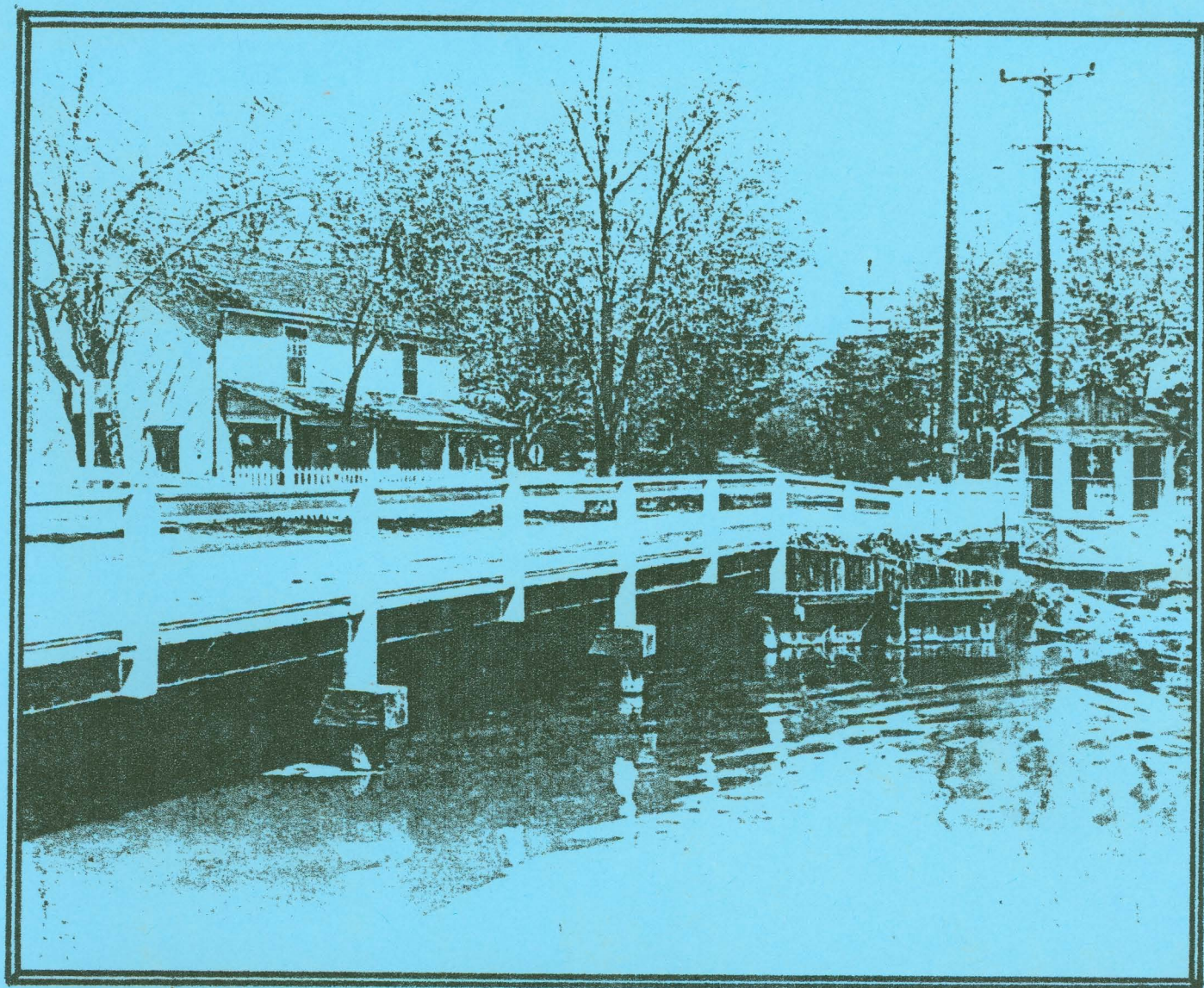


GEOLOGY OF SOMERSET COUNTY IN BRIEF



BLACKWELL'S MILLS CANAL HOUSE & TOLL BOOTH

NEW JERSEY GEOLOGICAL SURVEY

STATE OF NEW JERSEY

**Department of Environmental Protection
Rocco D. Ricci, Commissioner
Glenn L. Paulson, Assistant Commissioner**

**Bureau of Geology and Topography
Kemble Widmer, State Geologist**

GEOLOGY OF SOMERSET COUNTY IN BRIEF

by

**Debra Tobiasen
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1978

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GEOLOGY OF SOMERSET COUNTY IN BRIEF

Topography

Somerset County is located in north-central New Jersey and lies within three physiographic provinces. About 16 square miles near Gladstone, Peapack, and Bernardsville lie within the New Jersey Highlands section of the New England Physiographic Province. This area consists of flat-topped ridges underlain by highly resistant Precambrian igneous and metamorphic rocks. The valleys are underlain by less resistant Paleozoic limestone. A small isolated area, less than one square mile, of sands and gravels of the Atlantic Coastal Plain Province occurs in the southeastern section of the county atop Little Rocky Hill. The majority of the county is within the Piedmont Province and is underlain by conglomerates, sandstones, shales, argillites and diabase of the Triassic Newark Group. The most interesting geomorphic features in the county lie within this province.

The First, Second and Third Watchung Mountains are located in the northeastern section of the Piedmont Province. During Late Triassic and Early Jurassic time at least three major periods of volcanic eruptions occurred here, resulting in the accumulation of extensive basaltic lava sheets which formed the Watchungs. The horseshoe-shaped outline of these mountains readily identifies them on a topographic map. Lava which did not reach the surface formed dikes and sills in the Rocky Hill and Sourland Mountain areas. These large intrusives are probably part of the same mass of lava that formed the Palisades, the 400 foot high cliff along the west bank of the Hudson River.

Sourland Mountain is located in Hillsborough Township and extends into Hunterdon and Mercer Counties. It rises to an elevation of about 500 feet. The top of the mountain is a fairly flat-topped plateau with

