UNEARTHING NEW JERSEY

NEW JERSEY GEOLOGICAL SURVEY
Department of Environmental Protection

Vol. 4, No. 2 Summer 2008

MESSAGE FROM THE STATE GEOLOGIST

This issue of *Unearthing New Jersey* focuses on aquifer framework and water resource studies currently being conducted by the Geological Survey. Pete Sugarman and Don Monteverde summarize investigations of the deep aquifers in the Cumberland-Salem area using coreholes and geophysical logs. The region depends heavily on ground water for irrigation and potable water and is among the fastest growing parts of the state. The Potomac-Raritan-Magothy aquifer system is a major source of ground water there and is susceptible to salt water intrusion from the Delaware Estuary. Their work has developed a comprehensive understanding of the hydrogeologic framework governing the aquifer system and is designed to support better water resource management.

Steve Johnson continues his documentation of historic artesian wells. This time he has researched a well drilled in 1866 at the Harrisville Paper Mill in southeastern Burlington County using augers turned by horses. This was the first documented well completed in the important Atlantic City 800-foot sand aquifer. Flowing artesian wells yielding over 1,000 gallons per minute were commonly reported in this aquifer. These watery gushers are New Jersey's version of Texas oil at Spindletop. Water flows from the well to this day.

The Survey welcomes your feedback on the content or format of the newsletter (www.njgeology.org/comments). Other recent geologic activities and digital publications of the Survey are noted in the newsletter and elsewhere on the Survey's Web site. Printed maps and reports are available to the public through the DEP Maps and Publications Fulfillment Office (609) 777-1038, PO Box 402, Trenton, N.J. 08625-0402. Due to budget constraints, over-the-counter purchases are no longer available. Go to www.njgeology.org/pricelst/orderform.pdf for more information. A publications price list is maintained on the Web. Unpublished information is provided at cost by writing the State Geologist's Office, N.J. Geological Survey, PO Box 427, Trenton, N.J. 08625-0427. Staff are available to answer your questions 8 a.m. - 5 p.m. Monday through Friday by calling (609) 292-1185.

Karl W. Muessig,
New Jersey State Geologist

INVESTIGATING DEEP AQUIFERS USING COREHOLES AND GEOPHYSICAL LOGS IN SOUTHWEST NEW JERSEY

By Peter J. Sugarman & Donald H. Monteverde

Southwestern New Jersey depends heavily on ground water for irrigation and potable water. In 1999 about 67 billion gallons of ground water was withdrawn. These withdrawals have created significant water-level declines in the primary aquifers serving this region (Lacombe and Rosman, 2001). Like much of New Jersey, critical issues face water-resource planners here because demand for water is projected to increase significantly during the next 20 years. The Salem/Cumberland vicinity is projected to be one of the five fastest growing areas in the state (Cauller and others, 1999) highlighting the need for additional water sources, and careful water-resources planning.

Other issues face planners besides increased water use. A major source of water in this region, the Potomac-Raritan-Magothy aquifer system (PRM), is susceptible to salt water

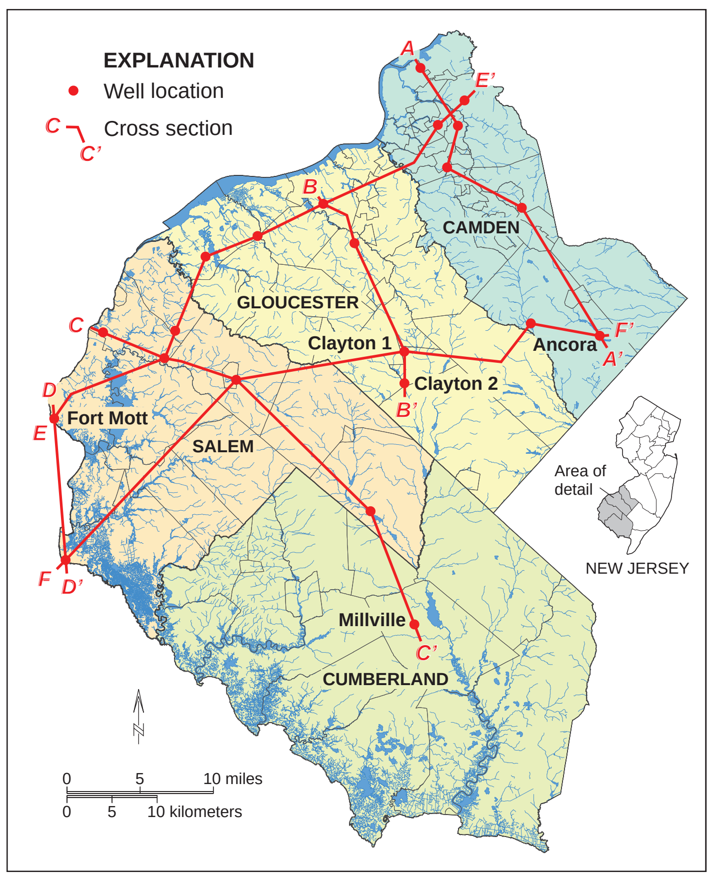


Figure 1. Location map of study area showing wells and cross sections.

