THE GLACIAL HISTORY OF LONG ISLAND

I. PRE-GLACIAL GEOLOGIC HISTORY

A. Late Paleozoic Era
   1. As Pangaea neared completion, an elongated embayment formed where the Narragansett Bay lowland now lies.
   2. This trough was occupied by an arm of the late Paleozoic ocean
      a) Coarse gravels were washed into the bay by rivers from nearby mountains.
      b) The gravels were converted to conglomerate which in turn were converted to metaconglomerates by tectonic forces.
   3. Remains of forests of primitive trees were converted into beds of coal in swamps around the quiet waters of the bay.
   4. The present position of Long Island was buried under thousands of feet of sedimentary rock.

B. Late Paleozoic Era
   1. Pangaea stood firm with the Appalachians as its backbone.
   2. This landmass remained intact for tens of millions of years, into the Mesozoic Era.

C. Mesozoic Era
   1. End of Triassic Period
      a) Pangaea began to rift apart.
         ◆ Similar to present-day rifting in the east African rift region
         ◆ Sheets of lava extruded from rifts
         ◆ Basins (deep valleys) formed in the rifted depressions of eastern North America
         ◆ Nearby highlands were eroded by streams which deposited the eroded sediments in the basins. These became the red sandstone layers over which basaltic lavas flowed.
         ◆ Basins included the Hartford Basins which is now occupied by the Connecticut River Valley
         ◆ Other rifts are buried under the continental shelf, one which lies off the south of L.I.
         ◆ The Newark Basin is another rift, of eastern New Jersey, between the Appalachians and the coastal plain.
      b) Gradually, the Atlantic Ocean filled the widening gap between the separating continents.

   2. Jurassic and Cretaceous Periods
      a) The sea floor widened and the sea transgressed over the continental lowlands.
      b) Sediment layers accumulated to form a wedge of coastal plain and continental shelf sediments.
         ◆ They are thousands of feet thick
         ◆ Beneath southeastern Long Island the shelf includes nearly 1,000 feet of upper Cretaceous deposits.

D. Tertiary Period (Between 65 million and 2 million years ago)
   1) Layers of marine sediments were deposited to the east and south of eastern Long Island.
   2) Eastern L.I. has late Cretaceous sands and clays.
      a) Some have thin seams of lignite
      b) Nodules of iron pyrite are present
      c) Formed in the wetlands on the margin of the Cretaceous sea.
      d) Thrusted into glacial deposits, being transported southward by the glacier from the sea floor outcropping beneath Long Island Sound.
II. GLACIATIONS

Glaciers of the Pleistocene Epoch transported and deposited vast quantities of sediment, derived from the New York and New England highlands, forming moraines at the outer edge of the ice. The terminal moraine and several recessional moraines of two glaciations cross Long Island, Block Island, Martha’s Vineyard and Nantucket.

During the last 200,000 years, continental glaciers moved southward from eastern Canada and deposited moraines along virtually the same terrain. Rising sea level and ocean currents resulted in erosion of these features contributing to shaping eastern Long Island into its characteristic two forks.

The Laurentide ice sheet, named for its source in Canada, covered southern New England and New York. The shoreline of the Atlantic Ocean at the maximum extent of the glaciation was about 70 miles south of the ice front near the edge of the continental shelf. Sea level was over 350 feet below its present level and rivers cut canyons into the shelf where ice-age mammals grazed on land covered with tundra and spruce forests.

A. The First Glaciation

1. Early Pleistocene Epoch
2. The shape of the land controlled the flow of glacial ice.
   a) Filled valleys and thinned over the hills
   b) Ice flowed like a river extending out of the major valleys a lobes
3. Major landforms channeled ice into south-trended lobes.
   a) Narragansett Bay lowland
   b) Connecticut-Rhode Island upland
   c) Connecticut River valley
   d) Hudson River valley
4. Two warm intervals in the late Pleistocene Epoch
   a) Sangamon Interglacial
      ◆ A warm climatic stage between glacial stages
      ◆ Peaked about 125,000 years ago
      ◆ Separates the Illinoian and Wisconsinan glacial stages
      ◆ Warmer than present and had a sea level about 10 feet higher than today
   b) Mid-Wisconsinan Interstadial
      ◆ A warm climatic interval between ice advances within an glacial stage
      ◆ Not as warm as the Sangamon
      ◆ Sea level was about 60 feet lower than the present
      ◆ Centered around 30,000 years ago
5. Deposited the older drift sheet before 40,000 years ago either:
   a) during a glacial advance about 60,000 years ago (early Wisconsinan) or
   b) during the Illinoian glacial more than 140,000 years ago.

