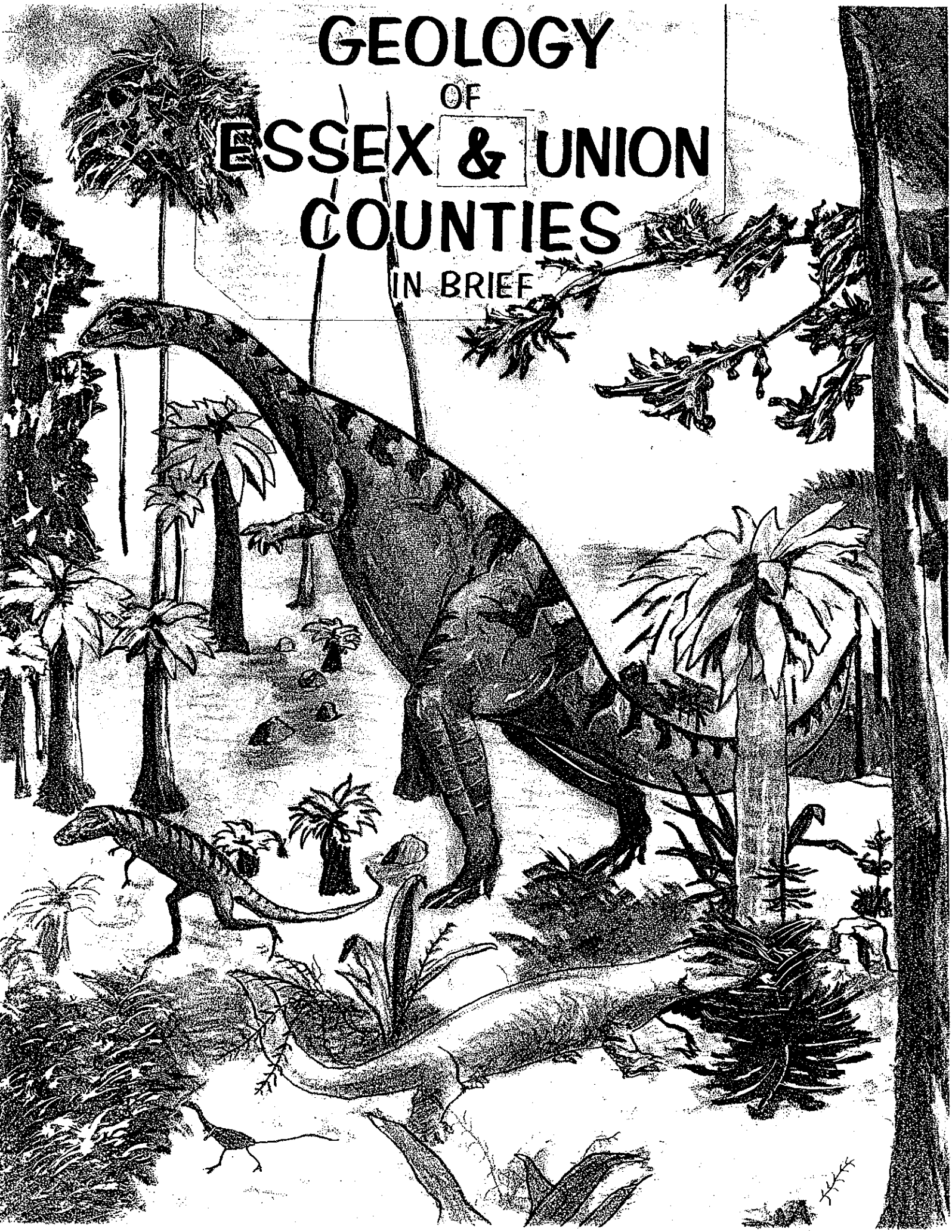
GEOLOGY OF ESSEX & UNION COUNTIES IN BRIEF



STATE OF NEW JERSEY

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Bureau of Geology and Topography
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GEOLOGY OF ESSEX AND UNION COUNTIES IN BRIEF

by

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Topography

Essex and Union Counties lie entirely in the Piedmont Physiographic Province which is characterized by a plateau and high area. The province is chiefly a plain with gently rounded hills separated by wide valleys which slope downward toward the east and southeast. In the counties, the Piedmont plain extends to the southeast and is composed of sedimentary sandstone and shale and the high area to the northwest is composed of igneous basalt of the First and Second Watchung Mountains. The present topography is a result of the modification by glacial material, which blankets the area with as much as 250 feet of sand, silt, clay and boulders.