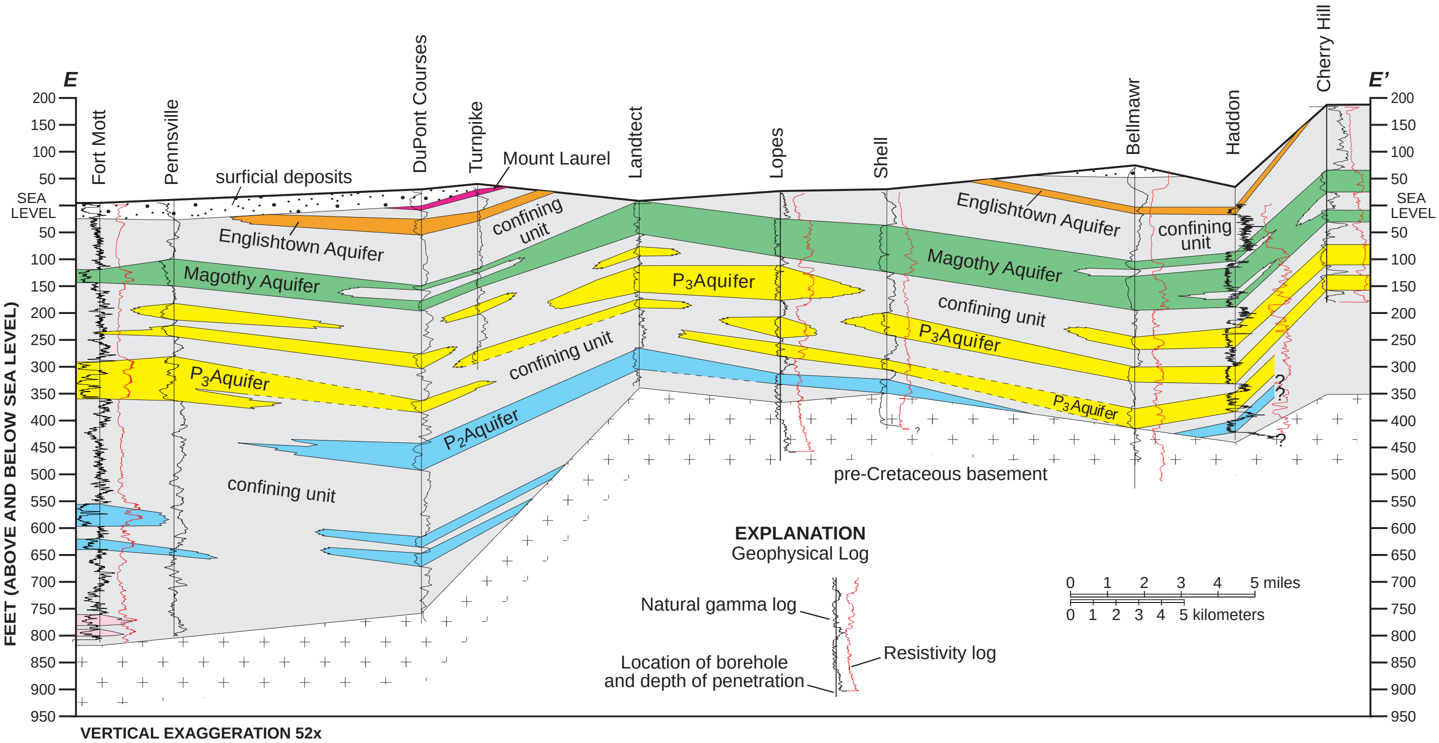


Figure 2. E-E': Hydrogeologic section along strike in Camden, Gloucester and Salem counties near the Delaware River.

intrusion due to its proximity to the Delaware estuary. Heavy pumping of the PRM has drawn salt water into the lower layers of the system.

These concerns prompted initiation of a study of the deep confined aquifers beneath the New Jersey Coastal Plain (NJCP). The investigation was designed to develop a comprehensive understanding of the hydrogeologic framework governing the aquifer system. In question is the systems ability to store and transmit water, and how best to prevent excess withdrawals and limit them to sustainable levels. In the study area (fig. 1), the PRM is the main water source for Salem, Gloucester, and Camden Counties. Improvement of our understanding of the PRM aquifer system, and other deep confined aquifers, is through the analysis and integration of stratigraphic data from continuous coreholes at Ancora (Miller and others, 1999), Clayton (Owens and others 1998), Fort Mott (Sugarman and others, 2004), and Millville (Sugarman and others, 2005) with existing geophysical logs collected from regional water wells.

NJGS
1835

STATE OF NEW JERSEY
Jon S. Corzine, *Governor*
Department of Environmental Protection
Lisa P. Jackson, *Commissioner*
Land Use Management
Mark Mauriello, *Assistant Commissioner*
New Jersey Geological Survey
Karl Muessig, *State Geologist*

29 Arctic Parkway
P.O. Box 427
Trenton, NJ 08625
Telephone: (609) 292-1185
FAX: (609) 633-1004
www.njgeology.org

FRAMEWORK

The generalized hydrogeologic framework of aquifers and confining units was developed by mapping major sand beds (aquifers) and clay-silt beds (confining units) within each geologic formation. In places, specific sand units are consistent and thick enough to be mapped as a single aquifer within a specific formation. For example, each of the following formations has one confined aquifer: Mount Laurel, Englishtown, and Magothy (fig. 2).

The geometry of aquifer sands and confining units in the Potomac Formation is more complex than in younger units. Because of the largely fluvial depositional environment of the Potomac Formation (Glaser, 1969), there are numerous thin-to-thick sand and clay-silt lenses in the Potomac Formation that commonly are laterally discontinuous within short distances (fig. 2). A further complication exists as Potomac units onlap against the southeast-dipping pre-Cretaceous basement such that older units occur only in the deeper, eastern sections of the study area. To facilitate mapping of geologic and hydrogeologic units in the Potomac Formation, a biostratigraphic subdivision consisting of mappable units: unit 3 (P3), unit 2 (P2), and unit 1 (P1) from youngest to oldest (fig. 1) has been employed (Owens and others, 1998). This subdivision is based on pollen and spores using the pollen zones of Doyle and Robbins (1977). Unit 3 (early Cenomanian) correlates with pollen Zone III, unit 2 (Albian) with pollen Zone II, and unit 1 (Aptian to early Albian) with pollen Zone I. Potomac units 2 and 1 are entirely subsurface units in New Jersey (Owens and others, 1998).

Figure 2 is a northeast-southwest trending strike section that illustrates the geometry of aquifers and confining units near the Delaware River in Camden, Gloucester, and Salem Counties, and illustrates the characteristics of the Potomac aquifers. The best aquifers are found in the Potomac unit 3 (in addition to the Magothy), and reach a maximum thickness of just over 65 feet at Fort Mott.

Correlations of aquifer sands within the Potomac P2 and P1 aquifers are tenuous. P2 aquifer sands reach a maximum 50 feet in the study area (fig. 2). The continuity of these sand bodies between wells is uncertain because of limited resolution from widely spaced boreholes and lack of biostratigraphic data for precise correlations.

Although this report identifies the location and distribution of aquifers in the Potomac and Magothy Formations, it should be pointed out that many of these sand units, especially the deeper ones, contain water with chlorides above the 250 mg/L isochlor established by the U.S. Environmental Protection Agency for national secondary drinking water standards. Consequently, water from these aquifer units is unusable for potable supplies unless treated.

REFERENCES

Cauller, S.J., G.B. Carleton, and M.J. Stork. *Hydrogeology of, water withdrawal from, and water levels and chloride concentrations in the major Coastal Plain aquifers of Gloucester and Salem Counties, New Jersey: U. S. Geological Survey Water-Resources Investigations Report 98-4136*. Trenton: U.S. Geological Survey,1999.

