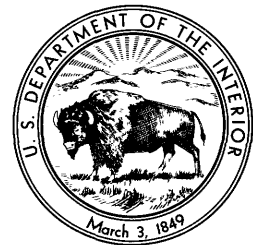


Fossils of the Littleton Formation (Lower Devonian) of New Hampshire

By A. J. BOUCOT *and* ROBERT ARNDT

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SHORTER CONTRIBUTIONS TO GENERAL GEOLOGY

FOSSILS OF THE LITTLETON FORMATION (LOWER DEVONIAN) OF NEW HAMPSHIRE

BY A. J. BOUCOT AND ROBERT ARNDT

ABSTRACT

Reexamination and study of fossils collected from 3 localities in New Hampshire show the presence of the brachiopods *Amphigenia* and *Eoderonaria* cf. *E. arcuata* at 2 of the localities. The evidence suggests a correlation of the containing strata with the Camden chert (Lower Devonian) of Tennessee. All the fossils are from slightly metamorphosed (chlorite zone) strata of the Littleton formation in northern New Hampshire. Fossils from highly metamorphosed (sillimanite zone) rocks correlated with the Littleton formation are determined to be of post-Early Ordovician age. Several thousand feet of unfossiliferous post-Silurian rocks, below the fossiliferous strata (Littleton formation) in the Littleton quadrangle, are present in part of the adjoining Whitefield quadrangle. The absence of these strata in part of the Whitefield quadrangle may be due to nondeposition or to erosion prior to deposition of strata of Camden age.

INTRODUCTION

The slightly metamorphosed fossiliferous beds of the Littleton formation crop out in the Littleton, Moosilauke, and Whitefield quadrangles of northwestern New Hampshire (fig. 3). Devonian fossils were first reported from this area by F. H. Lahee (1912). A previous study of the fauna by Cleaves (Billings and Cleaves, 1934) concluded that the strata which yielded the fossils are of Oriskany age. Restudy of the fossils available to Cleaves, plus those obtained from a new locality located by Arndt in the Whitefield quadrangle (collected by Boucot and others) demonstrates that the faunas are of Camden rather than of Oriskany age.¹ The locality in the Whitefield quadrangle was visited in the summer of 1949 by M. P. Billings, K. Fowler-Billings, and the authors.

The Littleton formation is the only formation in New Hampshire which has yielded generically identifiable fossils of Early Devonian age. All the speci-

mens are slightly metamorphosed. The Littleton has well-developed slaty cleavage and porphyroblasts of pyrite with pressure shadows of fibrous quartz (often in the beaks of the brachiopods). Metamorphism renders the specific identification of the fossils difficult. The nearest fossiliferous beds of similar age are to the northeast in Somerset County, Maine (upper part of the Moose River sandstone).

The following fossil-collecting localities are cited in text:

1. Pageau Farm (Tip Top Hill, loc. 8 of Billings and Cleaves, 1934), Littleton quadrangle, Grafton County, N.H. USGS SD-3247.
2. Mormon Hill (loc. 11 of Billings and Cleaves, 1934), Littleton quadrangle, Grafton County, N.H.
3. Mount Clough, Moosilauke quadrangle, Grafton County, N.H.
4. Dalton Mountain, Whitefield quadrangle, Coos County, N.H. USGS SD-3248. Two and three-quarters miles northwest of Whitefield, or one-half of a mile N. 10° E. of knob 2,000 feet elevation on northeast end of Dalton Mountain. (See fig. 4.)

AGE OF THE LITTLETON FORMATION

The fossils identified in the faunas collected from the Littleton formation and also the ones that are common to the upper part of the Moose River sandstone are shown on table 1. Inspection of table 1 indicates that the faunas from the Pageau Farm, Mormon Hill, and Dalton Mountain are very similar and therefore are concluded to be of the same age. The forms common to both the faunas of the Littleton formation and that of the upper part of the Moose River sandstone suggests that these two units are of the same age.

The presence of *Amphigenia* in three of the above mentioned faunas indicates that they are to be correlated with the zone of *Amphigenia* which elsewhere in North America (Cloud, 1942, p. 77; Cooper, 1942, chart) is thought to be restricted to strata of Onondaga age. In addition, the presence of highly convex speci-

¹The Camden chert, in Boucot's opinion, is of Early Devonian age, as it is a correlative at least of part of the lower Emsian portion of the standard section for the Devonian in the Rhineland. *Euryspirifer atlanticus* of the Littleton formation and the Moose River sandstone (upper part) is very similar to *Euryspirifer hercyniae* (Glebel) which characterizes the lower Emsian.