Elevations range from sea level at the Newark Bay to 521 feet above sea level in the First Watchung Mountain. The major drainage is from the Passaic, Rahway, and Elizabeth Rivers.

The wide low plain of the Piedmont serves as a major north-south corridor for the movement of goods and people between the cities of New York and Philadelphia. This is the reason for the high population density of Essex and Union Counties.

Geologic History

Proterozoic Era

Precambrian Period -- The oldest rocks in the county are not visible on the surface but compose the "basement" on which the Piedmont Plain sediments have been deposited. This rock was originally deposited as thousands of feet of sediment. After deep burial, these rocks were subjected to folding, faulting, and compression coupled with increased heat and pressure, metamorphosing the rocks. Molten igneous rock then intruded the metamorphosed sedimentary

rock, causing further alteration. These alterations formed metamorphic gneiss, a coarsely grained rock in which light and dark colored bands can be distinguished.

Life during the Precambrian was probably plentiful but primitive. Most forms were soft bodied so that preservation was almost impossible. In New Jersey there is no fossil evidence in the gneiss.

Mesozoic Era

Following Precambrian time, the next period from which there is evidence within the counties is the Triassic. Therefore, the entire Paleozoic Era and the Jurassic Period are missing from this part of New Jersey. During the Paleozoic, there was deposition elsewhere in New Jersey, but only fragments of Paleozoic rocks are found in the Triassic sediments of Essex and Union Counties.

The specific Paleozoic events in the local geologic history of Essex and Union Counties cannot be deciphered completely because all evidence used in reconstructing the geologic history during Paleozoic times is found beyond the borders of the counties.

Triassic Period -- In the later part of the Triassic Period a widespread earth movement affected Essex and Union Counties. During this episode, to the northwest of the counties a group of mountains called the New Jersey Highlands were uplifted, while the areas to the east were depressed. Following this uplift, a series of discontinuous intermontane basins were formed from Nova Scotia to North Carolina. The present Piedmont region of New Jersey formed the northern end of one of these basins and extended from southeastern New York and central New Jersey, southwest across Pennsylvania and Maryland to Virginia.

During this time the climate in the area was arid with seasonal torrential rains. When the rains caused streams to erode the Highlands, large amounts of sand and silt were carried in broad alluvial fans into the adjacent lowlands. The sediments deposited during this time have been referred to as the Newark Group. The group includes four types of sedimentary rock: arkose, red shales and associated pink sandstone, argillites, and a coarse conglomerate.

Red sandstone and shale are the only sedimentary rock types occurring in Union and Essex Counties and the formation is termed the Brunswick. The characteristic red color of the sediments resulted from iron-bearing minerals which were oxidized during the cyclic wetting and drying of the sediments which occurred with deposition.

The activity at the beginning of this time caused faults to be formed. These breaks formed fractures into which igneous magma gradually intruded until it overflowed onto the surface as lava. Three periods of igneous activity occurred during the time of sedimentary deposition. At least one flow occurred during deposition of the Brunswick shale. These lava or basalt flows compose the First and Second Watchung Mountains.

The bottom of the lava flows cooled quickly and, as a result, the rock is fine grained and dense while at the top of the flow it is porous and spongy due to escaping bubbles of steam and other gases as the lava cooled and solidified. Since the basalt or lava is more resistant to erosion than the Brunswick shale, it has not been worn down as fast as the surrounding rock.

