State Geological and
Natural History Survey
of Connecticut

THE BEDROCK GEOLOGY of the LITCHFIELD QUADRANGLE

WITH MAP

Open Map

BY

ROBERT M. GATES, Ph. D.

Miscellaneous Series No. 3

1951

State Geological and Natural History Survey of Connecticut

MISCELLANEOUS SERIES NO. 3

A REPORT ON THE BEDROCK GEOLOGY OF THE LITCHFIELD QUADRANGLE WITH GEOLOGICAL MAP

A study principally of the lithology and structure of the Hartland formation, together with a geologic and topographic map, scale: 1/31,680.

by

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A PUBLICATION OF THE

STATE GEOLOGICAL AND NATURAL HISTORY SURVEY

1951

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ABSTRACT. The Hartland formation, the predominant rock in the Litchfield quadrangle, includes a series of metasediments which have been intruded by the Mt. Prospect basic complex in the northwest corner of the area and by the Woodbury granite in the southern part. It also contains lenses and layers of a hornblende gneiss which Agar (1) has called the Mt. Tom hornblende gneiss. The Mt. Prospect complex has been described by E. N. Cameron (2) and a report on the Woodbury granite intrusive will be published in the near future. Therefore, attention has been focused on the Hartland formation, its lithology, and its relations to the intrusives mentioned above.

The rocks in this area may be conveniently grouped as follows, from oldest to youngest: 1) Berkshire formation, 2) Hartland formation, 3) Mt. Tom hornblende gneiss, 4) Diorite gneiss, 5) Younger basic intrusives, and 6) Woodbury granite and associated granite gneisses. The Berkshire formation, which is a series of mica quartzites, mica-quartz schists, and gneisses, is clearly the oldest rock, as indicated by the intensity of deformation and the multiplicity of pegmatitic injections compared to the Hartland formation. The Hartland formation is similar to the Berkshire in composition except for the amount of pegmatitic material, but is generally much less crumpled. The Mt. Tom hornblende gneiss tentatively is thought to have intruded the Hartland concordantly prior to the major deformation, since the foliations of the two rocks are everywhere parallel. Cameron indicates that the diorite gneiss is a metamorphosed concordant basic intrusive between the Hartland and Berkshire formations. The younger basic rocks (norites and pyroxenites) are intrusive into the diorite gneisses and associated rocks (2). Except for the large body in the southeast corner of the quadrangle, the Woodbury granite and pegmatites generally intrude the Hartland parallel to the foliation, although occasional dikes cross-cut the foliation.

The structure of the Hartland formation and its relations to the Mt. Prospect complex are not clear. The Hartland and Berkshire formations are separated by the Mt. Prospect complex, the Berkshire bordering it on the west and north and the Hartland on the south and east. These two formations become parallel northeast and southwest of Mt. Prospect in the Torrington and New Preston quadrangles, respectively. The dioritic gneisses occur at a major flexure in the regional trend of the Hartland formation. The foliation changes from roughly east-west south of the diorite to north-south east of it. The foliation and bedding are, wherever observed, essentially parallel and the dips are consistently north or west.

Minor structures all indicate isoclinal folding and overturning from the northwest. Linear elements in the Mt. Tom hornblende gneiss and minor crenulations of the mica layers in the schists all plunge northwest at a low angle.

Introduction

The main objectives of the mapping of this quadrangle were to learn the geology of the formations between the Mt. Prospect complex and the Woodbury granite and the relations of metasediments to them. The Mt. Prospect complex, which includes the northwest quarter of the Litchfield quadrangle, has been mapped in detail by Cameron (2), and the Woodbury granite intrusive, which includes a narrow strip along the southern border of the quadrangle, was mapped in part by Cameron in 1941 and completed by the writer in 1948. The major part of the quadrangle was mapped for the Connecticut Geological Survey in the summer of 1949. The seven and one-half minute quadrangle, 1/24000 scale, topographic sheet published by the U. S. Geological Survey served as a base map.

This mapping involved primarily a study of the lithology of the Hartland formation and an attempt to learn its structure. Previous work on the Hartland includes Rice and Gregory's (3) general treatment of the formation in western Connecticut and Agar's (1) detailed study of the rocks of the Shepaug Aqueduct tunnel which exposes a 2¾ mile section of the Hartland.

