above total.

Among the notable features of the record for 1909 was a large gain in the product of iron ore which reached an aggregate of 991,008 long tons valued at $3,179,358. This represented a gain in quantity of nearly 300,000 tons over the total for the preceding year. The production fell a little short of the output in 1907, but with that exception was the largest reported for any year since 1891. The iron market during the early months was still under the influence of the depression and it was not until the spring season had well advanced that the mines began operations at full capacity. There were 12 companies who reported a production, against 10 in 1908 and 13 in 1907. The Adirondacks furnished the greater part of the increase, though the mines along the Clinton belt showed a substantial gain.

The various materials of clay constituted the largest items in the year's record, with an aggregate value of $12,351,482, as compared with $8,918,863 in 1908. The increase of nearly 40 per cent in the value of the production was due principally to the revival of the building trades and consequent demand for structural materials. The combined output of brick, tile, fire-proofing and terra cotta used for building purposes was valued at $9,342,015, against $6,071,850 in 1908. In 1907 these materials represented a value of $8,909,392. The number of building brick made last year was 1,518,023,000 of which 1,218,784,000, or about three fourths, consisted of common brick from the Hudson river region. The value of the pottery manufactures showed a smaller relative gain with a total of $1,827,193 as compared with $1,653,241 in 1908. The number of plants that were engaged in clay manufacturing of all kinds was 232 or 10 less than in 1908.

The quarries of the State contributed material valued at $7,061,580, against $6,615,614 in the preceding year. The total was divided according to the various uses into: building stone, $873,651; monumental stone, $138,313; curb and flagstone, $800,620; crushed stone, $3,214,374; other uses $2,034,622. The output of slate, millstones and limestone used in making hydraulic cement is not included in these totals. All kinds of stone, except marble, participated in the increased activity, but limestone and trap furnished most of the gain due to their extending application in road building. Important as the quarry industries are, they still fall considerably short of supplying the local requirements in building and ornamental stones.

The hydraulic cement industries reported a product valued at $2,122,902, a little less than in 1908 when the valuation was given as $2,254,758. A decreased output was reported by the natural rock plants, the total amounting to 549,364 barrels against 623,588 barrels in 1908. That industry has shown a steady decline for a number of years past. The manufacture of portland cement, on the other hand, gained slightly with a product of 2,061,019 barrels against 1,988,874 barrels in the preceding year. A considerable increase in the production of this material may be expected for the current year.

From the salt mines and wells there was obtained a total of 9,880,618 barrels of salt valued at $2,298,652. The production was the largest in the history of the salt industry and represented an increase of nearly 10 per cent over the total for 1908 which was 9,005,311 barrels valued at $2,136,736. The gain was distributed between the output of rock and brine salt, both classes showing about the same proportionate increase. Onondaga county for the first time failed to return the largest production and was outranked by Livingston county which has been the center of the rock salt industry. Within the last 25 years the State has increased its output by over 400 per cent.

The mines and quarries of gypsum reported an output of 378,232 short tons, which was also the largest ever recorded in New York State. The gain over the total of 318,046 short tons for 1908 amounted to nearly 20 per cent. The value of the different gypsum materials, including plaster of paris, wall plaster, and gypsum sold in unburned condition was $907,601 against $760,759 in the preceding year. The important developments in the western counties have been chiefly responsible for the expansion of the industry which has increased nearly tenfold in the last decade.

Petroleum and natural gas were reported last year at a value of $2,960,356, against a value of $3,059,308 in 1908. There was little change in the production of petroleum which amounted to 1,160,402 barrels as compared with 1,160,128 barrels in the preceding year, but a marked decline in prices was responsible for a large reduction in valuation. The flow of natural gas was approximately 3,825,-215,000 cubic feet and was valued at $1,045,693.

The talc mines of the State made an output of 65,000 short tons valued at $617,500, or a little less than in 1908 when the production was 70,739 short tons valued at $697,390. The talc, as heretofore, came from the Gouverneur district of St Lawrence county, which practically enjoys a natural monopoly of the fibrous talc consumed in paper manufacture.

The garnet mines in the Adirondacks were more active last year and reported an output of 3802 short tons valued at $119,190 against 2480 short tons valued at $79,890 in 1908. Conditions in the abrasive trade were considerably depressed, otherwise a larger gain would have been registered.

A production of 2,342,000 pounds of crystalline graphite valued at $140,140 was made by the Adirondack mines. In 1908 the output was 1,932,000 pounds valued at $116,100.

The mineral springs of the State reported sales of 9,019,490 gallons valued at $857,342, as compared with 8,007,092 gallons valued at $877,648 in 1908.

The miscellaneous mineral materials, including apatite, carbon dioxid, clay, diatomaceous earth, emery, feldspar, marl, millstones, metallic paint, slate pigment, pyrite, quartz, slate, sand and sand-lime brick, that were produced in 1909, amounted in value to $2,170,-881. The value of the same materials in the preceding year was $1,904,472.

Mineral production of New York in 1905

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 117 822	$2 046 864
Natural rock cement	Barrels	2 257 698	1 590 689
Building brick	Thousands	1 512 157	10 054 597
Pottery	.....	.....	1 620 558
Other clay products	.....	.....	2 603 861
Crude clay	Short tons	6 766	16 616
Emery	Short tons	1 475	12 452
Feldspar and quartz	Long tons	17 000	48 500
Garnet	Short tons	2 700	94 500
Glass sand	Short tons	9 850	7 765
Graphite	Pounds	3 897 616	142 948
Gypsum	Short tons	191 860	551 193
Iron ore	Long tons	827 049	2 576 123
Millstones	.....	.....	22 944
Metallic paint	Short tons	6 059	70 090
Slate pigment	Short tons	2 929	22 668
Mineral waters	Gallons	8 000 000	1 000 000
Natural gas	1000 cubic feet	2 639 130	607 000
Petroleum	Barrels	949 511	1 566 931
Pyrite	Long tons	10 100	40 465
Salt	Barrels	8 575 649	2 303 067
Roofing slate	Squares	16 460	94 009
Slate manufactures	.....	.....	1 000
Granite	.....	.....	253 955
Limestone	.....	.....	2 411 456
Marble	.....	.....	774 557
Sandstone	.....	.....	2 043 960
Trap	.....	.....	623 219
Talc	Short tons	67 000	469 000
Other materials[a]	.....	.....	1 800 000
Total value	.....	.....	$35 470 987

[a] Includes apatite, carbon dioxid, diatomaceous earth, fullers earth, marl, sand and sand-lime brick. The value is partly estimated.

Mineral production of New York in 1906

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 423 374	$2 766 488
Natural rock cement	Barrels	1 691 565	1 184 211
Building brick	Thousands	1 600 059	9 688 289
Pottery	.....	.....	1 795 008
Other clay products	.....	.....	2 472 003
Crude clay	Short tons	5 477	9 125
Emery	Short tons	1 307	13 870
Feldspar and quartz	Long tons	13 660	44 350
Garnet	Short tons	4 729	159 298
Glass sand	Short tons	9 000	8 600
Graphite	Pounds	2 811 582	96 084
Gypsum	Short tons	262 486	699 455
Iron ore	Long tons	905 367	3 393 609
Millstones	.....	.....	22 442
Metallic paint	Short tons	2 714	29 140
Slate pigment	Short tons	2 045	15 960
Mineral waters	Gallons	8 000 000	1 000 000
Natural gas	1000 cubic feet	3 007 086	766 579
Petroleum	Barrels	1 043 088	1 721 095
Pyrite	Long tons	11 798	35 550
Salt	Barrels	9 013 993	2 131 650
Roofing slate	Squares	16 248	57 771
Slate manufactures	.....	.....	4 150
Sand-lime brick	Thousands	17 080	122 340
Granite	.....	.....	255 189
Limestone	.....	.....	2 963 829
Marble	.....	.....	460 915
Sandstone	.....	.....	1 976 829
Trap	.....	.....	847 403
Talc	Short tons	64 200	541 600
Other materials[a]	.....	.....	1 850 000
Total value	.....	.....	$37 132 832

[a] Includes apatite, arsenical ore, carbon dioxid, diatomaceous earth, fullers earth, marl and sand and gravel exclusive of glass sand.

Mineral production of New York in 1907

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 108 450	$2 214 090
Natural rock cement	Barrels	1 137 279	757 730
Building brick	Thousands	1 366 842	7 424 294
Pottery	.....	.....	2 240 895
Other clay products	.....	.....	3 023 679
Crude clay	Short tons	3 927	6 163
Emery	Short tons	1 223	13 057
Feldspar and quartz	Long tons	8 723	36 230
Garnet	Short tons	5 709	174 800
Glass sand	Short tons	1 200	1 380
Graphite	Pounds	2 950 000	106 951
Gypsum	Short tons	323 323	751 556
Iron ore	Long tons	1 018 013	3 750 493
Millstones	.....	.....	21 806
Metallic paint	Short tons	5 269	59 521
Slate pigment	Short tons	620	3 700
Mineral waters	Gallons	8 000 000	1 000 400
Natural gas	1000 cubic feet	3 052 145	800 014
Petroleum	Barrels	1 052 324	1 736 335
Pyrite	Long tons	49 978	162 430
Salt	Barrels	9 657 543	2 449 178
Roofing slate	Squares	11 686	53 625
Slate manufactures	.....	.....	1 175
Sand-lime brick	Thousands	16 610	109 677
Granite	.....	.....	195 900
Limestone	.....	.....	3 182 447
Marble	.....	.....	1 571 936
Sandstone	.....	.....	1 998 417
Trap	.....	.....	941 627
Talc	Short tons	59 000	501 500
Other materials[a]	.....	.....	1 850 000
Total value	.....	.....	$37 141 006

[a] Includes apatite, arsenical ore, carbon dioxid, diatomaceous earth, fullers earth, marl nd sand and gravel exclusive of glass sand.

Mineral production of New York in 1908

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	1 988 874	$1 813 622
Natural rock cement	Barrels	623 588	441 136
Building brick	Thousands	1 066 533	5 200 951
Pottery	.....	.....	1 653 241
Other clay products	.....	.....	2 064 671
Crude clay	Short tons	4 697	11 605
Emery	Short tons	690	8 860
Feldspar and quartz	Short tons	16 413	68 148
Garnet	Short tons	2 480	79 890
Graphite	Pounds	1 932 000	116 100
Gypsum	Short tons	318 046	760 759
Iron ore	Long tons	697 473	2 098 247
Millstones	.....	.....	18 341
Metallic paint	Short tons	5 750	54 500
Slate pigment	Short tons	922	7 376
Mineral waters	Gallons	8 007 092	877 648
Natural gas	1000 cubic feet	3 860 000	987 775
Petroleum	Barrels	1 160 128	2 071 533
Pyrite	Long tons	23 775	104 798
Salt	Barrels	9 005 311	2 136 736
Sand and gravel	.....	.....	1 130 291
Sand-lime brick	Thousands	8 239	55 688
Slate	.....	.....	111 217
Granite	.....	.....	367 564
Limestone	.....	.....	3 119 835
Marble	.....	.....	692 857
Sandstone	.....	.....	1 711 585
Trap	.....	.....	723 773
Talc	Short tons	70 739	697 390
Other materials[a]	.....	.....	333 648
Total value	.....	.....	$29 519 785

[1] Includes apatite, carbon dioxid, diatomaceous earth and marl.

Mineral production of New York in 1909

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	2 061 019	$1 761 297
Natural rock cement	Barrels	549 364	361 605
Building brick	Thousands	1 518 023	8 159 096
Pottery	.....	.....	1 827 193
Other clay products	.....	.....	2 365 193
Crude clay	Short tons	12 174	11 585
Emery	Short tons	892	10 780
Feldspar and quartz	Short tons	16 111	52 444
Garnet	Short tons	3 802	119 190
Graphite	Pounds	2 342 000	140 140
Gypsum	Short tons	378 232	907 601
Iron ore	Long tons	991 008	3 179 358
Millstones	.....	.....	19 247
Metallic paint	Short tons	6 560	65 600
Slate pigment	Short tons	1 155	9 130
Mineral waters	Gallons	9 019 490	857 342
Natural gas	1000 cubic feet	3 825 215	1 045 693
Petroleum	Barrels	1 160 402	1 914 663
Salt	Barrels	9 880 618	2 298 652
Molding sand	Short tons	468 609	437 402
Sand-lime brick	Thousands	12 683	81 693
Roofing slate	Squares	21 187	126 170
Slate manufactures	.....	.....	880
Granite	.....	.....	479 955
Limestone	.....	.....	3 300 383
Marble	.....	.....	380 016
Sandstone	.....	.....	1 839 798
Trap	.....	.....	1 061 428
Talc	Short tons	65 000	617 500
Other materials[a]	.....	.....	1 483 000
Total value	.....	.....	$34 914 034

[a] Includes apatite, carbon dioxid, diatomaceous earth, marl, pyrite, and sand and gravel exclusive of molding sand.

SOME LIMITATIONS OF THE MINING FIELD IN NEW YORK STATE

With its varied and important mining industry, the State still affords room for new enterprise. The resources of nearly all the useful minerals represented within its boundaries are so abundant as to assure an indefinitely long life for productive operations. Through advances in technology, improved transportation facilities and the natural growth of markets additional sources of supply are being brought constantly within the zone of economic development; in these ways a widening field of industrial opportunity is provided for energy and capital.

It seems hardly necessary to mention, however, that the mineral wealth of the State has its natural limitations which are of fundamental import to industry. The valuable deposits are not only restricted as to variety, but their areal distribution is conditioned by the nature of the local rock formations or other features that have been more or less well defined from scientific inquiry and explorations. A knowledge of the geological conditions surrounding the occurrence of the useful minerals is very necessary to the proper conduct of field operations. In these days of the expert practitioner, mining bureaus and geological surveys, guidance can easily be had. Few states have been so carefully studied in regard to geology and mineral occurrence as New York, and the accumulated information is largely on record and available to the public.

Yet the neglect of these obvious considerations is by no means uncommon, whereby results much wasted effort with very considerable financial loss. Organizations of capital are effected, costly construction work and development are entered upon frequently without any adequate basis for operations or knowledge of the conditions pertaining to the particular field so essential to success.

A recurring illustration of this tendency is afforded by the attempts which are made from time to time to develop coal beds in the State. The futility of such purpose, however well intentioned, was exposed by the work of the First Geological Survey in the early part of the last century and has been frequently emphasized since; yet there is still a manifest willingness to engage in unprofitable ventures of this kind. The fact that the New York series of rock formations does not contain representatives of the productive coal measures rests upon the most secure basis. But if further evidence be required it may be said that practically the whole of the New York section of stratified formations has been explored in outcrop, mine shafts or drill holes, so that all possibility of the existence of valuable deposits is absolutely removed.

Among the regions which are favored for such operations and which have recently received attention may be mentioned the Hudson River shale region, the Catskills and the southern part of the State along the Pennsylvania boundary. The belt of shales extending along the Hudson river from the Highlands northward to Washington county contains more or less carbonaceous matter, but never in sufficient amount to constitute a true coal. Where the shale has been crushed and compressed the carbon may be noticeable as a thin film on the surface of the shale fragments, giving the appearance somewhat of shiny anthracite, though a purely superficial one.

In the Catskills and the southern tier of counties we have a series of bedded formations which most closely approximate in period of deposition the Appalachian coal measures that are so productive in Ohio, Pennsylvania and the states to the south. Yet they all were laid down before the opening of the coal-making period proper, as shown by the respective stages of life development evidenced in the rocks.

The northern limits of the Appalachian fields geographically approach within such short distance of the New York boundary that some excuse existed for the search for coal before the time of geological surveys; now it can only be a matter of regret that the boundary should have been so discriminately fixed, when the addition of only a few minutes of latitude on the south would have brought portions of this wealth into the State.

Though deficient in coal some of the local formations contain valuable oil and gas pools which support a fairly important productive industry. The discovery of illuminating gas in the State dates back to as far at least as 1821 when wells were drilled at Fredonia, Chautauqua co., probably the first successful attempt to utilize the material in this country. There are now more than 1000 wells that supply natural gas for fuel and lighting purposes besides many more whose output is consumed on the ground for pumping oil. The petroleum industry was first started about 1865 in Cattaraugus county and is now represented by fully 10,000 active wells.

There is thus a solid basis for exploration and development of these resources and it is creditable to local enterprise that they have been brought to such a high state of productivity. The practical oil and gas prospector with his knowledge that comes from accumulated experience has been the chief factor in this achievement. Scientific study of the accumulations of oil and gas has yielded, however, some valuable information, though for the most part perhaps its data have only an indirect or negative application to field exploration. It may and often does help to establish the limit within which drilling operations should be conducted; it provides the means for identifying the productive strata and for tracing their bounds; and from the structure of the formations may point out the more promising places for exploration.

Both the results of such study and past experience show that only a part of the State can be considered as a profitable field for exploration. The areas comprised within the Adirondacks and the Highlands are of course absolutely barren territory, as they are

made up of crystalline rocks. The bordering areas of thin or disturbed sediments afford very little chance of productive wells and this is equally true of the great mass of shales and sandstones that constitute the Hudson River formation, between the Adirondacks and the Highlands. Small pockets of gas have been found occasionally in the shales, but in every case they have played out quickly when tapped by the drill. The territory immediately west of these areas and extending as far as the meridian running through the middle of Oneida lake is of doubtful value and has been explored only in places; the results of test wells so far have been disappointing as regards the existence of gas in quantity.

The productive fields of natural gas that have been discovered up to the present time are restricted to the central and western counties of which there are 15 or 16 that support an active industry. The extreme easterly localities are in Oswego county, where a few small pools have been found near the shore of Lake Ontario. The largest wells are all in the western section, chiefly in Erie, Chautauqua, Cattaraugus and Allegany counties, and it is only in that part that the industry has achieved any marked success.

The oil fields of New York are even more limited. No pools have been found outside of southern Cattaraugus and Allegany counties and a small area in southwestern Steuben county. There has been no notable addition to the producing territory in many years; it seems scarcely probable that the industry will ever be extended much beyond the present bounds.

Another matter which has assumed some importance in relation to the mining industry and should have careful consideration at this time is the reputed presence of gold sands in the Adirondacks. They can not be considered exactly a new development, since a good deal of attention was given them about 12 years ago during the Klondyke excitement; but public interest has been revived recently by attempts to start fresh enterprises which have received frequent notice in the press.

While discussions of the subject have already appeared from this office, the numerous requests for information indicate a need for further publicity of the facts so far as they can be learned.

It is well known that the stream valleys and lake basins of the Adirondacks are choked with gravel and sand deposits. These have been formed by the erosive action of water and ice upon the local rock formations, chiefly granites, syenites, gabbros and gneisses, with some much altered sediments. Quartz is naturally the main con-

stituent of the sands; but several other minerals occur in small amount, such as garnet, magnetite, pyroxene and hornblende which are common in the Adirondack rocks. No minerals have been found in the sands that are foreign to the region. The view expressed as to their derivation from the local rocks is, therefore, well established.

Gold quartz veins are not known in the Adirondacks or anywhere within the immediate region. Common white or milky quartz is rather plentiful, but it lacks the rusty, honeycombed appearance of gold quartz as well as the iron and copper sulphides with which the precious metals are associated in veins that have not undergone surface alteration. It is very likely that careful analysis would show a trace of gold in the Adirondack veins, but they are not mineralized in the usual sense of the term.

