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Metamorphic Geology of the Collinsville Area

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Trip D-4

METAMORPHIC GEOLOGY OF THE COLLINSVILLE AREA

by

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INTRODUCTION

Purpose

Geological work in the southern portion of Massachusetts and the southeastern portion of western Connecticut since 1964 has uncovered a variety of information that requires a new interpretation of the stratigraphy and structure in the Collinsville quadrangle. It is the intent of this trip to study the geology of this area in the light of this new information and to relate the structure and stratigraphy to the geology of the region.

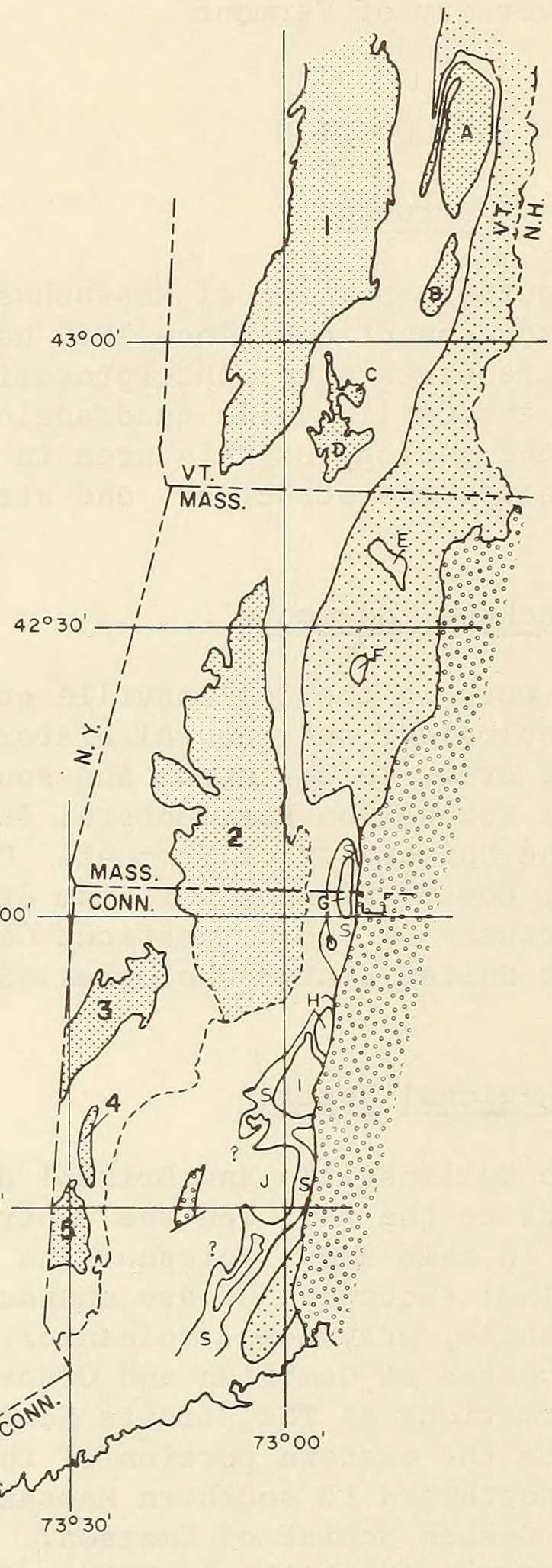
Acknowledgements

Support for the original work in the Collinsville quadrangle was provided by the Connecticut Geological and Natural History Survey. Subsequent work here and other areas to the north and south have been provided by a National Science Foundation Postdoctoral Fellowship and an institutional grant from the University of Vermont. Conferences with Robert Schnabel, Norman Hatch, Edward Simpson, William Crowley, James Dieterich, Leo Hall and many others of the Connecticut Geological and Natural History Survey and the United States Geological Survey have been extremely helpful.

Regional Setting

As shown in figure 1, the Collinsville and Bristol domes are located between the Berkshire Highlands to the west and the central Triassic basin to the east. The rocks in this area represent the western portion of the New England eugeosynclinal sequence and are characterized by metamorphosed derivatives of shale, graywacke, volcanics, and minor amounts of sandstone and carbonates of Cambrian and Ordovician age. Such regionally persistent formations as The Straits Schist and the Collinsville Formation underlie the eastern portion of the Collinsville quadrangle and can be traced northward to southern Massachusetts where they outcrop just west of the Goshen Schist of Emerson. The Hartland Group, which underlies the central and western portion of the quadrangle, is narrow in width from here to southern Massachusetts but widens to four times its width to the south in western Connecticut. Therefore, the area from Collinsville north provides an excellent opportunity to divide the Hartland into mappable units because the belt is narrow, outcrop is abundant and the compositional layering and foliation dip at steep angles to the west.

The rocks in the Collinsville area have been regionally metamorphosed to the kyanite grade in the southern portion of the quadrangle and the sillimanite grade in the northern part. The sillimanite isograde trends



EXPLANATION

Sedimentary and igneous rocks of Triassic age.

Metamorphic rocks of Silurian and Devonian age.

Metamorphic rocks of Cambrian and Ordovician age. (Includes some questionable Precambrian rocks in southeastern Vermont)

Metamorphic rocks of Precambrian and probable Precambrian age.

Highland Masses

1 Green Mountain Anticlinorium
2 Berkshire Highlands
3 Housatonic Highlands
4 Highlands near New Milford, Conn.
5 Hudson Highlands

Gneiss Domes

A Chester
B Athens
C Lake Raponda
D Sadawga
E Shelburne Falls
F Goshen
G Granby *
H Collinsville *
I Bristol *
J Waterbury *

* Contact between The Straits Schist and the underlying rocks. S

0 25 miles
SCALE

Fig. 1. Geologic Map of Southeastern Vermont, Western Massachusetts, and Western Connecticut

diagonally across the area in a northeastwardly direction.

Geology of the Collinsville Area

Since 1964, many new findings indicate that the stratigraphic column and structure must be modified in order to be incorporated into a regionally coherent framework. Although a unique interpretation that satisfies all the data is still not fully developed, several hypotheses can be suggested at this time which will require modification as current problems are resolved in the Hartland Group. One of the hypotheses represents a fresh approach, particularly in regard to the structure and stratigraphy in the eastern and western parts of the quadrangle. The remaining interpretation incorporates the structural configuration shown in plates 1 and 2 of Quadrangle Report 16 with some modification. Although I believe that recent data support the new interpretation, the other is still considered a possibility as we have much to learn about certain areas in western Connecticut during the next few years of geologic mapping.

