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GEOLOGY AND THE CIVIL WAR IN SOUTHWESTERN VIRGINIA: THE SMYTH COUNTY SALT WORKS

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Dusk, October 1, 1864 - In the fading twilight, Union General Stephen G. Burbridge must have stared anxiously at the low range of hills before him in the rugged country of southwestern Virginia. Tomorrow, Sunday, he would send his 5,000 soldiers to wrest these heights from their entrenched rebel defenders, for on the other side lay Saltville and its crucial brine wells, pumps, evaporating kettles and furnaces, and mounds of crystal-white salt. Tomorrow, men would fight and die to determine whether North or South would control Saltville and its massive salt production facilities, by far the single most important source of this precious mineral in the entire Confederacy.

INTRODUCTION

"Welcome to Scenic SALTVILLE - Salt Capital of the Confederacy" the sign proudly proclaims as one enters this small town in northwestern Smyth County, Virginia. And justifiably so, because this great salt-producing center during its peak war year in 1864 manufactured about 4,000,000 bushels (200,000,000 lbs.), an estimated two-thirds of all the salt required by the Confederacy (Lonn, 1933). No wonder, then, that this remote area found itself in the 1860s thrust into the very center of military activity in southwestern Virginia as North and South clashed over these vital salt operations.

Virginia's mineral contributions to the southern war effort during the American Civil War are numerous (Boyle, 1936; Whisonant, 1996). By the 1860s, Virginia was the main min-

eral-producing state in the South (Dietrich, 1970). Among the principal mined resources, in addition to salt, were lead, iron, niter (saltpeter), and coal. Interestingly, except for the coal which came primarily from the Richmond Basin, nearly all of the production of these resources was located west of the Blue Ridge with the main operations centered in southwestern Virginia. Even southwestern Virginia coal played an important role during the Civil War. According to Dietrich (1970, p. 147), coal from mines in Montgomery County fired the engines of the southern iron-clad *Virginia* (more commonly referred to as the *Merrimack*) during its battle with the *Monitor*. Furthermore, the *Virginia's* armor came from Oriskany iron ore produced at the Grace Furnace Mines in Botetourt County.

But of all Virginia's mineral contributions, perhaps none was more crucial to both the civilian population, as well as the military forces of the Confederacy, than salt (Lonn, 1933; Holmes, 1993). Of course, salt is essential in the human diet and during the Civil War, every soldier's ration included it. Salt is also necessary for livestock; a hoof and tongue disease that appeared among the cavalry horses of Lee's army in 1862 was attributed possibly to a lack of salt (Lonn, 1933). During Civil War times, salt was by far the primary means of preserving meat. Additional uses included packing certain foodstuffs (particularly eggs and cheese) and preserving hides during leather making, as well as being employed in numerous chemical processes and various medications (Holmes, 1993).

By the mid-1800s, three methods of producing salt were typically used: extracting salt from saline water wells (the most common), boiling down sea water or water from inland salt

lakes, and mining deposits of rock salt (Lonn, 1933). At the outbreak of the Civil War, the Southern states had five principal salt operations available, these being (1) the "Licks" on the Great Kanawha River, near Charleston, WV; (2) the Goose Creek Salt Works near Manchester, KY; (3) the wells in the counties of southwestern Alabama; (4) the Avery Island operations in southern Louisiana; and, above all, (5) the great wells in southwestern Virginia at Saltville. Salt was also produced in places along the Confederate sea coast and a large industry of this type developed in Florida during the war (Holmes, 1993).

The Goose Creek works were lost to the Confederacy almost immediately after the war began, as were the facilities in West Virginia. After Vicksburg fell on July 4, 1863, all of the extensive Louisiana sources were denied to the eastern Confederacy. Thus, by midsummer 1863, although the Alabama wells still serviced the Gulf Coast area, the Stuart, Buchanan, and Co. salt works in Smyth County, Virginia, had to supply the rest of the struggling South (Marvel, 1991). The presence of these crucial salt operations, together with the lead mines in southern Wythe County and the Virginia and Tennessee railroad over which these and other vital wartime commodities (as well as troops) moved, dictated Union military strategy in southwestern Virginia for the last two years of the war (Donnelly, 1959; Whisonant, 1996).

1966) who also came to the salt licks. Thousands of years later, Thomas Jefferson recorded in his famous *Notes on the State of Virginia* (1787, cited in Cooper, 1966) the first known vertebrate fossil taken from this region when Arthur Campbell presented him with a "large jaw tooth of an unknown animal lately found at the Salina."

Because of the unique combination of paleontological, archaeological, and historical features of the Saltville region, as well as the great economic significance of the salt and gypsum deposits, the geology of this area is well known. Key

