REPORT

ON THE

MANUFACTURE OF CHEMICAL PRODUCTS AND SALT.

PREPARED UNDER THE DIRECTION OF HENRY BOWER, CHIEF SPECIAL AGENT,

BY

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LETTER OF TRANSMITTAL.

To the Superintendent of Census.

Sir: I have the honor to submit herewith the final report on the manufacture of chemical products in the United States. As this is the first official report on this branch of industry, its preparation has been attended with extraordinary difficulty, owing to the lack of full and reliable information, particularly in matters of historical interest.

Manufacturing chemistry is so intimately associated with other branches of manufacture that it becomes difficult to locate the dividing line between them. In this report the plan pursued is, so far as practicable, that adopted by French statisticians. No attempt has been made to describe the various processes employed in the preparation of chemical products, as these differ so widely that the methods employed are almost innumerable. In the manufacture of a single article the processes employed by various makers are often essentially different. Moreover, such descriptions do not properly belong to a statistical report, but can be found in works on technical chemistry, and in the records of the patent office.

For convenience of reference the report is divided into two parts:

Part I treats of the general industry, with special mention of certain important products, and is accompanied by the following tables:

Table I.—Exhibiting by states the total production of chemical products in the United States.

Table II.—Exhibiting the statistics of the chemical industry in several of the principal cities. These points are centers of manufacture, and to secure uniformity in compilation statistics are given of the total manufacture within a radius of thirty miles.

Part II treats of the manufacture of common salt, and is accompanied by the following tables:

Table I.—Gives the general statistics of salt production in the United States for the census year 1880.

Table II.—Showing the relative production of the various salt-producing states according to the censuses of 1860, 1870, and 1880, respectively.

Table III.—Giving analyses of the brines and rock salts of the United States, which are fairly typical of their composition in the various sections.

Table IV.—Giving analyses of various brands and qualities of salt from the different sections.

Many small tables are introduced in both parts of the report when special mention is made of a product or the locality from which it is derived; but these are mainly compiled from the tables enumerated above.

In the compilation of these statistics I have been efficiently assisted by Mr. John Cooper, of Philadelphia, to whom my thanks are due.

Very respectfully, your obedient servant,

W. L. ROWLAND,
Special Agent.

PART I.—CHEMICAL PRODUCTION.

GENERAL DISCUSSION.

Although complete statistics of the chemical industry are given in the accompanying tables, it is desirable to give some of the more important features in a condensed form. No statistics are available to exhibit the growth of this industry, while its diversified character renders it impossible to consider each article separately, and therefore only a few chemical products have been selected for special mention.

During the census year 1,349 establishments were in operation, with aggregates of investment, cost, and production as follows:

Number of establishments	1,349
Value of buildings	$19,019,139
Value of machinery	$15,656,476
Total capital	$85,394,211
Number of men employed	26,776
Number of women employed	1,493
Number of children employed	1,251
Total amount paid in wages	$11,840,704
Tons of anthracite coal used	273,161
Value of anthracite coal used	$968,432
Tons of bituminous coal used	319,398
Value of bituminous coal used	$913,885
Total value of all materials	$77,471,836
Total value of products	$117,377,324

By this it will be seen that 41 per cent. of the total capital is invested in plant, exclusive of land. The average yearly wages paid is $401 11, allowing the same wages to men, women, and children; if, in determining the average yearly wages, those of women and children are considered as half those of men, the average of men's wages will be $420 66. This makes no allowance for establishments in operation during only a portion of the year. Inasmuch as a few discontinued work after the year began, while many more commenced operations during the last half of it, the figures given represent a lower average of wages than was actually the case. Only hands employed in manufacture are included in these statements, clerks, bookkeepers, superintendents, agents, and carters being omitted.

Among the materials used fuel is an important item for chemical establishments, and, other things being equal, cheap coal will invariably draw the manufacturing chemist to its neighborhood; 592,559 tons of coal, valued at $1,882,317, were consumed in this branch of industry during the year, with undetermined quantities of wood, coke, and charcoal.

Of the value of the product of this industry 10.08 per cent. was paid out in wages and 66 per cent. for materials, leaving 23.92 per cent. to meet the cost of freights, interest on capital, rent, superintendence, and other general expenses.

The diversified character of the industry allows the employment of capital in large or in small amounts, many operations, particularly in the manufacture of potash, being on so small a scale as to be omitted in the enumeration, since the law only admits the classification of establishments that produce in excess of $500 per annum. The amount of capital employed varies from merely nominal sums in many establishments to nearly $4,000,000 in others, with production in proportion to the capital.

From the statistics of Table I the following figures may be deduced as the average for each establishment:

Value of buildings	$14,098
Value of machinery	$11,606
Total capital	$63,302
Number of hands employed	22
Total amount paid in wages	$8,777
202 tons of anthracite coal used	$718
237 tons of bituminous coal used	$677
Total value of materials	$57,429
Total value of product	$87,011

The following table shows the number of establishments and total value of production in twelve of the leading states, in the order of production, with the percentages of each, compared with the total figures of the United States, only those states being given separately that make over 1 per cent. of the total production of the United States:

States.	ESTABLISHMENTS.		PRODUCT.			States.	ESTABLISHMENTS.		PRODUCT.		
	Number.	Percentages.	Total value.	Percentage.	Average percentage for each establishment.		Number.	Percentages.	Total value.	Percentage.	Average percentage for each establishment.
New York	217	16.08	$29,805,614	25.39	0.117	Missouri	39	2.89	$5,827,498	4.97	0.127
Pennsylvania	181	13.42	20,884,991	17.79	0.098	California	42	3.11	3,179,700	2.71	0.065
Massachusetts	179	13.27	10,604,662	9.04	0.050	South Carolina	29	2.15	2,693,053	2.30	0.679
New Jersey	62	4.60	9,499,577	8.09	0.130	Connecticut	41	3.04	2,419,743	2.06	0.050
Ohio	92	6.82	7,678,374	6.54	0.071	Rhode Island	41	3.04	1,968,041	1.68	0.041
Illinois	52	3.85	7,681,325	6.54	0.126	Twenty-six other states	314	23.28	7,891,624	6.72	0.021
Maryland	60	4.45	7,248,122	6.17	0.103						

It will be seen that the state of New York gives 25.39 per cent. of the entire production, followed by Pennsylvania with 17.79 per cent. The last column, containing the average percentage for each establishment in the various states, shows that New Jersey has the largest average production in the states mentioned, followed by Missouri, while the average percentages of New York and Pennsylvania are less.

These figures represent the geographical distribution of the industry as a whole, but the distribution of each article of production will not correspond with these percentages. Several of the special articles enumerated in Table I are produced by only a few establishments, and in limited quantity, the greater portion consumed within the United States being imported from foreign countries. For example, only one establishment mined and produced sulphur during the census year, yielding 1,200,000 pounds, while 176,238,600 pounds were imported; three establishments produced 80,518 pounds of aniline colors, while 563,872.12 pounds were imported; one establishment produced 56,292 pounds of phosphorus, valued at $29,271, while the importations were valued at $78,253; three establishments produced 40,259,938 pounds of soda salts, while 360,301,309 pounds were imported. On the other hand, four establishments produced 3,692,443 pounds of borax, of which only 15,278 pounds were imported; and six establishments produced 39,217,725 pounds of alum, of which 2,112,570 pounds were imported.

The following table serves to illustrate the distribution of the manufacture of special products, giving the states in the order of production, with the approximate percentage value in each, compared with the total value of products:

GLYCERINE.		NITRO-GLYCERINE.		STEARIC-ACID CANDLES.		OLEIC-ACID SOAP.		OTHER HARD SOAP.	
States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.
Ohio	57	California	36	Ohio	50	Ohio	42	New York	27
New York	32	Pennsylvania	23	California	16	Missouri	18	Illinois	17
California	4	New Jersey	19	Missouri	12	Pennsylvania	13	Pennsylvania	12
Missouri	4	Ohio	14	Kentucky	9	Illinois	11	Massachusetts	9
Kentucky	3	New York	3	New York	7	New York	6	Ohio	8
		Massachusetts	3	Illinois	6	California	6	New Jersey	7
		Michigan	2			New Jersey	2	Missouri	3
						Six other states	2	Rhode Island	2
								California	2
								Maryland	2
								Wisconsin	2
								Connecticut	1
								Twenty-four other states.	8

SOFT SOAP.		MANUFACTURED MANURES.		SULPHURIC ACID.		POTASH.		ACETATE OF LIME.	
States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.
Massachusetts	46	Maryland	27	Pennsylvania	26	Wisconsin	41	New York	50
New York	14	New York	13	New Jersey	19	Michigan	27	Pennsylvania	20
New Hampshire	11	New Jersey	12	New York	12	New York	10	Michigan	19
Illinois	10	Massachusetts	10	Ohio	10	Ohio	9	Maryland	4
Maine	6	South Carolina	8	Maryland	9	Maine	6	Vermont	3
Connecticut	3	Pennsylvania	7	Massachusetts	9	Indiana	5	Massachusetts	2
Pennsylvania	2	Delaware	5	Rhode Island	4	Minnesota	2	Rhode Island	1
Rhode Island	2	Virginia	4	California	3			New Jersey	1
New Jersey	2	Illinois	3	Illinois	2				
Eleven other states	4	Georgia	2	Missouri	2				
		Eighteen other states	9	Connecticut	1				
				Seven other states	3				

SULPHATE AMMONIA.		CASTOR OIL.		DRY COLORS.		WHITE LEAD.		OTHER SALTS OF LEAD.	
States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.	States.	Approximate percentage value of product.
Pennsylvania	30	Missouri	50	New York	34	Pennsylvania	24	New York	39
New York	24	New Jersey	25	Pennsylvania	19	New York	22	Pennsylvania	34
Ohio	14	Illinois	18	Connecticut	16	Missouri	21	Missouri	9
Illinois	7	California	6	Massachusetts	14	Ohio	11	California	9
New Jersey	7	Kansas	1	New Jersey	10	Illinois	6	Massachusetts	5
Massachusetts	6			Ohio	4	Massachusetts	4	Ohio	3
District of Columbia	3			Maryland	1	Nebraska	4	Kentucky	1
Kentucky	2			Five other states	2	California	3		
Connecticut	2					Maryland	3		
Missouri	2					Kentucky	2		
Louisiana	2								
Two other states	1								

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TABLE I.—STATISTICS OF THE CHEMICAL INDUSTRY, BY STATES AND TERRITORIES: 1880.

	States and Territories.	No. of establishments.	CAPITAL.			AVERAGE NUMBER OF HANDS EMPLOYED.			Total amount paid in wages during the year.
			Value of buildings.	Value of machinery.	Total capital.	Males above 16 years.	Females above 15 years.	Children and youths.	
			Dollars.	*Dollars.*	*Dollars.*				*Dollars.*
	The United States	1,349	19,019,139	15,656,476	85,394,211	26,776	1,493	1,251	11,840,704
1	California	42	368,300	409,725	2,406,350	548	16	9	282,614
2	Colorado	2	7,000	1,250	36,000	18	2	.....	13,200
3	Connecticut	41	285,050	305,250	1,434,250	506	30	4	270,754
4	Delaware	23	177,200	219,900	931,379	370	142	27	100,026
5	District of Columbia	12	73,500	41,900	205,967	132	.....	2	46,875
6	Florida	1	400	150	700	2	.....	.....	315
7	Georgia	4	65,600	28,000	245,000	82	.....	7	28,377
8	Illinois	52	784,429	747,849	3,348,550	1,293	72	98	571,417
9	Indiana	16	27,400	36,550	102,700	73	.....	.....	23,116
10	Iowa	17	63,456	54,221	219,600	108	6	3	34,020
11	Kansas	12	17,290	15,035	68,006	43	.....	2	12,992
12	Kentucky	15	172,988	137,700	712,440	157	27	.....	93,475
13	Louisiana	7	61,000	63,301	218,701	87	8	5	45,043
14	Maine	24	113,600	72,800	398,480	161	.....	.....	53,461
15	Maryland	60	959,350	570,839	5,578,302	1,361	.....	19	535,125
16	Massachusetts	179	1,530,233	1,067,998	6,828,473	2,016	63	64	953,784
17	Michigan	38	65,500	66,200	256,602	198	2	4	65,158
18	Minnesota	6	35,035	19,000	113,509	30	7	.....	19,024
19	Missouri	39	767,154	601,922	3,415,300	1,114	31	29	542,769
20	Nebraska	7	35,800	35,175	119,300	65	2	7	24,036
21	Nevada	7	31,800	24,800	274,500	53	.....	.....	33,670
22	New Hampshire	20	31,175	12,025	80,600	49	1	.....	19,849
23	New Jersey	62	1,712,920	1,372,344	7,371,400	2,345	78	232	1,172,654
24	New York	217	5,508,678	3,619,314	20,141,586	5,552	429	270	2,901,960
25	North Carolina	1	40,000	30,000	350,000	100	.....	25	40,000
26	Ohio	92	1,134,100	938,579	5,961,003	1,541	140	122	706,494
27	Oregon	2	3,950	8,200	22,000	8	.....	.....	3,700
28	Pennsylvania	181	3,932,125	3,824,031	18,349,930	4,273	336	187	2,151,709
29	Rhode Island	41	284,250	353,050	1,291,136	605	74	8	274,657
30	South Carolina	29	396,550	592,730	3,496,300	2,680	10	70	577,100
31	Tennessee	9	41,206	45,471	127,600	64	.....	1	14,406
32	Texas	6	7,000	5,833	30,000	16	.....	3	9,488
33	Utah	2	4,700	7,700	20,000	4	.....	.....	2,778
34	Vermont	11	59,800	28,550	195,900	95	.....	.....	23,422
35	Virginia	38	133,250	105,800	645,700	795	3	30	125,010
36	West Virginia	9	23,650	50,300	140,900	93	.....	10	32,999
37	Washington	1	500	200	2,000	3	.....	.....	1,000
38	Wisconsin	24	72,200	52,784	251,972	136	14	13	57,397

TABLE I.—STATISTICS OF THE CHEMICAL INDUSTRY, BY STATES AND TERRITORIES: 1880.

MATERIALS.						PRODUCTS.										
Anthracite coal.		Bituminous coal.		Value of all other materials.	Total value of all materials.	Aniline colors.		Anthracene.		Sulphate of ammonia.		Alum.		Borax.		
Tons. 273,161	*Dollars.* 968,432	*Tons.* 319,398	*Dollars.* 913,885	*Dollars.* 75,612,108	*Dollars.* 77,494,425	*Pounds.* 80,518	*Dollars.* 107,292	*Pounds.* 344,114	*Dollars.* 99,242	*Pounds.* 16,575,088	*Dollars.* 618,485	*Pounds.* 39,217,725	*Dollars.* 808,165	*Pounds.* 3,692,443	*Dollars.* 277,233	
1,793	14,087	6,718	43,404	2,060,687	2,119,078	.....	.....	.....	.....	.....	.....	.....	.....	1,422,443	107,333	1
.....	.....	288	1,162	47,838	49,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
17,407	54,124	1,015	5,145	1,763,166	1,822,435	.....	.....	.....	.....	375,000	15,000	.....	.....	.....	.....	3
2,011	14,004	.....	.....	795,070	809,074	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
302	1,260	920	3,530	212,123	216,919	.....	.....	62,684	8,875	530,000	21,200	.....	.....	.....	.....	5
.....	.....	.....	.....	500	500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
.....	.....	.....	.....	209,000	209,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
2,003	9,293	10,821	71,878	5,854,250	5,935,430	.....	.....	.....	.....	1,148,000	43,000	.....	.....	.....	.....	8
.....	.....	802	3,084	86,460	89,544	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
45	130	995	3,405	175,175	178,710	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
.....	.....	320	1,079	126,421	128,100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
.....	.....	6,000	12,610	455,363	467,973	.....	.....	.....	.....	400,000	16,000	.....	.....	.....	.....	12
.....	.....	400	2,000	154,007	156,007	.....	.....	.....	.....	287,000	10,045	.....	.....	.....	.....	13
2,056	13,333	350	2,100	313,108	328,541	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
1,950	8,442	31,788	127,185	4,490,010	4,625,637	.....	.....	4,664	717	.....	.....	.....	.....	.....	.....	15
17,065	75,028	14,886	76,748	7,236,927	7,390,703	.....	.....	.....	.....	950,000	35,000	.....	.....	.....	.....	16
.....	.....	3,270	6,627	171,358	177,985	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17
.....	.....	.....	.....	115,100	115,100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
668	4,321	30,044	74,976	3,976,977	4,056,274	.....	.....	.....	.....	250,000	10,500	.....	.....	.....	.....	19
.....	.....	1,127	4,122	206,198	210,320	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20
.....	.....	.....	.....	37,075	37,075	.....	.....	.....	.....	.....	.....	.....	.....	2,270,000	169,900	21
.....	.....	.....	.....	48,060	48,060	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22
76,909	215,945	5,402	23,981	5,848,370	6,088,296	.....	.....	.....	.....	1,100,000	41,250	6,378,550	91,961	.....	.....	23
75,308	806,563	17,419	61,380	20,050,075	20,418,018	80,518	107,292	265,516	73,650	3,872,000	149,160	3,750,000	70,000	.....	.....	24
.....	.....	.....	.....	150,000	150,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
100	105	49,359	101,158	4,074,132	5,075,395	.....	.....	.....	.....	2,500,000	86,250	.....	.....	.....	.....	26
.....	.....	.....	.....	10,000	10,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27
60,934	193,393	106,734	205,203	12,687,206	13,085,802	.....	.....	11,250	10,000	4,999,738	185,290	29,089,175	646,204	.....	.....	28
3,260	15,999	7,000	34,712	1,118,491	1,169,202	.....	.....	.....	.....	142,850	5,000	.....	.....	.....	.....	29
9,525	40,725	4,541	23,250	1,233,729	1,207,704	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
.....	.....	704	2,324	36,790	39,114	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
.....	.....	.....	.....	12,825	12,825	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32
.....	.....	12	78	23,564	23,642	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33
86	155	.....	.....	27,185	27,340	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34
.....	.....	1,160	4,600	524,075	528,675	.....	.....	.....	.....	21,000	790	.....	.....	.....	.....	35
.....	.....	5,387	8,543	64,463	73,006	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36
.....	.....	.....	.....	2,000	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37
100	625	2,102	8,995	311,031	320,651	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38

TABLE I.—STATISTICS OF THE CHEMICAL INDUSTRY, BY STATES AND TERRITORIES: 1880.

	States and Territories.	PRODUCTS—continued.							
		Bromine.		Phosphorus.		Castor oil.		Stearic acid candles.	
		Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Gallons.*	*Dollars.*	*Pounds.*	*Dollars.*
	The United States	404, 090	114, 752	56, 292	29, 271	893, 802	790, 741	18, 363, 066	2, 281, 000
1	California					50, 000	45, 000	2, 596, 000	375, 000
2	Colorado								
3	Connecticut								
4	Delaware								
5	District of Columbia								
6	Florida								
7	Georgia								
8	Illinois					192, 000	140, 350	1, 000, 000	130, 000
9	Indiana								
10	Iowa								
11	Kansas					13, 000	10, 100		
12	Kentucky							1, 811, 920	206, 263
13	Louisiana								
14	Maine								
15	Maryland								
16	Massachusetts								
17	Michigan								
18	Minnesota								
19	Missouri					436, 302	394, 041	2, 200, 000	284, 000
20	Nebraska								
21	Nevada								
22	New Hampshire								
23	New Jersey			56, 292	29, 271	200, 000	200, 000		
24	New York							940, 000	150, 000
25	North Carolina								
26	Ohio	150, 850	40, 462			2, 500	1, 250	9, 815, 146	1, 136, 337
27	Oregon								
28	Pennsylvania	90, 000	25, 120						
29	Rhode Island								
30	South Carolina								
31	Tennessee								
32	Texas								
33	Utah								
34	Vermont								
35	Virginia								
36	West Virginia	163, 840	49, 170						
37	Washington								
38	Wisconsin								

TABLE I.—STATISTICS OF THE CHEMICAL INDUSTRY, BY STATES AND TERRITORIES: 1880.

