UNEARTHING NEW JERSEY

NEW JERSEY GEOLOGICAL SURVEY
Department of Environmental Protection

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MESSAGE FROM THE STATE GEOLOGIST

The New Jersey Geological Survey has a long mining history in the Garden State. As the articles in this edition of *Unearthing New Jersey* discuss, gold and copper were mined during exciting times in our country's history. Another article addresses the less exciting, yet valuable granite that continues to be quarried in New Jersey and has contributed significantly to the construction industry.

Current mining activities in New Jersey are not producing Wall Street-valued commodities in the form of precious metals. Rather the quarries and sand pits produce Main Street-valued construction aggregate. The gross domestic product value for the New Jersey mining industry was approximately $122 million in 2008 (year 2000 dollars). At that time, there were 90 sand pits and 29 quarries. Data on the products from these active mine sites show 90 removing sand and gravel, 2 sand only, 18 industrial sand, 28 fill dirt and 29 rock or crushed stone (granite, for example).

The Survey has a renewed interest in the mines of the past because of the potential subsidence hazard they pose to the public. There are approximately 573 known abandoned mines, most of which are not accurately located and there is little information about them. Recently, we began a $359,000 project, funded in part by a Federal Emergency Management Agency Pre-Disaster Mitigation Grant. All historic information will be compiled under the grant and accurate GPS locations of all mine and subsidence features will be collected. A database of this information will be used to prioritize the hazard risk for all mine features and assist mine subsidence hazard mitigation by public agencies through an interagency task force, including the State Police Office of Emergency Management.

The Survey welcomes your feedback on the content or format of the newsletter. All Survey publications from it's 175 years of operation have been scanned and are available as free downloads from the web site. Hard copies of some maps and reports are also available for purchase by check. Our order form has more information. Unpublished information is provided at cost by writing the State Geologist's Office, N.J. Geological Survey, PO Box 420, Mail Code 29-01, Trenton, N.J. 08625-0420. 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

NEW JERSEY GRANITES

By Richard A. Volkert

Probably no other rock type is as well known as granite. Most everyone has heard of it, and likely has seen it whether or not they realize it. Granite is a very common igneous rock formed from magma in the Earth's crust. It is composed mainly of the minerals quartz, potassium feldspar and plagioclase feldspar. The texture of most granite is massive and homogeneous, creating a dense, hard rock that is resistant to erosion. The grain size is typically uniform, but it may range from medium grained to very coarse grained, with the latter commonly known as granite pegmatite. Granites may be different colors (e.g., white, gray, pink, or red) depending on the proportion of light and dark minerals that compose them, but most granite owes its characteristic pink color to an abundance of potassium feldspar that makes up much of the rock.

Geologists use a number of different classification methods to identify and name granites. Classification may use either the mineralogy or the geochemical composition of the rock. Mineralogical classification relies on the proportion of quartz and feldspars, whereas geochemical classification uses the concentrations or the ratios of major and trace elements in the rock. Once granites are classified, those which are mineralogically and geochemically similar, and of the same age and origin, may be grouped together and

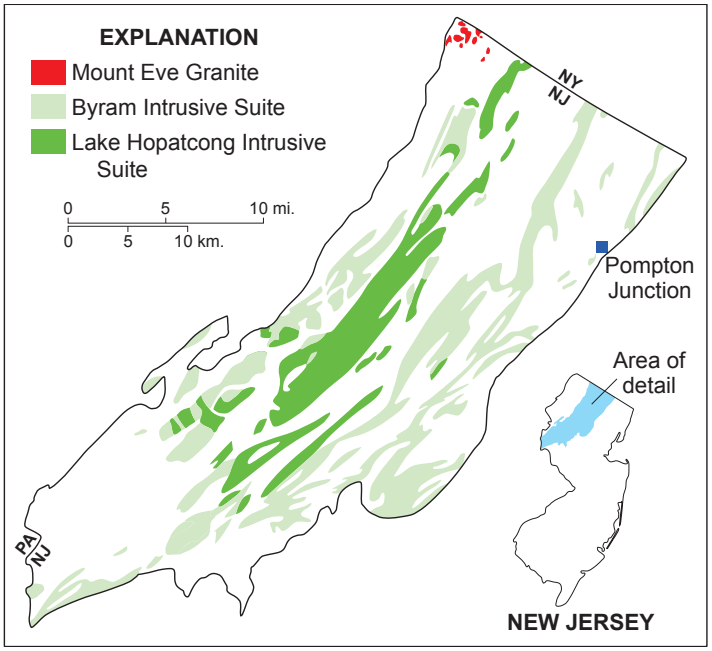

Figure 1. Map of granite distribution in New Jersey.

referred to as a suite. Suites are typically named for their "type" location; that is, the geographic area where they are best exposed. Geologists are able to determine the age of granite by using radiogenic isotopes of uranium and lead to date minerals such as zircon that crystallize from the magma that produces the granite.

DISTRIBUTION OF GRANITE IN NEW JERSEY

Granite of various types is found only in the New Jersey Highlands physiographic province where it underlies approximately 50 percent of the region (fig. 1). All of the granite is Mesoproterozoic (Precambrian) in age, and at more than 1 billion-years-old the granites are among the most ancient rocks in New Jersey.

The most abundant granites in New Jersey are part of the Byram Suite and the Lake Hopatcong Suite that form linear belts tens of miles long (fig. 1). Byram granite is characteristically pinkish-gray, medium- to coarse-grained, and composed of quartz, feldspar and hornblende (fig. 2). Lake Hopatcong granite is greenish-gray, medium- to coarse-grained, and composed of quartz, feldspar and pyroxene (fig. 2). Granites of the Byram and Lake Hopatcong Suites have been dated at 1.185 billion years and are the oldest known granites in New Jersey.

The Mount Eve Granite is confined to the northwestern Highlands (fig. 1) where it forms a series of bodies that continue to the north into New York. Mount Eve Granite is pinkish-white, medium- to coarse-grained, and composed of quartz, feldspar and hornblende (fig. 2). Mount Eve Granite has been dated at 1.02 billion years and so it is 165 million years younger than granites of the Byram and Lake Hopatcong suites.