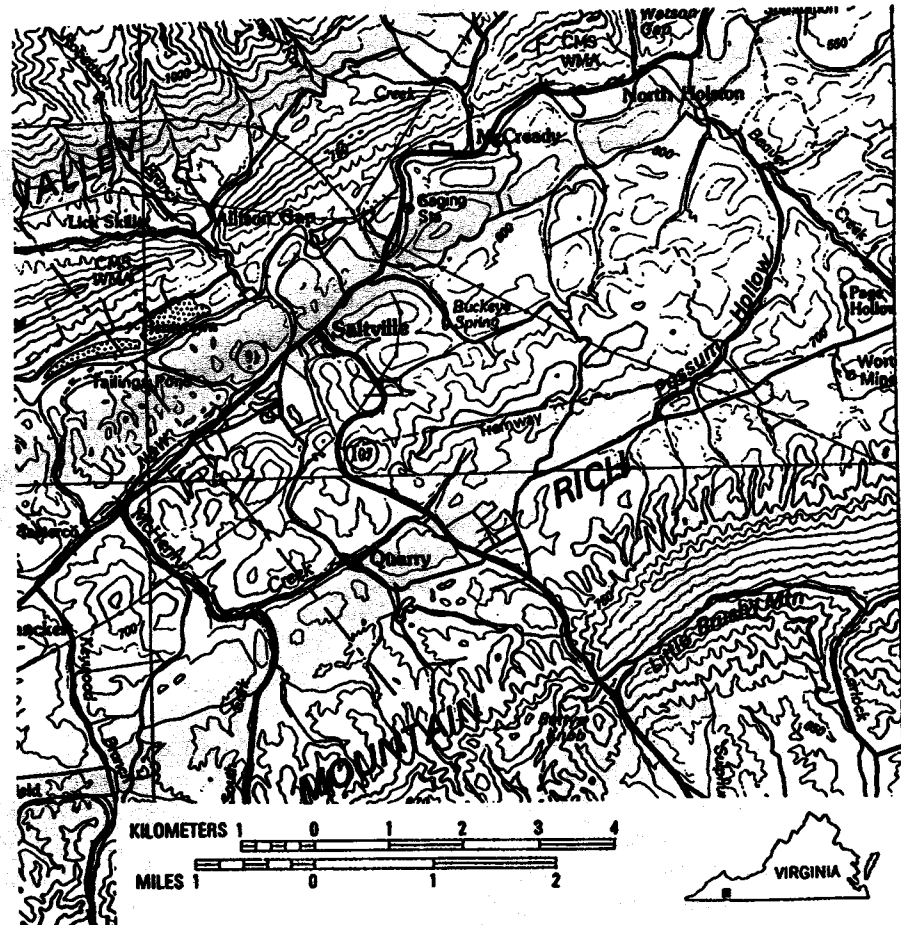


Figure 1. Location map and topography of Saltville area, Wytheville 30 x 60 Minute Series, U.S. Geological Survey.

GEOLOGY OF THE SALTVILLE AREA

The town of Saltville, located in the northwestern part of Smyth County near the Washington County line, lies in a small valley within the Valley and Ridge province of the Southern Appalachians (Figure 1). Geology and human history are intimately intertwined here, beginning with the arrival of Paleo-Indians in the Saltville Valley perhaps as early as 14,000 B.P. (MacDonald, 1996, cited in Roanoke Times, 1996). These early people may well have been attracted by the availability of salt from the natural brine springs and ponds; probably they hunted the "hordes of Pleistocene mammals" (Cooper,

references include Rogers, 1836; Boyd, 1881; Eckel, 1902; Watson, 1907; Stose, 1913; Butts, 1940; Cooper, 1966; Ray and others, 1967; and Sharpe, 1985. The brief synopsis below of the Smyth and Washington Counties evaporite deposits is taken largely from these works.

The Saltville Valley is underlain by the Maccrady Formation of Mississippian age, roughly 350 million years old (Figure 2). The Maccrady consists primarily of drab red and green shale and siltstone, limestone, dolostone, and evaporites. The Mississippian strata are part of a large regional structure known as the Greendale syncline (Figure 3). The southeastern limb of this feature is overturned and dips toward the southeast.

The thickest masses of salt, gypsum, and anhydrite, which have been commercially exploited since the late 1700s and early 1800s, occur within the Maccrady in the overturned limb. Overturning was caused by thrusting of Cambrian limestone, dolostone, shale, and sandstone over the younger Mississippian rocks in the syncline. The great thrust fault along which this movement occurred is aptly named the Saltville fault; it is a major Appalachian structure that can be traced for hundreds of miles from Alabama to Craig County, Virginia. In the Saltville area, the thrust fault crops out to the east and south of town along the base of the prominent hills formed by the Cambrian rocks in the hanging wall of the fault. The low ridges on the north and west side of the valley are composed of Mississippian limestone in the Greendale syncline. Beyond these to the west is the main drainage in this region, the southwest-flowing North Fork of the Holston River.

The evolution of geologic thinking concerning the origin of the Maccrady evaporites is interesting to trace. C. R. Boyd* (1881) was one of the first to note the relationship between the salt and gypsum occurrences and tectonic movements. Writing eloquently in his *Resources of South-west Virginia* (p. 102, 1881), he described the "extraordinary deposits of salt and plaster which mark the line of a great fissure in the crust of the earth"; this fissure "brings up the limestones of the Lower Silurian division . . . against a downthrow of Proto-Carboniferous rocks . . ." He ascribed this fissure, which he later called the "North Fork Fissure Line," to great pressure (from southeast to northwest). Changes in geologic age terminology aside, Boyd very accurately recognized the presence of the Saltville fault and its effect on localizing the salt and gypsum deposits. Not so presciently, he went on to say that the great fissure yawned open, great pieces of rock fell into the chasm, and ultimately, waters