The field work and the preparation of this report have been supported by the Connecticut Geological and Natural History Survey under the direction of Dr. E. L. Troxell. The writer gratefully acknowledges the continued interest and aid of the Commissioners of the Survey in the completion of this project. The writer also wishes to express his appreciation to Dr. E. N. Cameron for his interest in the problem and his cooperation in the preparation of the map and the report.

General Geology

The Litchfield quadrangle is located (Figure 1) in the western Connecticut Highlands which lie between the Housatonic Lowlands and the Connecticut Valley and are a part of the larger physiographic unit, the Green Mountain Plateau. The quadrangle is roughly bounded by Mt. Prospect and Mt. Tom on the west and the Naugatuck River on the east. The area is drained by the Bantam River and the West Branch of the Naugatuck. The Bantam River joins the Shepaug, which is tributary to the Housatonic River. The Naugatuck River also flows into the Housatonic although many miles south of where the Shepaug joins it.

The country is more or less gently rolling farm land, the hills rising 50 to 300 feet above the adjacent valleys. Drumloidal hills trending slightly west of north are prominent features, particularly around Bantam Lake, and are not uncommon in the northeast and southeast corners of the area. The prevailing westerly dip of the foliation and bedding is reflected in the steep east-facing slopes of the ridges and the more gentle western slopes. As expected, the more resistant quartzitic formations are the ridge-formers and the more micaceous rocks are found in the valleys.

The belt of metasediments separating the Mt. Prospect complex and the Woodbury granite (the Woodbury granite is entirely enclosed by the Hartland formation) is part of a formation of varying width, which extends from the east side of the Green Mountain anticlinorium in northern Massachusetts through western Connecticut to Long Island Sound. The Hartland formation in Connecticut is probably equivalent to the Hoosac schist in northern Massachusetts. The hornblende schists and gneisses occurring in the Hartland formation are lithologically identical to the Mt. Tom hornblende gneiss described by Agar (1). The granites and granite pegmatites intruding the Hartland appear to be similar in most respects to those associated more closely with the Woodbury granite. The correlation of the rocks of the Mt. Prospect complex with other rocks in New England is discussed in detail in another bulletin (2).

Discussion of Rock Formations

THE BERKSHIRE FORMATION

The Berkshire formation outcrops only in the northwest corner of the quadrangle, where it forms the northern border of the Mt. Prospect complex. Its relations to the Hartland formation are not clear since the two are not found in contact. However, poor outcrops of both formations are found within a half-mile of each other just west of the village of Litchfield. The attitudes of their foliations are roughly parallel, the Hartland striking N 35° W and dipping 35°-55° SW and the Berkshire striking N 40° W and dipping 75° SW. Reconnaissance mapping in the Torrington quadrangle to the north indicates that they have parallel trends roughly north-south. The Mt. Prospect complex occupies a roughly elliptical-shaped area between the Hartland and Berkshire formations at a major flexure in their regional trends. The relation of the Berkshire formation to the Mt. Prospect complex is discussed elsewhere (2).

The several rock types of the Berkshire formation may be generally classified as 1) mica-quartz gneisses and schists, 2) feldspathic mica-quartz schists, 3) micaceous quartzites. These rock types are layered and gradational in every way, the layers varying from a few inches to several feet. The series has been intricately folded and crumpled. Pegmatitic material which has been injected generally parallel to the foliation occurs as lenses and layers. Quartz and biotite are the predominant minerals, with varying lesser amounts of feldspar and muscovite and minor amounts of garnet. Agar (1, p. 27) summarizes this formation from a section in the Shepaug Aqueduct as ". . . a highly contorted biotite gneiss containing much quartz and oligoclase. Apatite, garnet, and sillimanite may be present. The biotite lamellae are frequently warped but the quartz is only rarely granulated."

THE HARTLAND FORMATION

The features of the Hartland formation which will be discussed in detail are its structure, its varied lithology, and its relations to the other rocks of the area. It outcrops well in the southern half and very extensively in the eastern half of the area. It is by far the most abundant rock type in the quadrangle. The general structure of the formation is that of a simple fold around the Mt. Prospect intrusive complex. The Hartland has five recognizable rock units which are inter-layered and grade into one another. Each of these types will be taken up individually. Contacts between the Hartland and all other rocks of the area except the Berkshire and the younger basic intrusives are exposed. These relationships will be discussed in the appropriate sections.