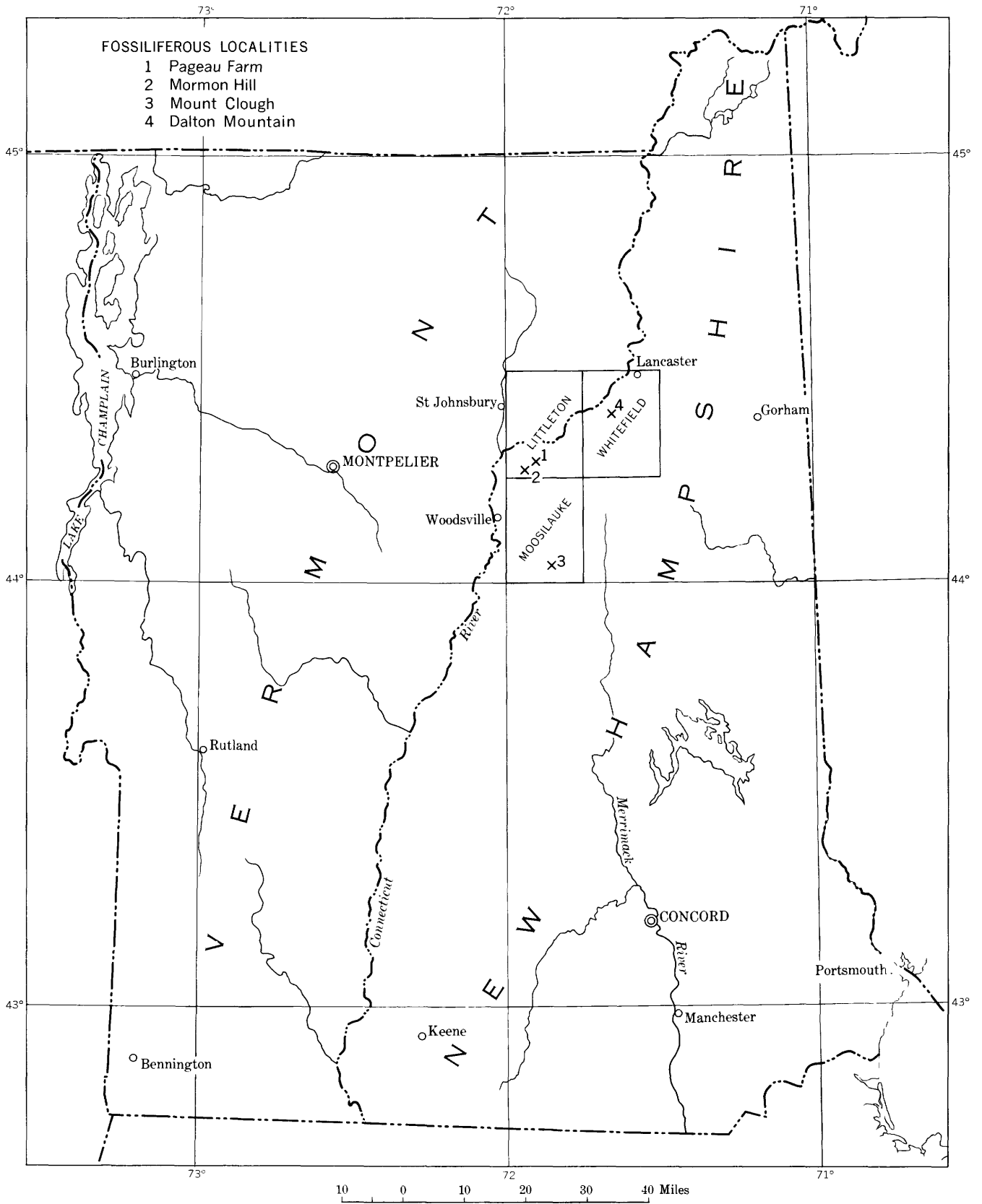


FIGURE 3.—Index map showing quadrangles cited in text.

TABLE 1.—Distribution of fauna from the Littleton formation of New Hampshire and the Moose River sandstone (upper part) of northern Maine

Fossil	Locality					Known stratigraphic range
	Dalton Mountain	Pageau Farm	Mormon Hill	Species common to Moose River sandstone (upper part)	Mount Clough	
Unidentified orthoid brachiopod.....		×				
<i>Rhipidomelloides muscolosa solaris</i>	×	×		×		Late Early Devonian.
<i>Costellirostra</i> sp.....	×					Late Early Devonian.
<i>Atrypa</i> "reticularis".....		×		×		Silurian and Devonian.
<i>Euryspirifer</i> cf. <i>E. atlanticus</i>		×	×	×		Late Early Devonian.
<i>Brachyspirifer</i> cf. <i>B. perimele</i>	×			×		Late Early Devonian.
<i>Protoleptostrophia</i> cf. <i>P. blainvillei</i>		×	×	×		
<i>Schuchertella?</i> sp.....			×	×		
<i>Leptaena</i> "rhomboidalis".....		×	×	×		Silurian to Mississippian.
" <i>Chonetes</i> " cf. " <i>C.</i> " <i>nectus</i>	×	×		×		Ordovician to Mississippian.
<i>Eodevonaria</i> cf. <i>E. arcuata</i>	×	×	×	×		Late Early Devonian.
<i>Amphigenia</i> cf. <i>A. parva</i>	×	×		×		Late Early Devonian.
<i>Prionothis?</i> sp.....		×		×		Late Early Devonian.
Brachiopod?.....					×	
Unidentified pterineoid pelecypod.....		×		×		
Pelecypod, unidentified.....	×					
<i>Tentaculites</i> sp.....			×			Ordovician to Devonian.

mens of *Eodevonaria*, and spiriferoids similar to *Euryspirifer atlanticus* are suggestive of a post-Oriskany age since these forms have not previously been reported from strata of Oriskany age or older.

