PHYSIOGRAPHIC MAP

The physical diversity of the northeastern states is obvious. The Adirondack Mountains constitute a nearly trigonal upwarp of irregular ridges in northern New York State. The hilly Appalachian Plateaus and Catskill Mountains are scoured by dendritic (treelike) branching streams. The Appalachian Valley and Ridge Province is marked by long, sinuous, even vermiform ridges. The coastal plain from southern New Jersey to eastern Long Island is relatively flat and featureless, except for the east-west-trending subarcuate terminal morainal ridges from Staten Island to the Cape Cod - Nantucket Island area, and the Early Tertiary cuesta trending diagonally northeast across New Jersey. Almost all of New England is hilly to mountainous with predominantly north- to north-east-trending ridges and valleys in alignment with the structural grain.

The physiographic map is derived from the "Physiographic Map of the United States" by R. E. Harrison, p. 57, *National Atlas of the United States of America* (U.S. Geological Survey, 1970), supplemented by names from *Landforms of the United States* by Erwin Raisz (revised 1957).

TECTONIC MAP

A tectonic map shows major uplifts, downwarps, fault zones, and areas of major igneous intrusions and outpourings of volcanic lavas. These features are complexly developed throughout the northeastern states owing to the many orogenic and plutonic events that have shaped the area over a billion-year period from Precambrian Helikian to Jurassic time.

West of the axial area of the East Coast orogenic belt, thrusts are directed west to northwest, and on the east they are directed southeast. This tectonic bilateral symmetry is strengthened by early to middle Paleozoic miogeosynclinal deposits at Boston Bay and possibly along the southeast coast of Maine.

The tectonic map was compiled mainly from two sources: *Tectonic Map of the United States* (U.S. Geol. Survey and AAPG, 1962) and *Geological Map of the United States* by P. B. King and H. M. Beikman (U.S. Geol. Survey, 1974).

FACTS ABOUT FOSSILS

The rocks of the earth contain an incredible 3-billion-year record of changing life. However, in the northeastern states the oldest known rocks are only half that old and consist of gneisses and marbles in which much of the original bedding texture and any fossil traces have been obliterated by several periods of metamorphism and plutonism. In fact, rocks as young as Pennsylvanian have been metamorphosed in much of southern New England.

Indefinite traces of fossils are found as vertical tubes (*Scolithos*), possibly made by marine worms, in the latest Precambrian or earliest Cambrian quartzites of eastern Pennsylvania. In the succeeding Early Cambrian beds, a fairly rich fossil fauna of marine shelled animals appears almost magically at several localities throughout the area, especially in western Vermont and in the Boston Bay area of eastern Massachusetts.

Ordovician limestones from Vermont to eastern Pennsylvania offer varied and increasingly complex fossil faunas, but the gently southward-tilted Silurian and Devonian strata of New York State are world famous for their hundreds of prolific fossil localities. To find the best Carboniferous faunas we must probe the Allegheny Plateau area of western Pennsylvania, where both marine faunas of brachiopods and crinoids and continental floras of fossil tree ferns (*Neuropteris*, *Pecopteris*, etc.) and scale trees (*Lepidodendron* and *Sigillaria*) may be collected on the same hillside.

Permian fossils are poorly known and are limited to southwest Pennsylvania, and Triassic and possibly earliest Jurassic fossils such as reptiles and freshwater fishes are exceedingly rare in the once-extensive continental redbeds, volcanic rocks, and grayish lake deposits--siltstones and claystones. To find the best Cretaceous and Tertiary fossils, one must prowl the stream banks and quarries of southern New Jersey. Some of these appear almost as fresh as the shells on our modern seashores but, unless treated, they will disintegrate to a white calcite powder within a few hours after being collected.

WHAT IS A FOSSIL?

A fossil is a relic of the past, generally preserved by a covering of sediments and revealed through natural erosion by rain and wind, or by human excavation. A fossil may be a shell or a bone that decays slowly and is replaced by calcite or other minerals, or it may be a log that is carbonized or replaced by silica or pyrite. An animal or plant, before it decays, may leave an impression in soft muds. After burial and compaction, the remains are preserved as casts and molds. Many decaying leaves in clay deposits produce a delicate carbon film that shows the finest detail.

WHERE FOSSILS CAN BE FOUND

The sedimentary rocks of the northeastern states, except for much of New England, yield fossils at thousands of localities, especially along high, eroded stream banks and deep road cuts, and in quarries. Many of these localities are listed in publications of state geological surveys and elsewhere in guidebooks of geological societies. Only a few are listed here. In collecting fossils, one must always respect highway and park regulations and request permission of private landowners.

FACTS ABOUT USEFUL MINERALS AND GEMSTONES

The northeastern states are replete with both useful and interesting minerals and gemstones. The list is long, and the collector--after researching the numerous state and federal geological survey publications, careful planning, and patient searching in a relatively small area--can amass scores of attractive specimens. However, certain basic ground rules must be observed. Localities noted below are the better known ones and are described very briefly owing to space limitation. As a rule, the quarries require special permission, and occasionally fees, and often have restrictions on place and time of collecting. Collecting localities on private lands require permission of the owners. In some states, collecting specimens along interstate and express highways is prohibited, and even some county roads where hazards exist may be off limits to collectors. The collector is urged to join an organized rock and mineral society for enthusiastic help in developing his or her collection.