Structure

The general structure of the Hartland formation is relatively simple. The strike of the foliation changes more or less gradually from east-northeast in the southern part of the area to north-northwest along the eastern border. The dip of the foliation is consistently northwest. If minor folds reflect major ones, the formation is isoclinally folded and overturned from the northwest. However, no major regional folds were found in this series of mica quartzites and schists. Agar (1, p. 23) also was unable to find any repetition of beds or major isoclinal folds in his 2¾ mile section in the Shepaug Aqueduct from the outfall end of the Waterbury reservoir to Bantam Lake. The Hartland formation indicates that there have been at least two stages of deformation: 1) the folding which produced the bedding-plane foliation and 2) a deformation which locally crumpled the foliation planes. Where best observed, these secondary crumples of the bedding-plane foliation strike generally northwest and plunge gently (20°-30°) in that direction. That is roughly the attitude of the major flexure in which the Mt. Prospect complex occurs. Some of the details of the structure of the Hartland formation follow.

In the area south of Bantam Lake and around Long Meadow Pond the foliation and the bedding both strike approximately N 60°-75° E and dip 35°-50° NW. The bedding is frequently evident and is always parallel to the foliation. The trend changes rapidly in the southeast corner of the area around Big Meadow Pond and Wigwam reservoir. Here the foliation strikes N 20°-40° E and dips 35°-50° NW.

A small fault striking N 45° W in the southeast corner produces a discontinuity in the otherwise smooth change in attitude of the formation. The fault is also marked by a cluster of pegmatite and granite intrusive dikes and sills in the area west of the Wigwam reservoir and south of Highway 109. The displacement is apparently slight since the trend of the foliation along the eastern border is not disturbed.

Along both sides of the Waterbury (Pitch, Morris, Wigwam) reservoirs the outcrops are good and monotonously regular in their north or northwest strike and westerly dip. This general attitude continues up to Litchfield village, the area east of it, and on into the Torrington quadrangle. Pegmatite injections parallel to the foliation are fairly common, especially north and west of the head of the reservoir.

The monotony of regularity is abruptly relieved in the northeast corner of the area where the foliation varies in strike from N-S to E-W and dips steeply west or south. Frequently in the more massive quartzitic members neither bedding nor foliation is decipherable. An important flexure in the regional trend is clearly indicated not only by the variable foliation but also by the abundance of granite and pegmatite here and in the quadrangles to the east and west. The degree of metamorphism of the Hartland formation here also reflects unusual deformation and/or granitic intrusives.

Lithology

The variations in the composition of the members of the Hartland formation are numerous, but mineralogically are not too complex. Quartz and mica are the predominating constituents and all gradations between nearly pure quartzite and nearly pure mica schist may be found. Plagioclase is generally present in minor amounts. The ratio of muscovite to biotite also varies, giving some rocks a dark gray color and others a bright silvery gray appearance. The other important minerals commonly present in certain areas are garnet, staurolite, and kyanite. The accessory minerals are apatite, pyrite, and zircon.

The textures vary widely in grain-size and uniformity. The mica and quartz may be distributed to give the rock a uniform color, or they may be separated into layers giving it a coarsely gneissic texture. Alternating layers of mica quartzite and mica-quartz schist produce a banded rock. The grain-size ranges from fine to coarse. The garnet, staurolite, and kyanite may be present in small amount or they may make up a considerable fraction of the rock. The garnet and staurolite usually occur as small crystals only 1/16 inch or so in diameter or length, although locally garnet crystals may be 6 inches in diameter. Kyanite is relatively rare, but does occur in quartz lenses in crystals up to 3 inches in length. Although many of these variations produce recognizable rock types, it is unusual to be able to trace any one for more than a mile before it yields to another type. The details and occurrences of some of these types are given below.

Mica Quartzite. The mica quartzite is one of the most abundant rock types and the most simple mineralogically. The standard type is well shown in outcrops in the region between Bantam Lake and Long Meadow Pond and is readily accessible in the Camp Columbia area. Exceptionally pure mica quartzites in which bedding and foliation are obscure occur in the extreme southwest corner of the quadrangle. The more or less standard mica quartzites outcrop extensively in the area east of the main highway from East Morris to Litchfield between one and three miles north of East Morris. They are also abundant in the northeast corner of the area. The rocks are light silvery gray to dark gray depending on the relative amount of muscovite and biotite present. The texture is uniform, fine- to medium-grained. The mica is normally disseminated throughout the quartzite and has its foliation parallel to the bedding. They are composed primarily of quartz with 10 to 30 per cent mica. Plagioclase is generally not apparent megascopically, but microscopic examination shows that it is usually present in minor amounts.