Hypothesis I. As I pointed out in 1964, one of the main problems in Collinsville was the stratigraphic and structural relationship of the rocks in the northeastward-trending folds to those found in and around the domes. Three possibilities were suggested, but the hypothesis that placed the rocks of the northeastward-trending folds stratigraphically on top of The Straits Schist, seemed to explain the data most satisfactorily (Stanley, 1964, p. 9-15). Furthermore, I suggested that the major folds of the Hartland Group were created when the domes and the Berkshire Highlands moved upward thus causing the overlying material to slide into the intervening area. The shearing stress generated between the rising rocks and the overlying mantle produced the counterclockwise rotation sense of the Ratlum Mountain-Garrett Mountain fold system and the clockwise rotation sense of the Slashers Ledges-Nepaug fold system (Stanley, 1964, plates 1 and 2). Although I suggested that the stratigraphic units of the Hartland might be part of an older nappe system, the northeastward-trending folds themselves were a direct result of the emplacement of the domes and the Berkshire Highlands.

Recent mapping by Gonthier (1964) and Martin (personal communications) in the Torrington quadrangle and Gates and Christensen (1965) in the West Torrington quadrangle have shown that the upper member of the Rattlesnake Hill Formation (queried on the geologic map) on Jones and Yellow Mountain in the western part of the Collinsville quadrangle grades westward into the pin-striped granulite and schist of unit I of the Hartland which is lithically similar to the Whigville and Wildcat Members of the Taine Mountain Formation in the Bristol dome. The Waramaug Formation, which underlies a large portion of the western part of western Connecticut, is found directly west of Hartland I in both of these quadrangles and appears along with unit I to extend northward into the New Hartford and West Granville quadrangles of northern Connecticut (see geologic map of western Connecticut). The geologic sections shown on plates 1 and 2 (Stanley, 1964) can be modified to incorporate this information by having the Collinsville Formation, The Straits Schist and the lower member of the Rattlesnake Hill Formations pinch out at depth as they extend to the west.

Hypothesis II. Recent mapping in the southern part of Massachusetts and in the southern part of western Connecticut sheds considerable doubt on Hypothesis I. In southern Massachusetts rocks that are identical to the rocks in the northeastward-trending folds in the Collinsville area appear to be stratigraphically older, not younger, than the rocks found in the domes (Stanley, 1967, 1968). The Straits Schist has been traced northward to this area and is found between the rocks of the northeastward-trending folds to the west and the main part of the Goshen Schist and, hence, is presumably younger, not older, than the rocks of the Hartland Group in Collinsville. The mapping that has been completed in this area indicates that the rocks outside of the domes form a large east-facing nappe which is draped over the North Granby dome (fig. 2). In this interpretation The Straits Schist forms the trough of a synclinal nappe and the Collinsville Formation, which is considered to be equivalent, in part, to the Hawley Formation (Hatch, 1967), forms a portion of the anticlinal cores of two stacked nappes; the upper limb of the lower one forms the domes of western Connecticut. Furthermore, west of the North Granby dome the rocks, which are in part continuous with the rocks in the northeastward-trending folds, are stratigraphically older than the rocks in the domes of western Connecticut.

Recent work by Crowley (1968) and Dieterich (personal communications) in the southeastern part of western Connecticut have shown that east-facing nappes cored by rocks belonging in part to the Collinsville Formation dominate much of the geology. Thus, the new interpretation shown in figure 3 for the Collinsville quadrangle is compatible with the regional geology from Massachusetts to Long Island Sound.

The structure in the western part of the Collinsville quadrangle must be reinterpreted in light of the nappe hypothesis and detailed mapping to the north and south and reconnaissance in the western portion of the Hartland Formation. In the first hypothesis the rusty schist member of the Slashers Ledges Formation forms the trough of the complex synform separating the Ratlum Mountain-Garrett Mountain fold system to the east from the Slashers Ledges-Nepaug fold system to the west. Recent mapping by Gonthier (1964), Gates and Christensen (1965) and Martin (personal communications) in the Torrington and West Torrington quadrangles has shown that their unit I of the Hartland forms a continuous belt between the rocks on Jones and Yellow Mountain in the northwestern part of the Collinsville quadrangle and the Waramaug Formation further to the west along the southern and eastern side of the Berkshire Highlands. Inasmuch as unit I of the Hartland in the western part of the eugeosyncline belt is lithically similar to the Taine Mountain Formation of the Bristol and Waterbury domes, the two are considered stratigraphically equivalent and correlative to the Moretown Formation of Massachusetts. Reconnaissance along the western part of the eugeosynclinal belt south of Litchfield and detailed mapping in the Newtown quadrangle have shown that unit I of the Hartland and other units lithically similar to the Moretown extend as far south as Danbury. Because the Satan's Kingdom and Slashers Ledges formations are tentatively correlated to the Rowe Formation of Massachusetts, a major synform containing younger rocks of the Moretown Formation and perhaps even a portion of the Hawley Formation, must be present along the western part of the eugeosynclinal belt just east of Cameron's Line. Thus the stratigraphic evidence to the west and southwest of the Collinsville area warrants reinterpretation of the structure in the western part of the quadrangle.