The rock and mineral industries have contributed much to the technological advancement of the northeastern states. Maine has the largest cement plant in New England and produces large quantities of sheet mica and feldspars. New Hampshire granite is world famous but sand and gravel now account for half the state's mineral output. Vermont produces world-famous granite and marble and much of the domestic mica. New York State produces much of the nation's rock salt and considerable emery. Pennsylvania produces the best lubricating oils in the world, and its coal reserves are tremendous.

New Jersey has about the largest mineral production of any state on an area basis--it has the richest zinc deposit in the country and produces millions of tons of clay for bricks, tiles, and terra cotta ware. The southern New England states of Massachusetts, Connecticut, and Rhode Island now produce largely prosaic rock material such as sand, gravel, crushed rock, and building stones; supplies are virtually unlimited.

COVER PHOTO

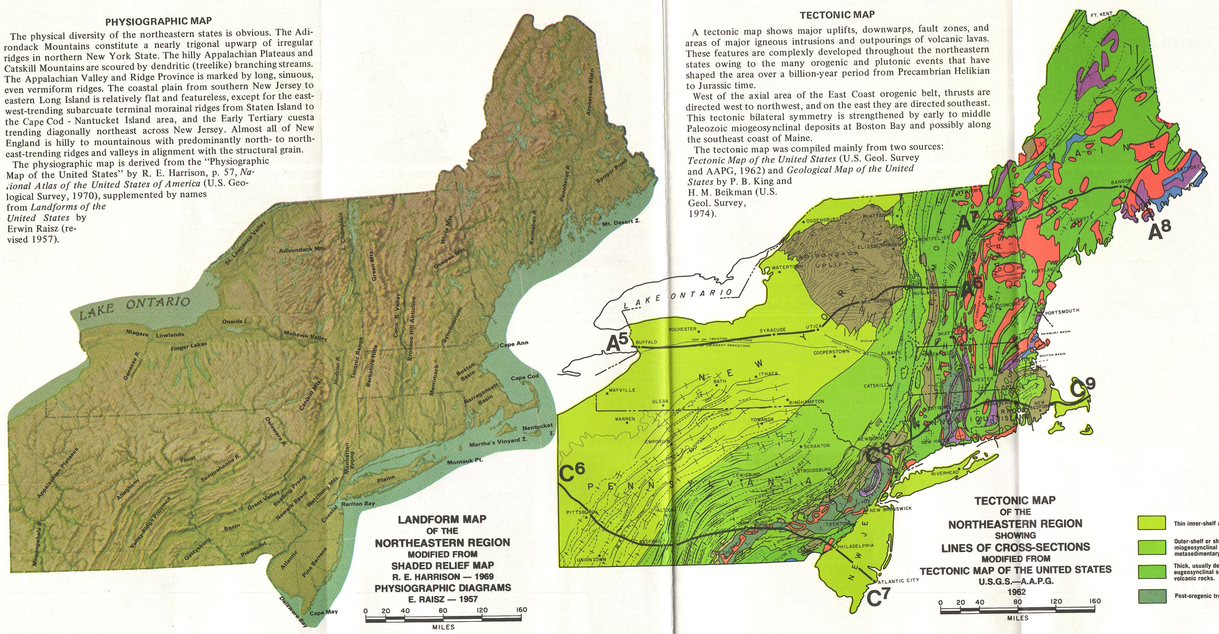
"A glory smites the craggy heights:
And in a halo of the haze,
Flushed with faint gold, far up, behold
That mighty face, that stony gaze!

* * * *

What earthquake shaped, what glaciers scraped,
That nose and gave the chin its angle?"

Excerpted from *The Old Man of the Mountain*, by John Townsend Trowbridge

Old Man of the Mountains ("The Great Stone Face") is west of US3 in Franconia Notch, New Hampshire. It is 1,200 ft above Profile Lake, and measures 48 ft from forehead to chin. The profile is formed of Conway granite belonging to the White Mountain plutonic sequence of Mesozoic age. The shape has resulted from differential erosion of five separate granite ledges.