small valleys flanking its sides. Some of the valleys are drained by intermittent streams, but the primary drainage is into Rock Brook, a constantly flowing stream which drains the southeast.

Roaring Brook is a geologically unusual stream along the northeastern flank of Sourland Mountain. Its channel is occupied by large boulders of diabase. The stream, which is not visible but very audible, flows beneath these boulders. The constant flow of water has washed out the finer material, leaving the large boulders in place within the stream's channel. Roaring Brook derives its name from the tremendous roar emitted by its tumbling waters during periods of excess rain or snow.

Most of Somerset County is within the Raritan River Drainage Basin. The North Branch which drains the northwestern area and the South Branch which drains the southwestern area meet in a central section of the county at Duke Island Park. From this point, the Raritan flows eastward and then southward along the Somerset-Middlesex County line to the Raritan Bay.

During the last glacial advance, ancient Glacial Lake Passaic filled the broad valley of the Watchung Mountains in the northeastern section of Somerset County. Today, a low-lying marshy area remains in reminder of the extinct glacial lake.

Precambrian

Exposures of Precambrian rock in Somerset County are limited to a few square miles in the Highland Province. These rocks were once igneous rock or sediments composed of sand, lime and mud that were subsequently altered by metamorphism. As a result of the chemical and physical changes caused by metamorphism, these rocks, sands and muds were transformed to gneisses, granular crystalline rocks with alternating bands of light and dark minerals.

Life during the Precambrian Era consisted of abundant soft-bodied forms that lived in the shallow seas that once covered New Jersey. Since soft-bodied animals do not preserve well and because metamorphism generally destroys any evidence of fossilization, the Precambrian rocks in New Jersey do not contain fossils. However, flecks of graphite occurring within the gneiss might represent carbon from ancient life forms which have been subsequently metamorphosed.