Domber, S.E. and J. L. Hoffman. *New Jersey water withdrawals transfer, and discharges on a watershed management area basis, 1900-1999: N. J. Geological Survey Digital Geodata Series DGS 04-9*, computer workbook. Trenton: New Jersey Geological Survey, 2004. www.njgeology.org/geodata/dgs04-9.htm

Doyle, J.A., and E. I. Robbins. *Angiosperm pollen zonation of the continental Cretaceous of the Atlantic Coastal Plain and its application to deep wells in the Salisbury Embayment: Palynology*, v. 1. Baton Rouge: Louisiana State University, 1977.

Glaser, J.D. *Petrology and origin of Potomac and Magothy (Cretaceous) sediments, middle Atlantic Coastal Plain: Maryland Geological Survey Report of Investigation no. 11*. Baltimore: Maryland Geological Survey, 1969.

Lacombe, P. J. and Robert Rosman. *Water levels in, extent of freshwater in, and water withdrawals from ten confined aquifers, New Jersey and Delaware Coastal Plain, 1998: U.S. Geological Survey Water Resources Investigations Report 00-4143*. West Trenton. NJ: U.S. Geological Survey, 2001.

Miller, K.G. et al., *Ancora Site Report*, in Miller, K.G., et al: *Proc. ODP, Init. Repts*., 174AX (Supplement). College Station Texas: Ocean Drilling Program, 1999.

Owens, J. P. et al., Bedrock geologic map of central and southern New Jersey: Miscellaneous Investigations Series Map I-2540-B. Reston, VA: U.S. Geological Survey, 1998.

Rosenau, J.C. et al., *Geology and ground-water resources of Salem County, New Jersey: New Jersey Division of Water Supply and Conservation Special Report 33*. Trenton: New Jersey Department of Conservation and Economic Development, 1969.

Sugarman, P.J. et al., *Millville Site Report. Initial Reports ODP Leg174AX* (Supplement). College Station Texas: Ocean Drilling Program, 2005.

Sugarman, P.J. et al., *Fort Mott Site Report*. Initial Reports ODP Leg 174AX (Supplement). College Station Texas: Ocean Drilling Program, 2004.

THE R. C. HARRIS WELL: A FLOWING FAILURE?

By Steve Johnson

INTRODUCTION

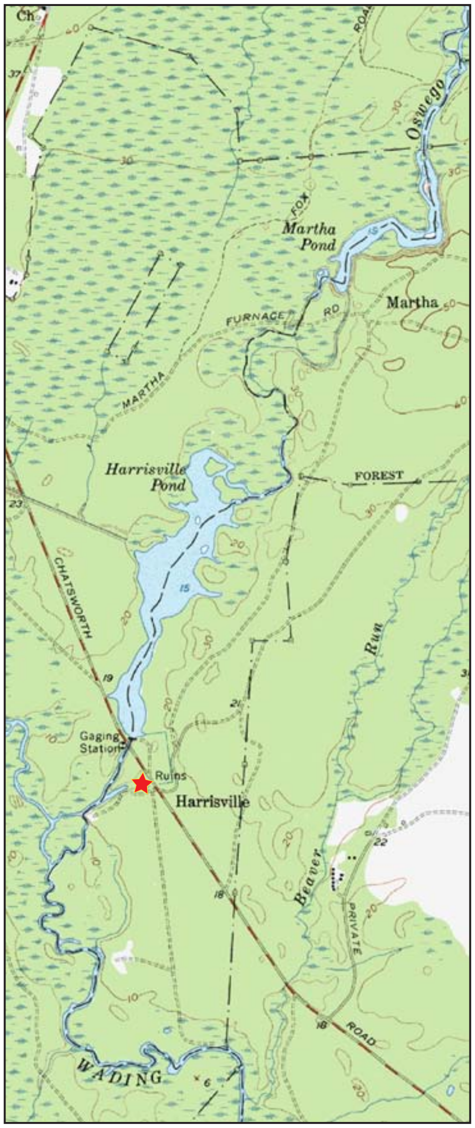
In 1866 at the Harrisville Paper Mill in southeastern Burlington County, one of New Jersey's earliest artesian wells, was drilled using augers turned by horses (real horsepower!) to approximately 395 feet below land surface. This was the first documented well completed in the important Atlantic City 800-foot sand aquifer; and one of the deepest wells in New Jersey's Coastal Plain until the 1880's. It was drilled for Richard C. Harris, owner of the paper mill, and is appropriately named the R. C. Harris well. Water flows from it to this day (fig. 1) but the well was never used at the mill or for drinking water. It was a flowing failure.

Figure 1. R.C. Harris Well, Harrisville, Burlington County. Note orangey brown stains (caused by precipitation of iron) near discharge pipe. The flow varies seasonally from 5-10 gallons per minute with lows in late summer and fall and highs in winter and spring. *Photo by S.W. Johnson*

BRIEF HISTORY OF HARRISVILLE

During the late eighteenth and nineteenth centuries, Harrisville was an industrial area deep in the Pine Barrens, now within Bass River Township, Burlington County. It is located in Wharton State Forest near Harrisville Lake about 6 miles northwest of New Gretna, and about 10 miles south of Chatsworth along County Road 679 (fig. 2). The lake was formed by damming the Oswego River for mill operations and, today provides outdoor recreation.

During the late eighteenth century at Harrisville, a slitting mill (part of the nail-making process), forge and sawmill were



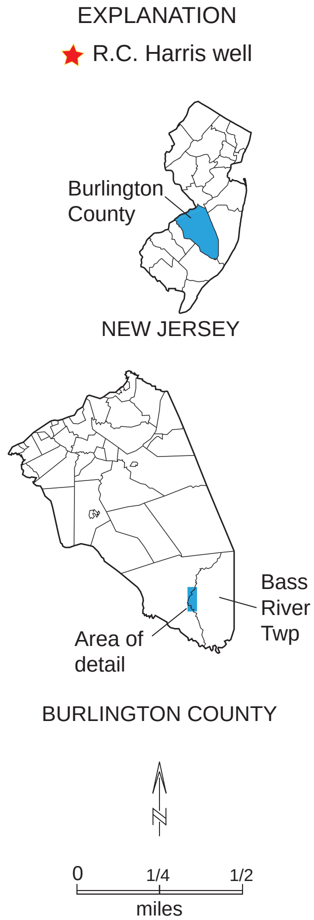


Figure 2. Detail from the Jenkins U.S. Geological Survey topographic quadrangle, showing location of Harrisville and the R. C. Harris Well, Bass River Township, southeastern Burlington County. The well is located near County Route 679.

operated by Evi Belangee and Isaac Potts (1795), and was later passed to many other owners. Undoubtedly, the first dam was constructed during this period and may have had a head of 5-6 feet to run the mills. Notably, Isaac Potts built a furnace one-mile to the east and named it after his wife, Martha.