To explain the presence of gold in the sands in any appreciable amount we must perforce look for its source in the ordinary country rocks — the deep seated igneous masses and the gneisses and schists. That gold should be generally distributed through rocks of this character to the value of even $1 a ton is certainly an exceptional, if not unique, phenomenon. And yet the basis of present and past mining operations in the region is the claim that the sands, from almost any section, apparently, will yield to proper treatment as much as $4 or $5 and even as high as $40 a ton.

There is a very wide discrepancy between these claims and the results obtained by reputable assayers. This is said to be due to the fact that the gold exists in a peculiar condition owing to which the ordinary methods of fire or wet assay are inapplicable to its recovery. Without inquiry further into that matter at present, we give here some determinations made by disinterested commercial chemists.

In an investigation for the State Museum of the so called "Sutphen" process which was in vogue during the earlier period of experimentation with these sands, J. N. Nevius collected samples from deposits at Hadley that were said to yield $7.50 a ton by that process. The following statements are extracted from his report:

A sample of sand collected from the spot from which the mill's supply is obtained was assayed for the Museum, and the value was reported to be a "trace" of gold to the ton, which means a value of less than 20 cents a ton. No value of silver was obtained. Another sample of the same sand was tested by Dr E. J. Wheeler, of Albany, for the presence of bromin, but no trace of

this element was detected. These two tests prove that the Hadley sand does not contain bromid of gold to the value of $7.50 a ton. In just what chemical combination or physical condition the gold could exist in the sand to the value of $7.50 a ton, and would not be detected by the fire assay, but, after undergoing a simple chemical operation, would be susceptible to amalgamation in paying quantities, is a question which remains for the people interested in this process to explain, before the scientific world, whose confidence rests implicitly on the accuracy of the fire assay, will credit their theory.

For analyses of sands from Lewis county, which is the scene of present activity in mining, we are indebted to *The Engineering & Mining Journal* (March 19, 1910) through whose enterprise samples were recently collected and assayed. The samples were taken by B. J. Hatmaker who had previously experimented with sands from the same localities. The following particulars are from Mr Hatmaker's letter transmitting them:

The samples marked "A" are from an immense deposit along the Black river and represent three samples taken 300 feet apart. These samples gave me, by fire, from $3.59 to $3.80 per ton. The samples marked "B" are from a deposit back in the hills which should run around $3. This particular sample was taken by Professor Locke, of the Boston Institute of Technology, and myself. It represents the sand of which Dr N. S. Keith, of Philadelphia, has milled several tons and has reported $2.50 to $3 recovery, by amalgamation. My fire assays in this have run $1.50 and $2.75. Professor Locke was unable to get more than a trace.

The report on the results of assay by the firm of Ricketts & Banks, as printed in *The Engineering & Mining Journal,* is as follows:

The samples of sand marked "A" and "B," received sealed under signature of B. J. Hatmaker, submitted for assay contain:

	"A"	"B"
Fire assay	0.005 oz.	0.005 oz
Wet assay	0.005 oz.	0.005 oz

gold per ton of 2000 pounds.

Additional samples marked "A" and "B" were also submitted by *The Engineering & Mining Journal* to the firm of A. R. Ledoux & Co. who made the following report:

The two samples of sand submitted to us on February 1, 1910, marked respectively "A" and "B," and sealed with paper bands, bearing the signature of B. J. Hatmaker, have been assayed by the usual fire assay method, yielding:

"A" — Gold = 0.0025 oz. per ton = $0.05 per ton

"B" — Gold = 0.005 oz. per ton = $0.10 per ton

This work was very carefully done, using large assay charges. In view of the statement that these sands are said to contain gold combined with some element, or elements, causing the gold to volatilize during the fire assay process, and that this method is not capable of detecting gold in these sands, we have repeated the assays by a wet method which involves digestion of the finely ground sands with *aqua regia* at a low temperature for a long time, filtering off the acid liquid, evaporating it to small bulk and examining the concentrated solution for gold. By this method we obtained:

In sample "A" — gold, trace

In sample "B" — gold 0.003 oz. per ton = $0.06 per ton.

Supplementing these tests, a portion of each sample was concentrated by panning and the concentrates were examined both with a hand glass and also microscopically. Neither sample showed the presence of any visible gold or of any usual mineral or substance which might possibly carry gold. The concentrates are principally magnetic iron particles mixed with some complex silicates of the garnet family.

Portions of each sample contained in closed tubes of hard glass were heated in a blast lamp flame to the melting point of the glass. A quantity of combined water condensed on the cool parts of each tube but neither sample yielded any sublimate of volatile matter whatever.

From the above tests we conclude that these samples are ordinary silicious sands and that they contain only traces of gold as are usually found in such sands. Traces of gold are frequently present in many rocks and sands, and it is not unusual to find gold values equivalent to a few cents per ton in ordinary rocks, such for instance, as granite paving blocks. These samples do not contain any extraordinary or unusual element or any substance which could cause the gold to volatilize in the ordinary process of assaying, nor in fact do they contain any volatile substance except combined water.

These results are certainly concrete and illuminative. Regarding the methods by which they were obtained, it seems sufficient to say that they are accepted and employed generally in chemical laboratories and that they have stood the test of long practice in all the mining regions of the world.

Without indulging in criticism of the good faith of those who have been at work on the Adirondack sands, we are unable to find in the notices of the press or in any literature which has been circu-

lated for the purpose of informing the public as to their claims, any satisfactory explanation of the processes employed for recovery of the gold which would account for the wide variance between their reported results and those obtained by the usual assay methods. We have been informed recently on creditable authority that in the so called "Sutphen" process, which was extensively advertised about 10 years ago, the methods consisted briefly of pulverizing the sand and amalgamation after treatment with a hot sodium carbonate solution. It was stated that the gold had a silicious coating which necessitated fine grinding and chemical treatment before amalgamation was effective. Even if that were true, there is no reason why the gold should not be set free by fire assay. On the other hand the claim that the gold exists in volatile state, something entirely new to chemical science, seems to be met and controverted by the recent assays.

The economic record of past enterprise in this field is certainly not reassuring to those intent on new ventures. Though it is impossible to give an accurate estimate of the outlay of capital represented by previous experiments, the total must amount to several hundred thousand dollars. An idea of the wide interest which the early enterprises aroused may be gained from the official records which show that over 4000 claims to gold and silver discoveries, mainly within the Adirondacks, were filed in the year 1898. We know of no instance where the public has received any financial return for its investment.

CEMENT

After the setback of 1908, a decided improvement in the cement trade seemed to be the natural order for last year. The market was undoubtedly somewhat broader, inasmuch as manufacturers found a more ready outlet for their product and were able also to reduce considerably the stocks that had accumulated during the previous year, but otherwise the conditions were not much changed. Prices continued at a low level, with a slight upward tendency in the later months. The disparity between productive capacity and consumption was accountable for the continuance of a depressed market. This condition seems to have been removed, or to have been greatly relieved at any rate, and the outlook for the trade at the opening of 1910 was more encouraging than it had been during the last two years. It may be said that local manufacturers enjoyed some advantages in marketing

their output by reason of the numerous large engineering developments in connection with the canal system, municipal water supply plants, hydroelectric installations, etc., that have been in progress recently throughout the State.

During the last few years the cement industry of New York has undergone radical changes. The manufacture of natural cement used to be the principal branch of the industry and was represented by many large and well equipped plants, with an average output of over 4,000,000 barrels a year. The output of the Rosendale district of Ulster county especially found a wide market. With the growth of the portland cement industry in this country, increased competition has so reduced prices that there is now very little margin between the cost to the consumer of that article and the natural cement. As a consequence the sales of the latter have decreased to a fraction of the former quota and most of the plants have been permanently closed.

The manufacture of portland cement on the other hand has grown rather steadily, though not so rapidly as to counterbalance the loss in the output of natural cement. That branch of the industry has been largely centralized in eastern Pennsylvania, where it was first established. For the last year or two increased interest has been shown, however, in the development of the local resources and there is little doubt that New York will eventually take a more prominent place in the trade, which it should occupy by reason of its abundance of raw materials and its market advantages. The erection of a new plant in the Hudson river region, with a reported capacity of 5000 barrels a day, has been underway during the last year.

The total production of cement in New York in 1909 was 2,610,383 barrels, or about the same as in the preceding year when it amounted to 2,612,462 barrels. In 1907 the quantity was reported at 3,245,729 barrels and in 1906 at 4,114,939 barrels. The accompanying table gives the annual output and value for each kind of cement since 1890. There were altogether 13 firms who reported a production last year, the same number as in 1908, but a loss of five as compared with those so reporting in 1907.

In the portland cement industry there was a slight gain of output, the aggregate amounting to 2,061,019 barrels valued at $1,761,297 against 1,988,874 barrels valued at $1,813,622 for 1908. With the placing in operation of the new plant at Green-

port near Hudson which is expected during the current season, a further increase should be registered for this year. This plant will be operated by the New York-New England Cement & Lime Co., under control of Pennsylvania interests. The other projects in the Hudson river region, mentioned in the review of last year, have not been so far advanced as to make them a probable factor in the industry during 1910.

The output of natural cement showed a continuance of the decline which has been underway since the beginning of the present decade. The total was 549,364 barrels valued at $361,605, against 623,588 barrels valued at $441,136 in 1908. Three companies in the Rosendale district contributed 487,864 barrels to the total; Onondaga and Erie counties contributed the remainder.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1890	65 000	$140 000	3 776 756	$2 985 513
1891	87 000	190 250	3 931 306	3 046 279
1892	124 000	279 000	3 780 687	3 074 781
1893	137 096	287 725	3 597 758	2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689
1906	2 423 374	2 766 488	1 691 565	1 184 211
1907	2 108 450	2 214 090	1 137 279	757 730
1908	1 988 874	1 813 622	623 588	441 136
1909	2 061 019	1 761 297	549 364	361 605

CLAY

BY HENRY LEIGHTON

New York State has an abundance of clay deposits suitable for the manufacture of all materials not requiring a white-burning or a refractory clay.

The Hudson river and Champlain depression furnish excellent red-burning clays for brickmaking and for a few other special uses, while glacial clays, both buff and red-burning, are widely distributed throughout the remainder of the State.

White-burning and refractory clays are found in the State only on Long Island and Staten Island. The irregular pockety nature of the deposits and the extensive use of New Jersey material have limited the use of these clays but their proximity to New York city may in time bring them into more prominence. Notwithstanding the lack of suitable clays near at hand, a number of porcelain, china and fire brick manufactories are in operation in the State and their production is constantly increasing.

The use of the Devonic shales of western New York for the manufacture of tile, paving brick, terra cotta etc., is continuing to increase and the value of shale brick as a high grade building material is becoming more widely known.

Production of clay materials

During the past year the clay-working industry partially recovered from the depression experienced in 1908. Building operations, as shown by the building permits granted, showed a largely increased activity. In New York city in May 1909, 352 buildings with an aggregate value of $18,620,491, were erected as against 204 with a value of $7,585,150 in 1908, or a gain of 145 per cent. In the same month, buildings erected in Buffalo showed a gain over the corresponding month of 1908 of 23 per cent. During the whole year the percentage of gain in building operations was most noticeable. This activity was reflected strongly on the output of structural clay materials and a return to nearly the production of 1907 was made.

The aggregate value of all clay manufactures in 1909 was $12,351,482 against $8,918,863 in 1908 and $12,688,868 in 1907. The number of firms or individuals engaged in the industry was 232 against 242 in 1908, while 42 of the 61 counties in the State participated in the industry. Examination of the output classified as to classes of material, brings out the fact that the increase was felt mainly among the structural materials. Common and front brick, architectural terra cotta, fireproofing, building tile and pottery all show large advances over the year 1908. Common brick shows the largest increase, being valued

at $8,009,766 against $5,064,194 in 1908. Front brick increased from $136,757 in 1908 to $149,330 in 1909; terra cotta from $709,360 in 1908 to $962,497 in 1909; fireproofing from $91,377 to $166,025. On the other hand, products not directly used in building operations, with the exception of pottery, showed a decreased output. Fire brick and stove lining were produced to a value of $486,894 against $545,951 in 1908; drain tile amounted to $268,589 against a production in 1908 of $273,134; paving brick had an output of $207,970 against $211,289 in 1908; and sewer pipe amounted to $117,324 against $133,716 in 1908.

Ulster continues to hold first place among the counties in total production of clay materials, the total value reported from it for the year being $1,620,468, a large gain over the year 1908. As in 1908 Rockland county held second place with an output of $1,488,457; Dutchess county with an output of $880,707 took third place while Onondaga was fourth with a value of $834,111. Other counties reporting productions of over $400,000 were Orange ($814,440); Erie ($753,362); Albany ($750,754); Richmond ($698,991); Kings ($490,946); Columbia ($472,280); Westchester ($438,243) and Queens ($435,182). The output of the first three counties, Ulster, Rockland and Dutchess, is made up almost wholly of common brick, while Onondaga county, the fourth in rank, produces large quantities of china ware.

Production of clay materials

MATERIAL	1907	1908	1909
Common brick	$7 201 525	$5 064 194	$8 009 766
Front brick	222 769	136 757	149 330
Vitrified paving brick	184 306	211 289	207 970
Fire brick and stove lining	624 033	545 951	486 894
Drain tile	162 167	273 134	268 589
Sewer pipe	463 500	133 716	117 324
Terra cotta	1 224 300	709 360	962 497
Fireproofing	45 672	91 377	166 025
Building tile	215 126	70 162	54 397
Miscellaneous	104 575	29 680	101 497
Pottery	2 240 895	1 653 241	1 827 193
Total	$12 688 868	$8 918 863	$12 351 482

Production of clay materials by counties

COUNTY	1907	1908	1909
Albany	$540 341	$538 213	$750 754
Allegany	111 751	44 627	22 601
Broome	8 250	*a*	nil
Cattaraugus	41 234	*a*	*a*
Cayuga	14 832	13 280	15 400
Chautauqua	113 350	128 866	118 897
Chemung	88 940	89 000	61 000
Clinton	4 250	3 920	*a*
Columbia	433 357	283 720	472 280
Dutchess	781 262	605 371	880 707
Erie	786 703	632 048	753 362
Fulton	2 000	*a*	*a*
Greene	237 620	113 373	346 982
Jefferson	20 352	17 897	11 175
Kings	574 863	416 474	490 946
Livingston	*a*	53 555	6 900
Madison	32 000	12 550	*a*
Monroe	583 664	240 087	278 991
Nassau	105 000	71 390	136 375
Niagara	16 282	10 892	22 923
Oneida	98 315	88 606	83 500
Onondaga	1 331 443	734 880	834 111
Ontario	342 810	214 246	196 345
Orange	789 297	747 637	814 440
Queens	*a*	*a*	435 182
Rensselaer	321 016	233 995	317 559
Richmond	1 121 524	587 919	698 991
Rockland	1 258 467	800 603	1 488 457
Saratoga	256 275	245 878	335 670
Schenectady	83 637	238 750	322 549
Steuben	186 124	166 544	205 036
Suffolk	127 610	125 430	68 370
Tompkins	7 100	*a*	*a*
Ulster	1 324 476	819 947	1 620 468
Warren	25 000	*a*	*a*
Washington	22 990	11 295	10 950
Westchester	390 773	226 062	438 243
Other counties*b*	505 960	401 808	112 318
Total	$12 688 868	$8 918 863	$12 351 482

a Included under "Other counties."
b Includes in 1907 Genesee, Herkimer, Livingston, Montgomery, New York, Queens, St Lawrence, Seneca and Wayne counties. In 1908, aside from counties marked *a* are included Genesee, Herkimer, Montgomery, New York, St Lawrence, Tioga and Wayne counties. In 1909, aside from counties marked *a* includes Genesee, Montgomery, New York, St Lawrence, Tioga and Wayne counties.

Manufacture of building brick

The output of common building brick in 1909 amounted to 1,507,126,000 valued at $8,009,766, a production exceeding that of any previous year with the exception of 1906. The production in 1908 was 1,056,769,283 brick valued at $5,064,194 while

that for 1907 amounted to 1,351,591,000 with a value of $7,201,-525. In addition to the common brick there were manufactured in 1909, 10,897,000 front brick valued at $149,330 as against 9,763,649 valued at $136,757 in 1908. The total output of brick used for building purposes was, therefore, 1,518,023,000 brick valued at $8,159,096 against 1,366,842,000 valued at $7,424,-294 in 1908. The manufacture was carried on by 180 companies or individuals in 36 counties. In 1908, 196 plants were in operation in 37 counties.

The average price per thousand, received for the common brick in 1909, as based on sales at the yard was $5.31 as against $4.79 in 1908 and $5.33 in 1907. The average value of the front brick was $13.70 a thousand against $14 in 1908 and $14.61 in 1907.

Production of common building brick

COUNTY	1908		1909	
	Number	Value	Number	Value
Albany	55 677 000	$255 013	80 343 000	$429 554
Cayuga	1 309 000	8 480	1 612 000	10 200
Chautauqua	8 046 011	50 919	7 815 000	52 047
Chemung	14 833 000	89 000	10 500 000	61 000
Clinton	640 000	3 920	250 000	1 500
Columbia	61 971 000	283 720	88 026 000	472 280
Dutchess	132 003 973	605 371	170 615 000	876 207
Erie	35 960 325	202 943	43 379 000	243 786
Greene	12 094 825	57 923	42 794 000	246 982
Jefferson	2 321 749	17 897	1 450 000	11 175
Livingston	490 000	3 555	1 100 000	6 700
Monroe	15 617 815	93 730	23 493 000	126 950
Nassau	11 675 000	63 890	20 000 000	118 560
Niagara	1 543 014	10 892	3 368 000	22 923
Oneida	17 436 000	83 731	16 000 000	83 500
Onondaga	14 028 000	76 030	22 800 000	154 250
Ontario	2 768 000	16 946	2 350 000	14 200
Orange	151 869 000	747 637	164 680 000	814 440
Rensselaer	10 949 400	60 723	19 895 000	102 225
Richmond	25 398 500	89 083	37 500 000	170 475
Rockland	173 926 094	800 603	275 262 000	1 488 457
Saratoga	51 034 000	243 728	70 539 000	333 728
Steuben	2 651 080	21 870	3 480 000	30 132
Suffolk	20 108 150	122 430	11 870 000	68 370
Ulster	179 165 560	816 947	304 904 000	1 620 468
Westchester	39 801 577	184 774	72 265 000	392 577
Other counties[a]	9 452 400	52 639	10 836 000	57 080
Total	1 056 769 283	$5 064 194	1 507 126 000	$8 009 766

[a] Includes in 1908, Allegany, Broome, Fulton, Herkimer, Montgomery, St Lawrence, Schenectady, Tioga, Tompkins, Warren and Washington. In 1909 the following counties are included: Allegany, Cattaraugus, Fulton, Montgomery, St Lawrence, Steuben, Tioga, Tompkins, Warren and Washington.

Hudson river region. By far the greater part of the output of common brick comes from nine counties bordering the Hudson river from Albany and Rensselaer counties southward. In this area the banks of the river are made up of a series of terraced deposits of clay with occasional sands or gravels. This more or less continuous clay bed is one of the most extensive in the United States and supports a brickmaking industry second to none in America or Europe.

The clays which are very constant in character are bluish in color, weathering to red at the surface and are rather calcareous

containing usually about 4 to 5 per cent of calcium oxid. They burn to a good red color, incipient fusion taking place at cone .05 and vitrification at .04. Besides the main use as material for soft mud brick, the clay has been successfully utilized in the manufacture of roofing tile and certain beds are used as a slip clay for glazing pottery.