Paleozoic Era

Shallow seas repeatedly advanced and retreated across the eastern United States during the Paleozoic Era, depositing thick accumulations of sediment in a deep trough which extended from Newfoundland to Alabama. Parts of New Jersey were inundated during this time and the nature of the material deposited reflects environmental conditions at the time of deposition. Of the several thousand feet of Paleozoic sediment which were probably deposited in Somerset County, only a few exposures representing two formations, the Hardyston Quartzite and the Kittatinny Limestone, are visible today. The Hardyston Quartzite of early Cambrian age was formed from clean sands and gravels rounded by early Paleozoic beaches. The Kittatinny Limestone, deposited during the Cambrian and Ordovician Periods, consist of great thicknesses of carbonate minerals which were deposited in warm shallow seas. Its presence indicates that New Jersey had a tropical or subtropical climate 500 million years ago.

Mesozoic Era

Somerset County underwent major periods of geomorphic alteration during the Mesozoic Era. During the early Triassic Period the landmasses which formed the supercontinent of Pangea separated, forming the continents

of North America, Africa and Eurasia. Prior to the breakup of Pangea, New Jersey was adjacent to northern Africa, probably near Morocco. Due to tensional forces, the land areas bordering the entire length of the break dropped downward, creating large normal faults or rift valleys on the margins of the continents. The geologic processes which formed the Triassic rift valleys are very similar to the processes operating upon the rift valleys in East Africa today.

The Newark Basin is one of these large down-dropped blocks and is a result of the continental rifting which affected New Jersey in the Late Triassic and Early Jurassic. These rift zones permitted the extrusion of the Watchung basaltic lava flows and the intrusion of diabase sills in the Palisades, Sourland Mountain and Rocky Hill areas. The Piedmont Province of Somerset County lies entirely within the Newark Basin, known otherwise as the Triassic Lowlands.

Three major formations, the Stockton Sandstone, the Lockatong Argillite and the Brunswick Shale, known collectively as the Newark Group, were being deposited within the Newark Basin during the Late Triassic and Early Jurassic. During the Late Triassic, arkosic sands were eroded from the Appalachian Mountains and New Jersey Highlands, then deposited within the Newark Basin, creating the Stockton Sandstone Formation. Gradually, accumulations of these sands and gravels blocked longitudinal drainage within the basin and, as a result, Lake Lockatong was formed in the central portion of the basin. As sandstone deposition ceased, lacustrine sedimentation began and the banded shales and argillites characteristic of the Lockatong Formation were deposited. Eventually the lake began drying up, leaving a broad mudflat area with poorly developed drainage in its place. At this point in time, spanning from late Triassic to

early Jurassic, the Brunswick Formation of red iron-rich muds and dark gray shales was deposited along the shores of the mudflats.

Also about this time a fissure eruption extruded approximately 600 feet of basalt atop a 30 mile long area of the recently deposited Brunswick Formation. This extrusion created the ridge of the First Watchung Mountain which was subsequently covered with 600 feet of silts, sands and muds before a second series of basaltic eruptions occurred forming the Second Watchung Mountain. Approximately 1500 feet of sediment was deposited atop this flow before the third and last series of lava eruptions occurred in the Early Jurassic, forming the Third Watchung Mountain. Throughout this period the Newark Basin continued to subside, with the greatest subsidence occurring along the northwest border of the basin adjacent to the New Jersey Highlands. This subsidence is responsible for the northwestward bend of the Watchung lava flows.

Geologists have long debated the probable existence of Jurassic sediments in New Jersey, but re-examination of facts and more research have solved the problem. Recently examined fossil evidence indicated that the upper sediments of the Newark Group are transitional between the Triassic-Jurassic boundary. Fossil assemblages also indicate an Early Jurassic age for the uppermost beds of the Brunswick Formation. The Watchung lava flows, which were extruded atop these sediments, have yielded radiometric dates that fall within the range of the Early Jurassic. These, among other facts, indicate that New Jersey seems to have Jurassic, as well as Triassic sediments.