The Pompton Pink Granite is found only in the northeastern Highlands at Pompton Junction in Passaic County and Riverdale in Morris County (fig. 1). Pompton Pink Granite is pink to pinkish-white with light green mottling, coarse grained and is composed of quartz and feldspar (fig. 3). The exact age of this granite is unknown, but based on its texture and relationship to other Precambrian rocks it is likely about 1 billion to 965 million years old.

Granite pegmatite is widespread throughout the Highlands where it forms very small bodies that have intruded into the other Precambrian rocks. Pegmatites are pinkish-white, gray, white, or greenish-gray, depending on the type of granite they are associated with, or the magma source they formed from. Pegmatites are composed mainly of quartz and feldspar and may also contain hornblende, biotite, or pyroxene (fig. 3). Granite pegmatites in the

Figure 2. Principal granite types found in the New Jersey Highlands include Byram (*top*), Lake Hopatcong (*middle*), and Mount Eve (*bottom*). *Photos by R.A. Volkert*

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1835

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Figure 3. Pompton pink granite (*top*) and granite pegmatite (*bottom*). Note the very coarse grain size of both samples contain crystals as much as several inches long compared to that of the granites in figure 2. *Photos by R.A. Volkert*

Figure 4. Abandoned historic quarry (*top)* and a modern quarry (*bottom*). *Photos by R.A. Volkert*

Highlands have been dated at about 1 billion to 965 million years old.

ECONOMIC USES

Granite of the Byram and Lake Hopatcong Suites, particularly the latter, is rich in iron and was mined during the 18th and 19th centuries for the iron ore (magnetite) deposits they hosted. During this same time, granite was quarried extensively for use as building stone throughout the northern part of the state, mainly in Passaic, Morris and Sussex Counties (fig. 4). In 1918, the Pompton Pink Granite became notable for its use in the construction of the landing at the entrance to the Smithsonian National Museum of Natural History in Washington, D.C. It was also used in 1895 in construction of St. Paul's Episcopal Church in Paterson (fig. 5). Other granite quarried in the Highlands was used to construct structures such as Coopers Mill in Chester, forges and furnaces for roasting iron ore such as those at the Boonton iron works and at Wawayanda State Park, houses and churches (fig. 5), monuments, and fountains. Granite was previously, and continues to be an important commodity for use in construction as crushed stone, aggregate, ballast for railroad tracks, road metal, rip rap for drainage and slope stability, and for landscaping.

Figure 5. Examples of granite's use as a building stone: Wawayanda furnace (*left*), Wawayanda State Park, Vernon Twp., Sussex County, and St. Paul's Episcopal Church (*right*), Paterson City, Passaic County. *Photos by R.A. Volkert*

NEW JERSEY GOLD

By Ted Pallis

INTRODUCTION

When the price of mineral resources begins to rise, the New Jersey Geolological Survey gets inquiries about availability of these mineral resources in the state. A few years back, Chinese companies were inquiring about iron ore from abandoned New Jersey mines as prices of steel climbed worldwide. More recently with the spike in gas prices, oil and natural gas information has been a frequent request. Recently, with the price of gold at record highs (over $1,200 an ounce), the NJGS has been fielding questions about gold prospecting in New Jersey. Perhaps this is a good time to look at previous gold rushes in New Jersey. Yes, there have been a few.

To review, gold is a chemical element with the symbol Au (Latin: *aurum*, "shining dawn"). On the Periodic Table of Elements its atomic number is 79. The metal generally occurs as nuggets or grains in rocks, veins and alluvial deposits. Gold is in the same chemical family as silver and copper, but with some very different qualities.

FIRST FIND

The first reference to a gold find in New Jersey was mentioned on May 24, 1722 when John Gosling, one of the proprietors of West Jersey, wrote to the Lords in England about the leasing of mines in America. He claimed to have found several rich mines in New Jersey consisting of silver and gold mixed with other metals (Koziar, 1954). Since that date, gold has been intermittently prospected for or stumbled upon. However, no great fortunes were ever made by gold miners in New Jersey and all active gold prospecting ended in the early 1900's. By then, it was determined that while gold was present in the state in small quantities, it did not occur in enough abundance to make it profitable.

Most New Jersey gold was obtained by trench prospecting, almost none was found by panning in local streams. In the western United States, placer deposits, which are alluvial, marine, or glacial deposits containing particles of valuable minerals, such as copper, silver, and especially gold, can be panned, but in New Jersey the mineral assemblage (lead, iron, copper, silver and gold) contained very little gold. Figure 1 shows a map of prospects and reported gold occurrences in New Jersey. Many of the old prospects are now overgrown or built on. The locations are approximate. The sites on the map are where gold has only been reported, most have not produced anything.

GOLD IN COPPER

In New Jersey, gold has been associated with copper ore of the Piedmont Province, a belt of sedimentary rocks extending from New York to Alabama. In New Jersey the Piedmont Province is roughly 1600 square miles or one-fifth of the state.

Associated with copper ore, gold has been found at the Arlington or Schuyler Mine in North Arlington, Bergen County, and at the Griggstown Mine near Griggstown, Somerset

