The Bedrock Geology of the Kent 7.5 minute quadrangle

by

Richard A. Jackson

Connecticut Geological and Natural History Survey
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THE BEDROCK GEOLOGY OF THE KENT QUADRANGLE, CONNECTICUT

By Richard A. Jackson

Abstract

Autochthonous and allochthonous rocks underlie the Kent quadrangle in western Connecticut. Precambrian basement is subdivided into five mapped units including Gray Biotite Gneiss, Gray Hornblende Gneiss-Amphibolite, Calc-silicate rock, Talc-Serpentine-Olivine-Anthophyllite rock and Granitic Gneiss. The Granitic Gneiss is subdivided into Augen Gneiss and Pink Granitic Gneiss. Map pattern and field evidence show that the Granitic Gneiss intrudes other Precambrian units.

Paleozoic rocks unconformably overlie the Precambrian. These include quartzite, schistose granulite, and schist of the Cambrian Lowerre Quartzite. Above the Lowerre, or locally the Precambrian, is a Cambrian/Ordovician sequence of carbonates, the Inwood Marble. Calcite marble or younger schistose granulite of Manhattan A rests unconformably on the Inwood or locally, the Lowerre Quartzite. Granulite, schist, gneiss and amphibolite of the Cambrian Manhattan C and the Ordovician Moretown Formation are in thrust fault contact with units of the autochthonous sequence.

Three separate thrust sheets were emplaced from the east during the Middle Ordovician Taconic orogeny. Following and possibly during emplacement, isoclinal folding occurred, with the rocks reaching sillimanite/K-feldspar grade metamorphism. The

Candlewood Lake Pluton and related pegmatites, cutting the autochthonous and allochthonous rocks, intruded while the rocks were still hot. During the Middle Devonian Acadian orogeny, large-scale isoclinal folds dominating the present map pattern were formed. A late-stage conjugate slip cleavage set, trending northwest and northeast, warped the axial surfaces of earlier folds. Retrograde metamorphism probably occurred during each of the later events.

EDITORIAL NOTES

This work was originally presented to the CGNHS in 1980 by Richard A. Jackson. Much of this unpublished work was then incorporated in the Bedrock Geologic Map of the State of Connecticut edited by Rodgers (1985). However many of the geologic units described in this study are not recognizable by name in Rodgers (1985), due in most part to differences in the scopes of the studies and interpretation. Therefore a correlation chart is presented in Appendix III to allow the reader to correlate the units as they were named in this study to the unit names which were used for the Bedrock Geologic Map of the State of Connecticut (Rodgers, 1985).

This worked was compiled by R. Altamura (1987-92) and C. Guzofski (1997-98) for the Connecticut Geologic and Natural History Survey. N. Ratcliff, C. Muerguerian, and J. Kent provided both technical and grammatical editing of the report, while R. Altamura and C. Guzofski provided the final editing and compilation. All the figures from the original manuscript have been digitally replicated from the originals by C. Guzofski using Adobe Illustrator V. 4. Any discrepancy between these computer drafted figures and the originals is solely the fault of C. Guzofski.

INTRODUCTION

Location. The Kent, Connecticut quadrangle covers about 55 square miles, and is located 1 mile east of the New York State Line, between latitudes 41° 37' 30" N and 41° 45' N and longitudes 73° 22' 30" W and 73° 30' W (Figure 1).

Topography and Drainage. The Kent quadrangle displays a varied topography with gently sloping river valleys, numerous scattered swamps, and many hills of moderate to high relief. Long distance views may be seen from Cedar Hill (el. 830 feet), Straits Rock (el. approximately 790 feet), and Mt. Tom (el. 960 feet) in the southern part of the quadrangle and from Pine Ledge (el. approximately 1,100 feet), Segar Mountain (el. approximately 1,200 feet), and from the hilltop (el. 1,370 feet) at Camp Kenico, near Wyantenock State Forest, all of which are located in the northern part of the quadrangle. The total relief in the area is 1,200 feet from an elevation high of 1,425 feet on Bromica Mountain and east of Mauwee Peak in the north-central part of the quadrangle, to a low of 225 feet in the Housatonic River valley in the southwest corner of the quadrangle.

The Housatonic River and its tributaries flow through the Kent quadrangle. The major tributaries are the East Aspetuck River in the southeast corner, and the West Aspetuck River in the central portion of the quadrangle. These join and flow into the

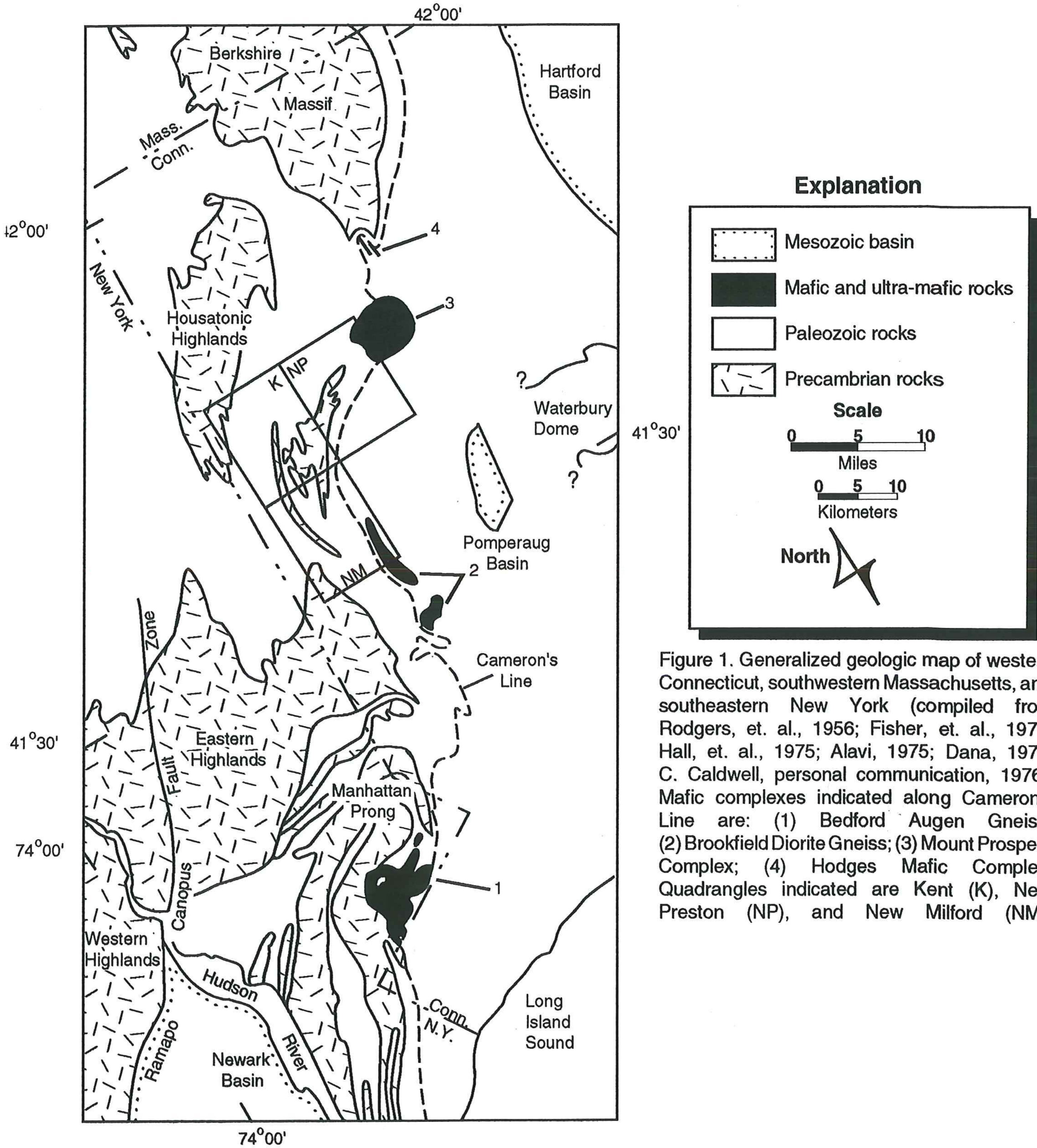


Figure 1. Generalized geologic map of western Connecticut, southwestern Massachusetts, and southeastern New York (compiled from Rodgers, et. al., 1956; Fisher, et. al., 1970; Hall, et. al., 1975; Alavi, 1975; Dana, 1977; C. Caldwell, personal communication, 1976). Mafic complexes indicated along Cameron's Line are: (1) Bedford Augen Gneiss; (2) Brookfield Diorite Gneiss; (3) Mount Prospect Complex; (4) Hodges Mafic Complex. Quadrangles indicated are Kent (K), New Preston (NP), and New Milford (NM).

Housatonic River in the New Milford quadrangle to the south (Figure 1). Several lakes and ponds are scattered throughout the quadrangle, some of the larger ones are, from west to east, Hatch Pond, North and South Spectacle Ponds and the west part of Lake Waramaug.

Geologic Setting. Precambrian rocks are exposed in the Berkshire Highlands, Housatonic Highlands, Hudson Highlands, Manhattan prong, and in several other areas in western Connecticut (Figure 1). Except for the occurrence of Triassic/Jurassic rocks, most of southwestern New England and adjacent parts of New York consist of high-grade metamorphosed Paleozoic miogeosynclinal and eugeosynclinal rocks, locally intruded by Paleozoic plutons.

The stratigraphy of high-grade metamorphic rocks mapped in the Kent quadrangle represents a northern continuation of a stratigraphic sequence of rocks in the Manhattan prong of southeastern New York and adjacent southwestern Connecticut established by Hall (1968a, 1968b, 1976). Autochthonous and allochthonous rocks underlie the Kent quadrangle. Precambrian rocks of igneous and sedimentary origins, are unconformably overlain by Cambrian quartzite and schist of the Cambrian/Ordovician carbonate-bank, marble sequence. All of these rocks are unconformably overlain by Middle Ordovician calcite marble and schistose granulite. These autochthonous rocks are overlain by an allochthonous sequence of Cambrian and/or

Ordovician eugeosynclinal schists, granulites, gneisses and amphibolites.

A major tectonic and lithologic boundary, a thrust indicated as Cameron's Line (Rodgers, et al., 1956), occurs east and southeast of the rocks of the Kent quadrangle. Mafic and ultramafic igneous rocks that occur locally along its trend include the Mount Prospect complex, mapped by Cameron (1951) several miles east of the study area in the New Preston quadrangle, and the Brookfield Diorite several miles south of the study area in the New Milford and Danbury quadrangles (Clarke, 1958). East of Cameron's Line is a sequence of schist, quartzite, amphibolite and gneiss of the eugeosynclinal Moretown Formation, which may be equivalent in age to the Cambrian/Ordovician miogeosynclinal sequence (Hall, 1976).

<u>Data Acquisition and Analysis.</u> Forty six weeks were spent in the field from 1974 to 1977. The 7 1/2-minute United States Geological Survey topographic map of the Kent quadrangle, enlarged to 1:12,000, was used for mapping geologic contacts. Outcrops were located directly on this enlarged base map in the field on the basis of topography, culture, altimeter readings and pace and compass traverses. The extent of bedrock exposures and an estimated 10-foot contour to bedrock, based on topography and outcrops, are shown on the outcrop overlay pattern on Plate 1.

Petrographic analysis was performed on thin sections from approximately 200 rock samples. The locations for the samples are indicated on Plate 1. Mineralogic modes indicated in the tables were estimated from these sections (Appendix I). In addition, the relative ages of metamorphism and structural fabric development were determined from mineral associations and physical arrangements. Key metamorphic reactions were established.

Acknowledgments. Professor Leo M. Hall of the University of Massachusetts, Amherst, who spent many days in the field and in the office, has my highest gratitude. He has had a major influence in the development of my field ability. Professors Peter Robinson, Howard Jaffe and Gregory Webb also of the University of Massachusetts gave their advice freely on many occasions. John Rodgers of Yale University and Hugo Thomas and Sidney Quarrier of the Connecticut Geological and Natural History Survey spent a helpful day in the field with me. Excellent field assistance was provided by Gregory Merkel (summer, 1975) and David Klepacki (summer, 1976) of the University of Massachusetts. Richard Dana and Catherine Caldwell, also of the University of Massachusetts and mapping in adjacent areas, were most helpful in solving mutual field problems. Rub-on symbols used on many of the plates were drafted originally by Peter Robinson at the University of Massachusetts.

The Connecticut Geological and Natural History Survey provided generous financial support for this investigation from 1974-1977. It is a pleasure to extend thanks to the local residents of the Kent area for their interest and kind

hospitality. E. O. Phelps and Sons, Well Drillers, of Bantam, Connecticut, provided valuable well log information.

Previous Work. Percival (1842) accomplished the first organized reconnaissance mapping of the entire state of Connecticut and published a geologic map of the State. More detailed mapping by W. H. Hobbs (1893) and J. D. Dana (1872, 1877) in parts of western New England and eastern New York was incorporated in the map of Gregory and Robinson (1907), as well as the Connecticut State Survey Bulletin by Rice and Gregory (1906). Gates (1952) mapped the New Preston quadrangle (Figure 1) at 1:31,680. A preliminary geologic map of Connecticut was published by Rodgers, et al. (1956). G. Carroll (unpublished) made a reconnaissance study of the Kent quadrangle on file with the Connecticut Geological and Natural History Survey. A surficial geologic map (Kelley, 1975) and an aeromagnetic map of the quadrangle (U.S. Geological Survey, 1971) were produced at 1:24,000 scale.

Purpose. The purpose of this study was to map and interpret the stratigraphy and structure of bedrock in the Kent quadrangle. Lowerre Quartzite and Precambrian gneisses were found by Hall (personal communication, 1974) in early reconnaissance in the Bear Hill - Mt. Tom area in the southeast part of the quadrangle. This indicated that the stratigraphy established in southeastern New York and adjacent parts of southwestern Connecticut (Hall, 1968a, 1968b) could be traced northward into the Kent quadrangle. Most of the rocks of the Kent quadrangle, including those underlying Bear Hill - Mt. Tom, had been combined into one unit known as the Waramaug Formation (Rodgers, et al., 1956). The major purpose of this investigation was to establish a more detailed stratigraphic and structural interpretation of the geology of the Kent quadrangle.

STRATIGRAPHY

Bedrock in the Kent quadrangle is Precambrian through Middle Ordovician in age. Autochthonous rocks are Precambrian gneiss, amphibolite, and calc-silicate rock, the Cambrian Lowerre Quartzite consisting of quartzite, schistose granulite, and schist, the Cambrian/Ordovician Inwood Marble including dolomite marble, granulite, and calcite granulite, and schistose granulite. Granulite refers to a texture that displays recrystallized grains of nearly equal size.

In the Kent quadrangle the allochthonous Manhattan C and the Moretown formations are separated by Cameron's Line thrust (Rodgers, et al., 1956). They consist of schist, micaceous or schistose gneiss and granulite, quartzite, amphibolite, and calc-silicate rocks. These rocks are interpreted as an eastern, oceanic facies equivalent of the Cambrian/Ordovician autochthonous rocks, later transported westward over the autochthonous rocks in several thrust sheets.

Two major unconformities are present in the stratigraphic section of the autochthonous sequence. A basal unconformity has Lowerre Quartzite or locally Inwood Marble resting on Precambrian rocks. Higher in this sequence, Middle Ordovician Manhattan A rests unconformably on Inwood Marble or Lowerre Quartzite.

Precambrian

Precambrian rocks include three mappable stratigraphic units of uncertain relative age. They are considered to be, from oldest to youngest, Gray Biotite Gneiss, Calc-silicate, and Hornblende Gneiss-Amphibolite. The age sequence, however, may be reversed because of inversion due to folding. Intrusion by Precambrian igneous rocks, erosion associated with the Lower Paleozoic unconformity, and an involved structural history complicate Precambrian stratigraphic relations.

Precambrian Gray Biotite Gneiss extends eastward into the New Preston quadrangle and southward into the New Milford quadrangle (Hall et al., 1975). Equivalents of the other Precambrian units, Calc-silicate and Hornblende Gneiss-Amphibolite, are not known extensively enough to be mapped separately in the New Preston or New Milford quadrangles. Rice and Gregory (1906) noted that the Becket Gneiss, a gray biotite gneiss, in the Housatonic Highlands, is similar to Fordham Gneiss in the New York City area. Modern investigations show that the Fordham Gneiss in the White Plains-Glenville area of New York and Connecticut (Hall, 1968a, 1968b, 1976) is lithically very similar to Precambrian stratigraphic units in the Kent area. Zircons from the Fordham Gneiss of the White Plains area of New York indicate a minimum Pb^{207}/Pb^{206} age of about 980 m.y. (Grauert and Hall, 1973). This age may represent the approximate end of zircon recrystallization, during the Grenville orogeny.

Although foliation and layering in Precambrian units are nearly vertical in much of the field area, an accurate estimate of thickness is not possible due to repitition by faulting and folding. Neither the top nor bottom of the units is defined because they are in contact only unconformably with overlying Lower Paleozoic rocks or Precambrian intrusives.

Gray Biotite Gneiss.

Distribution. The Gray Biotite Gneiss is an extensive Precambrian unit underlying parts of all Precambrian regions in the Kent quadrangle (Plate 2). It is present on Mt. Tom in the southeast and it extends north from Lower Merryall to Kent Hollow, west and southwest of Tamarack Swamp, and in extensive exposures north of Peet Hill in the central part of the area. In addition, Gray Biotite Gneiss trends north-south on the west slope of Long Mountain and is located in the Housatonic Highlands in the northwest part of the quadrangle.

Lithology. The Gray Biotite Gneiss Member includes well-foliated, interlayered light-gray, gray and dark-gray biotite-quartz-feldspar gneisses with various amounts of hornblende. A typical exposure is the road cut on Route 341 about 2,000 feet west of its junction with Route 7 and 500 feet west of the bridge crossing the Housatonic River in Kent village. Here, the unit consists of interlayered gneisses of various shades of gray and degrees of foliation development.

Six main rock types are recognized in this member: poorly foliated or well-foliated, light-gray, biotite-quartz-feldspar gneiss (Appendix I, Table 1: specimens T-3, T-8, 42, 98, 232); poorly foliated, gray, fine-grained, siliceous, biotite-quartz-feldspar gneiss (Appendix I, Table 1: specimens T-7, T-15, 137, 138); foliated, pale pink and light-gray, muscovite-biotite-microcline-plagioclase-quartz augen gneiss; well-foliated, well layered, gray or dark-gray amphibolite and hornblende gneiss (Appendix I, Table 1: specimens T-6, 34, 1428); poorly foliated, dark-gray, garnet-hornblende-biotite-quartz-feldspar gneiss with garnet porphyroblasts up to 1/2 inch across (Appendix I, Table 1: specimen T-13); and well-foliated, light-gray or greenish gray, locally rusty-weathering, diopside-quartz-plagioclase-hornblende-microcline calc-silicate rock (Appendix I, Table 1: specimens 976, 993, 1657), locally a diopside-olivine-tremolite-calcite calc-silicate rock.

Hornblende Gneiss-Amphibolite.

Distribution. The most extensive exposures of the Gray Hornblende Gneiss-Amphibolite are in the southeast part of the Kent quadrangle (Plate 2) on Bear Hill-Iron Hill. Smaller discontinuous exposures are on Mt. Tom, east of Upper Merryall village, and on Sugar Loaf Hill, all in the east or southeast part of the quadrangle. Other known occurrences are south of Mt. Algo and north of the village of Macedonia, both in the Housatonic Highlands in the northwest part of the quadrangle.

<u>Lithology</u>. Amphibolite, gray hornblende gneiss and gray biotite gneiss compose this unit. Amphibolite accounts for 10 - 20% of the unit, but is locally more abundant. It is poorly foliated or well-foliated, dark-gray or black, amphibolite with or without epidote (Appendix I, Table 2: specimens T-2, 37, 40), (Appendix I, Table 2: specimen T-2). Gray hornblende gneiss is a well-foliated, gray or dark-gray, hornblende-microcline-biotite-quartz-plagioclase gneiss (Appendix I, Table 2: specimens 118, 205, 297, 374, 392, 429; 610-b). The third main rock type in this unit is a well-foliated, light-gray or gray, biotite-quartz-feldspar gneiss (Appendix I, Table 2: specimens 349, 357, 430) similar to the gneisses in the Gray Biotite Gneiss Member. Typical exposures of the Hornblende Gneiss-Amphibolite Member are along the southern slope of Iron Hill in the southeast quarter of the quadrangle.

<u>Calc-silicate</u>.

<u>Distribution</u>. The Calc-silicate Member of the Precambrian crops out in two places in the Kent quadrangle (Plate 2). In the south it is exposed on the slopes northeast and south of Tamarack Swamp, and in the northwest it is present south of Mt. Algo in the Housatonic Highlands.

<u>Lithology</u>. The most abundant rock type in this unit is a poorly foliated or massive, greenish-black and white, tan-weathering, biotite-epidote-diopside-hornblende calc-silicate

(Appendix I, Table 3: specimens 1976, M-24). Associated rocks are white or tan, coarse-grained calcite marble, gray, rusty weathering, sulfide-bearing calcareous granulite, tan-weathering, slabby granulite, amphibolite, and gray biotite gneiss. A typical exposure of the Calc-silicate Member is easily accessible on the small hill about 2,000 feet north-northeast of Tamarack Swamp in the southern part of the quadrangle.

Paleozoic

Paleozoic rocks include autochthonous Cambrian Lowerre Quartzite, the Cambrian/Ordovician Inwood Marble, the Middle Ordovician Manhattan A, and allochthonous Manhattan C, and the Moretown Formation.

Lowerre Quartzite. In the Kent quadrangle the Lowerre Quartzite consists of quartzite, schistose granulite, and schist and minor calc-silicate rock (Plate 2). The eastern or offshore facies of the Lowerre consists of interbedded schistose granulite and schist with minor micaceous granulite and quartzite. Equivalent rocks of the western, nearshore facies are more quartzitic with abundant glassy, massive quartzite and conglomeratic quartzite, and only minor schistose granulite. The Peet Hill Member of Lowerre Quartzite is feldspathic granulite and calc-silicate rock.

Name. Merrill (1890) first described a quartzite near the Lowerre railroad station in Yonkers, New York, stratigraphically between the Fordham Gneiss and Inwood Marble. He later named this unit Lowerre Quartzite (Merrill, 1898).

Distribution. Lowerre Quartzite is abundant throughout the quadrangle (Plate 2). It is almost continuously exposed surrounding the Precambrian gneisses in the southeast, north of Peet Hill and near Henderson Pond near the south boundary of the quadrangle trending north toward Peet Hill. It is sporadically exposed near the Precambrian gneisses of Long Mountain and Ore Hill in the southwestern and central parts of the quadrangle, on Pine Hill, and on the small hill 2,000 feet west of Pine Hill. More continuous exposure of Lowerre Quartzite occurs along the east border of the Housatonic Highlands.

Lithology. The Lowerre consists of quartzite, micaceous granulite, schist, and minor calc-silicate rock. Microcline is abundant in most specimens (Appendix I, Table 4). Tourmaline needles up to one inch long are common in minor amounts. Locally, Lowerre Quartzite rocks display a characteristic red- or reddish tan-weathering that is thought to indicate magnetite alteration.

Quartzites are massive or poorly foliated, buff, light tan, or light gray, and locally glassy (Appendix I, Table 4: specimens 10, 103, eastern, or offshore facies; specimens T-5, T-14, western or near-shore facies). Conglomeratic quartzite is present in contact with gneisses of the Housatonic Highlands (Appendix I, Table 4: specimen T-5) and on Pine Hill. Bedding thickness (as defined by lithology, texture, color, etc.) is 1/4 inch to 15 feet.

Micaceous granulites are typically poorly foliated, light-gray or gray, tan or reddish tan-weathering (Appendix I, Table 4: specimens T-1b, 1-a, 1-b, 162-a, 162-b, 315, 1253-b, 1473, 1576). On the east slope of Mt. Tom is a well-foliated, micaceous granulite with alternate light-gray and gray laminae up to 1/4 inch thick (Appendix I, Table 4: specimen T-1b). Micaceous granulites with epidote are locally present (Appendix I, Table 4: specimens 162-a, 162-b).

Schistose granulites are well-foliated, light gray or gray, tan or red or reddish tan-weathering, biotite-muscovite-quartz-feldspar (Appendix I, Table 4: specimens T-1a, 146, 1051, 1253-a, 1923). Nodules of quartz and microperthite (Appendix I, Table 4: specimens T-1a, 1923) or of sillimanite (Appendix I, Table 4: specimen 1015) up to 1/2 inch across are locally abundant throughout the Lowerre Quartzite. Common quartz-feldspar lenses parallel to foliation are possibly pebbles elongated during deformation.

The continuous Lowerre exposures from Henderson Pond northward to the south flank of Peet Hill (Plate 2) are largely well-foliated, medium- to coarse-grained, gray, tan or reddish tan-weathering, garnet-sillimanite-biotite-muscovite-quartz, feldspar schist. Nodules, up to 1/2 inch across, of sillimanite, garnet, or sillimanite with garnet cores are abundant. Elsewhere in the area common constituents of the unit include biotite-muscovite-quartz-feldspar schists (Appendix I, Table 4: specimen 1257).

Abundant exposures of the eastern facies Lowerre (as lithically described above) occur on the steep eastern slope of Mt. Tom in the southeast part of the quadrangle. A typical quartzite exposure of the western facies is in a road-cut on Route 341 about 2,000 feet west of its intersection with Route 7.

Peet Hill Member. Found in numerous exposures on Peet Hill and elsewhere in central and south-central parts of the quadrangle (Plate 2), this member of Lowerre Quartzite is a well-foliated, light-gray or gray-weathering, gray, micaceous or schistose feldspathic granulite (Appendix I, Table 4: specimen 934). Biotite aggregates, noted cutting the foliation and/or parallel to foliation in certain specimens, respectively, up to 1/4 inch across, are abundant in the schistose granulites (Appendix I, Table 4: specimens 933, 1073-1, 1073-2). A typical exposure of schistose feldspathic granulite occurs in the central part of the quadrangle, in a low road-cut along a secondary road 500 feet north of its intersection with Meetinghouse Road and 4,000 feet south of Peet Cemetery. Massive or weakly foliated, light-gray or gray, calc-silicate rock is common along the east slope of Peet Hill (Table 4: specimens 1075, 1146-1, 1146-2). Interlayered massive granulites containing lavender-garnet and garnetiferous schistose granulites (Appendix I, Table 4: specimen 1319) are exposed in a low road-cut north of Peet Hill. Sulfides are locally present in rocks of this member.

The Peet Hill Member is interbedded with other rocks of the Lowerre Quartzite. This is especially noteworthy in the southern part of the quadrangle in outcrops several hundred feet east of Henderson Pond and on a hill about 1,000 feet east of Long Mountain Cemetery. Locally, the Peet Hill Member is tan- or reddish-tan-weathering with sillimanite or garnet nodules up to 1/8 inch across, similar to the granulites of the Lowerre.

Thickness. Thickness of the Lowerre Quartzite varies considerably. A maximum thickness of approximately 1,400 feet was observed in the East Aspetuck Valley (Plate 2) on the border of the New Preston quadrangle, although Dana (1977) reports a maximum thickness of about 1,500 feet farther northeast in this quadrangle. Because the upper contact plane of the Lowerre Quartzite in this valley can be interpreted as either a depositional unconformity or a thrust plane, the true maximum thickness of the unit is unknown. In the White Plains-Glenville area of New York and Connecticut, Hall (1976) reports a maximum thickness of 700 feet for the Lowerre Quartzite.

Correlation. The Lowerre Quartzite rests unconformably on Precambrian gneisses and extends east into the New Preston quadrangle and south into the New Milford quadrangle. Lithic similarities as well as stratigraphic position allow correlation with Lowerre Quartzite in the Manhattan prong (Hall, et al., 1975).

Eastern exposures in the Kent quadrangle consist of schistose granulite and schist, whereas in the west quartzite and conglomeratic quartzite are common. This same relationship between locally schistose older Lower Cambrian Dalton and clean, massive younger Cambrian Cheshire is found in western Massachusetts and northwestern Connecticut (Zen and Hartshorn, 1966; Ratcliffe, 1969; Harwood, 1975). In west-central Vermont, Cady (1945) describes the lower portion of the Cambrian Cheshire Quartzite as much less massive and more argillaceous or schistose than upper parts. In the Bennington-Wilmington area of southwestern Vermont (Skehan, 1961) the more schistose Lower Cambrian Dalton Formation is overlain by the cleaner, more massive Cheshire Quartzite. The schistose Lowerre in eastern parts of the Kent quadrangle and the more massive quartzitic Lowerre in the west may possibly represent a time-transgressive sequence, with the rocks in the east being deposited before those in the west.

Age. The age of the Lowerre Quartzite has long been in question. Merrill (1898) and Merrill, et al. (1902), Balk (1936) and Barth (1936) considered it Cambrian, whereas Berkey (1907) and Prucha (1956) did not recognize it as a separate unit. However, mapping in the White Plains-Glenville area of New York and Connecticut, Hall (1963a, 1968b, 1976) correlates the Lowerre Quartzite with the Cambrian Poughquag Quartzite in the north (Merrill, 1898; Merrill, et al., 1902; Balk 1936 and Barth, 1936). In Dutchess County, New York (Knopf, 1927) and in Orange County, New York (Jaffe and Jaffe, 1973) the Poughquag Quartzite rests unconformably on the Precambrian. At the former locality, the Poughquag contains olenellid fragments and *Scolithus* tubes. In the Monroe quadrangle, Orange County, New York, the subhorizontal Poughquag Quartzite rests with marked angular unconformity on vertically dipping Precambrian gneisses (Jaffe and Jaffe, 1973). Hall (1968a, 1968b, 1976) also correlates the Lowerre with other basal Cambrian quartzites, such as the Dalton and Cheshire of New York, Connecticut, western Massachusetts, and Vermont. Lower Cambrian fossils in the Cheshire Quartzite in Vermont presented by Walcott (1886) and Shaw (1954) suggest this age.

In the Kent quadrangle, the Lowerre Quartzite clearly rests unconformably on Precambrian gneisses. Truncations of gneiss along the unconformity are abundant throughout the area. This unconformable relationship is especially well displayed on the east flank of Mt. Tom in the southeastern part of the quadrangle (Plate 2). Here Pink Granitic Gneiss and Gray Hornblende Gneiss-Amphibolite are truncated in short distance along strike by the basal contact of the Lowerre Quartzite (Hall, et al., 1975). These correlations indicate the Lowerre Quartzite in this region is Cambrian.

<u>Inwood Marble</u>. Inwood Marble consists of two members in the Kent quadrangle. Member A is a thick-bedded, white or gray tremolite dolomite marble and Member B is thin, interbedded granulite, calc-silicate, calcite marble, and dolomite marble.

<u>Name</u>. Merrill (1890) proposed the name Inwood Limestone for the carbonate deposits resting on Lowerre Quartzite found on

northern Manhattan and elsewhere in southeastern New York. On their preliminary geologic map of Connecticut, Gregory and Robinson (1907) included all Connecticut marbles in the Stockbridge Limestone. The name Woodville Marble was introduced for the carbonates in the East Aspetuck Valley between Woodville and Danbury by Rodgers, et al., (1956). Owing to lithic similarities and stratigraphic correlations to follow, the name Inwood Marble will be used here.

Distribution. Inwood Marble is abundant in the Kent quadrangle (Plate 2) including, from east to west: East Aspetuck Valley, West Aspetuck Valley and the Tamarack Swamp area, western Lake Waramaug and Kent Hollow, valleys east and west of Long Mountain, and along the Housatonic River from the northwest border of the quadrangle south through Gaylordsville. Member A of the Inwood is present only in the eastern area, whereas both members A and B are found in the west (Plate 2).

Member A. Four subdivisions of Member A are mapped in an anticline in the East Aspetuck Valley along the southeast border of the quadrangle (Plate 2), and they are from the oldest to youngest Gray Dolomite, Quartzite, White Dolomite, and White and Gray Dolomite.

The Gray Dolomite consists largely of gray or light-gray tremolite-bearing dolomite marble locally with thin interbedded light-gray and white dolomite marble. This easternmost unit of Inwood Member A is exposed in several deeply weathered outcrops.

Thick glacial cover conceals the stratigraphy further southeast along the east side of the valley.

The Quartzite is a slabby, brown- or tan-weathering, gray, muscovite-biotite-quartz-microcline micaceous granulite (Appendix I, Table 5: specimen 838). Thin quartz-feldspar laminae are commonly present.

The White Dolomite is a massive or thick-bedded, white or light-gray, tremolite dolomite marble (Appendix I, Table 5: specimens 826-b, 841) with thin layers of coarse tremolite, diopside and quartz locally present (Appendix I, Table 5: specimen 826-b). Light-tan dolomite marble is present near Northville Cemetery. Pyrite and phlogopite are accessory minerals (Appendix I, Table 5: specimens 841, 842).

Massive or thick-bedded, white or light-gray and light-gray or gray, interbedded tremolite dolomite marble (Appendix I, Table 5: specimen 829) characterize the White and Gray Dolomite unit. Thin lenses of coarse tremolite and quartz are locally present.

Although the top and bottom of Member A are not exposed in the East Aspetuck Valley and structural deformation complicates estimation of its thickness, exposures around Strastrom Pond and in the valley east of Ore Hill indicate Member A is up to 1,000 feet thick. Kent Hollow is largely underlain by Member A, but structural complications there also preclude estimation of its thickness.