The faunules obtained from the Littleton formation in the Littleton and Whitefield quadrangles occur in structurally isolated synclines from which the strata cannot be traced directly into the adjacent highly metamorphosed rocks with which they have been correlated.

At Mount Clough (fig. 3, loc. 3) two specimens were obtained from the metamorphic rocks correlated with the unmetamorphosed Littleton formation (Billings and Cleaves, 1935, p. 530-536). Both specimens were identified as brachiopods by Cleaves, and the better specimen (pl. 3, fig. 26) as "*Spirifer* sp. indet." The better specimen was probably a coarsely plicated bivalve, but no basis for reliable phyletic assignment, much less a generic assignment, exists. It is Boucot's opinion, after studying various faunas of early Paleozoic age from the northern Appalachians, that the specimens probably are brachiopods rather than pelecypods, although this opinion cannot be proved on a morphologic basis. If the specimens are brachiopods or pelecypods, it is probable that the containing beds are of post-Early Ordovician age. In Boucot's opinion the better specimen could be assigned to any coarsely plicate brachiopod, including forms such as *Platystrophia* and *Howellella*.

More detailed assignment of the strata must be based on stratigraphic sequence and lithologic similarity rather than on any fossil evidence.

As recognized by Billings and Cleaves (1935, p. 534), these specimens from Mount Clough were not sufficiently diagnostic to date the enclosing rocks. They assigned the rocks to the Littleton formation on the basis of stratigraphic position and lithologic character.

Because beds of massive gray sandstone at locality 2 are very poorly exposed, no attempt was made to determine their stratigraphic position within the sandy member. Cobbles of quartzite of the type found in the Albee formation are present in an outcrop of conglomerate that is approximately 250 feet west of locality 2 (fig. 4). Their large size suggests that the conglomerate lies relatively close to the contact with the Albee formation. The relation of bedding to cleavage indicates that a syncline lies to the southeast as at locality 2.

GEOLOGY OF THE DEVONIAN FOSSIL-COLLECTING LOCALITY ON DALTON MOUNTAIN

Fossils of Camden age are found in two exposures on the northwest limb of the Dalton Mountain subsidiary syncline (fig. 4) (Billings, 1955). The rocks at both exposures are slaty sandstone of the Littleton formation. At locality 1, which has yielded the most fossils and from which all the described material has come, the strata lie between 65 and 170 feet above the base of the sandstone, depending on whether the beds are repeated by folding or dip uniformly toward the southeast, with no minor folding. Field data indicate the presence of some minor folding, but its extent is undetermined because of the small size and scattered