LANDFORM MAP OF THE NORTHEASTERN REGION
MODIFIED FROM SHADED RELIEF MAP
R. E. HARRISON — 1969
PHYSIOGRAPHIC DIAGRAMS
E. RAISZ — 1957

TECTONIC MAP OF THE NORTHEASTERN REGION
SHOWING
LINES OF CROSS-SECTIONS
MODIFIED FROM
TECTONIC MAP OF THE UNITED STATES
U.S.G.S.—A.A.P.G.
1962

MAP SOURCES FOR GEMSTONES, MINERALS, FOSSILS, AND PLACES OF INTEREST

1. American Automobile Assoc., Tour Books--Midwestern and Northeastern, 1975-76: Washington, D. C.
2. Billings, M. P., Geology of New Hampshire, Pt. 2, Bedrock geology: Dept. of Resources and Economic Development, Concord, NH, 1979.
3. Cantwell, D. W., Racine State Park and Mt. Katahdin: Bull. 12, Dept. of Forestry, Augusta, ME, 1972 rev. ed.
4. Chapman, C. A., The geology of Mt. Desert Island, Maine: Dept. of Geology, Univ. of Illinois, 1962.
5. Cheney, J. A., The geology of Mt. Mansfield State Forest: Dept. of Forests and Parks, Vermont Devt. Comm., Vermont Geol. Survey, 1974.
6. Cuthbert, E. H., Fossils of the Connecticut Valley: Connecticut Geol. and Natural History Survey, Hartford, CT, 1968.
7. Connecticut, points of interest, Bicentennial edition: Connecticut Dept. of Commerce, Hartford, CT 06106, 1975.
8. Dodge, H., Dinosaur tracks (and more) book: Doubleday, NY, 1958.
9. Graham, J. J., Mineral resources map of New York State: New York State Museum and Science Service, 1953.
10. Grant, R. W., Massachusetts mineral localities: Museum of Comparative Zoology leaflet, Harvard Univ.; and Mineral Collecting in Vermont, Spec. Pub. 2, 1968.
11. Hotz, P. E., Uranium and thorium collecting in Pennsylvania: Pennsylvania Geol. Survey, Rept. 68, reprint, 1973.
12. Lapham, D. M. and A. R. Geyer, Minerals collecting in Pennsylvania: Pennsylvania Geol. Survey, Rept. 69, 1967, 3rd ed., 1973.
13. Matthews, W. H., III, A guide to the national parks, v. 1, The eastern parks: Am. Museum of Natural History, Natural History Press, 1964.
14. National Geographic Society, Guide to America's Scenic Wonders: National Parks of the United States and Canada, Vol. 1, Eastern States: Washington, D. C.
15. Pearre, N. C., Mineral deposits and occurrences in Massachusetts and Rhode Island exclusive of clay, sand and gravel and peat: U.S. Geol. Survey, Bull. 1411, 1975.
16. Meyers, T. R., Geology of New Hampshire: Pt. 1, New Hampshire minerals and mines: Dept. of Resources and Economic Development, Concord, NH, 1956.
17. Pennsylvania Park Guide Series: Commonwealth of Pennsylvania.
18. Rand, J. R., Maine pegmatite mines and prospects and associated minerals: Mineral Resources Bull. 3, Maine Geol. Survey, Augusta, ME, 1957.
19. Rand McNally road atlas, U.S., Canada, and Mexico: 51st Ann. Ed., Rand McNally.
20. Reader's Digest Assoc., 1973, Scenic wonders of America: Pleasantville, NY.
21. Ramsen, J. L., Fossils in America: Harper and Row, NY, 1964, and The rock Hunter's Field Guide, 1970.
22. Smith, H. G., The Cretaceous fossils of New Jersey: New Jersey Bureau of Geology and Topography, Trenton, NJ.
23. Symons, E. H., Rock hound's guide to Connecticut: Pequot Press, Chester, CT.
24. Thompson, G. G., Geology of the Champlain basin in Vermont: Vermont Geol. Survey, Spec. Pub. 1, 1967.
25. Weimmer, P. L., An introduction to invertebrate fossils of New York: New York State Museum and Science Service, Handbook 1, 1961, 2nd ed., 1970.
26. Wilkinson, A., Wounds of Franklin and Steuben Hill: New Jersey Bureau of Geology and Topography, Trenton, NJ.

PLACES OF GEOLOGICAL INTEREST

NEW YORK 1. *Niagara Frontier:* Niagara Co.; includes 11 State Parks, 7 associated with Niagara Falls and the geologic history of the Niagara River; exposures of latest Ordovician, Early Silurian, and Middle Silurian strata. The nearby *Buffalo* museum of *Science* (2) and *Rochester Museum of Science* (3) have excellent geological exhibits.

4. *Allegany State Park:* S of Salamanca; dissected Allegheny Plateau, only unglaciated portion of the state. *Olean Rock City*, S of Olean, features spectacular blocks of Pennsylvanian Olean Conglomerate.

5. *Letchworth State Park:* includes a postglacial gorge in the Genesee River from Portageville to Mt. Morris which exposes Late Devonian sandstones and shales.

6. *Watkins Glen State Park:* S of Seneca Lake; deeply incised postglacial erosion in Late Devonian sandstones and shales.

7. *Taughannock Falls State Park:* on SW shore of Cayuga Lake, N of Ithaca; superb example of V-shaped hanging valley entering broad U-shaped valley; highest single-drop waterfall (215') in the Appalachians--caprock is Sherburne Sandstone, face is Genesco Shale; Tully Limestone present at lower water level.