Mica-Quartz Schist. The mica-quartz schist differs mineralogically from the mica quartzite primarily in the relative amounts of mica and quartz. Interlayered mica quartzite and mica-quartz schist is undoubtedly the most common rock type of the Hartland formation. The interlayering may be on a scale of inches or feet and the layers may grade into one another. These rocks usually carry a small amount of garnet in addition to the normal accessory minerals. Where neither rock type predominates, the outcrop is classified as mica quartzite and schist. Good examples of the mixed quartzite and schist are best observed in the road cuts along Highway 109 between Morris and East Morris and along the east side of the Waterbury reservoir. A contact between a large mica quartzite layer and mica-quartz schist can be traced from the road cut on the east side of the reservoir ½ mile below where Highway 109 crosses the West Branch of the Naugatuck for 2½ miles N 15° W to where the outcrops discontinue. Extensive outcrops of this rock occur in the area immediately west of the Pitch reservoir.

Mica-Quartz Gneiss. Locally a gneissic equivalent of the mica-quartz schist is a recognizable rock type. The main difference between the schist and the gneiss is the separation of the quartz and mica into distinct layers. These layers are usually of the magnitude of a fraction of an inch, the mica layers generally being narrower and occasionally wrapped around quartz lenses or augen. The grain-size is normally coarser than the schist. Lenses and discontinuous veins of quartz parallel to the gneissosity are prominent features of this variant. The quartz veins do occasionally cross-cut the foliation. The mica-quartz gneiss may be explained best as a result of a higher degree of metamorphism than the schists, perhaps fluxed by hydrothermal solutions. The granites and pegmatites usually associated with these gneisses indicate a probable source of solutions. This type of gneiss is best exposed on the hill on the east side of the Waterbury reservoir or above the uppermost dam. It can be traced for 1½ miles northward from the dam where it is lost under glacial drift. It is present to a much lesser extent on top of the cliffs on the west side of Pitch reservoir.

Garnetiferous Mica-Quartz Schists. Garnet crystals in the mica quartz gneiss produce another recognizable unit. Most commonly the crystals are 1/16 to ⅛ inch in diameter and occur in sufficient quantity to give the rock a knotty appearance. Staurolite crystals frequently accompany the garnet in minor amounts, only locally in abundance. The micas tend to wrap around the augen of garnet crystals but not to a marked degree. Microscopic examination of the garnet-bearing gneiss shows that occasionally potash feldspar is formed at the expense of the muscovite. Magnetite is one of the more abundant accessories. Garnetiferous layers do occur in predominantly mica-quartz schist or gneiss but are quantitatively unimportant. The development of garnet crystals of average size seems to be more nearly related to the composition of the original sediment than to the degree of metamorphism.

The major outcrops of the garnetiferous mica-quartz schist and gneiss are in a wedge-shaped area east of Litchfield. Eastward from the

Litchfield cemetery for a mile is a remarkably uniform and fairly continuous section of this rock. It again outcrops a mile south of this section fairly extensively but in a much narrower belt. Still another mile south it gives way to rather standard mica quartzite and schist with only occasional garnet-bearing layers.

A rock of the above type, the bulk of which is composed of garnet cystals up to 6 inches in diameter, outcrops in a small area 1,000 feet west of the road 3 miles south of East Morris on the highway to Watertown. Mica-quartz schists and gneisses bearing garnet and/or staurolite and sometimes kyanite are fairly abundant here. Wisps, lenses, and discontinuous veins of quartz are also prominent features. This half square mile of relatively high grade metamorphism is surrounded by rather standard mica quartzites and schists. Although granites and pegmatites are not present in the immediate area, it seems most likely that the higher grade of metamorphism here is a result of underlying intrusives rather than of very local dynamic stresses.

Staurolite-(Kyanite)-Garnet-Mica-Quartz Schists and Gneisses. The garnet-bearing schists and gneisses vary locally because of the presence of staurolite and more rarely, kyanite. There are no continuous beds of staurolite-bearing gneisses or schists in this quadrangle, but 1½ miles north of Litchfield in the Torrington quadrangle a coarse staurolite-mica-quartz gneiss outcrops continuously for nearly 2 miles. It is more or less continuous along strike with the thick section of garnet-mica-quartz gneiss (with occasional staurolite crystals) east of Litchfield and is very likely the higher grade metamorphic equivalent of it.