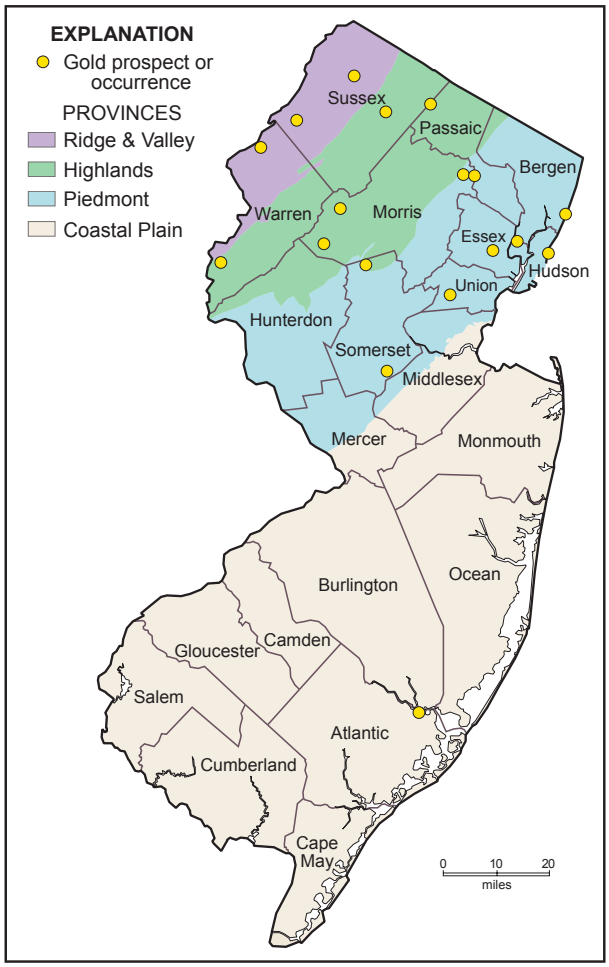

Figure 1. Gold occurrences in New Jersey. This map does not include "gold rushes" where no gold was obtained.

County. Sometime between 1900 and 1905 the New Jersey Geological Survey assayed a small amount of the gold from the Griggstown Mine. The results were 0.01 ounces of gold per ton (Woodward, 1944).

Gold has also been reported in many areas of New Jersey other than the Piedmont, including locations near Beemerville, Sussex County, south of Harmony, Warren County and near Budd Lake, Morris County (Banino, 1969). Reports of gold in the state are also associated with pyrite. Occurrences have been noted at Fort Lee, Bergen County, and at the base of Kittattinny Mountain in Warren and Sussex Counties. The gold at the base of the Shawangunk Conglomerate which forms Kittattinny Mountain are pyritiferous beds which have been assayed for gold with a reported value of $11.00 per ton (Cook, 1868). In the 1970's, a mining claim was filed with the attorney general to mine gold and other precious metals from the Silurian quartzites in northern New Jersey.

Also, gold has been found in quartz veins as at Castle Point, Hoboken in Hudson County and Long Valley, Morris County (Banino, 1969). Small amounts of gold have also been collected from some ore of the Franklin Zinc Mine material in Franklin, Sussex County (fig. 2).

RUSH OF '28

Other gold discoveries were reported and may have or

Figure 2. Small gold grain, in red circle, embedded in a piece of Franklinite from the Franklin Zinc Mine, Franklin Boro, Sussex County. Sample courtesy of Richard Hauck, Sterling Hill Mining Museum. *Photo by J.H. Dooley*

may have not been legitimate. The following are a few notable gold finds reported. In November of 1928, Public Service Electric and Gas of New Jersey company employees came across rock containing specks of gold in East Orange, Essex County, during construction of manholes at Central and South Munn Avenues. The workers ignored the gold and put in the manholes as instructed. This ended the East Orange gold Rush of "28" (Koziar, 1954). In 1935, gold nuggets were found in a sand bank by a contractor at the foothills of the Ramapo Mountains where Route 23 intersects Pompton Plains Boulevard in Pompton Plains, Pequannock Twp, Morris County. The contractor who was leasing the property to quarry the area for fill during construction of Route 23 had to hire five guards to keep claim diggers off the property after the discovery. The estimate to mine the gold was $250,000 and it was assayed at $16 per ton. The contractor chose not to mine the gold, but instead continued to use the sand material for fill (Koziar, 1954). Curiously, there was a report that at one time Tiffany & Co. had a jewelry processing plant adjacent to the location of the gold find.

GOLD MINE FLOODED

A gold discovery was reported during 1895 by the Somerville based Unionist–Gazette newspaper. The gold mines were said to be somewhere near Peapack in Somerset County. The newspaper reports claim "100 tons of ore were taken from the ground from the farm of John Sutphen" and was ready to be shipped. Samples were sent to New York City and assayed there. Unfortunately for the gold miners, water was encountered in the shaft eighteen feet down and equipment to pump the water out was not available. It appears no further gold ore was mined.

There have also been attempts at fraud relating to gold discoveries. A 1894 newspaper account of a gold mine in the Jacksonville section of Pequannock Twp, Morris County, is full of charges and countercharges concerning the salting of the mine owned by John Van Ness. Six mines were reported being operated on the Van Ness Farm. The mined ore was loaded on barges and floated down the Morris Canal to a $50,000 gold mill on the Passaic River at Grafton and Riverside Avenues, in the Woodside section of Newark, Essex County. But a metallurgist and mining engineer stated that nearly all of the gold extracted was put in the ore by individuals, salted and not naturally occurring. Eventually the gold claims were unsubstantiated (Koziar, 1954).

GOLD HYSTERIA

At times there was quite a bit of hysteria regarding gold finds which amounted to nothing. During 1880, the New York Times reported there was a short lived but intense gold rush in New Jersey that stirred certain areas into a frenzy at the hope of finding gold. The activity was in central New Jersey in and around several former copper mining areas. During the last week of July, Mr. John Hallack Drake of the Atlantic Coast Mining Company and Captain Macasey, an assayer, went to Rutgers University to visit Professor George Cook, the state geologist of New Jersey at the time. The two men brought with them gold specimens from the copper mines in the area. Professor Cook thought that there was some gold in the state but the quantities were so small it was uneconomical to mine. However, Hallack Drake and Macasey claimed that within a year the New Jersey gold mines would be the richest in the world. Pumps were installed in the Field Mine in Bound Brook, Somerset County, to prepare it for mining, but it appears no gold was ever actually mined there.

Curiously, a few weeks later, in Hopewell Township, Mercer County, along the Hunterdon County border, the New York Times also reported a farmer named Horatio Ege, claimed to have discovered some gold on his property. Gold was said to be found on surrounding farms in the area too. Some of Ege's neighboring farmers supposedly started digging furiously and even gave up farming for a time trying to strike it rich. The locals were so excited about finding gold they claimed the town of Hopewell was to become the next center of the new gold fields in New Jersey. Unfortunately, no gold was mined and the gold rush was over almost as quickly as it started.