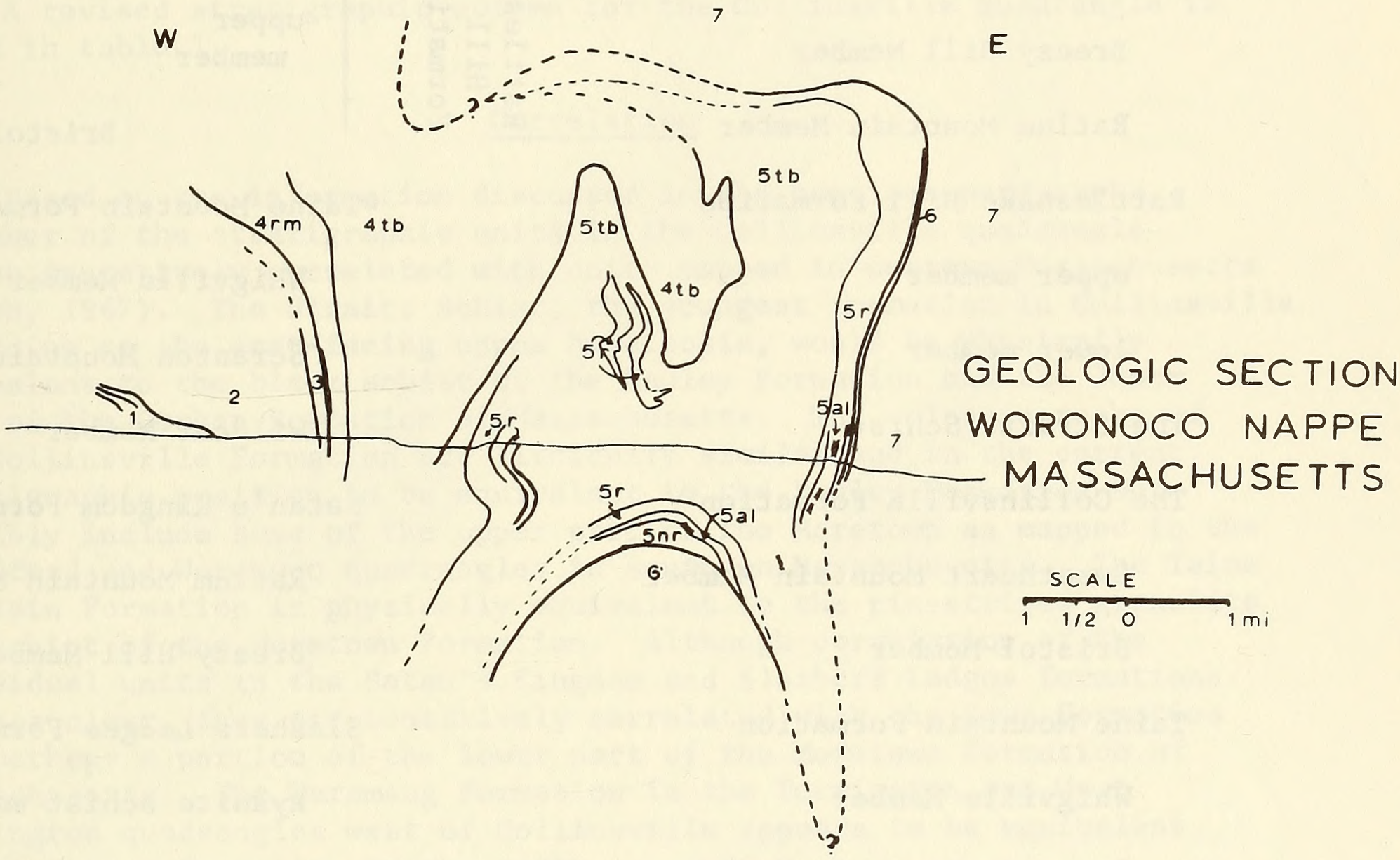


Fig. 2. Numbers refer to map units. Hoosac Formation? (1), Moretown Formation? (4), Hawley Formation? (5), The Straits Schist (6), Goshen Formation (7).

Table I.

Stratigraphic Column for the Collinsville Quadrangle

1964 Version	East-facing Nappe Hypothesis 1968 Version
Slashers Ledges Formation	The Straits Schist
rusty schist member	Collinsville Formation
kyanite schist member	Rattlesnake Hill Formation: lower member - Sweetheart Mountain Member; upper member - Bristol Member
Satan's Kingdom Formation	*Taine Mountain Formation
Breezy Hill Member	Whigville Member
Ratlum Mountain Member	Scranton Mountain Member
Rattlesnake Hill Formation	Wildcat Member
upper member	Satan's Kingdom Formation
lower member	Ratlum Mountain Member
The Straits Schist	Breezy Hill Member
The Collinsville Formation	Slashers Ledges Formation
Sweetheart Mountain Member	kyanite schist member
Bristol Member	rusty schist member
Taine Mountain Formation	
Whigville Member	
Scranton Mountain Member	
Wildcat Member	

* Unit I of the Hartland Formation (Gates and Christensen, 1965) is considered to be equivalent to the Taine Mountain Formation.

The cross section shown in figure 3 is revised from cross section A - A''' of QR 16. The complex, mushroom-shaped synform separating the two fold systems is reinterpreted here as a major antiform. The rocks to the west of this antiform are involved in a series of folds that enable the Moretown, and possibly younger units in southwestern Connecticut, to reappear between the stratigraphically older formations of the Slashers Ledges-Satan's Kingdom area in the Collinsville quadrangle and the Waramaug Formation in the Torrington quadrangle to the west. These folds are further complicated by a series of imbricated, pre-metamorphic thrusts. These thrusts have been postulated to explain the absence here of key stratigraphic units which are present in the folds of the Ratlum Mountain-Garrett Mountain fold system to the east. The thrust zone shown in figure 3 is interpreted as the northern extension of Cameron's Line and, hence, may well be part of the root zone for the Taconic allochthon of western Connecticut.

A revised stratigraphic column for the Collinsville quadrangle is shown in table 1.

Correlation

Based on the information discussed in the previous paragraphs, a number of the stratigraphic units in the Collinsville quadrangle can be tentatively correlated with units mapped in western Massachusetts (Hatch, 1967). The Straits Schist, the youngest formation in Collinsville according to the east-facing nappe hypothesis, would be physically equivalent to the black schist of the Hawley Formation and the lower part of the Goshen Formation of Massachusetts. The volcanic rocks of the Collinsville Formation are lithically similar and in the correct stratigraphic position to be equivalent to the Hawley Formation but possibly include some of the upper part of the Moretown as mapped in the Blandford and Woronoco quadrangles in southern Massachusetts. The Taine Mountain Formation is physically equivalent to the pin-striped granulite and schist of the Moretown Formation. Although correlation of the individual units in the Satan's Kingdom and Slashers Ledges formations is less clear, they are tentatively correlated with the Rowe Formation and perhaps a portion of the lower part of the Moretown Formation of Massachusetts. The Waramaug Formation in the Torrington and West Torrington quadrangles west of Collinsville appears to be equivalent to the Hoosac Formation to the north.

FIELD TRIP STOPS

Taine Mountain Traverse
(34.0N - 55.5E)

Reference. QR 16.

Geologic Map - plate 1, southeastern portion of map west of Unionville, Connecticut.

Cross Section - plate 3.

Stratigraphic Description - pages 17-30.
Descriptions include the Taine Mountain Formation, the Collinsville Formation, and The Straits Schist.