South Jersey iron production began to slow after the War of 1812 and most operations ended before 1848. The bog iron furnaces could not compete with Pennsylvania iron ore and the ready supply of high grade anthracite and bituminous coal available for fuel. Responding to this new reality, in 1835 a paper mill, using largely salt hay from the nearby salt marshes, was established at Harrisville instead of a furnace. The Wading River Manufacturing and Canal Company constructed the mill, enlarged the dam to provide 10-12 feet of head, and dug the canals (fig. 3). Also the company under William McCarty's directorship diverted the West Branch of the Wading River via a 0.5 mile long canal into the Oswego River (or east branch) just upstream in the lake. This increased the water power running through the approximately 10 to 30-feet wide and 8-feet deep canals leading to the paper mill's water turbines. Significant amounts of energy are generated by impounding water and channeling it through canals to power a turbine or generator. This early paper mill was one of the largest in America. Until the 1830's paper was hand made. Papermaking machines were not invented until the early 19th century.

The company was managed by William McCarty, who was originally from Shelburne, Nova Scotia. By 1813 he had published a New York daily newspaper and a monthly magazine, *The Ladies' Miscellany*, and after 1813 was co-owner of a publishing house, McCarty & Davis of Philadelphia, Pennsylvania.

Figure 3. Harrisville Canal constructed in the 1830's by McCarty's Wading River Manufacturing and Canal Company and modified in the 1860's by Harris. Canal conveyed impounded water to the turbines which powered the paper mill. Canal in this view is approximately 25 feet wide by 8-10 feet deep. *Photo by S.W. Johnson.*

Beginning in the 1830's, the area was known as McCartysville, and was designated so on T. Gordon's Map of New Jersey from the 1830's. The mill produced durable brown wrapping paper used by butchers, hardware stores, and others. The color was due to contact with the lake's tea colored water used during the manufacturing process. It was a successful business with yearly profits over $10,000.00. However, financial difficulties around 1841, and later a significant fire, caused the paper mill to cease operations from 1844 to 1851.

Richard C. Harris, who had worked for McCarty and others, bought the paper mill and appurtenances around 1851 for $6,000. After probate actions due to the death of one of the co-owners, and for an additional $8,000, Richard became owner with his brother, William D. Harris. Beginning with the Harris' ownership of the mill, the area's name changed to Harrisville (and sometimes Harrisia).

In addition to the paper mill, pond, lake, and canal, the property included a sawmill, blacksmith shop, gristmill, mansion house, tenant houses, store, barns, and stables

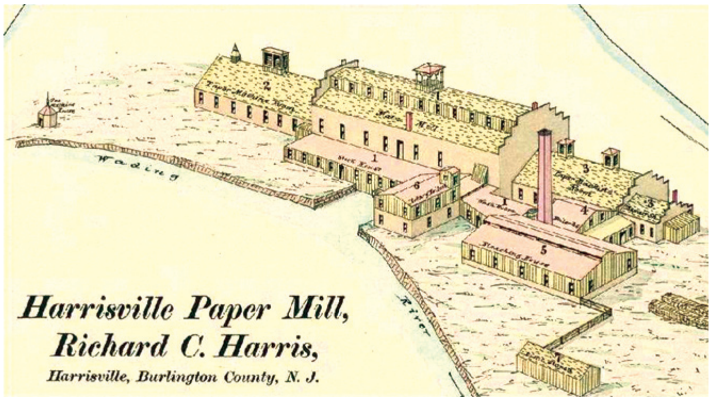


Figure 4. Schematic drawing of a large portion of the Harrisville Paper Mill. Note tail race exiting mill beneath building labeled 1, and flowing to Wading River. Sketch modified from Hexamer General Survey, Volume 12, 1877.

(fig. 4). Harris installed white picket fences and cast-iron gas street lamps in front of the houses along the main street. The gas for the lamps was made at Harrisville's Springfield Gas Machine situated underground near the paper mill. This machine converted gasoline liquid into vapor using a mechanical air pump and gas generator. Underground pipes conveyed the gas vapor to the street lights and gas lamps at the mill.

The paper mill ceased operations around 1892. The property passed briefly through Joseph Wharton's hands who attempted to develop Pinelands water into a supply for Philadelphia. He was unsuccessful because the New Jersey legislature put a halt to the project. A YMCA summer camp ran for a few years at Harrisville in the early twentieth century. In 1914, a forest fire swept through the vicinity destroying most of the town.

Today Harrisville is a part of Wharton State Forest. Vestiges of Harrisville's past glory, notably the crumbling iron stone (jersey stone) walls of many buildings (fig. 4) and, of course, the canals. Having been disconnected from the lake, the canals that once powered the mighty mill are now dry. However, the R. C. Harris Well continues to flow adjacent to the green chain-link fence near the crumbling mill walls.

Figure 5. A portion of the Paper Mill's west wall today. Small amounts of white stucco remain on the wall from the original finished surface. Photo by S.W. Johnson.

THE R. C. HARRIS WELL

The R. C. Harris well was drilled with metal augers using horses to turn them. It was completed to a depth of 375 feet below land surface and yielded a small supply of water with high iron content.

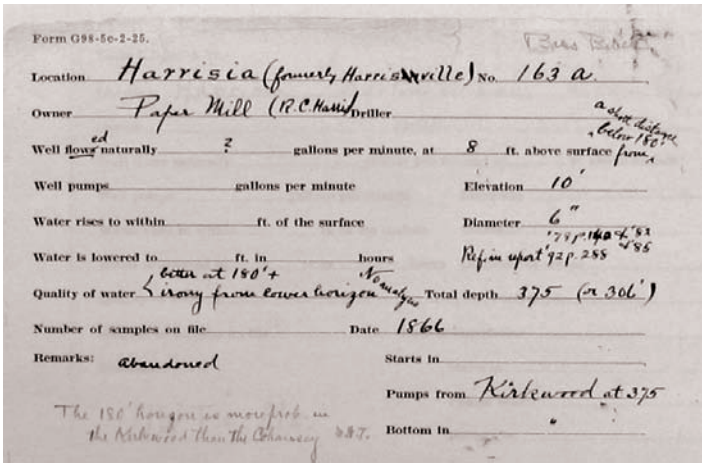
Harris intended the well to supply water for a wrought-iron boiler at the mill which had rusted rapidly using surface water which, in the Pinelands, also has a high iron content. Interestingly, Harris reported in 1879 that the driller found water in a gravelly bed at approximately 200 feet and the water rose in the drill casing 8 feet above the ground. The water at this depth looked free of iron. The driller persuaded Harris to let him drill deeper, but this water was found to be high in iron content. Harris judged the well a failure and abandoned the project. No further wells were dug.