Deposits characteristic of the Atlantic Coastal Plain Province outcrop in the southeastern corner of Somerset County. These deposits reflect several periods of marine encroachment and regression, indicating

that sea level fluctuation was a phenomenon that affected areas throughout the world during this time.

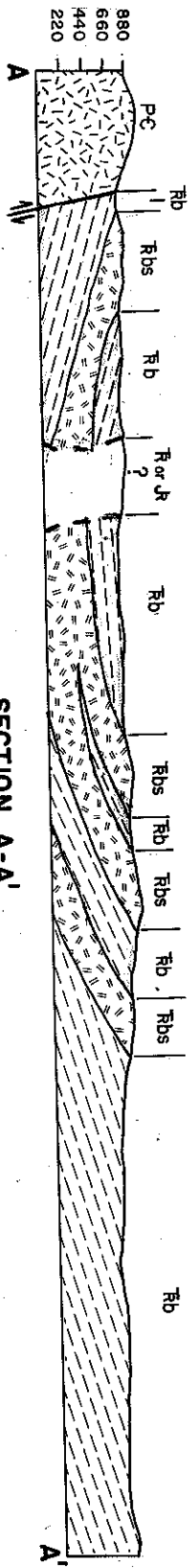
Cenozoic

During the early part of the Cenozoic Era, Somerset County underwent a protracted period of erosion. By the end of the Miocene Period, 13 million years ago, this area had been reduced to a broad low area with meandering drainage to the southeast. After Miocene time, gradual uplift occurred in areas north of Somerset County creating an increase in stream gradient. This caused the streams to flow faster and to have more erosive power. As a result, the softer, less resistant and severely fractured material was eroded away, forming valleys, and the more resistant rocks remained, forming ridges.

The major events of the latter, or Quarternary Epoch, were the waxings and wanings of the Pleistocene continental ice sheets. At its greatest extent, the Wisconsin glacier's southernmost edge entered the northern region of New Jersey. Although Somerset County was not glaciated, it felt the effects of the ice as it retreated. A lobe of ice blocked the northeastern passage of the Watchung Mountains and glacial meltwaters accumulated in front of the ice within the Watchung valley, creating the now extinct Glacial Lake Passaic.




GEOLOGIC CROSS-SECTIONS OF SOMERSET COUNTY

New Jersey Geological Survey 1978

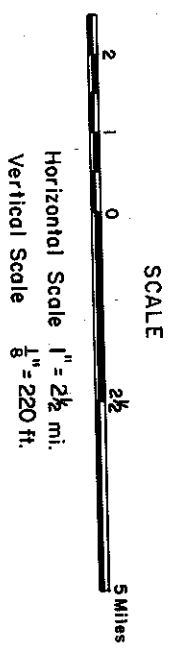


SECTION A-A'