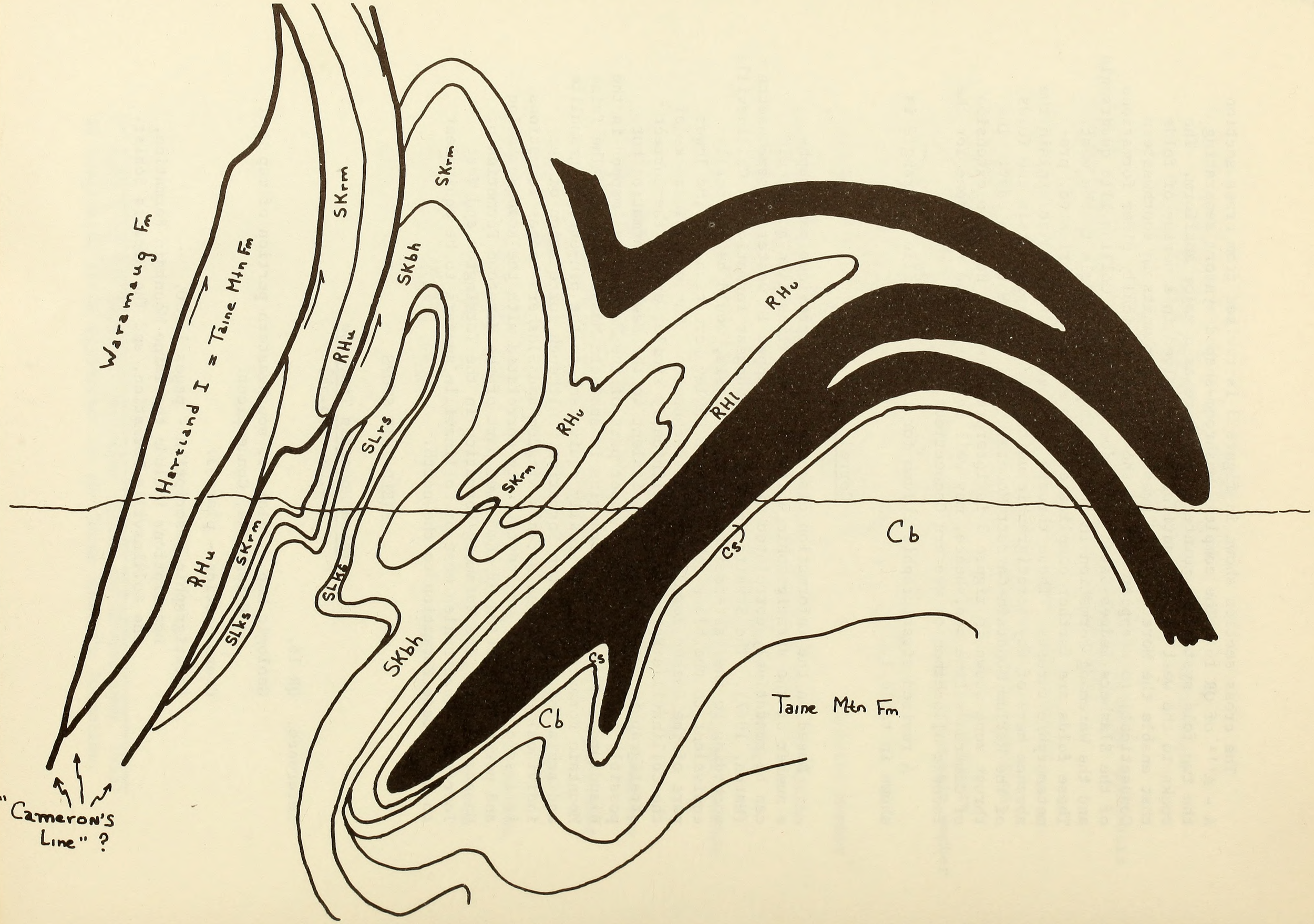


Fig. 3. Revised cross section A-A''' of the Collinsville quadrangle. [illegible] The [illegible] chis[illegible] both[illegible] symb[illegible] key[illegible] to g[illegible] logi[illegible] p. [illegible]

Mineral Assemblages - tables 1-7 appearing on pages 18, 19, 21, 22, 24, 28 and 30.

Structural Data - pages 69-76.

Description. Taine Mountain is unique in that five map units are exposed in a tight isoclinal synform whose axial surfaces are curved and dip at moderate angles to the southwest. The traverse will start in the Scranton Mountain Member of the Taine Mountain Formation southwest of Washington Turnpike and proceed northeastward across Taine Mountain to the outcrops of the Bristol Member of the Collinsville Formation located along the west bank of the Farmington River near Unionville, Connecticut. In so doing we will pass through a synform underlain by the Scranton Mountain Member, an antiform cored by the Wildcat Member of the Taine Mountain Formation and the isoclinal synform underlain by The Straits Schist which separates the Bristol from the Collinsville dome (fig. 4). As you will note on the geologic map, the Whigville Member, the highest unit of the Taine Mountain Formation, underlies only two small portions of the Bristol dome in the Collinsville quadrangle. One of these is located just north of our line of traverse. The rocks in this unit are identical to the Wildcat Member.

Minor Structures. Mineral lineation, mullions and a variety of fold styles can be observed along the proposed traverse. Of particular importance are the crenulate folds that are developed in the schists of the Sweetheart Mountain Member of the Collinsville Formation and The Straits Schist in the southern end of the isoclinal synform separating the two domes. In profile these folds vary in style from rather open crenulations to tight chevron folds with slip cleavage along the axial surface. As these structures are traced from the southern end of the synform towards the north, a new foliation develops from the slip cleavage associated with the crenulate folds south of Taine Mountain Road, and dominates the structure north of the road. The statistical parallelism of the axial surfaces of the crenulate folds with the calculated axial surface of the isoclinal synform indicates that they are contemporaneous and formed when the Bristol and Collinsville domes developed. In style and geometry the crenulate folds in the Collinsville quadrangle are identical to similar folds developed in the Woronoco and Blandford quadrangles where four generations of fold structures have been delineated (Stanley, 1968). The geometry of the folds south of Taine Mountain Road is shown in diagram B of figure 15 on page 75 of QR 16.

Sweetheart Mountain Traverse

(35.5N - 55.0E)

Reference. QR 16.

Geologic Map - plate 1, east side of the Nepaug Reservoir.

Cross Section - B-B''', plate 2.

Stratigraphic Descriptions - pages 22-30.

Mineral Assemblages - tables 5, 6, and 7.

Structural Data - pages 71-76.

Description. Sweetheart Mountain is situated on the northward-plunging hinge of the Bristol dome and is underlain by the Collinsville Formation and The Straits Schist. The traverse will start at the base of Phelps