PRODUCTS—continued.

Soaps.						Glycerine.		Nitro-glycerine.		Manufactured manures.		Dry colors.		
Oleic acid soap.		Other hard soaps.		Soft soaps.										
Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Tons.*	*Dollars.*	*Pounds.*	*Dollars.*	
33, 058, 411	1, 707, 969	378, 743, 627	18, 299, 350	34, 494, 100	358, 280	7, 117, 825	961, 477	3, 039, 722	1, 830, 417	727, 453	19, 921, 400	67, 482, 415	4, 086, 821	
2, 135, 000	94, 300	8, 027, 500	429, 860	.....	.....	394, 800	38, 736	1, 242, 424	655, 680	1, 000	20, 000	.....	.....	1
.....	.....	1, 800, 000	60, 000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
1, 800	108	2, 626, 534	183, 041	949, 408	11, 327	.....	.....	.....	.....	7, 475	248, 050	6, 490, 000	638, 000	3
.....	.....	742, 000	34, 000	.....	.....	.....	.....	.....	.....	37, 917	998, 165	.....	.....	4
.....	.....	1, 400, 679	55, 024	.....	.....	.....	.....	.....	.....	6, 300	199, 000	.....	.....	5
.....	.....	16, 000	600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11, 287	341, 500	.....	.....	7
1, 818, 000	190, 720	68, 204, 500	3, 183, 520	3, 519, 144	36, 600	.....	.....	.....	.....	27, 015	633, 990	203, 000	12, 125	8
.....	.....	1, 808, 500	61, 587	6, 000	100	.....	.....	.....	.....	1, 574	44, 877	.....	.....	9
.....	.....	3, 574, 025	177, 609	122, 710	2, 711	.....	.....	.....	.....	960	13, 000	.....	.....	10
.....	.....	3, 698, 000	159, 208	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
461, 880	15, 386	2, 907, 000	112, 800	.....	.....	220, 964	24, 625	.....	.....	1, 665	42, 000	832, 000	12, 480	12
.....	.....	3, 970, 000	164, 000	.....	.....	.....	.....	.....	.....	1, 823	68, 108	.....	.....	13
.....	.....	1, 004, 000	59, 162	1, 758, 760	22, 017	.....	.....	.....	.....	5, 850	175, 000	.....	.....	14
140, 000	6, 890	8, 178, 000	350, 310	.....	.....	.....	.....	.....	.....	191, 571	5, 457, 258	2, 599, 541	52, 922	15
10, 000	600	32, 991, 877	1, 545, 125	15, 505, 880	163, 479	.....	.....	90, 000	54, 000	69, 387	1, 920, 623	7, 482, 442	590, 289	16
.....	.....	2, 028, 500	85, 157	145, 520	1, 552	.....	.....	80, 000	44, 000	900	27, 000	.....	.....	17
.....	.....	2, 610, 000	116, 000	.....	.....	.....	.....	.....	.....	600	12, 000	.....	.....	18
8, 540, 000	312, 400	16, 537, 869	562, 563	250, 000	2, 750	400, 000	38, 000	.....	.....	5, 905	146, 932	156, 000	17, 680	19
.....	.....	522, 000	26, 160	.....	.....	.....	.....	.....	.....	470	4, 700	.....	.....	20
.....	.....	413, 200	24, 792	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21
.....	.....	800, 225	33, 012	2, 777, 256	37, 846	.....	.....	.....	.....	.....	.....	.....	.....	22
630, 000	36, 600	23, 002, 320	1, 328, 741	1, 579, 000	6, 430	.....	.....	454, 990	338, 037	80, 859	2, 290, 202	4, 362, 000	405, 200	23
1, 904, 946	99, 224	95, 027, 871	4, 833, 497	4, 894, 510	50, 686	2, 100, 000	312, 000	72, 000	54, 000	88, 336	2, 636, 159	14, 643, 968	1, 409, 734	24
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12, 000	300, 000	.....	.....	25
14, 686, 619	710, 356	35, 709, 464	1, 495, 505	45, 000	575	3, 912, 061	548, 116	577, 473	259, 863	13, 365	377, 025	*1, 775, 000*	*154, 600*	26
.....	.....	420, 000	24, 000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27
2, 350, 966	225, 482	39, 433, 197	2, 219, 580	1, 217, 232	8, 076	.....	.....	522, 835	424, 837	53, 507	1, 432, 345	25, 325, 464	759, 551	28
270, 000	10, 800	8, 367, 540	440, 270	736, 360	7, 242	.....	.....	.....	.....	11, 979	156, 427	.....	.....	29
.....	.....	40, 000	1, 400	.....	.....	.....	.....	.....	.....	64, 794	1, 537, 230	.....	.....	30
.....	.....	1, 222, 930	48, 000	*24, 000*	*300*	.....	.....	.....	.....	314	12, 070	.....	.....	31
.....	.....	610, 000	28, 975	27, 400	290	.....	.....	.....	.....	.....	.....	.....	.....	32
.....	.....	608, 000	33, 360	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33
.....	.....	350, 700	20, 750	89, 600	1, 225	.....	.....	.....	.....	.....	.....	3,662, 000	33, 840	34
.....	.....	1, 123, 000	52, 785	.....	.....	.....	.....	.....	.....	28, 921	791, 341	.....	.....	35
.....	.....	64, 785	4, 530	832, 000	3, 120	.....	.....	.....	.....	620	16, 300	.....	.....	36
.....	.....	80, 000	4, 800	20, 000	300	.....	.....	.....	.....	.....	.....	.....	.....	37
97, 200	5, 103	6, 903, 411	329, 267	84, 320	1, 054	.....	.....	.....	.....	1, 050	19, 500	1, 000	300	38

TABLE I.—STATISTICS OF THE CHEMICAL INDUSTRY, BY STATES AND TERRITORIES: 1880.

	States and Territories.	PRODUCTS—continued.									
		White lead.		Other salts of lead.		Ground barytes.		Zinc oxide.		Acetate of lime.	
		Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Tons.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
	The United States	123, 477, 890	8, 770, 699	11, 375, 466	758, 680	19, 165	371, 829	20, 121, 761	766, 337	6, 593, 000	156, 892
1	California	4, 000, 000	260, 000	100, 000	65, 000						
2	Colorado										
3	Connecticut					6, 000	150, 000				
4	Delaware										
5	District of Columbia										
6	Florida										
7	Georgia										
8	Illinois	7, 889, 079	489, 181								
9	Indiana										
10	Iowa										
11	Kansas										
12	Kentucky	2, 365, 000	176, 550	150, 000	9, 000						
13	Louisiana										
14	Maine					2, 200	50, 000				
15	Maryland	3, 240, 000	249, 000							224, 000	6, 720
16	Massachusetts	4, 758, 521	360, 073	627, 474	40, 000					135, 000	3, 500
17	Michigan									1, 500, 000	30, 000
18	Minnesota										
19	Missouri	26, 400, 324	1, 813, 600	1, 082, 000	71, 100	4, 425	100, 094	660, 000	29, 700		
20	Nebraska	3, 000, 000	350, 000								
21	Nevada										
22	New Hampshire										
23	New Jersey							16, 774, 756	654, 051	80, 000	1, 800
24	New York	28, 144, 009	1, 951, 507	5, 234, 360	292, 400					3, 171, 544	78, 080
25	North Carolina										
26	Ohio	13, 140, 458	967, 321	345, 000	21, 500			30, 405	2, 388		
27	Oregon										
28	Pennsylvania	30, 540, 499	2, 153, 467	3, 831, 632	259, 205	1, 500	20, 000	2, 656, 600	79, 698	1, 260, 000	30, 650
29	Rhode Island									45, 000	2, 250
30	South Carolina										
31	Tennessee					465	10, 685				
32	Texas										
33	Utah										
34	Vermont									177, 465	3, 886
35	Virginia					4, 575	41, 050				
36	West Virginia			5, 000	475						
37	Washington										
38	Wisconsin										

TABLE I.—STATISTICS OF THE CHEMICAL INDUSTRY, BY STATES AND TERRITORIES: 1880.

PRODUCTS—continued.

Potash and pearlash.		Soda.		Sulphur.		Sulphuric acid.		Glucose.		Value of all other products.	Total value of all products.	
Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars*	*Dollars.*	*Dollars.*	
4, 571, 071	232, 643	40, 259, 938	866, 560	1, 200, 000	21, 000	308, 765, 432	3, 661, 876	151, 740, 400	4, 551, 212	44, 927, 101	117, 377, 324	
						5, 105, 995	129, 195			959, 596	3, 179, 700	1
										35, 000	95, 000	2
						5, 163, 669	53, 500			1, 115, 717	2, 419, 743	3
										107, 021	1, 140, 080	4
						400, 000	5, 000			33, 340	322, 439	5
										520	1, 120	6
										12, 000	353, 500	7
						4, 140, 000	62, 000	48, 380, 000	1, 450, 400	1, 309, 439	7, 681, 325	8
232, 500	11, 625									38, 281	156, 479	9
								860, 460	25, 812	68, 611	287, 743	10
										16, 865	186, 233	11
										111, 151	726, 255	12
						1, 050, 000	15, 750			71, 758	329, 059	13
270, 200	14, 010					2, 000, 000	35, 000			207, 728	563, 517	14
						43, 020, 000	340, 340			778, 465	7, 243, 122	15
						23, 016, 381	326, 666			5, 565, 207	10, 604, 662	16
1, 393, 962	62, 542					980, 000	4, 916			107, 937	363, 104	17
146, 000	5, 840									85, 800	220, 540	18
						2, 880, 000	57, 600			1, 986, 538	5, 827, 498	19
										6, 140	387, 000	20
		1, 800, 000	16, 560	1, 200, 000	21, 000	1, 440, 000	16, 540			34, 740	283, 532	21
										38, 053	108, 911	22
						74, 094, 625	693, 113			3, 382, 921	9, 499, 577	23
515, 500	23, 442					41, 363, 543	438, 723	102, 500, 000	3, 075, 000	14, 001, 054	29, 805, 614	24
											300, 000	25
493, 229	20, 761					24, 200, 000	386, 000			1, 469, 565	7, 678, 374	26
											24, 000	27
		38, 459, 938	850, 000			66, 346, 819	937, 522			10, 611, 964	20, 884, 991	28
						9, 500, 000	130, 000			1, 216, 052	1, 968, 041	29
										1, 154, 423	2, 693, 053	30
										49, 865	121, 520	31
										9, 010	37, 075	32
											38, 360	33
										41, 795	101, 496	34
						897, 000	9, 000			112, 200	1, 007, 166	35
						1, 867, 400	20, 511			115, 204	299, 310	36
										500	5, 600	37
1, 511, 181	94, 423									71, 741	521, 388	38

TABLE II.—STATISTICS OF THE CHEMICAL

	Centers of manufacture. (a)	No. of establishments.	CAPITAL.			AVERAGE NUMBER OF HANDS EMPLOYED.				Total amount paid in wages during the year.
			Value of buildings.	Value of machinery.	Total capital.	Males above 16 years.	Males below 16 years.	Females above 15 years.	Females below 15 years.	
			Dollars.	*Dollars.*	*Dollars.*					*Dollars.*
1	New York	159	5,530,548	3,641,035	20,078,350	5,467	334	419	13	2,899,412
2	Philadelphia	109	3,701,722	3,562,597	17,634,773	3,973	176	336	5	2,048,028
3	Boston	106	1,064,907	764,918	4,438,248	1,464	61	50	.....	727,662
4	Baltimore	43	898,100	513,029	5,303,252	1,184	6	.....	11	505,775
5	Chicago	29	595,829	482,779	2,051,800	889	92	69	.....	428,710
6	Saint Louis	35	752,604	696,422	3,392,200	1,025	23	29	.....	488,687
7	Cincinnati	32	864,100	659,254	4,393,203	962	49	102	.....	442,000
8	Buffalo	16	602,700	497,400	2,907,200	1,107	109	9	.....	582,420
9	Providence	62	493,550	464,000	2,146,586	822	8	81	.....	372,353
10	San Francisco	33	338,000	378,425	2,297,550	488	8	16	.....	256,443
11	Charleston	23	345,000	488,400	3,009,000	1,772	69	10	.....	986,779
12	Pittsburgh	35	451,434	368,161	1,887,704	470	5	1	.....	201,174
13	Cleveland	22	189,500	220,600	1,290,200	403	51	18	.....	189,160
14	Louisville	12	167,688	135,300	699,440	150	.....	27	.....	60,875
15	Richmond	10	78,500	49,000	372,000	132	1	3	.....	29,260
16	New Orleans	7	61,000	63,301	218,701	87	5	8	.....	45,943
17	Washington	12	73,500	41,000	205,967	182	2	.....	.....	46,875

	Centers of manufacture. (a)	PRODUCTS—continued.							
		Bromine.		Phosphorus.		Castor oil.		Stearic acid candles.	
		Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Gallons.*	*Dollars.*	*Pounds.*	*Dollars.*
1	New York	.....	.....	.....	.....	200,000	200,000	940,000	150,000
2	Philadelphia	.....	.....	56,202	29,271	.....	.....	.....	.....
3	Boston	.....	.....	.....	.....	.....	.....	.....	.....
4	Baltimore	.....	.....	.....	.....	.....	.....	.....	.....
5	Chicago	.....	.....	.....	.....	.....	.....	1,000,000	130,000
6	Saint Louis	.....	.....	.....	.....	623,302	530,841	2,200,000	284,000
7	Cincinnati	.....	.....	.....	.....	.....	.....	9,805,646	1,135,487
8	Buffalo	.....	.....	.....	.....	.....	.....	.....	.....
9	Providence	.....	.....	.....	.....	.....	.....	.....	.....
10	San Francisco	.....	.....	.....	.....	50,000	45,000	2,596,000	375,000
11	Charleston	.....	.....	.....	.....	.....	.....	.....	.....
12	Pittsburgh	90,000	25,120	.....	.....	.....	.....	.....	.....
13	Cleveland	.....	.....	.....	.....	.....	.....	.....	.....
14	Louisville	.....	.....	.....	.....	.....	.....	1,811,920	206,263
15	Richmond	.....	.....	.....	.....	.....	.....	.....	.....
16	New Orleans	.....	.....	.....	.....	.....	.....	.....	.....
17	Washington	.....	.....	.....	.....	.....	.....	.....	.....

	Centers of manufacture. (a)	PRODUCTS—continued.									
		Dry colors.		White lead.		Other salts of lead.		Ground barytes.		Zinc oxide.	
		Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Tons.*	*Dollars.*	*Pounds.*	*Dollars.*
1	New York	16,418,968	1,605,134	28,868,000	1,725,750	5,294,360	292,400	.....	.....	16,774,756	654,051
2	Philadelphia	10,165,215	637,716	14,906,431	1,003,450	2,924,314	203,128	500	5,000	.....	.....
3	Boston	4,535,000	356,815	4,758,521	360,073	627,474	40,000	.....	.....	.....	.....
4	Baltimore	2,599,541	52,922	3,240,000	249,000	.....	.....	.....	.....	.....	.....
5	Chicago	83,000	10,000	7,889,079	489,181	.....	.....	.....	.....	.....	.....
6	Saint Louis	156,000	17,680	23,928,324	1,690,000	1,082,000	71,100	4,100	96,650	660,000	29,700
7	Cincinnati	551,000	120,600	10,552,213	760,261	245,000	14,500	.....	.....	.....	.....
8	Buffalo	.....	.....	1,600,000	130,000	.....	.....	.....	.....	.....	.....
9	Providence	1,200,000	150,000	.....	.....	.....	.....	.....	.....	.....	.....
10	San Francisco	.....	.....	4,000,000	260,000	100,000	65,000	.....	.....	.....	.....
11	Charleston	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	Pittsburgh	2,003,249	20,975	15,634,068	1,150,017	907,318	56,077	.....	.....	.....	.....
13	Cleveland	824,000	30,000	2,588,245	207,060	100,000	7,000	.....	.....	80,405	2,868
14	Louisville	882,000	12,480	2,365,000	176,550	150,000	9,000	.....	.....	.....	.....
15	Richmond	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	New Orleans	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	Washington	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

a These centers include all works situated within a radius of thirty miles from the center of each city, and, therefore, in many cases include portions of adjoining states.

INDUSTRY, BY CENTERS OF MANUFACTURE: 1880.

MATERIALS.						PRODUCTS.										
Anthracite coal.		Bituminous coal.		Value of all other materials.	Total value of all materials.	Aniline colors.		Anthracene.		Sulphate of ammonia.		Alum.		Borax.		
Tons.	*Dollars.*	*Tons.*	*Dollars.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	
129,434	435,413	12,787	58,146	19,270,961	19,773,520	32,000	42,500	265,516	78,650	4,000,000	188,250	5,220,000	100,375	.....	.....	1
67,160	230,740	85,988	180,157	12,434,688	12,845,591	.....	.....	11,250	16,000	4,459,738	167,740	32,247,725	677,720	.....	.....	2
11,318	47,458	13,608	69,367	5,296,572	5,413,397	.....	.....	.....	.....	950,000	35,000	.....	.....	.....	.....	3
1,944	8,406	31,387	125,579	4,141,552	4,275,537	.....	.....	4,664	717	.....	.....	.....	.....	.....	.....	4
2,986	9,254	18,545	69,042	4,596,288	4,674,584	.....	.....	.....	.....	1,148,000	43,000	.....	.....	.....	.....	5
668	4,321	30,596	74,120	4,004,371	4,082,812	.....	.....	.....	.....	250,000	10,500	.....	.....	.....	.....	6
.....	.....	34,126	71,050	3,667,007	3,738,726	.....	.....	.....	.....	1,500,000	48,750	.....	.....	.....	.....	7
436	2,100	7,050	17,365	3,293,254	3,312,779	.....	.....	.....	.....	72,000	2,160	1,750,000	30,000	.....	.....	8
4,524	21,719	7,706	38,612	2,237,670	2,298,010	.....	.....	.....	.....	142,350	5,000	.....	.....	.....	.....	9
1,703	14,987	6,716	43,404	1,961,454	2,019,845	.....	.....	.....	.....	.....	.....	.....	.....	130,000	10,400	10
3,525	16,725	8,215	16,250	970,321	1,003,296	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
.....	.....	20,181	26,686	1,227,875	1,254,561	.....	.....	.....	.....	540,000	17,550	.....	.....	.....	.....	12
.....	.....	10,038	21,687	851,548	873,235	.....	.....	.....	.....	1,000,000	37,500	.....	.....	.....	.....	13
.....	.....	6,048	12,575	450,498	463,073	.....	.....	.....	.....	400,000	16,000	.....	.....	.....	.....	14
.....	.....	960	3,600	332,000	335,600	.....	.....	.....	.....	21,000	790	.....	.....	.....	.....	15
.....	.....	400	2,000	152,007	154,007	.....	.....	.....	.....	287,000	10,045	.....	.....	.....	.....	16
392	1,260	920	3,536	212,123	216,919	.....	.....	62,084	8,875	530,000	21,200	.....	.....	.....	.....	17

PRODUCTS—continued.