Member B. Inwood Member B is best exposed in the Housatonic River about one mile north of Merwinsville and in a rock cut behind a condominium complex about 1,000 feet northeast of the intersection of Route 7 and the railroad track in the Kent Village. Bedding from laminations up to 4 feet thick of numerous rock types characterizes Member B (Appendix I, Table 5). These rock types are: orange- or tan-weathering dolomite marble (Appendix I, Table 5: specimen 1828-1) locally with thin gray siliceous beds with pyrite; tan- or orange-weathering phlogopite calc-silicate (Appendix I, Table 5: specimens 2031, 2540); light-gray dolomite (Appendix I, Table 5: specimen 1829-8); thin rusty-weathering or black granulite with light-gray laminae (Appendix I, Table 5: specimen 1829-3); red- or yellow-tan phlogopite dolomite marble (Appendix I, Table 5: specimen 1828-6) locally with thin well-foliated purplish lenses; dark-gray phlogopitic dolomite marble (Appendix I, Table 5: specimen 1829-9); well-foliated purple or light-gray phlogopitic dolomite marble (Appendix I, Table 5: specimen 1829-10); and interbedded light-gray and cream dolomite marble. Tremolite, diopside, and phlogopite are common accessory minerals (Appendix I, Table 5).

Inwood Marble Member B is 1,000 feet thick in the Housatonic River Valley south of Kent. Since the top of the unit is marked by an unconformity, the maximum thickness is unknown. The total apparent thickness of Inwood Marble is about 2,300 feet in the Kent quadrangle. Hall (1968a and 1968b) reports a 2,000-foot thickness for Inwood Marble in the White Plains area of southeastern New York.

Correlation. Based on lithic similarities, Gregory and Robinson (1907) included all marbles in western Connecticut as Stockbridge Marble. Although Gates (1954) called the marble in the East Aspetuck Valley Stockbridge Marble, Rodgers, et al., (1956) introduced the name Woodville Marble. In the Danbury quadrangle, Clarke (1958) considered the marbles as Inwood, the marbles being nearly physically continuous with the Inwood type locality in the Manhattan prong. Inwood Marble members A and B in the Kent quadrangle are lithically similar and have the same stratigraphic position as the following: Inwood Marble Members A and B in the Glenville-White Plains area of southeast New York and southwest Connecticut (Hall, 1968a, 1968b); Stissing Dolomite and Pine Plains Formation (Knopf, 1962) in Dutchess County, New York; Stockbridge units A and B in the Bashbish Falls (Zen and Hartshorn, 1966) and Egremont (Zen, 1969) quadrangles in southwestern Massachusetts; the Dunham Dolomite and the Winooski and Monkton Formations (Doll, et al., 1961) in northwestern Vermont.

Age. A correlative marble outside the Kent quadrangle has been identified as Cambrian, Lower Ordovician, or both (Rodgers, et al., 1956; Risher, et al., 1970). Knopf (1927) describes Cambrian gastropods in the Stissing Dolomite of the Stockbridge-Wappinger Marble of Dutchess County, eastern New York.

Manhattan A. Manhattan A is subdivided into a tan-weathering, calcite marble and a younger, well-foliated, gray, biotite schistose granulite with interbedded calcite marble at its base. This makes the contact between the two units gradational.

Name. The name Manhattan Schist (Merrill, 1890) was applied to the schists stratigraphically above the Inwood Marble in southeastern New York. Gray schists locally with interbedded calcite marble and mappable tan-weathering calcite marble comprise Manhattan A (Hall, 1968a, 1968b), the basal Manhattan unit in the Glenville-White Plains area of the Manhattan prong.

Distribution. In the Kent quadrangle (Plate 2), Manhattan A is exposed in the East Aspetuck River valley in the southeast, east in the Golf Course Hill area, and south of Peet Hill. In western parts of the quadrangle it is found, from north to south, near The Cobble, Spooner Hill, Cedar Hill, and the village of Gaylordsville.

The Calcite Marble Member. Rocks in this member of Manhattan A are massive or well-foliated, (phlogopite), tan- or tan-orange-weathering, tremolite-diopside-phlogopite calcitic marble (Appendix I, Table 6). Thin-bedded, light-gray or white granular, phlogopitic calcite marble occurs in a road cut at Hatch Pond, as well as near Gaylordsville (Plate 2). In the East Aspetuck Valley phlogopitic dolomite marble is rare (Appendix I, Table 6: specimen 864). Locally, the Marble Member contains up to 1/4-inch-thick gray calcitic lenses and thin siliceous beds.

Well-foliated phlogopitic calcareous schist is locally present in the Housatonic River valley (Appendix I, Table 6: specimen 2064).

The Granulite Member. This unit consists of interlayered micaceous or schistose granulite and schist with lesser calc-silicate rock and calcite marble (Appendix I, Table 7). The basal part of the Granulite Member has interbedded calcite marble, schistose granulite and schist. The calcite marbles are lenticular in plan and discontinuous. Depending on phlogopite abundance, they are massive or well-foliated, tan- or tan-orange-weathering, white or light-gray, tremolite-diopside-phlogopite calcite marbles (Appendix I, Table 7: specimens 2061-b, 2323-a, 3112-b).

The schistose granulite is a gray or dark-gray, muscovite-biotite-plagioclase-quartz rock (Appendix I, Table 7: specimens T-9, 1830, 2061-a, 3112-a) locally with sillimanite or garnet nodules up to 1/8 inch across (Appendix I, Table 7: specimens T-9, 2061-a). Schists are well-foliated, gray, tan or rusty weathering, and consist of sillimanite, muscovite, biotite, quartz, and plagioclase (Appendix I, Table 7: specimen 3112-a). Schistose granulites and schists are locally characterized by single crystals or aggregates of biotite up to 1/4 inch oriented across foliation. Weathering of pyrite, pyrrhotite or both gives the rocks a rusty appearance (Appendix I, Table 7: specimen 2178). These sulfides are also locally present in the micaceous or schistose granulites and calc-silicate rocks. Calc-silicate rocks contain abundant hornblende, diopside, and tremolite (Appendix I, Table 7: specimens 825, 2104, 2114, 2178, 2372).

Thickness. Along the western part of the East Aspetuck River valley, the apparent thickness of the Calcite Marble Member is 300-400 feet, nearly the same as on the east slope of the Housatonic River valley near Kent. The Granulite Member reaches an apparent thickness of 500 feet along the west slope of Spooner Hill south of Kent. Structural complications make thickness estimates less reliable in other areas of the quadrangle. The total maximum apparent thickness for Manhattan A is approximately 900 feet in the Kent quadrangle. Hall (1968a) reports a thickness of 900 feet in the White Plains area of southeast New York.

Correlation. The Calcite Marble and Granulite Members in the Kent quadrangle are lithologically similar and hold the same stratigraphic position as: Manhattan Member A described by Hall (1968a) in the Manhattan prong, the Balmville Limestone and the Walloomsac Formation of Dutchess County, New York (Fisher, 1962; Knopf, 1962), the Walloomsac Formation in the Bashbish Falls Massachusetts quadrangle (Zen and Hartshorn, 1966), and the Whipple Marble Member and the Ira Formation (Zen, 1961; Doll, et al., 1961) in western Vermont.

Age. Lithology and stratigraphic position enabled Hall (1968a and 1968b) to correlate Manhattan A with the Balmville Limestone exposed north of the Hudson Highlands and the Whipple Marble Member in Vermont, both of which are Middle Ordovician. Pelmatozoan fragments in calcite marble at the base of the

Manhattan A at Verplanck, New York indicate a Paleozoic age (Ratcliffe and Knowles, 1968) and support the correlation. Mapping within the Kent quadrangle suggests that the Moretown Formation is thrust over Manhattan A in the East Aspetuck River valley (Plate 2).

Manhattan C.

Name. Merrill (1890) referred to all of the schists stratigraphically above the Inwood Marble as Manhattan Schist. More recently, Hall (1968a, 1968b, 1976) subdivided the Manhattan Formation and interpreted that the upper two units, Member B and Member C, are in thrust contact with the physically lower autochthonous rocks including Manhattan Member A.

Distribution. Allochthonous Manhattan C is most extensively exposed in the northeast part of the quadrangle (Plate 2) underlying parts of Warren, the Wyantenock State Forest, Treasure Hill, and Golf Course Hill. Further west, Kent, Segar, and Bull mountains are held up by Member C. It also occurs on The Cobble near Kent Village, on Spooner and Cedar hills west of South Kent and on several hills near Gaylordsville.

Manhattan C occurs in two thrust sheets in the Kent quadrangle. The lower, Waramaug thrust sheet, contains the Schistose Gneiss Member, the Schistose Granulite, Amphibolite, and the Siliceous Granulite members. The higher, Above All thrust sheet, includes the Schistose Gneiss and Above All members (Plate 2).

Schistose Gneiss Member. The Schistose Gneiss Member is a coarse-grained, well-foliated, tan- or reddish-tan-weathering, light-gray or gray, garnet-sillimanite-biotite-muscovite-plagioclase schist commonly with garnet porphyroblasts and sillimanite nodules up to 1/2 inch across, giving a characteristic "warty" appearance on weathered surfaces (Appendix I, Table 8: specimens T-4, 824, 911, 1186, 1837, 1842-b, 2323-b, 2323-c, 3112-c, 3544). The schist has a thick, uniform composition with bedding only locally identifiable by slight lithologic differences. Although this coarse-grained variety of the Schistose Gneiss is found primarily in western parts of the Waramaug thrust sheet, it occurs locally in the east, such as on Golf Course Hill. Near Mauwee Peak in the north-central part of the quadrangle a rare coarse schist with garnets up to 1/2 inch across is exposed. In eastern parts of the Waramaug thrust sheet and within the Above All thrust sheet, the Schistose Gneiss Member is mineralogically similar to the coarse schist except that it has abundant sillimanite nodules only 1/8 to 1/4 inch across (Appendix I, Table 8: specimens 1186, 1842-b, 3112-c).

The schist locally grades into a well-foliated schistose granulite (Appendix I, Table 8: specimens 806, 808, 1837) or micaceous granulite (Appendix I, Table 8: specimens 805, 921). Calc-silicate rocks occur in Merwinsville (Appendix I, Table 8: specimen 2601). On the Cobble, a garnetiferous granulite is present (Appendix I, Table 8: specimen 2163). Thin, discontinuous glassy quartzite lenses are locally present and are best displayed on a steep hill adjacent to the west shore of Hatch Pond. Interbedded calc-silicate rocks are especially abundant on Golf Course Hill near Lake Waramaug (Appendix I, Table 8: specimens 815, 877, 877-a, 880). The thin calc-silicate beds may be part of Manhattan A, tightly infolded or disarticulated within Manhattan C rocks.

Schistose Granulite Member. This member is composed of micaceous gneiss, schistose gneiss, and schist with lesser amounts of thin-layered gneiss, calc-silicate rock, and amphibolite (Appendix I, Table 9).

The micaceous gneiss is a massive or poorly foliated, light-gray or gray, muscovite-biotite-plagioclase siliceous micaceous gneiss (Appendix I, Table 9). Local variations consist of abundant quartz lenses, up to 1/2 inch thick, parallel to foliation (Appendix I, Table 9: specimens 1844-d1, 1844-f) and quartz-feldspar-mica aggregates up to 1/8 inch across (Appendix I, Table 9: specimen 3490).

Schistose gneiss is a well-foliated, tan- to light-gray-weathering, light-gray or gray, garnet-muscovite-biotite-plagioclase-quartz rock (Appendix I, Table 9). Irregular quartz lenses, up to 1 inch thick and parallel to foliation are common.

The schist is a well-foliated, locally coarse-grained, light-gray, kyanite-sillimanite-garnet-biotite-muscovite-quartz-plagioclase schist (Appendix I, Table 9) with locally abundant quartz lenses or stringers, up to 1 inch thick and parallel to foliation. Sillimanite nodules up to 1/4 inch are locally present.

A well-foliated, thinly layered, light-gray and black, muscovite-biotite-quartz schistose gneiss (Appendix I, Table 9: specimen 3146) with light-gray plagioclase augen, up to 1/4-inch across is present in several locations on Segar and Bull mountains. These elongate augen are parallel to one another and lie in the foliation. The thickness of this gneiss varies but is typically 10-15 feet.

Minor interbeds of massive or poorly foliated, light-gray or greenish gray, hornblende-epidote-microperthite-quartz calc-silicate rock (Appendix I, Table 9: specimens 1844-e, 1851-b) are locally present.

Discontinuous, thin dark-gray or black hornblende gneisses (Appendix I, Table 9: specimens 1842-a, 1852-a), lithically similar to those in the Amphibolite Member, are present within the Schistose Granulite Member.

Amphibolite Member. Amphibolite in this unit is massive or poorly foliated, black or greenish gray, and consists of garnet, quartz, and plagioclase (Appendix I, Table 10). Garnet is locally present and in one specimen (Appendix I, Table 10: specimen 2853-a) conspicuous garnets 1/8 inch across with plagioclase rims give a "bull's-eye" appearance to the rock. Thin greenish epidote-bearing layers and lavender garnet-bearing layers are sometimes present.

Siliceous Granulite Member. This unit is best exposed in the New Preston quadrangle (Dana, 1977), but occurs in a few scattered outcrops in the northeast Kent quadrangle. It is largely a massive or poorly foliated, tan-weathering, light-gray, biotite-muscovite-feldspar-quartz micaceous granulite or thinly laminated quartzite. Accessory tourmaline needles up to 1 inch long are conspicuous. Quartz-feldspar nodules up to 1/2 inch across are present.

Above All Member. First described in the New Preston quadrangle by Dana (1977), the Above All consists mainly of well-foliated, medium- or coarse-grained, light-gray- or tan-weathering, biotite-muscovite-feldspar-quartz schist. Abundant quartz-feldspar lenses or stringers, 1/4 to 1/2 inch thick and parallel to foliation (Appendix I, Table 10: specimen 3907), are characteristic of the rocks in this unit. Pegmatite or quartz lenses several inches thick are also common. Rusty weathering patches of sulfide minerals are locally present. Some schists display abundant small garnet and sillimanite crystals similar to those in the Schistose Gneiss Member. The schists locally grade into light-gray or gray schistose or siliceous gneisses similar to gneisses of the Schistose Granulite Member.

Thickness. Structural details of the allochthonous sheets are not completely understood, complicating estimation of thickness. About 1,000 feet of Schistose Gneiss is exposed on Spooner Hill. At least this thickness of 1,000 feet and possibly more is found in the Warren area. North of Lake Waramaug, the apparent thickness of the Schistose Granulite Member is nearly 1,000 feet . The Amphibolite Member on Geer Mountain and Bald Hill is 250 feet thick. The Siliceous Granulite is approximately 50 feet thick north of Lake Waramaug. The Above All Member has an apparent thickness of about 1,000 feet.

Without the stratigraphic top of the formation exposed, the total apparent thickness of Manhattan C in the Kent quadrangle is about 3,300 feet. Until the detailed structural geometry is understood more clearly, this thickness is suspect.

Correlation. Hall (1976) correlates Manhattan C in the White Plains-Glenville area with the Waramaug Formation of western Connecticut and the Hoosac Formation of western Massachusetts and western Vermont. In the Kent quadrangle, Manhattan C is interpreted to be thrust over Manhattan A calcite marbles, schists, and granulites and, as noted approximately 1 mile north of Peet Hill (Plate 2), Manhattan C is in thrust contact with Inwood Marble Member A and the Peet Hill Member of Lowerre Quartzite. Although Hall (1968a, 1976) maps the thrust contact locally beneath amphibolites of Manhattan B, the unit there is discontinuous, and its absence in the Kent quadrangle is not considered critical.

Farther north in the Bashbish Falls (Zen and Hartshorn, 1966) and Egremont quadrangles (Zen, 1969), the Everett Formation is thrust over the Middle Ordovician Walloomsac Formation. The

Everett consists of quartzose and micaceous phyllites at low metamorphic grade and almandine-chlorite-staurolite schist with increasing metamorphic grade. This unit is possibly correlative, at least in part, with the schists of the Schistose Gneiss Member of Manhattan C in the Kent quadrangle. Zen (1969) correlates the Everett Formation with the following rock units: the Greylock Schist of western Massachusetts, the Mount Anthony Formation of the Taconics in Vermont (Hewitt, 1961; MacFadyen, 1956) the Hoosac and part of the Pinnery Hollow Formation of Vermont, and the Underhill Formation of northern Vermont (Doll, et al., 1961).

Age. No fossils have been found in the Manhattan Member C but in the White Plains-Glenville area of the Manhattan prong, Hall (1968a and 1968b, 1971 and 1976) interprets it as an eastern facies equivalent in age to the Cambrian Lowerre Quartzite and the basal Inwood Marble. Based on structural and stratigraphic evidence, Dana (1977) considers the Above All Member as the youngest portion of Manhattan C.

Moretown Formation.

Name. The Moretown was named by Cady (1956) after that locality in the Montpelier quadrangle in central Vermont. The Moretown contains granulites and schists that locally display a characteristic pinstripe lamination.

Distribution. Rocks of this formation are present in a few scattered exposures in stream gullies in the southeast quadrangle (Plate 2).

Lithology. Despite poor exposure, two members of the Moretown Formation are recognized in the Kent quadrangle: the Schist and Granulite Member and the Amphibolite Member. The first consists of interbedded well-foliated, light-gray, tan-weathering, biotite-garnet-chlorite-muscovite-quartz schist (Appendix I, Table 11: specimen 857) and thin-bedded, massive, vitreous, gray, mica-plagioclase quartzite (Appendix I, Table 11: specimen 856-a). Thin calc-silicate beds are locally present. The Amphibolite Member is a slabby, well-foliated, black or greenish-black quartz-plagioclase amphibolite (Appendix I, Table 11: specimen 859) with abundant hornblende needles.

Correlation. The Moretown trends southward from Vermont into Massachusetts (Doll, et al., 1961). Hatch, et al. (1968) mapped the Moretown Formation southward across Massachusetts. Hall (1976) correlates the Schist and Granulite Member of the Hartland Formation in the White Plains-Glenville area of the Manhattan prong with the Taine Mountain Formation (Stanley, 1964; Hatch and Stanley, 1973) and Hartland I (Gates and Christensen, 1965; Martin, 1970) in western Connecticut. The stratigraphic relationship of the Moretown to other rocks in the Kent quadrangle is unclear because it is in fault contact with these rocks as indicated from mapping relationships within the East Aspetuck valley.

Age. The Moretown Formation is considered to be Ordovician (Doll, et al., 1961). Hatch, et al. (1968) assign the Moretown to early Middle Ordovician in western Massachusetts. The unit's relationship to the Middle Ordovician unconformity in western New England is not clear. The Moretown is probably the youngest allochthonous unit in the Kent quadrangle and may represent an eastern facies equivalent to Manhattan A or it may predate the Middle Ordovician Unconformity and thus be older than Manhattan A.

STRATIGRAPHY OVERVIEW

Basal Paleozoic Unconformity. The basal unconformity separates Lowerre Quartzite and locally Inwood Marble from Precambrian gneisses. An irregular depositional surface developed on the gneisses apparently accounts for thickness variations of the Lowerre Quartzite. By the time some topographically high areas were flooded, carbonate deposition was already occurring in the shelf zone, thus marble rests unconformably on basement in those areas.

Evidence for a basal unconformity is conclusive. Basement units truncate with angular unconformity along the Paleozoic-Precambrian contact everywhere in the quadrangle (Plate 2). Angularity is not evident at the unconformity in the field because later deformations rotated Precambrian structural elements so that they are nearly parallel with Paleozoic ones.

Middle Ordovician Unconformity. Middle Ordovician Manhattan A calcite marble or granulite is in direct contact with Inwood Marble Members A or B, or with Lowerre Quartzite (Plate 2). This contact is interpreted as an unconformity.

The Middle Ordovician unconformity brings Middle Ordovician rocks into contact with older units. This unconformity is clearly documented at several places in western Vermont (Zen, 1967). It is also identified in the Bashbish Falls and Egremont area of southwestern Massachusetts and adjacent parts of Connecticut as well as in the Manhattan prong of southeastern New York and adjacent parts of southwestern Connecticut (Hall, 1968a, 1976).

Correlation. A plausible regional correlation of the autochthonous miogeosynclinal rocks of the Kent area is provided in Figure 2. This interpretation is largely based on a similar diagram by Hall (1968a, 1968b, 1976). Figure 3 is the correlation of allochthonous and autochthonous rocks in the Kent quadrangle. This correlation considers a reconstruction of the original distribution and interrelations between the rock units of the Kent quadrangle. It is based on stratigraphic and structural interpretations in the Manhattan prong and western Connecticut (Hall, 1968a) and in the adjacent New Preston quadrangle (Dana, 1977) as well as interpretation of stratigraphy in the Kent quadrangle.

Lowerre Quartzite is a basal clastic miogeosynclinal deposit, unconformably resting on Precambrian basement, time-transgressive from east to west. It is overlain by Inwood Marble, a carbonate shelf deposit. Rocks of Manhattan C, deposited as shales, graywackes, calcareous granulites, and basalts are interpreted as eastern equivalents of the Lowerre and at least part of the Inwood (Figure 3). Lithic similarities between parts of the allochthonous Manhattan C and the autochthonous Lowerre indicate a time equivalence.

The Moretown Formation is tentatively interpreted as equivalent to part of the Inwood Marble and older than Manhattan

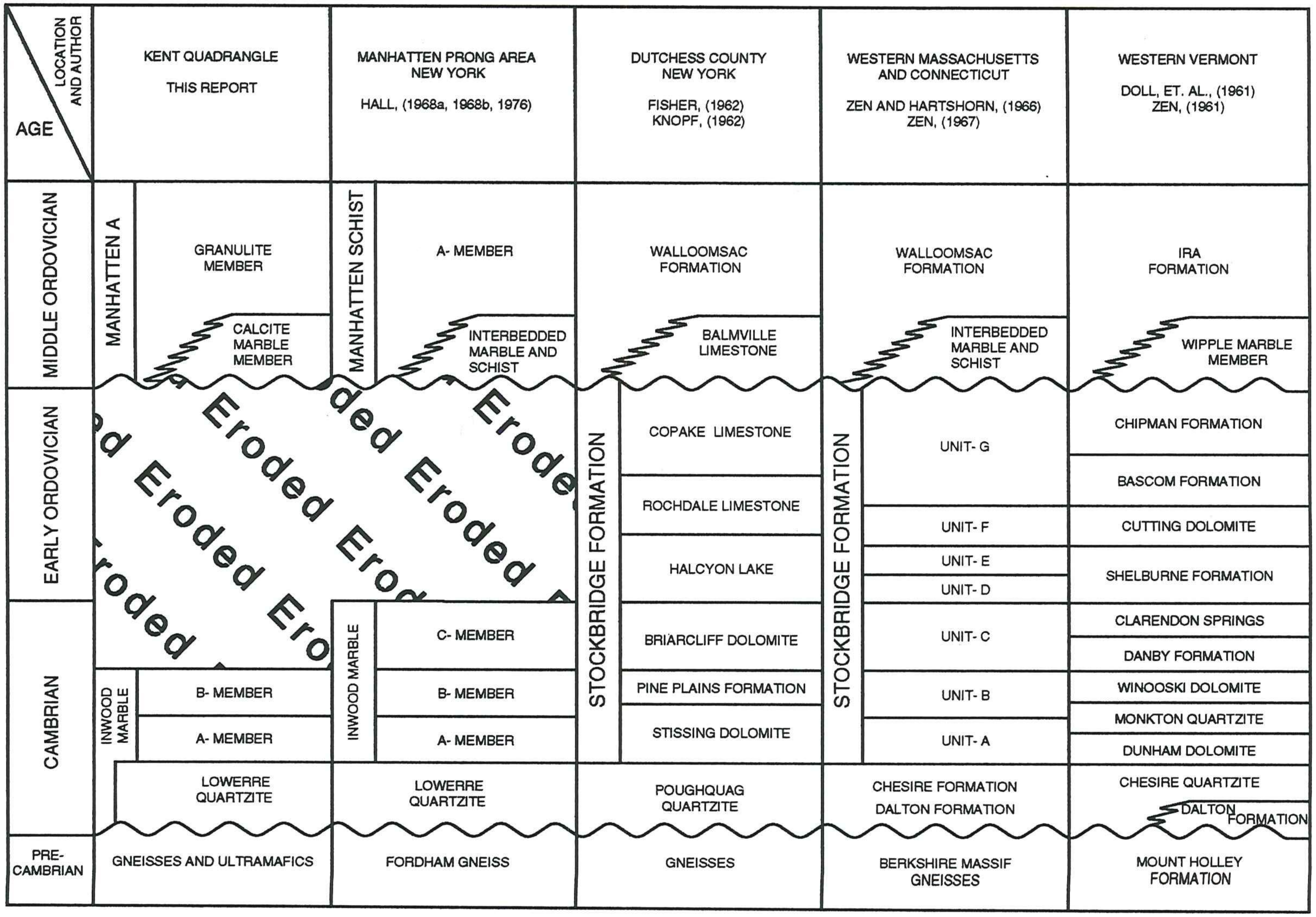


Figure 2. Proposed regional correlation of the miogeosynclinal stratigraphic subdivisions in the Kent quadrangle, based upon a similar diagram by Hall, (1968a,1968b, 1976).

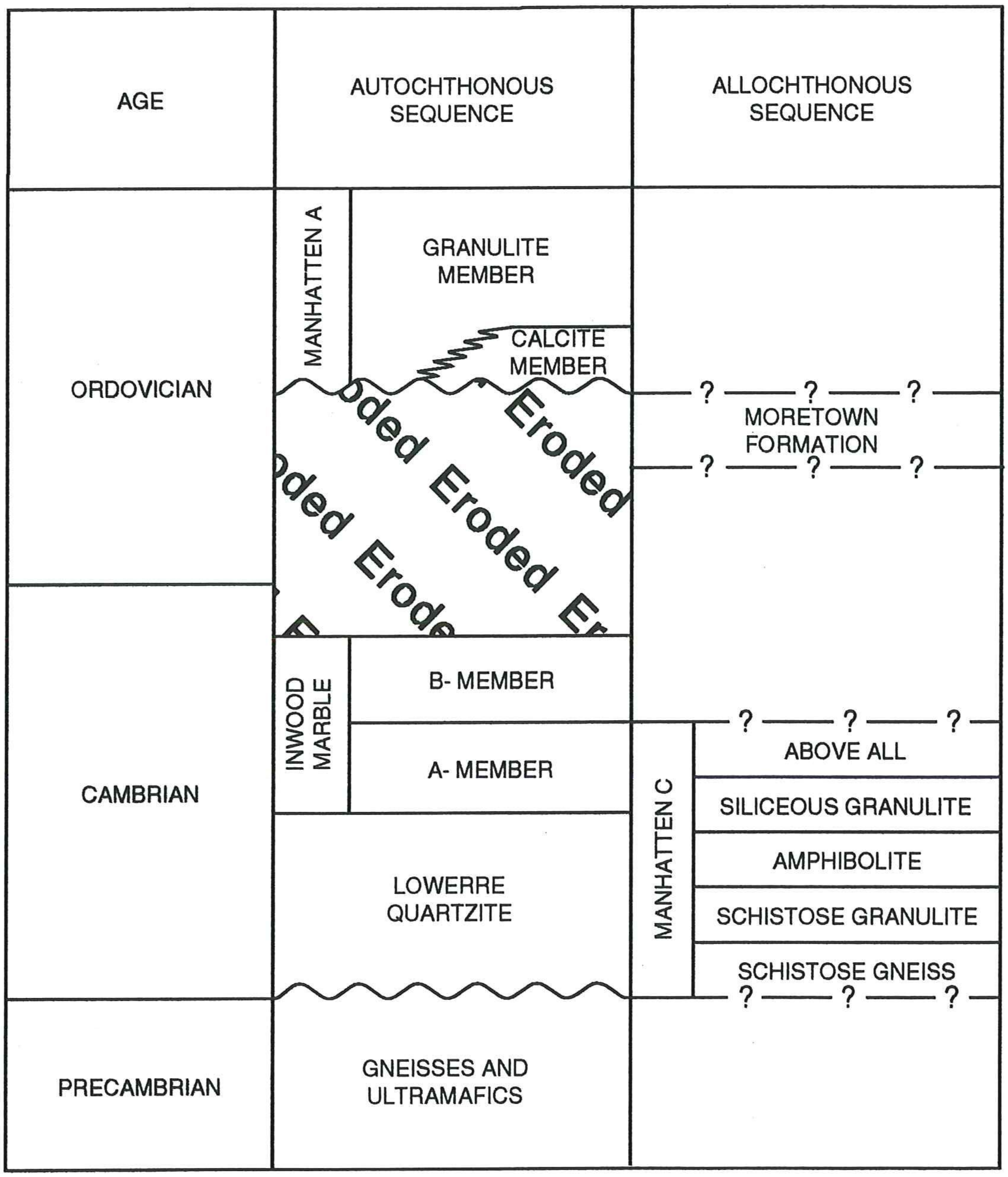


Figure 3. Proposed correlation of allochthonous rocks and autochthonous rocks in the Kent quadrangle. See text for descriptions.

A. It is unclear if the Middle Ordovician unconformity ever developed in the east.

IGNEOUS ROCKS

The Kent quadrangle contains both Precambrian and Ordovician igneous rocks. Precambrian igneous formations include ultramafic rock and granitic gneiss. These rocks are unconformably overlain by Lowerre Quartzite or locally by Inwood Marble. The Ordovician(?) Candlewood lake Pluton and its associated pegmatites intrude autochthonous and allochthonous rocks.

Precambrian

Ultramafics.

Distribution. A single exposure of ultramafic rock occurs on the east slope of a hill 2,000 feet north of the village of Macedonia in the Housatonic Highlands (Plate 2). Although exposure is limited, the unit is mapped as a lens of about 200 feet across and 500 feet long. The internal structure of this ultramafic body is not known.

Lithology. Several rock types characterize the ultramafic unit. Coarse-grained, gray olivine and anthophyllite with varied amounts of talc and serpentine are the most abundant components (Appendix I, Table 12: specimen 4302). Bladed and fibrous anthophyllite crystals up to 3 inches long are locally present as well as chlorite "books" up to 8 inches across and 3 inches thick.

Amphibolite and coarse hornblendite are found in the eastern part of the exposure.

The southern contact between the ultramafic body and gray biotite gneisses is characterized by shearing and the development of a cataclastic (or protomylonitic) texture. Fresh biotite crystals up to 1/8 inch across may have recrystallized during shearing.

Correlation and Age. No other ultramafic rocks were found in the quadrangle. Amphibolite and hornblendite are reported in the Cornwall quadrangle, further north in the Housatonic Highlands (Gates, 1961). A zone of cataclasis, with both gneisses and ultramafic rocks, is present along one contact, and the age of the ultramafic rock is not certain.

Granitic Gneiss.

Two textural varieties of Granitic Gneiss have been mapped within the Kent quadrangle. Augen Gneiss is a well-foliated, coarse-grained, pink and black, microcline gneiss and the Pink Granitic Gneiss is a massive microcline gneiss.

Distribution. In the southeast, Augen Gneiss is present along the northwest slope of Mt. Tom, on Bear Hill and extends several miles northeast from Camp Ella Fohs Pond into the New Preston quadrangle. In the Housatonic Highlands, Augen Gneiss trends southwest from Mt. Algo into the Dover Plains, New York quadrangle.

The Pink Granitic Gneiss is abundant (Plate 2) in the southeast. Here it trends continuously northeast from the New Milford quadrangle and Mt. Tom to Iron Hill, Bear Hill, Sawyer Hill and into the New Preston quadrangle. It also occurs about 2,000 feet east of Upper Merryall, northeast of Peet Hill and on Sugar Loaf Hill. Ore Hill, located in the central part of the quadrangle, is largely held up by Pink Granitic Gneiss. Abundant exposures of the unit can be found in the Housatonic Highlands, primarily on Mt. Also and around Macedonia Village.

Lithology. The Augen Gneiss is a well-foliated, light-brown- or tan-weathering, pink and black or light-gray, biotite-quartz-plagioclase-microcline augen gneiss (Appendix I, Table 12). Pink microcline augen (1/4 to 1/2 inch across) with biotite wrapping around them characterize this unit. Microcline augen approximately 1 1/2 inches across are present on Sugar Loaf Hill, near the east border of the quadrangle. Variations in the color of the augen, due to weathering, include orange, yellow-orange, orange-pink or tan-pink. Augen composed largely of plagioclase crystals with minor amounts of microcline crystals are gray. Hastingsite, identified by 2V values approximately 20^{o}, is in several samples (Appendix I, Table 12: specimens 52, 261, 753, 761). Locally on Bear Hill and Mt. Tom, rocks in this unit consist of 1/4 inch alternating layers of pink microcline and quartz and gray or dark-gray, biotite, plagioclase, and quartz. In a road cut approximately 2,000 feet west of Kent Village on Route 341, the augen gneiss contains widely scattered concentrations of garnet. In addition, minor, thin, dark-gray, biotite gneisses with hornblende and epidote are locally interlayered with the augen gneiss (Hall, et al., 1975).

Locally a distinctive zone of rocks marks the contact between the Augen Gneiss and the Pink Granitic Gneiss. This contact zone is best exposed approximately 1,000 feet east of Camp Ella Fohs in a large outcrop adjacent to the road. Between the biotite-microcline augen gneiss and the pink quartz-microcline gneiss there is a transition, possibly resulting from cataclasis from a coarse-grained augen gneiss to a medium- and fine-grained well-foliated variety. This zone displays a marked increase in biotite and plagioclase content, with the rock grading into gray augen gneiss. At this contact there is a well-foliated gray gneiss, mapped as part of the Augen Gneiss unit. This contact zone gneiss is also present at several places north of Mt. Tom. It is not evident elsewhere in the quadrangle.