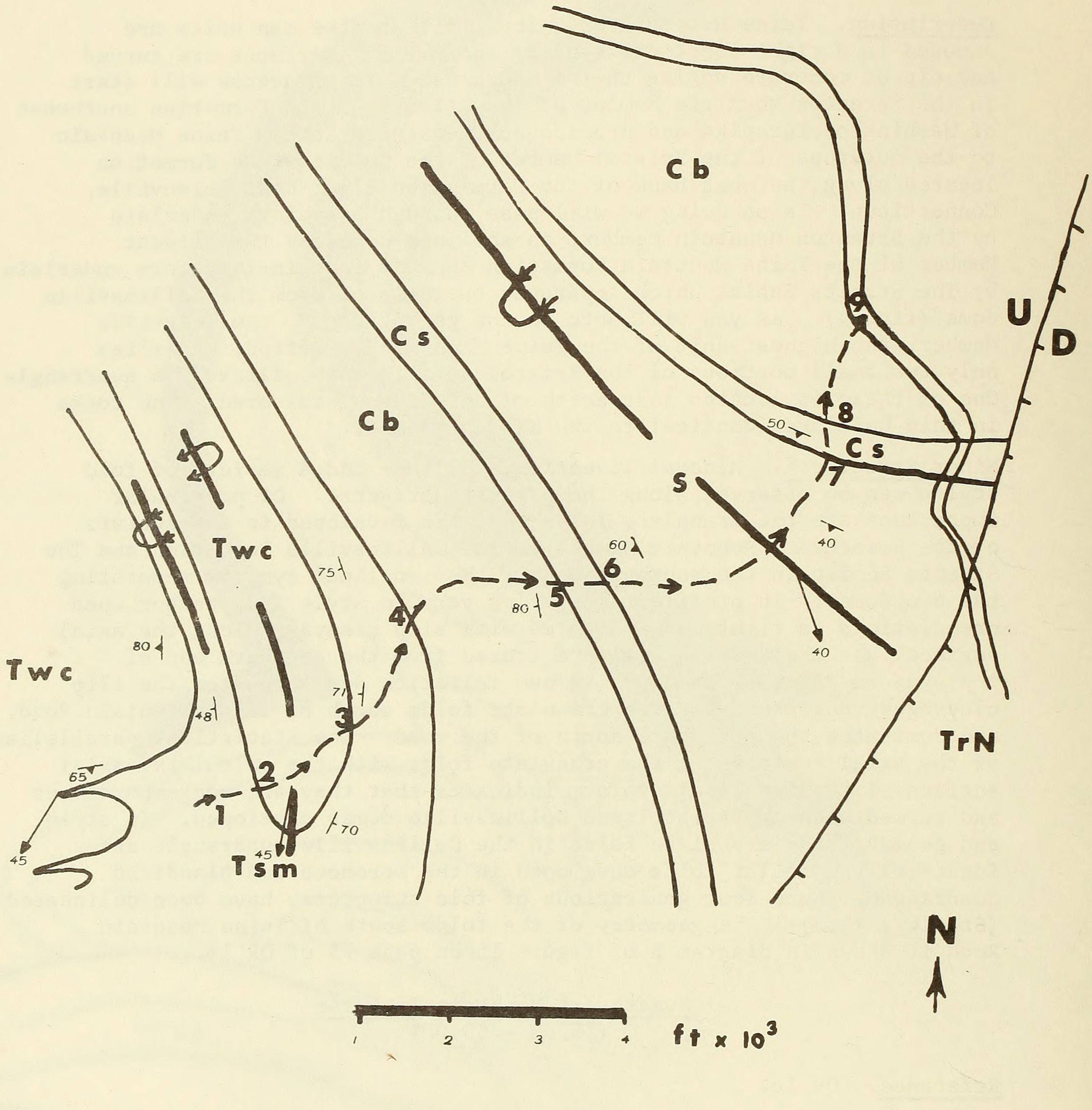


Fig. 4. Traverse map of the Taine Mountain area. Numbers refer to stop locations.

Dam near the intersection of Clear Brook Road and Ford Road on the west side of the isoclinal synform separating the two domes (fig. 5). Typical outcrops of The Straits Schist are located on either side of Ford Road. The contact between the Sweetheart Mountain Member and The Straits Schist is exposed on the north side of Clear Brook Road just west of the intersection with Ford Road. Here the contact is marked by amphibolite and crumbly, deeply-weathered rusty schist. Typical outcrops of the Sweetheart Mountain Member are found along the dirt road north of Phelps Dam and on the southern cliffs of Sweetheart Mountain. Although the contact between the Sweetheart Mountain Member and the Bristol Member is not exposed on the north banks of the Nepaug Reservoir, it can be estimated to within ten feet across strike. Here, the feldspathic binary mica schist typical of the Sweetheart Mountain Member grades into plagioclase gneiss and amphibolite of the Bristol Member. A bed of garnet quartz granulite which is characteristic of the upper part of the Bristol Member is found at several localities along this portion of the Nepaug Reservoir.

Minor Structures. A variety of minor structures are displayed throughout the Sweetheart Mountain area. In the schistose rocks, crenulate folds are well-developed and are characterized by northward-plunging axes and westward-dipping axial surfaces. These structures are identical in style to the crenulate folds south of Taine Mountain Road and are considered contemporaneous in age. In the rocks of the Bristol Member of the Collinsville Formation, folds of different ages, boudinage, and mineral lineation are well exposed. Joints, some of which are curved, and quartz-filled tension fractures are among a variety of brittle structures available for study. The orientation of a sample of these structures is shown by appropriate symbols on the geologic map (QR 16, plate 1).

Rattlesnake Hill Area
(37.0N - 55:5E)

Reference. QR 16.

Geologic Map Plate 1 - This area is located on the northern limb of the Collinsville dome, just west of East Hill along the Bahre-Johnson Road.

Cross Section - Section A-A''', plate 2.

Stratigraphic Description - pages 28-36.

Mineral Assemblages - tables 7, 8, 9.

Structural Data - See Geologic Map and diagram A of figure 15 on page 75.

Description. The western contact of The Straits Schist with the Rattlesnake Hill Formation is well-displayed in the pastures on the east and west side of Bahre-Johnson Road (fig. 6). Outcrops of The Straits Schist are found to the east of the brook whereas the outcrops of the lower member of the Rattlesnake Hill Formation are situated to the west. Between the brook and the road the calc-silicate gneiss and interbedded rusty schist are well-exposed and are typical of the western contact between The Straits Schist and the Rattlesnake Hill Formation north of the Nepaug Reservoir. South of the reservoir calc-silicate gneiss and

