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Ohio Mining Journal

Title: Salt and Bromine Production in Ohio: Salt Wells of the Pomeroy District

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Issue Date: 1-Mar-1885

Citation: Ohio Mining Journal, vol. 3, no. 2 (March 1, 1885), 7-14.

Abstract: Item consists of reviews of salt production in the salt wells of the Pomeroy, or Ohio Valley District, Meigs County; Tuscarawas County, Guernsey County; and Columbiana County.

URI: <http://hdl.handle.net/1811/32458>

Appears in Collections: [Ohio Mining Journal: Volume 3, no. 2 \(March 1, 1885\)](#)

*SALT AND BROMINE PRODUCTION IN OHIO.—BY
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SALT WELLS OF THE POMEROY DISTRICT.

The Pittsburg coal seam has an excellent development at Pomeroy. It lies about 150 feet above low water in the Ohio. It has a thickness of $4\frac{1}{2}$ feet, increasing in the swamps to 6 feet. A large area immediately adjoining the river originally held the seam, and mining has been carried on vigorously for a long term of years. The seam is not homogenous, but it consists of two benches, quite unequal in thickness and also in quality. The lower bench, 3 to $3\frac{1}{2}$ feet thick, is of a much better character than the top bench. The latter is 12 to 15 inches in thickness and is high in ash and sulphur and also carries a cannel streak. It was long ago found that the character of the entire seam was greatly lowered by sending out the top coal, and it finally became necessary to reject it altogether from the coal supplied to the river market. A large amount of coal, $\frac{1}{4}$ at least of the entire seam, was therefore to be thrown into the waste, cumbering the mine and reducing the out-put. To use this inferior coal and also the slack and screenings produced by mining, it was decided by the proprietors of the Pomeroy field to establish salt furnaces, provided a supply of brine could be obtained. The Ohio Valley salt interest was thus distinctly based upon the low-grade coal of the upper bench of the Pittsburg seam at this point.

Drilling for salt water was begun about 1850, and a good supply was found at a depth of 1010 feet in the pioneer well of the Pomeroy Salt Company. A smaller supply was passed at 300 feet in the Mahoning sandstone. The well head is about 60 feet below the level of the coal seam, making the main salt rock about 1075 feet beneath the Pomeroy coal, or about 600 feet below the place

of the Nelsonville coal. This shows the salt rock to be the Logan sandstone or upper Waverly, which we have already found supplying the salt wells of both the Muskingum and the Hocking Valleys.

The brine is supplied in good quantity. For some time after drilling the first wells, it flowed from the well heads, but it was soon found necessary to pump the brine, and the length of the lift has been gradually increased until the present time. It is now lifted about 500 feet. The well is cased to 600 feet, and the salt water rises about 100 feet in the casing. Aside from this, there is no falling off in the supply.

The strength of the brine is moderate, reading about $107\frac{1}{2}$ on the Beaume scale. This strength has been uniformly maintained in all of the wells, except when one or another may be temporarily invaded by fresh water from above. The brine carries but a small amount of sulphates, but it holds considerable iron and, like other Ohio brines, is extraordinarily rich in bromides.

There are now in operation in this district 15 furnaces. At one time, there were 26 in operation—13 on each side of the river. The business was fairly successful from its beginning until the end of the war. After the war was ended, the work of re-supplying the Southern States with salt, for which the Ohio was most advantageously situated, brought an extraordinary but short-lived prosperity to this field, which in the end proved a real misfortune. The success of the business at this time attracted \$2,000,000 of new capital, and the production was brought up to a maximum of 1,200,000 barrels annually—a larger quantity of salt than the regions naturally tributary to the Ohio Valley could make use of. At about the same time the competition of Saginaw salt began to be felt, and the Ohio Valley manufacture has since been carried on at a confessed disadvantage. The 15 furnaces now in operation produce about 800,000 barrels each year, and this amount is sold as fast as it is manufactured. The barrel in which the salt is packed costs not less than 30 cents, Southern Ohio oak, which is the most accessible lumber supply, being discarded and replaced by elm, linn, and other white woods, mainly from northern Ohio. The price of salt on the yards falls as low as 70 cents at times. This leaves 40 cents for manufacturing and packing 280 pounds of salt.

It requires great skill in management and great economy in every expenditure to make 7 pounds of salt for one cent and save any profit. But in reality the manufacture is not conducted with the highest degree of economy. The processes are comparatively rude and a great deal of heat escapes in hot water and even in steam. More skill has been used and much better results obtained in these respects in the Michigan salt manufacture.