LEGEND

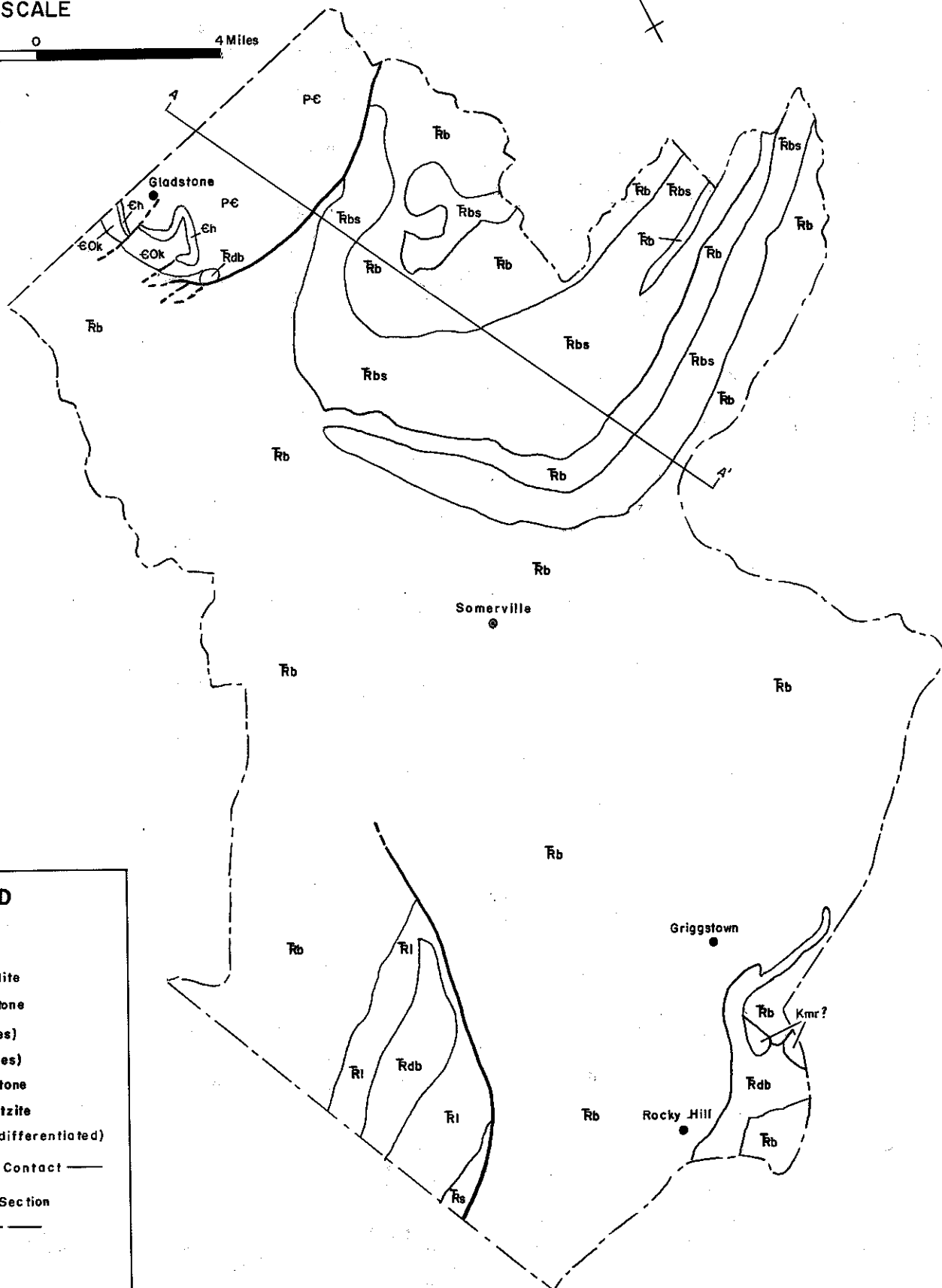
-  Rbs Triassic Basalt
-  Rb Brunswick Formation
-  PC Precambrian (Undifferentiated)

NOTE:
Rbs may be transitional between
Triassic and Jurassic.



GEOLOGIC MAP OF SOMERSET COUNTY

SCALE



LEGEND

- Kmr — Magothy Raritan
- Rb — Brunswick Shale
- Ri — Lockatong Argillite
- Rs — Stockton Sandstone
- Rbs — Basalt (Extrusives)
- Rdb — Diabase (Intrusives)
- COk — Kittatinny Limestone
- Ch — Hardyston Quartzite
- PC — Precambrian (Undifferentiated)

Fault — Formation Contact —

A — A' Cross Section

County Boundary — — —

NOTE:

Rbs may be transitional between Triassic and Jurassic.