The iron at the well's discharge pipe is evidenced by orangey brown stains on the soil. Iron precipitates out of the water when it reacts with oxygen in the air (fig. 1). Treatment to remove iron from water had not yet been developed and was not an option in 1866.

A log of the well cuttings collected during drilling was provided to the New Jersey Geological Survey in 1891 (fig. 5) by Mahlon Broon, a worker at the paper mill who witnessed the procedure and made the following record:

Depth (feet)	Sample Description
0-77	sand
77-85	sand (like that in the creek)
85-98	blue mud
98-108	clay, with metal (probably iron pyrites)
108-124	marly mud
124-131	strata with old wood
131-146	mud and shells
146-198	hard rock (probably sandy clay cemented)
198-231	sand and boiling spring water
231-245	dark, slushy sand
245-261	yellow sand
261-306	coarse red sand
306-318	dark sand
318-331	white clay
331-368	green marl, irony water
368-375	slate, stone (?)

Based on Broon's log, the R. C. Harris Well penetrated the Cohansey aquifer from 0-131 feet below land surface (bls). The Cohansey aquifer is composed of sands and clay lenses and is generally a water-table aquifer receiving recharge directly from rainfall. The Kirkwood Formation is found below the Cohansey, and is separated from it by clay (mud and shells in log). Also composed of sand and clay, the Kirkwood Formation is present from about 131-331 bls. The Kirkwood aquifer here is a confined or artesian aquifer. A green marl or silty clay representing the Atlantic City Formation underlies the Kirkwood. Particles of the mineral glauconite give the



Form G98-5c-2-25.

Location Harrisia (formerly Harrisville) No. 163 a.

Owner Paper Mill (R. C. Harris) Driller

Well flowed naturally ? gallons per minute, at 8 ft. above surface from a short distance below 180'

Well pumps gallons per minute Elevation 10'

Water rises to within ft. of the surface Diameter 6"

Water is lowered to ft. in hours Ref. in report '92 p. 288

Quality of water better at 180'+ irony from lower horizon Total depth 375 (or 306')

Number of samples on file Date 1866

Remarks: abandoned Starts in

Pumps from Kirkwood at 375

Bottom in

Figure 6. Original well record of the “Harris Well” probably recorded sometime after 1892 at the New Jersey Geological Survey. Note that well at that time flowed naturally 8 feet above surface, and was remarked as “abandoned”. *Photo by S.W. Johnson*.

Atlantic City Formation its green color. Glauconite is a dull green, granular mineral of the mica group, that was most likely deposited in a deep, marine environment

This well is the first well in the Atlantic City 800-foot sand aquifer which occurs here from about -200 to -300 feet bls. This aquifer is one of New Jersey’s most important aquifers used for water supply in southeastern New Jersey. It generally receives recharge from rainfall and snowmelt which travels underground in the aquifer from west to east down the dip of the formation. The formation dips southeast at about 20-30 feet per mile.

Beneath a large part of Southern New Jersey the 800-foot sand is sandwiched between major clay units and is a confined or artesian aquifer. The water is under pressure because the elevation where it enters (recharges) the aquifer is higher than the well screen in the R. C. Harris well. Because, the aquifer is recharged 20-30 miles west of Harrisville, water enters the aquifer above sea level while the aquifer at Harrisville is some 200 feet below sea level. Thus the water is under pressure (“seeking its own level”), rises in the well casing and sometimes even flows above the surface of the land. When this happens the result is a flowing well. In 1866 when the R. C. Harris Well was completed its water flowed 8 feet above the land; notably at Atlantic City in the 1890’s water from wells in the same aquifer flowed more than 25 feet above land surface. Flowing artesian wells were common in this aquifer especially along the Atlantic coast. Well yields have commonly been reported over 1,000 gallons per minute. These watery gushers are New Jersey’s version of Spindletop, yielding clear, cool water instead of Texas oil.

Another interesting aspect of this early well is the method its iron casing was connected together. Casing is pipe that keeps sand and soil out and the well open. It allows passage of tools down to advance the well depth, and apparatus to pump water out. The casing of the R. C. Harris well was connected with a heated metal band or collar, which, on cooling, firmly clasped adjacent casing lengths together. Casing lengths (usually 20 feet long) today are usually screwed together using an internally threaded collar coupling, or welded one to another.

Although the R. C. Harris well was never used for water supply, it was a significant accomplishment. It paved the way for further exploration and eventual use of one of New Jersey’s most important water resources—the Atlantic City 800-foot Sand aquifer. The R. C. Harris Well was not a flowing failure!

RESOURCES

Beck, Henry C. *Forgotten Towns of Southern New Jersey*. New Brunswick: Rutgers University Press, 1936.

Boyer, Charles S. *Early Forges & Furnaces in New Jersey*. Philadelphia: University of Pennsylvania Press, 1931.

Braddock-Rodgers, Kenneth. “Fragments of Early Industries in South Jersey,” *Journal of Chemical Education* Volume 8, Number 10 (1931): 1915-1929.

Dellomo, Jr., Angelo N. *Harrisville A Journey Down the Sugar Sand Roads of Yesteryear*. Atlantic City, New Jersey: Angelo Publishing Co., 1977.

Epstein, C.M., Montgomery, J., Sousa, D., Embs, D. and Cook, K. Hydrology of the First Artesian Well in the Kirkwood Formation (Abstract), *Bulletin of the New Jersey Academy of Science* (Spring 1985): 51.

Fowler, Michael and Herbert, William, A. *Paper Town of the Pine Barrens*. Eatontown, New Jersey: Environmental Education Publishing Service, 1976.

Harrisville Paper Mill, Plate 1151, Hexamer General Surveys, Volume 12, 1877. www.philageohistory.org/rdic-images/view-image.cfm/HGSv12/HGSv12.1151.