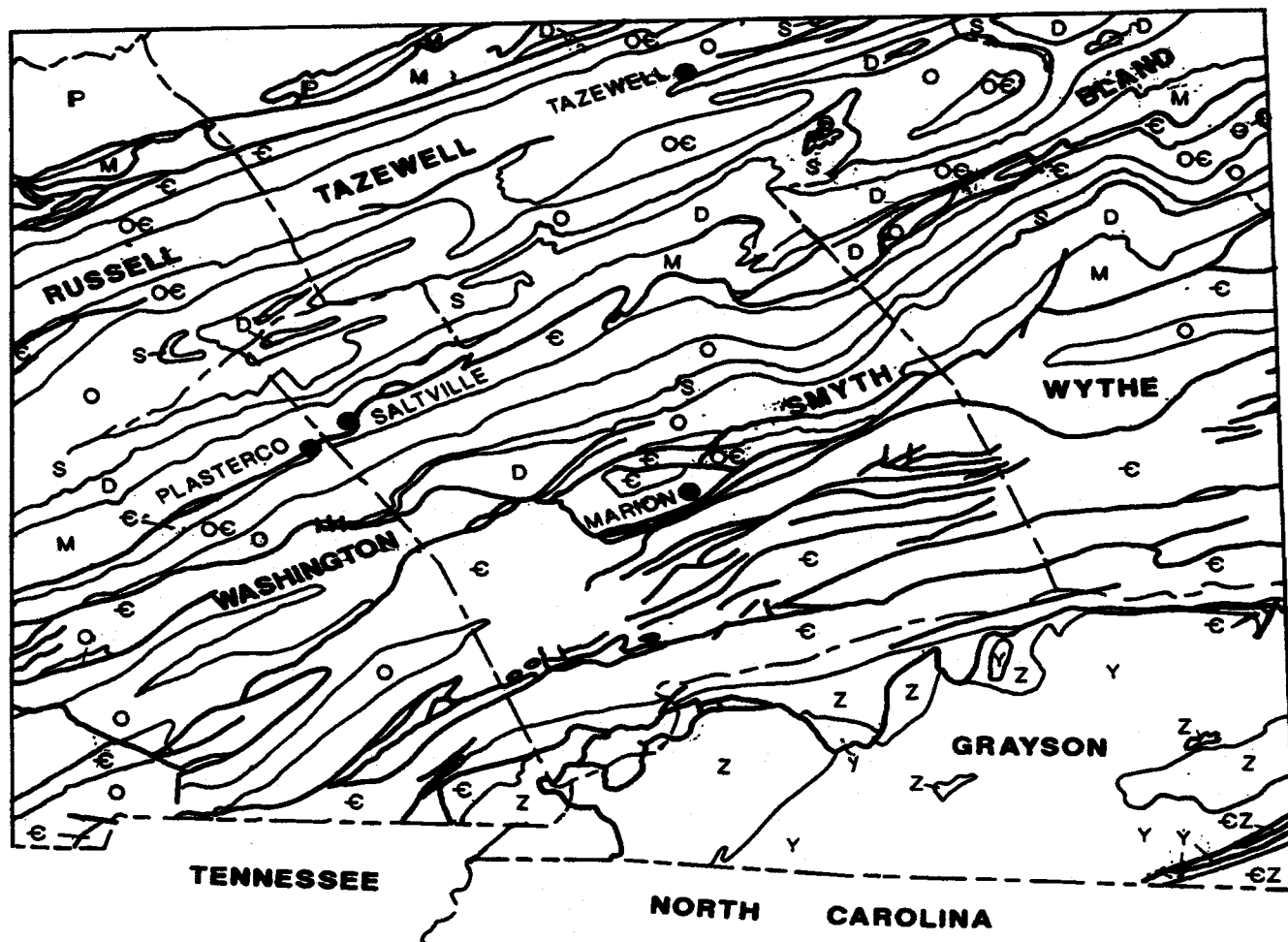


Figure 2. Sketch geologic map showing Saltville area geology (refer to Virginia Division of Mineral Resources, 1993 for additional details). Note location of Saltville in northwestern corner of Smyth County, Saltville fault (heavy line trending northeast through Saltville), and Mississippian strata (M) on northwest side of fault. P = Pennsylvanian rocks; M = Mississippian rocks; S = Silurian rocks; O = Ordovician rocks; E = Cambrian rocks; Y and Z = Proterozoic rocks.

*Charles R. Boyd is a fascinating individual. A Wythe County native, he served in the Confederate Army as an engineer during the Civil War, during the course of which he helped prepare the defenses for Saltville. After the war, he obtained a degree in geology from the University of Virginia and wrote extensively on the economic mineral resources of southwestern Virginia (M. McKee, unpublished materials, 1995, Virginia State Library). On one of his maps, he even signed himself "State Geologist, ex officio," a title he may have used somewhat loosely.

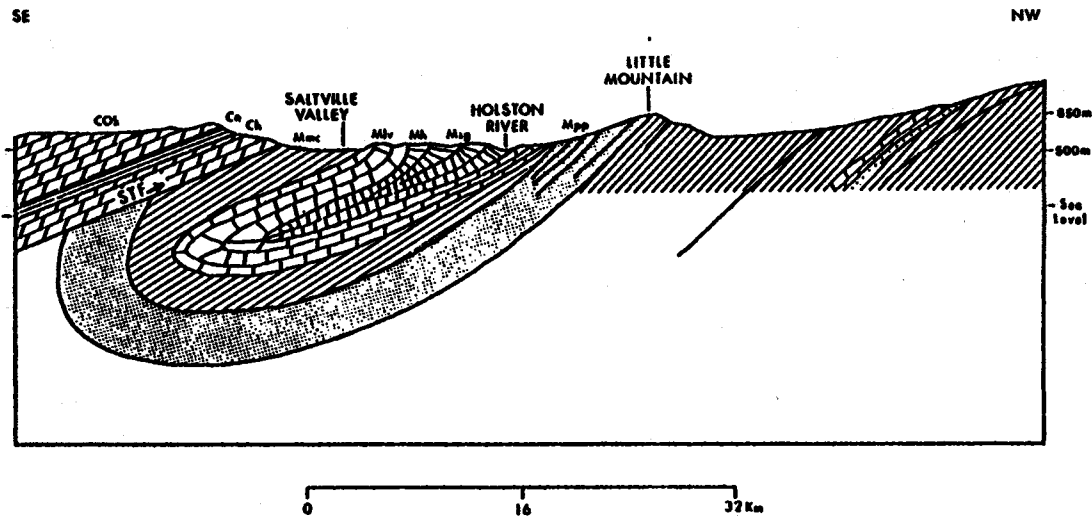


Figure 3. Geologic cross-section of the Saltville region along the Smyth-Washington County line (from MacDonald, 1984; after Cooper, 1966). COk, Cn, Ch = Cambro-Ordovician and Cambrian formations; M = Mississippian formations (Mmc = Maccrady Formation); STF = Saltville thrust fault.

from the surrounding strata poured thousands of tons of salt and gypsum into the opening.

By the early 1900s, a clearer picture of the Saltville fault and its relationship to the overturned southeastern limb of the Greendale Syncline had emerged (Eckel, 1902; Watson, 1907; Stose, 1913). Eckel (1902) reached a correct interpretation concerning the depositional origin of the evaporites themselves when he concluded that both salt and gypsum were deposited as part of the original sedimentary sequence through the evaporation of sea water. (Earlier thought had interpreted, for example, the gypsum as an alteration product of limestone.)

Cooper's 1966 paper is noteworthy because he stressed the tectonic brecciation of the salt and gypsum beds that created the "boulder zones" style of occurrence. He noted that the interbedded salt, anhydrite, limestone, and variegated shale in the Maccrady were sheared and macerated during overturning of the southeastern limb of the Greendale syncline by overthrusting along the Saltville fault. As the salt began to move, interbedded shale, anhydrite, and dolomite beds were broken and dismembered; these broken fragments were then engulfed by the flowing salt. Cooper's account explains why so little bedded evaporite material has been found in the Maccrady in this area.