TWO GOLD RUSHES

Cape May's only "Gold Rush" took place in September of 1925 when one day a group of New Yorker's stopped into a general store in Chatsworth in Ocean County and showed the proprietor some gold nuggets they claimed to have found farther south. The gold find was reported to be just north of Cape May. Hundreds of people were said to be digging in the sand to find the valuable gold pieces. But none were found, only hundreds of worthless Cape May Diamonds (translucent quartz crystals) and several dark stones streaked with a yellow substance (Pittsburgh Press, 1925).

Probably one of the most fascinating gold rushes in New Jersey took place near Egg Harbor, Atlantic County in the Coastal Plain. It was reported in an article in the Daily Alta California, a newspaper out of San Francisco on January 9,

1869. Part of the lore of the early settlers of the Egg Harbor area was they believed there were gold mines under the ground of the South Jersey Pine Barrens. For years, farmers in Egg Harbor along the Atlantic Ocean would drive their cattle into the plains in the spring to uplands farther inland for grazing during the summer. The cattle usually remained there until the winter when they were brought back to Egg Harbor. There was a legend that one of cattle, on the way back too Egg Harbor drank from a watering hole on the East Plains. Shortly after reaching its destination the cow was slaughtered and inside the stomach was found a number of particles of gold. It was thought the cow swallowed the gold while drinking from one of the watering hole on the plains. After this discovery several search parties were formed and prospecting took place for gold near the watering hole. After not much digging, it was reported that minute particles of gold were discovered near what was familiarly known as the "watering holes" to the locals. The gold was taken to Philadelphia for examination. It was found to be pure gold but was in such small amounts was not economical to mine. The gold fever then subsided in Egg Harbor but not in the minds of the inhabitants who still believed the plains of the Pine Barrens could be an El Dorado.

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We are just an advanced breed of monkeys on a minor planet of a very average star. But we can understand the Universe. That makes us something very special.

Steven Hawking (b. 1942), English physicist

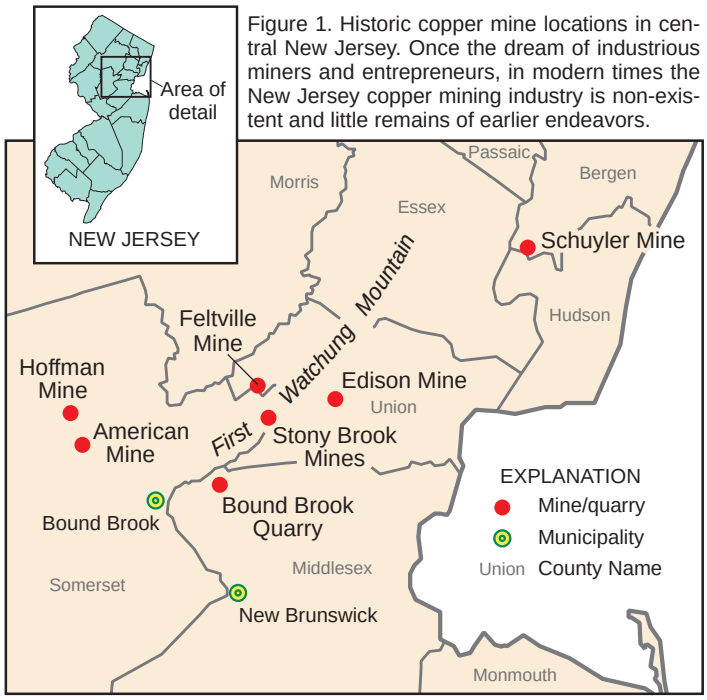

Figure 1. Historic copper mine locations in central New Jersey. Once the dream of industrious miners and entrepreneurs, in modern times the New Jersey copper mining industry is non-existent and little remains of earlier endeavors.

Central New Jersey Copper

By F.L. Müller

EARLY EXPLORERS

Early Dutch explorers of New Netherland (the seventeenth-century province on the East Coast of North America) sent home to Europe specimens of copper from the settlements. "In 1659 the directors in Holland wrote to Governor Stuyvesant that they had received a piece of good and pure copper from New Netherland, and that there was a copper mine in the Navesinks" (Decker, 1942, p. 8 *in* Kraft, 1996, p. 44). "Nevesinks, also spelled 'Neve Sincks' or Newesingh" was well known to the Dutch Administrators in New Amsterdam (lower Manhattan Island) and probably most Dutch seamen. The Nevesinks, or as written today 'Navesink', is the name of the river located in northeastern Monmouth County near Sandy Hook, New Jersey" (Kraft, 1996, p. 46). Explorers from Holland investigating the Navesink area may have mistaken the dark green grains in the sand and in the marl as evidence of copper. It is, however, glauconite, a green to black, iron-rich clay mineral (Parris, 1982, p. 8 *in* Kraft, 1996, p. 48). As they pushed up into the central portion of the region, they did find elemental copper and copper carbonates in the New Brunswick area (fig. 1). Although the Schuyler Mine of North Arlington and the American Mine of Bridgewater may have been profitable for a time, the copper of the Piedmont was never economically significant.

The Feltville Copper Mine, located in the Union County Park at Surprise Lake, was reputed to be a colonial prospect but was not verified until the Civil War period. This writer visited the site 60 years ago and viewed a tunnel approximately three feet high extending from the wall of the ravine in a southerly direction. When the ravine was revisited some 20 years later, the tunnel was covered. However, on

the northerly bank was a greenish black layer in the shale containing wires and threads of elemental copper. The ore was not of any significant economic importance.

NINETEENTH CENTURY MINES

In the beginning of the nineteenth century a few miles southwest of the Feltville prospect and a mile north of Plainfield, tunnels were dug on both sides of the Stony Brook gorge. The longest was 400 feet. The east side was worked by the Green Valley Copper Company and the west side by the New Jersey Copper Mining Company. The ores were in an eight inch to two and a half foot bed in the metamorphosed zone at the contact of the basalt with the red shale. The ores were copper carbonates and a gray copper oxide. Tradition holds that native silver was also found at these mines.