Soaps.						Glycerine.		Nitro-glycerine.		Phosphate rock.		Manufactured manures.		
Oleic acid soap.		Other hard soaps.		Soft soap.										
Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Tons.*	*Dollars.*	*Tons.*	*Dollars.*	
1,964,946	102,874	82,619,995	4,128,531	5,006,390	57,550	2,190,000	312,600	454,990	338,037	.....	.....	121,605	3,532,652	1
2,890,966	250,682	31,808,384	1,069,340	138,600	1,230	.....	.....	.....	.....	.....	.....	96,206	2,478,018	2
10,000	600	21,960,252	1,077,795	9,892,440	85,543	.....	.....	.....	.....	.....	.....	45,609	1,244,253	3
140,000	6,890	7,854,000	336,110	.....	.....	.....	.....	.....	.....	.....	.....	176,980	5,095,270	4
1,800,000	100,000	65,929,000	3,077,440	768,000	3,000	.....	.....	.....	.....	.....	.....	25,400	620,000	5
8,540,000	312,400	14,295,869	470,163	250,000	2,750	400,000	38,000	.....	.....	.....	.....	7,505	160,772	6
14,551,619	704,636	19,282,364	824,851	.....	.....	3,740,061	523,116	.....	.....	.....	.....	6,000	204,000	7
.....	.....	20,405,000	1,187,840	560,000	9,000	.....	.....	.....	.....	.....	.....	12,000	420,000	8
270,000	10,800	10,605,310	537,010	1,183,000	13,864	.....	.....	.....	.....	.....	.....	15,604	226,377	9
2,135,000	94,300	7,495,000	368,100	.....	.....	394,800	38,736	1,242,424	655,680	.....	.....	1,000	20,000	10
.....	.....	40,000	1,400	.....	.....	.....	.....	.....	.....	103,605	559,377	64,782	1,536,690	11
.....	.....	6,382,068	201,340	948,532	5,670	.....	.....	.....	.....	.....	.....	150	4,500	12
15,000	900	1,438,000	52,405	.....	.....	166,000	25,000	577,473	259,863	.....	.....	5,540	145,100	13
461,880	15,336	2,605,000	99,500	.....	.....	220,964	24,025	.....	.....	.....	.....	1,665	42,000	14
.....	.....	1,073,000	50,285	.....	.....	.....	.....	.....	.....	.....	.....	15,100	476,600	15
.....	.....	3,070,000	164,000	.....	.....	.....	.....	.....	.....	.....	.....	1,823	68,106	16
.....	.....	1,400,679	55,024	.....	.....	.....	.....	.....	.....	.....	.....	6,300	199,000	17

PRODUCTS—continued.

Acetate of lime.		Potash and pearlash.		Soda.		Sulphuric acid.		Glucose.		Value of all other products.	Total value of product.	
Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*	
.....	.....	.....	.....	.....	.....	80,731,175	862,817	.....	.....	14,564,223	29,040,794	1
.....	.....	.....	.....	38,459,938	850,000	82,628,847	922,142	.....	.....	10,913,801	20,131,314	2
.....	.....	.....	.....	.....	.....	23,016,981	326,666	.....	.....	4,169,718	7,696,465	3
224,000	6,720	.....	.....	.....	.....	49,920,000	340,840	.....	.....	774,965	6,773,434	4
.....	.....	.....	.....	.....	.....	4,140,000	62,000	.....	.....	1,236,389	5,861,001	5
.....	.....	.....	.....	.....	.....	2,880,000	57,600	.....	.....	1,981,538	5,753,694	6
.....	.....	.....	.....	.....	.....	4,000,000	71,000	.....	.....	1,069,612	5,476,633	7
.....	.....	100,000	5,000	.....	.....	7,000,000	113,750	102,500,000	3,075,000	51,900	5,024,650	8
180,000	5,750	.....	.....	.....	.....	9,500,000	130,000	.....	.....	2,484,699	3,483,500	9
.....	.....	.....	.....	.....	.....	5,105,995	129,195	.....	.....	940,196	3,001,607	10
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,600	2,128,067	11
.....	.....	.....	.....	.....	.....	8,154,965	115,149	.....	.....	303,927	1,990,325	12
.....	.....	25,000	1,450	.....	.....	20,200,000	815,000	.....	.....	348,695	1,432,861	13
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	109,151	710,955	14
.....	.....	.....	.....	.....	.....	897,000	9,000	.....	.....	19,200	555,875	15
.....	.....	.....	.....	.....	.....	1,050,000	15,750	.....	.....	71,758	329,659	16
.....	.....	.....	.....	.....	.....	400,000	5,000	.....	.....	33,340	322,439	17

Industrial progress appears in an extraordinary degree in the advances made by applied chemistry during the present century. Scientific research has opened a vast field for the application of many new and valuable compounds, and has also reduced the cost of many chemical products, rendering some hitherto unimportant chemicals convenient and economically available and enlarging the applications of others already in use. Chemistry has unlocked the treasures of the earth to enrich the soil, to beautify and render complete our homes, to clothe us, to cure or relieve the sick, to preserve health by cleanliness and purification, and to supply the means of illumination. The rapidity with which the experimental discoveries of the scientist are adapted to practical purposes is, at times, astonishing to the investigator himself. Beside the utilization of our natural resources, the waste products of manufacture are the constant subject of investigation, and often interesting and valuable products result therefrom. The debt of various branches of art and manufacture to new and improved methods of modern chemistry can hardly be overestimated. Chemical processes and products are, indeed, so intimately associated with nearly all manufactures as to be inseparable, and therefore it becomes a difficult matter to locate accurately the dividing line where manufacturing chemistry ends and purely mechanical operations commence.

In this report the plan adopted is, so far as possible, similar to that employed by the statisticians of France. Preparations of drugs, pharmaceutical mixtures, and proprietary medicines are not enumerated; but manures, soap, candles, glycerine, white lead, and colors are included, their manufacture being true chemical processes. The production of unground dry lead and colors appears, while grinders of paints and colors are excluded from this tabulation.

Petroleum and its allied products, though properly classified under this head, have been made the subject of investigation by the Census Office, and the results will appear in a separate report.

It must be remembered that this report exhibits the statistics of the industry *during the census year*, from June 1, 1879, to May 31, 1880, which was unfortunately a year of considerable depression, although before its close the tide of activity set in and the production of chemicals was largely increased, the demand being met, not only by a greater supply from existing establishments, but in many cases by the erection of additional and larger works. The production of glucose during the census year gives no adequate idea of the extent of that industry at the present time. (*a*)

In the compilation of these statistics of the chemical industry a number of the products have been deemed of special interest; and their production has therefore been tabulated separately, and has been particularly mentioned in the following pages.

SODA.

An important feature developed by this report is the small amount of soda salts produced in this country. Soda is by far the most important chemical product used, and its consumption has borne an intimate relation to the advance of civilization. The record of its use extends to very early times. In the Old Testament, a substance called "neter", which effervesced with vinegar, is mentioned as having been used for cleansing. This is probably the same Egyptian word which the Romans called "nitrum", which certainly referred to soda, and not to saltpeter. The word "natron" first occurs in Europe in the fifteenth century, though at that time potash and soda were not recognized as different substances, but as only modifications of the same. In 1702 a difference was recognized, and it was established in 1736. Until the time of the French revolution potash was the more important of the two salts, and was distinguished as the "vegetable alkali", in contradistinction to the "mineral alkali", or soda.

Until within a few decades potash was exclusively prepared from wood ashes, as it is now in this country. As the demand for alkali increased with augmented population and higher civilization, the inadequate supply of potash in Europe, and the cost of transit from heavily-wooded countries, steadily increased its cost. For this reason many attempts were made to utilize the soda of common salt by conversion into the carbonate, but they were not successful until, in 1791, the French government granted Nicholas Le Blanc a patent for the manufacture of soda from salt.

The invention of his process achieved one of the grandest results of manufacturing chemistry, and is particularly noteworthy as being perfect from the beginning; for, although many minor details have been altered and improved, the principal methods employed are the same to this day. The process consisted of two parts:

1. The formation of "sodium sulphate, or salt-cake", by the decomposition of common salt with sulphuric acid; and 2. The formation of sodium carbonate by mixing and heating the salt-cake with charcoal and limestone.

This process is still used for the production of soda from salt, though small coal has been substituted for charcoal, and other improvements have been made by the collection and recovery of the waste products. The process was not introduced into England to any extent until 1824, and has never, except on a small scale, been adopted in this country.

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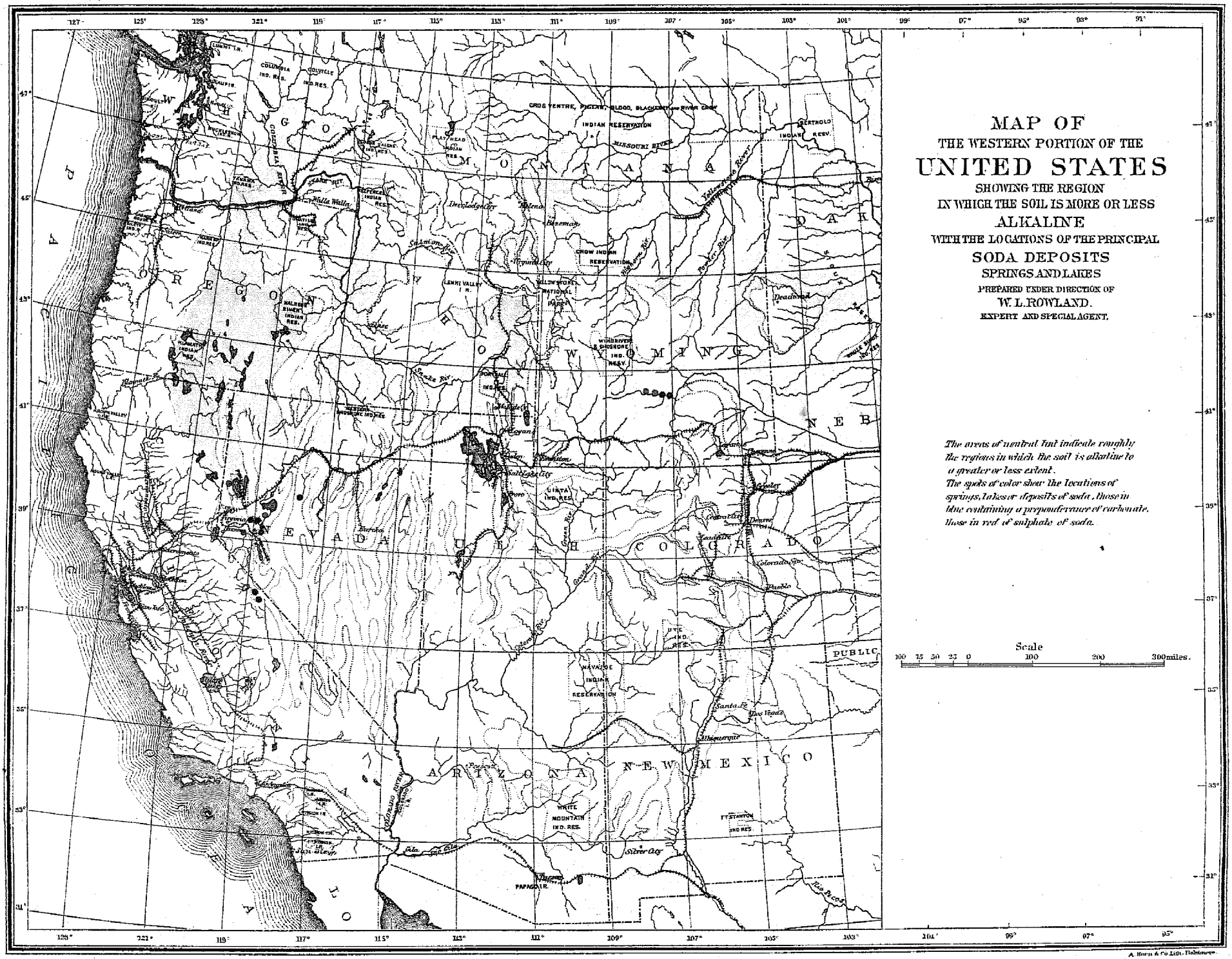
a According to an article by Professor Wiley (*Popular Science Monthly*, June, 1881, p. 251), "on August 1, 1880, ten glucose factories were in operation in the United States, consuming daily about 20,000 bushels of corn." Professor W. H. Brewer, quoting this in his census report on the cereals (p. 106), adds that he has personal knowledge that the capacity of one or two establishments was greatly overestimated, and that the daily consumption was undoubtedly much more. Professor Wiley is also quoted by Professor Brewer as estimating for May, 1881, a consumption daily of 35,000 bushels, there being nine new factories in process of construction, half of them now running.



A. Hoen & Co Lith. Baltimore.

The uses of soda are almost innumerable. For every pane of window-glass that admits light to our houses and shelters us from the weather; for every pound of hard soap we use; for every sheet of our paper, whether for writing or for printing; for the bleaching of cloth; and even for the manufacture of bread, as well as for many other important and necessary articles, we are largely dependent upon this chemical.

The total consumption of soda salts in the United States during the census year is estimated at 398,500,000 pounds, while the total production, by this report, is given as 40,259,938 pounds, or about 10 per cent. of the consumption. At the same time the United States contains vast amounts of carbonate and sulphate of soda, found in large lakes and deposits throughout the western states and territories.

The accompanying map has been prepared to indicate the position of the more important of these formations, with special reference to facilities for railroad transportation. The flat tint shows that portion of the United States denominated "alkaline", where the rainfall is less than the evaporation, by which soluble salts are brought to the surface. In this belt occur many lakes whose waters contain a greater or less percentage of soda salts, as well as deposits of the crystallized mass. In most cases calcium and magnesium salts are present, but usually in small amounts, while the general composition of the salts in these lakes and deposits varies from nearly pure carbonate in some to chloride and sulphate in others.

This "alkaline belt" is situated in the least explored region of the United States; and as the soil is generally unfit for cultivation without irrigation, owing to the insufficient rainfall, private exploration has been confined to a search for minerals, and but little attention has been paid to the alkaline deposits. It has therefore, owing to the lack of reliable information of the extent and character of the lakes and deposits, been impossible to obtain complete data for the preparation of this map. The "alkali" of the plains, so called in distinction from common salt, is largely sulphate of soda. The accompanying map exhibits the location of a number of these deposits or lakes that I have visited, or concerning which reliable information has been obtained. A few of these will be subsequently described in detail. No attempt has been made to show the extent of these deposits, as it would be impossible on a map of so small a scale.

The only natural deposit now worked to any extent for soda is situated in the Carson desert, Churchill county, Nevada, 24 miles south from Wadsworth, the nearest point on the line of the Central Pacific railroad. It consists of two lakes, evidently the craters of extinct volcanoes, separated by a distance of about 225 yards. These lakes are circular in form, with precipitous banks, rising in some places to a height of 150 feet, and have no outlet, being supplied by fresh-water springs. The larger lake covers an area of 402 acres, and is very deep, soundings having been made to a depth of 170 feet. The water of this lake carries carbonate of lime, which deposits in an amorphous condition on the rocks, or, meeting the concentrated solution of soda, combines with it to form gaylussite, which crystallizes, often in beautiful forms, on any convenient substance.

In the spring, after the rainy season, both lakes are well filled with water, which gradually evaporates during the summer, concentrating the larger and causing the smaller lake to become nearly dry. An analysis of a sample of water from the larger lake, taken in August, and analyzed by Professor O. D. Allen, (*a*) gave in 1,000 parts:

	Per cent.
Sodium chloride	64.9413
Sodium sulphate	13.7626
Sodium carbonate	29.2482
Sodium sulphide	0.2384
Potassium sulphate	3.6515
Magnesium carbonate	0.0652
Silica	0.2050
Excess carbonic oxide	0.4658
	112.5780

A sample taken and analyzed by Mr. Henry Pemberton, of Philadelphia, gave:

	Per cent.
Sodium carbonate	3.286
Sodium sulphate	1.848
Sodium chloride	7.371

corresponding to 26.5 per cent. sodium carbonate in the solid constituents.

Several attempts have been made to work this lake, but all have been thus far unsuccessful, owing to the difficulty of economically purifying the soda. (*b*)

In the spring the smaller lake covers an area of about 8 acres, but is nearly dry by the end of the dry season. The soil in and around the lake is impregnated with soda, and at various points, from 1 to 3 feet under the surface, a sea-green, ice-like mass of soda is found. An analysis which I made of this natural soda gave:

	Per cent.
	73.16
Sodium carbonate	1.68
Sodium chloride	1.58
Sodium sulphate	23.70
Insoluble residue	

The natural soda thus contains only 3.26 per cent. of foreign soluble matter.

a *United States Geological Exploration of the Fortieth Parallel*, by Clarence King.

b It is stated by the superintendent of the small lakes that 400 tons of soda were made from this large lake in the summer of 1881.

The lake is fed by numerous small springs rising from the bottom, that are no doubt fresh until they come into contact with the soda-saturated soil, which is thus leached, and the soda brought into the lake. This lake is divided by means of earth-work embankments into several small ponds or basins, in which the evaporation is effected by solar heat. The crystallized product is collected and air-dried under open sheds, thus losing its water of crystallization and rendering its transportation to market less expensive. It is sacked, hauled by wagon to Wadsworth, and is sent by rail to San Francisco.

Several smaller deposits in Nevada have been worked at various times in small amounts, but only for the San Francisco market, as the cost of transportation renders it impracticable to ship East. This alkaline belt extends from northwestern Nevada to Death valley, in California. The lakes of this section have no outlets, and are all more or less highly saturated with the alkaline leachings of the soil, with a composition varying from nearly pure carbonate to sulphate or chloride. The alkaline waters and deposits of this belt contain nearly pure sodium salts,

A large deposit of nearly pure sulphate of soda occurs in Nevada, close to the California line, about 60 miles north of the railroad. This bed is said to be from 2 to 8 feet in thickness, extending over an area of from 100 to 200 acres, and underlying a layer of soil from a few inches to 2 feet thick. A sample of the soda, analyzed by Mr. Henry Pemberton, gave:

	Per cent.
Sodium sulphate	49.33
Sodium chloride	0.93
Water	49.74
Silica	traces.

corresponding to 98.15 per cent. sodium sulphate in the dried mass.

Analyses of alkaline incrustations or efflorescences in Nevada, published in the *United States Geological Exploration of the Fortieth Parallel*, gave—

1. Sample collected near Hardin City, Nevada, analyzed by Professor O. D. Allen:

	Per cent.
Sodium carbonate	52.10
Sodium sulphate	27.55
Sodium chloride	18.47

2. Sample from Brown's station, Nevada, analyzed by R. W. Woodward:

	Per cent.
Sodium sesquicarbonate	18.15
Sodium sulphate	20.88
Sodium chloride	49.67
Sodium borate	11.30

3. Sample from Peko station, Nevada, analyzed by R. W. Woodward:

	Per cent.
Sodium carbonate	73.50
Excess carbonic oxide	10.07
Sodium sulphate	4.60
Sodium borate	4.49
Sodium chloride	7.55

One of the largest and most interesting known deposits is situated 70 miles north of Rawlins, in Wyoming territory, about one mile from Independence rock, and consists of three large lakes, called, respectively, the New York lake, Wilmington lake, and Horseshoe lake. The New York lake is the largest of these, and is liquid even at the end of the dry season. A sample of the water was taken for analysis, but was unfortunately lost in transit; it is said, however, to consist mainly of sulphate. During the rainy season this lake overflows considerable of the surrounding surface, where it evaporates during the dry season, and the salt remains as a deposit. An examination of one of these small ponds that was nearly dry showed a thin crust of white soda salts extending over most of the surface, under which was a layer of soft, sticky blue mud, with a strong odor of sulphureted hydrogen. This layer of mud was from 3 inches to 2 feet deep, and covered a sea-green, ice-like mass of soda; but having no facilities for boring, it was impossible to determine its depth. A sample of this salt, dried at 110° centigrade, which I analyzed, contained:

	Per cent.
Sodium carbonate	59.24
Sodium sulphate	19.28
Sodium chloride	1.25
Other salts	1.54
Insoluble residue	18.64

The Wilmington lake covers an area of about 75 acres, and is divided during the dry season into two lakes. At the time these lakes were visited (October, 1880) one was entirely dry, and the water in the other was almost covered with a snow-white mass of soda from 1 to 4 inches thick. Underlying this was found the same blue mud, but no soda deposit, nor has any been found by deep boring.