Pierce, Arthur D. *Iron in the Pines*. New Brunswick: Rutgers University Press, 1957.

The Springfield Gas Machine, Manufacturer and Builder, Volume 8, Issue 4. (April 1876). cdl.library.cornell.edu/cgi-bin/moa/moa-cgi?notisid=ABS1821-0008-250. 88.

Vermeule, Corneliu C. *Report on Water-Supply, Water Power, the Flow of Streams and Attendant Phenomena.* Trenton: John L. Murphy, 1894.

Woolman, Lewis. “Artesian Wells in Southern New Jersey.” In *Annual Report of State Geologist 1892*, 288 - 289. (Trenton: John L. Murphy, 1893).

ARSENIC IN WELL WATER OF THE HIGHLANDS: NATURAL SOURCE OR A LEGACY OF MINING AND SMELTING?

By Mike Serfes

Arsenic concentrations in private well water of up to 273 µg/L were found during a 2007 well water-sampling program in Warren County, New Jersey. This concentration is the highest ever found in ground water in New Jersey and far exceeds the state Drinking Water Standard of 5 µg/L.

In 2004, arsenic concentrations of up to 6940 mg/kg were found in soil samples from a farm field. This concentration is 347 times the New Jersey standard for soil clean up of 20 mg/kg that is applied to known contaminated sites. Geochemical data collected as part of the National Uranium Resource

Evaluation conducted by the US Federal Government in the late 1970's found that stream sediments in the local watershed have anomalously elevated concentrations of: arsenic, copper, lithium, molybdenum, tungsten and yttrium compared to the rest of New Jersey.

The Highlands has had a long history of iron mining and smelting that dates back to the middle 1700's. It is uncertain if the arsenic is natural or anthropogenic in origin. The NJDEP, Geological Survey and the Site Remediation Program are working to determine the source of the arsenic. Precambrian crystalline rocks generally form the uplands, Paleozoic non-carbonate and carbonate rocks underly the valleys, and quaternary glacial deposits and highly weathered bedrock or saprolite are at or near the surface. Excavations in the farm field with the extremely high arsenic soil concentrations have determined the deeper soil to be saprolite (figs. 1, 2 and 3). The source of the arsenic in the saprolite is still being investigated. Waste from iron-furnaces such as slag covers much of the surface in some areas (fig. 4). Slag will be evaluated as a potential source of arsenic to the ground water in the region. Wells with the highest arsenic concentrations are being examined to determine the rock types they are in, the depths and types of openings that the water flows into the well from, and the chemistry of that water (fig. 5). This and additional work including the use of GIS, geophysical techniques, the collection and analyses of ground water, soil, rock, mine and furnace waste, the installation of monitor wells, video imaging and packer testing of well boreholes are all to be conducted as part of the investigation.

Figure 1, *top*, John Curran and Gregg Steidl look into pit excavated for soil profile evaluation. Figure 2, *middle*, Ron Witte in pit examining soil types and profile. Figure 3, *bottom*. Saprolite in pit shows mineral bands in a lighter mineral matrix. *Photos by M. Serfes*

Figure 4, *top*, Mike Serfes points to a multilayered outcrop of slag associated with furnace smelting activities. *Photo by S. Spayd.* Figure 5, *bottom*, Steve Spayd using an M-scope to measure water level in a domestic well known to have high arsenic concentrations. *Photo by T. Pallis*

FLUORESCENT MINERALS

By F.L. Müller

Is there a world capital in New Jersey? There sure is! The Franklin and Sterling Hill area in Sussex County is "The Fluorescent Mineral Capital of the World." Some 83 different fluorescent minerals have been reported from these mines. The area, at various times mined for iron, copper, limestone and most productively, zinc, has produced more confirmed mineral species than any place on Earth. Although such mines as the Cork Hill and Limecrest Quarries have produced interesting amphiboles, chondrodites, norbergites and fluorites which also fluoresce, the zinc mines at Franklin and Sterling Hill have produced the greatest variety of mineral species. In natural light, seemingly dull looking rocks burst into a brilliant range of colors when viewed in the dark under long or short wave ultraviolet light (fig. 1). This phenomena prompted the Travel Channel series "Cash and Treasures," hosted by Kristen Gum, to do a feature on the mine at Sterling Hill. This placed it in the prestigious company of the gold fields of the West, the diamond mine in Arkansas, the emerald, sapphire and ruby mines of the Carolinas, and the tourmaline mines of California.

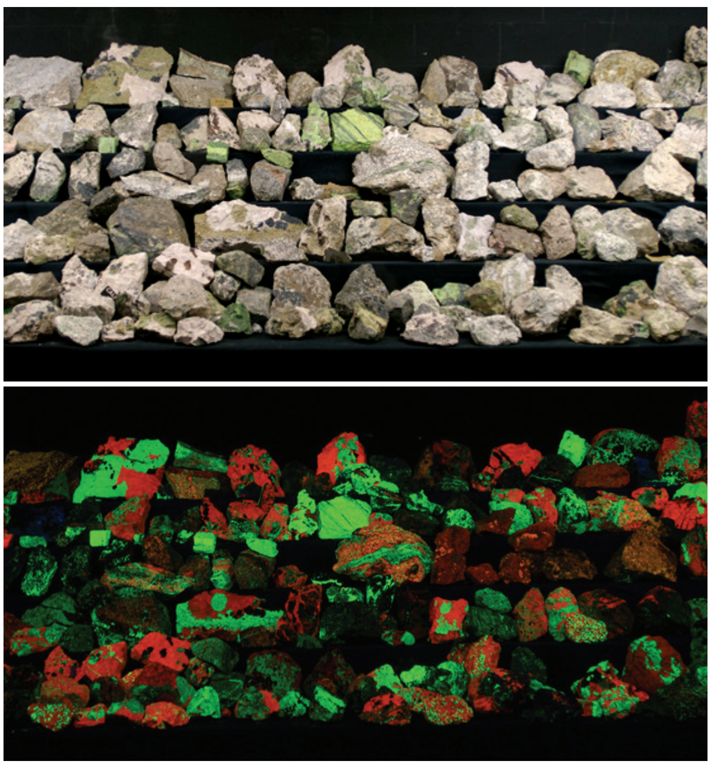


Figure 1. These photographs are of the same mineral display at the Franklin Mineral Museum, Franklin, Sussex County, viewed in plain light, *top*, and ultraviolet light, *bottom*. *Photos by R.P. Tollo*

A few of the eagerly sought-after fluorescent mineral varieties are esperite, which fluoresces yellow, wollastonite, which fluoresces orange, sphalerite, which fluoresces orange, red, or blue, hardystonite, which fluoresces purple, svabite, which fluoresces brown and hydrozincite, which fluoresces blue-white. Most prized by collectors, especially children, are the startlingly colorful "Christmas Tree" ore specimens. These specimens come from ore adjacent to the zinc ore vein. They are composed of willemite, a zinc silicate and calcite, a calcium carbonate. The calcite which is gray, white, pink or orange in natural light fluoresces a brilliant orange-red in short wave UV light. The willemite which can be a range of colors from green to red to a so called "black" in daylight, shines bright green in UV. Thus these glowing specimens resemble traditional holiday colors. The phase activating the fluorescence is manganese.