The brick are manufactured entirely by the soft mud process and are burned in scove kilns, modern methods seemingly taking slight hold in the district.

The importance and growth of the industry in the region has been due to the ease with which the clay can be mined from the terrace, manufactured practically on the dock, and loaded directly onto barges and shipped to New York city.

The year 1909 showed a marked improvement in business conditions and an increased activity in building operations. This activity was felt in the Hudson river yards and a much larger output of brick was made. The total output was 1,218,-784,000 brick valued at $6,443,190 of which all but 210,000,000 were shipped, reliable estimates giving that amount as held over. This would give as the total sales 1,008,784,000 as against 817,459,000 in 1908. The figures in the tables for 1909 represent the total manufactured while in 1908 they are given as the total sold.

The increased output was accompanied by such an increased demand that prices showed a gratifying increase, the average price per thousand being $5.28 against $4.75 in 1908 and $5.20 in 1907. There were 119 plants in operation with an average production of 10,326,000, against 114 plants with an average output of 7,171,000 in 1908. As in former years Ulster county had the lead in production with a total of 304,904,000 brick valued at $1,620,468, against 179,166,000 valued at $816,947 in 1908. Rockland county held second place as heretofore, while Dutchess county ranked third, displacing Orange county which held third place in 1908.

Output of common brick in the Hudson river region in 1908

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	55 677 000	$255 013	$4 57
Columbia	4	61 971 000	283 720	4 57
Dutchess	18	132 004 000	605 371	4 58
Greene	4	12 095 000	57 723	4 77
Orange	8	151 869 000	747 637	4 92
Rensselaer	6	10 949 000	60 723	5 54
Rockland	29	173 926 000	800 603	4 60
Ulster	26	179 166 000	816 947	4 55
Westchester	7	39 802 000	184 774	4 64
Total	114	817 459 000	$3 812 511	$4 75

Output of common brick in the Hudson river region in 1909

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	80 343 000	$429 554	$5 34
Columbia	5	88 026 000	472 280	5 36
Dutchess	19	170 615 000	876 207	5 13
Greene	5	42 794 000	246 982	5 77
Orange	8	164 680 000	814 440	4 93
Rensselaer	6	19 895 000	102 225	5 64
Rockland	30	275 262 000	1 488 457	5 40
Ulster	26	304 904 000	1 620 468	5 31
Westchester	8	72 265 000	392 577	5 43
Total	119	1 218 784 000	$6 443 190	$5 28

Other clay materials

The manufacture of vitrified paving brick was carried on by three companies in Chautauqua, Greene and Steuben counties, as against five companies in 1908. The output was 12,778,000 brick valued at $207,970 against 14,570,140 valued at $211,289 in 1908. The average price per thousand was $14.50 in 1908 and $16.27 in 1909. There was a decided decrease in the production of fire brick and stove lining in the State, the total output of fire brick being $411,796 and of stove lining $75,098 against values of $442,967 and $102,984 respectively in 1908.

Eleven companies were active during the year and the industry showed little change aside from the general decrease in manufacture. The material for these products is all obtained outside of the State, mostly from New Jersey.

The manufacture of drain tile and sewer pipe is carried on in Albany, Cayuga, Erie, Genesee, Kings, Madison, Monroe, Onondaga, Ontario, Saratoga, Washington and Wayne counties. The output of drain tile in 1909 amounted to $268,589 against $273,184 in 1908. Eighteen companies are represented in the output, while the two leading counties were Erie and Ontario. This product is used mainly for underdraining farm land, and the education of the farmer along such lines has been instrumental in recent years in increasing the demand for tile.

Sewer pipe is manufactured in the State by but three firms located in Brooklyn and Rochester. The value of the output in 1909 was $117,324 against $133,716 in 1908 and $463,500 in 1907, a constant decrease for which the underlying cause is not apparent.

Fireproofing, including terra cotta lumber, hollow brick, and various other kinds of hollow terra cotta fireproofing, is manufactured mainly from local materials, in Erie, Kings, Monroe, New York, Onondaga and Rensselaer counties, six firms being represented in the output. The output for the year was $166,025 against $91,377 in 1908. The output for 1909, however, includes some hollow brick, heretofore included with common building brick.

Building tile, including roofing tile, vitrified floor tile and a terra cotta tile similar to fireproofing was manufactured in Allegany, Kings and Monroe counties by six firms. The total value of the output for 1909 was $54,397 against $70,162 in 1908.

The roofing tile industry is one deserving more prominence among the clay-working activities of the State. Two firms, the Alfred Clay Co., and the Ludowici-Celadon Roofing Tile Co., manufacture this product at Alfred, Allegany co., while in Malden, Ulster co., the industry has, in recent years, been undertaken. One firm, the German American Roofing Tile Co., is at present turning out a good grade of tile from a small plant but as yet supplies only a local trade. Roofing tile are becoming more popular in this country on account of their beauty and durability, and with suitable clays at hand at both Malden and Alfred, a larger industry should be established. The plant of

the Ludowici-Celadon Co. was destroyed by fire in the fall of 1909 and has not yet been rebuilt.

Vitrified floor tile are manufactured by but one firm, the Brooklyn Vitrified Tile Works of Brooklyn.

Architectural or ornamental terra cotta is manufactured by three large firms located in Queens, Richmond and Steuben counties. The output for the year 1909 amounted to $962,497 against $709,360 in 1908, an encouraging increase.

Pottery

Clays suitable for the finer grades of pottery products, such as china and porcelain ware, are not found to any extent in the State. The clay beds of Long Island and Staten Island have furnished some grades of stoneware clay and these are at times used in the New York and Brooklyn plants. The main supply of material for china making, however, must be shipped in from without the State; the feldspar from Canada, the kaolins from the south, and the stoneware clays from New Jersey.

Of the commoner grades of clay used for red earthenware manufacture, the State has an abundance but the demand for such ware is not sufficient to establish any extensive industry.

The total production of pottery in the year amounted to $1,827,193 as compared with $1,653,241 in 1908, indicating a marked advance. The production came from 23 plants located in the following counties: Albany, Erie, Kings, Nassau, Onondaga, Ontario, Schenectady, Washington and Westchester. Onondaga county continues to lead in production with a total from the six active plants of $671,566 while, Erie, Schenectady, Kings and Ontario counties also have large productions.

The manufacture of stoneware seems to be steadily declining in the State, the production in 1909 amounting to $41,298 or less than one half of the production in 1906.

Red earthenware, consisting mainly of flower pots, shows a production of $32,800 or about the same as has been reported for several years. The increase in production was confined mainly to the white products not made from New York materials, such articles being china tableware, sanitary ware and electrical supplies. The china tableware is made mainly in Buffalo and Syracuse; the electrical supplies in Victor, Syracuse, Schenectady and Brooklyn; and the sanitary ware in New York and Brooklyn.

Value of production of pottery

WARE	1907	1908	1909
Stoneware	$65 271	$44 712	$41 298
Red earthenware	28 296	31 645	32 800
Porcelain and semiporcelain*a*	1 181 162	900 548	999 663
Electric and sanitary supplies	869 378*b*	595 247	697 573
Miscellaneous	96 788	81 089	55 859
Total	$2 240 895	$1 653 241	$1 827 193

a Includes china tableware and cream-colored ware.
b Includes a value of about $200,000 for hardware trimmings used in electric supplies.

Crude clay

In the foregoing tables relating to clay products no account has been taken of the crude material entering into their manufacture. There are a few producers in the State who do not utilize the crude clay themselves but ship their output to others for manufacture. The clay most widely exploited for shipment is the slip clay found within the city limits of Albany and known to the trade as "Albany slip." This clay belongs to the terrace clays of the Hudson valley. It resembles in appearance the general run of Hudson river brick clays, but in chemical composition differs in having much larger percentages of the alkalis, soda and potash. These fluxing impurities give to the material a low fusibility and it is therefore in demand as a natural glaze for stoneware, giving to such products a rich, brown glaze.

In addition to the output of slip clay, refractory and white-burning clays are mined and shipped from Long Island and Staten Island. Kaolin for paper sizing is mined at Shenandoah, Dutchess co., and pottery clays are shipped from various points in the State, shipments in 1909 being made from Warners and Amboy Station, Onondaga co.; Chili, Monroe co.; and Amenia, Dutchess co.

The total production for 1909 amounted to 12,174 short tons valued at $11,585, against 4697 tons valued at $11,605 in 1908. The total tonnage seems to have increased while the value remained the same, which was no doubt due to the fact that a large proportion of the clay shipped in 1909 was of a lower grade and sold at a lower figure. Seven producers figured in

the output, two producing slip clay; one, fire clay; one, paper clay; and three, potters clay.

EMERY

The emery mines in Westchester county increased their output last year by about 200 tons. The product reported was 892 short tons valued at $10,780 as compared with 690 short tons valued at $8860 in 1908. The production was still considerably below the average as the annual shipments have usually exceeded 1000 tons. The poor showing may be attributed to a decrease in the demand for abrasives which was noted as well in other branches of the productive industry.

The statistics of output are based upon the crude material as shipped from the mines where it undergoes only a rough sorting or cobbing. The emery is mainly shipped to Pennsylvania for grinding and manufacture. The producers in 1909 were as follows: Blue Corundum Mining Co., Easton, Pa., Keystone Emery Mills, Frankford, Pa., and the Tanite Co., Stroudsburg, Pa. The Hampden Corundum Wheel Co. of Springfield, Mass., and J. R. Lancaster of Peekskill who in the past have been actively engaged in the industry made no output last year.

The New York emery is a mixture of corundum, spinel and magnetite in varying proportions. It occurs as a hard, dense rock, of dark gray to nearly black color, sometimes showing the corundum in well developed prismatic crystals of lighter shade. The corundum, which of course is the more valuable constituent, may constitute as much as 50 per cent of the entire mass, or it may be subordinate to the other ingredients. The emery occurs in the form of lenses and bands within basic igneous rocks of the gabbro family. It is the result of segregation of the heavier rock minerals, and the deposits are analogous to the bodies of titaniferous magnetites which occur in gabbroic rocks. Some of the deposits, indeed, contain a fairly high percentage of magnetite and were once mined for iron ore, but the material proved too refractory for use in the blast furnace.

FELDSPAR

There was no notable change in the feldspar industry during 1909. The demand for the better quality of feldspar which is used in pottery manufacture continued dull and prices showed

little improvement from the low level of the previous year. The production of this grade consequently did not attain the usual proportions. The quarries of roofing feldspar were more active and the demand for the material seems to have been nearly normal. The greater part of the output belonged to that grade which is really a crushed pegmatite containing more or less quartz, mica and other ingredients in addition to feldspar.

The production for the year amounted to 13,871 short tons valued at $46,444, as compared with 14,613 short tons valued at $53,148 in 1908. There were four companies who contributed to the output, the several quarries being situated in Westchester, Essex and Saratoga counties.

Most of the pottery feldspar was quarried in Westchester county by P. H. Kinkel's Sons, though the Adirondack Spar Co. made a small output from their property at Batchellerville, Saratoga co., also the Crown Point Spar Co., of Crown Point shipped a small quantity which was obtained in the course of operations for the production of roofing materials. The Barrett Manufacturing Co., with quarries near Ticonderoga, produced roofing feldspar alone. In addition to feldspar the shipments from the quarries included some rock quartz and scrap mica. The quartz came from Westchester county and was used for the manufacture of wood filler. The production of mica was reported by the Crown Point Spar Co. as a by-product of milling operations. The combined value of these materials amounted to $7000.

The average value of the pottery grades in 1909 was about $3 a long ton for crude and $6 a short ton for ground feldspar. The crushed feldspar for roofing and poultry grit brought $2.75 and $3 a short ton.

No new quarries were opened during the year and the trade situation gave little encouragement to exploratory work. The only change in the list of producers was occasioned by the transfer of the property formerly worked by the Claspka Mining Co. to the Adirondack Spar Co. of Glens Falls.

GARNET

The abrasive garnet trade in 1909 made some progress toward recovery from the severe depression of the preceding year, but it did not attain great activity. After such an extreme decline a more decided upturn might have been expected. The

general record of the mining industries showed, however, that the improvement was slow during the year and conditions on the whole were scarcely so prosperous as had been depicted in current reports. There was no evidence of any developments unfavorable to the Adirondack garnet mines in particular, and a more active market may be anticipated for the coming season.

The production of garnet last year amounted to 3802 short tons with a value of $119,190. The gain over the output for 1908, which was 2480 tons valued at $79,890, was thus more than 50 per cent, but it may be doubted if the consumption showed a corresponding increase. The total for 1907, the largest on record, was 5709 tons valued at $174,800. Prices remained practically unchanged; they have fluctuated only slightly in recent years, the average being between $30 and $35 a ton.

No new mines were opened in 1909. The producing companies included the North River Garnet Co. with mines at Thirteenth lake; the American Glue Co. and H. H. Barton & Sons who worked properties near North river; and the American Garnet Co. who operated the Smith mine on Mt Bigelow in northern Essex county.

The Adirondack garnet that is mined belongs to the common iron-bearing variety and the better grades have a deep red color. It is associated with a basic rock of which plagioclase feldspar and hornblende constitute the other ingredients. The rock shows the effects of metamorphism and the garnet is probably the result of a recrystallization. The garnet crystals are of variable size; those found on Gore mountain near North river often measure a foot or more in diameter and a single crystal has yielded more than a ton of abrasive; elsewhere in the region the crystals seldom exceed a diameter of 5 or 6 inches. The fact that the garnet is more or less shattered facilitates its recovery by hand picking which is practised by all but one of the companies. When the large crystals are broken into, they crumble under slight pressure and can be removed from the matrix without much difficulty. The fragments generally exhibit smooth surfaces on one or more sides due to a well developed parting, and this feature adds considerably to the efficiency of the Adirondack garnet for abrasive uses. The fractured condition of the crystals is probably the result of regional compression, evidences of which are ob-

servable in extensive crushing and faulting of the country rocks.

The deposit on Mt Bigelow is of different character than the others. The garnet there is found along the contact of anorthosite in irregular and lenticular bodies that consist in greater part of the single mineral. It has a massive appearance and breaks into granular particles but occasionally shows a platy fracture like the crystal garnet. The principal impurity is a greenish pyroxene. The masses measure as much as 40 feet in thickness. Along with the garnet there are bands of amphibolite and crystalline limestone, the whole assemblage having the appearance of a sedimentary series which has been caught up by the anorthosite during its intrusion and metamorphosed.

The capacity of the mines is much greater than the average output. The production could be raised to 10,000 tons a year without taxing the present facilities. The North River Garnet Co. has the only property that is equipped for work throughout the year. It is the only company also that makes use of mechanical methods for recovery of the garnet. The mines and mill are situated on the slope of a mountain on the east shore of Thirteenth lake. The whole western face of the mountain consists of the garnet rock, the supply of which is practically inexhaustible. The rock is crushed and then run through special types of jigs. Close work is required of these in order to effect a separation of the garnet and hornblende which differ by only half a unit in their specific gravity. The garnet concentrates, however, are brought up to a high degree of purity.

The shipping point for the region is North Creek. The garnet is shipped unsized in bags.

The manufacture of garnet abrasives in this country is limited to a few companies and there is very little demand for the mineral for export. The mining field, therefore, can not offer encouragement to new developments so long as present facilities remain so largely in excess of the market requirements.

In the last two or three years a small quantity of Spanish garnet has been imported into the United States for manufacture. This garnet is said to be obtained from river sands. It is cheaper than the domestic garnet, but on account of its uniformly small size is useful only in a limited way. The imports for the year 1909 amounted to 536 short tons valued at $10,315.

The ports of entry are New York and Boston. The value of the garnet averaged $19.29 a short ton. In 1908 the imports amounted in value to $2095 and in 1907 to $6432.

GRAPHITE

The production of crystalline graphite in the Adirondack region made a good gain last year, but the increase was due to a more active campaign on the part of the principal enterprise and not to any contribution by new mines. There were no important changes in the mining situation. The increase of output, which amounted to about 20 per cent as compared with the total returned for 1908, did not suffice, however, to bring up the production to the record of earlier years. Market conditions were favorable in spite of the general business depression; the best grades of flake graphite from the Adirondacks have always commanded prices above the average and these have shown recently a marked upward tendency.

The American Mine of the Joseph Dixon Crucible Co. occupied, as heretofore, the leading place in the industry. For many years it has been the largest and most successful enterprise of the kind in the country. Its position has been attained through experienced management and the perfection of its methods for the separation and refining of the graphite. It has had also the advantage of an unusually rich deposit for its type, combined with certain features which make the graphite more easily recoverable than is often the case. The quartzite that constitutes the matrix is practically free from other scaly minerals and the graphite flakes are of large size.

Adjoining the American mine on the southwest, the property of W. H. Faxon of Chester, N. Y. has been explored recently with promising results. The same series of quartzites, limestones and gneisses are in evidence, though the graphite deposits appear to occupy a higher position than those of the American mine. That they are not a direct continuation of the latter is apparent from a field examination and is further indicated by slight differences in their character. There are two beds of graphitic quartzite separated by garnetiferous gneiss. The upper or main bed measures from 6 to 14 feet thick; and the lower one about 4 or 5 feet. They are cut off at the southwest end by a diabase dike, near which they are also slightly thrown by a transverse fault. The beds have been exposed along the

outcrop by test pits and explored on the dip by drilling so as to prove their persistence over a large area. The average rock is fairly uniform in graphite which is of somewhat finer flake than that obtained from the American mine. It is planned to make mill tests during the current season; if they are favorable the construction of a large plant and the active exploitation of the deposits may be anticipated.

GYPSUM

The gypsum industry which has advanced very rapidly in the last few years continued its progress during 1909. Though no new mines or quarries began active work within the period, increased operations on the part of the enterprises who recently entered the field, in the natural course of development, brought about a considerable gain of output. Trade conditions were still somewhat unsettled and from that standpoint the showing was better than might have been expected.

The output of crude gypsum amounted to 378,232 short tons, against 318,046 short tons in 1908, an increase for the year of 60,186 short tons or nearly 20 per cent. The production was reported as 323,323 tons in 1907; 262,486 tons in 1906 and 191,860 tons in 1905; so that it has almost doubled within the last five years.

Of the quantity of crude rock that was mined or quarried in 1909 about 70 per cent was converted into calcined plasters by the producing companies. Their reports showed a total of 209,223 tons of plaster of paris and wall plaster manufactured, with a value of $699,110. In 1908 the total was 160,930 tons valued at $574,757. The amount of gypsum ground for land plaster was 9468 tons valued at $19,283, against 5712 tons valued at $14,255 in the preceding year. The quantity sold in crude state for mixture in portland cement and for calcination in plaster mills outside the district was 126,606 tons valued at $189,-208 against 95,146 tons valued at $171,747 in 1908.

Production of gypsum

MATERIAL	1908		1909	
	Short tons	Value	Short tons	Value
Total output, crude	318 046	.....	378 232	.....
Sold crude	95 146	$171 747	126 606	$189 208
Ground for land plaster	5 712	14 255	9 468	19 283
Wall plaster, etc. made	160 930	574 757	209 223	699 110
Total value	.....	$760 759	.....	$907 601

The principal developments in the industry in recent years have centered about the western localities, and these now furnish most of the supply. Genesee county is the largest producer of crude gypsum, as well as of manufactured materials, like land plaster, plaster of paris and wall plasters. Its output of crude rock in 1909 amounted to 259,321 short tons. Monroe county which ranked as the second largest producer reported an output of 90,970 short tons. The rest of the gypsum came from Onondaga, Cayuga and Erie counties.