There is a prominent knob in the extreme northeast corner of the Litchfield quadrangle and the southeast corner of the Torrington quadrangle composed of a very coarse staurolite-garnet-mica-quartz gneiss. The staurolite and garnet crystals are normally ½ to 2 inches in their greatest dimension. Weathering has produced an exceptionally rough rock, the garnet and staurolite crystals standing out as large knots. The mica flakes are also large and wrap around the augen of staurolite, garnet, and quartz. This knob is in the center of a major, but local, flexure in the regional trend apparently associated with the granites and pegmatites north and south of it. Here again the relatively high grade of metamorphism seems to be related to intrusive activity.

In summary it appears that the present mineralogical variations of the Hartland formation are related to its original variations in composition and not to regional metamorphism. There is no obvious regional scheme in the distribution of the different metamorphic types; in fact more often than not the higher grades of metamorphism are related spacially to igneous intrusives. The kyanite-bearing schists and gneisses are very rare and so local in nature as to preclude their use in delimiting metamorphic zones. Commonly the kyanite crystals occur in random orientation in quartz augen in the gneisses, which indicates that they were not formed by regional stress.

MT. TOM HORNBLENDE GNEISS

The Mt. Tom hornblende gneiss occurs in the Hartland formation as concordant lenses and layers. Usually contacts with the enclosing sediments are not to be seen, but wherever visible the foliations of the sediments and the hornblende gneiss are parallel. Outcrops of the hornblende gneiss, neither plentiful nor exceptionally good, are rather isolated, small patches only rarely in visible contact with the Hartland formation. Any conclusions on the origin of this rock must be tentative pending further study of its relations to the Hartland formation in the New Preston quadrangle. The Torrington quadrangle also has fairly extensive outcrops of a hornblende gneiss which is probably the same as the Mt. Tom gneiss. The special distribution of the gneiss indicates an intrusive origin, but no cross-cutting relations of the Hartland formation by the hornblende gneiss have been observed. That it has undergone the same regional stresses as the Hartland is clearly indicated by its foliation and the lineation of the hornblende needles. Its foliation is always the same as that of the nearest Hartland, and where the hornblende needles have a linear direction, it is similar to the secondary crenulations of the mica foliations of the schist.

The best exposures of the gneiss occur in two areas: 1) a mile southeast of Morris and 2) 1,000 feet north of the corner 1½ miles west of the south end of Long Meadow Pond. The area north of the main road 1¼ miles east of Litchfield shows the lens and pod-like nature of gneiss where outcrops of both the Hartland and the hornblende gneiss are adequate.

The hornblende gneiss in this area is probably the same as the Mt. Tom hornblende gneiss described by Agar (1, p. 32). It is platy, dark green to black and white, gneissic or schistose rock composed principally of hornblende and andesine with minor amounts of magnetite, quartz, titanite, epidote, and biotite. Locally it is studded with garnet crystals 1/32 to 1/8 inches in diameter. The hornblende crystals occur either in random orientation in the plane of foliation or with a preferred lineation. This direction is consistently N 60°-80° W, plunge 20°-30°, even in widely scattered outcrops. The plagioclase is mottled and cloudy and is interstitial to the hornblende. The hornblende needles vary from a fraction of an inch up to an inch and a half in length.

A thorough study of the Mt. Tom hornblende gneiss in the New Preston quadrangle is planned and definite conclusions regarding its origin and relations to the Hartland are anticipated.

THE DIORITIC GNEISSES

These rocks and their modifications form the bulk of the Mt. Prospect complex. The reader is referred to the Survey Bulletin on the Mt. Prospect complex (2) for a detailed discussion of them. These dioritic gneisses which occupy an area between the Berkshire and Hartland formations have been described by Cameron (2, p. 16) as follows:

"The prevailing types of gneisses are fine-grained to medium-grained hornblende, biotite, and hornblende-biotite diorite gneisses consisting essentially of the minerals named together with oligoclase-andesine and minor amounts of other minerals. All are foliated, distinctly to indistinctly; some have linear structure due to parallel arrangement of hornblende prisms. The various types form layers fractions of an inch to more than 200 feet thick."