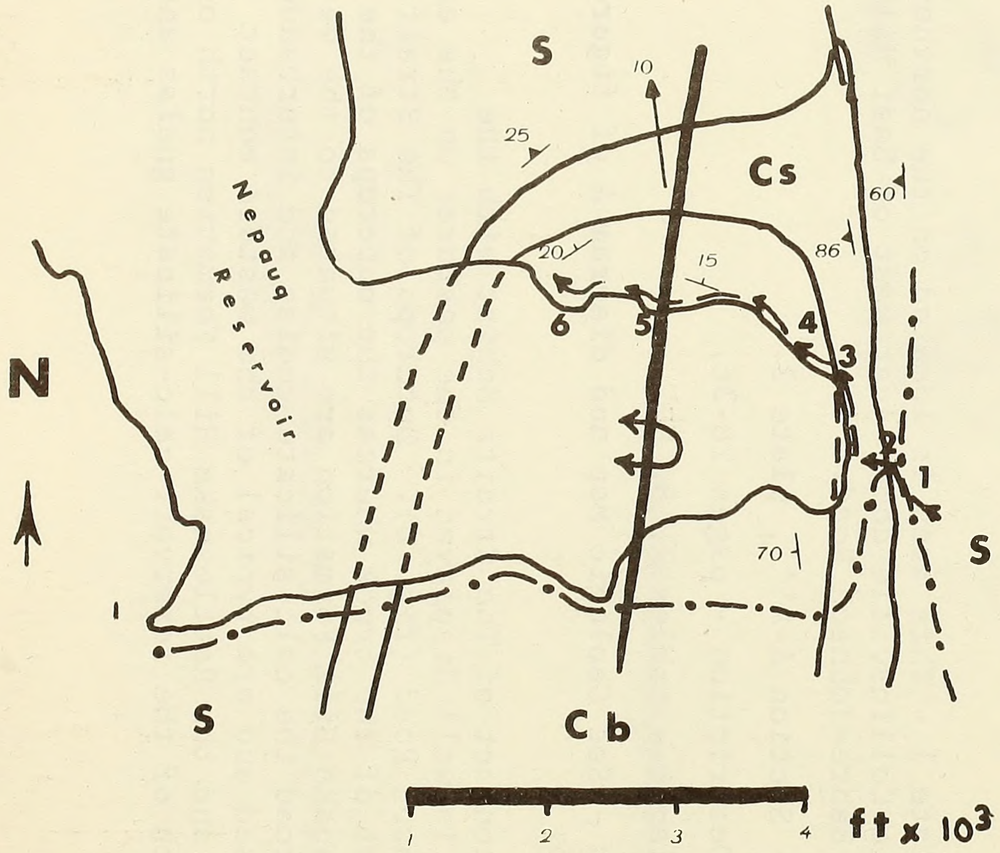


Fig. 5. Traverse map of the Sweetheart Mountain area. Numbers refer to stop locations.

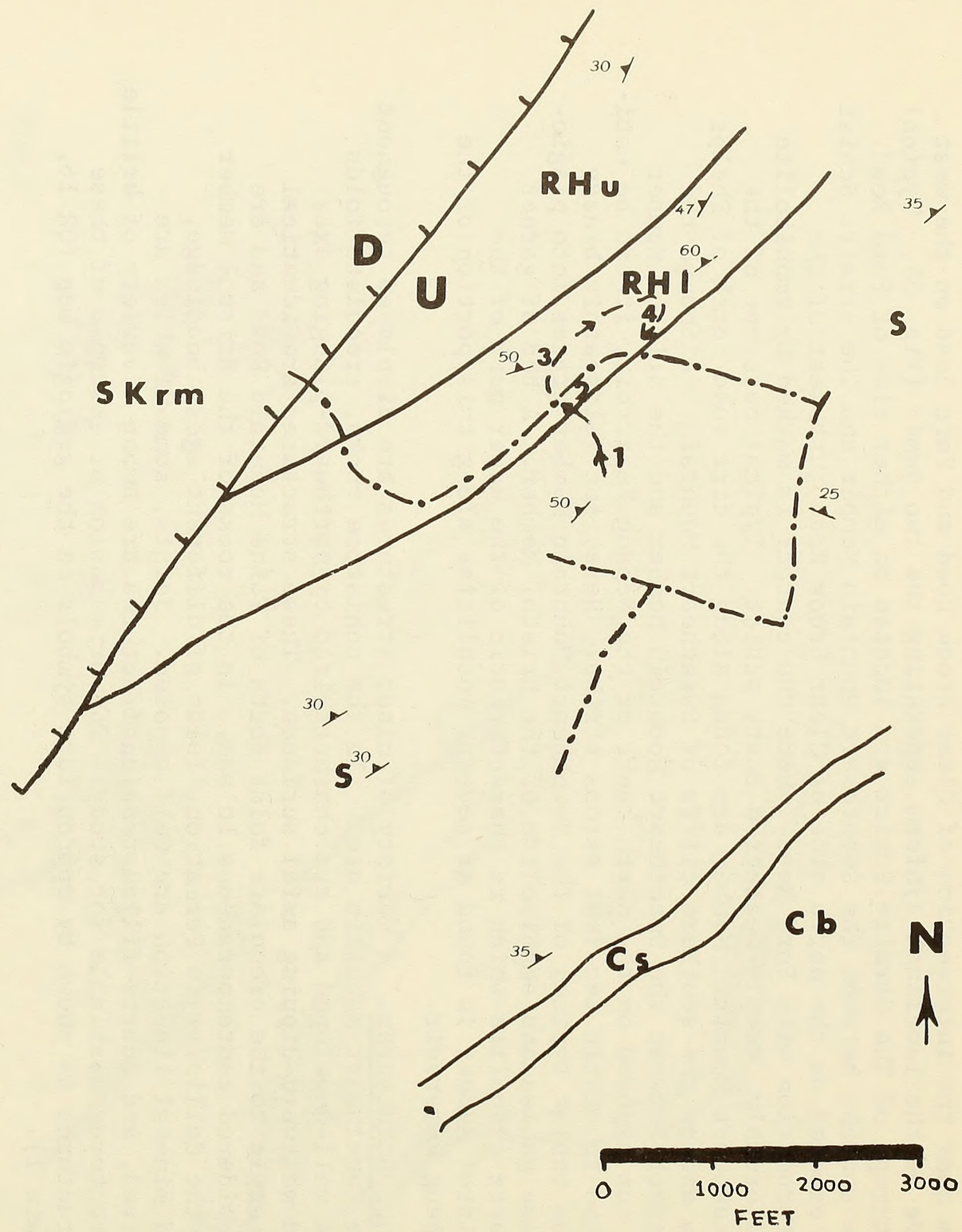


Fig. 6. Traverse map of the Rattlesnake Hill area. Numbers refer to stop locations.

associated rocks have not been found at this same horizon. West of the Bahre-Johnson Road outcrops of the kyanite-garnet-mica-plagioclase-quartz schist with beds of amphibolite are abundant and are typical of most of this map unit.

According to the revised hypothesis on the structure of the Collinsville quadrangle, the lower member of the Rattlesnake Hill Formation is physically equivalent, or a facies of, the Sweetheart Mountain Member of the Collinsville Formation. These two units are similar in the following respects:

(a) Both units are schist, rich in plagioclase and contain kyanite, garnet, muscovite, biotite, and quartz. Staurolite is an additional phase in the Sweetheart Mountain Member and has not as yet been observed in the lower member of the Rattlesnake Hill Formation.

(b) Both units contain beds of amphibolite.

(c) Both schists are somewhat similar in appearance with planar segregations of plagioclase and quartz.