The following brief account of the gypsum resources of the State and their industrial development has been taken from a report, now in press, for the State Museum.

NOTES ON THE GYPSUM DEPOSITS OF NEW YORK

Distribution of gypsum. The workable gypsum beds of New York are found in the Salina stage of the Upper Siluric or Ontaric system. There are two main areas of Salina strata, of which the larger is represented by a belt that extends with unbroken continuity from Albany county through central and western New York to the Niagara river and thence into the province of Ontario. The Salina of this area is mainly a shale formation. The other elements are gypsum which occurs in the upper shale beds, rock salt near the middle of the section, and limestone which is present in the central and western parts as a thin capping to the shale and also occurs in bands of inconsiderable thickness within the shale itself. The sequence is here shown in order from the highest to the lowest member:

5 *Bertie waterlime.* An argillaceous magnesian limestone, possessing hydraulic properties. Its thickness ranges from about 50 feet in Erie county to 10 feet or less in eastern New York. Used for natural cement.

4 *Camillus shale.* Drab, gray, green and red shales with beds of gypsum and dolomite in the upper part. Smaller seams and veins of gypsum are found all through the shale. The total thickness reaches 300 feet in the central part of the State.

3 *Syracuse salt.* An assemblage of alternating beds of rock salt and shale, not definitely delimited with regard to the Camillus and Vernon shales. The presence of rock salt is the only criterion for its recognition. The salt beds have not been found east of Madison county and they occur only under a thick covering where they have been protected from solution.

2 *Vernon shale.* A prominent member of the Salina in the section west from Herkimer county. Has a thickness of 500 feet in Onondaga county. It is distinguished by a bright red color except in the western part where it is banded with gray and green shales and becomes less conspicuous.

1 *Pittsford shale.* A local phase of the Salina, notable only for its Eurypterid fauna. The type locality is near Rochester.

The second area of Salina strata is in southeastern New York and consists of two belts, one of which follows the Shawangunk mountain uplift and the other the parallel Skunnemunk uplift. The principal members are conglomerate, shale and sandstone. No gypsum has been found in this region and in view of the fact that the strata here were accumulated in a separate basin, entirely independent of the other, its presence may be regarded as very uncertain.

General features of the deposits. The gypsum as a rule forms regularly stratified beds which are made up of layers varying from a few inches to 4 feet or so thick. The beds are not, of course, continuous throughout the Salina belt, but have the shape of elongated lenses which follow each other along the strike and dip with intervals in which they may be absent or of greatly diminished size. The workable deposits are thus segregated into more or less well defined areas. When exposed in natural outcrop the beds are apt to show irregularities due to solution of the gypsum by ground waters; in this way the entire removal of the gypsum seems to have resulted in some places where it was only thinly covered by shale or limestone.

The main deposits lie within the upper part of the Camillus shales and as the whole formation has a slight southerly dip (about 1 foot in 100), their line of outcrop is near the southern border of the Salina belt as traced on the map. A useful indicator in the field is the Bertie waterlime which is more resistant to weathering than the shales and which can often be located by the character of the topography. The gypsum usually occurs within a few feet of the base of the waterlime.

The deposits exhibit a considerable variation of character in different parts of the belt. In Madison county, on the eastern end, they consist of a loose friable mixture of gypsum crystals (selenite) and clay, and have originated seemingly by solution and recrystallization of former beds or disseminated gypsum. These deposits

are not well stratified but form pockets and larger masses of lenticular and irregular shape of perhaps a few hundreds of feet in area. In exposure the clear gypsum, freed from the admixed clay, lends a semblance of purity to the deposits which is very deceptive; the actual gypsum content is usually less than 75 per cent. The deposits are worked only as a source of material for land plaster.

The deposits that are worked in Onondaga county and in the counties to the west, belong to the usual stratified type and are more homogeneous than those first described. They are made up of finely divided gypsum fibers or minute crystals forming a felted mass in which the impurities are evenly distributed. The color of the gypsum varies from gray or drab to nearly white.

The maximum development of the gypsum is reached in Onondaga county where there is a single bed 60 feet thick consisting of a number of individual layers which vary somewhat in appearance and color, though they are quite uniform in regard to gypsum content. This bed is exposed in the townships of Dewitt and Manlius, east of Syracuse, where it is quarried for land plaster, for admixture with portland cement, etc. In western Onondaga county, the gypsum as seen in outcrop has a thickness of 15 or 20 feet.

Near Union Springs, Cayuga co., a deposit from 20 to 30 feet thick is worked.

The Salina belt crosses Seneca, Wayne and Ontario counties and deposits of workable dimensions are found at frequent intervals. No production has been made from this section in recent years, though some of the gypsum, notably in Ontario county, is of very good quality. In the town of Victor, two beds, 8 feet and 6 feet thick, have been found by drilling and the drill cores indicated a close resemblance to the gypsum at Garbutt, Oakfield and Akron farther west.

The deposits are encountered in the town of Wheatland, Monroe co. and are there mined on an extensive scale for the manufacture of calcined plasters and for other purposes. Two beds are generally present, separated by 6 feet or more of limestone. The upper bed measuring from 5 to 8 feet thick is mainly worked though the lower bed is of equal size and purity. The area at present developed covers about 3 square miles.

Another important locality is in the town of Oakfield, Genesee co., where a light-colored rock 4 feet or more thick is extensively mined and employed in calcined plaster manufacture. The plaster works near Oakfield Station are the largest in the State.

In Erie county, the whole middle of which is crossed by the Salina belt, mines have been recently opened near Akron, 20 miles east of Buffalo. The bed is 4–5 feet thick, light-colored and well adapted for calcination. It is probable that gypsum occurs also in the interval between Akron and Buffalo, though no records of its discovery have been made known. A series of test wells put

down by the Buffalo Cement Co., at Buffalo several years ago showed two beds of white gypsum each 4 feet thick. The upper bed was encountered at 43 feet from the surface and the lower one at 62 feet, with a 2 foot bed at 49 feet. An attempt to explore the upper bed by a vertical shaft was relinquished after meeting a heavy flow of water and nothing has been done since toward the development of the deposits.

Chemical composition of the gypsum. Analyses of average samples of the deposits from different localities recently made for the State Museum, indicate that the gypsum content ranges between the general limits of 64 or 65 per cent and 95 per cent. The quality seems to improve toward the west. The impurities are mainly clay, lime and magnesia carbonates and quartz.

	1	2	3	4	5
SiO_2	.51	.40	2.93	4.00	8.31
Al_2O_3	1.19	2.97	1.92	1.74	4.53
Fe_2O_3	.79	.77	1.10	1.11	1.34
CaO	30.62	30.76	26.27	29.36	21.50
MgO	1.20	1.53	8.29	2.81	7.20
SO_3	43.59	43.78	33.83	35.79	30.47
CO_2	1.02	2.80	11.02	6.38	9.50
H_2O	20.52	17.53	14.87	17.93	14.53
	99.44	100.54	100.23	99.12	97.38
Gypsum calculated	93.74	94.26	72.84	77.06	65.49

1 Akron, Erie co. 2 Oakfield, Genesee co. 3 Garbutt, Monroe co. 4–5 Lyndon, Onondaga co. Analyses are by George E. Willcomb.

Methods of extraction. The gypsum beds of the eastern section are worked by quarry methods. The smaller pocket deposits have been exploited only in a desultory manner, their yield from year to year depending upon the local market for land plaster. More systematic operations are carried on in connection with the rock gypsum of Onondaga and Cayuga counties. The beds are exposed along the edges of hills with a variable covering of limestone and drift which is stripped off or allowed to fall into the excavation as the gypsum is removed from the face. The gypsum is broken down by drilling and blasting. Power drills of the percussion type and hand drills are both employed. As the quarry advances into the hill an increasing overburden is encountered and in the course of time may become a serious obstacle to the continuation of open quarry work. Operations are then either transferred to a new locality or changed to underground mining.

In the section west of Cayuga county the gypsum is worked underground, by means of an adit where the bed approaches close to the surface, otherwise by a vertical shaft. This method has

also been introduced recently in some of the Onondaga quarries. The main adit entries which serve for haulage are driven from 5 to 8 feet high and from 6 to 10 feet wide. The larger dimensions refer to the mines near Jamesville where the gypsum is excavated in large rooms and removed by 2-horse wagons that are loaded directly at the quarry face. When the beds are only 5 feet or so thick the rock is hauled out on mine cars attached to a cable. The size of the rooms ranges up to 30 feet square. The overlying limestone makes a firm roof and little artificial support in the way of timbering or packing is required.

The mines at Akron, Oakfield and Garbutt are entered by vertical shafts from 50 to 70 feet deep or by adits. The underground workings follow the pillar and room system but are more regularly planned than those of the adit mines. The mines are often electrically lighted, ventilated by forced draft and when necessary are drained by pumps which raise the water from a sump at the shaft bottom. Gas, electricity and steam are used for power purposes, the former being supplied from the natural gas belt of Erie co. Electric locomotives are in use for underground haulage, but in most mines the cars are pushed by hand or drawn by mules. The gypsum is drilled for blasting by either auger or percussion drills. For hoisting from the shafts, a bucket elevator is employed at one mine, while at the others single and balanced platform hoists are generally used. Most of the mines are connected with the milling plants by narrow gage railways.

Manufacture of gypsum plasters. A part of the gypsum from the mines and quarries is shipped in lump form to land plaster mills and portland cement works. The latter are also supplied with crushed gypsum which is shipped in bags. A small part is ground into land plaster by the mining companies. The remainder of the product, which represents the larger quantity, is converted into calcined plaster in plants run in connection with the mines.

The calcined plasters made by the mining companies belong to the half hydrate class, their basis being plaster of paris. No anhydrous plasters like Keene's cement or German flooring plasters are manufactured from the local gypsum. The preparation of plaster of paris requires the two operations of grinding and calcination.

Grinding is accomplished in several stages and if the kettle process of calcination is used the stages follow consecutively until the material is reduced to a fine powder. The coarse crushing is effected by jaw or gyratory crushers. From these the gypsum passes into a "cracker" which resembles a coffee mill and reduces the lumps to about pea size. After this treatment the gypsum is ready for charging into rotary cylinders, but for the kettle process it is next run through a fine grinder of which there are many kinds in use. Buhrstones, the Sturtevant emery wheel, the Williams disintegrator, the Stedman disintegrator and roller mills all find application for gypsum grinding.

The kettle method of calcination is employed by most of the local plaster manufacturers. The kettles are cylinders of boiler iron from 8 to 10 feet in diameter, nearly square in vertical section and set upright in a brick wall. The kettle is charged through a trap in the cover and heat is gradually applied, passing from the fire chamber below into flues which traverse the kettle horizontally, and out through a stack at the top. About 10 tons of gypsum are calcined in a single charge. It is necessary to keep the mass in constant agitation to prevent overburning, which is accomplished by means of a vertical shaft with paddles connected with the mill shafting. The end temperatures range from about 350° to 400° F. The rotary kiln is used in two plants; it possesses advantages in that it is continuous, requires less power to operate and is more economical of heat than the kettle. The type that has been installed is known as the Cummer kiln. The crushed rock passes through the cylinder in about 10 minutes and is discharged into brick-lined bins when the calcination is completed by the residual heat in about 36 hours. The plaster is then ground.

The calcined plaster in part is converted into wall plasters, plaster board, etc., and partly sold as stucco. Wall plasters are made from plaster of paris by the addition of some retarder, an organic or mineral substance which delays the time of setting, and of a fiber, such as hair, shredded wood or asbestos. Plaster boards are formed of layers of paper cemented with plaster of paris.

IRON ORE

The year 1909 was characterized by extreme fluctuations in the iron trade. During the first few months market conditions were little better than in 1908, which was a year of unrelieved depression. The mining companies were unable to contract for more than a fraction of their normal output and consequently operated on a small scale. There was even then a considerable surplus of ore which had to be stocked. By the middle of the year the market had experienced a decided improvement which finally brought an end to the long depression. Mining was then resumed at the usual rate and for the remaining months the demand for ore was sufficient to keep the mines running at their maximum capacity.

The output reported by the mines was 991,008 long tons valued at $3,179,358. This was practically an increase of 300,000 tons over the product for 1908 which amounted to 697,473 long tons valued at $2,098,247. The total fell somewhat short of the output in 1907 but with this exception was the largest reported in any year since 1891. The average value of the ore was $3.21 a ton against $3.01 a ton in 1908.

Classified as to variety the production consisted of 934,274 long tons of magnetite valued at $3,043,084 and 56,734 tons of hematite valued at $66,790. A large part of the magnetite (535,812 long tons) was marketed in the form of concentrates with an approximate average content of 65 per cent iron; the remainder (398,462 long tons) was shipped in lump form with a tenor ranging from about 52 to 60 per cent iron. The hematite ore, mainly from the Clinton belt in central and western New York, averaged about 40 per cent in metallic iron.

Altogether there were 12 companies which reported an output last year, against 10 companies in 1908 and 13 in 1907. The new producers were the Salisbury Steel & Iron Co., at Salisbury Center, Herkimer co., and the Ontario Iron Ore Co., at Ontario Center, Wayne co.

The accompanying table gives the production of iron ore distributed according to kinds for the period 1890–1909 inclusive. The statistics covering the years previous to 1904 are taken from the annual volumes of the *Mineral Resources* published by the United States Geological Survey. The production of magnetite as given in the table represents high grade ore and concentrates ready for the furnace and not the mine output which is considerably larger.

Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	Total value	Value per ton
	Long tons	Long tons	Long tons	Long tons	Long tons		
1890	945 071	196 035	30 968	81 319	1 253 393	.....	.....
1891	782 729	153 723	53 152	27 612	1 017 216	.....	.....
1892	648 564	124 800	53 694	64 041	891 099	$2 379 267	$2 67
1893	440 693	15 890	35 592	41 947	534 122	1 222 934	2 29
1894	.....	.....	.....	.....	242 759	.....	.....
1895	260 139	6 769	26 462	13 886	307 256	598 313	1 95
1896	346 015	10 789	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 999	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 985	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	329 467	66 389	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 899	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 894	2 15
1905	739 736	79 313	8 000	Nil	827 049	2 576 123	3 11
1906	717 365	187 002	1 000	Nil	905 367	3 393 609	3 75
1907	853 579	164 434	Nil	Nil	1 018 013	3 750 493	3 68
1908	663 648	33 825	Nil	Nil	697 473	2 098 247	3 01
1909	934 274	56 734	Nil	Nil	991 008	3 179 358	3 21

The list of active producers in 1909 included for the Adirondack region: Witherbee, Sherman & Co., and the Port Henry Iron Ore Co., at Mineville; the Cheever Iron Ore Co., Port Henry; the Chateaugay Ore & Iron Co., Lyon Mountain; the Benson Mines Co., Benson Mines; and the Salisbury Steel & Iron Co., Salisbury Center. The producers in southeastern New York were the Sterling Iron & Railway Co., Lakeville, and the Hudson Iron Co., Fort Montgomery.

The output of hematite was made by the Old Sterling Iron Co. with mines near Antwerp, Jefferson co.; Furnaceville Iron Co. and the Ontario Iron Ore Co., Ontario Center, Wayne co.; and C. A. Borst, Clinton, Oneida co.

Mineville. There was a good advance in the output of Mineville and if the demand for ore had been more active during the first part of the year the mines would have made a new record. The combined production of Witherbee, Sherman & Co., and the Port Henry Iron Ore Co. was 705,000 long tons, as compared with 502,663 tons in 1908 and 751,155 tons in 1907 which was the largest reported for any one year. The ore came from the Old Bed mines, including the Welch, "21," Joker and Bonanza workings, and the two Harmony shafts. The Barton hill mines of Witherbee, Sherman & Co. were under development but contributed no output. The new Clonan shaft which was started by the Port Henry Iron Ore Co., to tap "21" mine, was practically completed during the year, and should soon be in operation.

With a commendable policy of maintaining development and improvement work in advance of exploitation the Mineville companies have brought their mines and surface plants up to a high state of efficiency. The hoisting capacity is now well over 1,000,000 tons a year, which is larger than that of any other iron mining center in the east. From a technical point of view there are few iron mining localities anywhere of more interest than Mineville.

Among the improvements to the surface plants which have been underway during the year may be mentioned the new 800-ton mill, the third one to be constructed by Witherbee, Sherman & Co. This mill is situated between "A" and "B" shafts of the Harmony mines, the ore from which it is designed to treat. It is of fireproof construction, the materials being reinforced concrete and steel, and will cost $125,000 or more. The

plan of ore treatment will conform in general to that practised in the other mills, with such improvements as experience has suggested. The ore will undergo a preliminary crushing at the shaft houses and then be carried to a 1000-tone storage bin at the mill. After further reduction it will pass through Ball-Norton drum separators, then will be recrushed to ¼-inch size and separated on belt machines. The capacity of 800 tons in 10 hours for which the mill is designed will no doubt be considerably exceeded in practice. The development of the Harmony mines has yielded such favorable results that another mill was needed for handling their output.

The additional power required for the enlarged operations at Mineville has been provided for by the installation of a new 1500 kilowatt turbine engine at the Port Henry station. A low pressure turbine which uses the exhaust from a Corliss engine, has also been installed at the Mineville power house.

Some interesting developments have occurred in connection with recent explorations, through which additional light has been thrown upon the structure and geology of the ore bodies. The great Joker-Bonanza body has been shown to have quite different outlines on the southern section than had been anticipated, while another deposit apparently unconnected with it has been found in the footwall. These changes are indicated more definitely in a bulletin[1] recently issued by the State Museum.

A test hole put down in the old workings on Barton hill had reached (March 1910) a depth of about 1000 feet. The rock shown in the core belonged to the ordinary type that forms the walls of the principal ore bodies, with occasional bands of dark hornblendic gneiss. No gabbro was encountered in the section, though that rock occurs on the eastern slope of the hill. The ore-bearing gneiss thus continues without a break to a considerable depth below the point reached in the mine workings. Between the depths of 960 and 990 feet the rock was heavily charged with magnetite, but little ore was found.

Cheever mine. This, the oldest of the iron mines in the Port Henry district, has assumed new life after lying idle for many years. The ownership of the property, formerly held by O. S. Presbrey, who was instrumental in restoring it to activity, has

[1] Kemp & Ruedemann. Geology of the Elizabethtown and Port Henry Quadrangles. N. Y. State Mus. Bul. 138. 1910. p. 106 et seq.

been taken over by the Bethlehem Steel Co. and Witherbee, Sherman & Co., under the title of the Cheever Iron Ore Co. Many improvements to the mining and milling plants are now in progress.

The Weldon and French shafts on the south end are the principal openings through which the exploration of the old workings has been conducted. These shafts have been retimbered and inclosed and are once more in operation. They afford access to some promising territory. A good ore body has already been found on the north side of the Weldon, in the interval between that mine and the northern workings. This body supplies most of the output at present. It averages 8 or 9 feet thick and is of good grade. There is a possibility of discovering similar deposits under the valley to the south of the Weldon mine, as indicated by recent magnetic surveys. The northern workings also will be explored for ore that may have been left from previous operations.