Finally, Sharpe (1985) gave the most recent detailed account of the depositional environments associated with the evaporites. He placed much of the Maccrady in a mud-rich sabkha environment. "Sabkha" is an Arabic term for a wide tidal flat complex developed along a coastline in a hot, arid region, such as today's Persian Gulf region. In this model, the evaporites originated as bedded diagenetic minerals precipitated within the sabkha sediments from briny interstitial pore fluids. Later, the evaporite beds underwent post-depositional tectonic alteration and deformation as described by Cooper (1966). Sharpe suggested that ancient (Mississippian) southwestern Virginia may have resembled a modern environment such as where the Colo-

rado River flows into the Gulf of California.

Sometime near the end of the Pleistocene, by at least 14,000 years B.P., natural salt springs, seeps, and ponds, created by ground water dissolution of the salt-bearing overturned Maccrady strata, attracted large mammals into the Saltville Valley. Cooper (1966, p. 28) called Saltville the great "salt lick" in the southeastern United States. Among the large vertebrates found here are mammoths, mastodons, musk oxen, giant ground sloths, caribou, moose, deer, and horses. The large mammal remains are contained in a fluvial gravel layer of late Wisconsin age (MacDonald, 1984); above this stratum are late Pleistocene to Holocene beds of fluvial marsh, lake, and valley-fill origin that contain a variety of plant and animal fossils. MacDonald (1984, p. 22-23) reported a number of Paleo-Indian artifacts recovered from the Saltville Valley. Work continues on these intriguing and important Pleistocene and Holocene paleontological and archaeological materials.

PRE-CIVIL WAR HISTORY AND TECHNOLOGY OF SALT PRODUCTION

No one knows precisely when humans began to use the salt available in the Saltville Valley. According to Marvel (1991, p. 11), thousands of years ago Native Americans camped here to hunt and evaporate some of the brines in the salt ponds for salt acquisition. By the 1750s, the property containing most of the saline springs and ponds belonged to Charles Campbell, who obtained a patent of land at the Salt Lick from Lord Dinwiddie in the name of King George II. Upon his death, the grant passed to his only son William. During the Revolution, William Campbell attained the rank of general and commanded the victorious American forces at the Battle of King's Mountain. William's cousin Arthur (presenter of the "large jaw tooth" to Thomas Jefferson) be-

gan the first commercial development of the salt in 1782; other Campbell family members soon became involved in salt manufacture. These early salt works of the late 1700s consisted of wells from which the brine was drawn, furnaces in open sheds in which the saline waters were boiled in kettles, and salt houses where the salt was stored (Kent, 1955). The kettles used were camp kettles of the times, which had an 8- to 12-gallon capacity.

Competition began to develop in 1795 when William King began his own salt production on land adjoining the Campbell family. In 1799, King dug a 200-foot-deep shaft, intending to mine the bedded salt deposits; this is the first known salt mine (albeit unsuccessful) in the U.S.A. Before the shaft encountered the rock salt, the well began filling with water. Unable to overcome his water problems, King reverted to the use of wells and furnaces for salt production (Saltville Historical Society, undated). Meanwhile, the original Campbell family operations passed by marriage into the hands of Francis Preston, who retired in 1797 after two terms in Congress to devote full time to salt manufacture. Thus, by the turn of the nineteenth century, competing salt works were in place in the Saltville Valley that supplied the immediate area covering parts of five states and even some markets beyond. For the next 60 years, the two salt operations grew and intertwined, being known generally as Preston's and King's salt works (Marvel, 1991).

During the first half of the nineteenth century, southwestern Virginia experienced commercial development of a number of mineral resources besides salt. Gypsum or "plaster" was prospected for and mined from the Maccrady in the vicinity of Plasterco, just a few miles southwest of Saltville, as early as 1815 (Cooper, 1966). Originally used mostly to "sweeten" or condition the soil for farmers, gypsum production increased as new uses such as plaster products were found (Sharpe, 1985). Other regional mineral resources were also exploited, so that by the 1850s, southwestern Virginia produced an abundance of salt, plaster, shot, pig iron, and lead for the area between the Cumberland and the Smokies (Marvel, 1992). The completion of the Virginia and Tennessee Railroad in 1856 from Lynchburg to Big Lick (Roanoke) and then down the Great Valley to Bristol and beyond greatly aided economic development in this region (Noe, 1994). Of particular interest to the salt works was the construction of a railroad spur from Glade Spring on the main line over to Saltville in 1856 (Kent, 1955).

The technological aspects of the salt manufacture at Saltville is an interesting story. In the 1750s, Charles Campbell, original owner of the salt ponds and springs, followed the Indian practice of simple boiling down the salt from the surface occurrences to meet his own needs (Marvel, 1992). By 1800, William King was producing 200 bushels a day by using open shed furnaces to evaporate water bucketed from his wells. (Surprisingly, brine evaporation by boiling in kettles continued as the basic salt production technique until 1892.) In 1840, a shaft was dug to intercept the brine stream, but at a depth of 210 feet rock salt was encountered (Watson, 1907). Even though salt thicknesses of several hundreds of feet were eventually discovered in the subsurface, commercial production was always by brine extraction

methods (Bartlett, 1971). By 1842, production from six wells reached 200,000 bushels annually.

A fascinating sketch of the Saltville area appeared in an 1857 article in Harper's magazine (reprinted in Saltville Confederate Times, undated) that gives a detailed account of how the salt was manufactured in the mid-nineteenth century (Figure 4):

"The salt is procured by sinking wells to the depth of the salt bed, when the water rises within forty-six feet of the surface, and is raised from thence by pumps into large tanks or reservoirs elevated a convenient distance above the surface. The brine thus procured is a saturated solution, and for every hundred gallons yields twenty-two gallons of pure salt.

The process of manufacturing it is perfectly simple. An arched furnace is constructed, probably a hundred and fifty feet in length, with the doors at one end and the chimney at the other. Two rows of heavy iron kettles, shaped like shallow bowls, are built into the top of the furnace - in the largest works from eighty to a hundred in number.

Large wooden pipes convey the brine from the tanks to these kettles, where the water is evaporated by boiling, while the salt crystallizes and is precipitated. During the operation a white saline vapor rises from the boilers, the inhalation of which is said to cure diseases of the lungs and throat.

At regular intervals an attendant goes round, and with a mammoth ladle dips out the salt, chucking it into loosely woven split baskets, which are placed in pairs over the boilers. Here it drains and dries until the dipper has gone his round with the ladle. It is then thrown into the salt sheds, immense magazines that occupy the whole length of the buildings on either side of the furnaces.