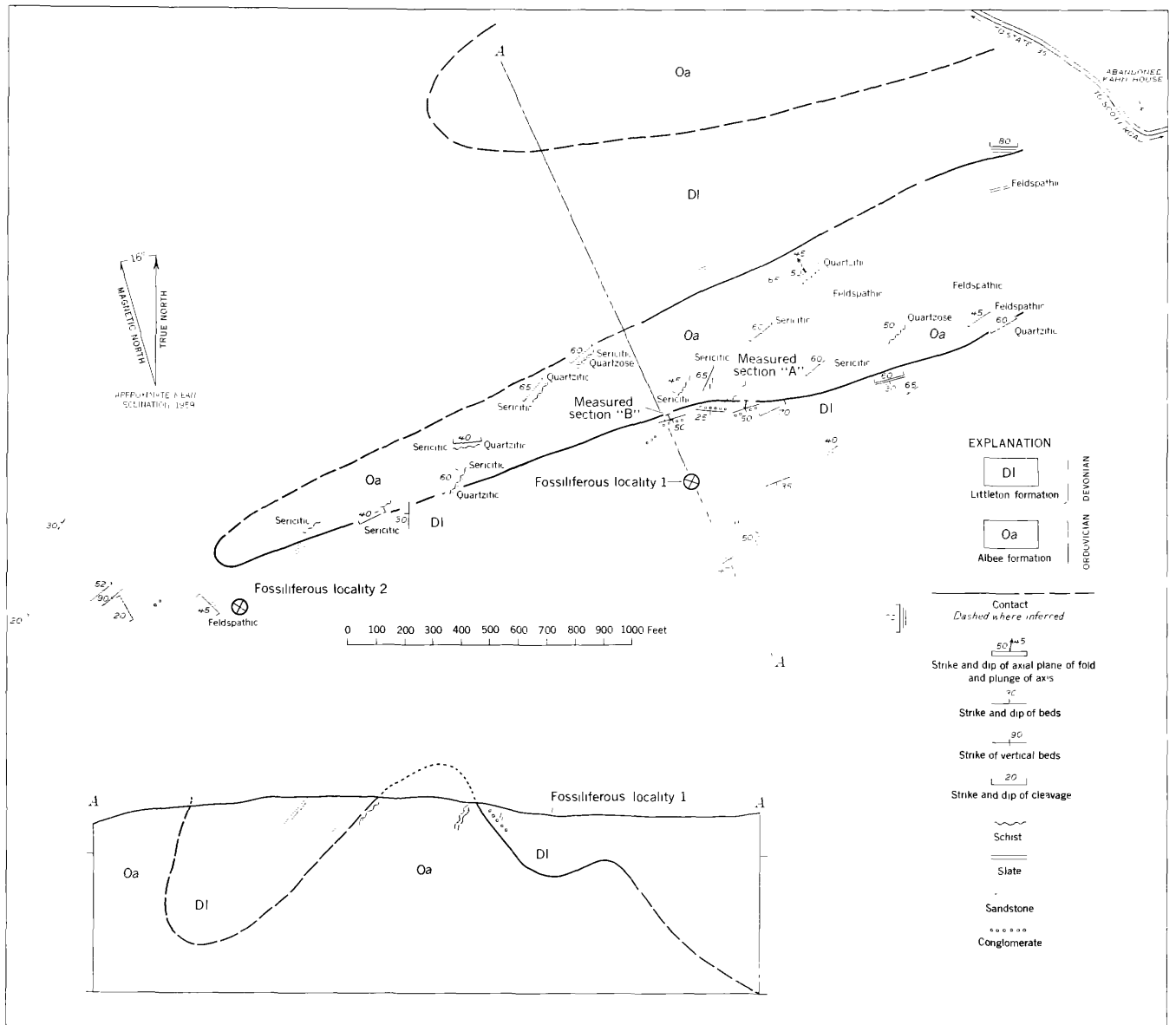


FIGURE 4.—Geologic map and cross section of area adjacent to the Devonian fossil locality, Dalton Mountain, Whitefield quadrangle, New Hampshire.

nature of the outcrops of essentially massive, slaty sandstone. General structural relations are shown in the cross section (fig. 4).

North of locality 1, the base of the Littleton formation consists of quartz-pebble conglomerate, gray quartzite, and dark-gray slaty sandstone that lie on the Albee formation. The contact between the formations is not exposed, but at one place it occurs within a covered zone 15 feet wide. The character of the base of the Littleton formation is suggested in two sections measured across the strike of the beds at this locality and shown below:

Section A of figure 4

Extensive covered zone	Feet
Conglomerate	2
Quartzite	1½
Gap and lateral offset	2
Conglomerate	2
Covered zone	15
Albee formation	—

Section B of figure 4

Conglomerate	Feet
Gap	1
Gray sandstone	15
Gap and lateral offset	3
Conglomerate	8
	1

Quartzite.....	Feet 3
Conglomerate.....	1
Quartzite.....	3
Gap and lateral offset.....	6
Gray sandstone.....	3
No other outcrops in this area	

Because beds of massive gray sandstone at locality 2 are very poorly exposed, no attempt was made to determine their stratigraphic position within the sandy member. Cobbles of quartzite of the type found in the Albee formation are present in an outcrop of conglomerate that is located approximately 250 feet west of locality 2 (fig. 4). Their large size suggests that the conglomerate lies relatively close to the contact with the Albee formation. The relation of bedding to cleavage indicates that a syncline lies to the southeast as at locality 1.

STRATIGRAPHY OF THE LITTLETON FORMATION ON DALTON MOUNTAIN

Fossils of Camden age have been found at three localities in the slightly metamorphosed strata of the Littleton formation in northern New Hampshire (fig. 3). In the Littleton quadrangle, at the Pageau Farm and Mormon Hill, diagnostic fossils occur about 2,500 to 3,000 feet above the base of the Littleton formation (Billings and Cleaves, 1934, p. 422), whereas on Dalton Mountain in the Whitefield quadrangle they occur about 65 to 170 feet (depending on whether the beds are repeated by folding or dip uniformly toward the southeast) above the base of the formation. In the Littleton quadrangle, as pointed out by Billings (1937), no fossils have been found in the lower 2,000 feet of the Littleton formation (which occurs in an isolated canoe-shaped syncline). Moreover, the formation rests with apparent conformity upon the Fitch formation, of Silurian age (Billings, 1937). Although older Lower Devonian fossils have not been found in the 2,500 feet of beds underlying those that contain fossils of Camden age in the Littleton quadrangle, there is no a priori reason to conclude that these barren beds are of the same age as those that contain fossils (Billings and Cleaves, 1934, p. 422).

The Littleton formation of Dalton Mountain occurs in a doubly plunging syncline. A small central anticline divides the doubly plunging syncline of Dalton Mountain lengthwise into two subsidiary synclines (Billings, 1955, geologic map).