An important improvement which is now being carried out is the change from steam to electric power for driving the mill and air compressors and for hoisting the ore. The necessary electric current is to be supplied by the Port Henry station. Under the new system both shafts will be operated from a central hoisting station. The compressed air service will be enlarged to provide for about double the former drill capacity.

The mill is equipped for handling 500 tons of crude ore a day. From the shafts the ore is carried by a gravity system to the receiving bin whence it passes through coarse crushers preliminary to the first separation. This is performed by a magnetic cobbing machine. The remainder is then recrushed by rolls and is run through the usual drum and belt machines, with a further crushing between the separations.

A gravity tramway connects the mines with the railroad at the lakeside, a few hundred feet to the east, where the concentrates are loaded onto cars for shipment.

Salisbury mine. The first shipments of concentrates from this mine, near Salisbury Center, Herkimer co., were made in 1909. The new mill was not completed, however, until late in the year, so that actual productive operations were limited to a short period. In the equipment of the mine and mill the Salisbury Steel & Iron Co. has adopted the most modern machinery suited for the conditions, and the results obtained

in the short run last year were reported to have been very satisfactory. A feature, novel to the Adirondack region, is the use of producer gas which is supplied by the company's plant; gas engines of 750 horsepower are installed and their power is transmitted to the mine and mill by electric current. The company operates its own branch railroad which connects with the New York Central lines at Dolgeville.

Lake Sanford. The development of the titaniferous deposits of this locality has been continued during the past year. Sanford hill has been largely cleared off and the ore exposed in several places. A few thousand tons of the ore were taken out and hauled by wagon to North Creek to be shipped for experimental purposes. Exploration with the diamond drill has been chiefly directed during the year to the Cheney deposits which lie to the west of Lake Sanford. The ore here occurs in gabbro and is mostly a fine grained mixture of magnetite and silicates; though in places it has a coarser texture like the usual grade of Sanford ore.

Sufficient work has been done to insure a large ore supply when mining is once started. Prominent metallurgists have expressed confidence that the magnetite can be reduced successfully in the blast furnace, at least when used in mixture with other ores, and offers have already been made for a large tonnage. Active operations can not be undertaken, however, until a railroad is constructed to the mines. The natural outlet, which is by the way of the Hudson river valley to North Creek, unfortunately seems to be blocked by the necessity of crossing State lands. The other alternative, to run the line east to some point on Lake Champlain, means the laying of from 50 to 60 miles of track over a rough country, whereas the distance to North Creek is only about 30 miles. It is hoped that a satisfactory solution of the difficulty may be reached, for the opening of the mines would give a great impetus to the iron ore industry of the State.

Clinton hematites. The production of ore along the Clinton belt was larger last year than in 1908, and it will probably show a further gain during the current year. In Wayne county the Ontario Iron Ore Co. started operations and the Wayne Iron Ore Co. made preparations for an active mining campaign at the opening of the present season. The Furnaceville Iron Co. contributed about the usual output from this region. At Clin-

ton, Oneida co., C. A. Borst has been the only active producer in the last few years.

Dutchess county limonites. According to current reports in the press, plans are under consideration for the reopening of the Kelly mine in the Salisbury limonite district. The Kelly Iron Ore Corporation is said to have taken a lease of this property which is situated in the town of Northeast near the Connecticut State line. The mine was last worked in 1888 as an open cut, but if the present plans are made effective it will be exploited hereafter by underground methods. It has convenient shipment facilities over both the New York Central and the New York, New Haven and Hartford lines.

It has also been reported that the Dover mine is under lease for the purpose of operation. This mine is situated in the town of Dover and at one time supplied ore to the Dover furnace.

The production of limonite in this region was once of considerable importance. After the year 1885, when the Lake Superior shipments began to develop rapidly, the output steadily diminished and one mine after another suspended work. The only mine which has been operated in recent years is the Amenia which was closed down in 1906. The prices of ore have since advanced to such an extent that the operation of the mines is again receiving consideration.

MILLSTONES

The production of millstones, although much smaller than formerly, is still an important industry in certain sections of Ulster county. This area furnishes nearly all of the millstones produced in the United States, the other producing states being Pennsylvania, Virginia and North Carolina. In addition to the domestic supply a large number of millstones and buhrstones are annually imported from France and other European countries.

The New York stone is known as Esopus stone, a name derived from a former name for Kingston, which was an important shipping point. It is a firm white conglomerate varying in fineness from that of a coarse sandstone to a coarse conglomerate with some pebbles 2 inches in diameter. It is composed of partially rounded whitish quartz pebbles in a silicious matrix. The stone is obtained from certain beds of Shawangunk grit, a rock lying unconformably upon the Hudson river shales and

formerly correlated with the Oneida conglomerate, but now known to lie in the horizon of the Salina. Its thickness varies from 50 to 200 feet.

The quarrying operations are carried on along the northern border of the Shawangunk mountains, in Rochester and Wawarsing townships, Ulster co., mainly along the line of the New York, Ontario and Western Railroad at Wawarsing, Kerhonkson, Accord, Kyserike, Granite, St Josen and Alligerville, while New Paltz and Kingston also are shipping points.

Quarrying is carried on with but a small equipment, the stone being worked out by hand bars, wedges and sometimes with the use of powder. It is dressed by hand at the quarry into millstones and chasers. The millstones are dressed into stones varying in diameter from 15 inches to 54 inches or even larger and are used for the grinding of paint, grain, cement, gypsum etc. The chasers are stones dressed to run on edge on a platform of blocks of the same material, and are used in grinding heavier material such as quartz, feldspar, barite etc. Depending largely on their weight for crushing the fragments, they are of large size varying usually in diameter from 54 to 72 inches.

The production of millstones has decreased very much in recent years owing to the introduction of roller mills in flour making, and ball mills, emery stones and other improved grinding machinery in other industries. The demand for millstones is now largely from corn-grinding mills in the south and from gypsum and plaster mills, while chasers are still used in quartz, feldspar and barite mills.

The value of the production of millstones and chasers and rough blocks used for paving chasers amounted last year to $19,247 as compared with a value of $18,341 in 1908. The selling prices of millstones in 1909 ranged from $3 to $4 for a 16 inch stone up to $60 for a 72 inch stone. Chasers in sizes from 54 to 72 inches sold at prices ranging from $30 to $70 each.

MINERAL PAINT

Under this title are included the natural mineral colors which require nothing more than washing or grinding in their preparation for the market. The raw materials found in the State that have been used for the purposes are iron ore, ocher, shale and slate. New York is also one of the leading producers of artificial pigments, specially those made from lead, but the crude materials are mostly derived from without the State.

The Clinton hematite affords an excellent base for the manufacture of metallic paint and mortar color. The beds with a relatively high iron content are employed, as they possess the softness and uniformity of texture, as well as depth of color, which are generally sought for. The mines owned by C. A. Borst at Clinton, Oneida co. and those of the Furnaceville Iron Co. at Ontario, Wayne co. supply most of the ore for paint. The hematite from the former locality belongs to the oölitic variety and that sold to paint manufacturers carries about 45 per cent iron. The ore in Wayne county is of fossil character carrying about 40 per cent iron. The red hematite from St Lawrence county is also used for metallic paint.

The manufacturers of metallic paint and mortar colors in New York State include the Clinton Metallic Paint Co. of Clinton, the William Connors Paint Manufacturing Co. of Troy, and the Rossie Iron Ore Paint Co. of Ogdensburg. A considerable quantity of the Clinton hematite is shipped to points outside of the State for manufacture.

Both shale and slate are ground for mineral paint, their color depending largely upon the amount and character of the iron oxids present. When there is a large proportion of ferric oxid the shale and slate may be sold as metallic paint. At Randolph, Cattaraugus co. beds of green, brown and bluish shale occurring in the Chemung formation have been worked by the Elko Paint Co. In years past red shale from the base of the Salina formation has been obtained in Herkimer county for paint. A similar material occurring in the Catskill series has been worked at Roxbury, Delaware co. The red slate of Washington county, which belongs to the Cambric, is also ground for paint. The Algonquin Red Slate Co. of Worcester, Mass. and A. J. Hurd of Eagle Bridge, are producers of this material.

A product known as mineral black has been made from the slates found in the Hudson River series. Certain beds contain considerable carbon in a finely divided almost graphitic condition which gives them a dense black color.

The ferruginous clay called ocher is of common occurrence, but is not now worked in the State. Sienna, a deep brown variety of ocher, is found near Whitehall.

The production of mineral paints in 1909 was as follows: metallic paint and mortar color 6560 short tons valued at $65,600; slate pigment 1155 short tons valued at $9130. In 1908

the following quantities were reported: metallic paint and mortar color 5750 short tons valued at $54,500; slate pigment 922 short tons valued at $7376. These quantities represent only the pigments manufactured within the State from local materials. In addition a large quantity of Clinton ore is shipped to other states each year for manufacture.

MINERAL WATERS

New York has held for a long time a leading position among the states in the utilization of mineral waters. The different springs, of which over 200 have been listed as productive at one time or another, yield a great variety of waters in respect to the character and amount of their dissolved solids. There are some that contain relatively large amounts of mineral ingredients and are specially valuable for medicinal purposes; Saratoga Springs, Ballston Springs, Richfield Springs, Sharon Springs and Lebanon Springs are among the more noted localities for such waters. Numerous other springs are more particularly adapted for table use, containing only sufficient mineral matter perhaps to give them a pleasantly saline taste. Both kinds of waters are generally carbonated and sold in small bottles.

Of late there has developed an important business in the sale of spring waters which can hardly be classed as mineral in the common acceptance of the word, but which are extensively consumed for office and family use in the larger towns and cities. Their employment depends upon their freedom from harmful impurities, in which feature they are generally superior to the local supplies. In so far as such waters are an article of commerce they may well be included in a canvass of the mineral water industry. They are distributed usually in large bottles or carboys in noncarbonated condition.

Character of mineral waters. Among the spring waters that contain mineral ingredients in appreciable quantity those characterized by the presence of alkalis and alkaline earths are the most abundant in the State. The dissolved bases may exist in association with chlorin and carbon dioxid, as is the case with the springs of Saratoga county, or they may be associated chiefly with sulfuric acid as illustrated by the Sharon and Clifton Springs.

The mineral waters of Saratoga Springs and Ballston are found along fractured zones in Lower Siluric strata, the reservoirs occurring usually in the Trenton limestone. They are accompanied by free carbon dioxid, which together with chlorin, sodium, potassium, calcium and magnesium, exists also in dissolved condition. The amount of solid constituents in the different waters varies from less than 100 to over 500 grains per gallon. Large quantities of table and medicinal waters are bottled at the springs for shipment to all parts of the country. The carbon dioxid which issues from the wells at Saratoga is likewise an important article of commerce.

The waters at Richfield Springs contain the elements of the alkali and alkaline earth groups together with sulfuric acid and smaller amounts of chlorin, carbon dioxid and sulfureted hydrogen. They are employed for medicinal baths as well as for drinking purposes. The springs issue along the contact of Siluric limestone and Devonic shales. Sharon Springs is situated to the east of Richfield Springs and near the contact of the Lower and Upper Siluric. Clifton Springs, Ontario co. and Massena Springs, St Lawrence co. are among the localities where sulfureted waters occur and are utilized.

The Oak Orchard springs in the town of Byron, Genesee co. are noteworthy for their acid waters which contain a considerable proportion of aluminum, iron calcium and magnesium, besides free sulfuric acid.

The Lebanon spring, Columbia co. is the single representative in the State of the class of thermal springs. It has a temperature of 75° F. and is slightly charged with carbon dioxid and nitrogen.

Ordinary spring waters. The greater quantity of spring waters consumed in the State belongs to the nonmedicinal, noncarbonated class, represented by such springs as the Great Bear, Deep Rock, Mount View, Sun Ray, Chemung etc. The waters are obtained either from flowing springs or from artesian wells and are shipped in carboys or in tank cars to the principal cities where they are bottled and distributed by wagons among the consumers. The essential feature of such waters is their freedom from noxious impurities. This is generally safeguarded by the care exercised in the handling of the waters which are also regularly examined in chemical and bacteriological laboratories.

Carbon dioxid. Besides the sale of mineral waters, an extensive industry has been developed in the State in connection with carbon dioxid which is given off by some of the springs. The collection, storage and shipment of the gas for use in making carbonated beverages and for other purposes have received attention at Saratoga Springs, where the industry has become of greater importance even, as regards the value of the output, than the trade in the mineral waters themselves. Over 30 wells have been driven in that vicinity for gas alone. The carbon dioxid is pumped to the surface together with the water, separated from the latter at the well and then conveyed to gas holders, similar to those used by municipal gas plants, where it is stored preparatory to charging into cylinders. The cylinders are made to withstand the heavy pressure necessary to liquefy the gas and are of two sizes, the smaller holding about 25 pounds and the larger from 40 to 50 pounds. The principal producers are the New York Carbonic Acid Gas Co., the Lincoln Spring Co. and the Natural Carbonic Gas Co. The gas is said to be superior to that produced by the calcination of magnesite or other artificial methods.

List of springs. The following list includes the names and localities of most of the springs in the State that are employed commercially, as shown by a canvass of the industry:

NAME	LOCALITY
Baldwin Mineral Spring	Cayuga, Cayuga co.
Coyle & Caywood	Weedsport, Cayuga co.
Diamond Rock Spring	Cherry Creek, Chautauqua co.
Mrs D. N. Palmer	West Portland, Chautauqua co.
Breesport Oxygenated Mineral Spring	Breesport, Chemung co.
Chemung Valley Spring	Elmira, Chemung co.
Chemung Spring	Chemung, Chemung co.
Lebanon Mineral Spring	Lebanon, Columbia co.
Monarch Spring	Matteawan, Dutchess co.
Mt Beacon Spring	Matteawan, Dutchess co.
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Beauty Spring Water Co.	Lyons Falls, Lewis co.
Cold Spring	New York Mills, Oneida co.
Glacier Spring	Franklin Springs, Oneida co.
Lithia Polaris Spring	Boonville, Oneida co.
G. Wells Smith	Franklin Springs, Oneida co.
W. W. Warner	Franklin Springs, Oneida co.
Geneva Lithia Spring	Geneva, Ontario co.
Red Cross Spring	Geneva, Ontario co.
Crystal Spring	Oswego, Oswego co.
Deep Rock Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
J. Hagerty	Oswego, Oswego co.
Os-we-go Spring	Oswego, Oswego co.

NAME	LOCALITY
Redstone Spring	Oswego, Oswego co.
Mammoth Spring	North Greenbush, Rensselaer co
Shell Rock Spring	East Greenbush, Rensselaer co.
Massena Mineral Spring	Massena Springs, St Lawrence co.
Arondack Spring	Saratoga Springs, Saratoga co.
Artesian Lithia Spring	Ballston Springs, Saratoga co.
Chief Spring	Saratoga Springs, Saratoga co.
Congress Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Hathorn Spring	Saratoga Springs, Saratoga co.
Hides Franklin Spring	Ballston Springs, Saratoga co.
High Rock Spring	Saratoga Springs, Saratoga co.
C. N. Mead	Ballston Springs, Saratoga co.
Patterson Mineral Spring	Saratoga Springs, Saratoga co.
Royal Spring	Saratoga Springs, Saratoga co.
Saratoga Seltzer Spring	Saratoga Springs, Saratoga co.
Saratoga Carlsbad Spring	Saratoga Springs, Saratoga co.
Saratoga Emperor Spring	Saratoga Springs, Saratoga co.
Star Spring	Saratoga Springs, Saratoga co.
Washington Lithia Spring	Saratoga Springs, Saratoga co.
Chalybeate Spring	Sharon Springs, Schoharie co.
Eye Water Spring	Sharon Springs, Schoharie co.
Gardner White Sulphur Spring	Sharon Springs, Schoharie co.
Magnesia Spring	Sharon Springs, Schoharie co.
Red Jacket Spring	Seneca Falls, Seneca co.
H. W. Knight	Seneca Falls, Seneca co.
Pleasant Valley Mineral Spring	Rheims, Steuben co.
Setauket Spring	Setauket, Suffolk co.
Sparko Crystal Spring	Huntington, Suffolk co.
Elixir Spring	Clintondale, Ulster co.
Sun Ray Spring	Ellenville, Ulster co.
Vita Spring	Fort Edward, Washington co.
Briarcliff Table Water	Briarcliff Manor, Westchester co.
Gramatan Spring Water Co.	Bronxville, Westchester co.
Putnam Spring Water Co.	Peekskill, Westchester co.

Production. The canvass of the mineral springs for 1909 showed sales of 9,019,490 gallons with a reported value of $857,-342. In the preceding year the sales amounted to 8,007,092 gallons valued at $877,648. The number of springs reporting a production in each year was 48. The value of the waters is estimated at the spring localities and does not include the cost of bottling. No account is made of the waters used in hotels, sanatoriums etc., run in connection with the springs, though this is an important branch of the business in some places.

The above statistics should be considered only as approximations; the actual sales of waters doubtless exceed the reported quantities, since it is very difficult to obtain returns of all the trade. Some of the smaller producers keep no records of their business, and new springs, or those once abandoned, are constantly being utilized which may escape notice. The value of the annual sales of mineral waters very likely amounts to as much as $1,000,000.

The recovery of carbon dioxid from the wells at Saratoga Springs is the basis of an important industry that is carried on independently of the mineral water trade. The production of gas in recent years has averaged about 5,000,000 pounds valued approximately at $300,000. The gas is separated from the water at the well mouth and stored in tanks from which it is charged into cylinders under high pressure for shipment. The producers of gas include the Natural Carbonic Gas Co., New York Carbonic Gas Co., Lincoln Spring Co. and Geysers Natural Carbonic Gas Co.

Saratoga Springs. The need for conserving the mineral water supply at Saratoga has been brought to public attention recently, and the first steps to that end were taken last year through legislative enactment. It is aimed to place the spring properties under State supervision or control as a means of insuring against wasteful and injurious use on the part of private enterprise. A commission was appointed to investigate the situation at Saratoga and to take such action as might conduce to the restoration of the flow of the springs to their former strength and the maintenance of the future supply. The importance of adopting some plan for regulating the use of these valuable waters can scarcely be questioned, since it is well known that they are liable to deterioration and exhaustion in much the same way as other natural resources. Governmental control or ownership of mineral springs is a policy that has long been pursued by European states, with beneficial results.

NATURAL GAS

The productive gas fields of the State are distributed among 15 counties, of which Erie, Chautauqua and Allegany are the leading ones. The fields outside of the counties mentioned are scattered over the western section from Lake Ontario south to the Pennsylvania boundary. The most easterly localities where gas has been found in quantity are in Oswego county. Many wells have been drilled at different places in the eastern part of the State, particularly in the region south of the Mohawk river, but the exploration has been uniformly unsuccessful so far as locating any valuable pools.

According to the returns received for the year 1909, there were about 1250 wells in the State, the output of which was consumed for fuel and lighting purposes. No account was

taken of the wells that supplied gas for pumping operations in the oil districts. The number of individual producers was about 200, most of whom, however, made only a small output from one or two wells for their own supply. Aside from these minor enterprises, the industry was in the control of about 40 companies who distributed the gas for public use.