The Horseshoe lake covers an area of some 20 acres, and contains a deposit of soda averaging 5 feet in thickness. From the center of this lake a stream rises, the size of one's arm, which is strongly charged with soda salts.

A series of small lakes containing soda salts extends from this point southward, consisting principally of sulphate. At the end of the dry season they bear a resemblance to partially frozen lakes, from the crystallization of the soda on the surface.

Very few analyses have been made of these waters, but there have been sufficient to show the occurrence of an abundant supply of sulphate of soda, with a considerable quantity of carbonate.

The following extracts from a letter to the Superintendent of Census refer to one of these deposits located near Laramie City, Wyoming territory:

Inasmuch as you are collecting for your report of the decennial census statistics of the economy, property, and resources of the people, and have called upon me for data, I have the honor to submit the following with reference to the deposits of native soda existing in this territory.

Special attention was first directed to these deposits by a cube of the material taken from the principal one, which is near this place, and exhibited at the centennial exposition at Philadelphia. The cube exhibited contained over 200 cubic feet of solid crystalline sulphate of soda, almost chemically pure, and as it exists in its native state. Its constituent elements, as well as I can ascertain, are, by weight, as follows: 19.4 per cent. of soda and 24.8 per cent. of sulphuric acid, constituting 44.2 per cent. of sulphate of soda, the residue being the water of crystallization (55.8 per cent).

* * * * * * * * *

The deposit whence the sample mentioned was taken covers an area of more than 100 acres, being a solid bed of crystallized sulphate of soda about 9 feet thick. The deposit is supplied from the bottom by springs, whose water holds the salts in solution. The water rising to the surface rapidly evaporates, and the salts with which it is impregnated readily crystallize into the form mentioned. Upon removing any of the material the water rising from the bottom fills the excavation made, and the salts, crystallizing, replace in a few days the material removed. Hence the deposit is practically inexhaustible, and it now contains about 50,000,000 cubic feet of chemically pure, crystallized sulphate of soda ready to be utilized.

* * * * * * * * *

As the material of our native deposit is already sulphate of soda, we may dispense with the first and most expensive part of Le Blanc's process, the production of sulphate of soda from chloride of sodium and sulphuric acid. All that we have to do is to convert the sulphate soda into the carbonate, and here the latter part of that process seems precisely adapted to the purpose, and could be economically adopted, charcoal and limestone being cheap and abundant in the neighborhood.

* * * * * * * * *

And here it might be well to state that the deposit is convenient to lines of transportation, being only about 11 miles from this point on the Transcontinental railroad, the intervening country being a hard and level plain, affording an excellent natural road-bed, with grass and an abundance of good water at convenient intervals. Hence we have a resource here, in addition to our mines of the precious metals, which affords a most promising opportunity for the profitable and safe employment of capital in an immense industry. And as the source is inexhaustible, the cost of production such as to preclude successful competition by the importers, and other deposits of equal extent and affording material of equal purity cannot be found in this country, we may reasonably hope for the establishment of an industry here whose product will supply the entire soda trade of the United States, giving employment to a thousand hands, saving millions to the people, and enriching its proprietors.

Very respectfully, your obedient servant,

STEPHEN W. DOWNEY. (*a*)

Still another deposit is located near Morrison, about 12 miles from Denver, Colorado. This consists of three lakes, averaging 5 feet in depth, with an aggregate area of 16 acres. An analysis of the water by Professor Sidney H. Short gave 1.31 pounds of salts of soda and magnesia to the gallon, and an analysis of the salts found in the solution gave:

	Per cent.
Magnesium sulphate	39.37
Sodium sulphate	32.91
Calcium sulphate	4.51
Aluminium sulphate	1.50
Silicate	6.10
Water	15.53

The soil surrounding the lakes is also found to be thoroughly impregnated with these salts, an analysis of soil near the lakes giving 9.25 pounds to the cubic foot. This impregnation is said to extend to a depth of at least 52 feet over an area of 80 acres. Coal, limestone, sand, and fire-clay are found in the immediate neighborhood.

In the *Report of the Geological Survey West of the One-Hundredth Meridian*, by Lieutenant Wheeler, mention is made of a deposit of soda near Croton Springs, Arizona territory. The flat is several square miles in extent, and is covered with a thick deposit of soda, which, upon analysis, gave the following percentages:

	Per cent.
Sodium sesquicarbonate	15.51
Sodium sulphate	74.66
Sodium chloride	8.85
Other salts and loss	0.98

a A letter from Mr. Downey, dated March 9, 1882, states: "A road has already been constructed from Laramie City to these deposits by the Union Pacific Railway Company, who intend putting up works at or near Laramie City for the purpose of working the soda very extensively."

There are two small ponds in the flat which contain a saturated solution, and deposit during the dry season a white crust on the shore. An analysis of this gave:

	Per cent.
Sodium sesquicarbonate	26.25
Sodium sulphate	60.03
Sodium chloride	13.14
Other salts	0.58

Although these lakes and deposits occur over such a wide extent of country, few have been examined with a view to establish the manufacture of soda, the high cost of transportation and present distance to railroad having combined to render it economically impracticable. The territories are now being rapidly developed by the building of new railroads, and the time is near at hand when reduction in railroad freights will make these deposits available for the manufacture of soda.

MANUFACTURED MANURES.

Within the past ten years the consumption of manures has increased to an enormous extent, until their manufacture has become one of the great industries of the United States, producing during the census year finished goods to the value of $19,921,400.

Previous to 1800 only three patents for manures appear on the British patent roll. In the first third of the present century a few more were granted, but it was not until the time of Baron Liebig that the industry was brought into prominence. In 1840 Liebig produced his memorable work on organic chemistry in its application to agriculture and physiology, and from the works of this eminent chemist agricultural chemistry received a great impetus. In 1842 Mr. J. B. Lawes secured a patent in Great Britain for the conversion of tricalcic into monocalcic phosphate by means of oil of vitriol. The suggestion of this method, which has become the foundation of the modern industry of manures, is none the less due to Liebig. He, however, proposed to increase the fertilizing power of bone-dust by this means, while Lawes proposed to use the mineral phosphates. Although bone-dust must still be considered an important constituent of these manures, mineral phosphates have now become the largest source of supply.

Bearing in mind the greatly increased demand for phosphatic manures of this description, consequent upon their universally beneficent effects in the field, which would not otherwise have been met, and the reduction effected in their cost, at the same time with many other practical advantages which the command of these manures affords, we perceive that the means for rendering available for our present use the stores of phosphate of lime laid up by nature in a mineral form constitute without doubt the greatest boon conferred by modern chemistry on agriculture.

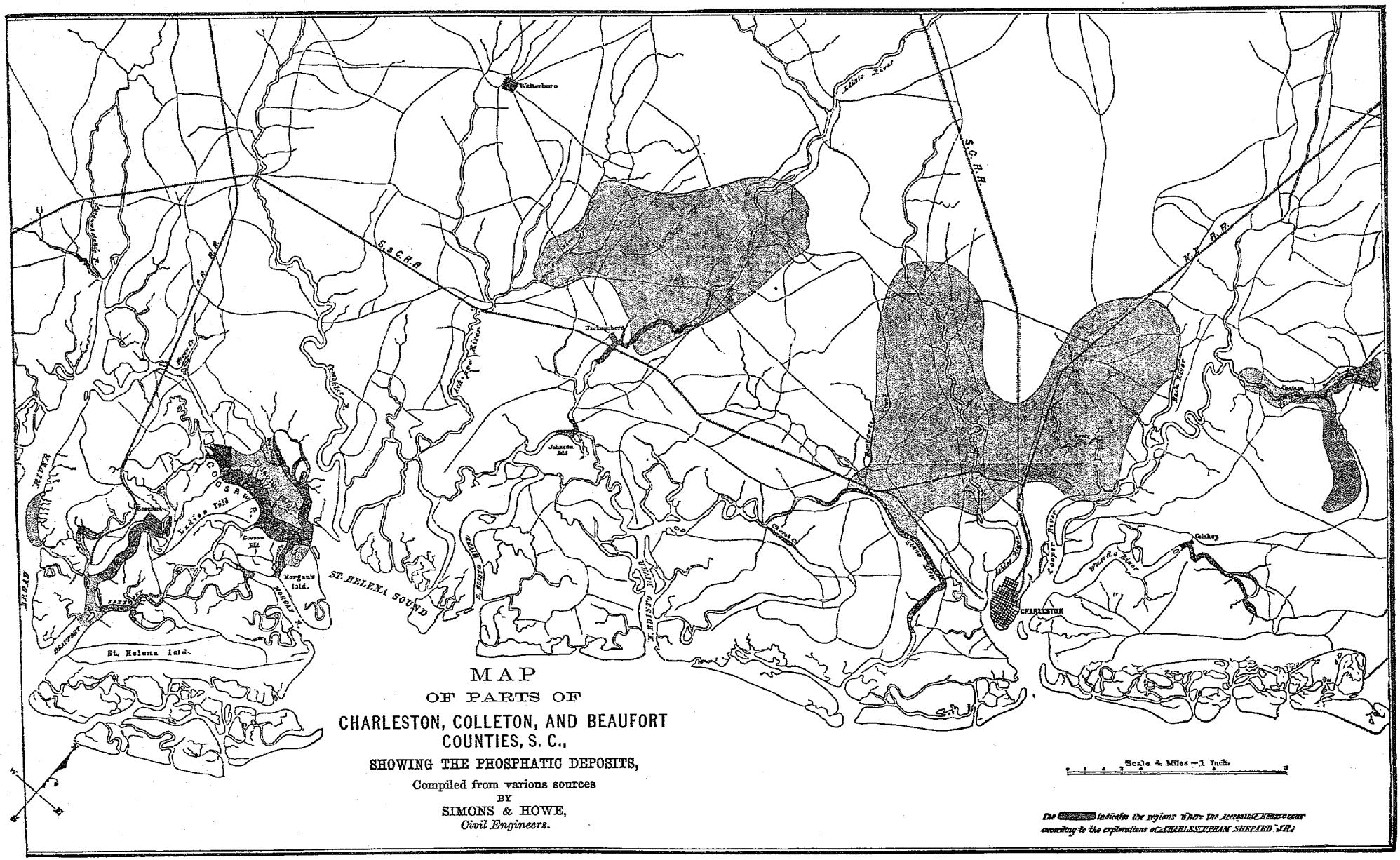
The general effects of manufactured manures may be best understood by bearing in mind the connection between their principal constituents (which for simplicity we may regard as nitrogen and phosphoric acid) and cultivated produce. All the albuminous compounds of plants or the flesh-forming principles of food contain nitrogen as their characteristic constituent, as well as smaller quantities of phosphorus (derived from phosphoric acid), in combination with the commoner organic elements, carbon, hydrogen, and oxygen. Again, phosphoric acid combined with bases, especially lime, forms a considerable portion of the ash of all agricultural produce. By the constant removal of these essential elements the soil becomes impoverished, unless they are returned to it in the form of manures. Liebig laid down as the prime condition of sound success this principle, viz: "*The faithful restitution to the soil of the ash constituents removed by the crops.*"

When England was searching the world for means to enrich an impoverished soil, Liebig said:

> England is robbing all other countries of the conditions of their fertility. Already, in her eagerness for bones, she has turned up the battle-grounds of Leipsic, of Waterloo, and of the Crimea; already from the catacombs of Sicily she has carried away the skeletons of many successive generations. Annually she removes from the shores of other countries to her own the manurial equivalent of three and a half millions of men, whom she takes from us the means of supporting, and squanders it down her sewers to the sea. Like a vampire she hangs upon the neck of Europe, nay, of the entire world, and sucks the life-blood from nations, without a thought of justice toward them, without a shadow of lasting advantage for herself.

In like manner, we may say: America is robbing herself of the conditions of fertility. Already has she exhausted many of the rich valleys of the East and begun vigorously to draw upon the fertility of the West. Annually she sends away food sufficient for millions of men, and the remainder she is squandering down her sewers to the sea.

To make return to the soil of the elements removed therefrom is the only way to counteract this great evil, and for this purpose the manufactured manures have proved themselves most eminently adapted. The exhaustion of the soil in the eastern, middle, and southern states has created a large demand for manufactured manures, particularly in cotton- and tobacco-producing sections. This demand has been augmented by a constantly-increasing call for these manures from the older and more densely populated portions of the West, until the production has assumed gigantic proportions.



MAP

OF PARTS OF

CHARLESTON, COLLETON, AND BEAUFORT COUNTIES, S. C.,

SHOWING THE PHOSPHATIC DEPOSITS,

Compiled from various sources

BY

SIMONS & HOWE,

Civil Engineers.

The shaded areas indicate the regions where the Accessible Deposits occur according to the explorations of CHARLES UPHAM SHEPARD JR.

The following table exhibits the distribution of the industry, with the total production of each state having more than one establishment, during the census year. Since that period the manufacture has largely increased, particularly in South Carolina, the chief source of mineral phosphates in the United States:

States, etc.	No. of establishments.	PRODUCT.	
		Tons.	Value.
Total	278	727,453	$19,021,400
Connecticut	13	7,475	248,050
Delaware	19	37,917	998,165
District of Columbia	3	6,300	199,000
Georgia	4	11,287	341,500
Illinois	7	27,015	633,900
Indiana	6	1,574	44,877
Kentucky	4	1,665	42,000
Louisiana	2	1,823	68,106
Maine	4	5,856	175,000
Maryland	40	191,571	5,457,258
Massachusetts	24	69,387	1,920,623
Missouri	7	5,905	146,932
Nebraska	2	470	$4,700
New Jersey	18	80,859	2,290,202
New York	26	88,336	2,636,159
Ohio	9	13,365	377,625
Pennsylvania	31	53,507	1,432,345
Rhode Island	12	11,979	156,427
South Carolina	7	64,794	1,537,230
Tennessee	3	314	12,670
Virginia	28	28,921	791,341
West Virginia	2	629	16,300
Wisconsin	2	1,050	19,500
California, Iowa, Michigan, Minnesota, and North Carolina.	5	15,460	372,000

The raw materials commonly employed may be divided into three groups:

a. Mineral and animal-bone phosphates.

b. Animal refuse, i. e., fish-scraps from the manufacture of oil, meat refuse from the slaughter-houses, and oil-cake from the oil manufacture.

c. Sulphate of ammonia.

SOUTH CAROLINA PHOSPHATES.

The principal mineral phosphate in use in this country is obtained in the state of South Carolina. The extent of accessible deposits, so far as known, is represented by the accompanying map, prepared and kindly furnished to the Census Office by Dr. C. U. Shepard, jr., chemist to the department of agriculture, Charleston, South Carolina.

It must be distinctly understood, however, that all the tract indicated by the red shading is only here and there available at the present time, the deepest shaded portions of the map representing the most accessible "river deposits". The red-colored territory represents, approximatively, 240,000 acres, while the extent of the accessible deposits may be roughly estimated at 10,000 acres. This section is low and flat, generally not more than 10 feet, above high-water mark, while elevations of over 20 feet are rare. The phosphate rock is found in lumps or nodules, distributed in layers of varying thickness, and usually only a few feet under the surface. Where water-courses have intersected this region the rock has been deposited in the beds of the streams, and this has caused mining to be divided into two classes, namely, "land mining" and "river mining".

Profitable land mining depends mainly upon—

1. The location of the deposit with reference to point of shipment or consumption.
2. The difficulties to be encountered in mining, namely, the depth and character of the overlying earth, drainage, presence of trees, etc.
3. The quality of the rock.
4. The extent and yield of the deposit.
5. The supply of water, wood, and labor.
6. The facilities for removing the rock.

Profitable river mining is chiefly dependent upon—

1. The location with regard to both commerce and health.
2. The depth of water and liability to storms.
3. Thickness and character of the rock-bed.
4. The probable occurrence with the rock of troublesome concomitants, such as marl and oyster-shells.
5. The quality of the rock.

The depth of the deposit in either case is a very important matter, as at present land mining is not profitable at an average depth exceeding 6 feet, nor water mining at a depth exceeding 20 feet. The generally level character of the strata in this section is favorable to successful mining. In many places phosphate beds are found underlying 20 acres or even hundreds of adjoining acres of land where mining is carried on at a depth not exceeding 6 feet, or form the bottom of broad and shallow stretches of water at a tolerably uniform depth. These, however, are the exceptions, and hence the extent of accessible deposits is limited to a small percentage of the whole known depo sit. The rock occurs in nodular masses, nearly round or kidney-shaped, that from the land being usually yellowish white in color, and from the water bluish black. The thickness of the stratum averages 8, and rarely exceeds 30 inches. The yield per acre varies from 300 to 1,200 tons. Numerous fossils of both land and marine animals occur, associated with the rock.

Beginning at the northeast corner of the accompanying map, the first deposit observed is in the Wando river. This has produced many thousand tons of high-grade rock, in small dark nodules, raised mainly by tongs. To the northwest of this deposit are the rock-beds of the eastern branch of the Cooper river. These contain a considerable quantity of rock, richer toward the junction of the two branches, but have been very little worked. The largest of the accessible deposits underlies that section included between Back and Stono rivers and Rantowle's creek. This is a land deposit, and occurs at a remarkably uniform depth. The Stono river has been successfully worked for a long time, and is still a popular field, owing to the favorable depth of water for working, either with dredges or with tongs, its proximity to the city, and the easy manipulation of the rock in process of manufacture.

The deposits of the Edisto river are of good quality, but lack continuity and uniformity in depth. An extensive deposit of rock occurs in the Bull and the Coosa rivers, and underlying Chisholm island, that has furnished a large proportion of the amount shipped. Several very heavy beds of phosphate rock occur in the neighborhood of Beaufort, but, unfortunately, they are of low grade, and are not worked at present.

A large income is annually yielded to the state from royalties, and the right to mine in the rivers is granted by the state. Two forms of privileges are granted, "exclusive rights" and "general rights"; the former give permission to mine exclusively within certain limits, while the latter allow mining in any river deposit to which no "exclusive right" has been granted. Both are subject to a royalty of $1 per ton on all mined. (*a*) The income to the state from land phosphate is derived from the usual state tax assessed on one-half the value of the rock mined.