The dioritic gneiss in this quadrangle is exposed mainly in the Shepaug Aqueduct tunnel and its only contact with the Hartland occurs there in the area under Cranberry Pond. This contact is described by Agar (1) and discussed in detail by Cameron (2) and hence the relationship will only be summarized here. The Shepaug Aqueduct section from the Bantam River siphon eastward shows an interlayering of the Hartland and the several variations of the diorite for several thousand feet. The foliation of the diorite gneiss is everywhere parallel to that of the adjacent sediments. Cameron (2, p. 28) believes that " . . . the foliation of the dioritic gneisses is a metamorphic feature produced at the time of regional deformation, hence the diorites must already have been emplaced either before, or early in, the period of deformation."

THE GRANITIC ROCKS

The granitic rocks vary in their occurrences from dikes and sills a few feet to a hundred feet in width to large discordant masses such as that in the southeast corner of the quadrangle. The sills and/or dikes are indicated on the map by red lines and the larger bodies are colored solid red. The sills can seldom be traced for any distance but their frequency and attitude in local areas indicate a common source if not interconnections between separated outcrops. The concordant nature of the pegmatite intrusives is so frequently observed that such a relation is assumed even when contacts with the sediments are not found. The general trend of most of the pegmatite outcrops confirms such a view. Pegmatite dikes cross-cutting the foliation of the sediments may be found, but they are not abundant. In most cases the sills and dikes are standard pegmatites although occasionally one is a normal granite. The larger intrusive bodies are almost invariably fine- to coarse-grained granite with some pegmatitic facies. The pegmatites are very generally scattered throughout the area, but concentrations are found around the fairly large masses of granite in the northeast corner, in the southeast corner, and in the area southwest of Morris reservoir. These rocks are unquestionably younger than all other rocks except perhaps the norites. The relationship between the granitic rocks and the norite is not known.

Normally the pegmatites and granites are composed of microcline, albite, and quartz with minor amounts of muscovite, biotite, garnet, and magnetite. The pegmatites and the smaller granite sills and dikes are uniform and normal in every way. The main body of the Woodbury granite, however, has several unusual features. The northeast end of the main intrusive outcrops in the southeast corner of the area. Here the border zones frequently show a layering or banding on a fine to coarse scale which is primarily a textural variation. In the granite as a whole the texture varies from aplitic to pegmatitic. Many outcrops may only be described as a patchy mixture of granite and pegmatite with all textural variations in between and with no regular distribution of any particular texture. Locally along broad zones large graphic crystals of microcline and quartz ranging from an inch to 2 feet in length occur in a fine- to medium-grained granite matrix. Frequently plumose muscovite in plumes up to 18 inches is associated with the graphic crystal zones. These unique features require additional petrographic study and will be discussed in a later bulletin on the Woodbury granite.

It is very probable that the granitic intrusions played an important part in the metamorphism of some of the garnet-staurolite gneisses and schists and in the feldsparization and granitization of the sediments near the Woodbury granite. However, the effect of a particular sill or dike on the contiguous schist is negligible. Most contacts are sharp and, wherever observed, there are no apparent contact metamorphic effects. The granite gneisses in the southeast corner near the Woodbury granite have their foliation parallel to that of the nearest Hartland sediments and are probably products of granitization. Large granite gneiss inclusions which may well be roof pendants are not uncommon in the main body of the granite. Their gneissosity is essentially parallel to the foliation of the nearby sediments. These gneisses vary from what appears to be feldsparized Hartland sediments to a good granite gneiss which is difficult to distinguish from some types of the Woodbury granite. Although the granite gneisses usually have rather sharp contacts with the granite, it is likely that they were produced at an early stage of the same intrusion. All the granites, granite gneisses, and pegmatites are considered to be genetically related.

YOUNGER BASIC INTRUSIVES

The younger basic rocks are olivene norites, quartz norite, hypersthene pyroxenite and basic dikes which intrude primarily the assemblage of dioritic gneisses. There are very limited outcrops of these rocks in the area northwest of Bantam. These rocks are part of the Mt. Prospect complex and the reader is referred to Bulletin 76 of the Connecticut Geological Survey (2) for the details.

Summary of Conclusions

The Hartland formation is a series of rocks composed largely of mica and quartz in varying proportions, normally with subordinate amounts of garnet, staurolite, and kyanite. Recognizable lithologic units can seldom be traced any considerable distance and are known in some cases to be local variations in a rather continuous member. These local variations are thought to be due, at least in part, to underlying granitic intrusives. No horizon was found which could be traced far enough to determine the structures in the Hartland. Minor folds must be relied upon to reflect the over-all structure of the formation. The general structure appears to be isoclinal folds overturned from the northwest. The Mt. Prospect complex as well as the clusters of granitic intrusives occur at flexures in the regional trend of the Hartland.