The surplus gas from the oil wells of Cattaraugus, Allegany and Steuben counties is collected mainly by the Empire Gas & Fuel Co., of Wellsville; the Producers Gas Co. of Olean and the United Natural Gas Co. of Oil City, Pa. The product is carried in pipe lines to Buffalo and other towns in the western part of the State. Buffalo is also supplied from the important fields in the eastern townships of Erie county, but elsewhere the supply is consumed mainly in the towns and villages that lie in proximity to the wells.

The quantity of gas produced in 1909 was approximately 3,825,215,000 cubic feet. To arrive at this total it was necessary to make estimates for some of the smaller producers who had no meters attached to their mains; but the proportion of the output involved in such estimates was inconsiderable. The reported value of the production was $1,045,693. This output of the wells was a little less than in 1908 when a total of 3,860,000,000 cubic feet was reported; but was larger than that for any year previous to 1908. Owing to a slight increase of prices — the average throughout the State having been 27 cents a thousand against 26 cents a thousand in 1908 — the value of the output was the largest on record.

The value of the production of natural gas during the past four years is shown in the accompanying table which is arranged to show also the contributions of the principal counties so far as practicable.

Production of natural gas

COUNTY	1906	1907	1908	1909
Allegany-Cattaraugus	$247 208	$250 159	$264 736	$282 964
Chautauqua	94 345	106 411	153 019	174 597
Erie*a*	317 554	320 199	451 869	461 531
Livingston*b*	52 805	55 780	54 083	59 888
Onondaga	16 385	17 030	13 837	12 310
Oswego	13 182	10 585	12 800	14 402
Wyoming*c*	25 100	39 850	37 431	40 001
Total	$756 579	$800 014	$987 775	$1 045 693

a Includes a part of the production of Genesee county.
b Includes also Seneca, Schuyler, Steuben, Ontario and Yates.
c Includes also Niagara and Genesee.

The record for the year shows less activity in the drilling of wells than usual, due perhaps to the unfavorable financial situation. The increment from new sources was insufficient to balance the natural decline in the output of the old wells, which has not occurred before in many years.

Among the notable developments of the year was the drilling of a deep well in northern Cattaraugus county which was reported to have encountered a pool in the Medina sandstone at a depth of 3300 feet. A 40 foot bed of rock salt was also penetrated. The well was located on the Sanders farm between Gowanda and Cattaraugus.

The South Shore Gas Co. completed a very successful well on the Griswold farm, near Forestville, Chautauqua co. The company has 32 wells, principally in the vicinity of Silver Creek and Dunkirk. The Frost Gas Co. added to its supply which is obtained from the towns of Sheridan and Pomfret. A new well in West Sheridan was reported to have shown a flow of 100,000 cubic feet a day.

A discovery of gas was made near Swain, in northeastern Allegany county, at a depth of 300 feet. The Burns Oil & Gas Co. put down a test well near Canaseraga which encountered a bed of rock salt at 3100 feet, but no gas in quantity.

The Allen-Salem Oil Co. completed a well on the Walker farm, 3 miles from Canisteo, Steuben co. Gas was found at a depth of 740 feet.

There was little change in the production of Erie county last year. The contribution from the fields, which are principally

in the eastern and southern parts, amounted to about 1,500,000,000 cubic feet or approximately 40 per cent of the total for the State. The wells in the eastern section are much the more important. They are largely controlled by the Akron Natural Gas Co., Alden-Batavia Natural Gas Co., Lancaster-Depew Natural Gas Co., Niagara Light, Heat & Power Co., and the United Natural Gas Co. In the southern part of the county the Springville Natural Gas Co. is the principal producer.

The Pavilion field of Genesee county, the most successful one that has recently been discovered in the State, made a good record in 1909. In all about 20 producing wells have been put down by the Pavilion and Alden-Batavia companies.

PETROLEUM

The oil district in the southwestern part of the State continues to afford a fairly large yield, though of course it has long since passed the high mark of productivity. The pools of Cattaraugus county were first tapped in 1865 and those in Allegany county about 1878, since which times they have been actively exploited. Many of the original wells that were drilled over 25 years ago still give a profitable return for pumping. No important discoveries have been reported in recent years, yet by redrilling of territory once abandoned as worthless and by gradually extending the bounds of the known pools the natural decline has been so checked that a long career of activity may be confidently expected for the future.

The productive area in Cattaraugus county is situated principally in Olean, Allegany and Carrolton townships, embracing about 40 square miles. The oil is found at depths ranging from 600 to 1800 feet. The larger pools are the Ricebrook, Chipmunk, Allegany and Flatstone. They occur in the Chemung formation of the Upper Devonic.

In Allegany county are the Bolivar, Richburg, Andover and Wirt pools which extend across the southern townships and are tapped by wells averaging from 1400 to 1800 feet deep. The Andover pool lies partly in the town of West Union, Steuben co. A recent estimate placed the number of productive wells in Allegany county at 6000.

The discovery of a new pool in northern Allegany county a few years ago aroused unusual interest in that it indicated a much wider range of the oil-bearing strata than had previously

been thought possible. The locality is in the town of Granger, on the Livingston county border. About 30 wells were put down, some of which flowed at first under natural pressure. They soon gave out, however, and the entire yield amounted to less than 3000 barrels. During the past year the exploration of another section in the northern part of the county was started by the drilling of a well near Swain, Grove township. The first well was put down on the Fred Bennet farm; a heavy pressure of gas was encountered at 700 feet and a flow of oil at 740 feet. A second well 400 feet from the first was immediately drilled to the same depth but proved to be dry. The value of the discovery can not be determined until further tests are made.

A test well at Canaseraga in the town of Burns, Allegany co., was drilled to a depth of 3200 feet. The record as reported in the *Petroleum Gazette* (July 1909) gave the occurrence of a small quantity of oil and gas at 275 feet in gray sand. Another streak of gas sand was struck at 400 feet. At 975 feet the drill tapped a 12-foot seam of chocolate sand with a light showing of oil and gas. From 975 feet to 2650 feet the strata were chiefly black and brown shales. At 2650 feet the drill entered limestone which was very hard and may have been the Onondaga; at least it was not the Niagara limestone as stated in the record. At 3050 feet the drill passed through 65 feet of clean unbroken salt. A blue shale was found at 3115 feet which continued to the bottom of the well at 3200 feet.

The production of petroleum in 1909 amounted to 1,160,402 barrels, or almost the same as in 1908 when it was 1,160,128 barrels. The value of the output was a little lower than in the preceding year due to a drop in the prices which fell off from $1.78 a barrel in the early months to $1.43 a barrel in December. The accompanying table gives the production and its value for each year since 1891. The statistics for 1904 and subsequent years have been compiled from pipe line receipts reported to this office by the companies who handle the output. The earlier statistics are taken from the volumes of the *Mineral Resources*. The following companies have pipe lines in the district: The Allegany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co., and Fords Brook Pipe Line Co., all of Wellsville; Vacuum Oil Co. of Rochester; New York Transit Co. of Olean; Emery Pipe Line Co., Kendall Refining Co., and Tide Water Pipe Co., Limited, of Bradford, Pa.

a **Production of petroleum in New York**

YEAR	BARRELS	VALUE
1891	1 585 030	$1 061 970
1892	1 273 343	708 297
1893	1 031 391	660 000
1894	942 431	790 464
1895	912 948	1 240 468
1896	1 205 220	1 420 653
1897	1 279 155	1 005 736
1898	1 205 250	1 098 284
1899	1 320 909	1 708 926
1900	1 300 925	1 759 501
1901	1 206 618	1 460 008
1902	1 119 730	1 530 852
1903	1 162 978	1 849 135
1904	1 036 179	1 709 770
1905	949 511	1 566 931
1906	1 043 088	1 721 095
1907	1 052 324	1 736 335
1908	1 160 128	2 071 533
1909	1 160 402	1 914 663

a The statistics for the years 1891–1903 inclusive are taken from the annual volumes of the *Mineral Resources*.

The records of new wells as compiled and published by the *Oil City Derrick* show that a total of 457 wells were completed in New York during 1909. The increment from the new wells amounted to 715 barrels a day. Of the number 32 were dry holes. In 1908 the corresponding totals were 450 new wells including 60 dry ones, with a daily production of 750 barrels.

PYRITE

Pyrite is a common ingredient of the metamorphosed sedimentary rocks which are found in the Highlands of southeastern New York and in the Adirondacks. It occurs disseminated in the crystalline limestones and schists and occasionally forms bands and lenticular masses of variable size and purity within the schists. In character these deposits are very similar to the magnetite bodies that are found within the altered sediments of both regions, and in fact the two minerals are frequently associated in their occurrence. On the other hand the magnetites that are contained in the acidic gneisses of igneous origin generally carry little or no pyrite. Pyrrhotite is

a common associate of the pyrite, and zinc blende and chalcopyrite may be usually observed in small amount. Large bodies of nearly pure pyrrhotite occur in the Adirondacks, but as they can not be utilized for their sulfur and carry only traces of nickel they have no commercial value.

In southeastern New York there are no active pyrite mines, though a deposit at Anthony's Nose, above Peekskill, was worked some 30 or 40 years ago as a source of ore for sulfuric acid manufacture. The ore appears to have carried considerable pyrrhotite and would not be considered mineable at the present day.

The principal deposits of pyrite in the Adirondack region are found along a belt of crystalline limestones and schists that extend from near Antwerp, Jefferson co., into the town of Canton, St Lawrence co. They take the form of impregnated zones, or fahlbands, the pyrite being intermixed with the minerals of the schistose country rock, which are chiefly quartz, feldspar and hornblende; some deposits have a pronounced lenticular shape, with the longer axis of the lenses parallel to the foliation of the schists. The pyrite occurs in crystals and crystalline aggregates of variable purity. The associated silicates are generally more or less decomposed. The surface portion of the deposits has the characteristic reddish stain and burnt look due to oxidation, though the weathered zone is remarkably shallow, the fresh pyrite being found usually within a few feet from the surface.

There are a number of mines and prospects in this region, but at present active mining is carried on only by the St Lawrence Pyrite Co., at Stellaville, near Hermon. The properties owned by the company include the Stella mines, which it took over in 1905, and other holdings in the vicinity that have been subsequently acquired. Most of the ore is of concentrating grade and is treated in a 500-ton mill equipped with Hancock jigs, Hartz jigs and Overstrom tables. The concentrates carry from 40 to 48 per cent sulfur. Electric current for power purposes is supplied from a central station at Hannawa Falls.

The mines at High Falls which were taken over a few years ago by the Oliver Mining Co. have not been placed in operation as yet, though the exploration by the diamond drill, which the company carried out, is reported to have shown very favorable results. The mines were once worked by the High Falls Pyrite Co., and later by the National Pyrites Co.

SALT

The canvass of the salt industry for 1909 indicated very little change in trade conditions from those reported for the preceding year. The only direction in which the trade may be said to have evidenced an improvement was in a larger consumption of certain grades of salt and a corresponding gain of output. The prices generally showed no response to the increased demand; in fact their average for the year was somewhat lower than in 1908 when the market felt the full effects of the financial stringency.

Keen competition with the industry of other states has tended of late years to reduce prices and to restrict the outlet for the local product. The manufacture of evaporated salt has developed rapidly in Michigan, Ohio and Kansas, under the influence of cheap fuel, which now supply the markets of the Middle West. In New York, New England and some of the adjoining territory, the local manufacturers still have the advantage, owing to more favorable freight rates. Along the seaboard, however, there is considerable competition with imported salt which comes chiefly from the Mediterranean countries and the West Indies. The importation is likely to increase in the immediate future by reason of a reduction in the duty of 20 cents a short ton on all grades of salt, that was incorporated in the Payne tariff bill.

The total quantity of salt obtained from the New York mines and wells last year was 9,880,618 barrels of 280 pounds. This may be considered a very satisfactory showing, as the output for 1908 amounted to 9,005,311 barrels and that for 1907, which was the largest previously reported for any one year, amounted to 9,657,543 barrels. The increase in production was thus 875,307 barrels or nearly 10 per cent, as compared with a decrease of 652,232 barrels or 7 per cent in the preceding year. The total value of the yield was $2,298,652 against $2,136,736 in 1908 and $2,449,178 in 1907, or an average of 23.3 cents a barrel against 23.7 cents in 1908 and 25 cents in 1907.

Converted to a tonnage basis the production last year amounted to 1,383,386.5 short tons against 1,260,743.5 short tons in the preceding year.

The gain was distributed between the output of rock and brine salt, both classes showing about the same proportionate increase.

It is to be noted that not all of the salt reported as above was actually marketed in that form. A very considerable part of the brine pumped from the wells each year is employed without evaporation for the manufacture of soda products. The Solvay Process Co., the principal manufacturer of such products in this country, has a number of wells in the town of Tully, Onondaga co., which supply brine to its works near Syracuse. The salt contents of this brine are included in the production. The small valuation placed upon the salt thus used reduces the average well below the actual value of the marketable product.

There were about 30 mines and works which contributed to the production last year, as compared with 32 in 1908 and 33 in 1907. Onondaga county alone was represented by more than one half of the number. The manufacture of salt by the solar process has long been centered in that county where it is carried on by individuals and companies operating in a relatively small way. The output has been marketed for many years through the Onondaga Coarse Salt Association. The operative plants in the other counties were distributed as follows: Livingston 3; Schuyler 2; Tompkins 3; and Wyoming 3. The International Salt Co., the largest producer of evaporated salt in the State, maintained three plants in operation, one each at Ithaca, Myers and Watkins. No new firms were added to the list of producers during the year.

The accompanying tables furnish details as to the production of salt in New York. In the tables for the years 1908 and 1909 the output is distributed among the several grades recognized in the trade. The classification is based upon methods of manufacture and purposes for which the salt is used. Table and dairy salt includes the finest grades of artificially evaporated salt, specially prepared for the table and for butter and cheese making; it brings the highest market price. Under common fine, is listed the other grades of fine, artificially evaporated salt that are not specially prepared. Common coarse represents the coarser product from artificial evaporation. Coarse solar salt is made by evaporation of brine in shallow pans exposed to the sun's heat. This process, as already stated, is used by manufacturers in Onondaga county; it can be carried on, of course, only during the summer months. Packers salt includes the product sold to meat packers and fish salters. Under "other

grades" are listed agricultural salt and other kinds not specified in the returns from producers, as well as the entire product of rock salt and of salt in brine used for the manufacture of soda products. These latter items form a very important part of the total. As will be observed the salt thus listed bears a much smaller valuation per barrel than the grades first mentioned.

Production of salt by grades in 1908

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine*a*	941 682	$372 485	$ .39
Common coarse	194 593	72 427	.37
Table and dairy	1 188 636	631 987	.53
Coarse solar	520 607	117 136	.22
Packers	36 114	14 515	.40
Other grades*b*	6 123 679	928 186	.15
Total	9 005 311	$2 136 736	$ .237

a Common fine includes a small amount of common coarse.
b Include rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

Production of salt by grades in 1909

GRADE	BARRELS	VALUE	VALUE PER BARREL
Common fine*a*	1 436 233	$494 464	$ .35
Common coarse	130 200	45 569	.35
Table and dairy	1 281 207	633 195	.50
Coarse solar	540 614	162 253	.30
Packers	99 123	38 344	.40
Other grades*b*	6 393 241	924 877	.14
Total	9 880 618	$2 298 652	$ .233

a Common fine includes a small amount of common coarse.
b Include rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

The distribution of the salt made this year, according to counties, shows that Livingston held first place in size of output, having superseded Onondaga county which was formerly the largest producer. The importance of the industry in Liv-

ingston county was due principally to the activity in rock salt mining at Retsof and Cuylerville. The Retsof Mining Co. and the Sterling Salt Co. furnished the output. The Genesee Salt Co. was the only producer of brine salt in the county.

Onondaga county was second in regard to production, though the greater part consisted of salt in brine consumed by the Solvay Process Co.

Tompkins county, represented by the International Salt Co., with two plants, and the Remington Salt Co., made the third largest output. Wyoming county with the three plants of the Worcester Salt Co., the Iroquois Salt Co., and the Rock Glen Salt Co., was fourth in the list, followed by Schuyler county with two plants owned by the International Salt Co., and the Watkins Salt Co.

The progress of the salt industry in New York during the last 25 years is summarized in the table below. The statistics for the years previous to 1904 have been extracted from the annual volumes of the *Mineral Resources.*

Production of salt in New York since 1885

YEAR	BARRELS	VALUE
1885	2 304 787	$874 258
1886	2 431 563	1 243 721
1887	2 353 560	936 894
1888	2 318 483	1 130 409
1889	2 273 007	1 136 503
1890	2 532 036	1 266 018
1891	2 839 544	1 340 036
1892	3 472 073	1 662 816
1893	5 662 074	1 870 084
1894	6 270 588	1 999 146
1895	6 832 331	1 943 398
1896	6 069 040	1 896 681
1897	6 805 854	1 948 759
1898	6 791 798	2 369 323
1899	7 489 105	2 540 426
1900	7 897 071	2 171 418
1901	7 286 320	2 089 834
1902	8 523 389	1 938 539
1903	8 170 648	2 007 807
1904	8 724 768	2 102 748
1905	8 575 649	2 303 067
1906	9 013 993	2 131 650
1907	9 657 543	2 449 178
1908	9 005 311	2 136 736
1909	9 880 618	2 298 652

SAND

The production of sand for its varied uses in engineering and building work, metallurgy etc., is carried on extensively in New York and most requirements of the different industries are or can be supplied by the local deposits. Considerable quantities of the more valuable molding sands are shipped to other states.

A brief account of the several branches of the sand industry was given in the issue of this report for 1908. According to the statistical canvass which was undertaken in connection with the report, the value of the production amounted to $1,130,291. This total should be considered, however, an approximation only; the actual output probably was considerably larger, as productive operations, specially in building sands, are so widely scattered and of so unstable character that no doubt many escaped enumeration. In the present report attention will be limited to the molding sand trade.

Molding sand. The use of sand in the casting of metals calls for a large supply of special grades which have a rather limited distribution, as compared with building sands, and are consequently more valuable.

In New York State there are two main areas in which good molding sand beds abound: (1) on the lands bordering the Hudson river from Orange county northward on both sides of the river, to Saratoga county; (2) in Erie county. The sand is found in shallow beds immediately underlying the sod and often covering many acres. Beds 8 inches or more in thickness are worked profitably, a 1-foot bed over one acre yielding about 1200 tons. The large increase in business in the iron and steel plants was directly responsible for an increase in the production of molding sand. The production in 1909 amounted to 468,609 short tons valued at $437,402, as against 312,819 tons valued at $277,290 in 1908. Notwithstanding the increase, however, the production fell far short of that reported in 1907 of 693,293 tons valued at $539,674, which would indicate that the foundries had not fully recovered from the panic conditions prevailing in 1908.

Of the total production the Hudson river region furnished 450,989 tons valued at $422,144 or about 96 per cent of the total. The remainder of the production was obtained mainly from Erie county.

The silica sand used in connection with the molding sand for the cores of the castings and known as core sand is obtained mainly around Oneida lake in Oneida county. Its production naturally increased also in 1909, the total being 30,230 tons valued at $25,472, against 27,624 tons valued at $22,371 in 1908.

SAND-LIME BRICK

The manufacture of sand-lime brick showed a marked increase during 1909, resulting in a production greatly in advance of that of 1908, though not equalling the output for 1907. The total production amounted to 12,683,375 brick valued at $81,693 as against 8,239,450 brick valued at $55,688 in 1908. The average value at the yard for the common brick in 1909 was $6.31 a thousand.