This process continues day and night without intermission for about a week, when it becomes necessary to cool off to clean the boilers, which have become thickly coated with a sedimentary deposit which impedes the transmission of heat.

This incrustation, sometimes called pan-stone, is principally composed of the sulphates of lime and soda, and its removal is the most troublesome and least entertaining part of the business.

The salt thus manufactured is of the purest quality, white and beautiful as the driven snow. Indeed, on seeing the men at work in the magazines with pick and shovel, a novice would swear they were working in a snow-bank; while the pipes and reservoirs, which at every leak become coated over with the snowy concretions, sparkling like hoar-frost and icicles in the sun, serve to confirm the wintry illusion."

This is the technology that produced the Smyth County salt during the Civil War. Thus, the South strove mightily to



Figure 4. Illustration of Saltville salt shed and railroad from Harper's Magazine, 1857 (Library of Virginia).

defend these priceless wells, pumps, pipelines, furnaces, and kettles. And the North fought just as ardently to destroy them.

CIVIL WAR YEARS: SALT PRODUCTION AND MILITARY EVENTS

Fighting broke out between Union and Confederacy on April 12, 1861, when rebel batteries opened fire on Fort Sumter in the harbor of Charleston, SC. By that fall, the Saltville works had been acquired by Stuart, Buchanan, and Co., who conducted operations throughout the Civil War and for a few years thereafter. (Interestingly, partner William A. Stuart was the older brother of famed cavalryman J.E.B. Stuart, whose wife and children spent much of the war in Saltville under William's care.) Shortly after the war began, the firm negotiated a contract with the Confederate government to provide 22,000 bushels of salt per month "to and for the uses of the Confederate State armies" (Saltville Historical Foundation, undated). Over most of the next three and one-half years, Stuart, Buchanan, and Co. managed to do this and much more.

In the decade before the war, the Saltville operations at times consisted of only a single furnace and about 70 kettles (Saltville Historical Foundation, undated). At its peak in 1864, the works included 38 furnaces and 2,600 kettles. (After the war, Yankee raiders claimed to have seen as many as 300 build-

ings prior to the destruction of the salt-producing facilities.) The huge salt output during the war years (reaching a peak of 4,000,000 bushels in 1864) commonly exceeded the ability of the Virginia and Tennessee railroad to transport it (Rachal, 1953). According to contemporary accounts, it was "a common thing to see as many as a thousand salt wagons at one time" lining the roads for miles waiting their turn for salt. Each wagon would bring a load of wood, needed for the furnaces, as part payment for the salt; the rest was paid in Confederate currency (Kent, 1955).

By fall of 1862, the Saltville output had become so important to the South that the states of Georgia, North Carolina, Tennessee, Alabama, Mississippi, South Carolina, and Florida, as well as Virginia, had all negotiated contracts to purchase salt or erect their own operations (Saltville Historical Foundation, undated). Several state-owned operations sprang up in the valley; the Georgia furnace, for example, occupied a space that became the site of the old Mathieson Salt Plant after the war (Kent, 1955).

But salt operations of this magnitude could not go on unchallenged by the Union, particularly since Federal forces occupied much of nearby West Virginia from the spring of 1862 onward. In summer 1863, with Lee's invasion of the North turned back at Gettysburg, Federal high command in West Virginia ordered the first attempt to get at the salt mines

(Walker, 1985). Colonel John Toland and about 1,000 mounted infantry and cavalry were assigned the task, but after a brief skirmish with Confederate troops in the Abbs Valley area of Tazewell County, Toland feared that Saltville's defenders would be alerted. He changed his plans to a raid on Wytheville and possibly the lead mines beyond. Toland was killed in a sharp firefight in Wytheville on July 18 and the Union raiders retreated back to West Virginia. In September 1863, a strong Union force got within 35 miles of Saltville but withdrew after a skirmish (Rachal, 1953).

In May 1864, Federal soldiers in West Virginia, this time under General George Crook, once again moved into southwestern Virginia, determined to destroy the salt works and cut the vital Virginia and Tennessee railroad by burning the "Long Bridge" over the New River at Central (Radford) (McManus, 1989). Crook detached General William Averell's cavalry to attack Saltville. But once in Virginia, Averell learned that the defense of the salt operations was in the hands of the formidable General John Hunt Morgan and his terrible men. Thinking better of his assignment, Averell chose to attack Wytheville instead; however, Morgan caught him at Crockett's Cove just north of Wytheville and punished Averell's command. Averell and Crook eventually withdrew their troopers to West Virginia without inflicting serious permanent damage on the area (McManus, 1989).

The next major military action involving the salt works occurred in fall 1864. By late September, Union General Stephen Burbridge (Figure 5), the widely despised military governor of Kentucky, decided to move on Saltville (Marvel, 1992). On September 20, Burbridge left Kentucky with about 5,200 mounted troopers, including the 5th U.S. Colored Cavalry. Burbridge chose a particularly difficult invasion route into southwestern Virginia, moving along the Levisa Fork of the Big Sandy River through the rugged, deeply dissected plateaus country. Marvel (1992, p. 105) gives a very dramatic account of the Federals going over an especially difficult mountain on September 28 at night during a thunderstorm. Perhaps as many as eight men and their mounts fell to their deaths from the precipitous trail. Others had to be rescued with ropes.

Meanwhile, on the Confederate side, Saltville's defense was the responsibility of the newly reorganized Department of Southwest Virginia and East Tennessee. The Department's commander, General John Breckinridge (Figure 5), like Burbridge, a Kentuckian, had been campaigning in the Shenandoah Valley but was hastening back to southwestern Virginia. As Burbridge approached Saltville on October 1, Breckinridge's chief lieutenant, General John Echols, was working miracles pulling together scattered forces for the defense of the salt works. In Saltville itself, command fell to General Alfred E. Jackson, derisively called "Mudwall" by his own men, a sobriquet he apparently earned by his ineptness compared to his more famous cousin, Stonewall Jackson (Davis, 1971). But "Mudwall" prepared Saltville's defenses well; when the Yankees finally attacked, they found the rebel soldiers firmly entrenched on the hills north and west of town (Marvel, 1991).