8. *Chittenango Falls State Park:* on NY13 E of Syracuse; caprock is Onondaga Limestone; face is Early Devonian Helderberg Limestone.

9. *Natural Bridge and Caverns:* off NY3, NE of Carthage; underground boat tour along the Indian River through Proterozoic marbles and gneisses.

10. *Ausable Chasm:* on Ausable River at Keeseville; carved in Late Cambrian Potsdam Sandstone. In places the rocky walls rise perpendicularly 100-200' above the twisting river.

11. *Petrified Gardens:* N of NY29, 3 mi W of Saratoga Springs; the finest display of Late Cambrian algal reefs (*Cryptozoon*) in eastern North America.

12. *Stark's Knob:* W of US4, N of Schuylerville; hill of pillow lava, transported west by gravity sliding during Middle Ordovician time. Only one of its kind in eastern U.S.

13. *New York State Museum:* downtown Albany; excellent mineral and fossil collections. *John Boyd Thacher State Park:* SW of Albany; prominent escarpment formed by Early Devonian limestones; classic locality for fossiliferous Early Devonian strata. *Cohoes Falls:* at Cohoes; largest drop along the Mohawk River, bypassed by locks in the Erie Canal. Bedrock is Snake Hill Shale, Austin Glen Graywacke, and a "Taconic" mélange.

14. *Gilboa:* N of the Schoharie Reservoir on NY85; site of the best-preserved Devonian flora in North America, including fossil stumps of seed-bearing tree ferns.

15. *Palisades Interstate Park and adjacent Harriman, High Tor, Bear Mountain, and Stony Point State Parks:* between N.Y.C. and Newburgh; highly metamorphosed gneisses, Late Triassic redbeds (conglomerates, sandstones, and shales), and Palisades Diabase (lava flow); also old iron mines.

MASSACHUSETTS 40. *Joseph Allen Skinner State Park:* 3 mi N of South Hadley; has a road passing Titian Piazza, a volcanic formation of overhanging rock columns, and the Devil's Football, a magnetic boulder weighing 300 tons.

41. *Nash Dinosaur Land:* 6 mi N of South Hadley; has a ledge containing 400 dinosaur footprints in museum.

42. *Museum of Science:* at Science Park, Boston; features displays and exhibits on natural history, physical science, and astronomy. *University Museum (Harvard):* Oxford St., Cambridge; houses geological and Mineralogical Museum; the prize historic *Kronosaurus* is of particular interest.

43. *Cape Cod National Seashore:* see front of map for description.

VERMONT 44. *Mount Equinox:* off US7 near Arlington, N of Bennington; at 3,816', this is the highest peak in the Taconic Range. Paved road to summit.

45. *Marble Exhibit:* US3 at Proctor; many varieties of marbles and granites; color motion picture explains quarrying and processing of marble. Marble carvings include bas-relief of da Vinci's "Last Supper."

46. *Champlain Fault:* at Lone Rock Pt. in Burlington; a classic thrust fault of major proportions.

47. *Huntington Gorge:* upstream from Jonesville on the Huntington River; a series of coalescing potholes.

48. *Mount Mansfield:* near Stowe; the loftiest peak in the Green Mountains and the highest point in Vermont (4,393'). Mount Mansfield State Forest can be reached from Stowe through Smuggler' Notch, a deep scenic gorge. Gondolas and toll road lead to the summit.

49. *Rock of Ages:* in Graniteville, SE of Montpelier on VT14; free guided tour of quarry operations; manufacturing processes can be viewed from observation deck.

NEW HAMPSHIRE 50. *Dixville Notch:* the northernmost and wildest of the White Mountains notches; traversed by NH26 between Colebrook and Errol.

51. *Crawford Notch State Park and Mount Washington:* on US302; Mount Washington is highest peak (6,288') in NE U.S. Cog railway to summit. Waterfalls with scenic cascades. Good rock exposures.

52. *Franconia Notch State Park:* on US3 in the White Mountains is a valley carved mostly in Conway Granite (Early Jurassic). Kinsman Range lies to the west and Franconia Ridge to the east. See cover-photo text.

53. *Echo Lake State Park:* 2 mi W of North Conway; scenic road leads to the summit of Cathedral Ledge 700' above the valley. Ledge is of Conway Granite shaped by the continental ice sheet.

54. *Ossipee Mountains:* S of Conway on NH16; classic example of cauldron subsidence; outer ring dike of Albany quartz syenite, intermediate block of Moat volcanics, interior stock of Conway Granite.

55. *Cardigan State Park:* 4½ mi E of Canaan; trail from west passes over Early Devonian schists and feldspathic quartzites; summit is composed of Kinsman Quartz Monzonite.

56. *Mount Monadnock:* near Jaffry, SW of Keene on NH12; the barren summit has best exposures in state of interbedded feldspathic quartzites and sillimanite schists of Early Devonian age. Best trails from east and north.