The Pink Granitic Gneiss is poorly foliated or well-foliated, depending on the abundance of biotite. It is fine-grained, light-tan- or pale pinkish tan-weathering, pink or pale pink, biotite-quartz-feldspar gneiss (Appendix I, Table 13) that is mineralogically very similar to the Augen Gneiss. Locally, lenses of small magnetite crystals are present (Appendix I, Table 13: specimen 19) and in two specimens magnetite comprises up to 3 percent of the rock (Appendix I, Table 13: specimens T-1, 743). In some specimens hornblende has a 2V approximately 20°, identifying it as hastingsite (Appendix I, Table 13: specimens 422, 563, 610-a). Aggregates of quartz, plagioclase and microperthite up to 1/4 inch across are locally present in the unit (Appendix I, Table 13: specimens T-1, 302, 335, 610-a).

On Iron Hill and Mt. Tom in the southeast part of the quadrangle there is a massive or well-foliated, light-tan or pale pink, muscovite-quartz-feldspar gneiss (Appendix I, Table 13: specimens 324, 437), approximately 20 feet thick, associated with the Pink Granitic Gneiss. Muscovite crystals up to 1/2 inch across are present in the Mt. Tom exposure. This rock is not extensive enough to be shown separately on Plate 2.

Correlation. Regional correlation is based on lithic similarities and age relations. The Yonkers gneiss, in the Manhattan prong, is a pinkish, biotite-hastingsite-quartz-feldspar gneiss, locally containing microcline augen (Hall, 1968a, 1968b, 1976). The Pound Ridge Granitic Gneiss also found in the Manhattan prong (Lessing, 1967) is a pink biotite-microcline-plagioclase gneiss. Noting these lithic similarities, the Granitic Gneiss in the Kent area is tentatively correlated with the Yonkers Gneiss. The Pound Ridge Granitic Gneiss is unconformably overlain by Cambrian Lowerre Quartzite.

Age. The map pattern suggests that the two units of the Granitic Gneiss intrude the Precambrian Gray Biotite Gneiss, Calc-silicate, and Gray Hornblende Gneiss-Amphibolite units (Plate 2). East and southeast of Ella Fohs Camp Pond, the Augen Gneiss cuts across the Gray Biotite Gneiss and Gray Hornblende Gneiss-

Amphibolite contact. Augen Gneiss also transects across these units approximately 2000 feet west of the summit of Bear Hill. In the Housatonic Highlands west of Pine Ledge, the Augen Gneiss and Pink Granitic Gneiss intrude the Calc-silicate Member.

Pink Granitic Gneiss cuts across the Hornblende Gneiss-Amphibolite and Gray Biotite Gneiss units on the northeast slope of Mt. Tom, on the east slope of Bear Hill and on the west slope of Sawyer Hill (Plate 2). At outcrop scale in the Housatonic Highlands numerous felsic dikes of both Augen Gneiss and Pink Granitic Gneiss intrude other Precambrian rocks. Dana (1977) found the Pink Granitic Gneiss to be clearly intrusive into the Augen Gneiss within the New Preston quadrangle.

The age relationship between the Pink Granitic Gneiss and the muscovite gneiss, mentioned in the Lithology section (p. 45), is uncertain. The muscovite gneiss is more aluminous and may represent a slightly later Precambrian granitic intrusion associated with the Pink Granitic Gneiss.

Radiometric dates are available for the Yonkers Gneiss and the Pound Ridge Granitic Gneiss of the Manhattan prong. For the Yonkers Gneiss, Long (1969) obtained a whole rock Rb-Sr isochron corresponding to an age of 575 $\pm$ 30 m.y. Grauert and Hall (1973) analyzed zircons in the Yonkers Gneiss and obtained a U-Pb isotopic age of 511 m.y. for Pb-206/U-238 and 515 m.y. for Pb-207/U-235. Allowing for disturbances of the U-Pb system of zircons from the Yonkers during the Taconic and Acadian events, they felt that the ages are compatible with the 575 ± 30 m.y. whole rock isochron determined by Long (1969). A whole-rock Rb-Sr isochron (Mose and Hayes, 1975) indicates the Pound Ridge Granitic Gneiss has an age of 596 ± 19 m.y.

Ordovician (?)

Candlewood Lake Pluton.

Name. On the Preliminary Geologic Map of Connecticut, Gregory and Robinson (1907) refer to the granitic rock on Long Mountain as Thomaston Granite, a term applied to many other granitic rocks in western Connecticut. These granites contain two micas and are massive to distinctly foliated granite (Rice and Gregory, 1906). In this report the rock previously called Thomaston Granite in the Kent quadrangle will be referred to as the Candlewood Lake Pluton.

Distribution. The granite is exposed extensively on Long Mountain, in the southern part of the quadrangle (Plate 2) trending northeastward to the west slope of Peet Hill. Pegmatites, possibly related to the main body, occur along strike near Comp Po-Ne-Mah in the northeast part of the study area. Other minor pegmatites, too small to indicate on the map, occur locally.

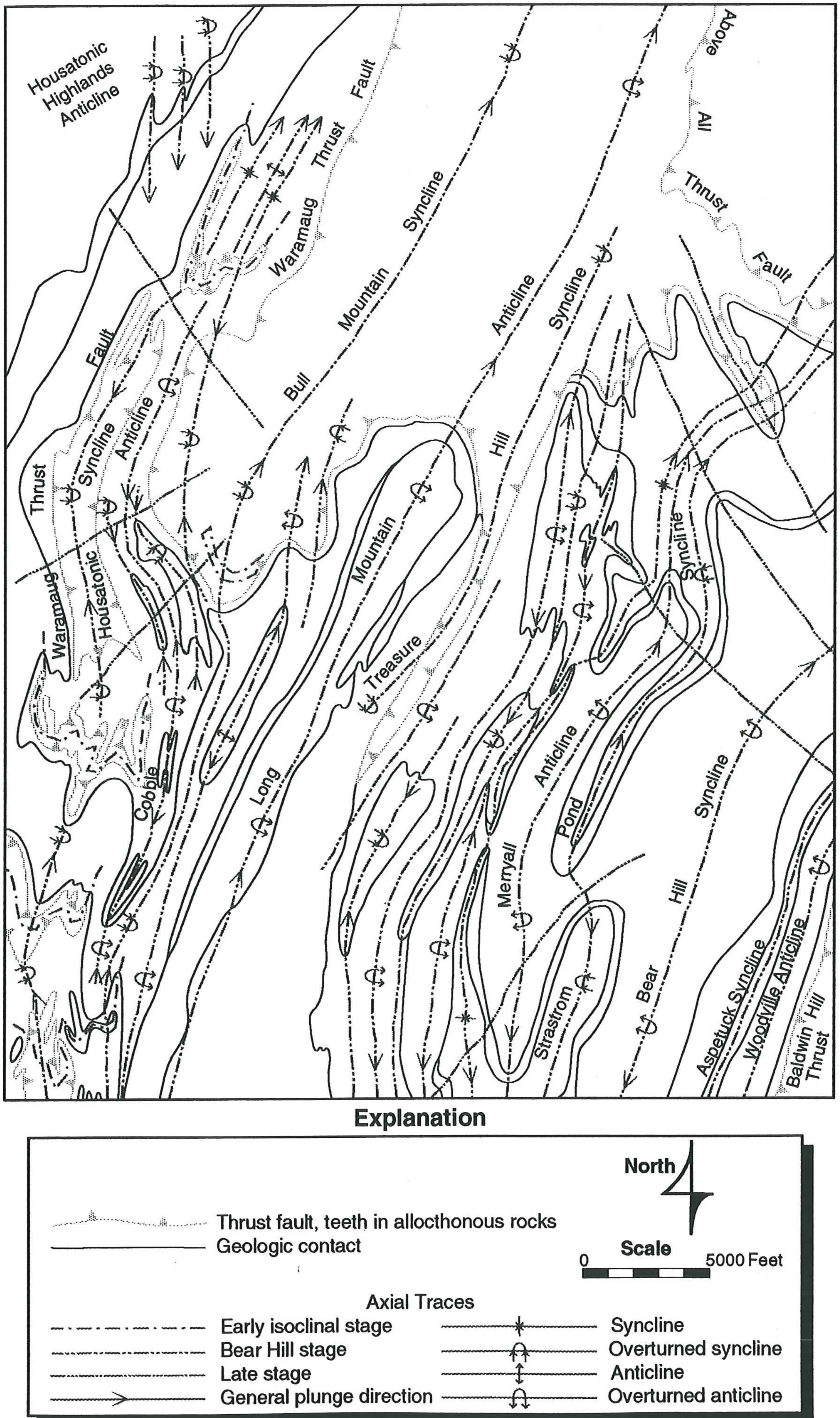
Lithology. The Candlewood Lake Pluton is largely a uniform, fine- or medium-grained, light-tan or pink-weathering, gray or white, muscovite-biotite-quartz-feldspar granite (Appendix

I, Table 14). Near the contact with stratigraphic units the igneous rock is well-foliated. Feldspar megacrysts up to 1/4 inch across are common. Garnet and muscovite are locally abundant near the contact with aluminous Paleozoic rocks. Granitic dikes and pegmatites are in the contact zone. Pegmatites, mined for muscovite near Camp Po-Ne-Mah, also contain garnets and tourmaline crystals. Within the main igneous body, abundant inclusions of Paleozoic and Precambrian rocks enable mapping of a stratigraphic contact through the body (Plate 2).

Correlation. Though each has a distinct textural difference, the Candlewood Lake Pluton is mineralogically similar to other Thomaston granitic bodies which were described by Rice and Gregory (1906). Some of these rocks have been more recently renamed. They include the Tyler Lake Granite (Gates, 1961) in the Cornwall-New Preston area, and Mine Hill Granite (Gates, 1954, 1959; Gates and Scheerer, 1963) in the Woodbury-Roxbury area. The Candlewood Lake Pluton intrudes allochthonous Manhattan C and Manhattan A Calcite Marble Member near Peet Hill Cemetery (Plate 2) in the Kent quadrangle. The Candlewood Lake Pluton and other granitic bodies named above may all represent a single intrusive event.

Age. In the Kent quadrangle, the Candlewood Lake Pluton intrudes autochthonous and allochthonous rocks. It is subparallel to the axial surface of the Bear Hill stage Long Mountain anticline (Plate 2 and Figure 4). Field evidence indicates that

Figure 4. Tectonic map for the Kent quadrangle



the pluton is clearly deformed by Bear Hill stage minor folds indicating that its intrusion was before this stage of deformation. Recent preliminary whole rock analysis of the granite (Mose, personal communication, 1979) indicates an Ordovician date for cooling.

STRUCTURAL GEOLOGY

The Precambrian deformations have not been worked out in detail. It is clear, however, that basement rocks in the Housatonic Highlands and elsewhere within the Kent area underwent a Precambrian, presumably Grenvillian, deformation with development of folds and associated axial plane foliation. Structural features are locally truncated by late Precambrian granite that became gneissic during Paleozoic deformation. Precambrian structures are truncated by the overlying Cambrian Lowerre Quartzite. The map pattern (Plate 2 and Figure 4) results from Precambrian deformation and a sequence of several major stages of folding during the Paleozoic. Early stage folds in Paleozoic rocks are isoclinal with a well-developed axial plane schistosity which is the dominant schistosity of the area's Paleozoic rocks. Three separate thrust sheets formed before or during early folding. Following the thrusting and early folding, the Bear Hill phase of folding formed major isoclinal to open folds that dominate the map pattern. These have a steep axial plane foliation and trend north or northeast. Late-stage deformation developed with an associated conjugate northeast and northwest axial planar slip cleavage.

Thrusting.

Three major thrust faults are mapped in the Kent quadrangle: the Waramaug Thrust, the Above All Thrust, and the Baldwin Hill Thrust (Plate 2 and Figure 4). Rocks in the Waramaug and Above All thrust sheets were deformed by the early isoclinal stage folds, Bear Hill stage, and late-stage folds. The Baldwin Hill thrust lies on the southeast limb of the Woodville anticline. Most movement along the fault must have preceded both the Bear Hill and late phases of folding.

Evidence for Thrusting. Evidence for thrust faulting in the Kent quadrangle is: 1) truncation of units above and below the fault surface; 2) rocks interpreted to be older physically on top of rocks interpreted to be younger or rocks interpreted to be facies and age equivalents stacked on top of each other.

Because only the Schistose Gneiss Member of Manhattan C is found in the westernmost exposure of the Waramaug thrust sheet, truncations above the fault are noted there. However, in some localities the thrust sheet rests on the Middle Ordovician Granulite Member of Manhattan A and in other places it rests on the older Calcite Marble Member (Plate 2). Furthermore, it is physically above the Lowerre Quartzite as well as Inwood Marble.

Further east, the Waramaug thrust slice contains several mapped units that are truncated in numerous places along the trace of the fault surface (Plate 2). Truncations below the fault surface are also well displayed. The allochthonous rocks of the

Waramaug slice rest on Lowerre Quartzite in the Peet Hill area (Plate 2) and on either the Granulite Member or Calcite Marble Member of Manhattan A or on Inwood Marble in other areas. Lithic similarities locally within the Schistose Granulite Member and the Siliceous Granulite Member itself to the Cambrian Lowerre Quartzite suggests that they are equivalent facies. Truncation evidence associated with the Above All thrust sheet and the Baldwin Hill thrust sheet is found in the New Preston quadrangle (Dana, 1977).

A narrow shear zone at the unconformity between Cambrian Lowerre Quartzite and the underlying Precambrian Augen Gneiss unit is present in a road cut at Kent School along Route 341 west of Kent Village (Hall, et al., 1975). This contact may represent a regionally significant zone of movement. However, in mapping this contact along the east limb of the Housatonic anticline (Plate 2 and Figure 4) no further evidence for shearing has been noted. Shearing at the road-cut therefore seems to be of local importance.

Major Folds.

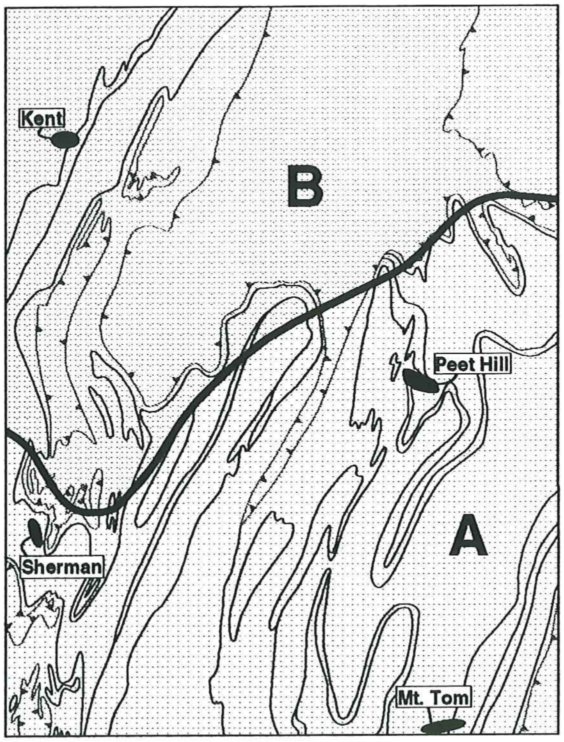
The tectonic map of the Kent quadrangle (Figure 4) displays axial traces of major folds associated with each phase of folding. No major folds associated with Precambrian deformation have been recognized.

Early Isoclinal Stage Major Folds. In the western part of the Kent quadrangle, from north to south, a series of early isoclinal folds in the allochthonous and autochthonous rocks dominate the map pattern (Plate 2 and Figure 4). Early isoclinal folds also occur in several areas further east within the Waramaug thrust slice but are particularly well displayed on the south slope of Bull Mountain (Plate 2 and Figure 4). These folds are overturned to the south and the thrust surface beneath Manhattan C is clearly involved in the folding. Although affected by later folding, the map pattern (Plate 2) and minor structural data suggest early east-west to northwest-southeast axial trends and a gently north or south plunge.

Specifically, those early isoclinal minor folds, as plotted in the western part of the quadrangle on Figure 4, trend northwest and west-northwest or trend southeast. Most of the early minor folds indicated on the equal-area diagram for subarea B (Figure 5-C) plunge southeast to west-southwest, while their trend is quite varied in subarea A, where the axes lie in a plane oriented N27E, 45SE (Figure 5-B).

The early overturned synclines, with allochthonous rocks in the cores, occur, from north to south, on The Cobble and Spooner Hill, Cedar Hill, on a hill 2,000 feet west of Gaylordsville, and on a hill one mile south of Gaylordsville (Figure 4 and Plate 2). Intervening valleys or lower elevations, underlain by the Calcite Marble Member of Manhattan A or by Inwood Marble, occupy cores of the related early anticlines.

Figure 5. Equal area plots of structural data related to early isoclinal stage of folding. Refer to Plate 2.



Explanation

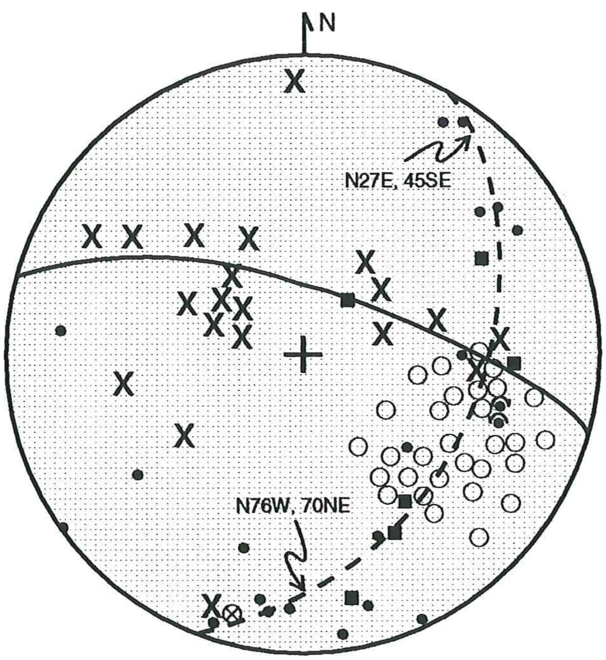
- Geologic contact
- Thrust fault: teeth in allochthonous rocks
- Subarea corresponding to labeled equal area plot
- Subarea contact

North

Scale 0 5000 Feet

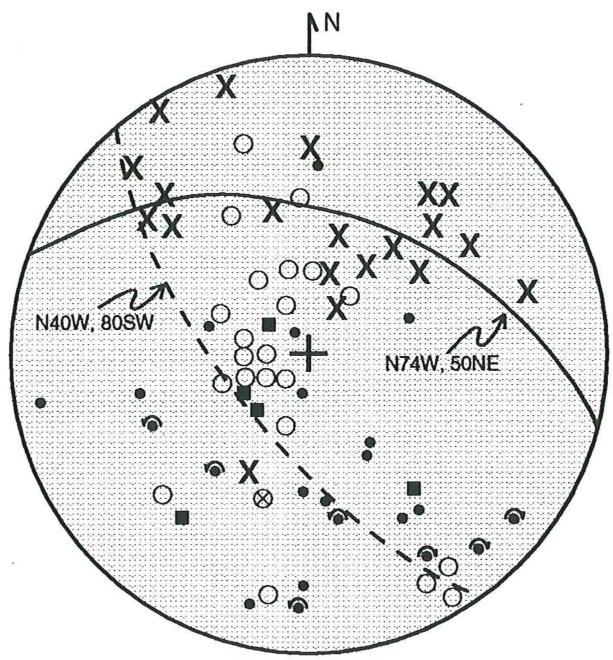
Symbols

- X axial plane (includes axial plane cleavage and the plane symmetrically dividing the fold)
- fold axis, rotation sense unknown
- fold axis, rotation sense known
- mineral lineation
- foliation/layering intersection
- pole to great circle defined by poles to foliation



Subarea A

n=20, axial planes
n=21, axes
n=30, mineral lineations
n=6, foliation/layering intersections
n=1, pole to great circle defined by poles to foliation



Subarea B

n=20, axial planes
n=22, axes
n=22, mineral lineations
n=5, foliation/layering intersections
n=1, pole to great circle defined by poles to foliation

Figure 6 is an enlarged tectonic map and structure section of the early isoclinal folds on Cedar Hill. The main early isoclinal folds are the Cedar syncline and the North Cedar anticline with the minor Little Cedar syncline and Little Cedar anticline. The axial traces of these early folds outline folds formed during the Bear Hill stage. These Bear Hill stage folds are indicated by axial traces on the tectonic map in Figure 6.

Early isoclinal folds displayed on the southern slope of Bull Mountain near South Kent are developed in the allochthonous rocks of the Waramaug thrust sheet (Plate 2 and Figure 4). Because the folds are truncated by the thrust, they are older than or contemporaneous with thrusting. Figure 7 is an enlarged tectonic map and structure section of the area. The map pattern suggests early axes trend east-west and northeast-southwest with plunge reversals across the axial surfaces of a late syncline. The later Bull Mountain syncline deformed the earlier isoclinal folds.

Bear Hill Stage Major Folds. The geologic map pattern of the Kent quadrangle is dominated by the Bear Hill stage of folding (Plate 2 and Figure 4). These large folds, isoclinal to open, have moderately to steeply dipping axial surfaces. Bear Hill stage major folds clearly deform the early isoclinal stage foliation and axial surfaces, indicated on the map of early foliation (Figure 8) and on the tectonic map (Figure 4).

Precambrian rocks are exposed in the cores of the Housatonic Highlands anticline, the Long Mountain anticline,

Figure 6. Tectonics of the Cedar Hill area. Refer to Plate 2. Explanation of letter symbols: **Omag** and **Omam**, Manhatten A Granulite and Marble Members; **O-Єib**, Inwood Marble Member B; **-Єmcgn**, Manhatten C Schistose Gneiss Member.

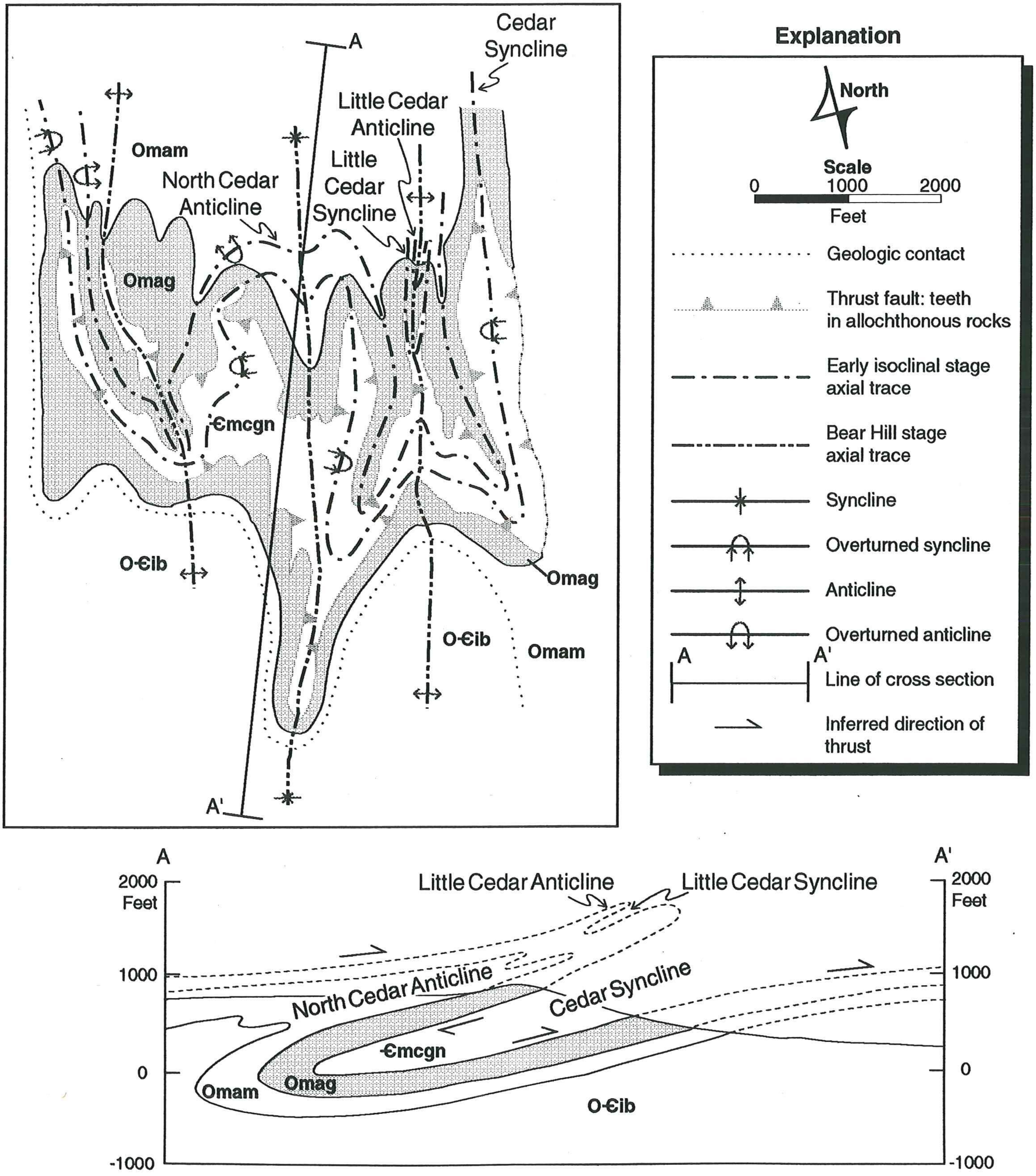
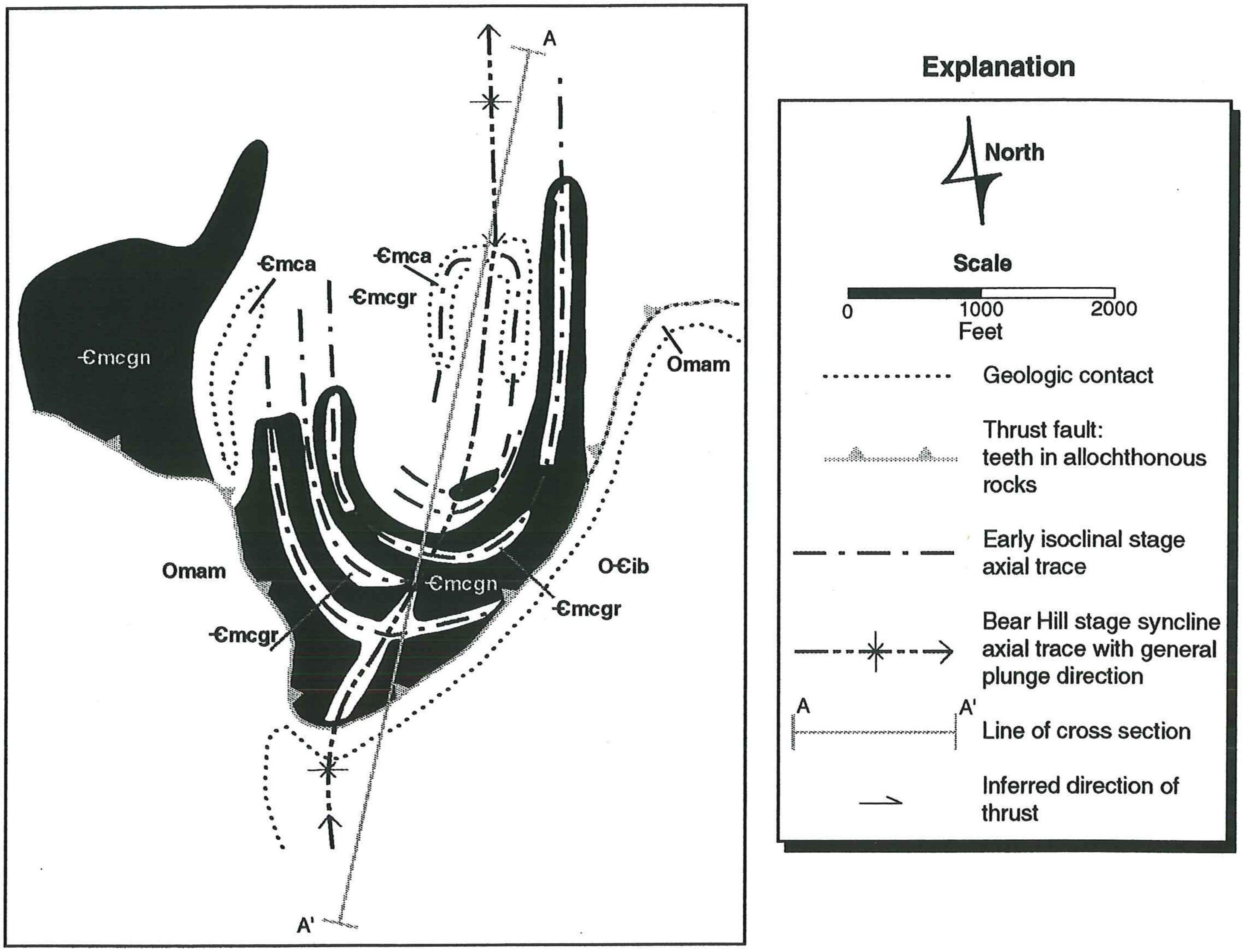
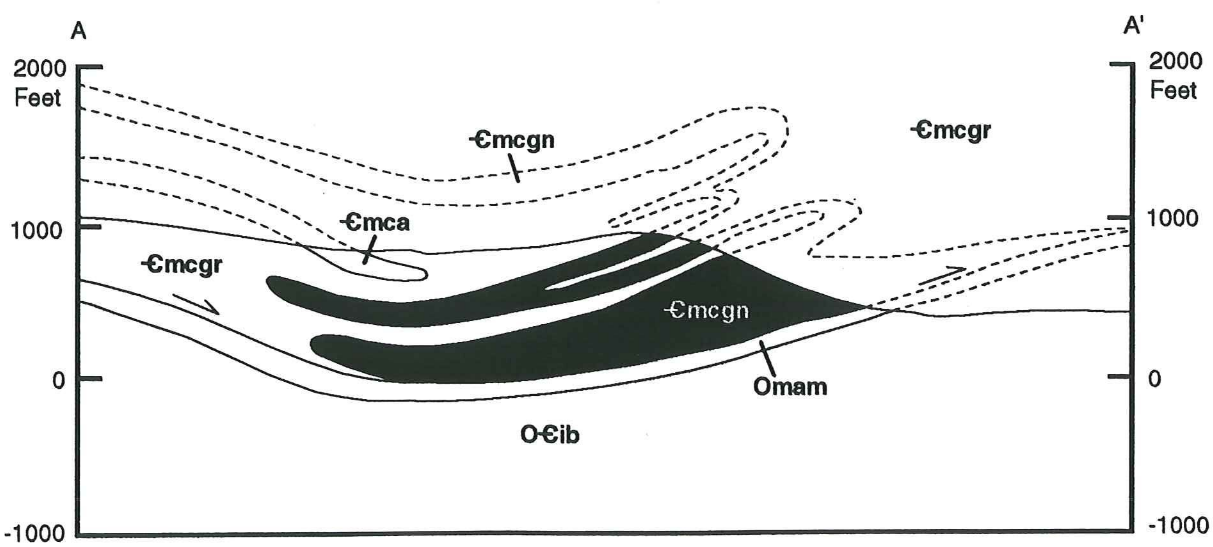


Figure 7. Tectonics of the Bull Mountain area. Refer to Plate 2. Explanation of letters: **Omam**, Manhatten A Marble Member; **O -Єib**, Inwood Marble Member B; **-Єmcgr**, **-Єmca**, and **-Єmcgn**, Manhatten C Schistose Granulite Member, Amphibolite Member, and Schistose Gneiss Member.