In 1784, a half mile east of Edison and seven miles northeast of New Brunswick, copper prospecting was also undertaken. Trenches were dug first followed by tunnels in the hillsides of the adjacent South Branch of the Rahway River. In 1812 and again in 1827 there was exploration at the same site. Nothing of economic value was discovered. In 1882 Thomas Edison invested in the site of these earlier endeavors and discovered a copper ore seam which could be mined. He abandoned the mine when the ore yielded less than 1 percent copper. "Lewis concluded in 1906 there seems little probability that there is a great body of ore at this place, such as a deposit of low grade would require for profitable exploitation and there is, therefore no encouragement for further expenditures in exploration" (Woodward, 1944, p. 99-100).

In 1866, north of Bound Brook in the gorge of the Middle Brook (fig. 2) which cuts the First Watchung Mountain (Orange Mountain Basalt), copper was mined on both sides of the gorge. Following the contact of the basalt with the hornfels a 300-foot tunnel with two 100-foot side galleries was mined on the east side. Twenty-five to 60 tons of ore was mined and shipped for smelting before work was abandoned. On the west side of the gorge a 700-foot tunnel was reported. Later quarrying revealed that the ore bed was about two feet thick in the hornfels and ran along the contact with the overlying basalt. Native copper, azurite and malachite with some chalcocite made up the bulk of the ore. A very small amount of native silver was discovered with the native copper. Woodward (1944) reports that some copper in small thin sheets and nodules was seen in the basalt a considerable distance from the base of the flow. The contact of the basalt and red beds on the floor of the quarry at Bound Brook has continued to produce copper. Collectors are reminded that this quarry is private property and trespassing is not allowed.

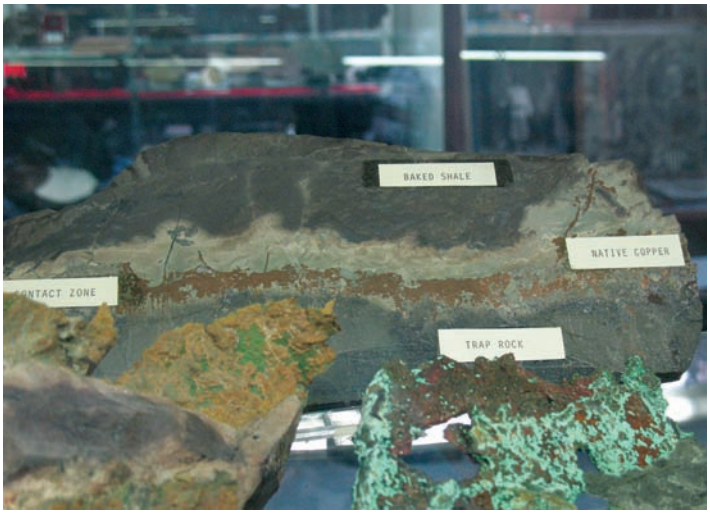

Figure 2. Copper sample from the Chimney Rock Quarry, over the site of the mines at the Middle Brook Gorge of the First Watchung Mountain. The copper is found at the contact of the baked shale and Orange Mountain Basalt. *Photo by T. Pallis, display at Sterling Hill Mining Museum*

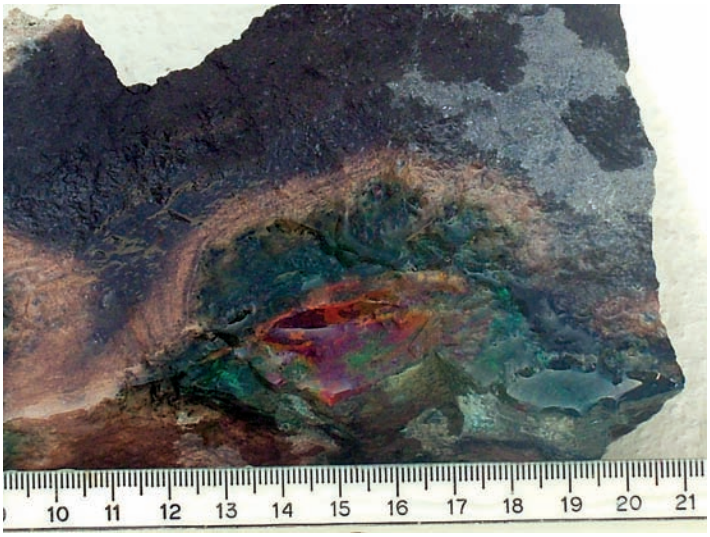

Figure 3. This copper sample from the American Mine contains native copper (bronze), cuprite (red orange), malachite (green) and chalcocite (black). The white band is wall rock alteration. *Photo by J. Dooley*

Similar mineralogy was found approximately four miles to the northwest at the Bridgewater (later, American) Mine and further north along the Watchung Mountain at the Hoffman Mine. The American Mine is the deepest copper mine in New Jersey. The discovery of copper took place early to mid-eighteenth century as fragments and masses were picked up on the hillsides north of Bridgewater and Somerville. "As much as 1900 pounds of the native metal in various masses is said to have been discovered before 1854" (Woodward, 1944, p. 77). When General Washington needed copper for the Continental Army which was in the area, legend says that enough was mined here to cast a brass cannon that was later used in the siege of Yorktown (Woodward, 1944, p. 78).

After the American Revolution there was little activity at the site until 1824 when the Bridgewater Copper Company, organized by Augustus Camman, opened a mine. But, they had little success and the mine closed by 1830. In 1834 the Washington Mining Company operated by Camman's son, Albert, together with Peter Stryker, cleaned out the prior workings and mined, trimmed, and sent a small quantity of ore to Boston for smelting. They were bought out by the Boston interests who operated the mine until water made it impractical to continue. In both the Bridgewater and the Washington-Boston ventures, capital invested exceeded copper produced. The mines were closed in 1844.