57. *Rye Harbor and Hampton Beach State Parks:* S of Portsmouth; sand beaches and coastal exposures of bedrock: Rye Formation (Ordovician?), interbedded quartzite and mica schist; folds plunge SW and sometimes are compressed to quartzite and mica schist; folds plunge SW and pinnacles are developed to develop a weak cleavage. *Isles of Shoals* can be reached by boat from Portsmouth in about an hour. Barren ledges of two-mica granite (Middle Devonian), some dikes, a few exposures of schist and diorite.

MAINE 58. *Desert of Maine:* Freeport, 2 mi W on Desert Rd. from S exit I-95 at junction of US1; guide service through about 175 acres of sand dunes which have grown in the past 85-90 years, some as high as 75', covering vegetation and small buildings.

59. *Acadia National Park:* see front of map for description.

60. *Baxter State Park:* 15 mi N of Millinocket; includes Mount Katahdin, the highest in the state (5,268'); many geological features including volcanic rocks, sedimentary rocks (some fossiliferous), and glacial erosional features.

61. *Quoddy Head State Park:* S of Lubec; includes 481 acres with rocky cliffs rising 50' above the ocean.

62. *Nylander Museum:* in Caribou; contains a geological and botanical collection. Open Mon.-Fri., 1-3 p.m.

GEOLOGY AND THE AMERICAN REVOLUTIONARY WAR

The long American struggle for independence (1775-1783) involved much scientific and technological knowledge that might seem rudimentary by present standards, but was highly pragmatic. Moreover, many of the leaders, on both sides of the Atlantic, took far more active roles in the advancement of science and technology than their counterparts today.

The American rebels had Benjamin Franklin, whose technological accomplishments are famous, and Thomas Jefferson, whose remarkable versatility included paleontological papers. On the English side, King George III had a keen interest in the sciences, including geology.

In America, the need for strategic metals and war materials, such as ammunition and gunpowder, became acute after the break with England. The supply from foreign allies was considerably diminished through enemy action at sea. The former colonials had to rely increasingly upon their own natural resources, which involved prospecting along metallogenic zones for the ores of copper and iron. Increased exploitation of Pennsylvania coal provided fuel for smelting.

Indirectly, another role of geology in the war was its determinant of the terrain types for military campaigns. That side most familiar with its strategic use was often the victor. Strategically, advantage was taken of flat land--valleys or plains--for easiest movement of men and material. Tactically, high ground afforded the best positions to repel attackers. For every terrain type there is a geological explanation.

Although all the original 13 states made contributions to the war effort, our remarks deal only with those states appearing on the accompanying map.

MASSACHUSETTS was the powder keg of the Revolution--hostility occurred there more than a year before the declaration of the Declaration of Independence. Military action in the Boston Bay area centered around prominent gravelly hills shaped beneath ice of continental glaciers and known as drumlins (see inset map of Boston). The high ground of two drumlins, Bunker and Breeds Hills, north of Boston, aided the colonists in repulsing the British on June 17, 1775, in the first real battle of the Revolution. Dorchester Heights, south of Boston, afforded George Washington ideal British force of Gen. Burgoyne and thereby frustrated its move toward Albany.

Fort Stanwix (Rome) and Oriskany Battlefield: Here, in August 1777, the Americans defeated the British force of St. Leger moving east to Albany.

Hudson Campaign of 1777: After Sir William Howe sailed to Philadelphia, Sir Henry Clinton moved his forces up the Hudson, captured some American forts in the gneissic hills of the Hudson Highlands, and was slowed by log and iron chain barricades forged from iron deposits in nearby Orange and Putnam Cos. In 1778, Clinton reached and burned Kingston, and then stopped 60 miles short of Albany. Thus the three-pronged attack on Albany failed completely.

NEW JERSEY is known as the cockpit of the American Revolution because three of Washington's four victorious battles--Trenton, December 1776 (L on map); Princeton, January 1777; and Monmouth, June 1778 (M on map)--and about 850 other battles and skirmishes were fought within its boundaries. Much of northern New Jersey was on the front lines during the war. The Americans, in their retreat across New Jersey from New York City, were pursued by Cornwallis, and later by Howe. Washington took his small force across the Delaware River into Pennsylvania. From here he attacked Trenton on December 25, 1776, and attacked Princeton 8 days later. He then established his headquarters on the heights about Morristown; except for the winter of 1777-78 at Valley Forge, Pa., Morristown was Washington's base of operations for the rest of the war. Morristown is in a highly defensible valley of Newark redbeds largely encircled to the east and south by prominent ridges of Watchung Basalt and to the west by Precambrian gneiss ridges of the northern New Jersey uplands.

Many iron mines and forges of New Jersey made portable stoves, cannonballs, and other necessities. There were also some bog-iron operations in southern New Jersey. Some copper was mined in the Watchung Mountains near Somerville during the Middlebrook encampment in 1778-79.

PENNSYLVANIA, the Keystone State--in reference to the centrally placed, carefully hewn stone that prevents the collapse of an arch--essentially served in that capacity during the war.