These two units differ, however, in that the eastern portion of the Rattlesnake Hill Formation contains beds of calc-silicate gneiss, whereas similar rocks have not been found between the Sweetheart Mountain Member and The Straits Schist. In central Connecticut, however, Crowley (1968) and Dieterich (personal communications) have found beds of marble, calc-silicate and amphibolite at various localities along the contact between the Collinsville Formation and The Straits Schist. In several of these areas sulphides and other metallic minerals have been concentrated. In the Collinsville quadrangle a similar metalliferous deposit was discovered and mined sometime in the past on the south face of Rattlesnake Hill just north of Route 44 (see geologic map, plate 1). Furthermore, amphibolite is commonly present at the contact of the Sweetheart Mountain Member and The Straits Schist such as found in the outcrops at the junction of Clear Brook Road and Ford Road just east of Nepaug Reservoir. Therefore, the eastern and western contacts of The Straits Schist in the Collinsville area are in part similar to the southeastern part of western Connecticut where beds of amphibolite and calcareous rocks mark either side of The Straits Schist. In conclusion, the data suggest that the lower member of the Rattlesnake Hill Formation is physically equivalent to the Sweetheart Mountain Member of the Collinsville Formation.

Structural Implications. If the correlation suggested in the above paragraphs is accepted, then the outcrop belt of The Straits Schist in the Collinsville quadrangle can be considered an isoclinal synform which is deformed by the Bristol and Collinsville domes. The synform separating the Collinsville and Bristol dome is interpreted as a younger structure that has remolded the lower limb of the earlier isoclinal synform which now envelopes both domes. The upper limb which is here marked by the contact between The Straits Schist and the lower member of the Rattlesnake Hill Formation has apparently not been affected by this latter deformation.

Ratlum Mountain Traverse
(37.5N - 55.0E)

Reference. QR 16.

Geologic Map, plate 1 - The area is located northeast of the Farmington River.

Cross Section - A-A''', plate 1.

Stratigraphic Description - pages 33-40.

Mineral Assemblages - tables 9, 10, and 11.

Structural Data - pages 76-81.

Description. Throughout the Ratlum Mountain area it has been possible to divide a portion of the Hartland Group into three map units, two of which, the upper member of the Rattlesnake Hill Formation and the Ratlum Mountain Member of the Satan's Kingdom Formation are repeated several times across strike and, hence, outline the four major folds of the Ratlum Mountain - Garrett Mountain fold system. The traverse on Ratlum Mountain will cross the best documented antiform in the area. The contact between the two map units, the lithologic details of the Ratlum Mountain Member and a variety of minor structures will be studied in the course of the traverse (fig. 7). Asymmetrical folds with a well-developed axial surface foliation, mineral lineation, fold mullions, and boudinage are the most important and abundant minor structures in the Ratlum Mountain area.

Of interest is a zone of schist containing large porphyblasts of plagioclase and a bed of amphibolite which have been traced throughout the Ratlum Mountain - Garrett Mountain fold system and conform fairly closely to the contact between the Rattlesnake Hill and Satan's Kingdom formations. Numerous outcrops of these two units are found throughout the Ratlum Mountain area and have been used as key beds within the Ratlum Mountain Member proper. The lens-like bodies of amphibolite are connected by a heavy dotted line on the geologic map (plate 1), and it is likely that they once were continuous. Evidence supporting this belief is found in several large outcrops where the amphibolite is present at the hinges of folds but is pinched off on the limbs. Furthermore, these amphibolite lenses appear to be confined to a rather restricted stratigraphic interval and, therefore, it is likely that they once formed a continuous layer which has subsequently been pulled apart during deformation.

Slashers Ledges - Satan's Kingdom Traverse
(37.0N - 54.0E)

Reference. QR 16.

Geologic Map, plate 1 - Located west of the Farmington River, north of the Nepaug Reservoir, south of Puddletown in the northwestern portion of the Geologic Map.

Cross Section - A-A''', plate 2.

Stratigraphic Descriptions - pages 36-41.

Mineral Assemblages - tables 10, 11, 12, and 13.

Structural Data - pages 81-84.

Description. The Slashers Ledges - Satan's Kingdom area is perhaps one of the most interesting areas in terms of structural geology and