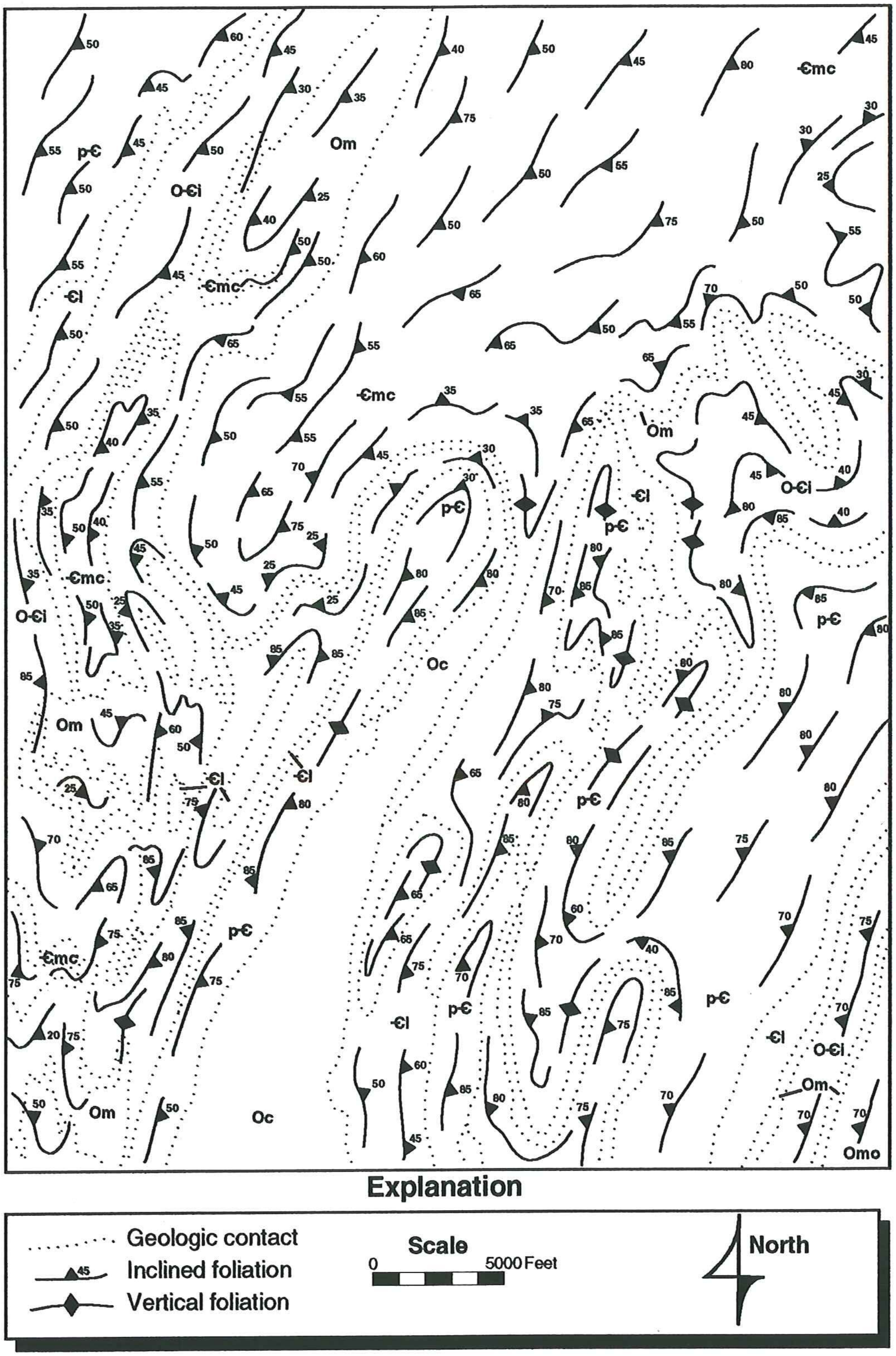


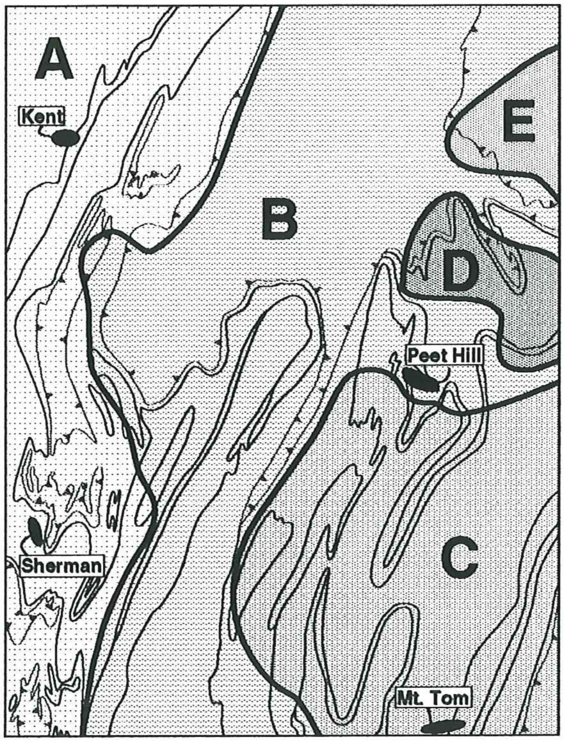
Figure 8. Strike and dip of early Taconian foliation. Explanation of letter symbols: Oc, Candlewood Lake Pluton; Om, Manhatten A; Omo, Moretown Formation; O-€l, Inwood Marble; -€l, Lowerre Quartzite; -€mc, Manhatten C; p-€, Precambrian Units.

anticlines on Peet Hill, the Merryall anticline, and the Bear Hill anticline (Plate 2 and Figure 4). Allochthonous rocks occur in the keels of the Housatonic syncline, the Bull Mountain syncline, and the Treasure syncline.

Major Bear Hill stage folds commonly are doubly-plunging northeast and southwest in the quadrangle. Changes in plunge direction are indicated on the tectonic map (Figure 4). The locations of the plunge changes for the various folds are based on minor structural data and map patterns. Plunge azimuth is a criterion for the subarea distinction of minor folds (Figure 9). However, plunge azimuth locations on the tectonic map (Figure 4) do not always agree with the generalized plunge azimuth of subareas. Each subarea contains many minor folds plunging in the opposite directions, thus supporting a doubly-plunging concept for Bear Hill stage folds. Because the folds are doubly-plunging and the exact plunge at any specific location on the fold is not known.

Axial traces of the major Bear Hill stage folds (Figure 4) trend north in the southern part of the quadrangle and northeast in the northern and eastern parts of the region. This shows the influence of later, large-scale folds. Minor map scale anticlines and synclines of the Bear Hill stage are abundant throughout the quadrangle, locally deforming earlier isoclinal folds. Resulting interference patterns are well displayed along the Housatonic syncline. Here, east-west trending early isoclinal folds with axial surfaces gently dipping north are deformed by Bear Hill

Figure 9. Equal area plots of structural data for subareas related to the Bear Hill stage of folding. Refer to Plate 2.



Explanation

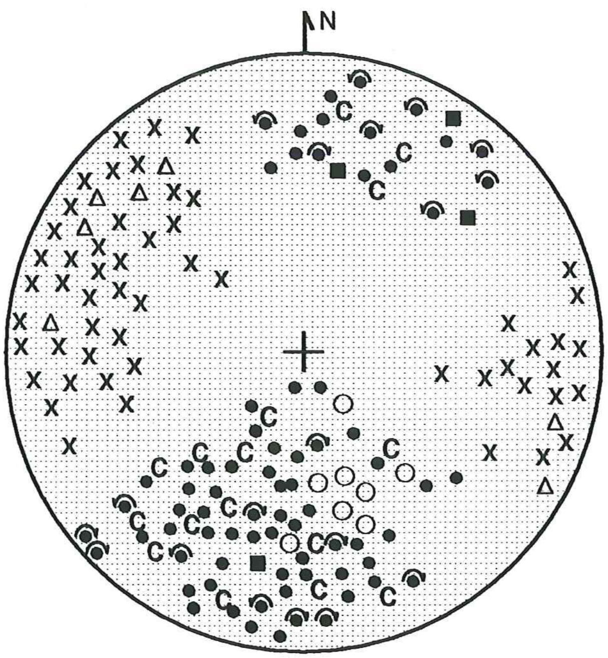
North

Scale
0 5000
Feet

- Thrust fault: teeth in allochthonous rocks
- Geologic contact
- **A** Subarea corresponding to labeled equal area plot
- Subarea contact

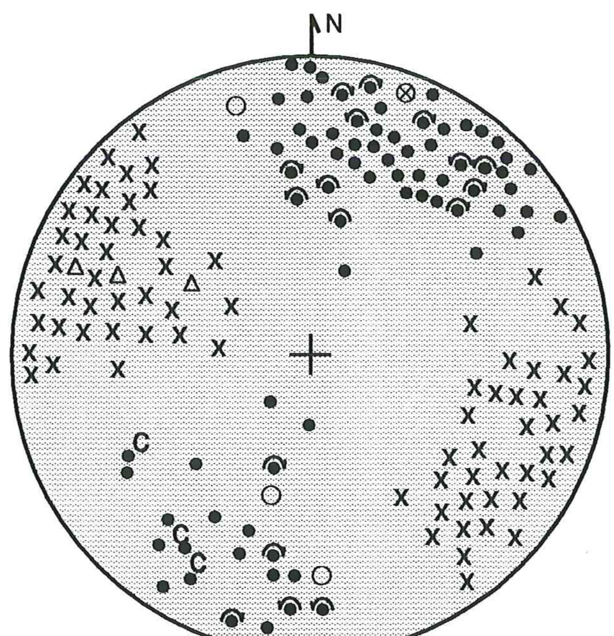
Symbols

- x axial plane (including cleavage or the plane symmetrically dividing the fold)
- ● fold axis, rotation sense unknown
- fold axis, rotation sense
- ●C crinkle fold axis
- ○ mineral lineation
- ■ foliation/layering intersection
- ⊗ pole to great circle defined by poles to foliation
- △ pole to quartz-filled faults or joints



Subarea A

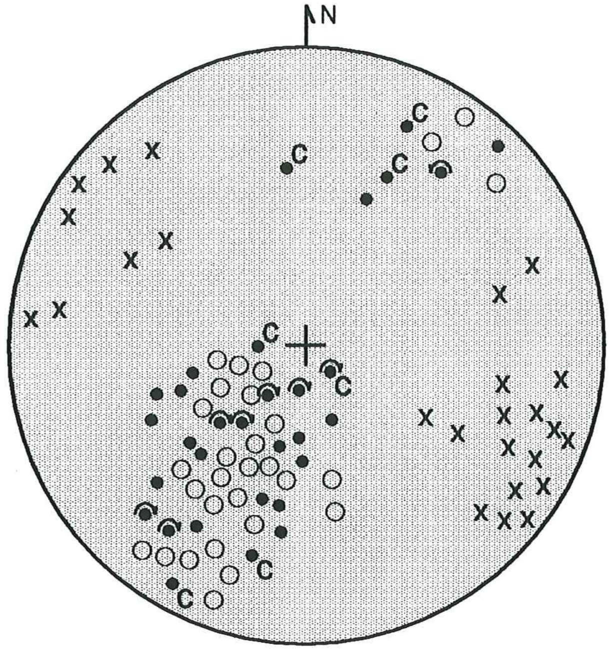
n=59, axial planes
n=74, fold axes
n=8, mineral lineations
n=5, foliation/layering intersections
n=8, poles to quartz-filled faults or joints



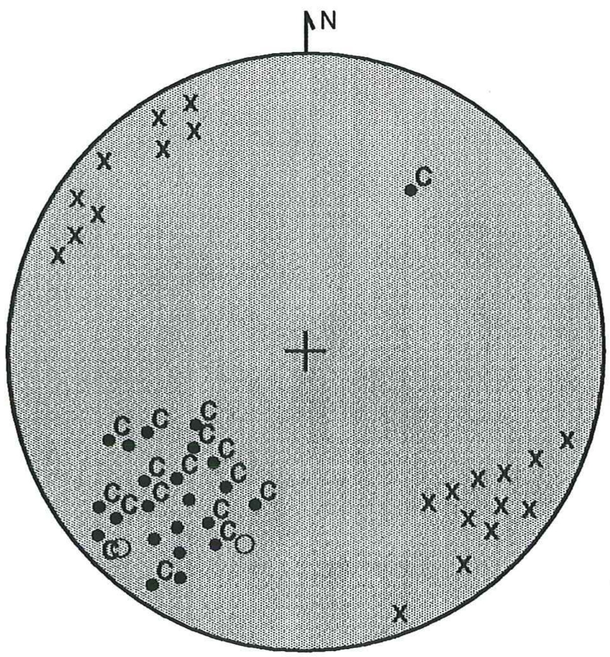
Subarea B

n=82, axial planes
n=84, fold axes
n=5, mineral lineations
n=1, poles to great circle defined by poles to foliation
n=3, poles to quartz-filled faults or joints

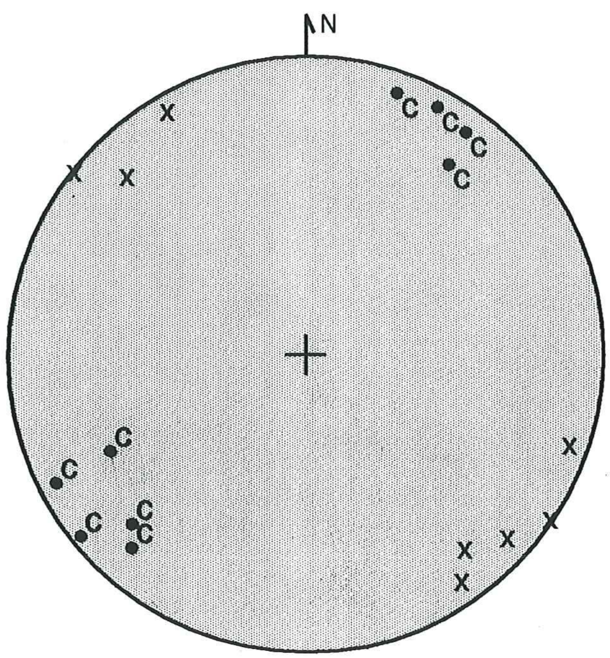
Figure 9. Continued



Subarea C
n=25, axial planes
n=36, fold axes
n=29, mineral lineations
n=1, foliation/layering intersection



Subarea D
n=21, axial planes
n=23, fold axes
n=4, mineral lineations



Subarea E
n=8, axial planes
n=9, fold axes

stage isoclinal folds with nearly vertical axial planes.

Only the southeastern limb of the Housatonic Highlands anticline is in the Kent quadrangle. Several minor map scale Bear Hill stage folds are present along the limb (Plate 2 and Figure 4). Minor structural data here suggests a southern plunge for the anticline.

The Candlewood Lake Pluton trends north-northeast, within the axial traces of the Long Mountain anticline (Plate 2 and Figure 4) and the Treasure Hill syncline. Minor map scale folds, thought to be Bear Hill stage, locally deform the intrusive contact. This suggests that the intrusion occurred before the Bear Hill stage event.

Late Stage Major Folds. The present map pattern is produced by late stage deformation superimposed on earlier structural features. Late stage minor folds have axial planes trending either northwest or northeast, as a conjugate set. The late northeast-trending cleavage is definitely distinguishable from Bear Hill northeast-trending cleavage only where cross-cutting relations can be determined in outcrop. Variation in axial trace directions of Bear Hill stage folds illustrate the effects of late stage folding on the map pattern (Plate 2 and Figure 4). In addition, interference patterns resulting from the intersection of Bear Hill stage and late stage features are locally present.

Axial traces of the Bear Hill stage Housatonic syncline and Cobble anticline in the region of Spooner Hill-Hatch Pond (Figure

4) change direction from northeast to northwest, proceeding southward. A late northeast-trending fold causes this broad warping. In the southern part of the quadrangle, folds in Bear Hill stage axial traces are present (Figure 4). These are caused by late folds with east-northeast-trending axial surfaces. This same late deformation can be traced south into the New Milford quadrangle (Hall, et al., 1975).

Late stage map-scale folds are also present in the east and northeastern parts of the study area (Figure 4). Here the trend of the late axial surfaces is northwest.

Details of the structural complexities of the Kent Hollow-Golf Course Hill area are provided in Figure 10. A series of late stage anticlines and synclines trending northwest interfere with northeast-trending Bear Hill stage folds. Interference of the Kent Hollow folds with the Golf Course Hill syncline results in deepening of the hinge line of the northwest plunging syncline in the Golf Course Hill area. Likewise, the Sugar Loaf anticline interfering with the Bear Hill anticline results in the deepening of the northwest plunging anticline in the Sugar Loaf Hill area (Figure 10).

Emplacement and Deformation of the Candlewood Lake Pluton. Field evidence suggests the relative timing of emplacement of the Candlewood Lake Pluton. In an outcrop approximately 2,000 feet southeast of Peet Cemetery in the central part of the quadrangle, granitic rock of the pluton intrudes schist of Manhattan C. The foliation in the schist, presumably associated with the early

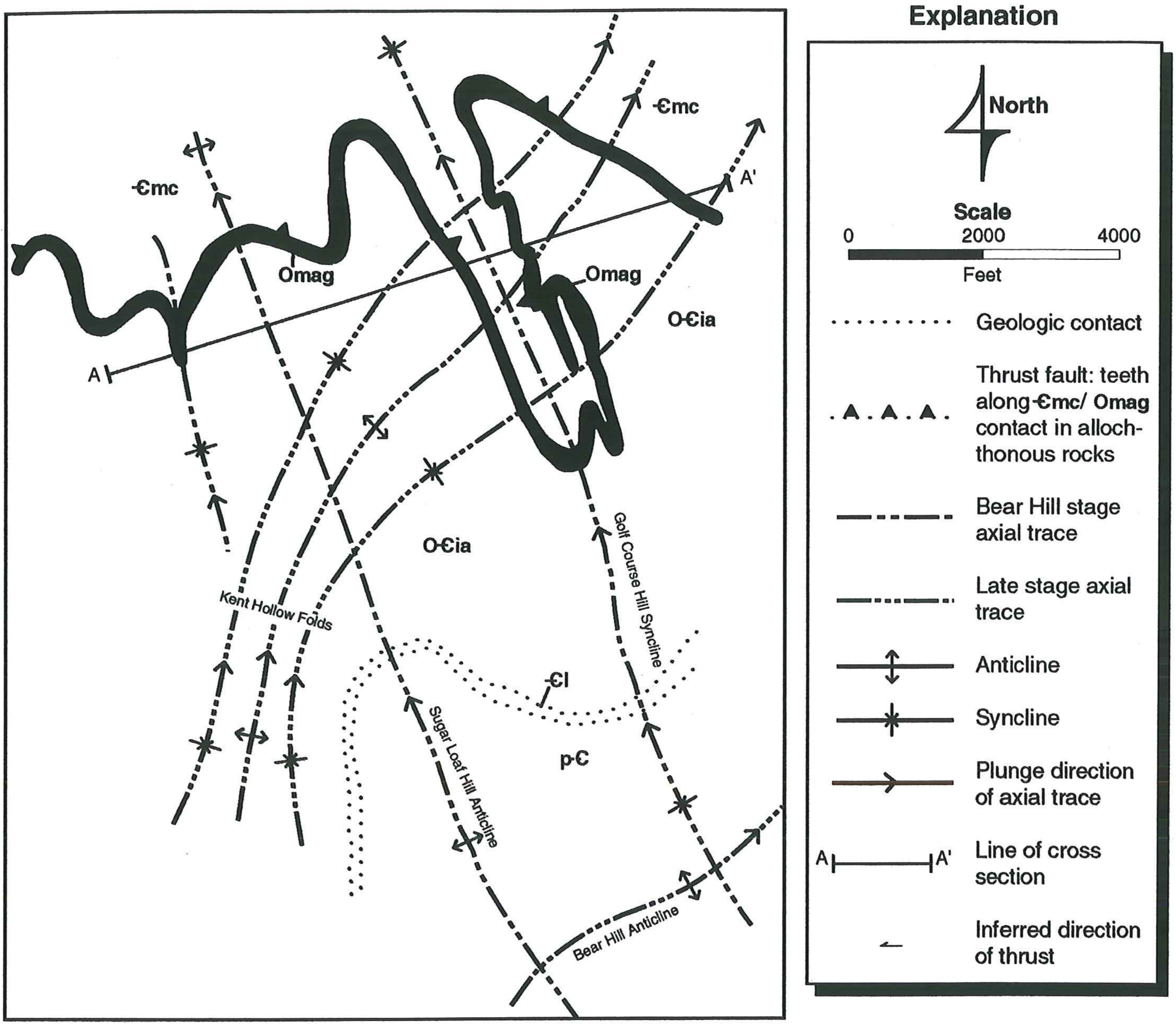
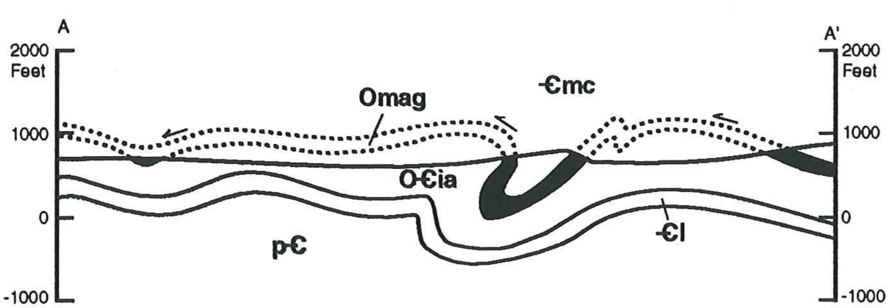


Figure 10. Tectonics of the Kent Hollow-Golf Course Hill area. Refer to Plate 2. Explanation of letter symbols: **Omag**, Manhatten A Granulite Member; **OЄia**, Inwood Marble Member A; **Єl**, Lowerre Quartzite; **Єmc**, Manhatten C; **p Є**, various Precambrian units.



isoclinal stage folding, is subparallel or parallel to a well developed foliation in the granite. Both foliations are deformed by Bear Hill stage minor folding with its associated axial plane foliation. Transecting the early isoclinal stage foliation and Bear Hill stage structural features is a late stage east-northeast crenulation cleavage. These same deformational relations are noted in many other localities in the quadrangle. This evidence implies the pluton was emplaced at the time of the early isoclinal stage deformation, during the Taconic orogeny. Acadian, Bear Hill stage folding deformed the pluton, evidenced at the outcrop scale as well as on the scale of the geologic map. The Long Mountain anticline and Treasure Hill syncline deform the sheet-like Candlewood Lake Pluton (Plate 3).

Minor Structural Features. Minor structural features associated with all stages of folding are recognized in the field area. These deformational features include minor folds, planar surfaces, and various lineations. These features have been mapped out on Plate 4 (minor folds and slip cleavage), Plate 5 (bedding and schistosity), and Plate 6 (mineral lineations) and they should be used in conjunction to this section. Minor folds are those that are too small to be shown on the geologic map. The wave length of such minor folds ranges from less than an inch up to 20 feet. The quadrangle has been subdivided into subareas for each stage of folding to compile structural data on equal area diagrams.

Precambrian Stage. No minor folds known to be related to this stage were noted, however, planar features that developed during Precambrian deformation have been recognized. In the Housatonic Highlands, the Precambrian Augen Gneiss and Pink Granitic Gneiss intrusive bodies clearly transect Precambrian paragneiss units, locally cutting across a foliation that is nearly parallel to the compositional layering in these paragneisses. This foliation probably developed during Grenvillian deformation.

On Mt. Tom in the southeast quarter of the quadrangle, a Precambrian foliation also subparallel to gneissic layering is deformed by minor folds of the Paleozoic early isoclinal stage. The Precambrian lineation resulting where this foliation intersects compositional layering trends southwest where it was identified in the Mt. Tom area (Figure 11-A, pg. 71).

Early Isoclinal Stage. In the rocks of the Kent quadrangle, the pervasive schistosity, Taconian in age, is parallel to the axial planes of the early isoclinal folds. The average trend of early Taconian foliation in the Kent quadrangle is plotted on Figure 8. Except where it wraps around the hinges of later major folds, the early foliation trends north-northeast and dips moderately to steeply west or east. Sillimanite, quartz, mica, tourmaline, hornblende, and tremolite display distinctive relations to early fold axes. Sillimanite locally occurs in large elongate nodules parallel to the early fold axes. Tourmaline, hornblende, and tremolite, respectively, have long axes oriented parallel to the early minor fold axes. In addition quartz grains are elongate parallel to the axes. Muscovite and biotite lie in the early axial plane schistosity.

Early minor folds occur at numerous sites and the following are most notable and reasonably accessible. In a river-washed outcrop of Inwood B, located along the tight bend in the Housatonic River approximately 2000 feet north of the gaging station in Sherman, several small early isoclinal folds are deformed by numerous later Bear Hill stage folds. In a roadcut approximately 2000 feet west of the intersection of Routes 7 and 341 in Kent Village along Route 341, in the Lowerre Quartzite is a minor early isoclinal fold with tourmaline needles, up to one inch long, parallel to its axis. In addition minor early isoclinal folds deformed by later Bear Hill stage folds are present in several closely spaced outcrops approximately 2000 feet east of Kent Village and 1000 feet north of a small swamp along the west slope of The Cobble in Manhattan C rocks.

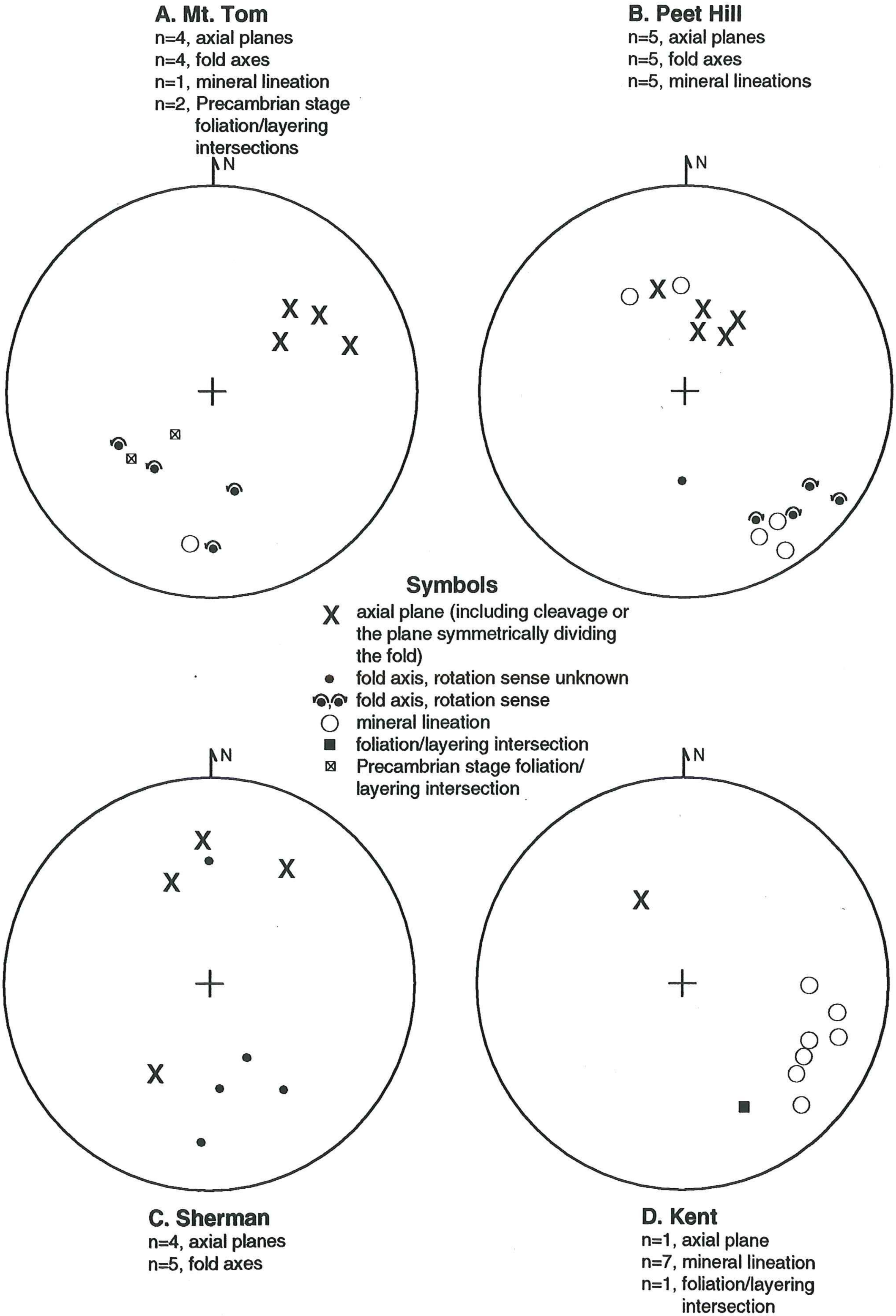
At these localities and elsewhere within the quadrangle, the early isoclinal stage folds show a similar type geometry with beds thinning on the limbs and thickening in the hinges. Where the early isoclinal stage folds are deformed by folds of the later Bear Hill stage and the two sets of folds are nearly coaxial, the result is hook interference patterns like that described by Ramsay (1967). Early isoclinal recumbent or overturned folds with gently dipping axial surfaces are refolded by later folds with steeply inclined axial surfaces. The axial surfaces of the first folds become folded with the limbs of the first folds. The outcrop traces of the early folds display continuously converging or diverging forms with the axes of the early folds and the later Bear Hill stage folds being nearly parallel. However, the map pattern in the western part of the quadrangle (Figure 6 and Plate 2) indicates a heart and anchor shaped interference pattern similar to that described by Ramsay (1967). In this grouping the map pattern is closed with early axes trending at a high angle to the later axes.

The Kent quadrangle is divided into two subareas, A and B, based on trends of early stage structural features and an equal area diagram of early isoclinal stage minor structural features is presented for each (Figure 5). Early minor structural features in the quadrangle show considerable scatter due to multiple deformation (Figure 5), and the boundary between subareas A and B is tenuous due to considerable overlap in the trends of the early stage features. In subarea A (Figure 5-B) early linear features lie roughly on the N27E, 45SE plane indicated. In subarea B (Figure 5-C) the early linear features lie on the N40W, 80SW plane indicated. The early axial plane schistosity is varied in trend with poles lying on the N76W, 70NE plane indicated on the plot for subarea A (Figure 5-B) and on the N74W, 50NE plane shown for subarea B. The two poles plotted from these two great circles are nearly parallel to later Bear Hill stage fold axes. The pole in subarea A (Figure 5-B) plunges gently south-southwest. While it doesn't plunge north, as many of the Bear Hill stage minor folds do in parts of subarea A, its gentle plunge is not many degrees from a north plunge.

Detailed analyses of early stage structural features from four large outcrops are presented in Figure 11. In the Mt. Tom area of the quadrangle (Figure 11-A) early fold axes show a counter-clockwise rotation sense and plunge south or southwest at moderate angles, while at Peet Hill (Figure 11-B) the early fold axes vary in rotation sense and plunge gently southeast with one axis plunging south. Also at Peet Hill early mineral lineations plunge N5-20W. In the river-washed outcrop at Sherman (Figure 11-C) as at Peet Hill early fold axes plunge gently or moderately south or southeast but one plunges north. At Kent (Figure 11-D) tourmaline lineations parallel early axes and plunge moderately or gently east-southeast or southeast. Early foliation-bedding intersections plunge moderately southeast. The data indicated in Figure 11 supports the descriptions of the early isoclinal stage structural features for the entire quadrangle (Figure 5).

Quartz lenses are commonly present in thick-bedded schist in the Lowerre Quartzite or the Schistose Gneiss Member of Manhattan C. While the lenses are typically parallel to the early schistosity, some are deformed into isoclinal folds which have the schistosity parallel to their axial planes. It is possible that at least some of the lenses represent deposited pebbles, while others may be quartz lenses or veins emplaced parallel to the

Figure 11. Equal area plots of early stage structural features from detailed outcrop analyses. Refer to Figure 9 for station locations.



early schistosity. This relationship between quartz lenses and schistosity is particularly well displayed on the west knob and adjacent westerly steep slope of Cedar Hill in the southwest part of the quadrangle. Here quartz veins in Manhattan C are deformed into tight folds with an axial planar early stage schistosity. This early foliation is in turn deformed by later Bear Hill stage crinkle folds.

Bear Hill Stage. Minor structural features of the Bear Hill stage are the most pervasive in the Kent quadrangle. Minor folds, similar in style, are isoclinal to moderately open. Bear Hill stage axial plane slip cleavage deforms the early schistosity, minor folds and mineral lineations. This Bear Hill stage slip cleavage locally develops into schistosity in the hinge region of minor folds. Locally, quartz grains are elongate and hornblende crystals have long crystallographic axes parallel to Bear Hill stage fold axes. Muscovite and biotite form the Bear Hill stage axial plane schistosity where it is developed.

Bear Hill stage minor folds are abundant. In several places on Golf Course Hill in the eastern part of the quadrangle Bear Hill stage crinkle folds in Manhattan C schists deform early isoclinal stage schistosity and associated sillimanite nodules or garnet porphyroblasts. Tremolite needles up to two inches long in Inwood B are crinkled by Bear Hill stage folds in several outcrops in a pasture located one mile north of Birch Hill in the western part of the quadrangle.

Bear Hill stage minor linear features differ in trend throughout the quadrangle. This variability can also be noted in most individual outcrops. This is due either to varied orientations of earlier structural features or post Bear Hill stage deformation. The Bear Hill stage structural features are plotted along with late stage structural features on Plate 4 and are shown in equal area diagrams (Figure 9) for each of the five subareas.

Subareas (Figure 9) are defined by the plunge directions of Bear Hill stage minor folds measured in them. While most of the folds in subareas A, C and D plunge moderately to gently south-southwest, many others in each subareas have north-northeast plunges. However, minor Bear Hill stage folds measured from subareas B plunge moderately to gently north-northeast and south-southwest. Few Bear Hill stage minor folds were found in subarea E and they plunge gently northeast or southwest.

While Bear Hill stage minor folds and mineral lineations are rarely steeply plunging (Figure 9) their moderate to gentle plunge north or south has a mean trend of N22E, plunging from 40SW to 25NE. This illustrates the doubly plunging nature of Bear Hill stage folding throughout the quadrangle. Axial plane slip cleavage, or locally schistosity, generally dips moderately or steeply northwest or southeast (Figure 9). The mean strike of the axial planes of Bear Hill folds in N27E.