Philadelphia is a Fall Line city where the Cretaceous and Tertiary deposits of the Atlantic coastal plain end against the much older and harder metamorphic and igneous rocks of the Piedmont. Here, stream bottoms become shallow and rocky, with rapids, and thus the head of navigation. About 20 miles west of Philadelphia, a hilly section underlain by Precambrian and early Paleozoic schists, granites, and mafic gneisses comprises the Valley Forge area (west of I on map), the site of an early ironworking forge destroyed by British action in 1777--and which became Washington's headquarters during the critical winter of 1777-78. These forges were common throughout the Piedmont area--e.g., at Hopewell (H on map)--owing to easy access to iron ore deposits, to limestone deposits, to wooded areas for charcoal, and to coal deposits.

The Cornwall complex (F on map), which includes the furnace area and the ore banks, first developed in 1742, became a major source of iron ore unequaled until the development of the Lake Superior ranges. This industry was important in the production of 42 cannons for the war as well as munitions and other vital material for the continental army.

In mid-1777 Howe, deciding to attack Philadelphia rather than Albany, sailed south and landed near the head of Chesapeake Bay for an attack at the city's back door. Washington anticipated this move and had his forces entrenched at Chadd's Ford (C on map) of Brandywine Creek (now bridged by US1), in schist and granite terrain 25 miles WSW of Philadelphia. Howe made a feint toward this position, whereas his main force wheeled around the right flank of Washington's main force to attack it from the rear and force the rebels to retreat to Chester. After this victory, Howe's army entered Philadelphia on September 27.

Germantown (east of I on map), on low, rolling schist terrain, is now a northern suburb of Philadelphia. Here, on October 4, 1777, Washington's army of 11,000 attacked Howe's army of less than 9,000 in order to regain Philadelphia, but was forced to retreat after two American columns collided in the fog and the flanking columns of inexperienced militia failed to enclose the enemy. After this darkest hour, Washington and his troops retreated to winter quarters at Valley Forge, which site also served to protect the industrial hinterland to the west.

VERMONT, before it became a state in 1791, was an independent republic for 14 years. Its famous military force, known as the "Green Mountain Boys," under the dashing Ethan Allen, captured Fort Ticonderoga and lost it 2 years later, and was defeated by Burgoyne's British forces at Hubbardton, Vt. (U on map) on July 7, 1777. The succeeding battles, which were victorious at Bennington (W on map), and thereafter British forces in the Champlain Valley suffered reverses, causing their commander, Burgoyne, to surrender on October 17, 1777.

The Green Mountain Boys' familiarity with the rough terrain of their homeland was a factor for their eventual victory and independence from British harassment.

NEW HAMPSHIRE, the granite state, was the first of the original 13 to establish an independent government, which operated from January 1776 to June 1784. During the Revolution, it provided thousands of troops under the successful command of Gen. John Stark, who had a commission from New Hampshire. Its varied contributions to the war effort left the state and many of its citizens heavily in debt. Its rugged topography and equally rugged citizenry undoubtedly deterred the British forces from conducting military ventures in this state.

MAINE was an integral part of Massachusetts from 1691 to 1820, when it was admitted as a state of the union as a result of the Missouri Compromise.

During the Revolution, much of eastern Maine was held by British forces. Falmouth (Portland) was burned after it defied British law in 1775. Also in that year, Benedict Arnold marched through Maine on his expedition to Quebec, starting from Fort Western, now Augusta. The first naval battle of the war (the battle of the "Margaretta"; June 1775) was fought offshore near Machias (Z on map). The Americans failed to recapture Castine, which the British seized in 1779. They then built and occupied Fort George (Y on map) to protect the mouth of the Penobscot River. The very long, indented shoreline--2,500 miles--which resulted from the drowning of hundreds of glaciated valleys made it almost indefensible against a maritime power such as England, who could strike anywhere on its coast with superior power.

FOSSIL, GEMSTONE, AND MINERAL LOCALITIES

FOSSIL LOCALITIES

QUATERNARY: **Q1** Exposures (old gravel pits) in Ingraham Esker and Champlain Sea deposits (sands) north of Plattsburgh (Clinton Co., NY); pelecypods, gastropods, barnacles. **Q2** Excavations of sinkholes 4 mi N of New Paris (PA) by the Carnegie Museum of Natural History (Pittsburgh) have yielded rich Pliocene to Holocene faunas. **Q3** Liberty St. brick claypit at Danvers (Essex Co., MA): Pleistocene marine mollusks.

PALEOCENE: **Tx1** In small stream N of New Egypt railroad station (Ocean Co., NJ): many mollusks, echinoids, brachiopods.

CRETACEOUS: **K1** Sea bluffs along S shore of Raritan Bay from Cliffwood Beach to Highlands (Monmouth Co., NJ): many localities of marine mollusks from Upper Cretaceous sandstones and clays. **K2** Small stream near corner of Maple Ave. and Grove St., Haddonfield (Camden Co., NJ): marine mollusks in Upper Cretaceous Woodbury clays. **K3** Mullica Hill (Gloucester Co., NJ) on S side of US322 where it joins NJ45: mollusks of Upper Cretaceous Mount Laurel and Navesink beds.