The following table gives the statistics of "the mining of phosphate rock in South Carolina":

	Number of establishments.	Capital.	AVERAGE NUMBER OF HANDS EMPLOYED.			Total amount paid in wages during the year.	MATERIALS.						PRODUCT.	
			Males above 16 years.	Males below 16 years.	Females above 15 years.		Number of tons of anthracite coal.	Value.	Number of tons of bituminous coal.	Value.	Value of all other materials.	Total value of all materials.	Tons of phosphate rock mined.	Value.
Total for State	21	$2,071,300	2,405	70	10	$490,047	6,800	$28,000	3,376	$17,550	$279,109	$324,659	211,377	$1,123,823
WATER PHOSPHATE.														
Beaufort county	5	485,300	904	1	.....	190,288	6,000	24,000	1,326	7,000	240,694	271,694	107,772	504,446
Charleston county	4	230,000	230	.....	.....	16,159	.....	.....	550	2,750	200	2,950	10,166	55,172
Total	9	715,300	1,134	1	.....	206,447	6,000	24,000	1,876	9,750	240,894	274,644	117,938	619,618
LAND PHOSPHATE.														
Charleston county	10	1,201,000	971	69	10	247,600	800	4,000	1,500	7,800	37,900	49,700	81,740	444,800
Colleton county	2	65,000	300	.....	.....	36,000	.....	.....	.....	.....	315	315	11,699	59,405
Total	12	1,356,000	1,271	69	10	283,600	800	4,000	1,500	7,800	38,215	50,015	93,439	504,205

The mining of the South Carolina rock was begun in 1868, and increased very rapidly during the following ten years, stimulated by an increasing foreign demand, which suddenly fell off in 1879, owing to the depression existing in England and on the continent of Europe. The following table, prepared by Mr. E. Willis, of Charleston, shows the shipments of crude rock from South Carolina: (*b*)

Tons shipped from—	1875. From June 1, 1874, to May 31, 1875.				1876. From June 1, 1875, to May 31, 1876.				1877. From June 1, 1876, to May 31, 1877.				1878. From June 1, 1877, to May 31, 1878.			
	Foreign ports.	Domestic ports.	Consumed.	Total.	Foreign ports.	Domestic ports.	Consumed.	Total.	Foreign ports.	Domestic ports.	Consumed.	Total.	Foreign ports.	Domestic ports.	Consumed.	Total.
Total	70,546	32,560	19,684	122,790	75,815	38,231	18,850	132,896	102,767	47,053	13,400	163,220	121,742	68,946	17,635	208,323
Beaufort	44,617	7,000	.....	51,617	50,384	2,400	.....	59,784	73,923	6,285	.....	80,208	100,619	8,217	.....	108,836
Charleston	25,929	25,560	19,684	71,173	25,431	28,831	18,850	73,112	28,844	40,768	13,400	83,012	21,123	60,729	17,635	99,487
Other points than Beaufort and Charleston.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

a Since the census year the royalty on river rock has been increased to $1 25 per ton.

In the comparison of Mr. Willis' figures with the reports of this office, it must be borne in mind that the former represent amounts *shipped* and the latter amounts *mined*.

Tons shipped from—	1879. From June 1, 1878, to May 31, 1879.				1880. From June 1, 1879, to May 31, 1880.				1881. From June 1, 1880, to May 31, 1881.				1882. From June 1, 1881, to January 31, 1882.			
	Foreign ports.	Domestic ports.	Consumed.	Total.	Foreign ports.	Domestic ports.	Consumed.	Total.	Foreign ports.	Domestic ports.	Consumed.	Total.	Foreign ports.	Domestic ports.	Consumed.	Total.
Total	119,566	60,899	18,900	199,365	61,375	107,348	22,040	190,763	70,768	157,824	38,142	266,734	58,259	129,184	32,286	219,729
Beaufort	97,709	8,618	.....	106,417	47,157	13,346	.....	60,503	62,200	65,895	.....	128,095	53,811	46,747	.....	100,558
Charleston	21,707	52,281	18,900	92,948	14,218	94,002	22,040	130,260	8,568	91,929	38,142	138,639	4,448	75,242	32,286	111,976
Other points than Beaufort and Charleston.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,195	.....	7,195

By this it will be seen that the exportation fell off from 121,742 tons in 1878 to 70,768 tons in 1881. Meanwhile the domestic consumption has increased from 86,581 tons to 195,966 tons. The shipments for the eight months from June 1, 1881, to January 31, 1882, aggregate 219,729 tons, an average of 27,466 tons per month.

This industry, though inaugurated during the troublous "reconstruction era", has overcome all obstacles, and now produces raw material to the value of one and one-quarter million dollars. The rock is mainly used at home in the manufacture of manures.

The composition of the South Carolina phosphates varies widely, and it is therefore impossible to show their typical composition. As the result from hundreds of analyses of clean and dry samples, of fair to excellent qualities, Dr. Shepard gives the following percentages:

	Per cent.
Phosphoric acid	*a* 25 to 28
Carbonic acid	*b* 2½ to 5
Sulphuric acid	½ to 2
Lime	35 to 42
Magnesia	traces to 2
Alumina	traces to 2
Sesquioxide of iron	1 to 4
Fluorine	1 to 2
Sand and silica	4 to 12
Organic matter and combined water	2 to 6
Moisture	½ to 4

In addition to these ingredients, sodium, chlorine, and occasionally other elements occur in small quantities. Iron pyrites, rarely found beyond 1 per cent., are included under the estimate of sulphuric acid and sesquioxide of iron. The organic matter is nitrogenous, containing occasionally as high as one-quarter per cent. of nitrogen.

SULPHUR AND SULPHURIC ACID.

The production of sulphur in this country is very limited, as only one establishment was enumerated in 1880. The works are located about 35 miles northwest of Humboldt station, Nevada, in the Rabbit Hole range of the Humboldt mountains, where the sulphur is mined and purified. The crude material is found in a more or less pure state in irregular masses, associated with gypsum and a white ash, and varies in color from a pale lemon yellow to a shiny black. The latter is considered the richest, owing to its dense structure, which causes it to produce a greater weight of sulphur to a given volume of ore.

To separate the sulphur from the accompanying impurities the crude material is charged into an upright cast-iron boiler and steam is admitted under a pressure of 40 to 60 pounds. The sulphur is run off from the bottom, remelted, and purified in pans, and cast into cylinders or rolls weighing 250 pounds, then carried 35 miles to Humboldt, and shipped by rail to San Francisco. Until quite recently the mining of sulphur has not been profitable, mainly owing to the high cost of transportation. The market is limited to the Pacific coast.

About twelve years since a large deposit of sulphur was discovered in Calcasieu parish, Louisiana, while boring for petroleum. An attempt was made two years ago to utilize this deposit, but on account of difficulties arising from the flow of water the enterprise was abandoned.

The consumption of sulphur has rapidly increased within the past few years. In 1878 962,049 pounds of crude sulphur were imported into the United States, and 1,756,745 pounds in 1880. Since then the consumption has largely increased, owing to the establishment of a number of new acid-works, as well as a greater production in those already existing.

a Equivalent to bone phosphate of lime, 55 to 61 per cent. *b* Equivalent to carbonate of lime, 5 to 11 per cent.

The uses of sulphuric acid are innumerable and its manufacture is of prime importance, large quantities being annually consumed in the refining of petroleum and in the manufacture of manures, sulphate of ammonia, alum, copperas, chlorine, phosphorus, and glucose. In Europe the acid is mainly produced by the combustion of pyrites, but in this country it is almost entirely made from sulphur. At the present time two establishments in New York and one in Georgia are using native sulphides of iron, and one in Vermont employs pyrites for the production of copperas, by the slow oxidation of the mineral.

The following table exhibits the number of establishments producing sulphuric acid during the census year, and the total production for each state having more than one establishment:

States.	No. of establishments.	PRODUCT.		States.	No. of establishments.	PRODUCT.	
		Pounds.	Value.			Pounds.	Value.
Total	49	308,765,422	$3,661,876	New York	5	41,363,543	$498,723
				Ohio	5	24,200,000	386,000
California	2	5,105,995	129,195	Pennsylvania	9	66,346,819	937,522
Connecticut	2	5,163,669	53,500	Rhode Island	2	9,500,000	130,000
Maryland	4	43,920,000	340,840	District of Columbia, Illinois, Louisiana, Maine, Michigan, Missouri, Nevada, Virginia, and West Virginia.	9	15,154,400	226,317
Massachusetts	4	23,016,381	326,666				
New Jersey	7	74,994,625	693,113				

POTASSIUM BICHROMATE.

This important chemical salt, owing to the discovery of extensive chrome-iron deposits in Maryland, was one of the first manufactured in this country. From this source the greater part of the chrome ores were obtained for domestic manufacture until the discovery of ore in California, where since 1869 many large deposits have been discovered and worked, particularly throughout the coast ranges. Ore also occurs in the Sierra Nevada range, but at present the cost of transportation is in most cases too great to admit of its utilization. Large quantities of ore have been shipped from Del Norte and San Luis Obispo counties, California, but in the latter the supply is very inconstant, owing to the bunchy character of the deposits.

The general results of over one hundred analyses of the ore found in California may be stated as follows:

	Per cent. of chromic oxide.
Del Norte county	39 to 45
Napa county	42 to 46
Placer county	35 to 55
Tuolumne county	44 to 45
San Luis Obispo county	38 to 60
El Dorado county	20

The production of bichromate in the United States during the census year was 4,000,000 pounds, valued at $520,000. A new company has recently been organized, which has purchased several California deposits, and will soon begin the manufacture of this useful chemical. The uses of potassium bichromate are various, but are mainly in the manufacture of chrome pigments, printing, dyeing, charging electric batteries, and in tanning leather.

POTASH.

The manufacture of "potash" and "pearlash" has been carried on for a long time by the leaching of wood ashes, the only source of these salts in the United States. The production has decreased very materially, owing to the scarcity of wood, as well as from the competition in foreign markets, caused by the introduction of potash from waste products of the beet-sugar industry and from the "Stassfurt salts".

During the census year potash and pearlash were produced in seven states, as follows:

States.	No. of establishments.	PRODUCT.		States.	No. of establishments.	PRODUCT.	
		Pounds.	Value.			Pounds.	Value
Total	68	4,571,071	$232,643	Minnesota	1	146,000	$5,840
				New York	8	515,500	23,442
Indiana	3	232,500	11,625	Ohio	12	493,229	20,761
Maine	8	270,299	14,010	Wisconsin	9	1,511,181	94,423
Michigan	27	1,393,962	62,542				

Until the introduction of the Le Blanc's process for the manufacture of soda the alkalies were made from the ashes of plants, trees, etc., marine plants furnishing soda and land plants potash; but this source soon became insufficient, for, as the demand increased, the supply of ash-producing substances decreased, consequent upon the

exhaustion of forest lands. By the introduction of Le Blanc's process soda soon became of prime importance, and, for most purposes where an alkali was needed, replaced potash. The purposes for which potash is best adapted are, however, sufficiently numerous to create a steady demand for that article. Its principal uses are for the manufacture of soft soap and for the preparation of potassium prussiate, bichromate, iodide, bromide, permanganate, hydrate, and chlorate.

PHOSPHORUS.

The manufacture of phosphorus was begun in the United States in 1870 by Messrs. Rose & Lowell, at Mount Holly, New Jersey. Phosphorus was then selling for $1 25 per pound, but the price was rapidly lowered by English competition to 70 cents in 1873, when Messrs. Rose & Lowell failed and the manufacture ceased. The property was then purchased by the present owners, who commenced to manufacture in January, 1874, when the price had again advanced to $1 20 per pound, presumably from the lack of American competition. Prices again declined to 50 cents in 1878, and the works were closed, and now remain idle. In 1877 the manufacture was undertaken in Camden, New Jersey, and has continued to the present time. It is understood that the larger part of the product is used in the manufacture of phosphor-bronze.

The principal use for phosphorus is in the manufacture of matches, which industry is mainly controlled in this country by a single company, who have contracted with an English company for their phosphorus supply at a price considerably below the market price in England and below the cost of production here. The market price of phosphorus in England to-day is about 70 cents, but it is imported into the United States, an *ad valorem* duty of 20 per cent. being paid, and is sold in New York for 60 cents per pound.

During the census year the production of phosphorus in the United States was 56,292 pounds, valued at $29,271, while the value of importations was $78,253.

BORAX (BIBORATE OF SODA).

Until 1872 all borax used in this country was either imported as such or was manufactured here from imported boracic acid; but during that year extensive deposits of natural borax were developed on the Pacific coast, and, by domestic competition, the price rapidly declined from 32 cents per pound in 1872 to 8 cents in 1879. (*a*)

Borax was first produced in California from the waters of Borax lake, in Lake county, a narrow sheet of water about one mile in length, whose contents at certain seasons were found to consist of a saturated solution of borax. It was also found that the mud at the bottom of this shallow lake was filled with borax crystals, and movable coffer-dams were put down, the mud was dug out and leached, and the partially-purified article prepared; but the weakening of the water and the solution of the crystals by the entrance of fresh water, as well as the discovery of large deposits in Nevada, caused the abandonment of these works several years since.

Four companies on the Pacific coast were engaged in the manufacture of borax during the census year; three raised and purified the natural borax, and the fourth made a small amount from native borate of lime. The oldest and most productive works are located near Columbus, Esmeralda county, Nevada. The borax occurs here as an efflorescence on the surface, and also impregnates the soil, in conjunction with borate of lime (Ulexite), sulphate of lime, and common salt. The soil is leached in large vats, and the borax is purified by settling and subsequent slow crystallization. The product is then hauled by wagons, 360 miles, to Wadsworth, on the Central Pacific railroad, and sent by rail to San Francisco, where it is shipped east by vessel.

Another large deposit occurs in San Bernardino county, California, in the slate range, which is worked in a similar manner, the product being hauled to San Bernardino.

The extent of the deposits of crude borax proves to have been largely overestimated, and they are now generally recognized to be only temporary in character. Doubtless, when these are exhausted, if no others are discovered, increased facilities for transportation will cause the borate of lime, now neglected, to be used in the manufacture of borax.

BROMINE.

The manufacture of bromine was begun in this country in 1846 by Dr. David Alter, of Freeport, Pennsylvania, who continued the business for about ten years and sold the product for from $6 to $8 per pound. At this time bromine was mainly used in the preparation of daguerreotype plates, but when this method of photography was superseded the demand for bromine decreased, and, in consequence, its production ceased.

In 1866 the discovery of the value of potassium bromide as a nerve sedative caused a renewed demand for bromine, and Messrs. Rosengarten & Sons, of Philadelphia, sent a chemist (Mr. C. W. Bodey) to Tarentum to investigate the subject. Works were erected, and the first bromine was made May 30 of that year. The demand increased so rapidly that the supply of bittern became insufficient in Pennsylvania, and in 1868 works were erected in Pomeroy, Meigs county, Ohio. As the demand grew the production also increased rapidly, and, by the adoption of improved processes of manufacture, the price steadily declined from $6 per pound in 1856 to 28 cents in 1880.

a It had gradually advanced to 13½ cents in January, 1882.

During the census year there were twelve establishments in operation in the following states, as follows: (a)

States.	No. of establishments.	PRODUCT.	
		Pounds.	Value.
Total	12	404,690	$114,752
Ohio	5	150,850	40,462
Pennsylvania	3	90,000	25,120
West Virginia	4	163,840	49,170

Analyses of the following bitterns have been published:

1. Sample from Freeport, Armstrong county, Pennsylvania, analyzed by Mr. M. H. Boyé, in 1848:

	Per cent.
Potassium chloride	0.128
Sodium chloride	0.877
Calcium chloride	24.640
Magnesium iodides, bromides, and chlorides	10.146
Total solids	35.791

The proportion of magnesium salts was divided as follows:

	Per cent.
Magnesium	2.5750
Bromine	0.7010
Chlorine	6.8660
Iodine	0.0035
Total	10.1455

2. Samples taken in 1880 from Midland, Michigan, and analyzed by Mr. Ayers, at the university of Michigan, resulted as follows (specific gravity, 1.2557):

	No. 1. Per cent.	No. 2. Per cent.
Sodium chloride	5.6754	6.0801
Calcium chloride	14.3574	14.5859
Magnesium chloride	3.9263	3.4019
Magnesium bromide	4.8356	4.8356
Calcium sulphate	0.0160	0.0160
Water	63.3941	63.3941
Total	92.2048	92.3136

At Pomeroy, Ohio, about one ounce of bromine is obtained from a gallon of bittern, or one pound for every two barrels of salt made.

The salt brines of the United States are richer in bromine than those of any other part of the known world, and now furnish large quantities for exportation. Home competition has lowered the price, until the profits of the business have been reduced to a very small margin.

NITRO-GLYCERINE.

This "high explosive" was first prepared in the laboratory in 1847, but it was not until 1865 that its great value as a blasting agent began to be recognized. It was first used in its pure liquid state, and many terrible accidents accompanied its transportation and use. This caused attempts to be made to reduce its dangerously explosive character, which resulted, in 1867, in the invention of dynamite, and led to its gradual introduction.

The general composition of dynamite consists of an absorbent, such as "infusorial earth", saturated with nitro-glycerine. It is found that a good "earth" will absorb from three to four times its weight of nitro-glycerine, and possesses the advantage over other absorbents of retaining it even under heavy pressure.

During the census year nineteen establishments were in operation making nitro-glycerine, as follows:

States.	No. of establishments.	PRODUCT.	
		Pounds.	Value.
Total	19	3,039,722	$1,830,417
California	4	1,242,424	655,030
Pennsylvania	10	522,835	424,837
Massachusetts, Michigan, New Jersey, New York, and Ohio	5	1,274,463	749,900

a Since the census year the manufacture of bromine has been started at Midland, Michigan, with considerable success.

The production has, however, largely increased since that period; but the largest nitro-glycerine works in the East, owned by a combination of leading gunpowder manufacturers, though in process of construction during the census year, did not begin operations till its close. Another large concern in California also commenced about the same time.

ACETATE OF LIME.

The manufacture of acetate of lime and its associated product, methylic alcohol, was started in the United States about the year 1867 by Messrs. J. A. Emmons and A. S. Saxon, in Crawford county, Pennsylvania. Their production gradually increased, and in 1874 Mr. George C. Edwards established the Burcey Chemical Company at Binghamton, New York, to refine the crude wood spirit obtained from the various acetate manufacturers. During the census year seventeen establishments were in operation in the following states:

States.	No. of establishments.	PRODUCT.			
		Acetate of lime.		Crude methylic alcohol.	Charcoal.
		Pounds.	Value.	Value.	Value.
Total	17	6,593,009	$156,892	$86,274	$31,770
New York	8	3,171,544	78,086	53,234	10,700
Pennsylvania	3	1,260,000	30,650	17,040	5,300
Michigan, Maryland, Massachusetts, Vermont, Rhode Island, and New Jersey	6	2,161,465	48,156	16,000	15,770

Beside the above amount of dry acetate, three establishments produced 130,000 gallons of liquid acetate (strength 15° to 36° Baumé), valued at $12,200. (*a*)

Two qualities of acetate are produced, known as "brown" and "gray", the production of the latter forming about one-fifth of the total.

a Since the census year the production has rapidly increased, until in April, 1882, twenty-eight firms were engaged in this manufacture, producing an average of 550 tons of acetate and 600 barrels of spirits per month. As several of these firms have more than one works, the total number of establishments is estimated as thirty-five.

PART II.—PRODUCTION OF SALT.

GENERAL DISCUSSION.

In the following table the most important statistics have been summarized as a basis for comparison of the condition of the salt industry in 1870 and 1880 respectively, with the percentage of increase or decrease:

	1870.	1880.	Percentage increase.
Number of establishments	282	268	* — 4.96
Number of blocks or furnaces	402	308	* —23.38
Number of vats or ponds	24,525	47,462	93.52
Total capital employed	$6,561,615	$8,225,740	25.35
Total wages paid	$1,146,910	$1,260,023	9.86
Total value of materials used	$1,760,070	$2,074,040	17.80
Total value of salt produced	$4,818,229	$4,829,566	0.24
Total bushels of salt produced	17,606,105	29,805,298	69.29

* Decrease.

By this it will be seen that the number of establishments and the number of blocks have decreased, while the capital and production have largely increased; but at the same time it appears that only 58.71 per cent. of the capital was turned over in 1880, to 73.43 per cent. in 1870; 69.03 per cent. of the value of the product was paid out for wages and materials in 1880, to 60.35 per cent. in 1870; and, though the amount of the product has increased 69.29 per cent., the value has increased only 0.24 per cent.

In the production of salt the brine is evaporated either by solar heat or by artificial heat, the former being exclusively used in the evaporation of surface brines, and the latter being generally employed for subterranean brines. In evaporation by artificial heat two distinct methods of heating are in use: First, by direct heat, as in the pan and kettle process; and second, by steam passing through pipes in the settlers and grainers. In Michigan steam is furnished by the exhaust of the adjoining saw-mills; in other localities by close evaporators or covered pans.