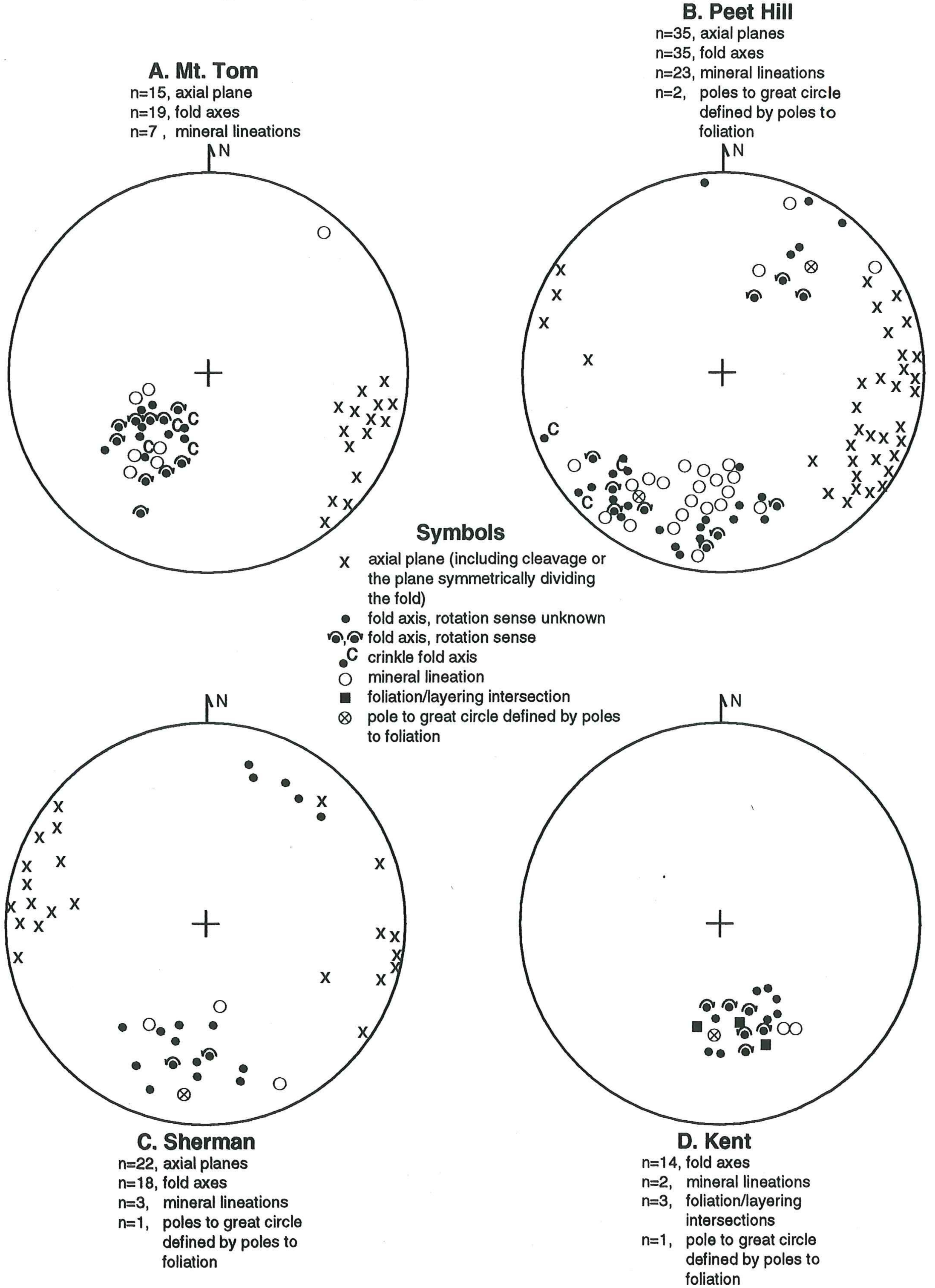
Locally, in the northern and western parts of the quadrangle, numerous quartz-filled joints or faults are present oriented parallel to the Bear Hill stage axial planes (Figure 9). Although the quartz veins commonly are three to six inches thick, one quartz vein at Beamon Pond near Route 341 in East Kent is nearly four feet thick.

Detailed analyses of Bear Hill stage structural features from four large outcrops are presented in Figure 12. The axial planes of minor folds trend north-northwest to northeast, dipping steeply west or east. Fold axes plunge gently to moderately south or north.

Late Stage. Open to moderately open minor folds and crinkles with well developed axial plane slip cleavage characterize the late stage deformation. Crinkling of early isoclinal phase or Bear Hill phase axial plane foliation is common. Mica and quartz lineations are locally parallel to late stage fold axes.

Late stage minor folds and slip cleavage are particularly well displayed in outcrops within 500 feet east of Long Mt. Road near Henderson Pond on the south-central border of the quadrangle. Here late stage east-northeast-trending axial plane slip cleavage deforms early stage schistosity and sillimanite nodules in schists in the Lowerre Quartzite. North of Ore Hill and approximately 2000 feet west of Flat Rock in the Schistose Gneiss Member of Manhattan C a late stage north-west-trending slip cleavage deforms minor Bear Hill stage folds.

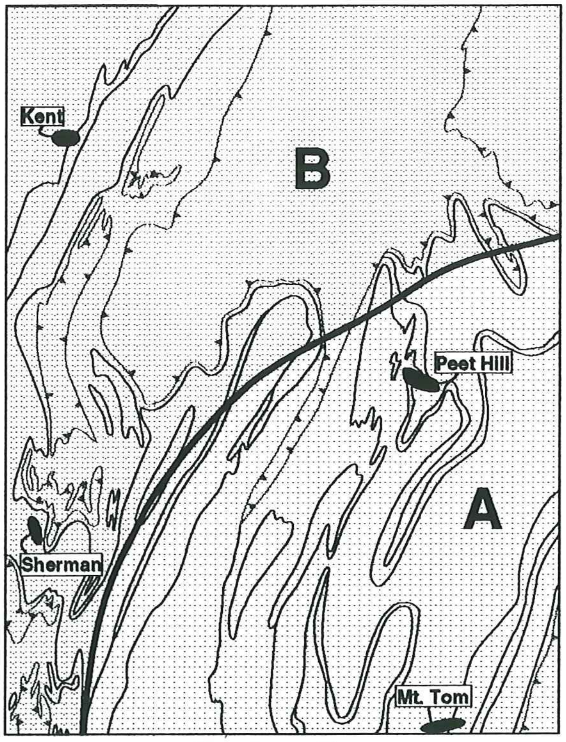
Figure 12. Equal area plots of Bear Hill stage structural features from single outcrops. Refer to Figure 9 for station locations.

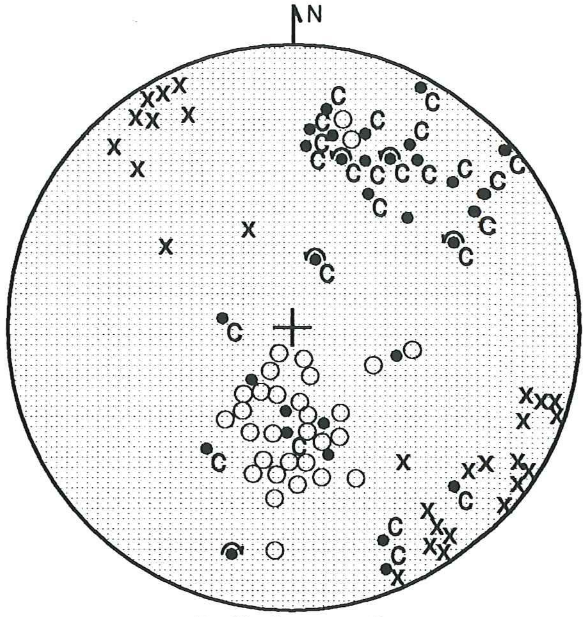


The Kent quadrangle is divided into two subareas based on the late stage minor structural features. Equal area diagrams of orientation data for each subareas are presented in Figure 13.

There are two separate axial plane slip cleavage orientations for the late stage of deformation, northeast and northwest. In subarea A (Figure 13-A) only the northeast oriented cleavage was identified. The reason for the absence of the northwest-trending slip cleavage is not known. In subarea A, the slip cleavage trends from N15E to N67E dipping moderately to steeply southeast or northwest (Figure 13-A). Associated minor fold axes and crinkle axes are moderate to steeply plunging northeast, southeast, south, and southwest. This scatter is probably due to variable orientations of foliation and layering prior to the late stage cleavage development. Both slip cleavage orientations are found in subareas B (Figure 13, B_1 and B_2). Separate northwest and northeast-trending slip cleavages are found in an outcrop of Manhattan C rocks located on Birch Hill at the north end of Spooner Hill in the west-central part of the quadrangle. Age relations here are unclear and contemporaneity is suggested. The mean orientation for the north-east-trending slip cleavage is N55E dipping steeply southeast or northwest, while the mean orientation for the northwest-trending slip cleavage is N40W dipping moderately to steeply southwest or northeast. However, there is considerable range in cleavage trends intermediate between the northeast and northwest. Scatter of late linear feature orientations is probably due to varied previous

Figure 13. Equal area plots of structural data from subareas related to the Late stage folding. Refer to Plate 2.





A. Subarea A.
n=28, axial planes
n=32, fold axes
n=31, mineral lineations

Explanation

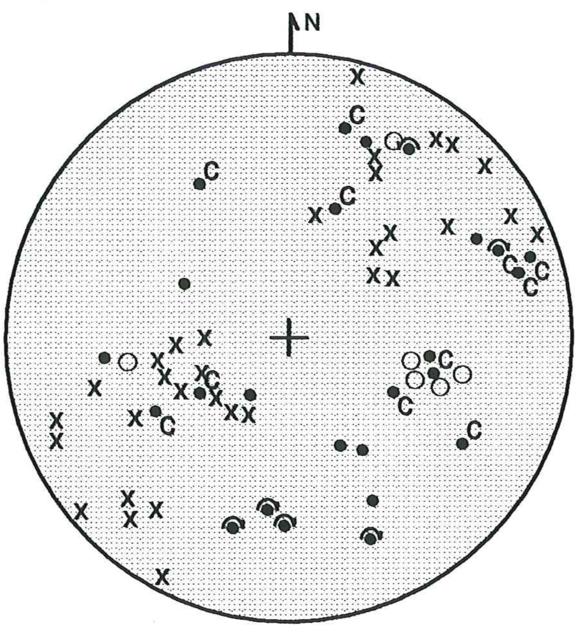
- Thrust fault: teeth in allochthonous rocks
- Geologic contact
- A Subarea corresponding to labeled equal area plot
- Subarea contact

North

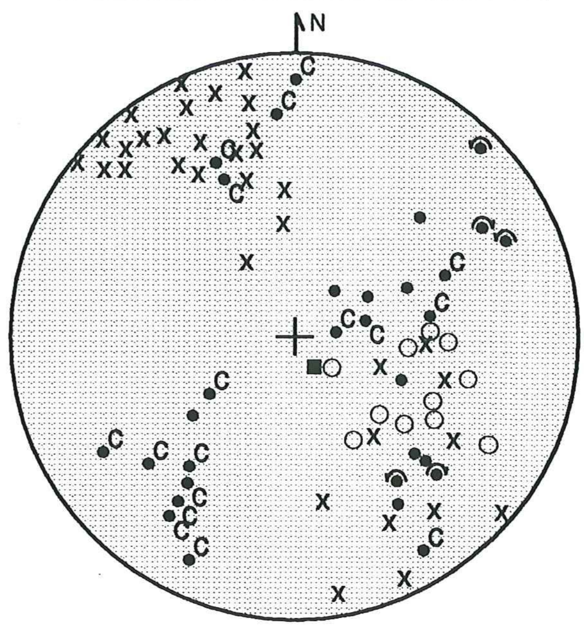
Scale
0 5000
Feet

Symbols

- x axial plane (including cleavage or the plane symmetrically dividing the fold)
- • fold axis, rotation sense unknown
- fold axis, rotation sense
- •C crinkle fold axis
- ○ mineral lineation
- ■ foliation/layering intersection



B_1: Subarea B: Northwest-trending cleavage
n=32, axial planes
n=24, fold axes
n=6, mineral lineations



B_2: Subarea B: Northeast-trending cleavage
n=34, axial planes
n=31, fold axes
n=11, mineral lineations
n=1, foliation/layering intersections

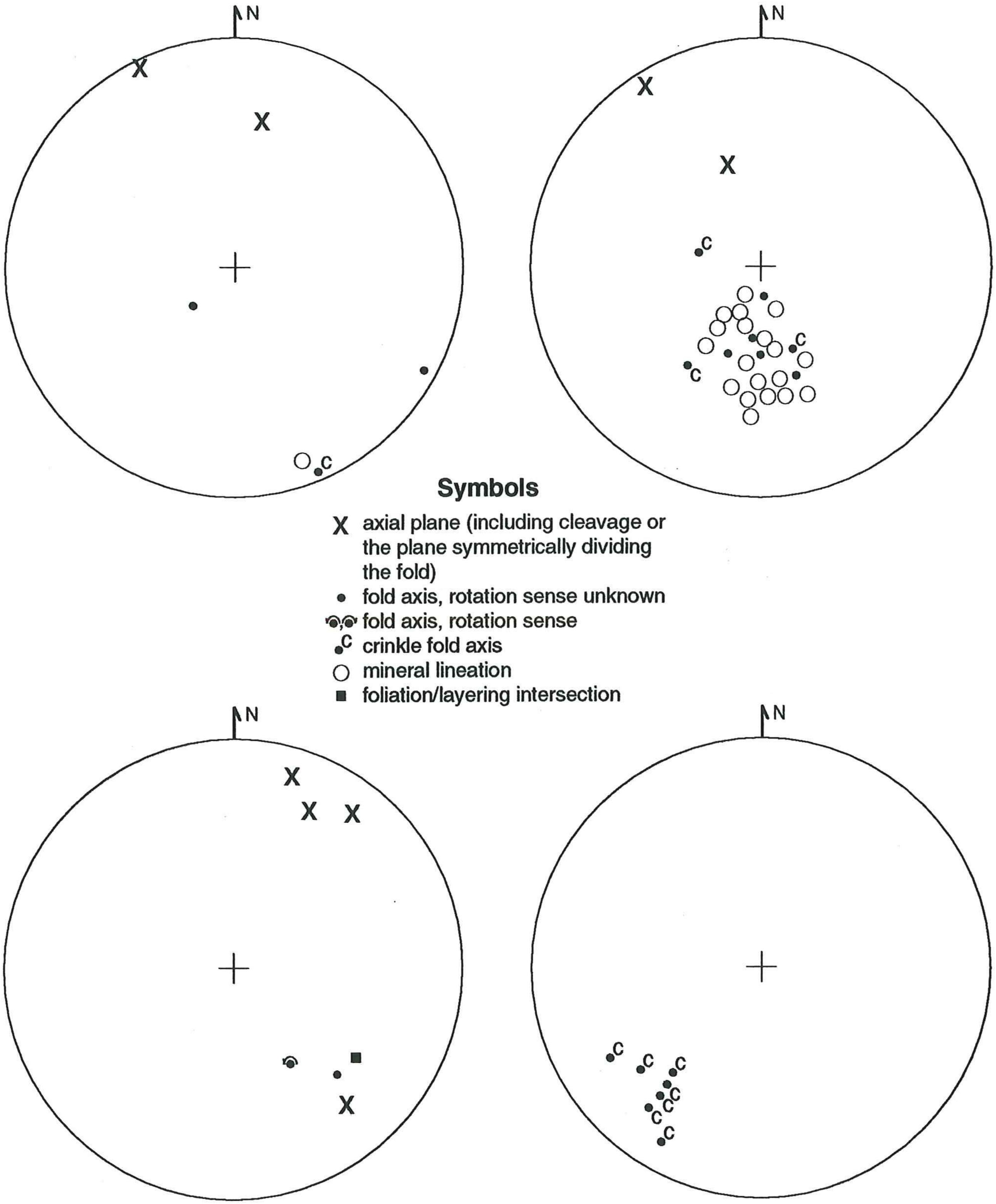
orientation of planar surfaces of early and Bear Hill stage events. Both the northwest- and northeast-trending slip cleavages deform Bear Hill stage minor structural elements. Where these late slip cleavages are found together, age relations are unclear, suggesting possible contempraneity.

Detailed analyses of the structural features that are related to late stage folding, as identified at four large outcrops, are provided in Figure 14. On Mt. Tom and Peet Hill the later axial plane slip cleavage trends east-northeast dipping moderately to steeply southeast. Crinkle axes are varied in trend but plunge moderately to steeply south. In the Sherman outcrop, a northwest-trending steeply southwest dipping slip cleavage is present. Axes plunge southeasterly at a moderate angle. At the Kent quadrangle, late crinkle axes plunge moderately to gently southwest.

Figure 14. Equal area plots of structural features related to late stage folding. Refer to Figure 13 for station locations.

A. MT. TOM
n=2, axial planes
n=3, fold axes
n=1, mineral lineations

B. PEET HILL
n=2, axial planes
n=8, fold axes
n=19, mineral lineations



C. SHERMAN
n=4, axial planes
n=2, fold axes
n=1, foliation/layering intersection

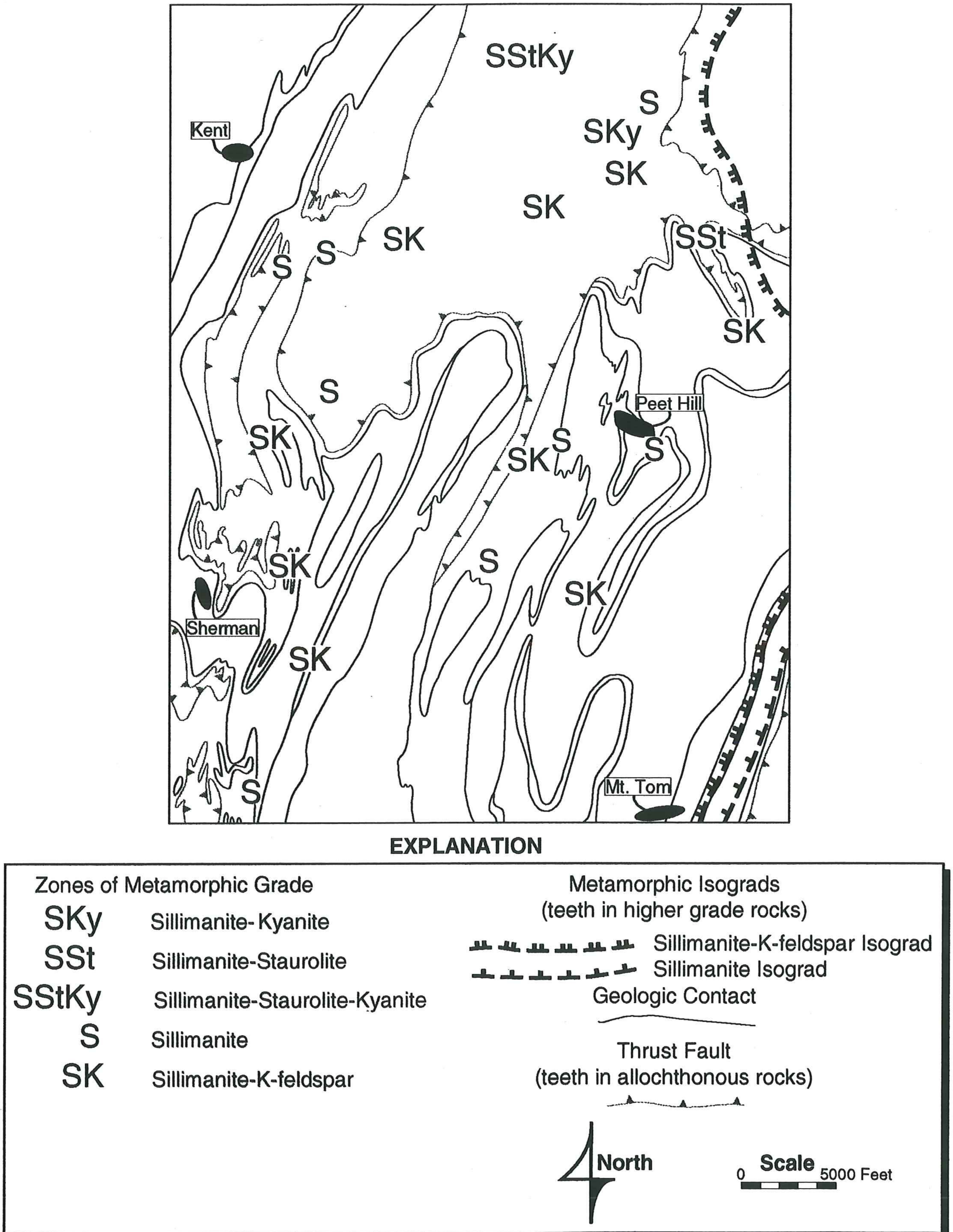
D. KENT
n=7, fold axes

METAMORPHISM

General Statement. The highest grade metamorphic zone in the Kent quadrangle is the sillimanite K-feldspar zone defined by the occurrence of sillimanite coexisting with K-feldspar. Sillimanite-K-feldspar and sillimanite isograds are defined in the quadrangle (Plate 2 and Figure 15). Rocks east of the Balkwin Hill Thrust in the southeast part of the quadrangle (Plate 2) are of kyanite-staurolite grade as they are to the east in the New Preston quadrangle (Dana, 1977). Key mineral assemblage localities are indicated in Figure 15. It is from these specific locations that an approximate sillimanite-K-feldspar isograd is drawn (Figure 15 and Plate 2). This isograd extends southwesterly along the central part of the East Aspetuck River Valley from the New Preston quadrangle (Dana, 1977) to the New Milford quadrangle. This same isograd (Figure 15 and Plate 2) enters the Kent quadrangle at Lake Waramaug (Dana, 1977), from where it trends north-northeast to the Kent-Ellsworth quadrangle border. The sillimanite isograd trends northeast along the east slope of the East Aspetuck River valley (Dana, 1977). In addition sillimanite, coexisting with staurolite and/or kyanite, is present in the north and northeast parts of the Kent quadrangle in the Waramaug thrust sheet (Figure 15).

Mineral Assemblages in Pelitic Rocks. The mineral assemblages in the more pelitic rocks of the Lowerre Quartzite, Granulite Member

Figure 15. Metamorphic zone map of the Kent quadrangle. Refer to Plate 2.



of Manhattan A, Manhattan C, and the Moretown Formation that include quartz muscovite, and plagioclase are:

1) biotite (Manhattan C, Appendix I, Table 9: specimens 1849, 2869-a, 3146).

2) biotite-K-feldspar (Lowerre Quartzite, Appendix I, Table 4: numerous samples; Manhattan C, Appendix I, Table 8: specimens 805, 921; Appendix I, Table 9: specimens 1323, 1844-g, 1852-b, 2883, 3560; Appendix I, Table 11: specimen 3907).

3) biotite-garnet (Manhattan C, Appendix I, Table 8: specimens T-4, 1837, 2163; Moretown Formation, Appendix I, Table 11: specimen 857).

4) biotite-garnet-K-feldspar (Granulite Member Manhattan A, Appendix I, Table 7: specimen 2061-a).

5) biotite-sillimanite (Manhattan C, Appendix I, Table 9: specimen 1844-c).

6) biotite-garnet-sillimanite (Lowerre Quartzite, Appendix I, Table 4: specimens 1073-2, 1253-a; Granulite Member Manhattan A, Appendix I, Table 7: specimens T-9, 3112-a; Manhattan C, Appendix I, Table 8: specimens 2323-c, 3112-c; Appendix I, Table 9: specimens 1842-c, 1850-a, 1851-c, 1852-d, 2869-b).

7) biotite-sillimanite-K-feldspar (Lowerre Quartzite, Appendix I, Table 4: specimens 934, 1051).

8) biotite-garnet-sillimanite-K-feldspar (Manhattan C, Appendix I, Table 8: specimens 911, 1186, 1842-b, 2323-b; Appendix I, Table 9: specimens 1844-a, 1850-b).

9) biotite-garnet-sillimanite-staurolite (Manhattan C, Appendix I, Table 8: specimen 824).

10) biotite-garnet-sillimanite-staurolite-kyanite (Manhattan C, Appendix I, Table 8: specimen 3544).

11) biotite-garnet-sillimanite-kyanite (Manhattan C, Appendix I, Table 9: specimen 1850-a).

Assemblages (7) and (8) indicate sillimanite-K-feldspar metamorphism. Assemblages (9), (10) and (11) may indicate separate episodes of metamorphism with the earlier high grade event producing sillimanite followed by a later lower grade event producing staurolite and kyanite. This will be considered in greater detail below.

Mineral Assemblages in Carbonate Rocks. Mineral assemblages in the carbonate rocks in the Inwood Marble Members A and B and Manhattan A are:

12) calcite-dolomite-phlogopite-K-feldspar (Inwood Marble, Appendix I, Table 5: specimen 1829-9).

13) calcite-dolomite-talc-phlogopite (Inwood Marble, Appendix I, Table 5: specimen 841).

14) calcite-dolomite-tremolite (Inwood Marble, Appendix I, Table 5: specimens 826-a, 829).

15) calcite-dolomite-tremolite (Inwood Marble, Appendix I, Table 5: specimen 842).

16) calcite-dolomite-tremolite-phlogopite-K-feldspar (Inwood Marble, Appendix I, Table 5: specimen 1828-1).

17) dolomite-tremolite-ferrian zoisite-phlogopite-K-feldspar (Manhattan A, Appendix I, Table 6: specimen 864).

18) calcite-tremolite-phlogopite (Manhattan A, Appendix I, Table 6: specimen 1751; Appendix I, Table 7: specimen 2061-b).

19) calcite-tremolite-diopside-quartz (Inwood Marble, Appendix I, Table 5: specimen 826-b; Manhattan A, Appendix I, Table 7: specimen 825).

20) dolomite-tremolite-diopside-phlogopite-K-feldspar (Inwood Marble, Appendix I, Table 5: specimen 1829-8).

21) calcite-dolomite-tremolite-diopside-phlogopite-plagioclase-K-feldspar (Inwood Marble, Appendix I, Table 5: specimen 1829-10).

22) calcite-tremolite-diopside-quartz-K-feldspar (Manhattan A, Appendix I, Table 6: specimen 827).

23) calcite-tremolite-diopside-phlogopite (Manhattan A, Appendix I, Table 6: specimen 1621).

24) calcite-tremolite-diopside-phlogopite-K-feldspar (Manhattan A, Appendix I, Table 6: specimen 2064).

25) calcite-tremolite-diopside-epidote-quartz-plagioclase-K-feldspar (Manhattan A, Appendix I, Table 7: specimen 2323-a).

26) calcite-dolomite-diopside-phlogopite-K-feldspar (Inwood Marble, Appendix I, Table 5: specimen 1828-6).

Assemblage (13) indicates metamorphism below talc breakdown, depending on X_{CO2} values during prograde reaction or may even indicate a retrograde event with a breakdown of tremolite. Metamorphism below tremolite breakdown is noted in assemblages (14), (15), (16), (17) and (18) with the coexistance of tremolite and diopside in assemblages (19), (20), (21), (22), (24) and (25). Metamorphism below diopside breakdown is indicated in assemblage (26).

Regional Metamorphism of Precambrian Ultramafic Rock. A mineral assemblage in the Precambrian ultramafic rock is:

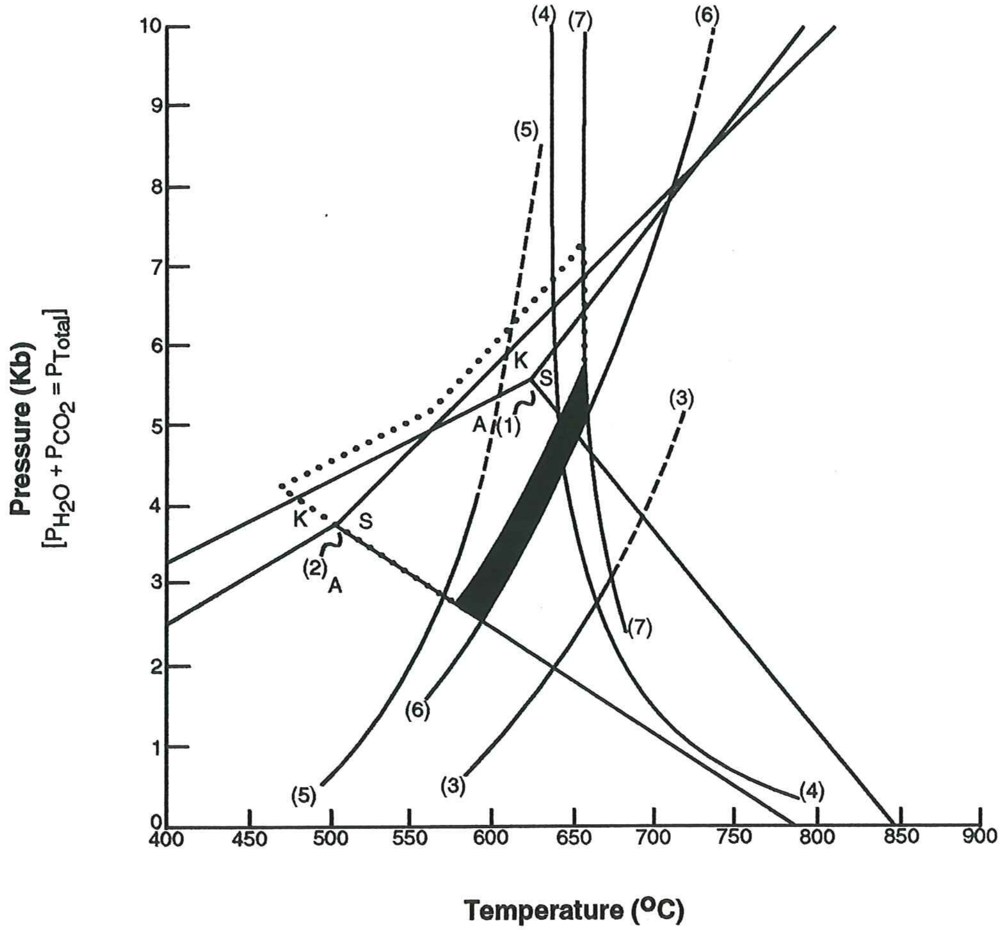
27) olivine-serpentine-talc-anthophyllite (Appendix I, Table 13: specimen 4302). Though probably originating as an olivine-orthopyroxene rock, later hydrothermal alterations have produced anthophyllite, serpentine and talc.

Conditions of Metamorphism. Several separate metamorphic episodes affected the rocks of the Kent quadrangle. Peak metamorphic conditions produced sillimanite and sillimanite-K-feldspar. A possibly later metamorphism locally formed staurolite (Specimen 824, Table 8, Appendix I) and/or kyanite (Specimen 3544, Table 8, Appendix I, and Specimen 1850-a, Table 9, Appendix I) growing across sillimanite. Quartz and mica were produced during the Bear

Hill stage and late stage deformations, and are parallel to associated minor folds or crinkles.

Sillimanite displays an interesting relation to garnet and biotite suggesting its origin. Biotite crystals grow along the fractures and rims of garnets. Sillimanite needles in turn grow on the biotite. The extent of this sillimanite growth on biotite ranges from only a few scattered needles on a biotite crystal, to nearly complete growth on biotite. In this later case, the sillimanite nodule has a remanent garnet core. Some nodules do not contain garnet. Chinner (1961) suggests that biotite acts as a nucleating agent for sillimanite crystals during prograde metamorphism. Yardley (1977) describes the sillimanite reaction: garnet plus muscovite equals sillimanite plus biotite plus quartz. In this reaction Yardley sequentially has garnet initially breaking down to biotite which is in turn replaced by sillimanite. Another possible reaction would be garnet plus K-feldspar plus H_2O breaking down to sillimanite plus biotite. Any of these reactions and sequence of events producing sillimanite may fit with the observed relations described above for rocks in the Kent quadrangle.

On a P-T diagram (Figure 16) experimental curves for reactions applicable to the rocks in the Kent area are presented. Included are Al_2SiO_5 univariant curves determined by Richardson, et al. (1969) and Holdaway (1971). Peak metamorphic conditions will be suggested based on sillimanite and sillimanite-K-feldspar



Reactions

(3) Muscovite + Quartz = K-Feldspar + Sillimanite + H_2O

(4) Granite Melting $X_{H_2O} = 1$

(5) Tremolite + Calcite + Quatrz = Diopside + CO_2 + H_2O

(6) Muscovite + Quartz = Al-silicate + K-feldspar + H_2O

(7) Granite Melting $X_{H_2O} = 0.8$

Figure 16. Pressure-temperature diagram indicating experimental reaction curves pertinent to the rocks in the Kent quadrangle. The shaded zone gives possible P-T conditions of maximum metamorphism, in which sillimanite-K-feldspar is in equilibrium. The region marked by the dotted border is applicable if kyanite is also a stable phase during prograde metamorphism. Explanation of letters; K; zone where kyanite is formed, S; zone where sillimanite is formed, A; zone where andalusite is formed. Sources for experimental data: (1). Richardson, et. al., 1969; (2). Holdaway, 1971; (3). Day, 1973; (4). Luth, et. al., 1964; (5). Metz, et. al., 1964; (6) and (7). Kerrick, 1972.

association.

Day's (1973) experimental curve for the reaction: pure K-muscovite plus quartz reacting to form K-feldspar plus sillimanite plus H_2O at X_{H_2O} equals 1 is presented. However, Kerrick (1972) presents two lines of evidence that shift Day's (1973) curve to lower temperature. (1) As the mole fraction of H_2O in the fluid phase decreases so does the reaction temperature. (2) The presence of sodium in muscovite lowers reaction temperatures. Since the coexisting plagioclase in the field area commonly has a high albite component this shift is possibly applicable here. On the P-T diagram (Figure 16) both Day's (1973) and the shifted Kerrick's (1972) experimental curves are presented.