The Battle of Saltville began around 11 a.m., Sunday, October 2. Arriving just earlier that morning at 9:30 with

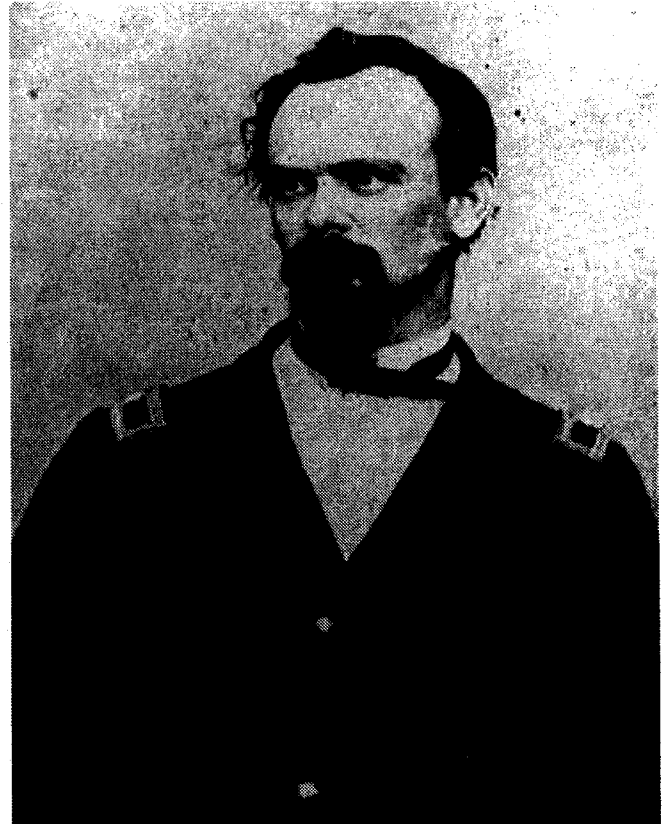


Figure 5. Opposing commanders at Battle of Saltville, Oct. 2, 1864. Union General Stephen Burbridge (above) failed to take the salt works. Confederate General John Breckinridge (below), in overall command of the Department of Southwest Virginia and East Tennessee, arrived at Saltville after the battle; his subordinates won the victory (Burbridge credit: Massachusetts Commandery, Military Order of the Loyal Legion and the US Army Military History Institute; Breckinridge: Library of Virginia).

1,700 men, Confederate General John Williams commanded Saltville's 2,500 defenders during the fight. Williams and the other southern field commanders handled their troops well for the six hours of the battle; conversely, Burbridge led his troops rather poorly. The Confederates commanded the heights and did terrible damage with their long-range Enfields firing downhill at the struggling Federals (Davis, 1971). Davis (1971, p. 11) describes an almost mirthful attitude among the Southerners, some shouting after a volley "Come right up and draw your salt." One soldier, after firing at a bluecoat, yelled "How's that? Am I shooting too high or too low?" By 5 p.m., Burbridge knew he was beaten and withdrew. Thanks to their excellent defensive positions, the Confederates lost fewer than a hundred killed and wounded; Burbridge reported a total of 350, most of them left behind on the field (Davis, 1971). The Battle of Saltville was a clear southern victory that kept the salt works safe for another few months. As Davis (1971, p. 48) points out, it could have led to more significant things but the Confederacy was too weak to exploit the victory.

One historical note of great interest to Civil War scholars concerning this engagement is the intensely debated "Saltville Massacre" (Davis, 1993). According to some (Davis, 1971), rebel soldiers, after the battle, shot many wounded Union troops, especially African-Americans, lying helpless on the battlefield; other Federals were murdered some days later in the Confederate hospital set up at nearby Emory and Henry College. Marvel (1991, 1992) vigorously disputes this and refers to the alleged massacre as a "legend." The interested reader is directed to these sources for detailed accounts.

A second Battle of Saltville occurred in December 1864 when Union forces under General George Stoneman (Figure 6) invaded southwestern Virginia. Stoneman, an ambitious commander with a spotty record thus far in the war (Secretary of War Edwin Stanton called him "one of the most worthless officers in the service"), was eager to regain his lost prestige (Evans, 1993). On December 10, Stoneman left Knoxville with about 5,500 mounted troopers and four artillery pieces. His objectives were to destroy not only the salt works but to knock out the crucial lead operations at Austinville in southern Wythe County and devastate the Virginia and Tennessee railroad. Driving weakened Confederate units before him, Stoneman moved up the Great Valley, eventually wrecking the railroad from Bristol to a few miles north of Wytheville. Many iron furnaces and production facilities were destroyed during this raid also, particularly in Wythe County. On December 17, a detachment of his troops overran the Austinville lead works. When Stoneman turned back toward Marion and defeated Confederate troops led by Breckinridge on December 17 and 18, the way to Saltville lay open.

Stoneman's forces arrived at Saltville on December 20 and overwhelmed its few hundred defenders, mostly young boys and old men. Marvel (1992, p. 134) describes the "orgy of destruction" that followed:

"Sledge hammers rang against salt kettles and masonry kilns; artillery shells and railroad iron rattled down the wooden well casings; soldiers broadcast sacks of salt like Romans at Carthage; everywhere sheds, stables, and offices crumbled in flames."

Their work done, Stoneman's troops left Saltville and withdrew from southwestern Virginia. But, incredibly, the salt works had not been permanently disabled. A report to General Breckinridge a few days after the Saltville raid said that fewer than two-thirds of the sheds and less than one-third of the kettles had been destroyed; some of the sheds and furnaces were left untouched (Lonn, 1933). Several weeks later, the furnaces were going once more and salt was again being furnished to the various states (Kent, 1955); this continued until the end of the war.

Stoneman returned to Knoxville in late December, his devastation of southwestern Virginia temporarily ended. Next spring, as the Confederacy collapsed, he returned and completed the destruction of the railroad and lead mines. By then, no amount of lead or salt or any other mineral resource could save the exhausted South; Lee surrendered at Appomattox on April 9, 1865. The war was finally over and with it ended the struggle for the great mineral-producing empire of southwestern Virginia.



Figure 6. Union General George Stoneman (Library of Congress). His raids in late 1864 and early 1865 devastated the Saltville operations as well as the Wythe County lead mines and the Virginia and Tennessee Railroad.