Black slate interbedded with thin white to gray quartzite is most abundant in the northwestern subsidiary syncline, and at the southwestern end of Dalton Mountain in the southeastern subsidiary anticline. Slaty sandstone is abundant in the southeastern sub-

sidary syncline, especially at the northeastern end of Dalton Mountain, where it contains a conspicuous basal conglomerate that lies both on black slate of the northwestern subsidiary syncline and on the Albee formation. The sequence of beds within the Littleton formation of the northeastern part of Dalton Mountain, from base to top, is black slate (with thin gray to white quartzite), conglomerate, and slaty sandstone. This is similar to the sequence within the Littleton formation in the Littleton quadrangle except that there are, in addition, volcanic rocks associated with the conglomerate, which is made up largely of volcanic material (Billings, 1937).

Direct measurement of the thickness of the Littleton formation on Dalton Mountain is not possible because of relatively poor exposure. Billings (1937, p. 474-475) has shown that the ratio of apparent thickness to breadth of outcrop is 1 to 2 in vertical beds north-west of the Ammonoosuc thrust in the Littleton quadrangle. If this relation holds on Dalton Mountain, the black slate of the northwestern subsidiary syncline might be about 1,500 feet thick, for its dip averages 45° NW., over a zone about 4,300 feet broad. Similarly, the thickness of slaty sandstone of the southeastern subsidiary syncline might be approximately 1,200 feet, and the total thickness of the Littleton formation here at the widest part of the zone of outcrop might be about 2,700 feet.

The Littleton formation of Dalton Mountain lies on top of rocks of pre-Silurian and Silurian age. Rocks of pre-Silurian age include the Albee formation, which consists of interbedded quartzite, slate, and phyllite; and overlying Ammonoosuc volcanics of slaty, phyllitic, and schistose tuffs, flows, breccia, conglomerate, slate, and quartzite. Small patches of conglomerate, arkose, and dolomitic slate, assigned to the Fitch formation of Silurian age on the basis of similar lithology, lie unconformably on the pre-Silurian rocks in scattered localities. The black slate of the Littleton formation lies on the Albee formation in the western subsidiary syncline; on Ammonoosuc volcanics at the southwestern end of Dalton Mountain; and locally on rocks of the Fitch formation. At the north end of Dalton Mountain gray, slaty sandstone and basal conglomerate (consisting of pebbles of vein quartz plus quartzite similar to that of the Albee formation, embedded in a dark-gray, slaty sandstone matrix) of the Littleton formation lie on the Albee formation.

Whereas fossils date the slaty sandstone as of Camden age, the black slate, lacking fossils, is undated except that it is younger than the beds assigned to the Fitch formation and could be either of Silurian age or Early Devonian age.

The patchy occurrence of the Fitch formation in the Dalton Mountain area requires either that uplift and erosion, renewed after deposition of the Fitch formation, stripped most of it; or that the Fitch formation was accumulated here only in locally inundated areas during the Silurian, prior to the widespread deposition of the black muds of the Littleton formation.

The widespread distribution of the Littleton formation over rocks of pre-Silurian age indicates that the older rocks were uplifted and eroded before Littleton time began.

It has been recognized that the basal beds of the Littleton formation are contrastingly black slate, conglomerate, or slaty sandstone in different areas and that the conglomerate and slaty sandstone on Dalton Mountain and elsewhere are of Camden age. The close proximity on Dalton Mountain of areas in which slaty sandstone and conglomerate are the basal beds of the Littleton formation with those in which black slate is the basal part (fig. 4) requires explanation. Three possible interpretations are suggested:

The area at the northeast end of Dalton Mountain was one of nondeposition during the accumulation of the black mud of the Littleton formation elsewhere.

While black argillaceous sediment accumulated elsewhere, older rocks in a positive area at the northeast end of Dalton Mountain were being eroded and produced coarse clastic sediment which was deposited to the southeast.

Local uplift and erosion followed widespread deposition of the black muds of early Littleton time and exposed the underlying Albee formation at the northern end of Dalton Mountain. Rock debris eroded from the Albee formation and black mud from the lower part of the Littleton formation were incorporated in the conglomerate and slaty sandstone of Camden age.

Of these three possible explanations the writers prefer that which explains the black slate and conglomerate belonging to the lower part of the Littleton formation on Dalton Mountain as facies equivalents of the same age. However, until fossils are found in the black slate, or until more detailed fieldwork reveals an actual intertonguing relation between the two, the above conclusion cannot be considered to have been proved. It would be very desirable to restudy the stratigraphic relations existing within the fossiliferous Early Devonian rocks of northern New Hampshire with a view toward solving this question.

SYSTEMATIC PALEONTOLOGY

The specimens studied by Cleaves (Billings and Cleaves, 1934) were reexamined, and his specimens are refigured in this paper. Plate and figure numbers in

the following discussions are those of this paper. Catalog numbers of the Museum of Comparative Zoology, Cambridge, Mass., are cited as MCZ; those of the U.S. National Museum as USNM.

Genus RHIPIDOMELLOIDES Boucot and Ams'ien, 1958

Rhipidomelloides musculosa (Hall, 1857) *solaris* (Clarke, 1907)

Plate 1, figures 2-14

Rhipidomella musculosa Hall, var. *solaris* Clarke, 1907, New York State Mus. Bull. 107, p. 284, figs. 1, 3 [not fig. 2].