The granite melting curve at X_{H_2O} equals 1, determined by Luth, et al. (1964), and the melting curve at X_{H_2O} equals 0.8, determined by Kerrick (1972) are shown on Figure 16. These curves give the lowest temperature of melt for the rocks in the field area. A lower temperature limit is suggested by the experimental curve: tremolite plus calcite plus quartz reacting to form diopside plus CO_2 plus H_2O (Meltz and Trommsdorf, 1968) at X_{CO_2} value would further lower the temperature of this reaction.

The shaded zone in the P-T diagram (Figure 16) indicates the possible maximum metamorphic conditions in the Kent quadrangle. Based on Richardson's, et al. (1969) curve the metamorphism occurred at approximately 5 kilobars and 650°C, while if Holdaway's (1971) curve is considered this indicates metamorphism with a pressure range of 3-5 kilobars and a temperature range of 575-650°C. If, however, the kyanite noted in some of the rocks represents prograde metamorphism and is in equilibrium with sillimanite, the shaded area would extend to the left, indicated by the dots in Figure 16, into the kyanite field of stability with its lower temperature values.

Candlewood Lake Pluton in Relation to Regional Metamorphism. The Candlewood Lake Pluton intrudes Precambrian and Paleozoic autochthonous and allochthonous rocks of the Waramaug thrust slice. A well developed foliation is subparallel to the early isoclinal stage schistosity. The absence of a well defined contact aureole with the country rock suggests that the intrusion of the granitic body occurred while the surrounding rocks were hot during the early isoclinal stage event.

Relations Between Structural Features and Metamorphism. Sillimanite nodules produced during the early isoclinal stage of deformation are elongate in the early axial plane schistosity and length parallel to early minor fold axes. If this stage of folding is Taconian then the maximum metamorphic grade in the Kent quadrangle occurred during the Taconic orogeny. In some pelitic rocks such as the Schistose Gneiss Member of Manhattan C and parts of the Lowerre Quartzite, where bedding is indistinct, early folds are recognized by the deformation of thin quartz and quartz-feldspar lenses or stringers having early axial plane schistosity.

Lenses or stringers are noted parallel to the early schistosity presumably on the limbs of folds. Quartz, biotite, muscovite, hornblende, tourmaline, and tremolite crystals are locally found parallel to the early isoclinal fold axes.

Bear Hill stage deformation forms minor folds and crenulations in the early schistosity. Locally early sillimanite nodules in pelitic units and tremolite blades in marble units are crenulated by Bear Hill stage folds. These textural relations are noted in the field and in thin section. Quartz and mica are commonly noted parallel to the axes of Bear Hill stage minor folds. Dana (1977) reports fresh kyanite laths growing across crinkled sillimanite crystals in rocks of Manhattan C in the New Preston quadrangle. The fresh kyanite and staurolite crystals growing on sillimanite noted in some thin sections from rocks of the Kent quadrangle may be the same age as those reported above by Dana (1977). These kyanite and staurolite crystals may have grown during the Bear Hill stage deformation.

Late stage folds and crenulations deform early schistosity and Bear Hill stage slip cleavage and schistosity. Muscovite, biotite, and quartz are parallel to late stage minor fold axes. Locally crystals of biotite up to 1/8 inch across grow across early schistosity. It is not clear whether these crystals are related to Bear Hill or Late stage deformation.

Retrograde Metamorphism. Fine examples of the effects of retrograde metamorphism are present at the outcrop scale and in thin section. Large nodules of coarse muscovite were possible initially early isoclinal stage sillimanite nodules. Close examination shows small fibers of sillimanite in the core region of the muscovite. These relations can be seen in the outcrops of Lowerre Quartzite along a secondary road a few hundred feet east of Baylordsville Station in the southwest quarter of the Kent quadrangle (Plate 2).

Several thin sections display late muscovite crystals replacing sillimanite in nodules and growing across other scattered sillimanite needles. Since K-feldspar is either absent or in trace amounts in many of these same rocks, a possible retrograde reaction producing muscovite is K-feldspar plus sillimanite plus H_2O equals muscovite plus quartz.

Fresh staurolite and kyanite growing across sillimanite nodules suggest a retrograde relation. Figure 17 is a microphotograph displaying euhedral staurolite crystals growing across sillimanite fibers in the Schistose Gneiss Member of Manhattan C. Chinner (1961) reports similar euhedral staurolite and kyanite crystals growing on sillimanite in pelitic schists in the Scottish Dalradian rocks. He thought the appropriate retrograde reaction to be: biotite plus sillimanite equals muscovite plus staurolite. Biotite and garnet are commonly found partly altered to chlorite in the Kent quadrangle.

Figure 17. Photomicrograph (field of view 5.5 x 8 microns) of the Schistose Gneiss Member of the Manhatten C Formation, specimen 3544, which was collected approximately 1000 feet southeast of the summit of Mauwee Peak, in the north part of the Kent quadrangle. In the center of the photomicrograph nearly euhedral staurolite crystals (pale yellow) are growing across bunched sillimanite fibers (light-gray or colorless).

A common mineral association in marbles suggests the retrograde reaction: diopside plus CO_2 plus H_2O equals tremolite plus calcite plus quartz. In the thin section, Specimen 826-b (Appendix I, Table 5), remnant diopside is rimmed by fresh tremolite, calcite, and quartz crystals. In addition Specimen 841 (Appendix I, Table 5) of Inwood A shows remnant tremolite breaking down to form talc plus calcite plus quartz.

An outcrop in the Amphibolite Unit of Manhattan C in the Waramaug Thrust slice has garnet crystals up to 1/8 inch across rimmed by pale white plagioclase and quartz, giving a bull's eye appearance in an otherwise black hornblende ground mass. Detailed study of Specimen 2853-a (Appendix I, Table 10) indicates that garnet, initially euhedral, is rimmed by plagioclase, quartz, and magnetite with hornblende present beyond the area of the original garnet crystal. The metamorphic reaction producing this mineral association is not clear.

Sillimanite, diopside, and tremolite crystals were produced during the early stage deformation and metamorphism. Minerals such as kyanite, staurolite, tremolite, and talc may have been produced by a second prograde metamorphism and not simply a retrograding late in the highest grade metamorphic event. This second metamorphism could be related to either a later phase or early deformation, or to the Bear Hill stage of deformation. Bear Hill stage produced regional scale isoclinal folds and conditions could have been hot enough during this deformation to cause much of the lower grade metamorphism described above. The age of the chlorite alteration from biotite and garnet is unknown.

ECONOMIC GEOLOGY

Two small pits located at the base of the west slope of Ore Hill in the central part of the quadrangle mark the sites where hematite was mined in Kent (Sheppard, 1837). The ore was transported to the Kent furnace, located adjacent to Route 7 in the northwest part of the quadrangle, for the extraction of the iron. Sheppard (1837) reports that the ore bed is found within micaceous gneiss and quart-mica slate. This is compatible with the present mapping that includes these pits entirely within the Lowerre Quartzite.

Pits in the northeastern part of the East Aspetuck River valley in the southeast quarter of the quadrangle indicate that the white dolomite marble of the Inwood Member A was quarried in several places. Discarded blocks adjacent to these pits suggest that the marble was quarried for building stone.

The Precambrian ultramafic body found in the Housatonic Highland (Plate 2) in the northwest part of the Kent quadrangle contains talc. Evidence of drilling and blasting at the large exposure there indicates at least a cursory interest in the economic potential of the deposit. It appears that mining operations were never carried out, however.

An accompanying descriptive rock chart is presented in Appendix II. This has been included to be utilized for engineering interpretations of the units within the Kent quadrangle. The rock chart lists some physical properties of the rocks for each unit and should be used in conjunction with the bedrock geologic map (Plate 2).

GEOLOGIC HISTORY

Precambrian rocks, originally shale, graywacke, calcareous rocks, impure sandstone, basalt and peridotite were deformed and metamorphosed during the Grenville orogeny. A later Precambrian event involved granite rocks intruding these older rocks. After this deformation and granitic intrusion, the Precambrian rocks were eroded. The sea transgressed across this erosion surface in the earliest Cambrian depositing shale, sandy shale, arkosic sandstone, or the quartzite and conglomerates of the Lowerre Quartzite unconformably on the crystalline basement. Inwood limestone was later deposited in a carbonate bank environment. At the same time as the Lowerre Quartzite and at least parts of the Inwood Marble were being deposited, Manhattan C shale, graywacke, impure sandstone, with interlayered basalt flows were being deposited in the east further offshore.

Prior to the main Taconic orogenic events, uplift with erosion resulted in the development of the Middle Ordovician unconformity. On this erosional surface, Middle Ordovician Manhattan A basal limestones followed by sulfide-bearing shales, were deposited. Further east at the same time or earlier the Moretown Formation with its interlayered shale, sandstone, graywacke, and basalt flows was being deposited.

The main Taconic events took place following this deposition. Thrusting, isoclinal folding with associated axial plane schistosity, and intense metamorphism, up to sillimanite-K-feldspar grade, characterize the orogenic activity in the Kent area. Several separate thrust slices bring rocks of Manhattan C westward over the shelf deposited units. Following emplacement, the thrust slices and the underlying autochthonous rocks were isoclinally folded and developed an axial plane schistosity that is the dominant planar feature in the rocks of the quadrangle. Associated with this early isoclinal stage deformation the Candlewood Lake Pluton intruded the autochthonous and allochthonous rocks.

During the Middle Devonian Acadian orogeny, the Bear Hill stage of deformation threw the rocks into isoclinal or open folds. Lower prograde or retrograde metamorphism may have occurred at this time.

A late event, possibly late Acadian or later, with associated conjugate slip cleavage, gently warps or folds the earlier structural features about a northwest or northeast axial plane cleavage. Late folds deforming earlier Bear Hill stage folds result in a large-scale interference fold pattern in the northeast part of the quadrangle.

A recent study was made by Kelley (1975) concerning Late Pleistocene Wisconsin glaciation in the area. Glacial and glaciofluvial erosional and depositional features were examined. Lacustrine silts and varved clays define small ephemeral ponds which developed in the narrow Housatonic River valley. Upland bogs developed post-glacially. Most recently, the Housatonic River has deposited alluvial stream gravels and flood silts.

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APPENDIX I

Petrographic Modes

TABLE 1. Estimated Modes of the Precambrian Gray Biotite Gneiss

	Foliated Biotite-Quartz-Feldspar Gneiss					Poorly-Foliated Biotite-Quartz-Feldspar Gneiss				Augen Gneiss
+Specimen	T-3	T-8	42	98	232	T-7	T-15	137	138	710
Quartz	4	43	37	35	17	48	45	51	56	37
*Plagioclase	4	43	22	19	51	37	27	35	18	21
Microcline	1	-	30	30	5	10	17	6	16	37
Muscovite	-	-	t	t	-	2	t	t	-	1
Biotite	13	12	10	13	22	3	11	3	10	4
Chlorite	-	-	t	t	-	-	t	-	t	t
Epidote	2	1	t	t	1	t	t	t	-	-
Hornblende	6	1	-	1[2]	t[2]	-	-	-	-	-
Calcite	-	t	-	-	-	t	-	-	-	-
Apatite	t	t	t	t	t	t	t	t	t	t
Zircon	t	t	t	t	t	t	t	t	t	t
Tourmaline	-	-	-	-	-	-	t	-	-	-
Sphene	-	-	1	2	4	t	-	t	t	t
Allanite	-	-	t	t	t	-	-	3	t	t
Chromite	-	-	-	-	-	-	-	t	-	-
Magnetite	t	t	t	t	t	t	t	2	t	t
Rutile	-	-	t	t	t	-	-	-	t	t
Hematite[3]	-	t	t	t	t	t	t	t	t	t
Ilmenite	t	-	-	-	t	t	t	t	t	t
Pyrite	-	-	-	-	-	t	-	-	-	-
*Mol% Anorthite[1]	47	52	Olig	33	And	21	51	And	27	16

t = trace amounts

+Specimen location on Plate 1.

TABLE 1. (Continued)

	Anphibolite-Hornblende Gneiss			Garnet-Hornblende Gneiss	Calc-silicate		
Specimen	T-6	34	1428	T-13	976	993	1657
Quartz	7	24	-	14	5	26	-
*Plagioclase	43	44	42	52	15	8	-
Microcline	-	14	1	-	29	39	-
Muscovite	-	-	t	-	-	-	-
Biotite	17	12	12	20	-	-	-
Chlorite	-	-	-	t	-	-	16[4]
Garnet	-	-	-	1	-	-	-
Olivine	-	-	-	-	-	-	6
Serpentine	-	-	-	-	-	-	2
Epidote	1	-	2	t	16	13	-
Hornblende	32	5	40	13	30	11	-
Tremolite	-	-	-	-	-	-	31
Diopside	-	-	-	-	2	-	6
Calcite	-	-	-	t	-	-	39
Fluorite	-	t	-	-	-	-	-
Apatite	t	t	t	t	t	t	t
Zircon	t	t	t	t	t	t	-
Sphene	t	1	3	-	2	1	-
Allanite	-	t	-	-	-	t	-
Chromite	-	-	t	-	t	-	t
Magnetite	t	t	t	t	-	-	t
Rutile	-	-	t	-	-	-	t
Hematite[3]	t	t	t	-	t	t	-
Ilmenite	t	t	t	t	-	-	t
Pyrrhotite	-	-	-	-	1	t	-
Pyrite	t	-	-	-	-	2	t
*Mol% Anorthite[1]	56	Olig	30	50	35	And	-

t = trace amounts

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method. If untwinned plagioclase, the composition is generalized as indicated by name based on relative relief and optic sign.

[2]Hastingsite, 2V approximately 20°.

[3]Hematite is a secondary mineral.

[4]Abnormal brown interference color.

Foliated Biotite-Quartz-Feldspar Gneiss

T-3. Foliated, light-gray, biotite-plagioclase gneiss. Specimen is from a road cut on Route 341 approximately 2000 feet west of the intersection of Routes 7 and 341 in Kent Village.

T-8. Foliated, light-gray, hornblende-biotite-quartz feldspar gneiss. Same location as T-3.

42. Well-foliated, light-gray and pink, biotite-plagioclase-microcline-quartz gneiss. Specimen collected approximately 3000 feet southeast of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

98. Well-foliated, thinly layered, tan and gray, biotite-plagioclase-microcline-quartz gneiss. Specimen collected along a ridge approximately 1000 feet southeast of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

232. Foliated, gray, microcline-quartz-biotite-plagioclase gneiss with abundant magnetite crystals up to 1/8 inch across. Specimen collected approximately 3500 feet west-southwest of the New Milford Church in the southeast quarter of the Kent quadrangle.

Poorly Foliated Biotite-Quartz-Feldspar Gneiss

T-7. Poorly foliated, light-gray, micaceous siliceous gneiss. Same location as T-3.

T-15. Poorly foliated, light-gray or gray, tan-weathering, biotite-microcline-plagioclase-quartz gneiss. Same location as T-3.

137. Poorly foliated, light-gray or pink, magnetite-biotite-microcline-plagioclase-quartz gneiss, with metallic mineral lenses up to 1/2 inch across. Specimen collected approximately 2000 feet south of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

138 Poorly foliated, gray, biotite-microcline-plagioclase-quartz gneiss. Specimen collected approximately 2000 feet south-southeast of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

Augen Gneiss

710. Poorly foliated, pale pink and light-gray, muscovite-biotite-plagioclase-microcline-quartz gneiss with scattered augen of feldspar and quartz up to 1/2 inch across. Specimen collected approximately 2500 feet southeast of the summit of Sugar Loaf Hill in the eastern part of the Kent quadrangle.

Amphibolite and Hornblende Gneiss

T-6. Poorly foliated, dark-greenish gray, quartz-biotite-plagioclase amphibolite. Same location as T-3.

34. Well-foliated, thinly layered, gray, hornblende-biotite-microcline-quartz-plagioclase gneiss. Specimen collected approximately 3000 feet east-southeast of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

1428. Well-foliated, black and white, pistacite-sphene-biotite-plagioclase amphibolite with abundant concentrations of biotite-hornblende up to 1/4 inch across. Specimen collected approximately 4000 feet north of the Upper Merryall Cemetery in the southeast quarter of the Kent quadrangle.

Garnet-Hornblende Gneiss

t-13. Poorly foliated, dark-gray, garnet-hornblende-biotite-quartz gneiss with garnet porphoblasts up to 1/2 inch across. Same location as T-3.

Calc-silicate

976. Well-foliated, light-greenish gray, rusty-weathering, diopside-sphene-quartz-plagioclase-pistacite-hornblende calc-silicate rock. Specimen collected in a road cut approximately 1000 feet west of the Upper Merryall Cemetery in the southeast quarter of the Kent quadrangle.

993. Well-foliated, light-gray and tan, rusty-weathering, pyrite-pyrrhotite-plagioclase-hornblende-pistacite-quartz-microcline calc-silicate rock. Specimen collected approximately 1000 feet west of the Upper Merryall Cemetery in the southeast quarter of the Kent quadrangle.

1657. Massive, light-greenish gray, olivine-diopside-chlorite-tremolite-calcite calc-silicate rock. Specimen collected approximately 2000 feet south-southeast of Tamarack Swamp in the southeast quarter of the Kent quadrangle.

TABLE 2. Estimated Modes of the Precambrian Hornblende Gneiss - Amphibolite Unit

	Amphibolite			Gray Hornblende Gneiss							Biotite-Quartz Feldspar Gneiss		
+Specimen	T-2	37	40	118	205	297	374	392	429	610-b	349	357	430
Quartz	2	1	2	42	36	13	8	34	12	13	34	6	43
*Plagioclase	62	58	32	20	31	31	44	38	38	31	14	62	31
Microcline	-	-	-	3	5	3	-	8	-	6	39	8	16
Muscovite	-	-	-	-	-	-	-	-	-	-	2	-	t
Biotite	8	t	18	-	19	t	-	10	9	-	11	22	10
Chlorite	-	7	-	-	-	-	-	-	-	-	t	-	-
Actinolite	-	-	-	-	-	-	-	-	-	3	-	-	-
Hornblende	25	34	43	12	1^{4}	41	38	1	41	35	-	-	-
Diopside	-	-	-	8	-	-	-	-	-	2	-	-	-
Tremolite	-	-	-	-	-	t	-	-	-	-	-	-	-
Clinozoisite	-	t	-	-	-	-	-	-	-	-	-	-	-
Epidote	3	-	-	15	2	11	6	9	-	7	t	2	t
Apatite	t	t	t	t	2	t	t	t	t	-	t	t	t
Zircon	t	t	t	t	t	t	t	t	t	-	t	t	t
Sphene	-	t	5	t	4	1	4	t	-	3	-	t	t
Tourmaline	-	-	-	-	-	-	-	-	-	-	-	t	-
Allanite	-	-	-	t	t	t	-	t	-	-	t	t	t
Pyrite	t	-	-	-	-	-	-	-	-	-	-	-	-
Magnetite	t	t	t	t	t	t	t	t	t	-	t	t	-
Hematite[2]	t	-	t	-	t	t	t	t	t	t	t	t	t
Ilmenite	t	-	-	-	-	t	-	t	t	t	t	t	t
Rutile	-	t	t	-	t	t	-	t	-	-	t	t	t
*Mol.% Anorthite[1]	57	54	46	26	Olg	25	38	33	47	And	And	42	15

t = trace amounts

+Specimen location on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method. If untwinned plagioclase, the composition is generalized as indicated by name based on relative relief and optic sign.

[2]Hematite is a secondary mineral.

[3]Metallic opaques of unknown composition.

[4]Hastingsite, 2V approximately 20°.

Amphibolite

T-2. Poorly foliated, dark-greenish gray, epidote-biotite-feldspathic amphibolite. Specimen collected approximately 3000 feet southwest of Northville center on Mt. Tom in the southeast quarter of the Kent quadrangle.

37. Well-foliated, gray, quartz-chlorite-plagioclase amphibolite. Specimen collected approximately 3000 feet southeast of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

40. Poorly foliated, dark greenish gray, quartz-sphene-biotite-plagioclase amphibolite. Specimen collected approximately 2500 feet south-southeast of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

Gray Hornblende Gneiss

118. Poorly foliated, greenish gray, diopside-hornblende-pistacite-plagioclase-quartz calc-silicate rock. Specimen collected approximately 1500 feet south of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

205. Well-foliated, gray or dark-gray hornblende-pistacite-apatite-sphene-microcline-biotite-plagioclase-quartz schistose gneiss. Specimen collected approximately 2500 feet south-southeast of Strastrom Pond in the southeast quarter of the Kent quadrangle.

297. Poorly foliated, gray, pistacite-quartz-plagioclase amphibolite. Specimen collected approximately 3500 feet west-southwest of the New Milford Church in the southeast quarter of the Kent quadrangle.

374. Poorly foliated, dark-gray, sphene-pistacite-quartz-plagioclase amphibolite. Specimen collected approximately one mile west-southwest of Northville center on the west slope of Mt. Tom in the southeast quarter of the Kent quadrangle.

392. Poorly foliated, gray, well-layered, hornblende-microcline-pistacite-biotite-quartz-plagioclase gneiss. Specimen collected approximately 3000 feet southwest of Northville center in the southeast quarter of the Kent quadrangle.

429. Poorly foliated, dark-gray or black, biotite-quartz-plagioclase amphibolite. Specimen collected approximately 1500 feet south of the summit of Iron Hill in the southeast quarter of the Kent quadrangle.

610-b. Well-foliated, gray, diopside-actinolite-sphene-microcline-pistacite-quartz-plagioclase-hornblende calc-silicate rock. Specimen collected approximately 3000 feet south-southeast of Hatch Four Corners on Sawyer Hill in the southeast quarter of the Kent quadrangle.

Biotite Gneiss

349. Well-foliated, light-gray, muscovite-biotite-plagioclase quartz-microcline gneiss. Specimen collected approximately 3000 feet southwest of the New Milford Church in the southeast quarter of the Kent quadrangle.

357. Well-foliated, light-gray or gray, quartz-microcline biotite-plagioclase gneiss. Specimen collected approximately 3000 feet southwest of Northville center in the southeast quarter of the Kent quadrangle.

430. Poorly foliated, light-gray, light-tan-weathering, biotite-microcline-plagioclase-quartz-gneiss. Specimen collected approximately 1500 feet south of the summit of Iron Hill in the southeast quarter of the Kent quadrangle.

TABLE 3. Estimated Modes of the Precambrian Calc-Silicate Unit

+Specimen	1976	M-24
Quartz	5	-
*Plagioclase	6	20
Microcline	-	17
Biotite	24	18
Epidote	24	3
Hornblende	38	7
Diopside	-	33
Scapolite	3	-
Calcite	-	t
Apatite	t	t
Zircon	t	t
Sphene	t	2
Allanite	-	t
Hematite[3]	t	-
Pyrite	t	-
Magnetite	-	t
Ilmenite	t	t
*Mol.% Anorthite[1]	31	29

t = trace amounts

+Specimen located on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method.

[2]Metallic opaques of unknown composition.

[3]Hematite is a secondary mineral.

1976. Massive, light-tan or tannish white and greenish black, scapolite-quartz-plagioclase-pistacite-biotite-hornblende-calc-silicate rock. Specimen collected approximately 2000 feet west of Pine Ledge on the western border of the Kent quadrangle.

M-27. Poorly foliated, greenish black and white, sphene-pistacite-hornblende-microcline-biotite-plagioclase-diopside calc-silicate rock. Specimen collected approximately 1500 feet northeast of Tamarack Swamp in the southeast quarter of the Kent quadrangle.

TABLE 4. Estimated Modes of the Lowerre Quartzite

Eastern Facies

	Schistose Granulite				Micaceous Granulite				
+Specimen	T-1a	146	1051	1253-a	T-1b	1-a	1-b	162-a	162-b
Quartz	27	36	14	49	46	40	38	71	90
*Plagioclase	t	-	t	7	-	t	t	-	-
Microcline	41	33	21	-	31	46	51	7	1
Muscovite	22	19	34	7	12	7	5	6	2
Biotite	10	11	16	20	11	7	6	9	5
Chlorite	t	-	-	-	t	-	-	-	t
Garnet	-	-	-	16	-	-	-	-	-
Sillimanite	-	-	15	1	-	-	-	7	2
Apatite	t	1	t	t	t	t	t	t	t
Zircon	t	t	t	t	t	t	t	t	t
Tourmaline	t	t	t	t	t	t	t	-	-
Allanite	-	-	-	-	-	-	-	t	t
Magnetite	t	t	t	t	t	t	t	t	t
Hematite[2]	t	t	t	t	t	t	t	t	t
Rutile	-	-	-	-	-	-	-	t	t
Ilmanite	t	t	t	t	t	t	t	t	t
Graphite	-	-	t	t	-	-	-	-	-
*Mol.% Anorthite[1]	?	-	?	38	-	?	?	-	-

t = trace amounts

+Specimen location on Plate 1.

TABLE 4. (Continued)

Eastern Facies

	Micaceous Granulite				Schist	Quartzite	
Specimen	315	1253-b	1473	1576	1257	10	103
Quartz	45	38	55	37	12	59	71
*Plagioclase	t	-	-	19	11	-	-
Microcline	37	42	34	18	11[3]	28	25
Muscovite	10	12	5	11	44	6	3
Biotite	8	8	6	15	22	3	t
Chlorite	t	t	t	t	-	4	1
Epidote	-	-	-	t	-	-	-
Apatite	t	t	t	t	t	t	t
Zircon	t	t	t	t	t	t	t
Tourmaline	t	-	-	t	t	t	t
Sphene	-	-	-	t	-	-	-
Allanite	-	-	-	t	-	-	-
Magnetite	t	t	t	t	t	t	t
Hematite[2]	t	t	t	t	t	t	t
Rutile	-	-	t	t	-	-	-
Ilmanite	t	-	-	t	t	t	t
Graphite	-	-	-	-	t	-	-
*Mol.% Anorthite[1]	32	-	-	12	36	-	-

t = trace amounts

TABLE 4. (Continued)

	Western Facies			Peet Hill Member				
	Quartzite		Schistose Granulite	Schistose Granulite			Calc-silicate	
Specimen	T-5	T-14	1923	933	934	1073-1	1073-2	1075
Quartz	76	87	9	49	50	57	29	42
*Plagioclase	-	-	-	26	18	16	36	26
Microcline	-	12	39	-	-	-	-	-
Muscovite	23	1	37	2	8	t	14	-
Biotite	-	-	15	23	23	19	21	17
Chlorite	-	-	t	-	-	-	t	t
Garnet	-	-	-	-	-	2	t	1
Sillimanite	-	-	-	-	1	-	t	-
Epidote	-	-	-	-	-	1	-	t
Hornblende	-	-	-	-	-	-	-	10
Diopside	-	-	-	-	-	-	-	1
Apatite	-	-	t	t	t	1	t	t
Zircon	t	t	t	t	t	t	t	t
Tourmaline	-	t	t	t	t	t	t	t
Sphene	-	t	t	-	-	t	-	3
Allanite	-	-	-	-	-	t	-	-
Magnetite	t	t	t	t	t	4	t	t
Hematite[2]	t	t	t	t	t	t	t	t
Rutile	-	-	t	-	-	t	-	t
Ilmenite	t	t	t	t	t	-	-	t
Graphite	-	-	t	t	t	t	t	-
*Mol.% Anorthite[1]	-	-	-	62	31	69	58	79

t = trace amounts

TABLE 4. (Continued)

	Peet Hill Member		
	Calc-silicate		Garnitiferous Granulite
Specimen	1146-1	1146-2	1319
Quartz	22	30	65
*Plagioclase	20	20	-
Microcline	20[3]	16[3]	-
Muscovite	t	-	1
Biotite	7	1	-
Chlorite	t	-	1
Garnet	-	-	28
Sillimanite	-	-	-
Epidote	1	5	-
Actinolite	-	-	3
Hornblende	7	22	-
Diopside	15	4	-
Calcite[2]	t	-	2
Apatite	t	t	t
Zircon	t	-	t
Tourmaline	t	t	-
Sphene	3	2	-
Allanite	t	t	-
Pyrite	1	-	-
Magnetite	4	t	t
Hematite[2]	t	t	t
Rutile	t	t	-
Ilmenite	t	t	t
*Mol.% Anorthite[1]	Byt	58	-

t = trace amounts

[1]Approximate composition of plagioclase feldspar in molecular % based on Michel-Levy method. If untwinned plagioclase the composition is generalized as indicated by name based on relative relief and optic sign.

[2]Mineral of secondary origin.

[3]Potassium feldspar is orthoclase, 2V = 40°.

Eastern Facies

Schistose Granulite

T-1a. Well-foliated, light-gray or gray, biotite-muscovite-quartz-microcline schistose granulite with quartz-feldspar nodules up to 1/2 inch across. Specimen collected approximately 2000 feet southwest of Northville center in the southeast quarter of the Kent quadrangle.

146. Well-foliated, light-gray, tan weathering, thinly laminated, biotite-muscovite-microcline schistose granulite. Specimen collected on the north slope of an isolated hill approximately 1000 feet north of the New Milford Church in the southeast quarter of the Kent quadrangle.

1051. Well-foliated, gray, sillimanite-biotite-microcline-muscovite schistose granulite with sillimanite nodules up to 1/2 inch across. Specimen collected approximately 2000 feet southeast of B.M. 644 in Upper Merryall in the southeast quarter of the Kent quadrangle.

1253-a. Well-foliated, well layered, gray, sillimanite-muscovite-plagioclase-garnet-biotite-quartz schistose granulite with scattered quartz lenses up to 1/4 inch thick. Specimen collected approximately 3000 feet east-northeast from the summit of Peet Hill in the central part of the Kent quadrangle.

Micaceous Granulite

T-1b. Well-foliated, thinly laminated, light-gray or gray, biotite-muscovite-microcline-quartz granulite with alternate light-gray and gray laminae up to 1/4 inch thick. Specimen collected approximately 3000 feet southwest of Northville center on the southeast border of the Kent quadrangle.

1-a. Well-foliated, light-gray, tan weathering, muscovite-biotite-microcline-quartz micaceous granulite. Specimen collected in a road cut approximately 100 feet from the eastern border of the Kent quadrangle along Route 25 in Marble Dale.

1-b. Well-foliated, gray, tan-weathering, muscovite-biotite-quartz-microcline micaceous granulite with irregular quartz-feldspar stringers up to 1/2 inch thick. Same location as #1-2.

162-a. Well-foliated, light-gray, tan-weathering, well bedded, microcline-muscovite-pistacite-biotite micaceous quartzite. Specimen collected approximately 1500 feet northwest of the New Milford Church in the southeast quarter of the Kent quadrangle.

162-b. Well-foliated, light-gray, tan-weathering, well bedded microcline-muscovite-pistacite-biotite granulite. Same location as #152-a.

315. Poorly foliated, light-gray or gray, well bedded, biotite-muscovite-microcline-quartz micaceous granulite. Specimen collected approximately 1500 feet west-southwest of Northville center in the southeast quarter of the Kent quadrangle.

1253-b. Massive, light-gray, tan weathering, biotite-muscovite-quartz-microcline micaceous granulite. Same location as #1253-a.

1473. Well-foliated, light-gray, thinly bedded, muscovite-biotite-microcline micaceous quartzite. Specimen collected approximately 3000 feet east-southeast of B.M. 1062 northeast of Peet Hill in the east-central part of the Kent quadrangle.

1576. Massive, light-gray or gray, muscovite-biotite-microcline-plagioclase-quartz micaceous granulites. Specimen collected approximately 3000 feet south of hill #734 along Treasure Hill in the east-central part of the Kent quadrangle.

Schist

1257. Well-foliated, gray, tan-weathering, plagioclase-microcline-quartz-biotite-muscovite schist. Specimen collected approximately 3000 feet northeast of Peet Hill and 500 feet northwest of specimen #1253-a in the central part of the Kent quadrangle.

Quartzite

10. Massive or poorly foliated, light-gray or tan, biotite-chlorite-muscovite-microcline micaceous quartzite. Specimen collected approximately 1000 feet west of road intersection 496 in Marble Dale in the southeast quarter of the Kent quadrangle.

103. Massive, light-gray, buff-weathering, muscovite-microcline quartzite. Specimen collected approximately 1000 feet southeast of Ella Camp Pond in the southeast quarter of the Kent quadrangle.

Western Facies

Quartzite

T-5. Well-foliated, brown-weathering, light-gray microcline-muscovite conglomeratic quartzite with blue quartz pebbles up to 1/2 inch across. Specimen collected in the road cut approximately 2000 feet west of the intersection of Routes 7 and 341 in Kent along Route 341.

T-14. Massive, buff-weathering, glassy, muscovite-microcline quartzite. Same location as #T-5.

Schistose Granulite

1923. Well-foliated, light-gray or tan, quartz-biotite-muscovite-microcline schistose granulite with irregular quartz-feldspar lenses up to 1/2 inch thick. Specimen collected on a terrace at an elevation of 740 feet, southwest of Pine Ledge and southwest of Thayer Brook near the west border of the Kent quadrangle.

Peet Hill Member

Schistose Granulite

933. Well-foliated, gray, muscovite-biotite-plagioclase-quartz schistose granulite with biotite crystals up to 1/4 inch across locally crossing foliation. Specimen collected on the western slope of the ridge extending northward into Kent Hollow approximately 3500 feet northwest from the road intersection 642, which is north of Bear Hill in the east-central part of the Kent quadrangle.