In 1880, the American Copper Company took over the property and workings, rejuvenating the previous mining

operation. Several tunnels were sunk. In the primary Bridgewater mine shaft which continued for 600 feet, the American miners extended the excavation to 1300 feet. The tunnel reached a depth of some 600 feet below the surface level. Many side galleries were cut; some were "expanded into rooms and chambers" (Woodward, 1944, p. 81). The 2040 feet of shafts, side galleries, and a drainage tunnel make this (with the exception of the Schuyler Mine in North Arlington) the greatest underground copper mine in New Jersey. Under various mine managers from 1901-1905, the amount of new innovations and equipment and excavation on the site increased. In 1905 the mine was not worked and a little later the company went out of business. In 1907-1908 the Alpha Company took over the mine and updated it. They ran an experiment which showed that 10 to 12 tons of ore (fig. 3) would yield one ton of concentrate which would produce 60 percent copper (1200 lbs Cu). A few copper ingots were produced. In December 1909, however, the mine was shut down. The tunnels soon filled with water and the equipment was taken away. The site soon was in ruin. Today little evidence remains of this historic site.

On the west slope of the First Watchung Mountain approximately two miles northwest of the American Mine, the Hoffman Mine was situated. This was dug by the True Vein Copper Company of Philadelphia. In the early 1800's they sunk a main shaft 136 feet deep near the town of Pluckamin. It is reported that the vein of ore was four feet thick, "penetrating shale, sandstone, and basalt" (Woodward, 1944, p. 94). Native copper was reported in 1812 in the main vein. Examination of the mine tailings done in 1905 revealed that the ore was chalcocite, malachite, and chrysocolla in sandstone and brecciated basalt (Woodward, 1944, p. 95). The majority of mining was done in the Civil War period and very shortly there after. Little mining is documented here after 1868.

The next issue of *Unearthing New Jersey* will conclude the digest of copper mining attempts in the state with a survey of the mines in the areas of New Brunswick, Flemington, and Grieggstown.

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Pyrite (FeS_2) -- a pale-bronze or brass-yellow, cubic mineral. Pyrite is an important ore of sulfur; sometimes mined for the associated gold and copper, and commonly known as **Fool's Gold**.

Mike Serfes sailing into retirement. *Photo by Ann Serfes*

MIKE SERFES SAILS AWAY

Dr. Michael E. Serfes retired from the New Jersey Geological Survey in September 2009 after 23 years of service to the state. Mike began his work at NJGS in the Bureau of Groundwater Pollution Analysis, but spent most of his years doing geoscience research in the Applications Section in the Bureau of Water Resources. At retirement Mike was a Research Scientist heading the ambient ground water quality program. His research emphasis was on natural ground-water quality, arsenic in ground water, non-point source ground-water pollution, ambient water-quality network and lead in drinking water.

Mike used his expertise to assist many state agencies, most recently, as a co-investigator of arsenic contamination in groundwater. He helped develop treatment systems for removing arsenic from domestic wells. He was a leader in the arsenic study in Oxford Twp, Warren County, where the origin of arsenic in domestic wells was determined. Mike produced two groundbreaking reports for NJGS: *NJGS Geological Survey Report (GSR) 35, Natural Ground-Water Quality in Bedrock of the Newark Basin, New Jersey* and *GSR 39, Ground-Water Quality in the Bedrock Aquifers of the Highlands and Valley and Ridge Physiographic Provinces of New Jersey.*

Mike earned a Ph.D. in Geological Sciences from Rutgers University in 2005, an M.S. in Geological Sciences from Lehigh University in 1984, and a B.A. in Earth Sciences from University of Southern Maine in 1981. He was HAZMAT certified and a Certified Professional Geologist in the Commonwealth of Pennsylvania.

Prior to working at the NJGS, Mike served in the Air Force and was stationed at Fairchild Air Force base in Washington.

In 2000, Mike started teaching night classes at Bucks County Community College in Newtown, Pennsylvania. In 2006, he was appointed adjunct professor at Rutgers

University and began teaching earth science classes.

After retirement, Mike and his wife, Ann, sailed into the sunset--literally. They sold their house, put all their worldly possessions in storage and sailed the Intracoastal Waterway to the west coast of Florida. In his retirement, Mike plans to pursue a second career as a university professor, continue running in marathons and when time allows try to complete his goal of reaching of the highest point of every state. Mike had a lot of passion for his work and a great sense of adventure. Although he stays in touch with the NJGS, Mike is missed by all of his former colleagues.

Dave Hall at a Green Acres acquisition in Hopewell Township, Mercer County, searching for buried tanks and drums. *Photo by Mike McCann*

DAVE HALL RETIRES

On August 1, 2010, David W. Hall retired from the New Jersey Geological Survey after 25 years of service.

At the time of his retirement, Dave was a Section Chief for the Geoscience Research and Support Section in the Bureau of Water Resources, a position he had held since 2005. He was a major contributor to the field of geophysics in New Jersey. Dave participated in many geophysical projects while at NJGS including engineering, environmental and borehole geophysics, offshore seismic research, pollution site investigations using geophysical techniques, and archaeogeophysics. His dedication and professionalism were exemplified by his enthusiastic participation in the collection of samples during offshore seismic cruises even while suffering from severe sea sickness.

Dave co-authored many papers on geophysics and geology including: *Geological Survey Report (GSR) 17, Geophysical Investigations to Determine Bedrock Topography in the East Hanover-Morristown Area, Morris County, New Jersey*, 1989; *GSR 26, A Marine Seismic Survey to Delineate Tertiary and Quaternary Stratigraphy of Coastal Plain Sediments Offshore to Atlantic City, New Jersey,* 1991; and *GSR 37, Geophysical Investigation of the Potomac-Raritan-Magothy Aquifer System and Underlying Bedrock in Parts of Middlesex and Mercer Counties, New Jersey*, 1996. He also authored the Geophysics Techniques section included in the *NJDEP Field Sampling Procedures Manual*.

Dave earned his M.S. in Geology/Geophysics in 1982 from Western Michigan University, and received a B.S. in Earth Sciences in 1979 from Bridgewater State College in Massachusetts. He was HAZMAT certified to Level A and a Certified Professional Geologist in Pennsylvania.

Prior to joining the NJGS, Dave was an oil field geologist in Oklahoma working for Gulf Oil Corp. Dave was also involved in other aspects of geology. In 2006 he took a three-month sabbatical to lead geology tours as a volunteer for the National Park Service at the Northern Rim of the Grand Canyon. As an adjunct professor, Dave taught night classes in Earth Science at the College of New Jersey for five years.