Clarke, 1909, New York State Mus. Mem. 9, pt. 2, p. 88, pl. 21, figs. 8, 10-11 [not fig. 9].

Platyorthis circularis Cleaves, 1934, [not Sowerby], Am. Jour. Sci., v. 28, p. 427-430, pl. 1, figs. 2, 3, 6.

Chonetes canadensis Cleaves, 1934, [not Billings, 1874], p. 431-432, pl. 1, figs. 5, 7, 8.

?*Schizophoria* sp. indet. Cleaves, 1934, p. 433.

Exterior.—Subcircular to transversely elliptical, unequally biconvex, the brachial valve with greater degree of convexity than the almost flat pedicle valve, which may be weakly sulcate. Hinge line short. Anterior commissure rectimarginate. Notothyrium filled by stout cardinal process. Pedicle interarea short. Surface multicostellate, increase in number of costellae by bifurcation and implantation. Pedicle interarea apsacline, brachial interarea orthocline.

Pedicle interior.—Delthyrial cavity shallow, dental plates anterolaterally merging with low ridges surrounding posterior half of muscle area and diverging at an angle of 60° to 110°. Hinge teeth short, stout, and diverging at same angle as dental plates. Muscle area very large and flabellate; may extend anteriorly almost to anterior margin. Anterior and lateral margins delicately crenulated with flat, usually grooved crenulations. Flabellate, paired adjustor-diductor scars, separated in median line by low, sharp myophragm, enclose small posteromedian adductor scars. Adductor scars paired, elongate, elliptical, anterior of pedicle callist, medially divided by myophragm.

Brachial interior.—Dental sockets open, brachio-phores diverging at angle corresponding to that of hinge teeth. Ponderous cardinal process extends to posterior margin; posterior face tilted anteriorly; anterior face tilted steeply posteriorly. Muscle area quadripartite, divided by low rounded septa. Muscle area extends anteriorly about two-fifths of length; anterior scars the larger. Brachio-phores long, supported anteriorly by secondary material, tips pointed.

Discussion.—This subspecies was first described by Clarke (1907), as a variety of "*Rhipidomella*" *musculosa* (Hall, 1857), from material collected by Olof Nylander. In the original description, "Moosehead Lake, Baker Brook Point; Brassua Lake east side;

Moose River at Stony Brook, Maine" are listed as localities (Clarke, 1907, p. 284). Clarke later gave the same locality list as above (Clarke, 1909, p. 88); on page 208 of the same volume, however, localities were assigned to four figured specimens (three of which had previously been figured in Clarke, 1907)—figures 8, 10, and 11 cited as from Tomhegan Point, Moosehead Lake, and figure 9 from Jackman Farm. Since rocks and fossils of only Oriskany age occur on Tomhegan Point and *R. musculosa solaris* is limited in both Maine and New Hampshire to beds of Camden age, it seems clear that the specimens represented by figures 8, 10, and 11 were collected from beds of Camden age probably on Baker Brook Point. Figure 9, representing a brachial valve, possesses the cardinalia and other characters of *Platyorthis*; it is, therefore, reasonable that it was collected from beds of Oriskany age at Jackman Farm.

Clarke's original description indicates that he founded his variety, considered here a subspecies, upon the characters of the pedicle valve: "These are all small shells with the enormous adductor (sic diductor-adductor) scar in a state of high development. These shells are somewhat less circular, more transverse than the New York and Grande Grève Oriskany specimens of *R. musculosa*, but their specific identity is not greatly veiled" (Clarke, 1907, p. 284). It is recommended that Clarke's name "*R. musculosa solaris*" be retained for the forms whose pedicle valves are figured in accordance with his implied intent.

Restudy of Cleave's collections shows that the specimens figured by him as *Platyorthis circularis* (pl. 1, figs. 9, 12, 13) are actually *Rhipidomelloides*. In addition several specimens figured by him as *Chonetes canadensis* (pl. 1, figs. 7, 8, 10) are also *Rhipidomelloides*, as is another assigned to *Schizophoria* sp. indet. (pl. 1, fig. 14).

The crenulations on the internal margins of *Platyorthis* are very distinctive owing to their branching character, as opposed to the unbranched crenulations present in rhipidomellids. "*Chonetes*" *canadensis* Billings, 1874, does not have internal margin crenulations, a subcircular outline or nearly so large a deeply impressed, flabellate muscle field in the pedicle valve. On the other hand it does have a short posterior median septum in the pedicle valve which is absent in *Rhipidomelloides*. *Chonetids* of the "*C.*" *canadensis* type do not possess dental plates, whereas *Rhipidomelloides* has prominently developed dental plates.

Holotype: The impression of a pedicle interior as figured by Clarke (1907, p. 284, right side of page, New York State Mus. type No. 8505) is here selected as the holotype.

Occurrence: Pageau Farm and Dalton Mountain.

Geologic location: Upper part of the Littleton formation in the Littleton quadrangle and base of the Littleton formation in the adjoining Whitefield quadrangle.