934. Well-foliated, gray, sillimanite-muscovite-plagioclase-biotite-quartz schistose granulite. Specimen collected 100 feet south of #933.

1073-1. Well-foliated, gray of dark gray, garnet-plagioclase-biotite-quartz schistose granulite with scattered biotite crystals up to 1/8 inch across growing across foliation. Specimen collected on the south slope of Peet Hill approximately 1000 feet east-southeast of road intersection 589 in the south-central part of the Kent quadrangle.

1073-2 Well-foliated, light-gray or gray, muscovite-biotite-quartz plagioclase schist with biotite crystals concentrated in lenses up to 1/4 inch thick. Same location as #1073-1.

Calc-silicate

1075. Weakly foliated, gray and pale white, diopside-garnet-sphene-hornblende-biotite-plagioclase calc-silicate rock. Specimen collected 100 feet north of #1073-1.

1146-1. Massive or poorly foliated, gray or dark gray, biotite-hornblende-diopside-orthoclase-plagioclase-quartz calc-silicate rock. Specimen collected on the east slope of Peet Hill approximately 2500 feet northwest of Erickson Corner in the southeast-central part of the Kent quadrangle.

1146-2. Massive or poorly foliated, light-gray, diopside-pistacite-orthoclase-plagioclase-hornblende-quartz calc-silicate rock. Same location as #1146-1.

Garnetiferous Granulite

1319. Massive, well layered, garnetiferous, lavender granulite and light-gray garnet-quartz micaceous granulite. Specimen collected in a small road cut on a secondary road north of Peet Hill approximately 500 feet south of B.M. 1155 in the east-central part of the Kent quadrangle.

TABLE 5. Estimated Modes of the Inwood Marble

	Inwood A						Inwood B	
	White Dolomite				White and Gray Dolomite	Quartzite		
+Specimen	826-2	826-b	841	842	829	838	1828-1	1828-6
Quartz	-	73[2]	1[2]	1[3]	-	31	1[3]	-
Plagioclase	-	-	-	-	-	t	-	-
Potassium Feldspar								
Microcline	-	-	-	-	-	42	-	29
Orthoclase	-	-	-	-	-	-	11	-
Muscovite	-	-	-	-	-	12	-	-
Biotite	-	-	-	-	-	15	-	-
Phlogopite	-	-	t	6	-	-	2	8
Chlorite	-	-	-	-	-	t	-	-
Epidote	-	-	-	-	-	-	-	-
Calcite[1]	8	7	1	5	2	-	3	2[6]
Dolomite[1]	89	-	98	85	95	-	83	22
Tremolite	3	14	-	3	3	-	t	-
Diopside	-	6	-	-	-	-	-	35
Talc	-	-	t	-	-	-	-	-
Apatite	-	t	-	-	t	t	-	t
Zircon	-	t	-	t	-	t	-	t
Sphene	-	-	-	-	-	-	t	1
Allanite	-	-	-	-	-	-	-	-
Tourmaline	-	-	-	-	-	t	-	-
Pyrite	-	-	-	-	-	-	-	t
Magnetite	t	t	t	-	t	t	t	3
Ilmenite	t	-	-	-	-	t	t	-
Rutile	-	-	-	-	-	t	-	-
Hematite[4]	-	-	-	t	-	t	t	-

t = trace amount   +Specimen location on Plate 1.

TABLE 5. (Continued)

Inwood B

Specimen	1829-3	1829-8	1829-9	1829-10	2031	2540
Quartz	13	2[2]	1[2]	-	7	-
Plagioclase	-	-	-	t	t	-
Potassium feldspar						
Microcline	59	12	5	7	5	67
Orthoclase	-	-	-	-	48	-
Muscovite	-	-	-	-	-	-
Biotite	-	-	-	-	-	-
Phlogopite	19	6	8	18	10	5
Chlorite	-	-	-	-	-	-
Epidote	-	-	-	-	t	-
Calcite[1]	1[6]	-	2	7	t	12
Dolomite[1]	-	73	83	54	-	t
Tremolite	-	6	-	11	7	-
Diopside	4	1	-	3	21	16
Talc	-	-	-	-	-	-
Apatite	t	t	t	t	t	t
Zircon	t	-	-	-	-	t
Sphene	t	t	-	-	2	t
Allanite	-	-	-	-	-	-
Tourmaline	-	-	-	-	-	-
Pyrite	-	t	1	t	-	-
Magnetite	4	t	t	t	t	t
Ilmenite	-	-	-	t	t	t
Hematite[4]	t	t	-	-	t	t

t = trace amount

[1]Carbonate mineralogy determined from chemical staining (Dickson, 1965).

[2]Quartz occurs in late veins.

[3]Quartz inclusions in retrograded tremolite.

[4]Hematite is a secondary mineral.

Inwood A

White Dolomite

826-a. Massive, white, tremolite dolomite with scattered tremolite needles u p to 1/4 inch in length. Specimen collected approximately 750 feet east-northeast of the Northville Cemetery in the East Aspetuck River Valley in the southeast quarter of the Kent quadrangle.

826-b. Massive, white or pale tan diopside-calcite-tremolite marble with pale glassy-gray quartz lenses up to 1/2 inch thick. Same location as #826-a.

841. Massive, pale-tan and thin light-gray interbedded, quartz-talc-dolomite. Specimen collected adjacent to the East Aspetuck River approximately 1500 feet southeast of the Northville Cemetery in the southeast quarter of the Kent quadrangle.

842. Massive or poorly foliated, white or light-gray, quartz-tremolite-phlogopite dolomite with phlogopite crystals up to 1/4 inch across and blades of tremolite up to 1/4 inch across. Specimen collected in the East Aspetuck River approximately 2000 feet southeast of the Northville Cemetery in the southeast quarter of the Kent quadrangle.

White and Gray Dolomite

829. Massive, light-gray or gray, tremolite dolomite. Specimen collected approximately 2000 feet northeast of the Northville Cemetery in the East Aspetuck River Valley in the southeast quarter of the Kent quadrangle.

838. Well-foliated, slabby, gray, tan-weathering, muscovite-biotite-quartz microcline schistose granulite. Specimen collected in a small stream approximately 3000 feet northeast of the Northville Cemetery in the East Aspetuck River Valley in the southeast quarter of the Kent quadrangle.

Inwood B

1828-1. Well interlayered, light-gray and lavender, light-gray and light-tan or orange-weathering, tremolite-phlogopite-quartz-orthoclase dolomite. Specimen collected behind a shopping center approximately 1000 feet northeast of the intersection of Route 7 and the Penn Central Railroad track in the Village of Kent.

1828-6. Well-foliated, well layered, light-gray and light-lavender, phlogopite-microcline-diopside dolomite. Same location as #1828-1.

1829-3. Thinly laminated, light-gray and gray, calcite-dolomite-diopside-quartz-phlogopite-microcline calcareous granulite with thin dark-gray quartz-feldspar granulite layers 1/8 inch thick and thin, light-gray, calcite-diopside-quartz-feldspar calcareous granulite layers up to 1/2 inch thick. Specimen collected approximately 200 feet east of #1828-1.

1829-8. Massive, light-gray, diopside-quartz-phlogopite-tremolite-microcline dolomite. Same location as #1829-3.

1829-9. Massive, light-gray or gray, quartz-microcline-phlogopite dolomite. Same location as #1829-3.

1829-10 Massive or poorly foliated, light-gray and lavender, diopside-microcline-tremolite-phlogopite dolomite. Same location as #1829-3.

2031. Massive, or poorly foliated, light-tan and gray, tremolite-quartz-phlogopite-diopside-microcline calc-silicate rock. Specimen collected on a small hill on the east shore of the Housatonic River approximately 2000 feet north of Kent Furnace in the northwest quarter of the Kent quadrangle.

2540. Massive or poorly foliated, pale tan, phlogopite-calcite-diopside-microcline calc-silicate rock. Specimen collected on a hill approximately 1000 feet north-northeast of a gaging station on the Housatonic River in Sherman in the southwest quarter of the Kent quadrangle.

TABLE 6. Estimated Modes of the Calcite Marble Member of Manhattan A

+Specimen	827	864	1621	1751	2041	2064
Quartz	18	-	-	-	t	t
Plagioclase	-	-	-	-	t	t
Microcline	15	7	-	-	42	13
Phlogopite	-	5	16	5	22	40
Chlorite	-	-	-	t[3]	-	-
Ferrian Zoisite	-	9	-	-	-	-
Tremolite	7	6	11	1	2	2
Calcite[1]	50[2]	-	67	94	1	31
Fe-Dolomite[1]	-	73	-	-	1	-
Diopside	7	-	6	-	32	14
Apatite	3	t	t	-	t	t
Zircon	-	t	t	t	t	t
Sphene	t	t	-	t	t	-
Tourmaline	t	-	-	-	-	-
Pyrite	-	t	t	-	-	-
Magnetite	t	t	-	t	t	t
Ilmenite	t	-	-	t	t	t
Hematite[4]	t	t	t	t	t	t

t = trace amounts

+Specimen location on Plate 1.

[1]Carbonate mineralogy determined from chemical staining (Dickson, 1965).

[2]Fe-calcite

[3]Low gray interference color indicates Mg/Fe ratio greater than 0.5.

[4]Hematite is a secondary mineral.

827. Poorly foliated, orange-tan-weathering, tremolite-diopside-microcline-quartz-calcite marble with thin gray layers of microcline and apatite. Specimen collected approximately 2000 feet northeast of the Northville Cemetery.

864. Well-foliated, thinly interbedded, gray and greenish-tan phlogopite-tremolite-microcline-ferrian zoisite dolomite marble. Specimen collected in a small stream approximately 100 feet east of Route 25 in Northville center in the southeast quarter of the Kent quadrangle.

1621. Well-foliated, orange-tan-weathering, diopside-tremolite-phlogopite calcite marble. Specimen collected approximately 2000 feet south of road intersection 589 adjacent to a power line south of Peet Hill in the south-central part of the Kent quadrangle.

1751. Coarse-grained, light-tan or white, tremolite-phlogopite-calcite marble. Specimen collected approximately 2000 feet southwest of Henderson Pond near the south-central border of the Kent quadrangle.

2041. Well-foliated, tan-orange-weathering, calcite-tremolite-phlogopite-diopside-microcline schistose calc-silicate rock. Specimen collected in a small road cut along a secondary road approximately 100 feet northeast from road intersection 438 south of Kent Furnace in the northwest quarter of the Kent quadrangle.

2064. Well-foliated, light-gray, tan-weathering, tremolite-microcline-diopside-calcite-phlogopite calcareous schist. Specimen collected approximately 2000 feet east of Kent center at an elevation of 540 feet.

TABLE 7. Estimated Modes of the Granulite Member of the Manhattan A

	Schistose Granulite				Calc-silicate					Calcite Marble		
+Specimen	T-9	1830	2061-a	3112-a	825	2104	2114	2178	2372	2061-b	2323-a	3112-b
Quartz	41	25	18	27	t	11	17	27	-	-	7	-
*Plagioclase	32	23	15	29	-	2	31	16	33	-	1	-
Microcline	-	19	26	-	-	-	9	12	13	-	18	-
Muscovite	1	t	2	5	-	-	-	-	-	-	-	-
Biotite	21	27	27	32	-	-	17	t	-	-	-	-
Chlorite	-	-	t	-	-	-	-	-	t	-	-	-
Garnet	1	1	6	1	-	-	-	-	-	-	-	-
Phlogopite	-	-	-	-	-	-	-	-	2	26	-	2
Epidote	-	-	-	-	-	-	-	-	-	-	t	-
Hornblende	-	-	-	-	-	17	11	19	-	-	-	-
Diopside	-	-	-	-	84	19	5	7	41	-	28	-
Tremolite	-	-	-	-	7	-	-	-	8[2]	5	10	58
Calcite	-	-	-	-	8	9	-	-	1	69	34	40
Pistacite	-	2	-	-	-	23	5	12	1	-	-	-
Scapolite	-	-	-	-	-	16	-	2	-	-	-	-
Sillimanite	4	-	-	7	-	-	-	-	-	-	-	-
Apatite	t	t	t	t	-	t	t	t	t	t	t	-
Zircon	t	t	t	t	-	t	t	t	t	-	t	t
Sphene	-	1	-	-	1	3	3	5	1	t	1	-
Tourmaline	t	t	-	t	-	t	-	-	t	-	-	-
Allanite	-	t	t	-	-	t	t	t	t	-	-	-
Magnetite	5	3	t	t	t	t	t	t	t	t	t	t
Pyrrhotite	-	-	-	-	-	-	-	-	-	-	-	-
Rutile	t	-	-	-	-	-	-	-	-	-	-	-
Hematite[3]	t	t	t	t	t	t	t	t	t	-	t	t
Ilmanite	t	-	t	t	-	t	-	t	-	-	-	-
Graphite	t	-	-	t	-	-	-	-	-	-	-	-
*Mol% Anorthite[1]	50	59	40	38	-	40	36	80	82	-	75	-

t = trace amounts +Specimen location on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method.

[2]Actinolite-hornblende series.

[3]Hematite is a secondary mineral.

Schistose Granulite

T-9. Well-foliated, gray, garnet-muscovite-sillimanite-biotite-quartz schistose granulite. Specimen collected in a small road cut along a secondary road approximately 1500 feet south of the intersection where Route 341 turns abruptly eastward one half mile southeast of Kent center.

1830. Well-foliated, gray or dark-gray, microperthite-plagioclase-quartz-biotite schistose granulite with thin "wispy" quartz-feldspar stringers and biotite crystals up to 1/8 inch across growing across foliation. Specimen collected in a small road cut on a secondary road approximately 250 feet south of the intersection where Route 341 turns abruptly eastward one half mile southeast of Kent center.

2061-a. Poorly foliated, gray or dark-gray, garnet-quartz-biotite-microcline schistose granulite with quartz lenses up to 1/4 inch thick. Specimen collected approximately 2000 feet east of Kent center on a terrace along the Telephone Line at an elevation of 590 feet.

3112-a. Well-foliated, light-gray, tan-weathering, muscovite-sillimanite-quartz-plagioclase-biotite schist. Specimen collected south of Route 341 approximately 1000 feet north of the northernmost cabin of Camp Leonard Leonore at an elevation of 450 feet.

Calc-silicate

825. Massive, light-greenish gray, tremolite-calcite-diopside calc-silicate rock. Specimen collected at the east base of Golf Course Hill 1000 feet south west of B.M. 706 near Lake Waramaug at the eastern border of the Kent quadrangle.

2104. Poorly foliated, light-greenish gray, calcite-quartz-scapolite-hornblende-diopside-epidote calc-silicate rock.

Specimen collected approximately 2500 feet east of the intersection of Route 7 and 341 in Kent on a small knob northwest of a small swamp.

2114. Massive or poorly foliated, gray or dark gray, diopside-epidote-microcline-hornblende-quartz-biotite-plagioclase calc-silicate rock. Specimen collected east of the Route 7 and 341 intersection in Kent 100 feet west of the summit of The Cobble.

2178. Poorly foliated, dark-gray and pale white, sphene-diopside-microcline-epidote-plagioclase-hornblende-quartz calc-silicate rock. Specimen collected along the eastern slope of the ridge approximately 500 feet west of B.M. 415, the point where Route 341 takes an abrupt turn eastward one half mile southeast of Kent center.

2372. Poorly foliated, white and pale green, actinolite-microcline-plagioclase-diopside calc-silicate rock. Specimen collected on the northern slope of the westernmost hill top of Cedar Hill at an elevation of 790 feet.

Calcite Marble

2061-b. Massive or poorly foliated, light-tan, tremolite-phlogopite-calcite marble. Same location as #2061-a.

2323-a. Massive or poorly foliated, light-tan and gray, quartz-tremolite-microcline-diopside-calcite marble. Specimen collected at the base of a small hill bordering the west shore of Hatch Pond east of Spooner Hill located in the western part of the Kent quadrangle.

3112-b. Poorly foliated, light-tan or pale white, phlogopite-tremolite-calcite marble. Same location as #3112-a.

TABLE 8. Estimated Modes of the Schistose Gneiss Member of the Manhattan C

Schist

+Specimen	T-4	824	911	1186	1842-b	2323-b	2323-c	3112-c	3544
Quartz	27	18	27	31	28	43	28	24	52
*Plagioclase	17	24	17	25	17	6	15	27	6
Microcline	-	-	t	t	t	t	-	-	-
Muscovite	34	16	26	6	22	13	16	11	17
Biotite	20	26	26	24	27	33	30	32	15
Chlorite	-	-	-	-	-	-	-	-	t
Garnet	2	1	1	10	1	2	6	1	4
Sillimanite	-	9	3	4	5	3	5	3	3
Staurolite	-	1	-	-	-	-	-	-	1
Kyanite	-	-	-	-	-	-	-	-	t
Apatite	t	t	t	-	t	t	t	t	t
Zircon	t	t	t	t	t	t	t	t	t
Tourmaline	-	3	t	t	t	t	t	t	t
Sphene	-	-	-	t	-	-	-	-	-
Magnetite	t	2	t	t	t	t	t	2	1
Hematite[2]	t	t	t	t	t	t	t	t	t
Rutile	-	t	t	-	-	-	-	-	-
Ilmanite	t	t	t	t	t	t	-	t	t
*Mol.% Anorthite[1]	31	33	26	25	35	38	39	30	48

t = trace amounts

+Specimen location on Plate 1.

TABLE 8. (Continued)

Specimen	Granulite						Calc-silicate				
	805	806	808	921	1837	2163	815	877	877-a	880	2601
Quartz	36	19	14	41	30	17	25	34	19	25	10
*Plagioclase	t	t	5	10	10	21	20	27	28	-	46
Microcline	35	30	32	30	-	-	-	-	-	35	-
Muscovite	13	28	22	6	38	1	-	-	-	5	-
Biotite	16	23	25	13	21	19	5	-	t	1	t
Chlorite	-	-	1	-	-	-	t	-	-	-	-
Garnet	-	-	-	-	1	42	-	-	-	-	-
Hornblende	-	-	-	-	-	-	20	18	-	-	-
Diopside	-	-	-	-	-	-	16	16	1	-	15
Calcite	-	-	-	-	-	-	-	4	t	-	t
Epidote	-	-	-	-	-	-	8	t	t	-	1
Actinolite	-	-	-	-	-	-	-	-	51	22	10
Zoisite	-	-	-	-	-	-	-	-	-	11	-
Apatite	t	t	1	t	t	t	t	-	t	t	t
Zircon	t	t	t	t	t	t	t	t	t	t	t
Tourmaline	t	t	t	t	t	t	t	t	-	-	-
Sphene	-	-	-	-	-	-	3	1	1	1	2
Allanite	-	-	-	-	-	-	-	-	-	t	-
Magnetite	t	t	t	t	t	t	t	t	t	t	-
Hematite[2]	t	t	t	t	t	t	-	t	-	-	t
Rutile	-	-	-	-	-	-	3	-	-	-	-
Pyrrhotite	-	-	-	-	-	-	-	-	-	-	16
Ilmanite	t	-	t	t	t	t	-	-	t	-	-
*Mol.% Anorthite[1]	?	Olg	38	27	27	40	78	77	70	-	72

t = trace amounts

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method.

[2]Hematite is a secondary mineral.

Schist

T-4. Well-foliated, gray-weathering, light-gray, plagioclase-biotite-quart-muscovite schist with local concentrations of small garnets of quartz lenses up to 1 inch thick. Specimen collected in a small road cut along a secondary road approximately 1500 feet south of the intersection where Route 341 abruptly turns eastward one half mile southeast of Kent center.

824. Well-foliated, gray, tan-weathering, garnet-staurolite-sillimanite-muscovite-biotite-quartz feldspathic schist. Specimen collected on the east slope of the northernmost hill top of Golf Course Hill approximately 2000 feet south-southeast of road intersection 730, 50 feet west of the state park boundary near Lake Waramaug.

911. Well-foliated, reddish tan-weathering, light-gray, microcline-sillimanite-plagioclase-muscovite-biotite-quartz schist with sillimanite nodules up to 1/2 inch across. Specimen collected on the Lake Waramaug State Park boundary on Golf Course Hill approximately 2500 feet north-northwest of road intersection 695.

1186. Well-foliated, light-gray, or gray, coarse-grained, microcline-sillimanite-muscovite-garnet-biotite-plagioclase-quartz schist. Specimen collected on the west slope of Peet Hill adjacent to a secondary road approximately 1000 feet south of road intersection 528 at an elevation of 580 feet in the central part of the Kent quadrangle.

1842-b. Well-foliated, light-gray, tan-weathering, microcline-sillimanite-plagioclase-muscovite-biotite-quartz gneissic schist with abundant thin quartz lenses. Specimen collected in a road cut east of a conspicuous hairpin curve on Route 341 east of Kent center approximately 3000 feet west of B.M. 977 on Route 341.

2323-b. Well-foliated, gray, microperthite-garnet-sillimanite-plagioclase-muscovite-biotite-quartz schist with thin irregular quartz lenses. Specimen collected at the north slope of a small hill bordering the west shore of Hatch Pond east of Spooner Hill located in the west part of the Kent quadrangle.

2323-c. Well-foliated, gray, tan-weathering, sillimanite-garnet-plagioclase-muscovite-quartz-biotite-schist. Same location as #2323-b.

3112-c. Well-foliated, light-gray, tan-weathering, sillimanite-muscovite-quartz-plagioclase-biotite schist with abundant sillimanite nodules 1/8 inch across. Specimen collected south of Route 341 approximately 1000 feet north of the northernmost cabin of Camp Leonard Leonore at an elevation of 450 feet.

3544. Well-foliated, light-gray or gray, kyanite-staurolite-sillimanite-garnet-biotite-muscovite quartzose schist with garnet crystals up to 1/2 inch across. Specimen collected approximately 1000 feet southeast of the summit of Mauwee Peak in the north part of the Kent quadrangle.

Granulite

805. Poorly foliated, light-gray, muscovite-biotite-quartz-microcline granulite. Specimen collected on the north tip of Golf Course Hill approximately 1000 feet south-southeast of road intersection 730 near Lake Waramaug.

806. Well-foliated, gray, tan-weathering, quartz-biotite-muscovite-microcline granulite. Specimen collected on the northeast tip of Golf Course Hill approximately 1500 feet south-southeast of road intersection 730 near Lake Waramaug.

808. Well-foliated, gray, quartz-muscovite-biotite-feldspathic schistose granulite. Specimen collected on the north tip of Golf Course Hill approximately 1500 feet south of road intersection 730 near Lake Waramaug.

921. Poorly foliated, gray, muscovite-biotite-feldspar-quartz micaceous granulite. Specimen collected on a small knob on the east slope of Golf Course Hill approximately 400 feet north of the southern boundary of Lake Waramaug State Park.

1837. Well-foliated, gray, tan-weathering, plagioclase-biotite-quartz-muscovite schistose gneiss with numerous thin quartz lenses up to 1/2 inch thick. Specimen collected in a large road cut adjacent to Hatch Pond approximately 3500 feet north along the secondary road from South Kent center in the western part of the Kent quadrangle.

2163. Massive, gray or dark-gray, quartz-biotite-plagioclase-garnetiferous granulite with quartz lenses up to 1 inch thick. Specimen collected on the south slope of The Cobble approximately 1500 feet northeast of B.M. 415 on Route 341 at an elevation of 760 feet.

Calc-silicate

815. Poorly foliated, dark-gray and pale white, biotite-epidote-diopside-hornblende-plagioclase-quartz calc-silicate rock. Specimen collected on the northernmost hill top of Golf Course Hill approximately 2000 feet south-southeast of road intersection 730 near Lake Waramaug.

877. Poorly foliated, light-green and gray, diopside-hornblende-plagioclase-quartz calc-silicate rock. Specimen collected on the eastern slope of the northernmost hill top of Golf Course Hill approximately 2000 feet south-southeast of road intersection 730 near Lake Waramaug.

877-a. Massive, dark-greenish gray and pale white, quartz-plagioclase-actinolite calc-silicate rock. Same location as #877.

880. Poorly foliated, light-green and gray, muscovite-zoisite-actinolite-quartz-microcline calc-silicate rock. Specimen collected on the west slope of the northernmost hill top of Golf Course Hill approximately 2500 feet south-southeast of road intersection 730 near Lake Waramaug.

2601. Massive, dark-gray, quartz-actinolite-diopside-pyrrhotite-plagioclase calc-silicate rock with irregular quartz lenses up to 1/2 inch thick. Specimen collected under the Route 7 bridge on the Housatonic River connecting Merwinsville and Gaylordsville in the southwest quarter of the Kent quadrangle.

TABLE 9. Estimated Modes of the Schistose Granulite Member of the Manhattan C Siliceous Gneiss

+Specimen	1323	1844-b	1844-d1	1844-d2	1844-d3	1844-f	1852-b	2869-a
Quartz	40	26	39	36	43	43	34	41
*Plagioclase	31	20	3	8	14	22	34	28
Potassium feldspar								
Microcline	t	28	30	32	24	14	-	-
Orthoclase	-	-	-	-	-	-	7	-
Muscovite	t	5	11	9	10	2	8	2
Biotite	29	18	16	13	5	18	17	29
Chlorite	-	-	-	t	2	t	t	-
Calcite	-	-	t	-	-	t	-	-
Epidote	-	3	1	2	2	1	-	-
Apatite	t	t	t	t	t	t	t	t
Zircon	t	t	t	t	t	t	t	t
Tourmaline	-	-	-	-	-	t	-	-
Sphene	-	-	t	-	t	t	t	-
Allanite	-	t	t	t	t	-	-	-
Magnetite	t	t	t	-	t	t	t	t
Hematite[2]	t	t	t	t	t	t	t	t
Ilmenite	t	t	t	t	-	t	-	t
Rutile	-	t	-	-	-	t	t	-
*Mol% Anorthite[1]	31	28	Olg	7	8	33	26	35

t = trace amounts

+Specimen location on Plate 1.

TABLE 9. (Continued)

	Siliceous Gneiss					Schistose Gneiss					
Specimen	3328	3387	3490	3512	3529	1842-c	1844-a	1850-b	1851-c	1853	2883
Quartz	32	34	41	47	48	28	40	31	30	35	31
*Plagioclase	37	19	25	29	28	22	17	30	23	35	28
Microcline	-	19	-	-	-	-	t	t	-	-	t
Muscovite	-	9	18	-	-	23	5	4	10	6	17
Biotite	30	17	16	19	22	25	29	33	23	20	24
Chlorite	-	-	-	-	t	-	-	t	t	t	-
Garnet	-	-	-	1	-	1	1	1	2	1	-
Sillimanite	-	-	-	-	-	1	4	1	12	-	-
Apatite	t	t	t	t	t	t	t	t	t	t	t
Zircon	t	t	t	t	t	t	t	t	t	t	t
Tourmaline	-	-	-	t	-	-	1	t	t	t	-
Sphene	t	2	-	-	-	-	-	-	-	-	-
Allanite	t	t	-	t	t	-	-	-	-	-	-
Magnetite	t	t	t	2	t	t	3	t	t	3	t
Hematite[2]	t	t	t	t	t	t	-	t	t	t	t
Ilmenite	t	-	-	t	t	-	-	t	t	t	t
Rutile	t	-	t	t	-	-	-	-	-	-	-
Pyrite	-	-	-	-	-	-	-	-	-	t	-
*Mol% Anorthite[1]	33	24	32	82	81	37	32	25	42	31	26

t = trace amounts

TABLE 9. (Continued)

	Schist							Thin-Layered Gneiss	
Specimen	1844-c	1844-g	1850-a	1851-a	1852-c	1852-d	2869-b	3560	3146
Quartz	17	23	8	20	14	10	16	7	30
*Plagioclase	18	21	17	19	31	10	5	5	41
Microcline	-	2	-	11	-	-	-	30	-
Muscovite	38	28	42	17	29	37	20	31	7
Biotite	20	26	28	31	25	36	27	27	22
Chlorite	t	-	-	-	t	-	-	-	-
Garnet	-	-	1	-	-	2	4	-	-
Sillimanite	t	-	t	-	-	5	7	-	-
Hornblende	-	-	-	-	t	-	-	-	-
Epidote	-	-	-	2	-	-	-	-	-
Apatite	t	t	t	t	1	t	t	t	t
Zircon	t	t	t	t	t	t	t	t	t
Tourmaline	-	t	-	-	t	t	-	t	-
Sphene	-	-	-	t	-	t	-	-	-
Allanite	-	-	-	t	-	t	-	-	-
Magnetite	6	t	3	t	t	t	4	-	t
Hematite[2]	t	t	t	t	t	t	t	t	t
Ilmenite	t	t	t	t	t	t	-	t	-
Rutile	t	t	t	t	-	t	-	-	t
Pyrite	-	-	t	t	-	-	-	-	-
*Mol% Anorthite[1]	32	41	25	32	Olg	25	37	28	25

t = trace amounts

TABLE 9. (Continued)

Specimen	Calc-silicate 1844-e	Calc-silicate 1851-b	Hornblende Gneiss 1842-a	Hornblende Gneiss 1852-a
Quartz	54	57	24	20
*Plagioclase	-	6	11	20
Potassium feldspar				
Microcline	-	17	-	-
Orthoclase	1	-	-	-
Muscovite	t	3	t[2]	-
Biotite	3	t	-	1
Chlorite	t	t	t	-
Garnet	-	-	2	-
Hornblende	13	8	31	50
Cummingtonite	-	-	29	-
Calcite	-	-	t[2]	-
Epidote	28	8	t[2]	-
Apatite	t	-	t	t
Zircon	t	t	t	t
Tourmaline	-	-	-	-
Sphene	1	1	-	1
Allanite	t	t	t	-
Magnetite	-	-	1	8
Pyrrhotite	t	t	-	-
Hematite[2]	t	t	t	t
Ilmenite	-	-	2	t
Rutile	t	t	-	t
Pyrite	t	t	-	-
*Mol. % Anorthite[1]	-	5	80	47

t = trace amounts

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method. If untwinned plagioclase the composition is generalized as indicated by name based on relative relief and optic sign.

[2]Mineral of secondary origin.

Siliceous Gneiss

1323. Poorly foliated, gray biotite-plagioclase-quartz micaceous gneiss. Specimen collected in a small stream eat of Ore Hill approximately 1000 feet northwest of B.M. 1155 at an elevation of 1040 feet in the central part of the Kent quadrangle.

1844-b. Massive or poorly foliated, light-gray, muscovite-biotite-plagioclase-quartz microcline micaceous gneiss. Specimen collected in a road cut on Route 341 near Bald Hill approximately 2000 feet northeast of road intersection 1198.

1844-d1 Massive or poorly foliated, light-gray or gray, muscovite-biotite-microcline-quartz micaceous gneiss with abundant quartz lenses up to 1/2 inch thick. Same location as #1844-b.

1844-d2 Massive or poorly foliated, light-gray or gray, plagioclase-muscovite-biotite-microperthite-quartz micaceous granulite. Same location as #1844-b.

1844-d3 Poorly foliated, light-gray, biotite-muscovite-plagioclase-microcline-quartz micaceous gneiss. Same location as #1844-b.

1844-f. Well-foliated, light-gray or gray, microperthite-biotite-plagioclase-quartz micaceous gneiss with abundant quartz lenses up to 1/2 inch thick. Same location as #1844-b.

1852-b. Well-foliated, gray, thinly layered, orthoclase-muscovite-biotite-plagioclase-quartz micaceous gneiss. Specimen collected in a road cut along Route 341 northwest of East Kent Village approximately 250 feet southwest of elevation marker 1171 in the northwest quarter of the Kent quadrangle.

2869-a. Well-foliated, gray, plagioclase-biotite-quartz micaceous gneiss. Specimen collected in a stream flowing between

Segar and Bull mountains at an elevation of 870 feet, in the northwest-central part of the quadrangle.

3328. Well-foliated, gray, biotite-quartz-micaceous gneiss. Specimen collected on the western part of the Geer Mountain approximately 1200 feet northwest of B.M. 1160 in the north-central part of the Kent quadrangle.

3387. Well-foliated, light-gray, muscovite-biotite-quartz micaceous gneiss. Specimen collected north of Route 341 on the western part of Kent Mountain on the base of a ridge approximately 2000 feet north-northwest from B.M. 977 on Route 341 in the north-central part of the Kent quadrangle.

3490. Poorly foliated, light-gray, biotite-muscovite-plagioclase-quartz micaceous gneiss with abundant augen of plagioclase-quartz-muscovite up to 1/8 inch across. Specimen collected adjacent to the western swamp from which Mauwee Brook flows, approximately 500 feet west-northwest from road intersection 1277 on Gorham Road in the northern part of the Kent quadrangle.

3512. Massive, gray or dark-gray, epidote-biotite-plagioclase-quartz micaceous gneiss. Specimen collected in Mauwee Brook at an elevation of 1020 feet, in the north part of the Kent quadrangle.

3529. Poorly foliated, gray or dark-gray, biotite-plagioclase-quartz micaceous gneiss. Specimen collected on Mauwee Peak hill top approximately 250 feet northwest of the summit in the northern part of the Kent quadrangle.

Schistose Gneiss

1842-c. Well-foliated, gray, sillimanite-muscovite-plagioclase-biotite-quartz schistose gneiss with quartz lenses up to 1/2 inch thick. Specimen collected in a road cut on Route 341 near Bald Hill approximately 2000 feet northeast of road intersection 1198.