The Mt. Tom hornblende gneiss occurs as a series of lenses in the Hartland formation and is probably older than the regional folding.

The scattered granites and pegmatites are not metamorphosed and were probably emplaced very late in the last regional deformation. They are considered to be genetically related to the main Woodbury granite intrusive.

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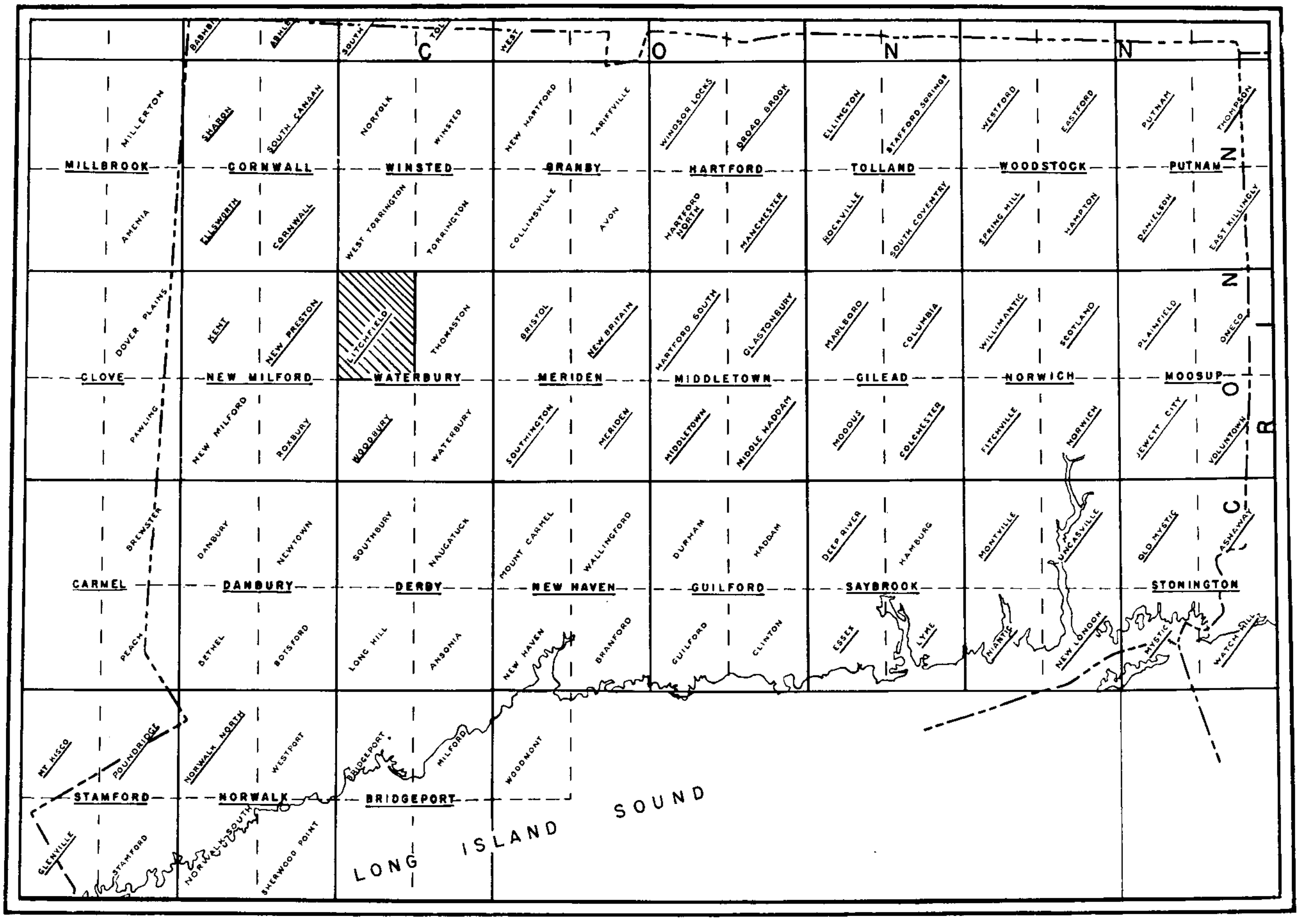

FIGURE 1. INDEX OF CONNECTICUT