Geographic distribution: Somerset County, Maine (upper part of the Moose River sandstone of Camden age); northern New Hampshire; the Green Pond area of New Jersey, ("*Schizophoria* sp. cf. *S. striatula* (Schlotheim)" of Weller [1903] from the Kanouse sandstone of Camden age); possibly the "*R. alsa?*" Hall" of Dunbar (1919) from western Tennessee (Camden chert of late Early Devonian age).

Figured specimens: MCZ 8666; 8667, 8668; 8675; 8677; 8680; USNM 125503, 125518 A, 125519, 125526, 125528.

Unfigured specimens: MCZ 8669 A, B, D.

Unidentified orthoid brachiopod

Plate 1, figure 1

Chonetes sp. indet. Cleaves, 1934, Am. Jour. Sci., v. 28 p. 433.

Remarks.—A single impression of the interior of a pedicle valve was referred by Cleaves to *Chonetes* sp. indet., but the presence of a cordate muscle field laterally bounded by short dental lamellae and the impress upon the internal impression of radial costellae are indicative of an orthoid. The material is too poorly preserved to be generically identified.

Occurrence: Pageau Farm.

Geologic location: Upper part of the Littleton formation.

Figured specimen: MCZ 8679B.

Genus COSTELLIROSTRA Cooper, 1942

Costellirostra sp.

Plate 1, figures 15–16

Remarks.—A few specimens from Dalton Mountain possess the generic characters of *Costellirostra*. They are somewhat fragmentary but exhibit the form given in the following descriptions.

Exterior.—The exterior is not well enough preserved to ascertain its ornamentation. Biconvex, well-developed sulcus on pedicle valve that extends into a prominent tongue anteriorly and corresponds to the prominent U-shaped anterior margin of the brachial valve. Outline subcircular.

Brachial interior.—Short median septum present at posterior end of valve. Cardinalia not preserved in specimens studied.

Pedicle interior.—Short hinge teeth, muscle field deeply impressed, consisting of large diductor scars surrounding small pair of partly covered adductor impressions. Posterior half of muscle field divided by median septum.

Occurrence: Dalton Mountain.

Geologic location: Base of Littleton formation.

Geographic distribution: Eastern North America.

Figured specimens: USNM 125513, 125686.

Genus **ATRYPA** Dalman, 1828**Atrypa "reticularis" (Linnaeus, 1767)**

Plate 1, figure 17

?*Atrypa reticularis* (Linnaeus), Cleaves, 1934, *Am. Jour. Sci.*, v. 28, p. 433.

Remarks.—A single impression of the brachial interior from the Pageau Farm has the characters of *A. "reticularis"* including the characteristic muscle field and impression of the external ornamentation. On the same piece is an impression of the interior of an *Amphigenia* pedicle valve.

Occurrence: Pageau Farm.

Geologic location: Upper part of the Littleton formation.

Geographic distribution: World-wide.

Figured specimen: MCZ 8681.

Genus **EURYSPIRIFER** Wedekind, 1923**Euryspirifer cf. E. atlanticus (Clarke, 1907)**

Plate 1, figures 18–20, plate 2, figures 1–4

Spirifer primaevus Steinger *atlanticus* Clarke, 1907, *New York State Mus. Bull.* 107 p. 260–262.

Spirifer gaspensis Williams and Breger, 1916 [not Billings, 1874] *U.S. Geol. Survey Prof. Paper* 89, p. 107–113, pl. 4, fig. 7.

Spirifer purchisoni Cleaves, 1934, [not Castelnau] *Am. Jour. Sci.*, v. 28, p. 433–435, pl. 2, figs. 1, 2, 3, 4.

Leptocoelia sp. indet Cleaves, 1934, *Am. Jour. Sci.*, v. 28, p. 436, pl. 1, figs. 10–13.

Exterior.—External fine ornamentation destroyed during metamorphism, biconvex, outline subcircular to alate, strongly developed angular fold on brachial valve, well-developed sulcus on pedicle valve, pedicle interarea apsacline and concave, brachial interarea orthocline to gently apsacline, bordered by 6 to 14 lateral plications. Anterior commissure uniplicate and crenulate.

Pedicle interior.—Short, stout dental plates support stubby hinge teeth and laterally enclose deeply impressed muscle field. Impression of muscle field projects posteriorly well behind hinge line. Impression of external plications pronounced.

Brachial interior.—Cardinalia consist of comblike structure sunk into the floor of the notothyrial cavity, discrete hinge plates whose posterior face forms one side of dental sockets. Impression of lateral plications like those of pedicle valve.

Comparison.—Small specimens of *Euryspirifer* and *Acrospirifer* have almost identical form, as it is only among the larger specimens that the increased number of lateral plications characterizing *Euryspirifer* becomes evident. It is not surprising therefore that the hysterolitids from the Pageau Farm were mistakenly associated with *Acrospirifer purchisoni*. The destruction of fine ornamentation in these shells prevents the generic identification from being positive. Note the absence of crural plates in the brachial valve (pl. 2,

fig. 2), these structures being characteristic of the howellellids. *E. intermedius* (Hall, 1859) has fewer lateral plications than *E. atlanticus* (Clarke, 1907).