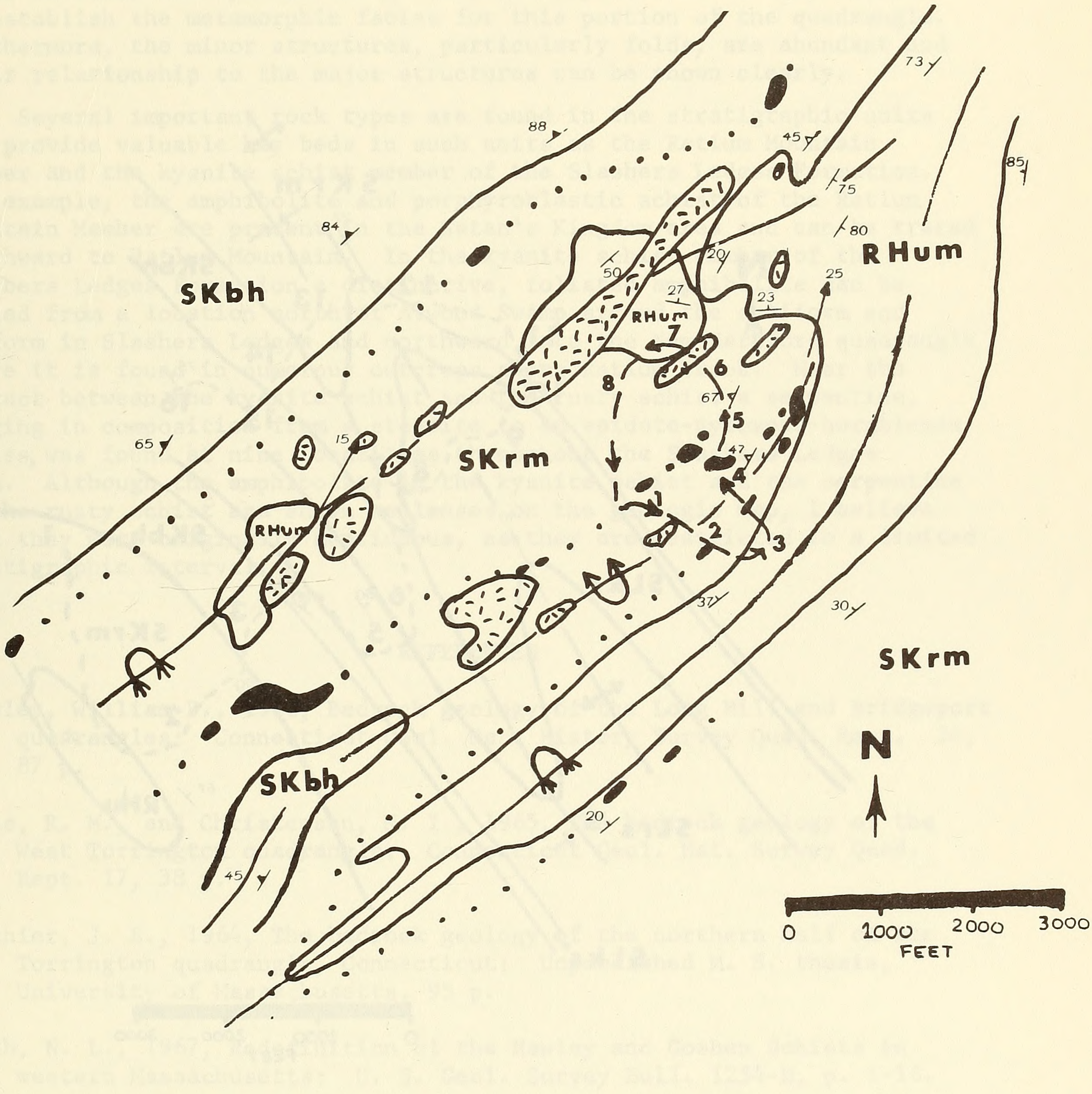


Fig. 7. Traverse map of the Ratlum Mountain area. Numbers refer to stop locations.

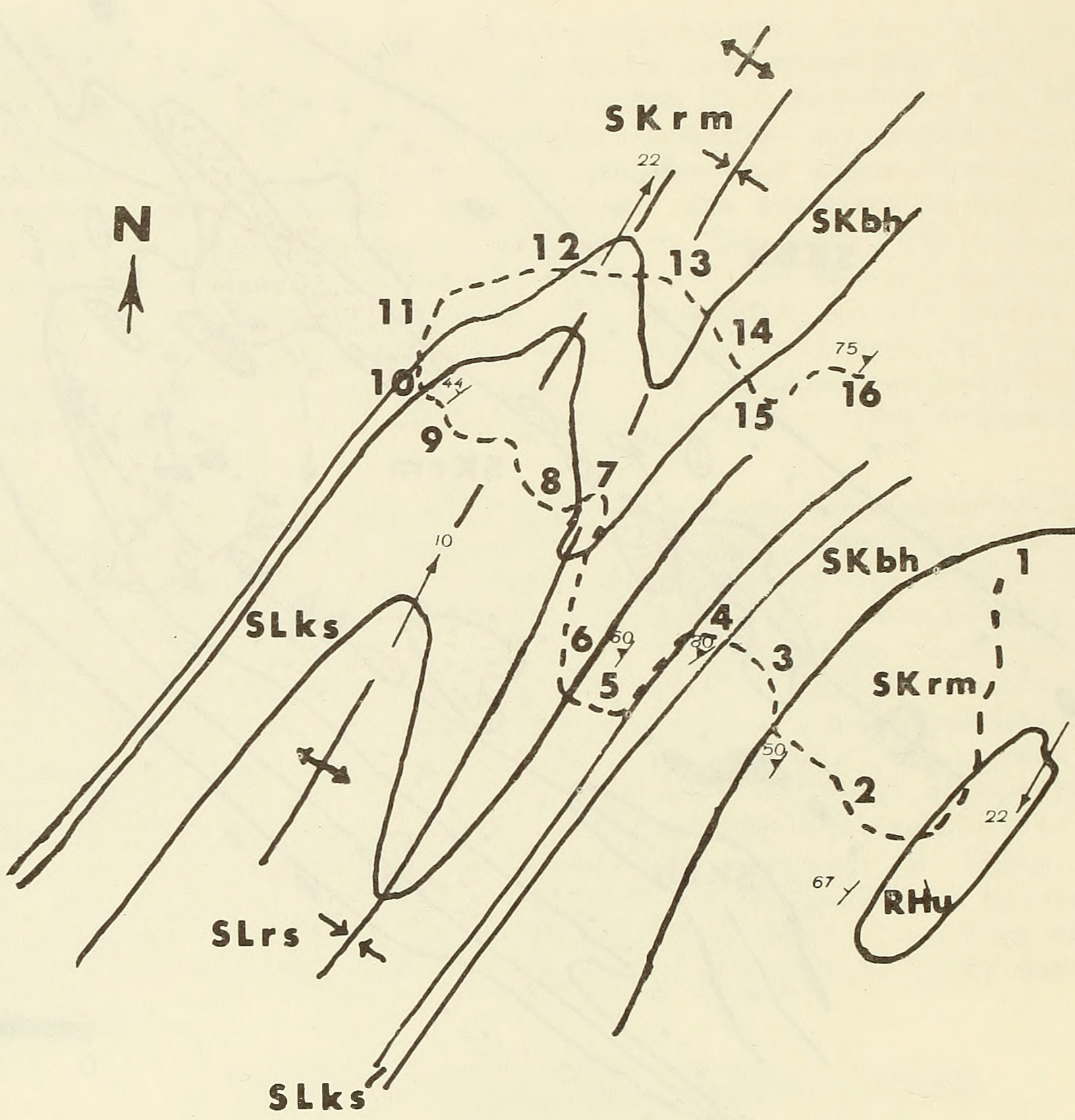


Fig. 8. Traverse map of the Slashers Ledge area. Numbers refer to stop locations.

metamorphic petrology. Both members of the Satan's Kingdom Formation and the Slashers Ledges Formation are well-exposed throughout the area and the traverse is designed to examine the various parts of these map units (fig. 8). The metamorphic stratigraphy in the area outlines a major antiform and synform and is sufficiently diverse in composition to establish the metamorphic facies for this portion of the quadrangle. Furthermore, the minor structures, particularly folds, are abundant and their relationship to the major structures can be shown clearly.

Several important rock types are found in the stratigraphic units and provide valuable key beds in such units as the Ratlum Mountain Member and the kyanite schist member of the Slashers Ledges Formation. For example, the amphibolite and porphyroblastic schist of the Ratlum Mountain Member are present in the Satan's Kingdom area and can be traced northward to Ratlum Mountain. In the kyanite schist member of the Slashers Ledges Formation a distinctive, foliated amphibolite can be traced from a location north of Atwood Swamp around the antiform and synform in Slashers Ledges and northward into the New Hartford quadrangle where it is found in numerous outcrops along Ratlum Brook. Near the contact between the kyanite schist and the rusty schist a serpentine, ranging in composition from a steatite to an epidote-pyroxene-hornblende gneiss, was found at nine localities throughout the Slashers Ledges area. Although the amphibolite in the kyanite schist and the serpentine in the rusty schist are shown as lenses on the geologic map, I believe that they were originally continuous, as they are restricted to a limited stratigraphic interval.

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