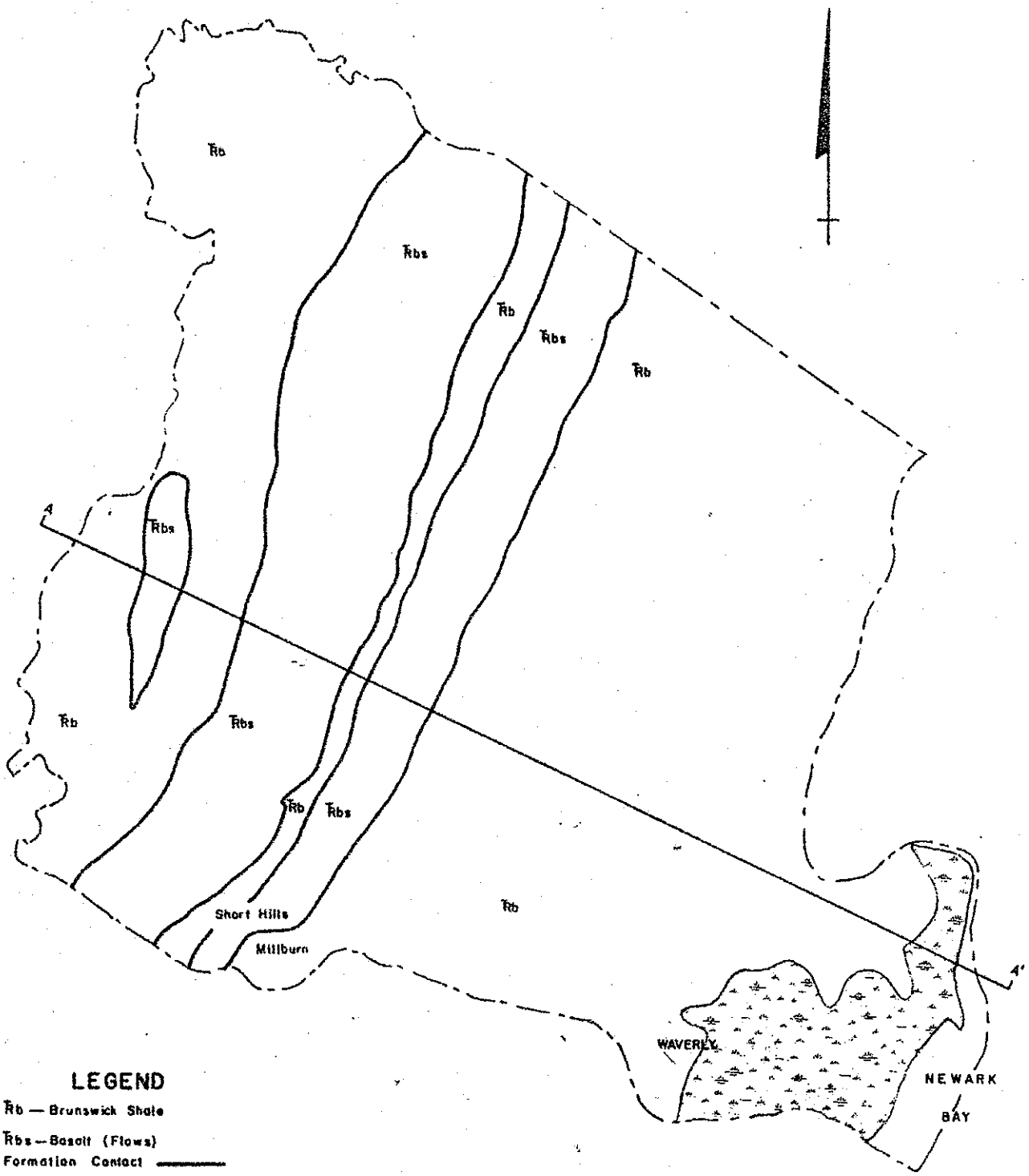
The arid climate prevailing during red bed deposition was not favorable for preservation of plants, but leaf impressions sometimes are found in dark gray beds formed under more favorable conditions during the wetter, but semi-

arid, cycles of the Triassic climate. Vertebrates were evolving rapidly and much evidence can be found for their existence. Very few finds have been made in Union and Essex Counties, though dinosaur tracks probably are abundant but have not been discovered because rock surfaces are rarely exposed in an area which is so densely populated. Fish and small shells are found in the Triassic lake bed deposits, but as yet none have been found in Union and Essex Counties.

Erosion was the dominant geologic process during the Jurassic Period in New Jersey, so that no rocks occur. During the Cretaceous, seas from the southeast invaded southern New Jersey. The lack of preserved sediments make it impossible to say whether or not strata of this age were deposited in Union or Essex County.