TRIASSIC: **Tr1** In road cuts of yellow shale of the Berwick Formation, 0.1 mi N of Pleasant Hill (Adams Co., PA): Pseudosetheria (similar to ostracods). **Tr2** Along Penn Central tracks 2 mi NNE of Mount Wolf (York Co., PA): ferns, calamites. **Tr3** Dinosaur State Park at Rocky Hill (Hartford Co., CT), E of exit 23 of I-91: dinosaur footprints on display in museum. For vertebrate localities open to collectors, write to the Yale Peabody Museum, New Haven, CT. **Tr4** Triassic shale and sandstone outcrops around Turner's Falls, Belchertown, Greenfield, South Hadley, Springfield, and Longmeadow (MA) in Connecticut Valley. Reptilian tracks and bones. Inquire locally.

PERMIAN: **P1** In shale and limestone of Washington Formation, at quarry on E side of county road 1.7 mi S of intersection of US40 and 19, (Washington Co., PA): small worm shells, ostracods, fish teeth.

PENNSYLVANIAN: **IP1** In quarries of Vanport Limestone 0.5 mi N of US422 and 9 mi W of Kittaning (Armstrong Co., PA): large crinoids, corals, gastropods, echinoids. **IP2** In road cuts of Ames Limestone along US22, 2.3 mi W of Murrayville (Allegheny Co., PA): brachiopods, corals, mollusks. **IP3** In quarries of Vanport Limestone 0.7 mi S of Wampum and 300 ft W of PA18, (Lawrence Co., PA): abundant gastropods (*Haveronopsis*), brachiopods, echinoids, corals, etc.

MISSISSIPPIAN: **M1** In road cuts of Corry Sandstone and Riceville Shale along PA77 (Crawford Co., PA), 1.3 mi W of intersection with PA8; unusual fossils such as rare sponges, the brachiopod *Syringothyris*, the gastropod *Worthenia*. **M2** In old quarry of Greenbrier Limestone on E side of Chestnut Ridge along US40, 8 mi E of Uniontown (Fayette Co., PA): abundant, well-preserved brachiopods, mollusks, crinoids, bryozoans.

DEVONIAN: **D1** In calcareous shales and limestones, along Cazenovia Creek near Springbrook (Erie Co., NY): brachiopods, pelecypods, bryozoans, trilobites, gastropods, cephalopods, ostracods, corals. **D2** In shales and limestones, along shores of the Finger Lakes (NY) and along streams tributary to them; (same as at location D1). **D3** In limestones, along US20 near Cherry Valley (Otsego Co., NY): brachiopods, bryozoans, corals, trilobites, pelmatozoan stems, echinoderms. **D4** In sandstones and shales, on W side of NY296, 1 mi SW of Iensonville (Greene Co., NY): plants. **D5** In sandstones, N side of NY97, west of Fish Cabin Creek, 1 mi E of bridge in Red Eddy, 9 mi NW of Port Jervis (Sullivan Co., NY): plants. **D6** Roadcuts of Middle Devonian Mahantango Formation, along PA191, 4mi N of Stroudsburg (Monroe Co., PA): coral reef with bryozoans, brachiopods, trilobites. **D7** Road cut of Catskill sandstone along US209 E of Harriy (Carbon Co., PA): rare pelecypod *Archanodon*. **D8** Shale outcrop just east of Deer Lake (Schuylkill Co., PA): brachiopods, crinoids, pelecypods, trilobites, etc. **D9** Road cuts in Mahantango Formation along road NW of Lewisburg at Little Gap (Carbon Co., PA): large horn corals, brachiopods, bryozoans, etc. **D10** Small quarry in Mahantango Formation behind restaurant and gas station at Seven Stars (Lehigh Co., PA): large mollusks, trilobites. **D11** Litchen belt from Wilkes-Barre to Dalton (Coos Co., NH), in slightly metamorphosed slates and quartzites; Middle and Upper Silurian Fitch Formation contains brachiopods, corals, crinoids, etc.; Lower Devonian Littleton Formation contains brachiopods, gastropods, crinoids.