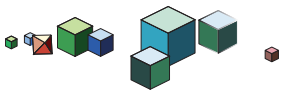
Dave is interested in auto mechanics and carpentry, which he plans to pursue in retirement. Dave had an extraordinary combination of scientific acumen, humility, concern for his colleagues, and love of animals. He was able and willing to mentor and educate those who were willing to listen and learn from his vast and varied knowledge and experience. Dave has a great sense of humor and a terrific boisterous laugh. He will be missed.

LET'S PLAY: GUESS THE MINERAL

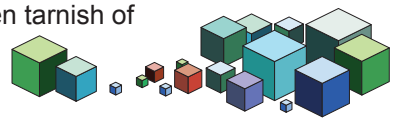
Here it is:

$$KAlSi_3O_8$$

Hint: This mineral provides the characteristic color to Pompton Pink granite.



Native copper is one of the few metallic elements to occur as a natural mineral, although it most commonly occurs mixed with other elements and in oxidized states. Native copper was an important ore in historic times. It typically forms irregular masses and has reddish, orangish and/or brownish color on fresh surfaces. When weathered it acquires a coat of green tarnish of copper (II) carbonate (verdigris).



Banner photographs by T. Pallis, J.H. Dooley & L.F. Müller

It was during my enchanted days of travel that the idea came to me, which, through the years, has come into my thoughts again and again and always happily--the idea that geology is the music of the earth.

--Hans Cloos--
Conversation with the Earth, 1954

OLDEST ROCK

The New Jersey Geological Survey (NJGS), teamed up with the U.S. Geological Survey (USGS) and the Australian National University (ANU) in a project funded by private grants to provide the most precise dating ever of New Jersey's oldest rocks.

Rich Volkert, a geologist with NJGS, and John Aleinikoff from the USGS in Denver, collected rocks from the New Jersey Highlands, which were then analyzed at ANU.

The rocks were shipped to ANU in Canberra, Australia where scientists used an intense beam of energy to measure the half-life of radioactive isotopes in zircon particles that contain lead and uranium. This method is known as the uranium-lead method of geochronology using the Sensitive High-Resolution Ion Microprobe (SHRIMP) technique.

Rich Volkert with Wanaque tonalite gneiss. *Photo by Kay Volkert*

The researchers were able to date the rocks to within nine million years of certainty, a degree of specificity never attained before. They found that the rocks are actually quite a bit older than the generalized billion-year-old estimate ascribed to them. Most of the rocks fell in a range of 1.02 billion to 1.25 billion years old, but a narrow belt stretching from Wanaque to Ringwood was dated at 1.37 billion years old, making these the oldest rocks in New Jersey.

"Rocks of the New Jersey Highlands form the roots of the ancestral Appalachian Mountains that were formed during a collision of continental land masses about one billion years ago," Volkert said. "The result of this mountain-building event uplifted the earth's crust in eastern North America, including the Highlands, to heights rivaling the present-day Rocky Mountains."

"Unraveling the geologic history of the Highlands . . .," said State Geologist Karl Muessig." . . . has practical applications for environmental risk assessment. For example, potassium-rich granites of a certain age . . . contain higher concentrations of radioactive elements than most other granites and are likely to produce higher radon levels in soil and water. More precise mapping of these granites will help better identify areas that may pose greater public health risks from radon."

NEW PUBLICATIONS

Effective January 28, 2011, only a limited number of items are available for sale. Visit our website for details.

DIGITAL GEODATA SERIES (DGS)
NEW DATA. DGS 10-1, *Dielectric Permittivity as a Function of Water Content for Selected New Jersey Soils*. Excel workbook available for download.

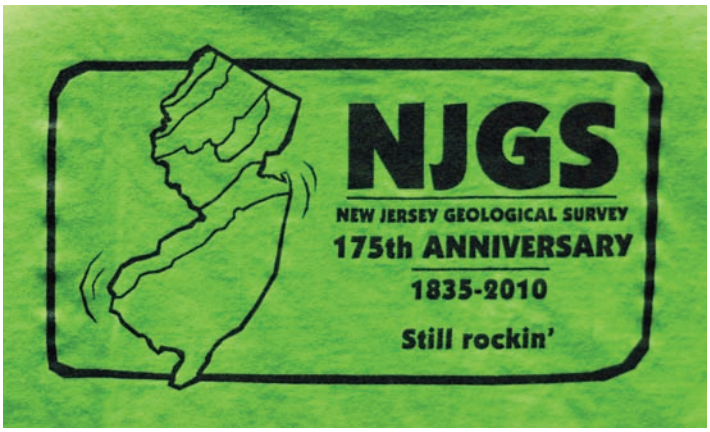
GEOLOGIC MAP SERIES (GMS)
NEW MAP. GMS 10-1, *Bedrock Geologic Map of the Pompton Plains Quadrangle, Passaic, Morris, Bergen, and Essex Counties, New Jersey*, Volkert, Richard A., 2010, scale 1 to 24,000, size 29x46, 1 cross-section, 4 illus. $10.00. Available for download.

NEW MAP. GMS 10-2, *Geologic Map of the Woodmansie Quadrangle, Burlington and Ocean Counties, New Jersey*, Stanford, Scott D., 2010, scale 1 to 24,000, size 36x46, 2 cross-sections, 1 table, 4 illus. $10.00. Available for download.

OPEN-FILE MAPS (OFM)
NEW MAP. OFM 78, *Bedrock Geology of the Long Branch Quadrangle, Monmouth County, New Jersey*, Stanford, Scott D. and Sugarman, Peter J., 2010, scale 1 to 24,000, size 36x42, 3 cross-sections. $10.00. Available for download.