SOMERSET COUNTY'S MINERAL RESOURCES IN BRIEF

The mineral resources of Somerset County consist of abandoned copper deposits in the Watchungs, diabase intrusives, known to quarrymen as trap rock, in the Rocky Hill area and minor quantities of clay and shale around Somerville. The annual value of mineral production in Somerset County for the mid-1970's was about 20 million dollars and was derived almost entirely from trap rock.

The outer rim of the First Watchung Mountain has been the exploratory site for most of the mining endeavors. Many of these were first prospected during colonial times. It has been widely documented that during the American Revolution, when Washington's troops were encamped in the New Jersey area, strenuous efforts were made to extract copper from the sandstone immediately below the First Watchung Mountain in order to forge a brass cannon. This legendary cannon was later used in the seizure of Yorktown.

These mines were subsequently abandoned and reopened during the mid and late 1800's. The Bridgewater Company was installed at Chimney Rock in 1824, but the volume of ore mined was not sufficient to cover operating costs. In 1835, the Washington Mining Company bought a 150 acre site adjacent to the Bridgewater mine. Water flooding into the mine became a serious problem and could not successfully be removed by their crude pumps; as a result, this attempt also failed. The American Copper Company took over the Bridgewater property and other small holdings in 1881. The quantity of ore obtained was minimal, therefore the mine ceased operation in 1883. This mine was reactivated in 1908, for the last time, by the Alpha Copper Company. With its innovative electrical equipment, the mine operated through 1910, but its inevitable closing came in late December of

that year. Remnants of these old mines still remain in documentation of the fruitless but persistent efforts to extract copper from this region.

Today, Somerset County ranks first in the state in production of stone commodities: concrete aggregate, roadstone, riprap, railroad ballast, roofing granules and filler material. Some of the stone is basalt and traprock mined at the Martinsville, Bernardsville and Rocky Hill quarries. One granite quarry is operated at Bernardsville. Gray sandstone mined close to the town of Martinsville has been used as building stone for churches in Somerville with satisfactory results. The clay and shale mined near Somerville are used in the production of face brick and sewer pipe.

As people migrated westward during colonial times, they were enticed by the fertile farmland of Somerset County and many settled there. The Somerset County area, together with the Hackensack valley, were famous for their rich soils, which were partially responsible for New Jersey getting the name of the "Garden State."

GEOLOGIC TIME SCALE

Geologic time intervals are unequal subdivisions of the earth's history corresponding to earth's geologic events. Eras are the longest divisions of time and contain many periods which are further subdivided into epochs. Formations, which are mappable units of rock or sediments, usually have lithology or characteristic distinctions and are assigned to that period or epoch during which they are formed.

A formation's place within the stratigraphic column is determined by the predominant form of life preserved as fossils within the rocks or sediments. If fossils are lacking, a formation's location in the time scale may be determined by its relationship to previously dated units. Only recently have geologists been able to place an absolute date on these relative time units by radioactive methods.

The geologic column is used throughout the world, although some regional modifications may be used for greater clarity.

In the accompanying stratigraphic column, the rock type given after the name is the most common variety found in the county. There may be variation of lithology within the formation from place to place.