There were six companies who reported an output last year, as follows:

NAME	LOCATION
Buffalo Sandstone Brick Co.	Buffalo
Rochester Composite Brick Co.	Rochester
Paragon Plaster Co.	Syracuse
Sandstone Brick Co.	Schenectady
Schenectady Brick Co.	Schenectady
Granite Brick Co.	Glens Falls

The Grant Brick Co. of Brooklyn and the Dyett Sand-Lime Brick Co., with a plant at Port Jefferson, are expected to begin operations during the present season.

Owing to the abundance of good brick clays in the State, specially along the Hudson river, the sand-lime brick industry is making no great progress, as compared with its growth in some parts of the country. There seems no reason, however, why the industry should not supply the local demand for the material, since there are large quantities of sand and limestone adapted to the purpose.

In a paper by S. V. Peppel [Geological Survey of Ohio, Bulletin 5] it is stated that the sand used for brick should show not over 10 per cent clayey impurities and should pass through a 20-mesh sieve. The lime may be high calcium or magnesian, but the former is preferred. The process consists of mixing the hydrated lime with the sand, pressing the brick, and subjecting them to a steam pressure of 120 pounds or so in a strong cylinder for 10 hours. This cooking transforms some of the ma-

terial into a hard, hydrous silicate of lime, which binds the sand grains together. The amount of lime used varies from 5 to 20 per cent depending on the purity of the sand.

Although several patented systems of manufacture are on the market, the general scheme is not patented and the manufacture of the brick can be undertaken by any one. In fact several American companies have recently entered the field with their own systems and no patents.

The estimated cost of a well equipped plant with a capacity of 20,000 brick, per 10 to 12 hours, is estimated by Mr Peppel to range, in Ohio, independent of site and buildings, from $20,000 to $25,000.

The cost of production in the United States, exclusive of depreciation in plant, interest on investment, loss of time in breakdown and repairs, etc., according to the same author, varies from $3 to $4 per 1000. The selling price ranges from $8 to $15 per 1000.

From a large series of tests made, Peppel considers sand-lime brick to be strong and durable and in all respects a safe and reliable building material.

SLATE

BY HENRY LEIGHTON

The slate belt of New York State occupies an area extending from the Poultney river, the northern boundary of Washington county, south to the Batten kill, and from the Vermont border west a distance varying from 6 miles in the northern to 12 miles in the southern portion. The majority of the active quarries are in the central part of the field, in Granville township. Under a slight covering of glacial drift and soil, the rocks of the belt consist of a series of Cambric and Ordovicic sediments, greatly metamorphosed and intricately folded. They are made up of limestone, shale, slate, quartzite and sandstone members, with slate predominating. The original bedding of the slates has been partially obliterated by the metamorphism and in its stead a pronounced cleavage has been developed. The dip of the cleavage planes is very steep, usually 45° or more. The original bedding planes can often be distinguished in the slates as bands or ribbons of varying color.

The slates vary in color, red, purple, mottled and green slates being found in the belt. Of these the red is the most valuable,

while a quality of green slate known as the unfading green is also quarried to a large extent.

The slate is taken out from large open pits or quarries, the face afforded by a side hill being often utilized. The blocks are loosened by blasting and by the use of bars, etc. Hoisting is effected by means of a traveler carrying a small hoisting cable and running on a larger wire cable strung across the pit. This cable is anchored on one side of the pit and passes over a tall mast on the other, giving an inclined cableway on which the traveler may run. The whole is operated by a small drum hoist which allows the traveler to run out to any position desired over the pit. It is then automatically locked to the cable and the smaller hoisting cable descends from it into the pit to receive its load. The block of slate is hooked to the cable, hoisted to the traveler and by it is carried directly to the trimming sheds or is loaded on cars which are pushed to the sheds. The waste rock, which must be hoisted as well, is dumped in huge conical piles around the mast.

For the manufacture of roofing slate, which is the main use of the slate, the blocks are carried into small sheds, often perched on the dump piles. These sheds are equipped with a trimmer, a few mallets and chisels and some shelving. Two men work in each shed. The block, usually from 4 to 6 inches thick, is turned on edge and carefully split with chisel and mallet into sheets from ⅛ to ½ inch thickness. The sheets thus formed are then squared up into rectangular roofing slates. The trimmer used for this purpose consists of two blades resembling lawn mower knives, a heavy fly wheel for giving sufficient momentum, a stationary straight edge beneath the knives, a feeding plate and a treadle to set the knives in motion. The slate is fed under the revolving knives and is thus sheared off an inch or so at a time until trimmed to the proper size. The larger slates bring the better prices and some skill is needed in the splitting and trimming. The men employed are paid either by the hour or by the square.

The slate used for billiard table tops, electrical switchboards, stair treads, and other purposes where slabs are required, is known as mill stock. For these purposes, certain beds only are suitable, and quarrying is conducted in the same manner as for roofing slate. The blocks are then dressed in mills where they are first sawed by circular toothed saws and then planed smooth on a planer and polished or rubbed on a rubbing table. The

saw is operated much in the same manner as a circular saw for sawing wood. The planer consists of a heavy steel blade about 8 inches wide mounted so as to remain stationary while the slab of slate passes under it on a sliding table. By setting the blade at the proper distance the slab can be trimmed and smoothed down to a level surface.

The most striking feature that is presented to a visitor in the slate region is perhaps the enormous piles of waste material. The waste in slate quarrying exceeds that from the quarrying of any other material, the dump often claiming 60 per cent of the total slate quarried. Some of the waste slate is ground and utilized in making paints and pigments while attempts at its utilization in cement and brick making have been made.

The quarries at present active are all located in a belt paralleling the Delaware & Hudson Railroad from northern Hebron township through Granville township to southern Hampton township. The following quarries were in operation during 1909, listed in order from the southern end of the belt, with location and product.

Mathews Slate Co., 1½ miles south-southwest of West Pawlet and ½ mile west of Vermont line; product, red roofing slate.

Nelson & Guthrie, 1½ miles west of West Pawlet, on line between Hebron-Granville townships; red roofing slate.

Granville Slate Co., 1 mile south-southwest of Granville just west of Vermont line; green roofing slate.

Higrade Slate Co., 1½ miles south of Granville; red roofing slate.

Excelsior Red Slate Co., 1 mile south southwest of Granville Railway station, on hillside west of Indian river; red roofing slate.

Beck Slate Co., just north of the Excelsior quarry; red roofing slate.

Enterprise Slate Co., ¾ of a mile south of Middle Granville, west of the Mettawee river; green roofing slate.

Williams Bros., ¾ of a mile north of Middle Granville on main road; green roofing and mill stock.

Prairie Slate Co., adjoining Williams Bros., on north; green roofing slate.

Ferndale Slate Co., 2½ miles north-northeast of Truthville; green roofing slate.

Mathews Slate Co., 3 miles north of Truthville in Whitehall township; green roofing slate.

Mathews Slate Co., Jamesville, ½ mile from railroad switch; green roofing slate.

New York Purple Slate Co., near Hampton; purple roofing slate.

The finished slate is all shipped by rail on the Delaware & Hudson Railroad. Some of the quarries are connected by switch with the main track, but in most instances the slate is hauled from ½ to 3 miles to the loading point. One quarry on the Vermont side of the line, transports the finished slate to Raceville by means of an aerial wire rope tramway, the buckets carrying the roofing slate to the shipping point and carrying coal back to the quarries.

The plants for the dressing of mill stock are all located in Vermont, the plant of the Mathews Slate Co. being situated almost on the line, near Jamesville. It is equipped with saws, planers, rubbing table and drills. The finished stock is hauled a short distance to the Jamesville switch for shipment.

Slate quarrying is a financially precarious undertaking. Often large amounts of money have been expended in the region with no return whatever, and this is evidenced by the abandoned prospects scattered over all the hills. The surface soil and glacial drift must first be removed and then the slate quarried out to some depth before any idea can be had concerning the character of the vein, all of which is costly. Even though a good seam or vein is found, it may, after a short quarrying season, become worked out and useless and the quarry must be abandoned. The best veins can be worked down along the dip only for a short distance on account of the overburden and the quarry must in time be extended along the strike, as is often done in the larger operations, or a new pit opened up. All of these factors, in addition to the large amounts of waste rock necessarily quarried and disposed of, combine to lower the profits or even bankrupt the operator. For this reason the opening of a quarry should be undertaken only under the supervision of a man of long experience and only by one with a large amount of capital for preliminary work.

Though quarrying operations are carried on the year round, working days are limited. Severe winter weather causes the quarries to close, while in wet weather at any time of the year it is impossible to have many men at work in the quarries. The treacherous slipping of the steeply inclined strata is the cause

of many serious accidents and during rainy weather the quarries must work short-handed.

The output of slate in the State increases and decreases irregularly from year to year, no very great change in the production having taken place in years. The use of various kinds of patent roofing papers, tars etc., has had a tendency to lower the demand for roofing slate, while on the other hand the increasing high price and scarcity of wooden shingles has increased the demand for other roofing materials. The fact that New York State produces such handsome red slates, which are obtained at but few other localities, causes a heavy demand for this grade and the price remains high. The supply of good red slate, however, is limited.

The year 1909 seems to have been an exceptionally brisk year among the quarries, and the production reached a figure exceeding any preceding year. The total value of the output was $127,050 against $111,217 in 1908 and $54,800 in 1907. The only other year showing an output of over $100,000 was 1903 when the value reached $111,998. The output consists mainly of roofing slates, of which there were produced 21,187 squares valued at $126,170, an average value per square of $6.99 against $8.09 in 1908. The high value as compared with the average value for other slate regions is due to the output of red slate which commands a value of $8 to $10 a square. About 11 per cent of the roofing slate made was of red or variegated color, the remainder of green.

The balance of the slate output was made up of mill stock, both red and green, with a total output of 8000 square feet valued at $880.

STONE

BY HENRY LEIGHTON

The quarrying of stone and its preparation for the market continue to hold a place among the most important of the mineral industries of the State. Although cement and concrete have to some degree supplanted cut building stone in constructional work, the use of the former materials has created an ever-increasing demand for crushed stone and rubble. A large amount of this crushed stone and in many cases the supply of building stone is now produced by large companies operating small areas intensively. Improvements in quarrying, drilling, crushing and transportation machinery have contributed largely to the increasing production of stone.

The State is well supplied with the various kinds of stone and in the extensively developed areas there are exceptionally good transportation facilities. The proximity of the Palisades to New York city and excellent shipping facilities have contributed toward the development of the trap quarries; the marble quarries of Dutchess county are likewise well situated; while the Onondaga limestones form a convenient escarpment but a short distance from Buffalo in the western part of the State.

The advance in the production of stone over 1908 was marked. The total production of stone in 1909 was $7,061,580, an advance over the production of 1908 which was $6,615,614, of 6 per cent. The advance, however, seems to have been restricted to but two classes of products: crushed stone and the miscellaneous uses such as lime, rubble etc. The crushed stone output advanced from $2,659,016 to $3,214,374 an increase of 20 per cent. The increase in the column headed "all others" was due to the large output of rubble and riprap, the increase in lime production and in the sandstone output, and to a transposition of some values in former years included with the building stone. A notable reduction in output was found in the stone used for building stone and curbing and flagging. The output of the former amounted to $873,651 in 1909 against $1,264,403 in 1908, while curbing and flagging was produced to the value of $800,620 against $928,511 in 1908.

All kinds of stone showed an increased output over 1908 with the exception of marble, the output of which fell from $692,857 in 1908, to $380,016 in 1909.

Trap rock showed the greatest increase in output rising from $723,773 in 1908 to $1,061,428 in 1909 or a gain of 46 per cent.

Production of stone in 1907

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAI VALUE
Granite	$84 774	$9 613	*a*	$92 950	$8 563	$195 900
Limestone	189 782	.....	$13 123	1 725 203	1 254 339	3 182 447
Marble	1 408 190	152 746	*a*	*b*	11 000	1 571 936
Sandstone	525 799	.....	1 051 070	55 818	305 730	1 998 417
Trap	*a*	.....	.....	939 027	2 000	941 627
Total	$2 208 545	$162 359	$1 064 193	$2 812 998	$1 642 232	$7 890 327

a Included under "All other." *b* Included under "Limestone."

Production of stone in 1908

VARIETY	BUILDING STONE	MONU-MENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$71 122	$27 585	*a*	$152 783	$116 074	$367 564
Limestone	245 655	.....	$15 668	1 647 629	1 210 883	3 119 835
Marble	567 444	111 492	.....	.....	13 921	692 857
Sandstone	380 182	.....	912 843	135 741	282 819	1 711 585
Trap	.....	.....	.....	722 863	910	723 773
Total	$1 264 403	$139 077	$928 511	$2 659 016	$1 624 607	$6 615 614

a Included under "All other."

Production of stone in 1909

VARIETY	BUILDING STONE	MONU-MENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$35 019	$33 818	$1 352	$182 029	$227 737	$479 955
Limestone	217 109	.....	15 363	1 744 314	1 323 597	3 300 383
Marble	262 934	104 495	25	6 403	6 159	380 016
Sandstone	358 589	.....	783 880	220 200	477 129	1 839 798
Trap	.....	.....	.....	1 061 428	.....	1 061 428
Total	$873 651	$138 313	$800 620	$3 214 374	$2 034 622	$7 061 580

Granite

The granites of the State are confined to the borders of the Adirondack region including Jefferson county and to southeastern New York. Many of them are durable and take a beautiful polish but they have never succeeded in competing as cut stone with the granite of the New England States. The causes assigned are various; less favorable facilities for transportation, irregularity of the deposits, and lack of a "name" or prestige are all in part responsible. Two promising fields for larger development of dressed building and monumental stone are the Pictou and Wellesley island area in the St Lawrence river, and the Ausable Forks quarries in Essex county. At the former locality large quantities of stone are being cut for paving blocks, while its use in polished form bids fair to become more popular.

The Ausable Forks granite has been quarried intermittently for many years. In recent years, however, the operations have been increased under the management of the Ausable Forks Granite Co., and in 1909 a large production of rough monumental and building stone was made. This stone is of somber green color, takes a handsome polish and is excellent for monumental and building purposes.

At Little Falls, Herkimer co., where an outlying tongue of syenite is quarried and crushed, three firms were in operation. The output is mainly sold as crushed stone for road and concrete work. The centralized location and good transportation facilities have given rise to a large industry. The plant of the Syenite Trap Rock Co. was destroyed by fire in November but will in all probability be rebuilt.

The industry in Westchester county remains in about the same condition as in previous years. The granite and gneiss of the county are quarried in a small way, and used locally, or shipped to New York. The gneissic character of the stone makes it of use, mainly, for building purposes, especially for foundation work. Some of the granite when polished, however, presents a pleasing appearance. Eight firms were operative in the county in 1909. Many Italians work quarries in an intermittent way, merely skimming off the top rock from place to place. This class of production must be omitted from the tabulations as it is impossble to collect accurate statistics.

One of the features of the year was the opening of a quarry at Cornwall, Orange co., by the Storm King Stone Co. which produced a large quantity of crushed stone.

Clinton, Fulton and Rockland counties also contributed to the production in 1909.

The total production for the year was $479,955 as against $367,564 for 1908, a gain of 30 per cent. This gain was almost entirely due to the enormous gain in output of paving blocks in Jefferson county and to the output from Orange county. The paving block industry made a very encouraging advance, the production in 1909 being more than double that of 1908. The stone for building purposes showed a decided decline in production over the year 1908. The production of building stone in 1909 was valued at $35,019 against $71,122 in 1908. Monumental stone, on the other hand, because of the activity at Ausable Forks gained slightly, the value for 1909 being $33,818 against $27,585 in 1908.

The crushed stone industry received a slight setback because of business troubles at Little Falls, but this was offset by the production of the two new firms in Orange and Rockland counties. The total production in 1909 reached $182,029 as against $152,783 in 1908.

Production of granite

	1907	1908	1909
Building stone	$84 774	$71 122	$35 019
Monumental	9 613	27 585	33 818
Crushed stone	92 950	152 783	182 029
Rubble, riprap	5 600	15 351	12 737
Other kinds[a]	2 963	100 723	216 352
Total	$195 900	$367 564	$479 955

[a] Includes in 1908 curbing, paving blocks, and minor uses.

Limestone

New York State is abundantly supplied with limestone. In the western and central parts of the State are the Onondaga and Niagara formations; in the northern section the crystalline limestones of St Lawrence county; in the east the Helderberg limestones; and in the southeast various crystalline limestones. These vary greatly in purity and this variation makes it possible to obtain a stone suitable for almost any purpose.

The stone discussed under this heading, with the exception of some crystalline limestone used for flux or lime making, is all of a noncrystalline, massive character. The stone used so extensively in portland cement manufacture is not included in the tabulations.

The total production of limestone for 1909, exclusive of that used in cement manufacture was valued at $3,300,383, a slight gain over the value for 1908 which was $3,119,835.

Among the counties Erie showed the largest production with a total of $853,764, a large increase over the production of last year. It was followed in descending order by Dutchess, Onondaga, Genesee and Jefferson counties, all of which showed large gains with the exception of Onondaga, whose production took a decided drop.

The production was distributed among the various products as follows: crushed stone $1,744,314; building stone $217,109; lime $452,874; furnace flux $434,311; other uses $451,775. All of these took part in the general increase in production but the stone used for building purposes which fell from $245,655 in 1908 to $217,109 in 1909. The lime made in connection with the products of the Solvay Process Co. and the Union Carbide Co. is included under "other uses."

Production of limestone

MATERIAL	1907	1908	1909
Crushed stone	$1 725 203	$1 647 629	$1 744 314
Lime made	*a*888 309	401 728	452 874
Building stone	189 782	245 655	217 109
Furnace flux	338 127	230 117	434 311
Rubble, riprap	14 588	*c*.....	82 748
Flagging, curbing	13 123	15 668	15 363
Miscellaneous	13 135	*b*579 038	*b*353 664
Total	$3 182 447	$3 119 835	$3 300 383

a Includes Solvay Process Co.'s lime.
b Includes lime made by Solvay Process Co. and Union Carbide Co., also rubble and riprap.
c Included in "Miscellaneous."

Crushed stone. The use of crushed limestone for road metal, concrete and railroad ballast is constantly increasing. Large, well equipped crushing plants in Erie, Genesee, Dutchess and Rockland counties are turning out enormous quantities, while smaller plants are located throughout the rest of the limestone areas. The railroads at the present time are largely using crushed stone in place of gravel as ballast; the agitation for good macadam roads has also aided in the demand, while the barge canal and other concrete constructions have increased the use of concrete. In the barge canal contracts, the quarries and crushers are located but temporarily and part of the stone thus used is probably not included in our tabulations.

The total value of the production of crushed stone for the year was $1,744,314, the largest yet recorded for any year. In 1908 the value was $1,647,629. Erie county leads in production with a value of $447,605 against $369,754 in 1908. It is followed in order by the following counties, the production for 1908 being inclosed in brackets; Dutchess $365,661 [$233,261]; Rockland, one large producer; Genesee $123,784 [$122,310]; Onondaga $110,886 [$108,768].

Lime. Since the earliest days of the State, the manufacture of lime has been carried on; and many active or abandoned lime kilns are found in all limestone sections. The prevailing economic conditions, however, have tended toward a consolidation of the industry and the manufacture is now mainly carried on from large well equipped plants. Warren county alone produces 38 per cent of the State's production, while the counties of Warren, Jefferson, Clin-

ton and Washington produce 71 per cent of the supply. The lime made by the Solvay Process Co. and the Union Carbide Co., since it is not marketed as lime, is not included in these tabulations.