B. Drift of the First Glaciation (the older lower drift)

1. Deposited up against and over the edge of the southward dipping upper Cretaceous deltaic and marine beds
2. The Ice Margin
   a) North of Long Island a few hundred feet thick
   b) Tapered southward to the crest of the moraines
   c) Advanced north to south across southern New York and New England
   d) Followed the Hudson valley lowland to its end.
   e) Meltwater carried glacial sediments to the south across the coastal plain forming an outwash plain
3. Lower drift is deeply channeled by stream erosion during a period of lower sea level.
   a) Later filled with meltwater gravel and sand (during glacial recession)
   b) Later filled with marine sand and clay during postglacial marine regression
   c) Erosion channels became buried valleys
      ◆ at about the same elevation as sea level during glaciation
      ◆ around 100 meters below present sea level.

4. The lower drift is not continuous beneath the younger drift (moraines)

5. Where exposed:
   a) it appears dark gray in color and where exposed to salt spray (breaking waves) it is hardened with salt
      rinds and has a steely appearance.
   b) at Montauk it rises above the present beach similar to a moraine forming the bulk of the bluff where
      exposed.

6. Appears to have been planed off by the late Wisconsinan glacier in places.

7. Has been deformed into tight folds, ripped into large blocks, and thrusted southward in places
   a) Result of later glaciation (older drift was frozen and behaved like rock)
   b) Ripped-up blocks surrounded by outwash and deltaic sands of upper drift

8. Montauk Till
   a) The compact till in the lower drift sheet
   b) Exposed in the Port Washington sand mine in western L.I. and in a sand pit in Port Jefferson.
   c) Deposited beneath the ice sheet
   d) Named for till at Montauk Point
   e) The major component of the “ripped up” till displaced into younger outwash.

9. Ice margin formed morainal hills of the south fork.
   a) Extended southeastward onto the continental shelf south of Montauk (now beneath the sea)
   b) Heavily eroded during the Holocene sea level rise.

10. Recession of the Early Glacier
    a) A lake formed between the ice margin and the terminal moraine.
    b) Varved silt and clay layers accumulated in the lake.
    c) Lake beds were later crumpled into tight folds by a later glacial advance.

11. At the end of the early glaciation, Long Island’s future location was buried in the lower drift sheet.

C. The Second Glaciation

1. Late Wisconsinan glacier that advanced 22,000 years ago.

2. Deposited the upper drift sheet and overlies the older drift sheet.

3. Covers much of Long Island

4. The upper drift is characterized by:
   a) deposits, structures and landforms associated with advancing ice
   b) features formed during glacial recession.
5. Terminal Moraines (Western Long Island)

   a) Trends in an easterly direction from the southwestern coast of Brooklyn
   b) It is the eastward continuation of the end moraine of the Hudson Lobe of the Laurentide glacier. The ice reached as far as the southern tip of Staten Island spreading westward across northern New Jersey.
   c) Is referred to as the Harbor Hill Moraine
   d) The eastern edge of the Hudson Lobe collided with the western margin of the Connecticut Lobe
      ◆ This formed a major interlobate zone.
      ◆ Characterized by elongated north-south ridges trending south from Huntington referred to as the Manetto Hills Interlobate Zone (mix of glacial, fluvial and deltaic sediments deposited in the intersection of the two glacial lobes).

6. Terminal Moraines (Eastern Long Island)

   a) Extends from the Manetto Hills Interlobate Zone (half Hollow Hills, Manetto Hills and Dix Hills)
   b) Deposited by the Connecticut Lobe of the Late Wisconsinan glacier
   c) Ronkonkoma Moraine
      ◆ Segment of the terminal moraine between the interlobate zone and Riverhead
      ◆ Described as a kame moraine composed of numerous coalescing kames covered by thin layers of meltout till.
      ◆ At its mid-point it is cut by a north-south meltwater channel that today is the present location of the Connetquot River and the Nissequogue River.
      ◆ Peaks at over 310 feet at Bald Hill
   d) Shinnecock Hill Moraine continues trending to the east where it broadens into a wide band of hummocky, kame, kettle and channeled topography.
   e) Interlobate zone between the Connecticut and Connecticut-Rhode Island Lobes of the Laurentide glacier is found north of Bridgehampton.
      ◆ Long Pond Channel and paternoster lakes are found here.
      ◆ The terminal moraine continues eastward (Amagansett Moraine segment which trends southeasterly