Many fluorescent specimens phosphoresce, that is, they continue to glow after the light source is removed. This is especially true of willemite specimens. Reportedly this phenomena was exploited during World War II to illuminate landing strip markings.

Collectors highly value specimens which contain esperite, hardystonite, and willemite because of the strong color play. They claim high prices at rock and mineral shows.

Dozens of publications discuss the locations and possible origins of the ore body. The geology of the area is very complex, having undergone high temperature and pressure metamorphism and intrusion of pegmatites and hydrothermal veins. A definitive explanation of the mineralogy and geologic history is still controversial.

The best collections of fluorescents can be viewed at the Sterling Hill Mining Museum or the Franklin Mineral Museum. Both can be visited on a single day's trip. A tour of the Sterling Hill Museum also allows the tourist to go into the mine and study the fluorescents in the actual ore vein. Collecting is possible at both locations for a fee.

All people with an interest in science and history should visit both museums and enjoy a trip into the past and a view of the exotic and beautiful world of fluorescent minerals.

CaF_2

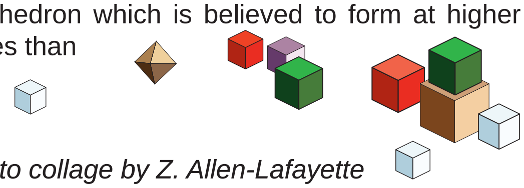
"When someone tells you something defies description, you can be pretty sure he's going to have a go at it anyway."

--Clyde B. Asher--

CaF_2

In 1852, George Gabriel Stokes, British mathematician and physicist, created the term "fluorescence" to describe the phenomena that occurs when the mineral fluorite (CaF_2) is illuminated with "invisible radiation" (ultraviolet light). Fluorescence is a type of *luminescence* that occurs when a cold body absorbs short wave radiation (ultraviolet light) and then emits long wave radiation (visible light).

Fluorite, also known as calcium fluoride, is used for optical purposes such as prisms and lenses. The cube is the most recognized habit of fluorite, followed by the octahedron which is believed to form at higher temperatures than the cube.



Banner photo collage by Z. Allen-Lafayette

NEW JERSEY GEOLOGICAL SURVEY HISTORICAL DOCUMENTS NOW AVAILABLE ONLINE

By Ted Pallis

The New Jersey Geological Survey (NJGS) has scanned most of its collection of books, annual reports, bulletins, final reports, special reports and maps. These scanned documents are gradually being posted on the internet for viewing or downloading as Adobe pdf documents on the NJGS web site at www.njgeology.org/enviroed/freepubs.htm#oldpubs. Until now, many of these documents were out-of-print and could be accessed only in the NJGS library and other selected libraries.

As always, a variety of maps and reports are available for sale by mail or fax through the DEP Maps and Publications Fulfillment Office. Due to budget constraints, over-the-counter purchases are no longer available. Go to www.njgeology.org/pricelst/orderform.pdf for more information.

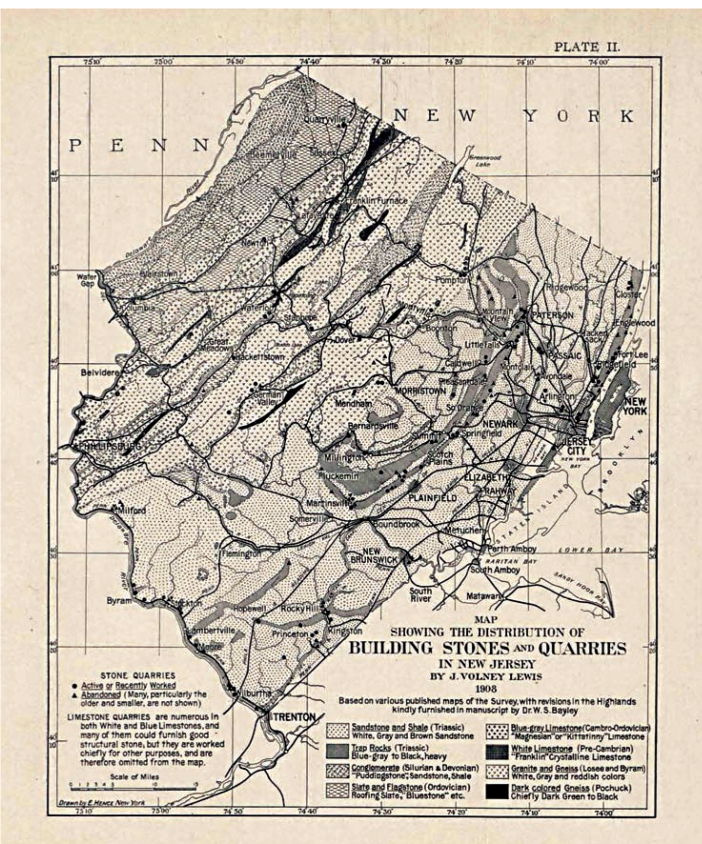
The information in the NJGS on-line historical documents dates to the 1830's when the early mission of the Survey was to map and describe the mineral resources, topography and geology of the state. Today, the mission of the Survey is to map, research, interpret and provide scientific information regarding the State's geology and ground water resources.

Various documents contain information about New Jersey's natural resources including geology, mineral resources, topography, forestry, botany, zoology, fossils, dinosaurs, water resources and much more. Many of the reports include fascinating lithographs, drawings, photographs and maps of the state. All of these reports are word searchable.