As has been previously stated, the upper bench of the coal mined here, together with the slack produced in mining, was the original reliance of the salt furnaces as to fuel, and most of them adhere to the old practice. A few, however, use the whole product of the mines, and it is a question whether the superior efficiency of the fuel, derived from the entire seam, does not fully compensate for the increased expense.

For transportation, Pomeroy has mainly relied upon the Ohio river, but within the last few years, railroads have reached the town, and salt can be shipped by them at fair advantage when the river is not available.

SALT WELLS OF TUSCARAWAS COUNTY.

In what is known as the Tuscarawas Valley salt field, three furnaces are now in operation, viz.:

Sugar Creek Salt Works, at Canal Dover;

Dover Salt Works, at Canal Dover;

Goshen Salt Works, three miles above New Philadelphia

Each of them depends on a single well, and each uses the entire product. The capacity of the three is about 60,000 barrels per year, the Sugar Creek Company producing more than either of the others. This field is generally counted the most successful in Ohio at the present time.

The wells are about 900 feet in depth, all of them reaching unmistakably the Berea grit, which yields gas in connection with the brine. The water now requires to be lifted 500 feet. Its strength is about 10° Beaume, sometimes gaining a little on this. The New Philadelphia well was first to be drilled, in 1866-7. The object sought for in drilling was oil. The other wells followed in close succession. A fourth well drilled near Dover failed to pro-

duce brine, but the supply of brine may be counted as practically unlimited.

The quality of the salt produced is good. It finds its chief market in central Ohio.

There is but a small proportion of sulphates in the brine. The processes used in the manufacture are a blending of the old and new. Steam is used in the evaporation in part only. Two of the companies mine their own coal, depending on the Middle Kittanning or No. 6 seam, which is very accessible. The Sugar Creek furnace makes use of slack exclusively, drawing its supply from the Pike Run and Cambridge mines.

One of the important features of the Tuscarawas field is the production of bromine from the bitter water. The percentage of this substance is higher here than elsewhere, or else greater skill and accuracy are used in its separation. Throughout the district one pound of bromine is produced to a barrel of salt. In the Pittsburg district the proportion is one pound of bromine to two barrels of salt, and in Pomeroy one pound to three barrels. The percentage in the Michigan salt wells is probably still lower than at Pomeroy. The production of bromine in the United States was begun by Dr. David Alter in the Freeport, Pa., salt-works, in 1849, but it is only since 1866 that the manufacture has been energetically pressed. It was introduced into Ohio in 18— in the Pomeroy district.

The following estimate of the present production has been furnished, but it is not based on full statistics :

Pomeroy 1,000 to 2,000 pounds a day.

Pittsburg 350 pounds a day.

Michigan 250 pounds a day.

Tuscarawas Valley 150 pounds a day.

The aggregate is about one ton a day. Under American production the market has fallen from \$8.00 to \$0.25 per pound. The demand is limited mainly to pharmaceutical productions, and it will not bear an indefinite expansion of production.

The production of bromine has been a notable relief to the Tuscarawas field in the depression which salt production has experienced within the last few years, and the manufacture has attained as great economy and efficiency here as at any other point, under the

skillful and scientific supervision of Mr. C. W. Bodey, proprietor and manager of the Sugar Creek Salt Works.

A deep well is now being bored near the Sugar Creek Salt Works by a joint stock company in search of natural gas. The records of the drilling, which has been kept with great accuracy by Mr. C. W. Bodey, who is in charge of the work, will appear on a subsequent page.

SALT WELLS OF GUERNSEY COUNTY.

The Scott Salt Works, three miles above Cambridge, on the line of the Central Ohio Railway, (Baltimore and Ohio), are the only important works in Guernsey county. Their production is about 4,500 barrels per year. Two or three small furnaces are situated in the Wills Creek Valley that have outlived their usefulness, but that still maintain a feeble production.

Two wells have been drilled at Scott's works. The record of the last is given in Geology of Ohio, vol. II, page 534. The main salt rock lies here 620 to 650 feet below the Cambridge coal, which shows it to be the Logan sandstone. Tradition makes the depth of the Wills Creek Valley about 450-500 feet. They are begun near the level of the middle Kittanning seam, upon which they depend for fuel. They are thus seen to agree with the Scott wells as to the horizon from which the brine is derived.

• The brine is weak, not rising to 107 Beaume, but it is said to be unusually free from impurities. The percentage of sulphate of lime, of iron and of bromine are all low. The pea coal and the slack of the large mine that is worked here furnish all the fuel for the furnaces. The salt has an excellent name in all of the markets that it reaches.

The Wills Creek Valley was one of the early sources of Ohio salt. All of the early wells bored here are said to have found a notable quantity of gas in the salt rock.