GEOLOGIC TIME SCALE - SOMERSET COUNTY

Era	Period	Epoch	Formation	No. of Million Years Ago	Geologic Events	Life Forms
CENOZOIC	Quaternary	Recent	Soil and alluvium	2.5	Erosion and deposition	Reign of man
		Pleistocene	Not present in county		The Great Ice Age	Woolly mammoths and mastodons; man
	Tertiary	Pliocene	Not present in county	7	Advance and retreat of Tertiary seas across N.J. Coastal Plain	Reign of mammals, whales, sea cows, rhinos.; bryozoans, echinoids, forams, annelids, mollusks
		Miocene		26		
		Oligocene		38		
Eocene		54				
	Paleocene	65				
MESOZOIC	Cretaceous		Not present in county		Sea floor spreading; advance & retreat of seas	Dinosaurs; crocodiles
	Jurassic	Late Middle	Not present in county	136	No. America, Africa and Eurasia drift apart	Dinosaurs; flying reptiles
		Early	Watchung Basalts Brunswick Shales	190	Palisades Disturbance	Aquatic reptiles, fish
	Triassic	Late	Watchung Basalts Diabase intrusives Lockatong Argillite Stockton sandstone	225	Watchung lava flows Palisades intrusion Newark Rift Valley formed; sea floor spreading	Fossil fish of Newark Group; dinosaurs; belemnites
PALEOZOIC	Permian		Not present in county		Ice Age; Appalachian Mt. formed; No. America, Africa and Eurasia collide	First mammals; rise of reptiles
	Carboniferous		Not present in county	280	Coal deposits	Great fern forests; amphibians dominate land
	Devonian		Not present in county	345	Extensive shallow seas	Brachiopods; Age of Fishes; first amphibians
			Not present in county	395	Extensive shallow seas	Eurypterids; first land plants; reef formers
	Silurian		Not present in county	430	Extensive shallow seas	Graptolites, trilobites, bryozoans
	Ordovician		Kittatinny Limestone	500	Extensive shallow seas; sea floor spreading	Age of trilobites, brachiopods, worms, gastropods
			Hardyston Quartzite	570	Extensive shallow seas, continents drift apart	
PRECAMBRIAN			Basement rock		Creation of N.J. Highlands Continental cores formed	Algae, bacteria, fungus

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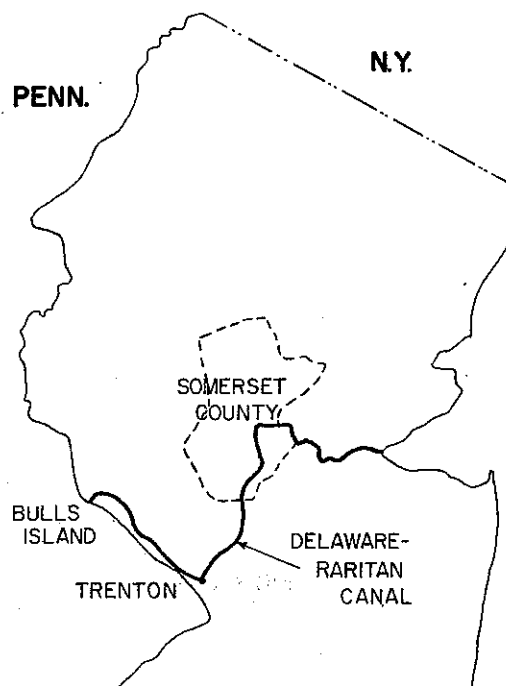
ABOUT THE COVER

The Delaware-Raritan Canal was opened to traffic in 1834. Its purpose was to hasten the shipment of coal between Reading, Pa., and New York by eliminating the long route down the Delaware River and around Cape May.

The Delaware-Raritan Canal feeder begins at Bulls Island and follows the Delaware River southward to Trenton. At Trenton the canal turns north-eastward toward Princeton. From there it follows the Millstone River to the Raritan. It flows eastward along the banks of the Raritan River, which it follows to sea level at New Brunswick.

1871 was the peak traffic year for the canal. Steamboats, sailing vessels, canal boats and rafts transported 2,990,095 tons of cargo, of which 2,526,925 was coal, along this route. The canal operated 12 hours a day, 250 days per year from 1834 to 1933. As more efficient systems of transportation were developed, the usefulness of the canal declined.

Today the 20 miles of canal which flows through Somerset County serves, in conjunction with the Raritan and Millstone Rivers, the water and recreational needs of the county. Bikers, canoeists and hikers enjoy the scenic beauty of the canal area.



COVER COURTESY OF
DELAWARE-RARITAN CANAL COMMISSION

PHOTOGRAPHED BY JAMES C. AMON