TABLE I.—GENERAL STATISTICS OF SALT PRODUCTION IN THE UNITED STATES: 1880.

States and Territories.	Number of establishments.	Capital.	Average number of hands employed: Males above 16 years.	Females above 15 years.	Children and youths.	Total amount paid in wages during the year.	Subterranean brines: Wells.	Average depth of wells.	Average strength of brine (degrees salometer).*	By artificial heat: Machines. Blocks or furnaces.	Kettles.	Aggregate capacity.	Pans.	Aggregate capacity.	Settlers.	Aggregate capacity.	Grainers.	Aggregate capacity.
							No.	*Feet.*		*No.*	*No.*	*Gallons.*	*No.*	*Gallons.*	*No.*	*Gallons.*	*No.*	*Gallons.*
The United States.	268	$8,225,740	4,125	20	144	$1,260,023	546	.....	.....	308	9,345	1,187,507	1,058	668,207	661	19,736,670	527	5,178,718
California †	25	375,650	188	.....	.....	50,620	.....	.....	.....	2	56	6,750	2	500	.....	.....	.....	.....
Kansas	1	6,000	2	.....	.....	700	1	93	24.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kentucky	3	20,500	34	.....	.....	8,750	3	560	34.0	3	78	7,600	4	3,040	2	15,484	1	12,701
Louisiana ‡	1	250,000	45	.....	.....	11,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Massachusetts †	5	9,000	8	.....	.....	1,030	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Michigan	86	2,147,269	1,416	.....	52	541,852	299	882	92.3	103	174	21,352	54	231,257	237	6,160,246	355	3,295,527
Nevada	7	45,300	31	3	2	9,688	150	30	12.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
New York	69	2,286,081	962	11	39	274,087	42	322	69.5	134	8,347	1,086,540	.....	.....	269	10,331,931	.....	.....
Ohio	25	832,600	449	2	2	105,261	58	912	36.8	26	291	22,265	359	150,632	59	1,202,035	59	561,484
Pennsylvania	16	234,500	131	.....	6	52,047	19	883	24.9	16	.....	.....	21	66,390	21	450,062	24	174,507
Texas	3	92,000	17	1	1	8,150	1	10	.....	2	59	5,600	.....	.....	2	400	9	500
Utah	10	13,400	62	3	8	20,932	4	2	82.5	2	.....	.....	.....	.....	.....	.....	.....	.....
Virginia	1	1,000,000	76	.....	.....	14,219	2	272	90.0	4	340	37,400	.....	.....	.....	.....	.....	.....
West Virginia	15	910,500	702	...	34	160,227	57	1,042	35.6	16	.....	.....	614	215,588	71	1,576,512	79	1,135,209
Wyoming	1	3,000	2	.....	.....	1,460	.....	.....	.....	.....	.....	.....	4	800	.....	.....	.....	.....

* 4° salometer = 1° Baumé. † Salt made from sea-water. ‡ Rock-salt mined and ground.

TABLE I.—GENERAL STATISTICS OF SALT PRODUCTION IN THE UNITED STATES: 1880—Continued.

States and Territories.	BY ARTIFICIAL HEAT—continued. Materials. Coal.	Value.	Wood.	Value.	Value of all other materials.	Total value of all materials.	BY SOLAR EVAPORATION. Machines. Vats or ponds.	Aggregate area.	Total value of materials.	PRODUCTS. Salt.	Total value of all products.
	Tons.		*Cords.*				*Number.*	*Square feet.*		*Bushels.*	
The United States.	453,846	$492,959	541,179	$423,141	$1,090,936	$2,007,036	47,462	75,253,446	$67,013	29,805,298	$4,829,566
California*	13	76	125	300	40	416	203	17,713,602	19,079	884,743	121,650
Kansas							33	60,000	710	13,000	5,700
Kentucky	3,760	3,408			5,600	9,008				83,000	21,950
Louisiana†										312,000	56,160
Massachusetts*							456	316,420	20	9,575	3,800
Michigan			524,655	377,939	629,294	1,007,233	3,750	807,180	2,500	12,425,885	2,271,913
Nevada							54	543,053	5,800	182,493	92,640
New York	136,843	240,112			233,004	473,116	42,939	12,068,796	33,904	8,748,203	1,107,760
Ohio	133,470	112,044	207	293	90,206	202,543				2,650,301	363,791
Pennsylvania	55,750	37,141			36,906	74,047				851,450	177,415
Texas			2,900	6,400	1,200	7,600	8	16,040	1,500	50,600	29,700
Utah			400	480	20	500	18	43,645,075	3,500	483,800	60,280
Virginia			12,000	36,000	3,000	39,000				425,895	127,678
West Virginia	124,010	100,178	162	269	91,666	192,113				2,679,438	380,369
Wyoming			730	1,460		1,460	1	21,780		5,000	8,760

* Salt made from sea-water. † Rock-salt mined and ground.

SALT, GROUND OR REFINED.

States.	Number of establishments.	Capital.	AVERAGE NUMBER OF HANDS EMPLOYED. Males above 16 years.	Females above 15 years.	Children and youths.	Total amount paid in wages during the year.	MATERIALS. Coal, tons.	Value.	Wood, cords.	Value.	Value of all other materials.	Total value of all materials.	PRODUCTS. Salt, bushels.	Value.
The United States.	8	$322,900	140	47	8	$44,997	1,746	$5,743	200	$500	$274,450	$280,693	1,044,600	$361,656
California	1	85,000	8	2	2	6,800					40,000	40,000	66,600	60,000
Maine	2	1,700	4			1,300					2,750	2,750	8,000	4,750
Michigan	1	7,000	7	7	6	5,000	500	2,500	200	500	16,000	19,000	50,000	30,000
New York	4	229,200	130	38		31,897	1,246	3,243			215,700	218,943	920,000	266,906

The following table exhibits the amount of salt produced by the various processes, and the sources from which the brines are derived:

States and territories.	BY SOLAR EVAPORATION. From sea or bay water.	From inland lakes, or natural deposits.	From subterranean brines.	BY ARTIFICIAL HEAT FROM SUBTERRANEAN BRINES. By kettle or pan process.	By steam evaporation process.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Total	887,968	930,808	3,011,000	8,860,171	16,115,351
California	878,393			6,350	
Kansas			13,000		
Kentucky				50,000	33,000
Louisiana		312,000			
Massachusetts	9,575				
Michigan			153,500	* 184,270 † 1,910,610	10,177,505
Nevada		114,908	67,500		
New York			2,777,000	5,971,203	
Ohio				276,343	2,373,958
Pennsylvania					851,450
Texas		16,600		34,000	
Utah		482,300		1,500	
Virginia				425,895	
West Virginia					2,679,438
Wyoming		5,000			

* Kettle process. † Pan process; used only in Michigan.

The following table shows the production of a number of the principal states and territories in the order of present production, with a statement of the increase during the decade from 1870 to 1880, with percentages.

States.	Rank.	PRODUCT IN BUSHELS.		INCREASE.	
		1880.	1870.	Bushels.	Percentage.
Michigan	1	12,425,885	3,981,316	8,444,569	212
New York	2	8,748,203	* 8,715,176	33,027	.....
West Virginia	3	2,679,438	4,633,750	1,954,312	†—42
Ohio	4	2,650,301	2,898,649	248,348	†— 9
California	5	884,743	174,855	709,888	406
Pennsylvania	6	851,450	579,970	271,480	47
Utah	7	483,800	1,950	481,850	24,710
Virginia	8	425,895	2,063	423,832	20,544
Louisiana	9	312,000	128,000	184,000	144
Kentucky	10	83,000	64,000	19,000	30
Massachusetts	11	9,575	22,846	13,271	†—58

* These figures are an average taken from the amounts reported by the New York state salt inspector for 1869 and 1870, as the figures of the Census Office are evidently incorrect.

† Decrease.

It is apparent that the greatest increase has been in Michigan, Utah, Virginia, and California. In New York the production did not materially increase, while in West Virginia, Massachusetts, and Ohio a large decrease is shown.

TABLE II.—COMPARATIVE STATEMENT OF THE SALT INDUSTRY ACCORDING TO THE CENSUS REPORTS OF 1880, 1870, AND 1860.

States.	Number of establishments.			Number of blocks or furnaces.			Number of vats or ponds.			Capital employed.			Wages paid.		
	1880.	1870.	1860.	1880.	1870.	1860.*	1880.	1870.	1860.*	1880.	1870.	1860.	1880.	1870.	1860.
The United States.	268	282	399	308	402	.....	47,462	24,525	.....	$8,225,740	$6,561,615	$3,602,215	$1,260,023	$1,146,910	$371,954
California	25	8	2	2	.....	.....	203	8	.....	375,650	66,500	800	50,620	13,400	5,400
Kentucky	3	4	6	3	.....	.....	.....	.....	.....	20,500	16,500	70,000	8,750	10,070	14,978
Massachusetts	5	9	13	.....	.....	.....	456	2,755	.....	9,000	27,300	30,525	1,080	1,875	5,892
Michigan	86	65	1	103	76	.....	3,750	3,461	.....	2,147,209	1,717,500	100,000	541,852	331,230	200
New York	69	93	296	134	147	.....	42,939	18,106	.....	2,286,081	1,584,211	2,313,590	274,087	204,226	24,520
Ohio	25	40	28	26	131	.....	.....	.....	.....	832,600	1,085,904	338,700	105,261	161,420	91,524
Pennsylvania	16	27	34	16	4	.....	.....	2	.....	284,500	171,700	190,800	52,047	57,980	64,776
Utah	10	1	.....	2	.....	.....	18	.....	.....	13,400	650	.....	20,932	300	.....
West Virginia (a)	16	20	14	20	.....	.....	.....	64	.....	1,910,500	1,031,300	523,800	174,446	290,800	148,464
Other states and territories.	13	15	5	2	44	.....	96	129	.....	396,300	260,050	124,000	30,998	75,600	16,200

States.	Total value of all materials used.			Bushels of salt produced.			Total value of salt produced.		
	1880.	1870.	1860.	1880.	1870.	1860.	1880.	1870.	1860.
The United States.	$2,074,049	$1,760,670	$1,054,980	29,805,298	17,606,105	12,717,198	$4,829,566	$4,818,229	$2,289,504
California	19,495	.....	.....	884,743	174,855	44,000	121,650	48,150	7,100
Kentucky	9,008	5,520	7,450	83,000	64,000	169,665	21,950	20,920	41,190
Massachusetts	20	250	1,020	9,575	22,846	31,525	3,800	11,550	9,832
Michigan	1,009,733	410,561	275	12,425,885	3,981,316	2,360	2,271,913	1,176,811	600
New York	507,020	494,854	676,301	8,748,203	†4,977,720	7,521,335	1,107,760	925,709	1,289,511
Ohio	202,543	352,922	139,627	2,650,301	2,898,649	1,743,200	363,791	773,492	276,871
Pennsylvania	74,047	83,208	48,603	851,450	579,970	1,011,800	177,415	187,312	196,916
Utah	4,000	240	.....	483,800	1,950	.....	60,280	780	.....
West Virginia (a)	231,113	385,255	166,204	3,105,333	4,635,813	2,076,513	508,047	1,508,855	410,684
Other states and territories.	17,070	27,865	15,500	563,008	268,986	116,800	192,960	164,650	56,800

* Not enumerated. † These figures are evidently incorrect, as the New York state salt inspector reported 8,662,237 bushels in 1869, and 8,748,115 bushels in 1870.

a Including Virginia, as follows:

Number of establishments.		Number of blocks or furnaces.		Number of vats or ponds.		Capital employed.		Wages paid.		Total value of all materials used.		Bushels of salt produced.		Total value of salt produced.	
1880.	1870.	1880.	1870.	1880.	1870.	1880.	1870.	1880.	1870.	1880.	1870.	1880.	1870.	1880.	1870.
1	2	4	.....	.....	.....	$1,000,000	$200	$14,219	.....	$39,000	$400	425,895	2,063	$127,678	$1,250

In 1860 the division of the state had not as yet been accomplished.

TABLE III.—ANALYSES OF BRINES AND ROCK-SALT IN THE UNITED STATES.

Date of analysis.	Locality.	Sodium chloride.	Calcium chloride	Magnesium chloride.	Bromides.	Iron carbonate.	Calcium sulphate.	Magnesium sulphate.	Other sulphates.	Other salts.	Total solids determined.	Analyst.
	BRINES.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
July 5, 1862	Syracuse, New York	15.3570	0.0795	0.1449	Traces.	0.0029	0.5747	.....	.....	.....	16.1590	Dr. C. A. Göessmann.
	Geddes, New York	15.2027	0.0795	0.1449	.....	0.0012	0.5747	.....	.....	.....	16.0070	Do.
	Salina, New York	14.9443	0.0827	0.1316	.....	0.0021	0.5873	.....	.....	.....	15.7480	Do.
	Liverpool, New York	14.1483	0.1037	0.1336	.....	0.0010	0.5234	.....	.....	.....	14.9100	Do.
April 11, 1860	Saginaw valley (first well), Michigan	17.9120	2.1420	1.5220	.....	0.1050	0.1160	.....	.....	0.2200	22.0170	Professor Douglass.
October, 1862	Banks, Bay county, Michigan	19.8595	2.9011	1.2612	.....	.....	0.0722	.....	.....	.....	24.1540	Dr. C. A. Göessmann.
	Port Austin, Huron county, Michigan	17.6161	3.1274	1.5075	.....	.....	0.0129	.....	.....	.....	22.3239	Do.
	East Tawas, Iosco county, Michigan	15.6141	3.4843	1.2433	.....	.....	0.0359	.....	.....	.....	20.3767	Do.
December, 1879	San Francisco bay, California	2.3756	.....	0.3030	0.0025	.....	0.1263	0.1837	0.0470	.....	3.0381	Fr. Gutzkow.
May, 1860	East Saginaw, Michigan	16.8710	3.2873	1.7743	0.0401	0.0116	0.0982	.....	.....	0.0745	22.1570	Professor Chilton.
1860	Saltsburgh, Indiana county, Pennsylvania.	7.1320	1.5726	0.3986	.....	0.0078	.....	.....	.....	0.0005	9.1115	George J. Poepplein.
	Pittsburgh, Allegheny county, Pennsylvania.	2.2756	0.3900	0.1344	.....	.....	.....	.....	.....	.....	2.8000	G. H. Cook.
	Charleston, Kanawha county, West Virginia.	7.3094	1.5162	0.3744	.....	.....	.....	.....	.....	.....	9.2000	Do.
	Saltville, Smythe county, Virginia	25.9750	.....	.....	.....	.....	0.3221	0.1029	.....	.....	26.4000	Do.
	Great Salt Lake, Utah	11.8628	.....	1.4909	.....	.....	0.0858	.....	1.4684	0.0862	14.9941	Professor O. D. Allen.
	ROCK-SALT.											
1879	Wyoming, New York	93.7400	0.4130	0.5560	.....	.....	1.6960	.....	.....	*3.2760	99.6810	Dr. F. E. Engelhardt.
August, 1869	Petit Anse island, Iberia parish, Louisiana.	99.6170	.....	.....	.....	.....	0.3180	0.0620	.....	.....	99.9970	Joseph Jones, M. D.
	Saltville, Smythe county, Virginia	99.5500	Trace.	.....	.....	.....	.....	.....	.....	0.4500	100.0000	C. B. Hayden.

* Insoluble matter.

TABLE IV.—ANALYSES OF COMMON SALT PREPARED FOR MARKET.

Date of analysis.	Kind of salt.	Locality.	Sodium chloride.	Calcium chloride.	Magnesium chloride.	Calcium sulphate.	Magnesium sulphate.	Other salts.	Moisture.	Authority.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
1854	Solar salt	Syracuse, New York	97.3100	0.0500	0.0500	1.0500	.....	.....	1.5400	Professor Cook.
April 7, 1875	Factory-filled dairy (kettle process).	....do	97.7598	.....	0.0591	1.2272	0.0769	0.0564	0.7880	Walz and Stillwell.
	....do	....do	98.5242	0.0473	0.0346	0.7217	.....	0.0264	0.0280	Do.
(Published) 1876	First quality (kettle process)	East Saginaw, Michigan	95.8422	0.3564	0.1408	0.3165	.....	.....	3.3441	Dr. C. A. Göessmann.
	First quality (pan process)	Bay City, Michigan	97.2880	0.3290	0.3400	0.0970	.....	.....	1.9460	S. S. Garrigues, Ph. G.
	First quality (steam evaporation process)	East Saginaw, Michigan	94.3660	1.3650	0.0940	0.4780	.....	.....	3.4780	Dr. H. C. Hahn.
	Solar	Zilwaukee, Saginaw county, Michigan.	96.4700	0.7430	0.4170	0.1730	.....	.....	2.1970	Do.
1861	Fine (steam evaporation process).	Hocking Valley, Ohio	93.2600	1.4300	0.7000	.....	.....	0.0100	4.6000	Dr. C. A. Göessmann.
	....do	Mason City, West Virginia	95.7700	0.6100	0.0400	.....	.....	0.1100	3.4700	Do.
	First quality (steam evaporation process).	Charleston, Kanawha county, West Virginia.	91.3100	1.2600	0.4300	.....	.....	.....	7.0000	J. P. Hale, M. D.
	....do	.... do	96.3800	0.2200	.....	.....	.....	.....	3.4000	Do.
	First quality (kettle process)	Saltville, Smythe county, Virginia.	99.1100	.....	.....	0.6800	0.1100	.....	0.1000	George W. Palmer.
April 16, 1874	Solar (from bay water)	Mount Eden, Alameda county, California.	98.4350	.....	.....	.....	*0.3650	.....	1.2000	Falkeman and Reese.
March 14, 1879	....do	....do	99.4400	Not given.				.....	.....	Prof. Thomas Price.
January 26, 1881	Ground rock	Petit Anse, Iberia parish, Louisiana.	99.8800	Trace.	.....	0.1260	.....	.....	.....	Prof. E. W. Hilgard.

* Sulphates of lime and magnesia.

Considerable difficulty has been experienced in the collection of the salt statistics, owing to a difference in nomenclature as well as in methods of manufacture in the various salt-producing sections. Two instruments are in use for the determination of density: the salometer in Michigan and New York, and Baumé's hydrometer in California, Ohio, Pennsylvania, and West Virginia, 1° of the former being equal to 0.26° Baumé, or, conversely, 1° Baumé is about equivalent to 4° salometer. The division of this salometer is based on the capacity of water for holding salt in solution, zero representing pure water (at 60° F.), and 100° water saturated with salt. In this report the strength of brine is indicated by this salometer, whose degrees are readily convertible into the Baumé scale through division by four.

The accompanying map represents graphically the location of the industry, processes employed, and the relative production of the various sections engaged in the manufacture, as well as the source of the brine supply.

Table III gives a statement of the composition of the best known brines; Table IV gives analyses of the manufactured product. These analyses are believed to be representative, though not complete; only two giving the percentage of bromides. They have been collated from various sources, and are of value to show not only the purity of the brines, but also as far as possible the other salts contained in the bitterns. These are utilized to some extent for the manufacture of epsom salts in Massachusetts, bromine in Pennsylvania, West Virginia, Ohio, and Michigan, and magnesium carbonate in California.

The consumption of salt in the United States during the year 1880 is estimated at 48,000,000 bushels, while the production was 29,805,298 bushels.

In the eastern states the industry has suffered from two causes, which have combined to limit the market to a smaller circuit: First, Liverpool salt, brought as ballast, has practically controlled the market on the seaboard; and, second, in the western market, where large quantities of salt are used for meat-packing, the low prices of Michigan salt have defied competition.

The latter portion of Table I gives the statistics of the production of ground or refined salt. For dairy purposes many dairymen have given the preference to certain brands of English refined salt, but several makers in this country now produce an equally pure article.