SUMMARY AND CONCLUSIONS

After 1865, salt manufacture continued at Saltville until Mathieson Alkali Works ceased production in 1906. Thereafter, this company made a variety of salt by-products until all operations in Saltville ended in the early 1970s. Gypsum

production continues from the Maccrady evaporites at the Locust Cove Mine a few miles northeast of Saltville; the gypsum is transported to the manufacturing plant at Plasterco to produce a variety of wallboard products (Lovett, 1995).

During the Civil War, the production of salt from the Smyth County works was of inestimable value to the Confederacy. Although salt shortages occurred during the war, especially for civilians, thanks to Saltville more than any other source these shortages were never severe enough to cause serious problems for the army. The Confederate Commissary-General Lucius B. Northrop, noted on January 25, 1865, that "the supply of salt has always been sufficient and the Virginia works were able to meet the demand for the army" (Holmes, 1993).

Today, there is much to see of historical interest at Saltville. Beautiful reconstructions of the salt furnaces with kettles, the walking beam brine pumps, and the wooden pipes through which the corrosive salt solutions were transported, are located at the Salt Park on the south side of town (Figure 7). Historical markers call attention to the important events in the development of the area. Salt ponds dot the floor of the valley, as they have for thousands of years. Most interesting of all to Civil War buffs, one can walk the hills and visit the sites over which North and South fought in the 1860s. (Caution: landowner permission is required in some cases.)

Finally, above all, I recommend a visit to Elizabeth Cemetery (Figure 8), situated on a small knoll on the north side of town. Here one finds burial plots, some of which predate the Civil War, of persons of historical importance, such as William Stuart and his family. But, even more intriguing, this little hill and cemetery occupied just about the center of the Confederate lines on October 2, 1864. On this very ground Yankee troopers charged Rebel soldiers, who eventually held firm and saved the salt works. Standing here silently among the tombstones one imagines, whispering in the evening breezes, the ghosts of those men who gave the "last full measure of devotion" in the little-remembered battles for Saltville so long ago.

ACKNOWLEDGEMENTS

This article is part of an on-going study examining the relationship between the geology of southwestern Virginia and the Civil War military history of that region. I am grateful to Stan Johnson and Palmer Sweet of the Virginia Division of Mineral Resources (VDMR) for providing initial materials at the beginning of the project. Ms. Marianne McKee and Ms. Petie Bogen-Garrett at the Virginia State Library have been especially helpful during my research. As concerns this Saltville article, I thank Charles Bartlett (Abingdon consultant), Douglas Ogle (Virginia Highlands Community College), Jim Lovett and Al Taylor (VDMR, Abingdon office) and Jerry McDonald (McDonald and Woodward Publishing Company) who provided me with much valuable material. I particularly appreciate the help of Ms. Sharon Hollaway, who prepared the manuscript.

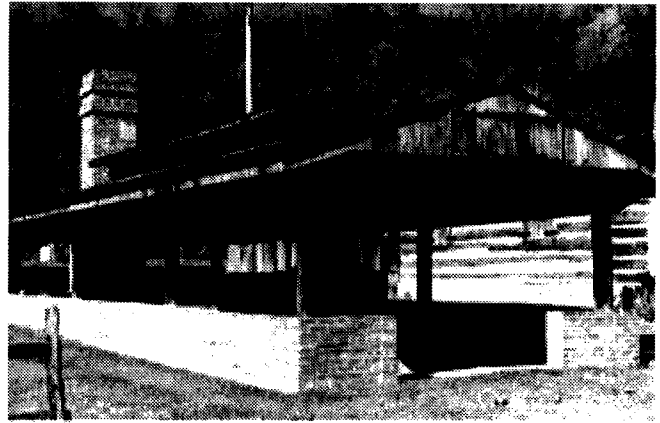


Figure 7. Salt Park on south side of Saltville with shed and furnaces and walking beam brine pump.



Figure 8. Elizabeth Cemetery occupied center of Confederate lines on Oct. 2, 1864. Northern and southern troops struggled amidst some of these tombstones to control this vital position.

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**ABSTRACTS SUBMITTED TO NATIONAL
MEETINGS BY DMR STAFF
FISCAL YEAR 96**

The following abstracts were submitted and papers presented at the 1995 Annual Meeting of the Geological Society of America.

**Digital Geologic Maps and Digital Geologic Mapping
in Virginia
by
Ian J. Duncan**

The Virginia Division of Mineral Resources (Virginia's Geological Survey) has converted its geological mapping program to a totally digital system. Map data is input from field observation in digital form. Satellite imagery (SPOT, LANDSAT.TM. and Synthetic Aperture radar data) along with digital aeromagnetic, gravity and radiometric data are being used to enhance geologic mapping capabilities. The digital maps, created using programs by R. Ambroziak, use a vector format. When combined with vectorized topographic contour data, these maps constitute true digital geologic maps. Raster

format or bit mapped versions of geologic maps, should not be referred to as digital geological maps, rather they represent digital images of maps. Such images do not allow the computer to access the three dimensional information inherent in all geological maps.

The Division currently intends to publish digital maps on CD-ROM's, also containing the necessary software to display and manipulate them. Digital map products should include information on the inherent accuracy of the geologic data and should be available in file formats that can be read into GIS systems, used by the consumers of geologic data. Our digital data is being increasingly used by planners, local governments and economic development agencies.

Digital maps should prove an important tool in increasing the use of geologic data in societal decision making processes. Seen in this context, the role of geologists as the creators of digital, spatial data may play a critical part in the long term viability of our profession.

Digital Mapping In The James River Basin, Virginia Piedmont: Applying New Technologies In Addressing Questions Of Regional Correlation, Geologic Structure, and Groundwater Potential

by
Nick H. Evans

Digital technology is revolutionizing geologic mapping and spatial data management in the western Virginia Piedmont. A multifaceted regional geologic data set has been assembled on a PC platform using public-domain software (GIV). This data set incorporates geologic contacts, structural data, metamorphic mineral assemblage distribution, satellite imagery, airborne magnetic and radiometric contours, and groundwater inventory data. Digital technology greatly enhances the efficiency with which multiple sets of spatial data are collected, manipulated, displayed on a screen or as hard copy, and archived.