SALT WELLS OF COLUMBIANA COUNTY.

Quite an extensive production of salt was maintained in this county for a number of years, the manufacture being chiefly confined to the Valleys of Yellow Creek and Little Beaver, but it has almost entirely disappeared under the competition that has come

in from outside fields. One furnace is still in operation near New Lisbon, and several have been operated, within the last few years in the Ohio Valley below East Liverpool. The horizon from which the salt water is derived clearly seems to be the Berea grit. The brine is weak, not exceeding five or six degrees, Beaume.

Noble county is to be credited with a single salt furnace, now, or recently, in operation. The well is shallow and the brine is derived from a coal measure sandstone, probably one of the divisions of the Mahoning sandstone. The production is insignificant.

This completes the brief review that was undertaken of salt production in Ohio. The facts may be summarized as follows:

I. Salt is now manufactured in the following districts of the State, which are named in order of their production:

1. Pomeroy, or Ohio Valley District, Meigs county.
2. Tuscarawas Valley District, Tuscarawas county.
3. Muskingum Valley District, } Muskingum county.
4. Hocking Valley District, Athens, } Morgan county.
5. Cambridge District, Guernsey county and Noble county.
6. Eastern Ohio District, Columbiana county.

II. The brine is obtained from two horizons, viz.: the Logan, or Upper Waverly sandstone, (frequently conglomeratic), and the Berea Grit, or Lower Waverly sandstone. To the first are to be referred all the wells of the list above given, except those belonging to the second and the sixth districts, viz.: the Tuscarawas Valley and the Eastern Ohio fields. The strongest water found in the State is about 10° Beaume, and water of this strength is derived from both the salt horizons.

III. The manufacture is in a more or less depressed or unsatisfactory condition throughout the State. This depression arises from the sharp competition which has prevailed in all Western salt markets during the last ten or fifteen years, and especially from the competition arising from Michigan salt, which has brought the price too close to the cost of production in Ohio to make the business a sound and growing industry. The brine furnished by the Michigan salt wells, which is derived, like part of our supply, from the Berea grit, has nearly twice the strength of any brine used in Ohio, approaching cold water saturation. This fact alone gives it a great advantage, but the points on which the cheap production mainly

turns are the following : Salt production in Michigan is connected with and subsidiary to the pine lumber manufacture of that State. Saw-mills and salt-works are established side by side and under the same ownership. All of the fuel used in the salt-works is derived from the waste or offal of the saw-mills. What would otherwise be a source of trouble and expense to the lumber manufacturers now becomes a useful and convenient product. Not even a pound of saw-dust needs to be wasted, but all is turned to account in steam production. In addition, the lumber used in salt barrels comes from odds and ends of the regular manufacture and would have no value were it not for this or some similar demand.

To these advantages are to be added the superior equipment and construction of the Michigan furnaces. Built recently and without interference from old traditions or old fashions, all the best processes in salt manufacture have been used in them, and many processes have been here improved in the way of economy of heat.

Furthermore, salt manufacture is carried forward under the protection of a very large and profitable industry, viz., lumber manufacture, and it shares in the business sagacity and enterprise that this great interest has developed. It shares also in the prosperity of this larger and stronger interest.

Whenever this favorable combination that now gives to the salt manufacture of Michigan so decided an advantage shall cease to exist—and it is obvious it cannot long be maintained, owing to the rapid reduction of the pine forests,—the salt production of Ohio will be freed from a competition that was made unnecessary and unwisely severe, and it will again assert itself and take the place to which its abundant and accessible supplies of salt water, its remarkable amount of bromides, and especially its cheap fuel and transportation, entitle it. Salt can now be bought at all the great distributing points of the State at 90 and 95 cents per barrel. An advance of 15, 10, or even 5 cents, upon the rates, would give to the business in Ohio the margin that it needs for comfortable working.

It must be added, in closing, however, that a new danger to our salt production is, perhaps, arising in Western New York. The surprising discovery, within the last few years, of vast deposits of rock salt, at great depths, in the vicinity of Mount Morris and

Warsaw, has been turned to account, and water is now forced from above into those beds, to be raised again, a saturated brine. Just what net advantage the new field will be found to possess, we cannot now determine, but it is entering the present markets, which are the lowest yet known, as if it were able to sustain itself in them. The four furnaces already established are said to be admirably equipped, and their capacity is put at 1,000,000 barrels annually. If a million barrels of salt are to be added from this field, older works, representing something like this capacity, will be forced to succumb, inasmuch as salt is a material the demand for which cannot be rapidly or greatly extended. The harsh but wholesome natural law of the survival of the fittest will be brought into play, and the fields which possess the fewest advantages will be abandoned first.