The total production of lime for the year was valued at $452,-874 against $401,728 in 1908, a gratifying advance. The production of the four leading counties was as follows, the 1908 production being inclosed in brackets: Warren $175,830 [$170,832]; Jefferson $57,368 [$52,454]; Clinton $47,488 [$45,000]; Washington $30,000 [$36,960]. Large increases of production were also reported from the following counties: Albany, Dutchess, Lewis and Ulster.

Building stone. The use of the limestones of the State for building purposes seems to be largely local, the stone rarely being shipped to any great distance from the quarry. Competition with Bedford limestone and Ohio sandstone seems impossible and our native limestones show little advance in production from year to year, while the past year a strong decline was experienced. In addition to competition with extralimital material, the increased use of concrete for foundation work has tended to restrict the use of cut stone, while at the same time it increases the use of rubble, riprap and crushed rock.

The increase in production in 1908, attributed to the activity of the quarry at Newport, Herkimer co. and those in Schoharie county, was not continued in 1909. The Newport Construction Co.'s quarry was idle; the Schoharie quarries did a slightly decreased business, while a loss was experienced from Jefferson county.

The total production amounted to $217,109 against $245,655 in 1908 and $189,782 in 1907. Erie county continued to be the largest producer with a total of $119,134 or about 54 per cent of the total for the State. Following in order are Schoharie county with $25,885; Onondaga county, $17,380 and Clinton county, $13,325.

Furnace flux. The limestones of the State are widely used for flux in blast furnace operations. The Onondaga limestone is extensively quarried for such purposes, the larger quarries being in Williamsville and Clarence, Erie co., and North Leroy, Genesee co. The Niagara limestone which is dolomitic entered the field during the year as a flux and a large amount of such rock was quarried by the Empire Limestone Co. at Pekin, Niagara co.

The Gouverneur district in St Lawrence co., was also a large producer, the stone being in reality a crystalline limestone or marble. One firm is in operation at Gouverneur, and the stone

is shipped to furnaces in Ohio. Quarries are also in operation in Chazy, Clinton co. and the stone is shipped to the blast furnaces at Port Henry. Aside from these larger quarries, small amounts are obtained from quarries throughout the State but are used only locally in small furnaces.

The total production of flux for 1909 was $434,311 a gain of 88 per cent over the production of 1908 which amounted to $230,117. This production even exceeded that of 1907 and was the largest yet recorded for the industry. Of the total production, Erie county contributed $257,966 or 59 per cent and Genesee county $99,814 or 22 per cent, both showing large increases in production over 1908. Clinton and St Lawrence counties also reported largely increased productions while Niagara county made its first appearance as a large producer.

Production of limestone by counties in 1908

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$104 250	.....	.....	$200	$500	$104 950
Cayuga	39 051	$400	$510	6 216	2 500	48 677
Clinton	18 136	45 000	5 640	8 250	7 592	84 618
Columbia	3 700	.....	4 500	360	.....	8 560
Dutchess	233 261	1 600	.....	.....	512	235 373
Erie	369 754	515	138 563	112 409	33 711	654 952
Fulton	4 666	12 840	.....	.....	.....	17 506
Genesee	122 310	2 520	53 407	2 461	100	180 798
Greene	3 270	.....	.....	1 000	.....	4 270
Herkimer	6 085	3 607	.....	30 000	5 180	44 872
Jefferson	2 500	52 454	.....	13 513	133 521	201 988
Lewis	780	4 000	.....	888	80	5 748
Madison	27 993	.....	3 000	.....	14 340	45 333
Monroe	14 002	21 756	.....	3 981	176	39 915
Montgomery	8 561	.....	.....	5 343	6 416	20 320
Niagara	12 950	5 400	.....	2 622	16 500	37 472
Oneida	26 150	.....	50	4 000	1 000	31 200
Onondaga	108 768	*a* 1 450	.....	16 709	*a* 355 105	482 032
Rensselaer	15 700	.....	100	3 425	6 750	25 975
St Lawrence	462	7 305	14 606	723	562	23 658
Saratoga	12 259	.....	.....	625	2 271	15 155
Schoharie	32 971	232	.....	30 555	.....	63 758
Seneca	1 340	400	60	1 120	2 980	5 900
Ulster	169 414	2 530	.....	.....	500	172 444
Warren	16 000	170 832	.....	1 005	3 357	192 194
Washington	55 860	36 960	.....	250	.....	93 070
Westchester	38 509	22 927	37	.....	.....	61 473
Other counties *b*	198 927	9 000	9 644	.....	1 053	218 624
Total	$1 647 629	$401 728	$230 117	$245 655	$594 706	$3 119 835

a Lime used by Solvay Process Co. included in "Other uses."
b Includes Essex, Ontario, Orange, Orleans, Rockland and Schenectady.

Production of limestone by counties in 1909

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$105 440	$4 600	.....	$200	.....	$110 240
Cayuga	36 734	400	$610	6 835	$2 500	47 079
Clinton	21 735	47 488	14 200	13 325	532	97 280
Columbia	9 883	.....	3 460	200	.....	13 543
Dutchess	365 661	4 000	.....	.....	.....	369 661
Erie	447 605	375	257 966	119 134	28 684	853 764
Fulton	.....	18 900	.....	.....	.....	18 900
Genesee	123 784	5 400	99 814	1 225	.....	230 223
Greene	4 177	.....	.....	500	30	4 707
Herkimer	6 611	3 350	.....	.....	.....	9 961
Jefferson	1 000	57 368	.....	562	153 420	212 350
Lewis	940	8 000	.....	887	2 359	12 186
Madison	24 176	.....	.....	840	12 000	37 016
Monroe	20 218	23 593	.....	3 917	2 454	50 182
Montgomery	42 832	.....	.....	10 440	1 503	54 775
Niagara	2 060	3 000	27 920	5 587	612	39 179
Onondaga	110 886	*a*600	.....	17 380	231 842	360 708
Rensselaer	15 700	.....	75	3 550	6 750	26 075
St Lawrence	6 630	5 350	23 994	2 993	1 103	40 070
Saratoga	11 316	.....	.....	100	.....	11 416
Schoharie	18 913	400	.....	25 885	.....	45 198
Seneca	1 050	360	40	865	210	2 525
Ulster	48 022	11 360	.....	1 200	.....	60 582
Warren	22 938	175 830	.....	1 156	1 750	201 674
Washington	47 660	43 200	.....	.....	2 000	92 860
Westchester	8 252	30 000	.....	.....	3 465	41 717
Other counties *b*	240 091	9 300	6 232	328	561	256 512
Total	$1 744 314	$452 874	$434 311	$217 109	$451 775	$3 300 383

a Lime used by Solvay Process Co. included in "Other uses."
b Includes Essex, Ontario, Oneida, Orange, Rockland and Schenectady counties.

Marble

The marbles of the State are confined to two main areas: Gouverneur, St Lawrence county and southeastern New York.

The Gouverneur stone is a rather coarse grained gray or bluish marble taking a good polish. It is quarried as "light," "medium," "dark" and "extra dark." It is utilized largely for monumental work and as dressed building stone.

In Dutchess county, near South Dover, a handsome white marble, equal to much of the imported stone, is extensively quarried and shipped to many points in the Eastern States. Its uniformity of color, its beauty and durability warrant for it a more extended use. It is to be hoped that with the two well equipped firms in activity the stone will become more widely known.

The Westchester county quarries near Tuckahoe, once so extensively developed, are no longer in operation with the exception of a small amount of stone quarried for crushing. At Ossining also small amounts of stone are crushed for the manufacture of artificial stone.

At Plattsburg, Clinton co., the Rutland-Florence Marble Co. continues to quarry small amounts of the mottled pink and gray Chazy limestone as marble for interior decorations.

The Trenton limestone at Glens Falls is also quarried and sold in the rough. It is a firm, compact, black limestone, often classed with marbles because of the fine polish which can be given to it.

The total production of marble for the year 1909 was $380,016 as against $692,857 in 1908 and $1,571,936 in 1907. This production was the smallest reported in a number of years. The Gouverneur district reports the most disastrous year ever known, while at South Dover a large curtailment of production was also shown. The reasons for such a condition can not be ascertained. The use of marble for decoration seems, in general, to have been increasing in the last few years, while as a monumental stone, no new developments would seem to have arisen to curtail its use. The curtailment seems to have been general throughout all the districts and over all products. Reports from Gouverneur would seem to indicate, however, that better conditions are likely to prevail in 1910, while in the South Dover district, the advent of the Dover White Marble Co., in addition to the South Dover Marble Co., will bring about a more lively trade.

Production of marble

VARIETY	1907	1908	1909
Building marble	$1 408 190	$567 444	$262 934
Monumental	152 746	111 492	104 495
Other kinds	11 000	13 921	12 587
Total	$1 571 936	$692 857	$380 016

Sandstone

Sandstones are widely distributed over the State, almost every county having some beds. The largest unbroken area is that extending across the southern tier of counties from Chautauqua county on the west to Ulster county on the east. This series will be described more fully under bluestone. North of this belt and extending in an east-west direction across western and central New York, are a series of sandstone strata that include the Oriskany, the Clinton and the Medina sandstones. Of these the latter, the Medina sandstone, is the only one of commercial importance. The main area covered by this stone lies along the southern shore of Lake Ontario in Niagara, Orleans, Monroe and Wayne counties. The stone is a medium grained, red sandstone, free from injurious impurities and easily dressed. Associated with it in places are white layers. It makes a very handsome building stone and has been much used for that purpose. Its main use, however, is for curbing and paving blocks. Many large quarries are actively engaged in getting out the stone for such purposes, the majority of them located in Orleans county between Medina and Holley.

The Potsdam sandstone is found in northern New York, around the border of the Adirondacks, from Jefferson county to Lake Champlain. It is one of the hardest, most durable and at the same time handsome sandstones in the country and it deserves a wider use. Its delicate pinkish color and its banding give it a most pleasing appearance. It is quarried in Franklin, Jefferson and St Lawrence counties and sold mainly as building stone or flagging.

The Hudson River series, comprising irregular strata of slates, sandstone and limestone, affords, at a few places, a sandstone suitable for quarry purposes. Quarries in this series are located in Rensselaer and Dutchess counties. Sandstones of Triassic age, known as "brownstones" were formerly quarried near Nyack, but the industry is now practically abandoned.

Bluestone. This variety of sandstone is bluish in color, fine grained and is jointed and bedded in such a regular manner that with careful selection of a quarry site, flagging and curbing can be extracted with a minimum amount of after-dressing. The bluestone is, for that reason, in demand chiefly for these purposes. The quarries are located in Greene, Ulster, Delaware and Sullivan counties, and thence west to Chautauqua

county. In the Hudson river and Delaware river areas, the industry affords no inconsiderable income to the farmers living in the hilly country, where other resources are rather limited. The stone is quarried the year round except in severe winter weather, and in the spring is hauled down the hillsides to the railway sidings or river docks where it is purchased by wholesale dealers and shippers. From thence it is shipped by barges on the Hudson river or by rail in other districts, to New York city, Philadelphia, and other coast cities, or inland to New York State cities.

In Wyoming county, the rock varies slightly in its jointed character and is of more value as a building stone. Quarries are operated on a larger scale and large quantities of dressed building stone are turned out.

The total production of sandstone in 1909 was $1,839,798 against $1,711,585 in 1908 or an increase of 7 per cent. This total, however, falls short of that for 1907 which was $1,998,417.

Bluestone contributed toward the above total $1,301,959 or 70 per cent, as against $1,151,386 in 1908. The increase seems to have been general over all the bluestone districts but among the products the increase was shown only in the building and crushed stone, the curbing and flagging showing a decreased production. This is no doubt due to the large use of cement in the construction of sidewalk and curb. In the table of production, the increase in the building stone is not apparent because of the fact that the stone used for sills and coping is included under "all other," as is also the Belgian bridge.

Sandstone, other than bluestone, showed a total production of $537,839 against $570,229 in 1908. The decrease was due to the small production of building stone in Orleans county and a large decrease in the production of crushed stone. The production of paving blocks which are obtained almost entirely from Orleans county, increased, the value being $248,751 against $239,239 in 1908.

Production of sandstone in 1908

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river	$26 400	$296 607	.....	$45 650	.....	.....
Delaware river	43 597	428 372	.....	1 630	$4 185	.....
Chenango co	54 871	27 309	.....	319	.....	$11 168
Wyoming co	170 722	450	.....	.....	3 042	.....
Other districts	13 199	5 820	.....	8 045	.....	.....
Total bluestone	$308 789	$758 558	.....	$55 644	$7 227	$11 168
Sandstone						
Orleans co	$59 138	$111 455	$227 537	$8 687	$1 470	.....
Other districts	12 255	52 830	11 702	71 410	20 095	$3 650
Total sandstone	$71 393	$154 285	$239 239	$80 097	$21 565	$3 650
Combined total	$380 182	$912 843	$239 239	$135 741	$28 792	$14 818

Production of sandstone in 1909

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE, RIPRAP	ALL OTHER
Bluestone						
Hudson river	$7 552	$256 193	.....	$175 000	.....	$116 268
Delaware river	23 165	324 906	.....	.....	$3 905	88 839
Chenango co	66 141	21 340	.....	.....	368	1 059
Wyoming co	191 276	480	.....	.....	443	850
Other districts	10 497	5 197	.....	7 662	.....	818
Total bluestone	$298 631	$608 116	.....	$182 662	$4 716	$207 834
Sandstone						
Orleans co	$16 017	$116 816	$246 091	$874	$4 283	$1 200
Other districts	43 941	58 948	2 660	36 664	8 245	2 100
Total sandstone	$59 958	$175 764	$248 751	$37 538	$12 528	$3 300
Combined total	$358 589	$783 880	$248 751	$220 200	$17 244	$211 134

Trap

Trap is a term badly misused by many quarrymen and contractors. Limestones, granites and fine grained sandstones if dark colored are often spoken of and even sold as trap. Prop-

erly speaking trap is a fine grained, dark colored igneous rock resulting from the cooling of a mass of molten material intruded into other rocks. It usually follows a vertical fissure and is known as a dike, or spreads horizontally between beds of stratified rock and is known as a sill or sheet. In appearance it is black or greenish black in color, fine grained and shows a crystalline structure. Under the microscope, in thin section, it is seen to be composed of lath-shaped feldspar crystals, containing dark colored pyroxene, olivene etc., in the interstices, the whole interlocked in such a manner as to give the rock its well known toughness. This toughness, as well as its cementing or bonding power, has given it a preeminent place as a road material for macadam roads. Whatever the lower courses may be, trap rock top dressing is usually specified.

Aside from its use as crushed stone, it has little demand. Although dressed and polished blocks present a handsome appearance, the cost of dressing and lack of demand have prohibited its use for such purposes in this State. In the New England States, related rocks are cut and polished as "black granite."

The main supply of trap in the State, comes from the Palisades on the lower Hudson river in Rockland county. This sheet of diabase is from 300 to 800 feet in thickness and has an outcrop of 70 miles, extending into New Jersey. It presents a practically unlimited supply of trap and large plants are in operation in both New York and New Jersey. The only other active locality in the State is near Greenfield, Saratoga co., where a trap dike is being quarried and crushed. Other localities, formerly active but now idle, are Port Richmond, Richmond co., Northumberland, Saratoga co., and Fort Ann, Washington co.

The production for the year 1909 amounted to 1,095,331 cubic yards valued at $1,061,428, as against a value of $723,773 in 1908 and $941,627 in 1907. About 80 per cent of the total was used as road metal, the remainder for concrete work and ballast. Six firms were in operation in Rockland county, the quarries situated at Haverstraw, Rockland Lake, Mt Ivy and West Nyack. One firm was in operation in the town of Greenfield, Saratoga co.

Among the changes in the industry were the formation of the Haverstraw Crushed Stone Co., taking over the Long Clove

Trap Rock Co. and Haverstraw Trap Rock Co., and the formation of the Ramapo Trap Rock Co., the latter not being active in 1909.

Production of trap

MATERIAL	1908		1909	
	CUBIC YARDS	VALUE	CUBIC YARDS	VALUE
Crushed stone for roads	755 754	$584 837	868 650	$823 696
Crushed stone for other purposes	175 144	138 026	226 681	237 732
Paving blocks, etc	.....	.....	.....	.....
Other	1 113	910	.....	.....
Total	932 011	$723 773	1 095 331	$1 061 428

TALC

The talc mines in St Lawrence county were operated last year on about the usual scale. During the last decade the production has averaged about 65,000 tons a year and has not varied from that amount by more than a few thousand tons. In 1907 the total fell off to 59,000 tons, due to the destruction by fire of one of the large mills, but this shortage was counterbalanced in 1908 by an output of 70,739 tons. In 1909 the production may be placed at about 65,000 tons. The value of the product was approximately $617,500 as compared with $697,390 in 1908.

A general description of the St Lawrence county deposits and of their industrial development was given in the issue of this report for 1908. Following the recent consolidation of mining interests by which the properties formerly operated by the United States Talc Co. and the Union Talc Co. came under the control of the International Pulp Co., no further changes of note have occurred. The latter company has been for some time the largest producer in the region and now occupies a dominant position in the production and sale of ground talc in this country.

The Ontario Talc Co. was the only independent producer in the district last year. The Uniform Fibre Talc Co. of New York, has a mill under construction at Talcville and is expected to begin operations during the current season. Its mining property is on Wintergreen hill, just west of Talcville.

Production of talc in New York

YEAR	SHORT TONS	VALUE	VALUE PER TON
1896	46 089	$399 443	$8 67
1897	57 009	396 936	6 96
1898	54 356	411 430	7 57
1899	54 655	438 150	8 02
1900	63 500	499 500	7 87
1901	62 200	483 600	6 99
1902	71 100	615 350	8 65
1903	60 230	421 600	7 ..
1904	65 000	455 000	7 ..
1905	67 000	519 250	7 75
1906	64 200	541 600	8 43
1907	59 000	501 500	8 50
1908	70 739	697 390	9 86
1909	65 000	617 500	9 50

The talc from the St Lawrence county mines is mainly of fibrous nature and it is this feature which makes it particularly valuable for incorporation in paper stock. The foliated variety occurs in some of the deposits but is utilized to a smaller extent; it is admixed in small amount with the fibrous article or is ground separately for coating of wall papers and other uses.

Though the district which lies southeast of Gouverneur has attracted most attention, the occurrence of talc elsewhere in the Adirondack region has long been known. During 1909 a deposit situated near Natural Bridge, Lewis co., was under development by the St Lawrence Talc & Asbestos Co. The talc is found there in somewhat similar relations geologically to those in the more northerly district, but it has the character rather of amorphous talc or soapstone, resembling the material from the Southern States. The recent operations are reported to have revealed a large quantity of rock of good quality. Natural Bridge is near the southern end of the belt of crystalline limestones and schists which belong to the same series as the limestones and schists in which the fibrous talc deposits are found, the two belts being about 10 miles apart and trending parallel in a northeast-southwest direction.

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New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

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These reports cover the reports of the State Geologist and of the State Paleontologist. Bound also with the museum reports of which they form a part.

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In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899–1903. The two departments were reunited in 1904, and are now reported in the Director's report.

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2 Botany
3 Economic Geology
4 Mineralogy
5 Entomology
6 "
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