D. Recession of the Second Glacier

1. Recession began shortly after 22,000 years ago.

2. Western Long Island

   a) As the glacier receded northward, recessional moraines were deposited north of the Harbor Hill moraine
   b) It is separated from the terminal moraine by lower topography formed by meltwater channels and outwash.
   c) Several other recessional moraines have been identified to the east (Northport, Stony Brook, Mount Sinai moraines).

3. Both the Hudson and Connecticut lobes of the Laurentide glacier retreated to ice stands near what is now the north shore of Long Island depositing recessional moraines. May have been deposited in as short a time as 2,000 years.

4. Eastern Long Island

   a) Roanoke Point Moraine of the Connecticut Lobe
   b) Major recessional moraine deposited on the present north coast of Long Island
   c) Aligned along the trend of hills that link it with the Sands Point Moraine of the Hudson Lobe in western Long Island, and the Fishers Island Moraine to the east.
5. Outwash Plains

a) Cover the southern half of the region (Long Island’s south shore).
b) Found between morainal areas.
c) Broad plain composed of layers of cross-bedded sands and gravel.
d) Deposited by glacial meltwaters.
e) Along the present shoreline it is covered by coastal deposits.
f) The outwash plains and sand parts of moraine (from outwash) often support poine barrens vegetation.

6. Long Island was ice free 20,000 years ago.

a) Sea level rose, gradually covering the continental shelf.
b) The higher hills of the moraines to the east became peninsulas.
c) From 20,000 and 12,000 years ago, glacial lakes, dammed between the glacier and the moraines filled the Long Island Sound and Block Island Sound basins.
d) The terminal moraine was breached and the lakes drained into the ocean.
e) Drainage in the Peconic area formed a channel along Gardiners Island and southward to Napeague Beach.
   ◆ The Montauk Peninsula was cut off from the rest of the South Fork.
   ◆ The offshore segment of the Amagansett Moraine was heavily eroded.
f) Sea level continued to rise for the next 6,000 years:
   ◆ Eroding the sea cliff into the Amagansett Moraine.
   ◆ Coast currents deposited sand that filled the breach by forming the Napeague Beach tombolo.
   ◆ As sea level continues to rise (about 1 ft/100 years), erosion of the Mountauk peninsula continues to supply sand for south shore beaches.

E. Other Glacial Features

1. Erratics

a) Large boulders that have been moved by glaciers, and do not match the underlying bedrock.
b) Examples: Target Rock (Lloyd Neck), the large (formerly painted) boulder on the corner of Nicolls Road and the south entrance to SUNY Stony Brook, a huge rock in a parking lot on the west side of Route 25A south of Port Jefferson, Shelter Rock in Manhasset.

2. Kettles

a) Steep-sided depressions formed by blocks of ice that separated from the glacier and became buried in glacial sediment (moraine deposits and/or outwash).
b) Examples: Lake Success, Lake Ronkonkoma, Scuttle Hole (Bridgehampton).

The glacial history presented is based on the work of Dr. Les Sirkin as described in *Eastern Long Island Geology with Field Trips* (Sirkin, 1996) and *Western Long Island Geology with Field Trips* (Sirkin, 1996).

The diagrams on the following pages are adapted from both of Dr. Sirkin’s books.
THE CONTINENTAL SHELF OFF LONG ISLAND

MAP VIEW

CROSS-SECTION ALONG MAP VIEW LINE AB

Upper glacial drift
(22,000 years old)

Lower glacial drift
(more than 40,000 years old)
LONG ISLAND MORAINES MAPS

MORAINES OF LONG ISLAND AND SOUTHERN NEW ENGLAND

EASTERN LONG ISLAND MORAINES

L.I. END AND RECESSIONAL MORAINES
LONG ISLAND SEA LEVELS

Sea Levels Shown: 10,000 BC, 2,000 AD, 2,300 AD