1844-a. Well-foliated, gray microcline-sillimanite-muscovite-plagioclase-biotite-quartz schistose gneiss with quartz lenses up to 1/2 inch thick. Specimen collected in a road cut on Route 341 near Bald Hill approximately 2000 feet northeast of road intersection 1198.

1850-b. Well-foliated, light-gray or gray, microcline-sillimanite-garnet-muscovite-plagioclase-quartz-biotite schistose gneiss with irregular quartz lenses up to 1/4 inch thick. Specimen collected in a road cut on Route 341 in East Kent Village approximately 500 feet southwest of road intersection 1177 in the northwest quarter of the Kent quadrangle.

1851-c. Well-foliated, gray and dark-gray, muscovite-sillimanite-plagioclase-biotite-quartz schistose gneiss with abundant thin quartz lenses. Specimen collected in a road cut on Route 341 near East Kent Village approximately 750 feet northwest of road intersection 1177 in the northwest quarter of the Kent quadrangle.

1853. Well-foliated, gray, muscovite-biotite-plagioclase-quartz schistose gneiss with abundant quartz lenses up to 1/2 inch thick. Specimen collected in a road cut on Route 341 northwest of East Kent Village approximately 200 feet north of elevation marker 1171.

2883. Well-foliated, gray, muscovite-biotite-plagioclase-quartz schistose gneiss with quartz lenses up to 1 inch thick. Specimen collected on the southern hill top area of Segar Mountain approximately 2500 feet east-northeast of B.M. 397 at an elevation of 1040 feet in the northwest-central part of the Kent quadrangle.

Schist

1844-c. Well-foliated, light-gray or gray, sillimanite-quartz-plagioclase-biotite-muscovite schist with abundant quartz lenses up to 1 inch thick. Specimen collected in a road cut on Route 341 near Bald Hill approximately 2000 feet northeast of road intersection 1198.

1844-g. Well-foliated, light-gray and gray, plagioclase-quartz-biotite-muscovite schist with quartz-feldspar porphyroblast up to 3/4 inch across. Same location as #1844-c.

1850-a. Well-foliated, light-gray or gray, sillimanite-garnet-quartz-plagioclase-biotite-muscovite schist. Specimen collected in a road cut on Route 341 in East Kent Village approximately 500 feet southwest of road intersection 1177 in the northwest quarter of the Kent quadrangle.

1851-a. Well-foliated, light-gray or gray, microperthite-muscovite-plagioclase-quartz-biotite schist. Specimen collected in a road cut on Route 341 near East Kent Village approximately

750 feet northwest of road intersection 1177 in the northwest quarter of the Kent quadrangle.

1852-c. Well-foliated, gray, tan-weathering, coarse-grained, quartz-biotite-muscovite-plagioclase schist. Specimen collected in a road cut along Route 341 northwest of East Kent Village approximately 250 feet southwest of elevation marker 1171 in the northwest quarter of the Kent quadrangle.

1852-d. Well-foliated, gray, sillimanite-plagioclase-quartz-biotite-muscovite schist with abundant thin quartz-feldspar lenses. Same location as #1852-c.

2869-b. Well-foliated, gray, garnet-sillimanite-quartz-biotite schist. specimen collected in a stream flowing between Segar and Bull Mountains at an elevation of 870 feet in the northwest-central part of the Kent quadrangle.

3560. Well-foliated, gray, quartz-biotite-muscovite-feldspar schist. Specimen collected within Wyantenock State Forest approximately 1000 feet west of Gorham Road on the southwest slope of the northeast-trending ridge at an elevation of 1410 feet in the northern part of the Kent quadrangle.

Thin-Layered Gneiss

3146. Well-foliated, well-layered, light-gray and black, muscovite-biotite-quartz-plagioclase schistose gneiss with light-gray plagioclase-bearing elongate augen up to 1/4 inch across. Specimen collected on the south slope of Bull Mountain approximately 2000 feet northeast of South Kent Village at an elevation of 950 feet in the west-central part of the Kent quadrangle.

Calc-silicate

1844-c. Massive or poorly foliated, light-gray and green, orthoclase-hornblende-pistacite-quartz calc-silicate rock. Specimen collected in a road cut on Route 341 near Bald Hill approximately 2000 feet northeast of road intersection 1198.

1851-b. Massive or poorly foliated, light-gray, plagioclase-hornblende-pistacite-microcline-quartz calc-silicate rock.

Specimen collected in a road cut on Route 341 near East Kent Village approximately 750 feet northwest of road intersection 1177 in the northwest quarter of the Kent quadrangle.

Hornblende Gneiss

1842-a. Massive, dark-gray, plagioclase-quartz-cummingtonite-hornblende amphibolite. Specimen collected in a road cut east of a conspicuous hairpin curve on Route 341 east of Kent Village approximately 3000 feet west of B.M. 977 on Route 341.

1852-a. Well-foliated, dark-greenish gray, plagioclase-quartz amphibolite. Specimen collected in a road cut along Route 341 northwest of East Kent Village approximately 250 feet southwest of elevation marker 1171 in the northwest quarter of the Kent quadrangle.

TABLE 10. Estimated Modes of the Amphibolite Member and The Above All Member of the Manhattan C

	Amphibolite Member					Above All Member
+Specimen	1843-a	1843-b	2853-a	2853-b	2912	3907
Quartz	21	19	6	13	15	10
*Plagioclase	22	18	35	35	18	4
Microcline	-	-	-	-	-	-
Muscovite	-	-	-	-	-	55
Biotite	1	1	-	-	3	30
Chlorite	t	t	-	-	1	-
Garnet	-	-	2	7	-	-
Hornblende	45	51	51	37[2]	63	-
Cummingtonite	-	-	-	4	t	-
Pistacite	-	3	-	-	-	-
Calcite[3]	-	-	-	2	-	-
Tourmaline	-	-	-	-	-	t
Apatite	t	t	t	t	t	t
Zircon	t	t	t	t	t	t
Sphene	11	8	-	-	-	-
Allanite	-	t	-	-	-	-
Magnetite	t	t	6	2	t	t
Hematite[3]	-	t	-	t	t	t
Rutile	t	-	t	-	-	-
Ilmenite	-	-	-	-	-	t
*Mol. % Anorthite[1]	38	31	35	33	37	26

t = trace amounts

+Specimen location on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method.

[2]Some hornblende crystals with cummingtonite exsolution lamellae.

[3]Mineral of secondary origin.

Amphibolite Member

1843-a. Well-foliated, thinly layered, dark-greenish gray, sphene-quartz-plagioclase amphibolite. Specimen collected in a road cut on Route 341 near Balk Hill approximately 1500 feet northeast from road intersection 1198 in the northeast part of the Kent quadrangle.

1843-b. Massive or poorly foliated, black and white, pistacite-sphene-plagioclase-quartz amphibolite. Same location as #1843-a.

2853-a. Massive, black, garnet-quartz-plagioclase amphibolite with conspicuous garnets 1/8 inch across with plagioclase rims. Specimen collected in a cut on a trail along the west slope of Bull Mountain at an elevation of 710 feet in the west-central part of the Kent quadrangle.

2853-b. Massive or poorly foliated, black or dark-greenish gray, cummingtonite-garnet-quartz-plagioclase-hornblende amphibolite with garnet-bearing lenses up to 1/2 inch thick. Same as location #2853-a.

2912. Poorly foliated, black and white, quartz-plagioclase amphibolite. Specimen collected along a prominent gully on the east side of southern hill top of Segar Mountain approximately 1000 feet west-northwest of the swamp between Bull and Segar Mountains at an elevation of 1000 feet.

Above All Member

3907. Well-foliated, gray or dark-gray, tan-weathering, plagioclase-quartz-biotite-muscovite schist. Specimen collected on a trail adjacent to the west shore of Straits Pond approximately 250 feet north of the house indicated on the map in the northwestern part of the Kent quadrangle.

TABLE 11. Estimated Modes of the Moretown Formation

+Specimen	Schist and Granulites 857-a	857	Amphibolite 859
Quartz	85	44	13
Plagioclase	5[1]	-	14
Muscovite	2	40	-
Biotite	2	3	-
Chlorite	1	8	-
Garnet	-	5	-
Epidote	2	-	3
Hornblende	-	-	68
Actinolite	1	-	-
Apatite	t	t	t
Zircon	t	t	t
Sphene	t	-	2
Tourmaline	-	t	-
Hematite	t	t	t
Magnetite	1	t	t
Pyrite	1	-	t
Rutile	-	-	t

t = trace amount

+Specimen location on Plate 1.

[1]Composition of untwinned plagioclase estimated as labradorite on basis of relative relief and optic sign.

[2]Hematite is a secondary mineral.

857-a. Massive, glassy, gray, epidote-biotite-muscovite-plagioclase quartzite. Specimen collected in a stream east of B.M. 360, on Route 25 north of Northville, at an elevation of 790 feet in the southeast part of the Kent quadrangle.

857. Well-foliated, tan or light-gray, laminated, biotite-garnet-chlorite-muscovite-quartz schist. Specimen collected in the same stream as in #856-a at an elevation of 770 feet.

Amphibolite

859. Well-foliated, dark-gray or black, quartz-plagioclase amphibolite with micro-layers of light-tan or white quartz and feldspar. Specimen collected in the same stream as in #856-a at an elevation of 730 feet.

TABLE 12. Estimated Modes of the Augen Gneiss Unit of The Precambrian Granitic Gneiss and The Ultramafic Rock Unit

	Augen Gneiss											Ultramafic Rock
+Specimen	T-10	T-11	T-12	11	52	193	261	530	535	753	761	4302
Quartz	47	32	27	27	31	21	26	31	24	21	15	-
*Plagioclase	25	7	3	t	27	30	22	28	34	39	43	-
Microcline	16	53	66	62	26	34	35	32	32	16	26	-
Muscovite[2]	4	3	1	3	t	-	t	-	3	t	t	-
Biotite	8	5	2	7	11	12	12	8	7	19	11	-
Chlorite	-	t	-	-	-	t	t	-	t	-	t	1
Olivine	-	-	-	-	-	-	-	-	-	-	-	38
Serpentine	-	-	-	-	-	-	-	-	-	-	-	19
Pistacite	t	t	-	t	2	2	4	-	t	2	3	-
Calcite	t	-	-	-	-	-	-	-	-	-	-	1
Hastingsite[3]	-	-	-	-	1	-	t	-	-	t	t	-
Flourite	-	-	-	-	-	-	-	-	-	t	-	-
Talc	-	-	-	-	-	-	-	-	-	-	-	22
Anthophyllite	-	-	-	-	-	-	-	-	-	-	-	17
Apatite	t	t	t	t	t	-	t	1	t	t	t	t
Zircon	t	t	t	t	t	-	t	t	t	t	t	-
Sphene	t	t	-	1	2	1	1	t	t	3	2	-
Tourmaline	t	-	-	-	-	-	-	-	-	-	-	-
Allanite	-	-	t	t	t	-	t	t	t	t	t	-
Hematite[2]	t	t	t	t	t	t	t	t	t	t	t	t
Magnetite	t	t	t	t	t	t	t	t	t	t	t	2
Chromite	-	-	-	-	-	-	-	-	-	-	-	t
Pyrite	t	-	-	-	-	-	-	-	-	-	t	t
Ilmenite	t	t	t	t	t	t	t	-	t	t	t	-
*Mol.% Anorthite[1]	Olg	33	34	?	33	And	29	Olg	4	8	3	-

t = trace amounts +Specimen location on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method. If untwinned plagioclase the composition is generalized as indicated by name based on relative relief and optic sign.

[2]Secondary mineral.

[3]Hastingsite determined by 2V approximately 20°.

Augen Gneiss

T-10. Well-foliated, alternate layers of light-gray and black, biotite-microcline-plagioclase-quartz gneiss with local augen of plagioclase and microcline up to 1/2 inch across. Specimen is located in a road cut approximately 2000 feet west of the intersection of Routes 7 and 341, in Kent along Route 341.

T-11. Well-foliated, alternate layers of pink and black, biotite-plagioclase-quartz-microcline augen gneiss with microcline augen up to 3/4 inch across. Same location as #T-10.

T-12. Well-foliated, pink, biotite-plagioclase-quartz-microcline augen gneiss with microcline augen up to 1 inch across. Same location as #T-10.

11. Well-foliated, pink and black, biotite-quartz-microcline augen gneiss with microcline augen up to 1/2 inch across. specimen located approximately 1000 feet west of road intersection 496 in Marble Dale in the southeast quarter of the Kent quadrangle.

52. Well-foliated, pink and black, ferrohastingsite-sphene-pistacite-biotite-microcline-plagioclase-quartz augen gneiss with augen of microcline up to 1/4 inch across. Specimen located approximately 3000 feet southeast of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

193. Well-foliated, light-pink or tan and gray, pistacite-biotite-quartz-plagioclase-microcline augen gneiss with scattered augen of quartz and microcline up to 1/2 inch across. Specimen located approximately 2000 feet southwest of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

261. Well-foliated, coarse-grained, pink and black, pistacite-biotite-plagioclase-quartz-microcline gneiss with augen of quartz, microcline, and plagioclase up to 1/2 inch across. Specimen located approximately 4000 feet west of the New Milford Church in the southeast quarter of the Kent quadrangle.

530. Well-foliated, pink and gray, biotite-plagioclase-quartz-microcline augen gneiss with few pink augen of microcline up to 1/2 inch across. Specimen located approximately 1500 feet west of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

535. Poorly foliated, pink and gray, biotite-quartz-microcline-plagioclase gneiss. Specimen located approximately 350 feet north of the summit of Bear Hill in the southeast quarter of the Kent quadrangle.

753. Well-foliated, pink and black, coarse-grained, pistacite-sphene-microcline-biotite-quartz-plagioclase augen gneiss with augen of microcline and quartz up to 1/2 inch across. Specimen located approximately 1000 feet north-northeast of the summit of Sugar Loaf Hill in the eastern part of the Kent quadrangle.

761. Well-foliated, pink and black, coarse-grained, biotite-quartz-microcline-plagioclase augen gneiss with augen of quartz, microcline and plagioclase up to 1/2 inch across. Specimen located in a road cut approximately 1000 feet south of road intersection 604 northwest of Sugar Loaf Hill in the easternmost part of the Kent quadrangle.

Ultramafic Rock

4302. Massive, coarse-grained, gray, anthophyllite-olivine ultramafic rock with serpentine and talc. Specimen located approximately 2000 feet north of Macedonia in the northwest quarter of the Kent quadrangle.

TABLE 13. Estimated Modes of the Pink Granitic Gneiss of The Precambrian Granitic Gneiss Unit

	Granitic Gneiss													Muscovite Gneiss	
+Specimen	T-1	19	171	177	279	302	327	335	422	563	578	610-A	743	324	437
Quartz	42	30	44	48	35	36	30	42	40	25	47	38	26	33	53
*Plagioclase	t	9	19	11	24	17	13	6	16	18	22	25	25	1	22
Microcline	46	57	33	39	35	38	55	48	39	54	30	25	41	54	5
Muscovite	4[2]	1[2]	-	t[2]	-	t[2]	1[2]	1[2]	1[2]	-	t[2]	-	-	12	17
Biotite	3	1	4	2	5	8	1	3	3	1	1	9	3	t	2
Chlorite	-	1	t	t	t	t	-	t	t	1	t	-	t	-	t
Garnet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Epidote	t	t	t	t	t	-	t	t	t	t	-	t	t	-	-
Hornblende	-	-	-	-	-	-	t	-	t	1[3]	-	1[3]	-	-	-
Flourite	1	t	t	-	-	-	t	-	t	-	t	t	-	-	t
Apatite	t	t	t	t	t	t	t	t	-	-	t	t	t	t	t
Zircon	t	t	t	t	t	t	t	t	-	t	t	t	t	t	t
Sphene	t	-	t	t	1	1	t	t	t	t	t	2	t	-	-
Tourmaline	t	-	t	-	-	-	-	-	-	-	-	-	-	-	t
Allanite	1	1	t	t	t	-	-	t	t	t	t	t	2	t	-
Hematite[2]	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t
Magnetite	3	t	t	t	t	t	t	t	t	t	t	t	3	t	t
Ilmenite	t	t	t	t	t	-	t	t	t	t	t	-	t	t	t
*Mol% Anorthite[1]	?	33	33	32	30	5	Ab	12	9	7	8	15	12	11	11

t = trace amounts

+Specimen location on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method. If untwinned plagioclase the composition is generalized by name based on relative relief and optic sign.

[2]Secondary mineral.

[3]Hastingsite, determined by 2V approximately 20°.

Granitic Gneiss

T-1. Well-foliated, pink or light-gray, biotite-quartz augen gneiss with augen of microcline up to 1/4 inch across. Specimen collected approximately 3000 feet southwest of Northville center along the east slope of Mt. Tom in the southeast quarter of the Kent quadrangle.

19. Poorly foliated, pink, biotite-plagioclase-quartz-microcline gneiss with thin magnetite lenses and quartz lenses. Specimen collected approximately 1000 feet south of road intersection 711 in Marble Dale in the southeast quarter of the Kent quadrangle.

171. Well-foliated, pink, tan-weathering, biotite-plagioclase-microcline-quartz gneiss. Specimen collected on a ridge approximately 500 feet west of the southern part of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

177. Poorly foliated, pink and tan, biotite-plagioclase-microcline-quartz gneiss. specimen collected on a ridge approximately 1000 feet west of the southern part of Ella Fohs Camp Pond in the southeast quarter of the Kent quadrangle.

279. Poorly foliated, pale pink or tan, biotite-plagioclase-microcline-quartz gneiss. Specimen collected approximately 3000 feet west of the New Milford Church in the southeast quarter of the Kent quadrangle.

302. Poorly foliated, pink and light-gray, biotite-plagioclase-microcline-quartz micaceous gneiss with small feldspar augen up to 1/8 inch across. Specimen collected approximately 3000 feet west of the New Milford Church in the southeast quarter of the Kent quadrangle.

327. Massive to poorly foliated, pink, biotite-plagioclase-quartz-microcline gneiss. Specimen collected adjacent to a topographic depression approximately 3500 feet west of Northville center in the southeast quarter of the Kent quadrangle.

335. Poorly foliated, pink, biotite-plagioclase-quartz-microcline gneiss with scattered augen of quartz and microperthite up to 1/4 inch across. Specimen collected approximately 3000 feet west-southwest of Northville center in the southeast quarter of the Kent quadrangle.

422. Massive or weakly foliated, pink, biotite-plagioclase-microcline-quartz gneiss. Specimen collected approximately 2000 feet north-northeast of Strastrom Pond in the southeast quarter of the Kent quadrangle.

563. Well-foliated, orange-pink, well-jointed with associated secondary mineralization, hastingsite-chlorite-plagioclase-quartz-microcline gneiss. Specimen collected approximately 1000 feet north-northwest of road intersection 711 in Marble Dale along the easternmost slope of Bear Hill in the southeast quarter of the Kent quadrangle.

578. Massive or poorly foliated, pink, biotite-plagioclase-microcline-quartz gneiss. Same location as #563.

610-a. Well-foliated, well-layered, pink and gray, biotite-microcline-plagioclase-quartz gneiss with local pink feldspar-quartz augen up to 1/4 inch across. Specimen collected approximately 1000 feet north of road intersection 711 west of Marble Dale in the southeast quarter of the Kent quadrangle.

743. Massive, pale pink or tan, biotite-plagioclase-quartz-microcline gneiss. Specimen collected approximately 1000 feet east of the summit of Sugar Loaf Hill in the easternmost part of the Kent quadrangle.

Muscovite Gneiss

324. Massive, pink or light-tan, plagioclase-muscovite-quartz-microcline gneiss with muscovite crystals up to 1/2 inch across. Specimen collected approximately 3000 feet west of Northville center in the southeast quarter of the Kent quadrangle.

437. Poorly foliated, light-tan or pink, garnet-biotite-microcline-muscovite-plagioclase-quartz gneiss. Specimen collected approximately 2000 feet north of Strastrom Pond on Iron Hill in the southeast quarter of the Kent quadrangle.

TABLE 14. Estimated Modes of the Candlewood Lake Pluton[3]

	Quartz Monzonite			Granite
+Specimen	1222	1748	1862	1316
Quartz	36	32	35	15
*Plagioclase	32	31	33	15
Microcline	27	20	30	40
Muscovite	2	1	t	7
Biotite	3	16	1	23
Chlorite	t	-	-	-
Garnet	-	-	1	-
Apatite	t	t	t	t
Zircon	t	t	t	t
Tourmaline	t	-	t	-
Imenite	t	t	t	t
Magnetite	t	t	t	t
Hematite[2]	t	t	t	t
Rutile	t	-	-	-
*Mol.% Anorthite[1]	17	15	11	27

t = trace amount

+Specimen located on Plate 1.

[1]Approximate composition of plagioclase feldspar in molecular % anorthite based on Michel-Levy method.

[2]Hematite is a secondary mineral.

[3]Plutonic classification based on Streckeisen (1967).

Quartz Monzonite

1222. Massive, light-pink or light-gray, muscovite-biotite quart monzonite. Specimen collected on the west slope of Peet Hill approximately 300 feet northeast of road intersection 528 in the central part of the Kent quadrangle.

1748. Massive or poorly foliated, muscovite-biotite quartz monzonite. Specimen collected in a stream on the southern border of the Kent quadrangle approximately 2000 feet east of Bass Road at an elevation of 450 feet.

1862. Massive, light-gray, muscovite-biotite-garnet-quartz monzonite. Specimen collected on the most southern of two knobs within a swamp east of Long Mountain, 3000 feet north-northwest of road intersection 742.

Granite

1316. Well-foliated, light-gray or pale pink, medium-grained, muscovite-quartz-biotite granite. Specimen collected north of Peet Hill 1100 feet northwest of B.M. 1062 and 1200 feet southwest of B.M. 1155 in the central part of the Kent quadrangle.

Appendix III. Correlation between the geologic units mapped within the Kent quadrangle for this study and the unit names used for the Bedrock Geological Map of Connecticut by Rodgers (1985). These differences derive from local usage of unit names by the author prior to the publication of the Bedrock Geological Map of Connecticut and differences in interpretation by the compiler of the State Bedrock Map. These correlations have been made based upon lithologic similarity and similar map pattern and unit occurrence. However, it should be noted that due to the scope of the State Bedrock Map, small units or lenses that were individually mapped in this study may not have been mapped out in the State Bedrock Map and were grouped together within a larger formation. Therefore all correlations, most notably those that are made between sub-members, are general in nature.

Authochthonous Metamorphic Rocks

		This study		Rodgers (1985)
Middle Ordovician	Manhatten A Formation	Omag- Granulite Member	Walloomsac Schist	Ow- Schist
Middle Ordovician	Manhatten A Formation	Omam- Marble Member	Walloomsac Schist	Owm- Basal Member
Cambrian and/ or Ordovician	Inwood Marble	O-Ꞓib- Member B	Stockbridge Marble	-Ꞓsb- Unit B
Cambrian and/ or Ordovician	Inwood Marble	O-Ꞓia- Member A (including all sub-members)	Stockbridge Marble	-Ꞓsa- Unit A O-Ꞓs- Marble
Cambrian	Lowerre Quartzite	-Ꞓlp- Peet Hill Member		-Ꞓd- Dalton Formation
Cambrian	Lowerre Quartzite	-Ꞓl- Quartzite		-Ꞓd- Dalton Formation

	This study	Rodgers (1985)
These correlations hold true for most of the quadrangle, excluding the Northwestern corner.		
Precambrian	p-Ꞓc- Calc-silicate	Ygs- Rusty Mica Schist and Gneiss
Precambrian	p-Ꞓha- Gray Hornblende Gneiss-Amphibolite	Ygh- Hornblende Gneiss and Amphibolite
Precambrian	p-Ꞓg- Gray Biotite Gneiss	Ygn- Layered Gneiss

Allochthonous Metamorphic Rocks

		This study	Rodgers (1985)
Middle Ordovician	Moretown Formation	Omo- Moretown Schist	Or- Ratlum Mountain Schist
Middle Ordovician	Moretown Formation	Omoa- Amphibolite Member	Or- Ratlum Mountain Schist

		This study		Rodgers (1985)
Cambrian	Manhatten C Formation	Including sub-members -Ꞓmcaa, -Ꞓmcgr, -Ꞓmca, -Ꞓmcsg and -Ꞓmcgn.	Manhatten Formation	Including sub-members -Ꞓma- Amphibolite Member and -Ꞓm- Manhatten Schist.

Igneous Rocks

	This study	Rodgers (1985)
Ordovician	Oc- Candlewood Lake Pluton	Og- Granitic Gneiss

	This study	Rodgers (1985)
These correlations hold true for most of the quadrangle, excluding the Northwestern corner.		
Pre-cambrian	p-Ꞓp- Pink Granitic Gneiss	Ygr- Pink Granitic Gneiss

Rock Units of the Kent Quadrangle

To be used with the Bedrock Geologic Map (Plate 2)

Igneous Rocks

Ordovician

Op | **Oc** — **Candle wood Lake Pluton** (Oc): Massive or foliated, light-gray, muscovite-biotite Quartz Monzonite. **Pegmatite** (Op) Country rock inclusions within the Pluton

Precambrian

p-Єpa — **Granitic Gneiss** (p-Єpa)

p-Єp — **Pink Granitic Gneiss** (p-Єp): Massive, pink, quartz-microcline gneiss

p-Єa — **Augen Gneiss** (p-Єa): Well foliatied, pink and black, biotite-quartz-microcline gneiss with abundant microcline augen

p-Єu — **Ultramafic Rock** (p-Єu): Coarse, massive, gray, olivine-anthophyllite rock with varied amounts of talc and serpentine

Stratigraphic Units

Autochthonous Rocks

Middle Ordovician

Manhatten A

Omag — **Granulite Member** (Omag): Well foliated, gray, biotite schistose granulite and Calc-silicate rock

Omam — **Marble Member** (Omam): Well foliated, tan weathering, calcite marble

Unconformity

Cambrian and/or Ordovician

Inwood Marble

O-Єib — **Member B** (O-Єib): Thin interbedded granulite, calc-silicate, calcite marble, and dolomite marble

O-Єia — **Member A** (O-Єia): White and gray dolomite marble

Subdivisions of Member A:

O-Єiad — (O-Єiad): White and gray dolomite marble

O-Єiaw — (O-Єiaw): White dolomite

O-Єiag — (O-Єiaq): Quartzite

O-Єiaq — (O-Єiag): Gray dolomite

Cambrian

Lowerre Quartzite

Єlp — **Peet Hill Member** (Єlp): Well foliated, gray, micaceous or schistose feldspathic granulite and calc-silicate

Єl — **Lowerre Quartzite** (Єl): Quartzite, micaceous granulite, schistose feldspathic granulite, schist, and minor calc-silicate rock

Unconformity

Precambrian

p-Єc — **Calc-silicate** (p-Єc): Massive, greenish black and white, biotite-diopside-hornblende calc-silicate rock and minor clacite marble

p-Єha — **Gray Hornblende Gneiss-Amphibolite** (p-Єha): Amphibolite and well foliated, gray, biotite-hornblende gneiss

p-Єg — **Gray Biotite Gneiss** (p-Єg): Well foliated, biotite-quartz-plagioclase gneiss

Allochthonous Rocks

Middle Ordovician

Omo / **Omoa** — **Moretown Formation** (Omo): Massive, glassy, micaceous quartzite and well foliated, gray, biotite-garnet-muscovite schist. Amphibolite Member (Omoa)

Cambrian

Manhatten C

Єmcaa — **Above All Member** (Єmcaa): Well foliated, mica-feldspar-quartz schist with abundant quartz and pegmatite lenses

Єmcgr — **Schistose Granulite Member** (Єmcgr): Massive or well foliated, gray, schistose gneiss, micaceous gneiss and granulite

Єmca — **Amphibolite Member** (Єmca): Massive, garnet-quartz-plagioclase amphibolite

Єmcsg — **Siliceous Granulite Member** (Єmcsg): Well foliated, tan-weathering, micaceous or schistose granulite, and quartzite

Єmcgn — **Schistose Gneiss Member** (Єmcgn): Well foliated, gray, schist with abundant sillimanite nodules

Appendix II: Descriptive rock chart of the Kent quadrangle.

Explanation: This chart lists physical properties of the rocks of each unit and it should be used with Plate 2. Rock unit: Description of unit; Variety percentage in unit: Major rock varieties in each unit with the approximate percentage of each variety relative to the whole unit; Color: Color of rock on freshly broken and weathered outcrop surfaces. Most common color listed first; Grain size: Approximate average grain size. Most common size listed first. Fine= < 1 mm.; medium= 1-4 mm.; coarse= 4-10 mm.; very coarse= greater than 10 mm; Minerals and percentages: Average percentage of major minerals in each rock type. Qtz.: Quartz, Plag.: Plagioclase, Micro.: Microcline, Bio.: Biotite, Musc.: Muscovite, Trem.: Tremolite, Chl.: Chlorite, Hbl.: Hornblende, Ep.: Epidote, Gar.: Garnet, Sphene: Sphene, Dolo.: Dolomite, Diop.: Diopside, Calc.: Calcite; Layering: Thickness of layering; Foliation: Quality and degree of development; Cut-slope stability: Qualitative estimate of outcrop stability on man-made rock cuts. Poor= significant deterioration within 25 years; moderate= significant deterioration 25-100 years; excellent= outcrop maintains shape indefinitely.

Rock Unit	Variety percentage of unit	Fresh Color	Weathered Color	Grain size	Minerals and percentages	Layering	Foliation	Cut-slope stability
Foliated gray gneiss	75% Gray biotite gneiss	Light-gray; gray; dark gray	Gray	Medium; fine	Qtz. : 30% Plag. : 30% Micro. : 18% Bio. : 12%	Thin; moderate; thick	Well developed; moderate; poor	Excellent; moderate
	25% Amphibolite (5%) and gray hornblende gneiss (20%)	Dark gray; gray; black	Gray; black	Medium; fine	Amphibolite: Plag. : 51% Hbl. : 34% Bio. : 7% Qtz. : 1% Gneiss: Plag. : 33% Hbl. : 24% Qtz. : 17% Bio. : 5%	Thick; moderate	Well developed; moderate; poor	Excellent; moderate
Calc-silicate	100%	Greenish black and white; gray	Greenish black; rusty	Medium; fine	Hbl. : 22% Bio. : 21% Diop. : 16% Ep. : 14%	Thick; moderate	Poor; moderate	Excellent; poor for rusty weathering layers
Granitic gneiss	65% Massive felsic gneiss	Pink	Tan; pink	Fine	Micro. : 42% Qtz. : 37% Plag. : 16% Bio. : 3%	Thick	Poor	Excellent
	35% Augen felsic gneiss	Pink and black	Tan and black; pink and black	Coarse	Micro. : 36% Qtz. : 28% Plag. : 24% Bio. : 7%	Thin	Well developed	Excellent; moderate
(Interlayered) Granulite and schist	100% Granulite	Buff; gray	Buff; gray; reddish tan	Medium; fine	Qtz. : 58% Micro. : 32% Musc. : 8% Bio. : 6%	Thin; thick	Well developed	Excellent
	Schist	Light-gray; gray	Tan; light-gray	Coarse; medium	Musc. : 44% Bio. : 22% Qtz. : 12% Plag. : 11% Micro. : 11%	Thick	Well developed	Moderate
Marble	75% Dolomite marble	White; gray; tan	White; gray; tan	Fine; mediuim	Dolo. : 75% Diop. : 4% Calc. : 3% Trem. : 3%	Thick; thin	Poor; moderate	Excellent; poor for calcite marble layers
	25% Calcite marble	White; tan	Orange-tan	Fine; medium	Calc. : 60% Micro. : 7% Diop. : 6% Trem. : 5%	Thin; thick	Well developed; poor	Poor; moderate
Schistose granulite	100%	Dark-gray; tan to gray	Dark-gray; rusty	Fine; medium	Qtz. : 28% Bio. : 27% Plag. : 25% Micro. : 11%	Thick; thin	Moderate; poor	Moderate; poor for rusty weathering layers
Schistose granulite	45% Schist	Tan; light-gray	Tan; light-gray	Coarse	Qtz. : 31% Bio. : 26% Musc. : 18% Plag. : 17%	Thick	Well developed	Moderate
	45% Schistose granulite	Gray; light-gray	Gray; light-gray	Fine; medium	Qtz. : 37% Plag. : 24% Bio. : 21% Musc. : 15%	Thick; moderate	Moderate	Excellent
	5% Schistose gneiss	Tan; light-gray	Tan; light-gray	Coarse	Musc. : 55% Bio. : 30% Qtz. : 10% Plag. : 4%	Thin	Well developed	Moderate
	5% Amphibolite	Black	Black; dark-gray	Medium	Hbl. : 49% Plag. : 26% Qtz. : 15% Sphene : 4%	Thick	Moderate; poor	Excellent
(Interlayered) Schist and granulite	90% Schist	Light-gray	Tan; light-gray	Medium	Qtz. : 44% Musc. : 40% Chl. : 8% Gar. : 5%	Thick; moderate	Well developed	Moderate
	Granulite	Gray; dark-gray	Gray	Fine	Qtz. : 85% Plag. : 5% Musc. : 2% Bio. : 2%	Thin	Poor	Excellent
	10% Amphibolite	Black	Black; dark-gray	Medium	Hbl. : 68% Plag. : 14% Qtz. : 13% Ep. : 3%	Thin	Well developed	Excellent
Quartz monzonite	100%	Gray; light-gray	Tan; light-gray	Medium; fine	Qtz. : 34% Plag. : 32% Micro. : 25% Bio. : 6%	Thick	Moderate; poor	Excellent