By this report it is intended to refer to processes in use only so far as is necessary to show the different conditions of advantage and disadvantage under which the various sections are placed. In the consideration of this industry in detail the several salt-producing sections are given in alphabetical order.

CALIFORNIA.

The history of the salt industry in California is of quite recent date, as will be seen by Table II, only two establishments having been enumerated in 1860. During the ten years previous to 1880 the production increased over 400 per cent., from 174,855 bushels in 1870 to 884,743 bushels in 1880. All but a small fraction of this is made from surface brines, the greater portion from the water of San Francisco bay.

On the east side of San Francisco bay, in Alameda county, twenty companies were in operation during the census year, and produced 849,193 bushels by solar evaporation from the bay water. The manufacturer here enjoys advantages not possessed by the eastern states, which enable him to produce salt from a weak brine and compete advantageously, both in quality and in price, with the Liverpool salt, which is largely imported in ballast. These advantages, briefly enumerated, are: First, a long dry season of six or eight months, during which little or no rain falls, thus avoiding the expense and trouble of covering the brines in wet weather, as no loss of time is incurred during the process; second, a constant wind, that furnishes power for the moving of the brines and assists in the evaporation; third, as this wind blows across the bay, no dust is conveyed or deposited that might render the salt impure.

In the largest and most complete works in Alameda county the bay water is admitted at high tide through flood-gates into a large pond formed on the surface of the ground by earth-dikes, where the evaporation commences, and is continued through a series of five similar ponds of decreasing size. The water is moved from pond to pond by means of paddles moved by wind-power, until it enters the sixth, where it has attained a strength of 100° salometer and all the sulphate of lime has been deposited. The first five ponds are clay-bottomed; the sixth and seventh, in which the salt is crystallized, are floored with wood. The bittern is drawn off from the crystallizing ponds when it reaches a strength of 114° salometer, the treatment in utilization of the magnesia contained in the bitterns being to produce carbonate of magnesia, a salable article.

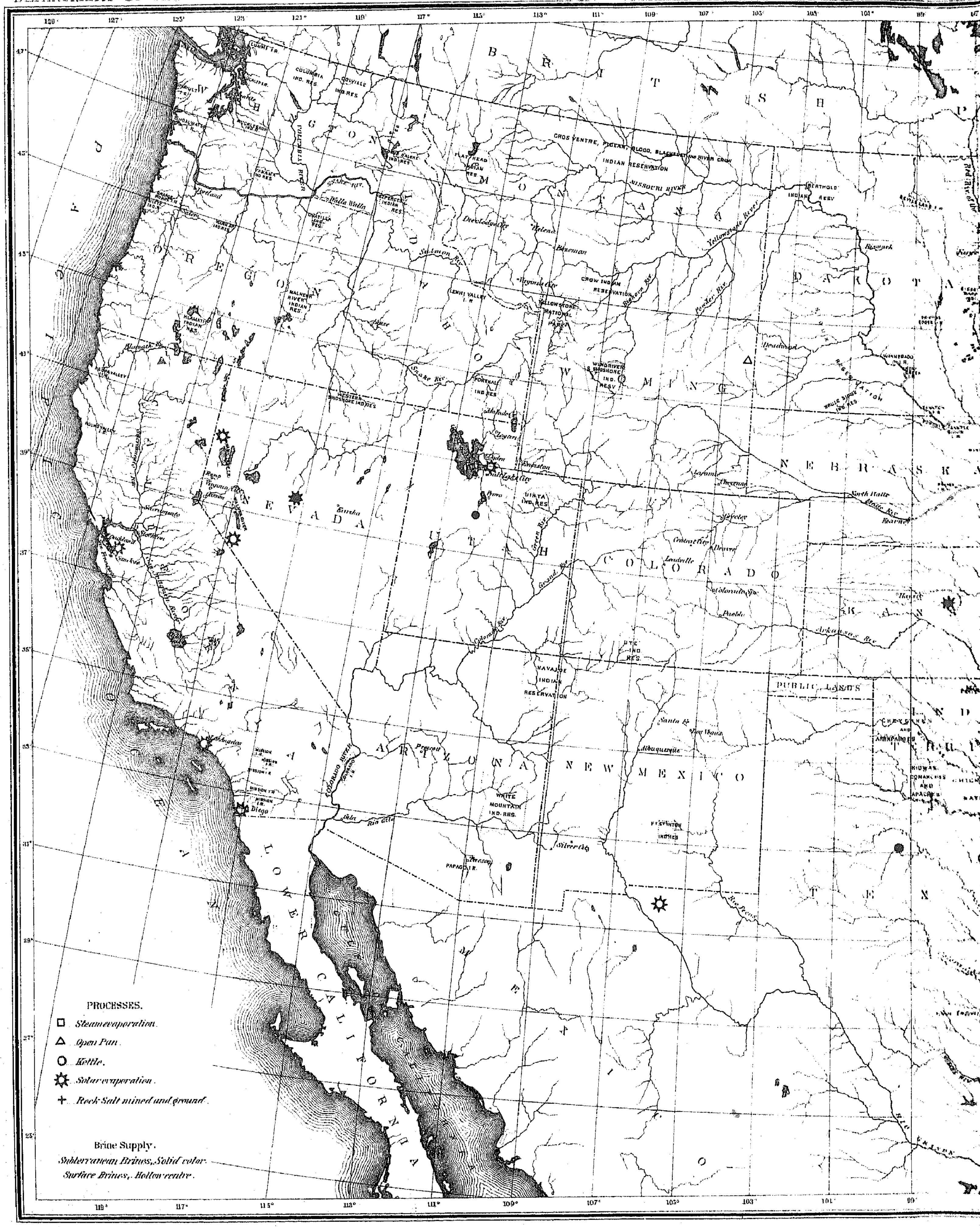
An analysis of the bittern, made by Fr. Gutzkow, in December, 1879, gave:

[Temperature of sample, 65° F.; strength of sample, 112° salometer.]

	Per cent. of solids.
Na Cl	16.5969
$Mg Cl_2$	10.8569
K_2SO_4	1.4533
$Mg SO_4$	5.5389
$Mg Br_2$	0.1090
	34.5550

Salt is made in a similar way in San Diego and Los Angeles counties, but in the latter county the brine is taken from a salt lake about 700 feet from the beach, and covering an area of 14 acres, with a depth of about 2½ feet. Previous to 1860 the salt crystallized naturally in the lake, but fresh-water springs entering, it has been necessary to pump the brine into receptacles. At first the salt was made in kettles, with "brew" (natural asphalt) for fuel, but this process has been replaced by solar evaporation in clay-bottomed ponds.

It must be admitted that some of the salt made on the coast by this process is of very inferior quality; but this is owing to carelessness and ignorance on the part of some of the makers, and would, no doubt, be avoided if a system of inspection were adopted and enforced either by the state or by an association of manufacturers.


PROCESSES.
Steamevaporation.
Open Pan.
Kettle.
Solarevaporation.
Rock Salt mined and ground.
Brine Supply.
Subterranean Brines, Solid color.
Surface Brines, Hollow centre.
NEVADA
UTAH
COLORADO
ARIZONA
NEW MEXICO
NEBRASKA
LOWER CALIFORNIA
PUBLIC LANDS
NAVAJOE INDIAN RESERVATION
YELLOWSTONE NATIONAL PARK
CROW INDIAN RESERVATION
Salt Lake City
San Francisco
Santa Fe
Albuquerque
Denver
Leadville
Pueblo
Cheyenne
Helena
Bozeman
Portland
Salem
Walla Walla
Missouri River
Yellowstone River
Snake Riv.
Salmon Riv.
Green Riv.
Grand Riv.
Colorado Riv.
Arkansas Riv.
Rio Gila
Rio Pecos

MAP OF THE

UNITED STATES

SHOWING THE LOCATION OF THE

SALT INDUSTRY

TOGETHER WITH THE PROCESSES EMPLOYED, SOURCE OF BRINE SUPPLY

AND APPROXIMATE PRODUCTION DURING THE CENSUS YEAR 1880.

PREPARED UNDER THE DIRECTION OF

W. L. ROWLAND, EXPERT AND SPECIAL AGENT.

A. Hoen & Co. Lith. Baltimore.

Siskiyou county is the only locality on this coast where salt is produced from subterranean brines. On the river, about six miles from Yreka, is a flowing well, 675 feet deep, capable of producing 10,600 gallons of brine per hour. It is accompanied by a continual flow of gas, which, when lighted, produces a yellow flame 30 inches in diameter and 5 feet in height. The brine in this well is very weak, and is concentrated by means of brush ricks before heating.

KENTUCKY.

The number of establishments producing salt in this state has decreased from six in 1860, with a production of 169,665 bushels, to three in 1880, with a production of 83,000 bushels. This decrease is mainly due to Michigan competition in the western markets and foreign competition on the sea-coast, which has limited the market to the local demand. In Clay and Breathitt counties the kettle process is in use, but in Meade county salt is made in furnaces similar to those employed in the Ohio River district, with the exception that natural gas is used for fuel.

LOUISIANA.

One of the most interesting salt deposits in America is situated on the island of Petit Anse, Iberia parish, Louisiana. This consists of a bed of superior salt, underlying a rolling section of country, with elevations varying from tide-level to 180 feet above. The deposit seems to follow the contour of the surface, but is mainly below the level of mean tide, and consists, so far as known, of a solid bed without flaw or fissure. The rock is composed of an aggregation of cubes, one-eighth to one-quarter of an inch in diameter, and weighs 125 pounds per cubic foot. The general appearance of the mine is similar to a tunnel driven through granite. So far as known at present, this deposit extends over about 140 acres, and is of unknown thickness. The shaft is now 100 feet in depth, of which 75 feet is solid salt. It seems strange that no effort has been made to ascertain the depth, but the manager says "a little calculation will show there is no need of it, as a known depth of 75 feet over an area of 140 acres will supply any possible demand for many years to come, and it would, therefore, be a mere matter of curiosity". The mine and plantation on which it is situated are now owned by the third generation of Averys who have lived on this island.

Salt-springs or licks were known to occur on the place as early as 1790, and in 1812 Mr. Avery, the grandfather of the present owners, boiled salt from these springs to supply the plantation and neighboring country. The return of peace with England, however, again permitted the importation of salt at rates with which these rude attempts could not compete, and salt manufacture ceased and became a mere tradition until the civil war of 1860, when supplies were again cut off, and Judge Avery resumed the work of his father. Batteries of sugar-kettles, and such plant as could be improvised from appliances in the neighborhood, were used, and the manufacture from the brine was pushed as far as appliances would admit.

Early in 1862 the brine supply became insufficient, and, upon sinking a new well, at a depth of 16 feet the workmen struck what they supposed to be a log or stone, but upon examination the supposed stone proved to be solid salt. Upon a more thorough investigation the probable extent of the deposit was established, and a report made to the confederate government at Richmond that resulted in the establishment of a post-office on the island, the building of a causeway, and consequently a more systematic method of working. At the point where the salt was first discovered it was but a few feet under the surface (only 11 feet in some places), and was therefore quarried like building-stone. In this way a very large amount was taken out and distributed over the South during the following year; but in 1863 the quarries were destroyed and the operations stopped by a federal expedition sent out for that purpose.

At the close of the war a company was formed, a shaft was sunk, headings were driven some 350 feet, and hoisting and grinding machinery was erected; but the venture did not prove a financial success, and was abandoned. In 1879 a second company undertook the work, but it was again abandoned. It is now in the hands of a company of New York capitalists. A canal is being opened from the island to the Gulf, which will furnish direct water communication with a market, and new and approved forms of machinery for crushing and grinding the salt have been adopted.

Analyses of this salt are given in Table III.

MASSACHUSETTS.

This is the only state on the Atlantic coast that still manufactures salt from sea-water. When operations were first begun in the early part of this century salt sold readily for $1 per bushel at the works, and lumber for the construction of vats and covers was less than half its present value. These combined advantages served to make it a profitable business at the time, but with the reduction in the value of salt and the increased cost of lumber the business has become unprofitable, and is fast dying out. The remaining works are now kept up by taking down old works to repair those in operation, but as soon as this make-shift is exhausted the business will undoubtedly cease.

MICHIGAN.

The existence of salt-springs in Michigan has been recognized from the earliest settlement of the state, and it was known that the Indians previously supplied themselves with salt from certain springs. In 1837, when Michigan was admitted to the Union, a state geologist was appointed, Dr. Douglas Houghton, who, in his report the following

year, said he regarded it important to examine the salt-springs, to select them for state purposes, and directed his investigation to that end during the following year, but with only partial success. Upon the death of Dr. Houghton other investigators continued the work, and became satisfied of the existence of strong brines in the state, which has been practically demonstrated by the deep borings now made.

The first practical attempt at salt-boring was made in Grand Rapids in 1859, and a well was sunk to a depth of 257 feet, but only a weak brine was obtained. In March, 1860, a well 636 feet deep was completed by the Saginaw Salt Manufacturing Company, and the manufacture began in July of the same year. The following represents the strength of brine found at various depths:

	Degrees salometer.
At 90 feet	1
102 feet	2
211 feet	10
212 feet	14
487 feet	26
516 feet	40
531 feet	44
559 feet	60
569 feet	64
606 feet	86
636 feet	90

Within the past ten years the production of salt in Michigan has increased from 3,981,316 bushels in 1870 to over 12,425,885 bushels in 1880. This has been due to a variety of causes, which have allowed the manufacturers to produce at small cost, and thereby undersell salt from other sections, and for some purposes to supply the entire western market. In the first place, the brines are more highly saturated than in any other section, especially in Bay and Midland counties, where many of them are completely saturated, and register 100° salometer, or even more, owing to the presence of other soluble salts. Further than this, the item of fuel is merely nominal, as the works are generally run in connection with saw-mills, and the exhaust steam is used for the evaporation of the brine. Even where this plan is not pursued fuel is cheap, wood from the saw-mills being purchased for about 50 cents per cord. Convenient transportation to market is another advantage possessed by this section, owing to its situation on the shores of the great lake system.

The following table exhibits the statistics of production in the several counties of the state:

Counties.	No. of establishments.	Capital.	Greatest number of hands employed at any one time during the year.	AVERAGE NUMBER OF HANDS EMPLOYED.			Total amount paid in wages during the year.	SUBTERRANEAN BRINES.			BY ARTIFICIAL HEAT.								
											Machines.								
				Males above 16 years.	Females above 15 years.	Children and youths.		Number of wells.	Average depth of wells in feet.	Average strength of brine (degrees salometer) 4° salometer=1° Baumé.	Number of blocks.	Number of kettles.	Aggregate capacity in gallons.	Number of pans.	Aggregate capacity in gallons.	Number of settlers.	Aggregate capacity in gallons.	Number of grainers.	Aggregate capacity in gallons.
The State...	86	$2,147,209	1,546	1,416	....	52	$541,852	209	877	92.4	103	174	21,352	54	231,257	237	6,160,246	355	3,295,527
Bay	28	926,000	569	531	....	21	244,860	89	907	96.0	33	.....	.....	2	5,984	73	2,048,274	157	1,538,313
Huron	6	171,800	215	178	....	5	64,400	13	1,013	86.4	9	.....	.....	25	60,184	49	804,752	9	44,493
Iosco	4	100,000	86	76	....	10	35,210	12	979	88.0	4	.....	.....	....	.....	18	601,342	23	356,121
Midland	1	20,000	15	15	....	....	6,750	1	1,300	110.0	1	.....	.....	....	.....	6	205,371	4	48,820
Saginaw	47	929,409	661	616	....	16	190,632	94	789	91.0	56	174	21,352	27	165,089	91	2,350,507	162	1,307,831

Counties.	BY ARTIFICIAL HEAT—continued.				BY SOLAR EVAPORATION.			PRODUCT.			
	Materials.				Machines.			If inspected.		Number of bushels salt.	Value.
	Number of cords wood.	Value.	Value of all other materials.	Total value of all materials.	Number of vats.	Aggregate area in square feet.	Total value of all materials.	Number of barrels (grade No. 1).	Number of barrels (grade No. 2).		
The State...	524,655	$377,939	$629,294	$1,007,233	3,750	867,180	$2,500	2,449,005	36,172	12,425,885	$2,271,913
Bay	211,692	126,283	276,975	403,258	500	19,680	2,500	994,439	7,342	5,008,905	936,473
Huron	47,820	47,820	58,200	106,020	.....	.....	.....	238,417	5,583	1,220,000	227,209
Iosco	34,643	16,321	31,700	48,021	.....	.....	.....	152,500	7,500	800,000	146,960
Midland	8,000	8,000	8,000	16,000	.....	.....	.....	25,060	5,610	153,350	25,901
Saginaw	222,500	179,515	254,419	433,934	3,250	847,500	.....	1,038,589	10,137	5,243,630	935,280

Since the census year the production has steadily increased,(a) the leading process employed being steam evaporation in grainers. The brine is settled cold, then admitted directly into the grainers, and evaporated by means of steam passing through galvanized-iron pipes. A considerable quantity of salt, especially in Huron county, is made by the pan process, by which the brine is evaporated in rectangular pans by direct firing. The kettle process was formerly used to a considerable extent, but is now almost entirely superseded by those above mentioned. Only three kettle-blocks were in operation during the census year. A small amount of salt was made by solar evaporation, three establishments working during that time.

As early as the year 1865 a system of inspection was adopted by a number of manufacturers; but as it was not general, a considerable quantity of inferior salt was put on the market, which served to injure the reputation of Michigan salt. In 1869, through the efforts of the Saginaw and Bay Salt Association, the state legislature passed an "act to regulate the manufacture and provide for the inspection of salt". Since that time it has been the duty of the inspector and his deputies to examine all salt prepared for market and brand it according to quality. A non-compliance with the terms of this act by the manufacturer is punishable by fine. This system of inspection has been followed to the present time, and has done much to raise the quality of the salt. The first-quality salt is divided into three grades: "fine," "packers," and "solar" salt, and is packed for shipment in barrels of 280 pounds, marked and branded according to law.

The brine in this state is noteworthy for its great strength, and therefore the small amount of sulphate of lime present. An examination of Table III shows the general composition of the brines. The variation in the depth of the wells and in strength of brine in the various counties is as follows:

	Depth of wells (feet).	Strength of brine (degrees).
Bay county	738 to 1,050	90 to 100
Huron county	550 to 1,800	80 to 90
Iosco county	900 to 1,050	83 to 92
Manistee county (b)	1,964	Rock-salt, 93 per cent. pure.
Midland county	1,300	110
Saginaw county	675 to 1,014	84 to 98

In obtaining the statistics of Michigan production it has been impossible to represent the actual amount of fuel used in the manufacture of salt, owing to the joint use of steam for the salt-blocks and saw-mills.

From present indications it appears that Michigan will hold first place in the salt production of the country for some time to come, or until her forests are exhausted and the strength of the brine weakened by the constant drain.

NEVADA.

Owing to the adoption of the chlorination process in the treatment of ores of the precious metals in the western states and territories a demand has been created that has caused the utilization of some of the salt deposits and brines so frequently occurring in these sections. This is particularly the case in Nevada, where, it will be seen, by an examination of Table I, there were seven establishments in operation during the census year, producing 182,408 bushels of salt, mainly used in this process, and of this amount 108,033 bushels were raised directly from natural deposits on the surface during the dry season. Through the section of country included between the eastern slope of the Rocky mountains and the Sierra Nevada are many ponds and lakes whose waters are more or less highly saturated with salt. During the dry season the water in many of these evaporates, leaving a more or less pure deposit which simply requires to be gathered for use. This is the source of the greater portion of the salt produced in Nevada, though three establishments evaporate a surface brine in prepared receptacles by the aid of solar heat. One establishment secures its brine by sinking a large number of wells to a depth of 30 feet; the remainder work with surface brines or deposits.