Cenozoic Era

Tertiary Period -- Deposition of Coastal Plain sediments continued in southern New Jersey and erosion continued in the counties. The topographic surface was reduced to a peneplain called the Schooley Peneplain, named after Schooley Mountain in Warren County, during the early Tertiary Period. A peneplain is a gently sloping surface of little relief upon which streams meander toward the sea. Remnants of this peneplain can be seen in the concordant crests of the Poconos in Pennsylvania; the Kittatinny Mountains in Sussex and Warren Counties, and the New Jersey Highlands in Sussex, Warren, Hunterdon, Morris, Passaic and Bergen Counties; and the Watchungs in Essex and Union Counties. Many streams flowed on this surface and the less resistant shales and sandstones eroded more rapidly than the resistant basalt ridges. The ancestral equivalents of the Rockaway River most likely played an important part in the development of the valley in Union County. The lowest surface which is presently being formed by the floodplain of the Rockaway River is called the Somerville erosion surface or peneplain.



LEGEND

Rb — Brunswick Shale

Rbs — Basalt (Flows)

Formation Contact ———

A ——— A' Cross Section

BOUNDARIES

County ——— – ——— – ———

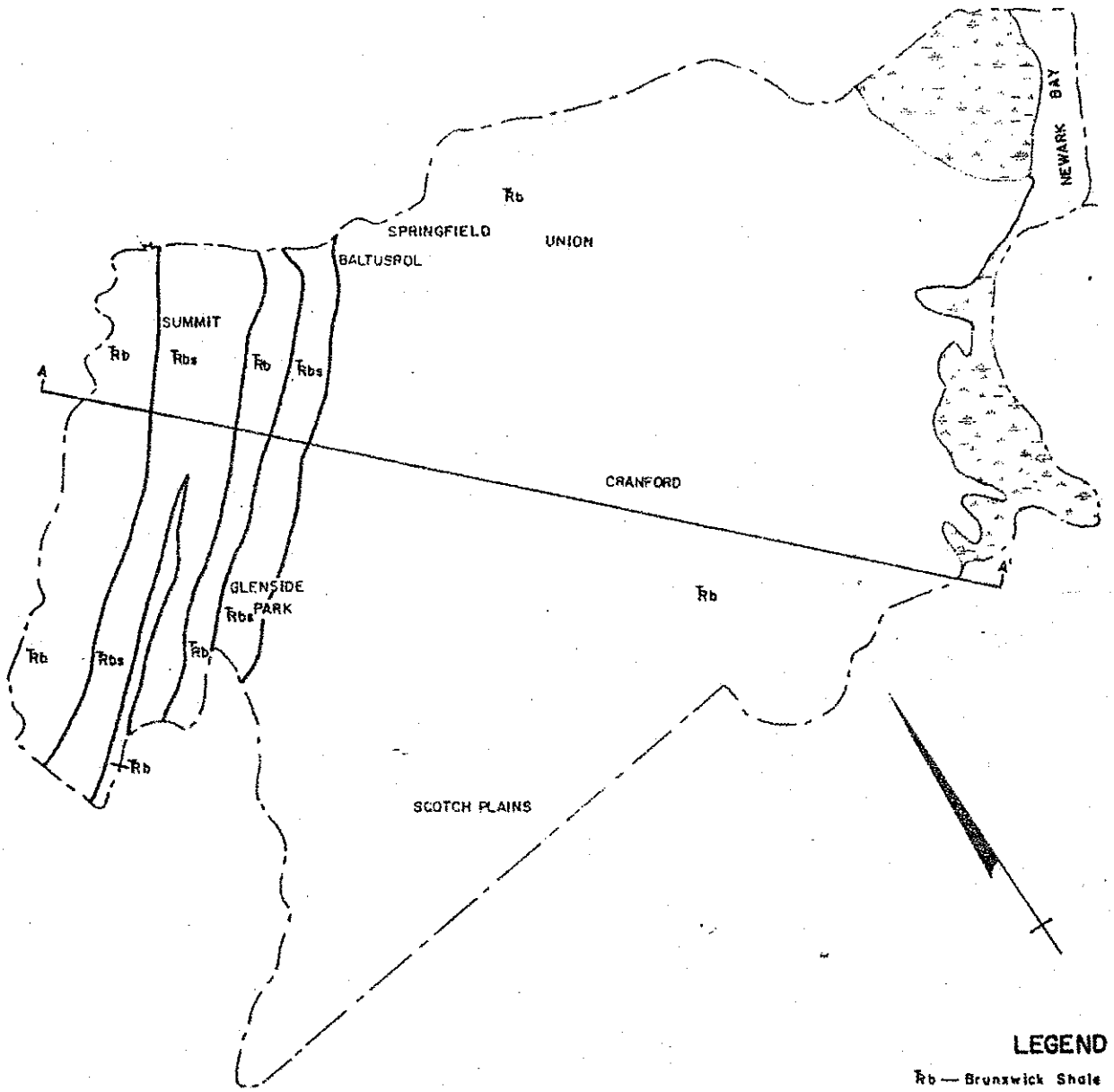
NOTE:
Surficial Quaternary deposits not shown.