Some interesting examples are 1) the Report on the Geological Survey of the State of New Jersey by Henry D. Rogers, 1836, 2) NJGS Bulletin 18, Archaeology of Warren and Hunterdon Counties and 3) NJGS Bulletin 57, Copper Mines and Mining in New Jersey. An RSS feed is available on the web site. By using the RSS feed you will get automatic notifications when new historical publications are added to the collection.

The NJGS is one of the oldest state geological survey in the country, predating the U.S. Geological Survey by forty-four years. NJGS was formed in 1835, the same year the British Geological Survey was created.

Please visit our website at: www.njgeology.org to explore New Jersey's natural history now available online.



"Plate II. Map Showing the Distribution of Building Stones and Quarries" in *Annual Report of the State Geologist for the Year 1908*. This is one of many historic plates, figures and photographs contained in the NJGS digital library. *Cartography by J.V. Lewis*, *1908*

"Children of a culture born in a water-rich environment, we have never really learned how important water is to us. We understand it, but we do not respect it."

William Ashworth
Nor Any Drop to Drink, 1982

EARTH SCIENCE WEEK

October 12-19, 2008

The American Geological Institute announced the theme of Earth Science Week (ESW) 2008 as "No Child Left Inside." This year ESW is designed to encourage young people to learn about the geosciences by turning off the television, logging off the computer, and going outside. Visit the ESW website for more information on how you can participate www.earthsciweek.org.

LET'S PLAY: GUESS THE MINERAL

Here it is:

$$(Na,Ca)\ (Mg,Fe,Mn,Li,Al)_3\ (Al,Mg,Fe^{3+})_6\ [Si_6O_{18}]\ (BO_3)_3\ (O,OH)_3\ (OH,F)$$

If you think you know this mineral, send your answer to: njgsweb@dep.state.nj.us

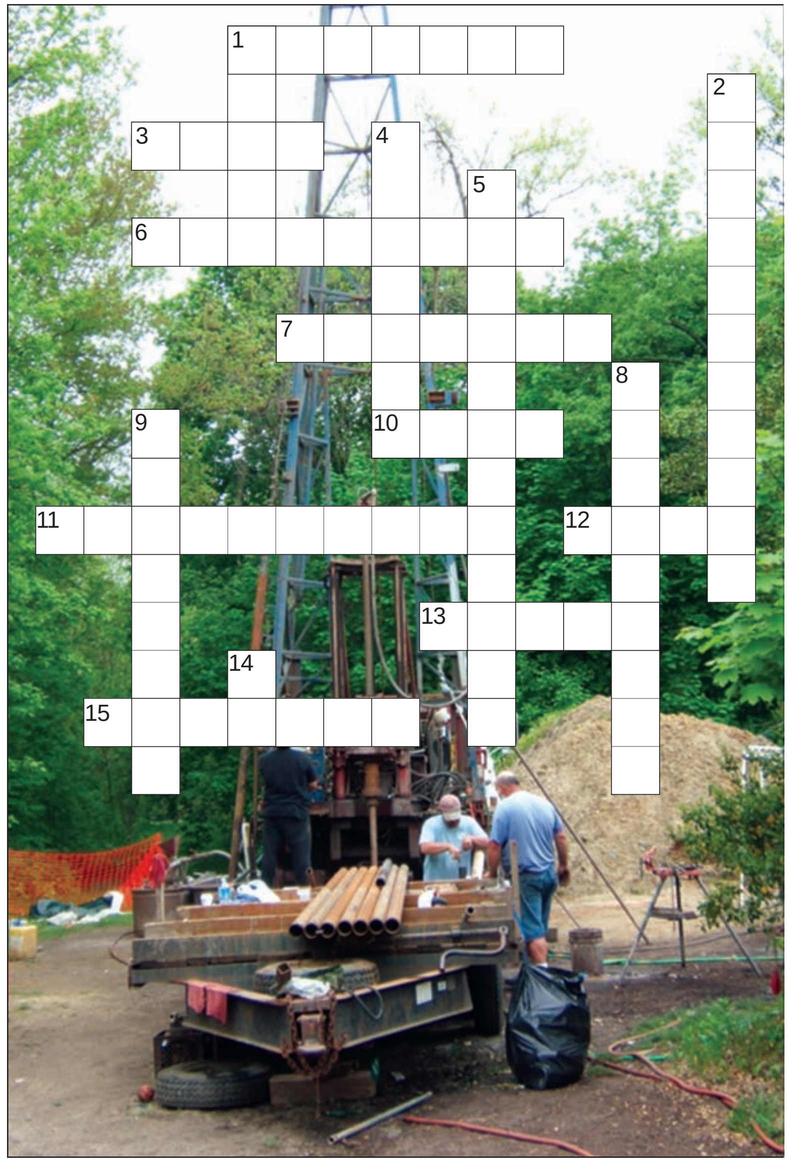
CROSSWORD CORES

ACROSS

1. Calcium carbonate
3. Zn
6. Fluorescent green
7. Mouth of river where fresh water comes into contact with seawater.
10. Mineralized fracture
11. Power necessary to raise 33,000 pounds one-foot in one-minute.
12. Generate a digital image
13. Unicellular reproductive bodies
15. Pertaining to rivers

DOWN

1. Channel filled with water
2. Unique eco-system
4. Potomac-Raritan-Magothy aquifer system
5. Science of rock layers
8. Overlapping or staggered
9. Well drilled to obtain geological information
14. Ultraviolet



Drilling a corehole in Medford Township, Burlington County. *Photo by H.L.L. Rancan*

THE FIRST DRILL FOR THE ARTESIAN WATER SUPPLY OF CAMDEN, N. J.

The First Drill for the Artesian Water Supply of Camden, N.J., circa 1911. *Photographer unknown.* In 1898, Camden's public water supply, which came from the Delaware River (surface water) was replaced by water from wells (ground water). With this change in water supply there was a remarkable decline in the number of cases of typhoid fever (*Salmonella typhosa*, transimitted by contaminated food and water) and deaths from that disease. Image from Postcard Images of New Jersey, West Jersey History Project. The West Jersey History Project is dedicated to helping, promoting, and publishing historical research about West Jersey and is an advocate for historic preservation in West Jersey.

CROSSWORD PUZZLE ANSWERS. Across: (1) Calcite, (3) zinc, (6) willemite, (7) estuary, (10) vein, (11) horsepower, (12) scan, (13) spore, (15) fluvial. **Down**: (1) Canal, (2) Pine Barrens, (4) PRM, (5) stratigraphy, (8) en echelon, (9) core hole, (14) UV.