NEW YORK.

Before the settlement of this country the Indians were accustomed to obtain salt from the salt-springs surrounding Onondaga lake, and the few white settlers in the neighborhood supplied themselves by boiling down the brine in kettles suspended over the fire by means of crotched sticks. The attention of the state having been called to the importance of these springs, in 1788 a treaty was entered into with the Onondaga tribe of Indians, by which the state agreed to care for the property for the mutual benefit of both whites and Indians; but the Indians became dissatisfied with the treaty, and in 1795 another treaty was made, by which the Onondaga Salt-Springs reservation was absolutely ceded to the state in consideration of a cash payment of $1,000 and the annual royalties of $700 and 150 bushels of salt. The area of the reservation is about 10 square miles, and includes the city of Syracuse, the town of Geddes, nearly all the town of Salina, and the whole of Onondaga lake. By this treaty the state is bound to hold and work the property forever.

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a By the report of the state salt inspector the production for the year ending November 30, 1881, is given as 13,751,495 bushels.

b Since the census year well-boring has begun on the western shore of Michigan, in Manistee county, and by January 1, 1882, one well was completed and four others were being sunk. At a depth of 1,964 feet the first well reached a bed of rock salt 32 feet in thickness.

Nothing was done by the state until 1797, when the property was surveyed, a superintendent appointed, and a duty of 4 cents a bushel collected by the state; the brine was raised by private individuals, and the state only stepped in to say that when a manufacturer had obtained all the water he wished, his neighbor should be allowed to take the surplus, if needed. In 1817 the duty was raised to 12½ cents a bushel, in order to aid in the payment for the canal connecting lake Erie with the Hudson river, and remained the same until 1833, when it was reduced to 6 cents, though for the last three years of that period a rebate was allowed which removed the entire duty and assisted toward the payment of the canal tolls. In 1846 the duty was modified to 1 cent per bushel, which has remained to the present day. In return for this duty the state sinks wells, raises water, and furnishes it to the manufacturer, and also inspects and weighs the salt.

Originally the Onondaga salt-springs were true springs, flowing over the surface; but, as the consumption of brine has increased, it has been necessary to sink wells, until now a depth of over 400 feet has been necessary in many wells to obtain a good supply of water. During the census year there were forty-two wells on the reservation, varying in depth and strength of brine in the four districts as follows:

	Depth of wells (feet).	Strength of brine (degrees).
Syracuse	250 to 330	52 to 74
Geddes	336 to 412	72 to 76
Liverpool	362 to 419	74 to 76
Salina	187 to 312	52 to 76

This, however, gives the strength of brines at a particular time during that period. The average strength of brine (at 60° F.) reported for the years 1879 and 1880 by Dr. Engelhardt is given as:

	1879. Degrees.	1880. Degrees.
Syracuse	66.61	66.13
Geddes	67.16	67.55
Liverpool	67.47	67.10
Salina	67.47	67.10

The following table gives the statistics of salt manufactured in the four districts of Onondaga county:

Districts.	Number of establishments.	Capital.	Greatest number of hands employed at any one time during the year.	Average number of hands employed.			Total amount paid in wages during the year.	Subterranean brines.			By artificial heat.				
				Males above 16 years.	Females above 15 years.	Children and youths.		Number of wells.	Average depth of wells in feet.	Average strength of brine (degrees salometer) 1° Baumé = 4° salometer.	Machines. Number of blocks.	Number of kettles.	Aggregate capacity in gallons.	Number of settlers.	Aggregate capacity in gallons.
Total	69	$2,286,081	1,040	962	11	30	274,087	42	319	70.4	134	8,347	1,086,540	269	10,331,931
Geddes	16	756,000	264	245	.....	14	88,049	10	376	74.3	25	2,091	250,250	40	1,387,700
Liverpool	12	423,500	192	187	.....	2	45,728	6	385	75.0	24	1,082	202,950	52	2,800,656
Salina	23	602,150	347	313	8	23	85,735	9	262	60.9	61	3,482	442,040	121	4,338,217
Syracuse	18	444,431	237	217	3	.....	54,575	17	299	64.4	24	1,092	190,400	56	1,805,358

Districts.	By artificial heat—continued. Materials.				By solar evaporation. Machines.			Product. If inspected.			
	Number of tons coal.	Value.	Value of all other materials.	Total value of all materials.	Number of vats.	Aggregate area in square feet.	Total value of all materials.	Number of barrels (grade No. 1).	Number of barrels (grade No. 2).	No. of bushels salt.	Value.
Total	136,843	$240,112	$233,004	$473,116	42,939	12,068,796	$33,904	933,068	3,916	8,748,203	$1,107,760
Geddes	38,925	69,455	41,860	111,315	14,132	4,077,136	13,541	186,044	.....	2,689,159	367,438
Liverpool	19,392	28,809	39,103	67,912	9,045	2,572,960	5,261	161,495	240	1,383,918	174,135
Salina	52,420	92,576	108,232	200,808	10,726	2,816,332	4,057	392,375	3,549	2,953,013	410,773
Syracuse	26,106	49,272	43,809	93,081	9,036	2,602,368	11,045	193,154	127	1,722,113	215,414

The industry in this state during the past ten years has been very much depressed, owing to domestic as well as foreign competition. In New York city Syracuse salt met with foreign competition, and if a market was sought in the West or South it met with the competition of Michigan salt, made and sold at prices unremunerative to the Syracuse manufacturer. This depression reached its lowest ebb in 1876, when less than 5,500,000 bushels were sold. A considerable improvement has taken place since that time, and many salt-blocks that were abandoned have again resumed.

There are three hundred and sixteen "water-rights" on the reservation, but during the census year only one hundred and thirty-four were in operation. (*a*)

The principal impurity in the brines, as will be seen by an examination of Table III, is sulphate of lime, which causes the kettle process to be employed to this day. But two processes are in use: the evaporation by solar heat and the kettle process; the former producing a very coarse salt, highly valued for meat-packing, etc., while the latter produces a fine salt, which, when purified, is excellent for table and for dairy purposes.

A deposit of rock-salt was discovered in 1878 about a mile from the village of Wyoming and about 40 miles southwest of Rochester, in New York state. Upon sinking a well for oil, at a depth of 1,300 feet a solid bed of rock-salt was discovered, about 70 feet in thickness, and preparations have been made to make salt from the brine produced by admitting fresh water to the salt deposit. An analysis of the rock-salt is given in Table III. The extent of the deposit is not known, and to determine it will require a series of borings. It is intended to employ the pan process at this place.

OHIO AND WEST VIRGINIA.

The manufacture of salt in these states is so intimately associated that it will be advisable to consider them as forming a common group, and take up the consideration of the several salt-producing sections, divided according to location, as follows:

District No. 1, Hocking valley, Athens county, Ohio.

District No. 2, Muskingum valley, Morgan and Muskingum counties, Ohio.

District No. 3, Tuscarawas valley, Columbiana, Guernsey, and Tuscarawas counties, Ohio.

District No. 4, Ohio River valley, Meigs county, Ohio, and Mason county, West Virginia.

District No. 5, Kanawha valley, Kanawha county, West Virginia.

The first salt made by the whites in Ohio was on the Scioto river, as early as 1794, at which time all salt was carried by pack-mules over the mountains and sold for from $6 to $10 per bushel. The production at the Scioto salt-works increased until 1808, when 20,000 bushels were made, and sold for $3 a bushel. Stronger brines were discovered elsewhere, and the manufacture ceased at this place.

The following table exhibits the statistics of the several districts in Ohio and West Virginia:

Districts.	Number of establishments.	Capital.	Greatest number of hands employed at any one time during the year.	AVERAGE NUMBER OF HANDS EMPLOYED.			Total amount paid in wages during the year.	SUBTERRANEAN BRINES.			BY ARTIFICIAL HEAT.							
				Males above 16 years.	Females above 15 years.	Children and youths.					Machines.							
								Number of wells.	Average depth of wells in feet.	Average strength of brine (degrees salometer) 40 salometer=10 Baumé.	Number of blocks.	Number of kettles.	Aggregate capacity in gallons.	Number of pans.	Aggregate capacity in gallons.	Number of settlers.	Aggregate capacity in gallons.	Number of grainers.	Aggregate capacity in gallons.
Total	40	$1,743,100	1,328	1,151	2	36	$265,488	115	956	36.5	42	291	22,265	973	366,220	130	2,778,547	138	1,695,393
Hocking valley	3	137,000	50	43	2	....	9,367	7	611	40.0	3	144	10,645	5	27,600	6	39,040	1	12,000
Muskingum valley	6	26,200	36	34	....	....	5,490	7	718	34.8	6	133	10,920	5	6,005	2	1,000	.....	.....
Tuscarawas valley	7	76,400	63	56	....	2	21,559	4	847	40.0	8	14	700	10	24,843	12	108,879	6	28,577
Ohio River valley	19	1,423,000	960	814	....	19	190,804	77	1,130	34.5	20	.....	.....	774	270,822	80	1,796,210	104	1,009,424
Kanawha valley	5	80,500	219	204	....	15	38,208	20	936	39.3	5	.....	.....	179	36,950	30	833,418	27	654,392

Districts.	BY ARTIFICIAL HEAT—continued. Materials.						PRODUCT.	
	Number of tons coal.	Value.	Number of cords wood.	Value.	Value of all other materials.	Total value of all materials.	Number of bushels salt.	Value.
Total	257,480	$212,222	369	$562	$181,872	$394,656	5,329,739	$744,160
Hocking valley	9,809	10,009	.....	.....	3,140	13,149	160,563	29,419
Muskingum valley	7,760	7,790	.....	.....	6,235	14,025	103,780	22,665
Tuscarawas valley	25,010	17,005	100	100	25,445	42,550	417,000	75,870
Ohio River valley	180,311	152,034	269	462	119,122	272,218	3,986,147	525,066
Kanawha valley	34,590	24,784	.....	.....	27,930	52,714	662,249	91,140

In the Hocking and Muskingum Valley districts the kettle process is chiefly used. In the Muskingum valley a considerable amount of salt was formerly made, but owing to weakening of the brine, as well as to some other embarrassments common to this section, the production has decreased to a small amount.

a By the report of the state salt inspector, 7,917,236 bushels were inspected during the year ending December 31, 1881.

The point of greatest production in these states is district No. 4—Ohio River valley. The works are situated on both sides of the Ohio river, at and near Pomeroy, Ohio. The first salt made in this district was on the West Virginia side, in 1849, from a well 700 feet deep, which was followed in 1851 by borings on the Ohio side and the subsequent manufacture of salt. The process now employed is a combination of the pan- and steam-evaporation processes, by which the brine is first heated in closed pans and the steam from these is conducted through copper pipes placed in the grainers. The pans differ from those used in Michigan and Pennsylvania, being of cast-iron, made in sections, with rounded bottom.

Fifth district.—The Kanawha valley is located in the neighborhood of Charleston, Kanawha county, West Virginia. This section was known and found available for the manufacture of salt by the Indians, and occasionally by white settlers, in colonial times, but the preparation of salt for market was not begun until 1797, when a kettle-block was erected, with a production of about 150 pounds of impure salt per day, which sold for from 8 to 10 cents per pound. This salt was made from brines at the surface, but in 1808 a well was sunk by another party to a depth of 58 feet, which furnished a stronger and more constant supply of brine; another kettle-block was erected, and the price fell to 4 cents per pound. The success of these parties induced others to sink wells, and already, by 1817, there were some thirty establishments in operation, producing over 600,000 bushels of salt. In this year the discovery of coal in the neighborhood gave a new impetus to the industry, and it shortly became the only fuel used. In these wells petroleum and natural gas occur, especially in the deeper borings. A few manufacturers at various times have employed the gas to lift the brines and furnish fuel for evaporation, but the liability of the flow of gas to cease has prevented its systematic employment as fuel.

Until the year 1835 the kettle process was alone used by the Kanawha salt-makers, but at that time a furnace was built of the same pattern employed in the Ohio River district, consisting, as stated, of a combination of the pan- and steam-evaporation processes; and this furnace gradually replaced the kettle-block, until the latter was entirely abandoned.

No solar salt is made in Ohio or West Virginia. The salt is packed for the market in barrels of two sizes: for general use, in barrels of 280 pounds, and for the meat-packing trade, in barrels of 350 pounds. Analyses of the salt are given in Table IV.

The principal impurities in the brines of this section are the chlorides of lime and of magnesia. Analyses of the brines are given in Table III.

An analysis of the bittern, furnished by Dr. J. P. Hale, gave the following result:

	Per cent.
Sodium chloride	26.63
Calcium chloride	57.55
Magnesium chloride	15.82
	100.00

The extreme variations in the depth of wells and strength of brines in the several districts of Ohio and West Virginia are as follows:

	Depth of wells (feet).	Strength of brines (degrees salometer).
District No. 1	562 to 670	40
District No. 2	490 to 900	26 to 40
District No. 3	900	40
District No. 4	1,000 to 1,350	30 to 40
District No. 5	900 to 1,000	28 to 48

The brines of these states contain a considerable percentage of bromides, and the bitterns resulting from the manufacture of salt have been largely worked for bromine. Further reference to this, together with analyses of the bitterns, is given in the article on "Bromine", page 21, of this report.

Recent analyses by Professor J. W. Mallett show the occurrence of iodides in these bitterns, but as yet no attempt has been made to utilize them. The following table gives the quantities of iodine found in four samples of bitterns:

Sample taken from—	Specific gravity at 15° centigrade.	Grains of iodine to the gallon.
	Per cent.	*Per cent.*
Snow Hill furnace	1.305	4.14
Daniel Boone furnace	1.270	2.80
Newcastle furnace	1.300	3.65
Hartford City furnace	1.285	2.60

Since the discovery of the strong Michigan brines and their subsequent working the production of salt in Ohio and in West Virginia has steadily declined, as manufacturers are unable to compete in the western market with the cheap Michigan product, and in the southern and eastern market with the imported article. The cost of manufacture is considerably more in Ohio and in West Virginia than in Michigan, owing to the weaker brines and

the necessity of using fuel solely for the production of salt. To be sure, coal outcrops at their very doors and cheap transportation is available, but these facilities do not enable them to compete with the Michigan manufacturer, who also has cheap transportation, as well as saturated brines and merely nominal cost of fuel. For these reasons the industry in these states has been gradually decreasing; furnaces have been abandoned and left to decay, while those in operation have only worked a part of the time, and from the present outlook these will, of necessity, be closed at no distant day, and the manufacture of salt in this district may become extinct, or only produce sufficient to supply a local demand.

PENNSYLVANIA.

The first salt-works in western Pennsylvania were erected in Westmoreland county about the year 1800, and salt was made from a weak brine, testing 16° salometer. As usual at this early date, the kettle process was employed, but this has been entirely superseded by a combination of the pan- and steam-evaporation process, similar to the one in use in Ohio and West Virginia, but differing in some practical details.

One of the newest plans, and apparently one of the most complete processes, is in use in Allegheny county. The brine, of a strength of 32° salometer, is obtained from a flowing well, which delivers it directly into the outside wooden settler or storage reservoir, from which it is pumped into an upright cylindrical boiler, where it settles while hot, and slowly concentrates to 48° by steam from the pans. It is then admitted into a series of three horizontal cylindrical boilers, where it is still further concentrated, the steam being used in heating the brine in the grainers. On the top of the furnace, over the horizontal boilers, is a series of three pans, heated by the products of combustion after they have passed the boilers, and into these pans the brine from the boilers is forced by the steam pressure existing in them. After leaving the pans and boilers the granulation takes place in the usual manner, by the steam-evaporation process. During the day coal is used for fuel, but at night the boilers are heated by natural gas, as the gas is used in the daytime by the rolling-mills in this vicinity and delivered at night to the salt-works. The economy of this process is denied by many, who assert that the boiler is soon destroyed by the action of the magnesium chloride developed in the heated brines; but the owner states that when air is completely excluded from the boilers no action ensues.

The principal impurities in the brines of western Pennsylvania are the chlorides of lime and of magnesium, as will be seen by an examination of Table III.

The depth of wells differs in Allegheny county from 580 to 2,000 feet, with a strength of brine from 20° to 34°; in Westmoreland county, from 400 to 450 feet, with a brine registering 16° to 28°.

The bitterns from the salt-works contain a considerable amount of bromides, which have been used for the preparation of bromine (see page 22).

The market for this salt is found in western Pennsylvania and on the borders of Ohio and Virginia. It is not shipped by the Ohio river, but is carried to the headwaters of the Monongahela.

TEXAS.

Deposits of salt or salt brines are found in many counties in Texas, but being worked in the crudest manner the salt is generally impure. The largest section containing brines or deposits is in El Paso county, where a superficial area of some 200 acres is covered by lakes, many of which evaporate completely during the dry season, leaving a solid deposit of salt. One of these is situated about 90 miles east of Ysleta, and covers an area of 60 acres. During the dry season this sun-dried product is simply shoveled up and hauled away to sell to the miners in New Mexico, or to Chihuahua, Mexico. The purchaser pays the owner of the deposit $1 per "faneja" (about 2½ bushels) and gathers and transports his own salt. The Mexicans formerly gathered salt from this place without royalty, in accordance with a time-honored custom, but the lakes were finally claimed by American parties, who demanded a royalty on the salt. To this the Mexicans took umbrage, and a fight ensued, in which thirteen American soldiers were killed, but the Mexicans were obliged to submit to the tax. During the census year 6,600 bushels were produced from this deposit.

In Nueces and Refugio counties sea-water has been evaporated to dryness, and in Lampasas county a "saline" was worked before and during the war, but has since been abandoned.

The most of the salt produced in Texas during the census year was made in Van Zandt county, where an establishment is located having one kettle-block, and a surface for solar evaporation of 16,640 square feet.

UTAH.

The concentrated brine of the Great Salt lake furnishes Utah with an inexhaustible supply of salt, and from this source is taken the salt used in the treatment of the ores in that territory. Up to the present time the mode of working has been very primitive, and produces a very impure salt.

The tides of the lake are caused by the winds; as when a stiff northwest wind is blowing the water will rise from 12 to 18 inches on the eastern side of the lake and overflow the marshes that are usually dry. This feature is turned to advantage in the manufacture of salt, and these marshes or lagoons are surrounded with dikes. Early in the season, when the wind is in a favorable direction, gates are opened and the lagoons are flooded. When the water recedes the gates are closed, and the retained water, therefore, evaporates gradually, often completely. The salt, which has crystallized in a solid cake on the bottom, is then broken up and removed for use. By this method the soluble impurities are retained in the salt; it is also very difficult to obtain it free from insoluble foreign matter, mud, etc. Only a small fraction of the salt is used for domestic purposes, however, and for the chlorination process pure salt is unnecessary.

In Juab county a small amount of salt is made from subterranean brines, and the existence of a large deposit of very pure rock-salt is stated by Professor Barfoot, of Salt Lake City, but it has not been possible to obtain detailed information.

VIRGINIA.

As early as 1765 it was known that wild animals were accustomed to frequent certain salt licks near the Holston river, and by 1790 the settlers made a considerable quantity of salt from these places for domestic uses. In 1820 an open well was sunk, which, at a depth of 216 feet, reached a bed of rock-salt. This open well was continued for 52 feet through the salt, and borings were made 110 feet deeper, but no water was found, nor was the bottom of the deposit reached. In 1874 the well was again cleaned out, and at a depth of 272 feet from the surface a tunnel was driven in a westerly direction 99 feet to a well previously bored, in which the brine was found too weak to use alone; this brine was thus admitted to the rock-salt, and a strong brine obtained. The deposit of rock-salt appears to cover at least 100 acres and is of considerable depth; and, with an unlimited supply of remarkably pure and strong brine, there is every prospect of a prosperous manufacture at this point for a long time to come.

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