SILURIAN: **S1** In dolostones, along town road at Pasque Gulf, 8 mi SW of Herkimer (Herkimer Co., NY): eurypterids. **S2** In shales and limestones, along the Potomac River at Rochester (Monroe Co., NY): brachiopods, bryozoans, ostracods, echinoderms. **S3** In dolostones and limestones, along NY429 at Pekin, (Niagara Co., NY): reefs with stromatoporoids, corals, echinoderm debris. **S4** Exposure of Keyser shale and limestone, 0.6 mi E of junction of US22 and US220 in Hollidaysburg (Blair Co., PA) and 0.1 mi N of US22: numerous small brachiopods and ostracods. **S5** Cuts in limestones along county road 0.2 mi S of intersection with PA17 at The Grove (Perry Co., PA): abundant brachiopods, bryozoans, and mollusks. About 3 mi to SW along PA274 and 0.8 mi W of Andersonburg are specimens of one of the oldest fish, the genus *Ameripeltis*, in sandstones. **S6** In road cuts S of Newfoundland railroad depot (Morris Co., NJ): corals and bryozoans in limestones. **S7** The Croyton belt extends for 32 mi from Unity (Sullivan Co., NH) to Hanover (Grafton Co., NH) in metasedimentary rocks. The Lower and Middle Silurian Clough Quartzite contains brachiopods and crinoids. The Middle and Upper Silurian Fitch Formation contains brachiopods, corals, crinoids, gastropods. **S8** Outcrops on west Knob Peninsula of North Haven Island, in Penobscot Bay, NW of North Haven and S of Pulpit Harbor (Knox Co., ME): abundant fauna of graptolites, brachiopods, etc.

ORDOVICIAN: **O1** In limestone belt, extending from Watertown to Carthage to Lowville to Boonville in Black River Valley (NY): brachiopods, bryozoans, crinoid debris, gastropods, cephalopods, trilobites, corals, ostracods, ichnofossils. **O2** In limestones and black shales, in outcrops in the Mohawk River Valley, from Utica to Amsterdam (NY): in shales--graptolites, trilobites, cephalopods; in limestones--brachiopods, bryozoans, gastropods, trilobites, pelmatozoan fragments. **O3** In limestones, in fields S and E of Chazy (Clinton Co., NY): brachiopods, bryozoans, gastropods, algae, stromatoporoids, sponges, trilobites, pelmatozoan fragments, cephalopods. **O4** Abandoned quarry of Martinsburg Formation at Swatara Gap on W side of PA72, 2 mi N of Lickdale (Lebanon Co., PA): trilobites, brachiopods, mollusks, etc. **O5** In Middle Ordovician limestone band on S side of paved road along Connadoguinet Creek, 2.7 mi NW of Plainfield (Cumberland Co., PA): abundant trilobites, brachiopods, cystoids, etc. **O6** In outcrops of Reedsville Shale along PA53, 0.8 mi N of intersection with PA550 in Bellefonte (Centre Co., PA): bryozoans, brachiopods, 3 genera of trilobites. **O7** Spur of Penn Central railroad N of county road and 1.7 mi WNW of Kaufman (Franklin Co., PA), which is 7.5 mi S of Chambersburg: many fine cystoids, trilobites, brachiopods. **O8** On S80-ft hill at Jacksonburg near Bluestone Quarry, NJ): brachiopods, trilobites, mollusks, in Middle Ordovician Jacksonburg limestones. **O9** Isle La Motte quarries (Grand Isle Co., VT) and outcrop: Middle Ordovician Day Point, Crown Point, Orwell, and Glen Falls limestones with the large gastropod *Maclurites*, cephalopods, brachiopods, blastoids, bryozoans, sponges. **O10** Thorp Point at Town Farm Bay about 1 mi W of railroad crossing, Charlotte (Chittenden Co., VT): Lower Ordovician Cassin Diascorn limestones with trilobites, cephalopods, gastropods, brachiopods. Nearby at Essex Ferry landing are Middle Ordovician trilobites. **O11** Shale quarry on S side of ME163 between Ashland and Mapleton (Aroostock Co., ME) and 0.6 mi E of sharp corner at foot of Pyle Mountain in abundant graptolites; rich brachiopod fauna in nearby Silurian limestone conglomerate.

CAMBRIAN: **€1** In sandstones and dolostones, along NY9N, 4 mi NW of Saratoga Springs (Saratoga Co., NY): trilobites, lingulid brachiopods. **€2** In limestones and limestone conglomerates, in vicinity of Troy (Rensselaer Co., NY): trilobites, gastropods. **€3** Fruitville Quarry of Lower Cambrian siltstones 4 mi N of Lancaster (PA): trilobite genera, *Paedumias* and *Olenellus*. **€4** At Chicken Rock, about 1 mi N of Columbia (Lancaster Co., PA) overlooking Susquehanna River: *Scolithus* (worm borings) in Lower Cambrian Chickies Quartzite. **€5** Abandoned quarries of Upper Cambrian Conococheague Limestone 0.3 mi S of oil tanks which are along PA32 about 0.5 mi SE of intersection with PA263 at Center Bridge (Bucks Co., PA): trilobite *Welleraspis* and brachiopod *Lingulella*. **€6** Hoppin Hill at North Attleboro (Bristol Co., MA): many trilobites including *Serrodiscus*, *Hebediscus*, *Strenuella*, and *Olenellus* (very rare). **€7** Outcrops in Weymouth (MA) area (see map of Metropolitan Boston): Lower Cambrian trilobites including *Callavia*, *Strenuella*, etc. Nearby at outcrops in Braintree area are Middle Cambrian trilobites such as *Paradoxides*, *Agnulos*, and *Ptychoparia*. **€8** Nahant (MA) area (see map of Metropolitan