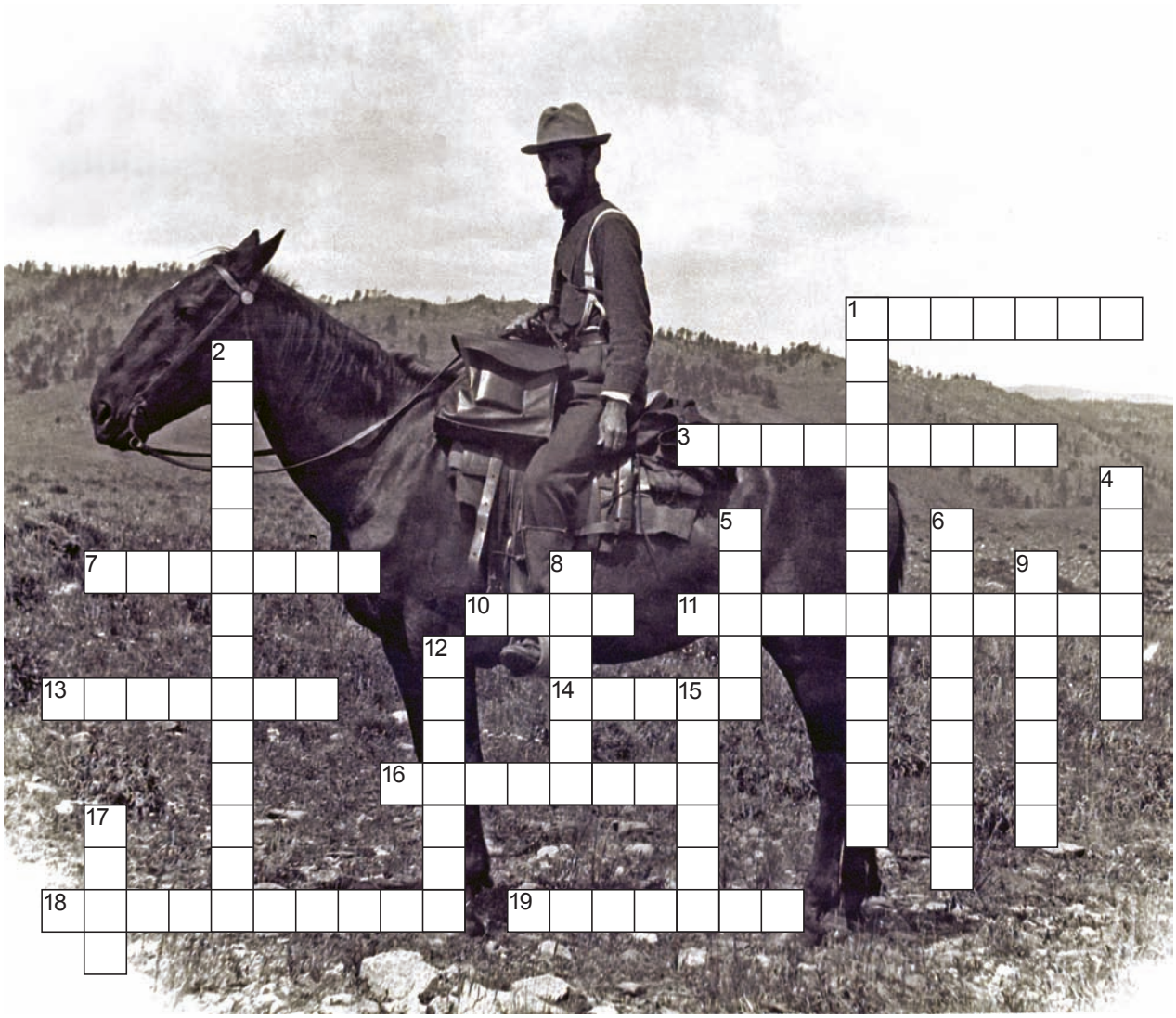
NEW MAP. OFM 79, *Surficial Geology of the Hackettstown Quadrangle, Morris, Warren, and Hunterdon Counties, New Jersey*, Stanford, Scott D., 2010, scale 1 to 24,000, size 36x45, 2 cross-sections, 2 illus., 18-page pamphlet. $10.00. Available for download.

NEW MAP. OFM 80, *Surficial Geology of the Allentown Quadrangle, Burlington, Mercer, and Monmouth Counties, New Jersey*, Stanford, Scott D., 2010, scale 1 to 24,000, size 33x36, 2 cross-sections. $10.00. Available for download.



Staff T-shirts at the 102nd Annual Association of American State Geologists Conference in June 2010, hosted by NJGS and held at Rutgers University, New Brunswick, New Jersey, proclaimed our 175th anniversary in celebratory day-glo green. The Survey was established on February 19, 1835 and has been proudly serving the State of New Jersey ever since.

CROSSWORD ANACHRONISMS



Henry B. Kummel, 5th State Geologist (1901-1937) of the New Jersey Geological Survey, heading out to do field work, circa 1898. *In the collection of NJGS, photographer unknown.*

ACROSS

1. Anaerobic conditions with toxic bottom waters, such as a fjord
3. Plateau bordered by abrupt clifflike edges
7. Long, irregular, sharp-crested, undercut ridge carved by wind erosion
10. Tool, pointed at one or both ends
11. Forked wooden stick used to locate ground water
13. Straight-edge ruler carrying a sighting device
14. Gradual change in a reference reading that is supposed to remain constant
16. Igneous rock having a relatively low silica content
18. Surveying instrument to plot lines of survey directly from observations
19. Overflowing of a stream caused by heavy rains

DOWN

1. Feature that develops as part of plate tectonics
2. Early mechanical agnetometer
4. Pillar of rock produced in a region of sporadic heavy rainfall
5. Surficial, unconsolidated rock debris transported from one place and deposited in another
6. Almost featureless plain, produced by fluvial erosion
8. Igneous rock composed predominately of light-colored minerals having a relatively low specific gravity
9. Compass used to take bedrock measurements
12. Paralic sedimentary facies
15. Crumbly or fissile materials that slides or flows
17. Means of transport to a field site

Cu

ACROSS: (1) Euxinic, (3) tableland, (7) yardang, (10) pick, (11) divining rod, (13) alidade, (14) drift, (16) basic, (18) plane table, and (19) freshet. **DOWN**: (1) Eugeosyncline, (2) Schmidt balance, (4) hoodoo, (5) drift, (6) peneplain, (8) acidic, (9) Brunton, (12) molasse, (15) flysch and (17) mule.