Base Map Atlas Sheet No. 40

GEOLOGIC MAP
OF
ESSEX COUNTY

SCALE

4 3 2 1 0 4 miles



LEGEND

Rb — Brunswick Shale

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Formation Contact ——————

A —— A' Cross Section

BOUNDARIES

State ——— -- ———

County ——— -- ———

NOTE:
Surficial Quaternary deposits not shown.

Base Map Atlas Sheet No. 40

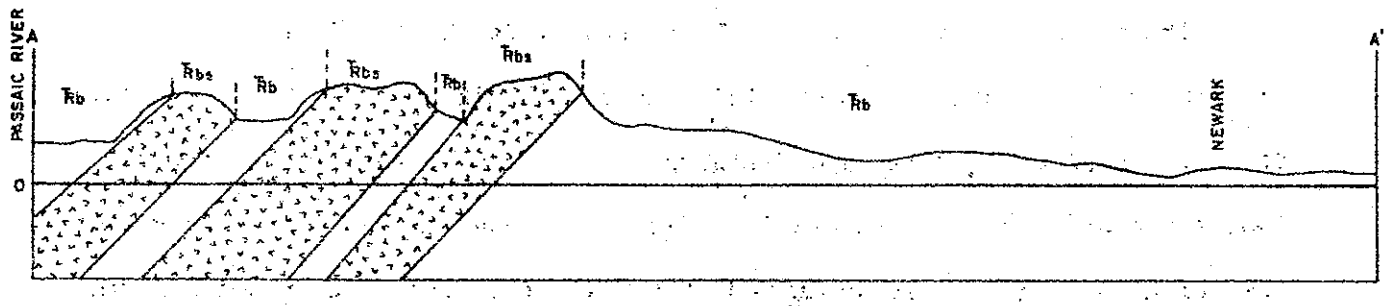
GEOLOGIC MAP
OF
UNION COUNTY

SCALE

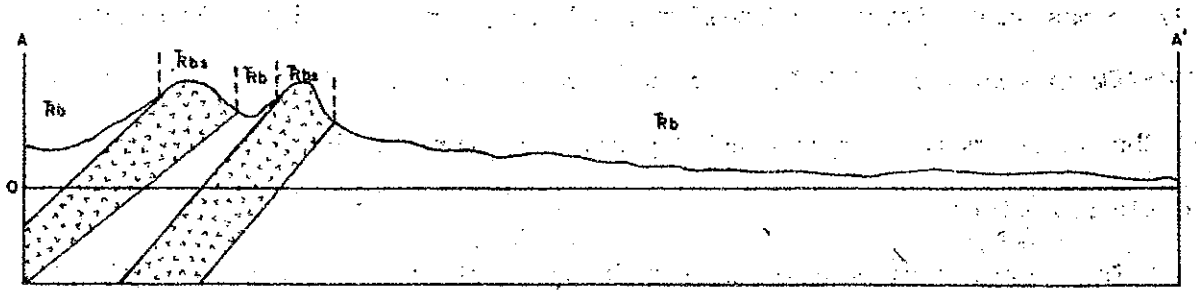
4 3 2 1 0 4 miles

GEOLOGIC CROSS SECTIONS
OF
ESSEX AND UNION COUNTIES

New Jersey Geological Survey 1974



ESSEX COUNTY



UNION COUNTY

LEGEND

Rb Brunswick Formation

Rbs Basalt Flow

SCALE

4 3 2 1 0 4 miles

Horizontal Scale: 1.3" = 4 Miles

Vertical $\frac{1}{10}$" = 200 Feet

Quaternary Period

Pleistocene Epoch -- Commonly known as the Ice Age, the Pleistocene Epoch represents the last million years of geologic history. The epoch is divided into four glacial and three interglacial stages. Three glacial advances reached New Jersey. In the last glacial stage, the Wisconsin, ice advancing from the north and northwesterly direction covered part of Essex and Union Counties.