The James River basin contains a lithotectonic boundary that extends throughout the Appalachian orogen, between metamorphosed rift- and drift-facies volcanic, siliciclastic, and carbonate rocks deposited on the Laurentian margin in the Early Paleozoic (southeast limb, Blue Ridge anticlinorium, BRA), and Cambrian-age metagraywacke, melange, and arc-related metavolcanic rocks (Potomac terrane, PT) that accreted to Laurentia during early Paleozoic collisional tectonics. The Smith River allochthon (SRA), structurally between the southwestern BRA and PT, has polyphase structural and metamorphic heritage.

In the northeast sector, lower greenschist-facies rocks of the BRA and the PT contain distinctive primary features that define lithologic mapping units. Stratigraphic and structural framework established with these units has been carried southwest into areas of greater structural complexity and higher metamorphic grade. Rocks of the northernmost SRA, remnants of the overturned limb of a regional-scale recumbent fold, contain primary features and chemistry consistent with Laurentian rift- and drift-facies units. Polyphase fault zones (Mountain Run-Buck Island, Bowens Creek) separate the BRA, PT, and SRA. These fault zones contain evidence for episodic brittle and ductile movement during Late Proterozoic(?) through Quaternary time, and include border faults on the Mesozoic Scottsville, Dan River, and smaller unnamed rift basins. High-yield water wells occur locally within the Mountain Run fault zone.

The following abstracts were submitted and papers presented at the 1995 National Speleological Convention.

Is This Cave Paleontologically Significant?

by
David A. Hubbard, Jr.

By 1985, approximately 2,500 caves were recorded in Virginia, 224 (9 percent) of these caves were included on the Virginia Cave Board's revised Significant Cave List. Only 12 Virginia caves were recognized as paleontologically significant. What constitutes a paleontologically significant deposit or feature and why are so few paleontological cave recognized?

Vertebrate skeletal accumulations in caves result from pit falls, anthropogenic activities, animal lairs, roost sites, wash-in, etc. No less potentially significant are pollen and invertebrate remains incorporated in speleothems. Most of these examples deposits are at least partially obscured and their study results in the destruction of the deposits. The study of such deposits must be conducted by or directed by professionals. These deposits are protected in Virginia by State law. In some cases, the fossils themselves may be less important scientifically than the context in which they were deposited. Context determination may require far more knowledge and attention to detail than the comparative work typically required to identify the organisms.

The fossils existing in the rocks in which caves are formed may be paleontologically significant and are typically exposed in rock outcrops. In Virginia's covered karst, the fossils in the carbonate rocks may be more readily observed in caves than in weathered outcrop. The occurrence of some exposed fossils may warrant the listing of a cave as paleontologically significant! Such fossils exposed in caves are protected by State law, but observation and identification can provide pleasure and knowledge to the caver, the speleological community, and the paleontological community!

Selected Karst Features Mapping in Virginia

by
David A. Hubbard, Jr.

Maps of selected karst features are published (1:250,000 scale) for two of the three sections of Virginia's Valley and Ridge Physiographic Province. Karst features selected to define the relative degree of karstification are sinkholes (karstic closed-contour-depressions) and cave entrances. The term sinkhole refers to : dolines, blind valleys, poljes, uvalas, etc. Sinkhole locations are determined by stereoscopic viewing of low altitude (approximately 4,000 m) panchromatic, aerial photography taken during leaf-off seasons. Cave entrance locations are from published and unpublished sources and the symbology only indicates a single or multiple entrance location. Karst features are plotted on a carbonate bedrock map differentiating sequences of Cambrian-Ordovician limestones interbedded with dolostones, Middle Ordovician limestones, Devonian-Silurian limestones, Mississippian limestones or non-carbonate rocks. The base map contains cultural and hydrologic features, but no topographic contours.

Questionable features have been field checked. Problems arose with pseudosinkholes such as ancient landslide sag ponds and old, open-pit mines. Additional problems have been posed by inaccurate TVA topographic maps based on late

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1940s bases, on which up to 10 percent of the features shown as sinkholes are misidentified. They are not topographic depressions and include hills. A number of features depicted as hills are sinkholes.

Mapping of the third and final Valley and Ridge Province karst section is in progress. Although sinkholes and cave entrance features may present a fair representation of the degree of karstification in Virginia, these features may not appropriately depict the relative degree of karstification in other areas of the United States.

Sinkhole Back-Flooding: A Localized Karst Hazard In Virginia

by
David A. Hubbard and Terri Brown

A series of back-flooding sinkholes in the Front Royal area of Warren County, Virginia may represent a significant threat to potential karstland residents. A highway construction project along U.S. Highway 340 resulted in an investigation of a number of epiphreatic sinkholes that flood in response to local groundwater fluctuations. Floodwater levels of up to 44 feet have been observed boiling-up in these sinkholes. The local aquifer is partially recharged by two sinking streams draining the Dickey Ridge area of the Shenandoah National Park and adjacent private property. One sinking stream flows north through the Park and sinks near the Park Entrance; the other stream sinks east of Skyline Caverns. During precipitation events, additional hydraulic head is apparently the result of surface runoff channeled from a relatively new subdivision into a sinkhole along Browntown Road. Concerns are that development in the areas containing the back-flooding sinkholes may result in: subsidenee of sink-

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hole fills, formation of new sinkholes, and the back-flooding of nearby currently unaffected sinkholes. An additional concern is that further development, adjacent to the affected area, will result in additional karst groundwater inputs enhancing the risk of new karst hazards including: subsidence, flooding, and groundwater pollution in this extremely active karst area.

NEW RELEASES

Publication 137: Geology and mineral resources of Henry County and the City of Martinsville, Virginia, by W. S. Henika, J. F. Conley, and P. C. Sweet, 22 pages, 1:50,000-scale full-color geologic map, mineral resource overlay, 15 figures, and 2 tables, 1996. **Price: \$11.25**

Publication 142: Coal, oil and gas, and industrial and metallic minerals industries in Virginia, 1994, by P. C. Sweet and J. E. Nolde, 26 pages, 12 figures, 11 tables, 1996. **Price: \$7.75**

Publication 143: Geologic map of Clarke, Frederick, Page, Shenandoah, and Warren Counties, Virginia: Lord Fairfax Planning District, by E. K. Rader, R. C. McDowell, T. M. Gathright, II, and R. C. Orndorff, full-color map, scale 1:100,000 with explanation. **Price: \$7.25**