The major glacial feature in Union County is the terminal moraine stretching from south of Scotch Plains north to Baltusro. In Essex County it occurs near Short Hills and Millburn. A terminal moraine marks the maximum southward advance of a glacier. It is composed of a heterogeneous mixture of clay, sand and stone dumped at the front of the glacier which forms a ridge-like accumulation of drift more or less discontinuous, broken by gaps, most of which mark the places where meltwater streams existed.

North and south of the moraine the rock surface is covered, generally, by drift deposits, stratified and unstratified. The unstratified drift or till is an unsorted mixture of boulders, pebbles, sand and clay. The stratified drift is composed of beds of clay, sand and gravel, which in the process of deposition were assorted and deposited by streams fed by water from the melting glaciers.

It is assumed that none of the drift was derived from regions north of New Jersey and that erosion did not exceed 25 feet in most places. Comparison of the topography in areas to the north and south leads to the conclusion that the ice sheet did not greatly erode the surface over which it passed in Essex and Union Counties. It is estimated that the ice stagnated in Essex and Union Counties for over 200 years.

There is a belt of stratified drift which stretches with some interruption from Waverly to Springfield and marks the edge of the ice at one stage

in its retreat. These short ridges are called kames. When material is dropped by the sediment laden streams, from under the glacial ice, kames are formed. Kames consist of stratified and sorted sand and gravel showing deposition by water. Kames differ from terminal moraine in that they are interrupted. Another feature in the belt is the appearance of pronounced depressions called "kettles." These occur at Waverly and Union where large masses of ice were buried in the sediments and took much longer to melt than the ice exposed in the glacier. Today, this belt of glacial sediment has been much modified by development.

Temporary lakes were formed during glacial times in several valleys which drained northward and whose lower courses were gradually blocked by ice. The largest glacial lake and the one whose history has been most carefully worked out is Lake Passaic, which occupied the upper Passaic Valley between the Highlands on the northwest and the Second Watchung Mountain on the south and east.

Prior to the invasion of the glacier, the drainage of the area was through a valley near Summit. As the ice advanced in the Valley of the Passaic, the outlet of the pre-glacial streams near Summit was dammed with sand and gravel, causing water to back up and form Glacial Lake Passaic. (See Geology of Morris County in Brief.)

An indication of life during the Pleistocene approximately 25,000 years ago is shown by a fossil discovery in 1936. Two tusks, 4'3" long, and four teeth of a mastodon were found in the Pleistocene sediments in Cranford. Resembling elephants, the mastodon was predominantly a browser living in the timber forests which existed in Union County at that time. Their extinction occurred at the end of the Pleistocene.

Geologic time intervals are unequal subdivisions of the earth's history corresponding to definite geologic events. Eras are the largest divisions of time and contain many periods, which are further subdivided into epochs. Formations, mappable rock units, are placed within the period during which they were formed. A formation's place within the stratigraphic column is determined by the predominant forms of life preserved within the rocks, distinctive lithology, and 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 local or regional modifications are sometimes used for greater clarity.

GEOLOGIC TIME SCALE

Era	Periods	Epochs	Formation or Rock Type (approx. thickness)	Approx. no. of million years ago
	Quaternary	Recent	Soil and Alluvium	0-1
		Pleistocene	Glacial Drift (0-460 ft.)	
CENOZOIC (recent life)		Pliocene		
		Miocene		
	Tertiary	Oligocene	Not present in county	1-70
		Eocene		
		Paleocene		
	Cretaceous		Not present in county	70-135
MESOZOIC (middle life)	Jurassic		Not present in state	135-180
	Triassic		Basalt (flows and dikes)	
			Brunswick Formation (600-8000 ft.)	
	Permian		Not present in state	225-270
	Pennsylvanian		"	270-285
PALEOZOIC (ancient life)	Mississippian		"	270-285
	Devonian		Not present in county	285-400
	Silurian		"	400-440
	Ordovician		"	440-500
	Cambrian		"	500-600
PROTEROZOIC	Precambrian		Assorted gneiss (? ft.)	600-2100+

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