Occurrence: Pageau Farm and Mormon Hill.

Geologic location: Upper part of the Littleton formation.

Geographic distribution: Somerset County, Maine (upper part of the Moose River sandstone of Camden age, and northern New Hampshire).

Figured specimens: MCZ 8662, 8663, 8664, 8682 A, 8682 B, 8682 C, 8682 D.

Unfigured specimens: MCZ 8661, 8760 A–D.

Genus **BRACHYSPRIFER** Wedekind, 1923**Brachyspirifer cf. B. perimele Clarke, 1907**

Plate 2, figures 5–7

Spirifer perimele Clarke, 1907, *New York State Mus. Bull.* 107, p. 253–254.

Remarks.—The collections from Dalton Mountain contain a few hysterolitids possessing the form of *B. perimele*. They have a relatively broad sulcus bordered by numerous, low, rounded costellae, and have a deeply impressed pedicle muscle field. Unfortunately the material is too poorly preserved to be specifically identifiable.

Occurrence: Dalton Mountain.

Geologic location: Base of Littleton formation.

Geographic distribution: Somerset County, Maine (upper part of Moose River sandstone of Camden age), and northern New Hampshire.

Figured specimens: USNM 125508 A, 125510, 125524 A.

Genus **PROTOLEPTOSTROPHIA** Caster, 1939**Protoleptostrophia cf. P. blainvillei (Billings, 1874)**

Plate 2, figures 8–12

Strophomena blainvillei Billings, 1874, *Paleozoic fossils: Canada Geol. Survey*, p. 28, pl. 2, fig. 1.

Leptostrophia magnifica Cleaves, 1934 [not Hall], *Am. Jour. Sci.*, v. 28, p. 430–431, pl. 1, fig. 1.

Chonetes canadensis Cleaves, 1934 [not Billings], *Am. Jour. Sci.*, v. 28, p. 431–432, pl. 1, fig. 4.

Remarks.—Most of the available specimens consist of pedicle valves that are indistinguishable from *Leptostrophia*, but the presence of a brachial interior (pl. 2, fig. 8) showing the absence of either socket plates or a swollen chilidium demonstrate that the leptostrophids from the Littleton formation belong to *Protoleptostrophia*. The specimen assigned by Cleaves (pl. 1, fig. 4) to "*Chonetes*" *canadensis* has the characteristic radial ornamentation of a leptostrophid rather than the interrupted radial ornamentation present in "*C.*" *canadensis*.

Occurrence: Pageau Farm and Mormon Hill.

Geologic location: Upper part of the Littleton formation.

Geographic distribution: Eastern North America.

Figured specimens: MCZ 8671, 8671 A, 8674; USNM 125501, 125520 A.

Unfigured specimens: MCZ 8672 A–D.

Genus **SCHUCHERTELLA** Girty, 1904*Schuchertella?* sp.

Plate 3, figure 1

Remarks.—A single specimen from Mormon Hill apparently belongs to *Schuchertella*. It has the form and ornamentation of an orthotetacid. It is not possible to indicate the specific affinities of this shell.

Occurrence: Mormon Hill.

Geologic location: Upper part of the Littleton formation.

Geographic distribution: Worldwide.

Figured specimen: MCZ 8670.

Genus **LEPTAENA** Dalman, 1828*Leptaena* "rhomboidalis" (Wilckens, 1769)

Plate 3, figure 2

Remarks.—A few fragments from Mormon Hill and the Pageau Farm possess the wrinkled ornamentation and geniculate form of *L.* "rhomboidalis."

Occurrence: Pageau Farm and Mormon Hill.

Geologic location: Upper part of Littleton formation.

Geographic distribution: Worldwide.

Figured specimen: MCZ 8673.

Genus **CHONETES** Fischer, 1837

"Chonetes" cf. "C." nectus Clarke, 1907

Plate 3, figures 3-9

Chonetes nectus Clarke, 1907, New York State Mus. Bull. 107, p. 263-264, 4 figs.

Chonetes hitchcocki Cleaves, 1934, Am. Jour. Sci., v. 28, p. 432-433, pl. 1, fig. 15.

Chonetes sp. indet Cleaves, 1934 idem, p. 433, pl. 1, fig. 14.

Chonetes vicinus deflectus Williams and Breger, 1916 [not Hall], U.S. Geol. Survey Prof. Paper 89, pp. 49-52, pl. 3, fig. 8.

Remarks.—The relatively coarsely costellate chonetid from the Pageau Farm and Dalton Mountain is similar in form, as far as can be determined from the poor specimens available, to "*Chonetes*" *nectus*. Unfortunately, Cleaves' material is too poor to enable one to demonstrate statistically that his "*Chonetes hitchcocki*" is not a synonym of "*C.*" *nectus*, but the morphology of the specimens is similar, as is their stratigraphic position; therefore, it seems most reasonable to consider them as synonymous.

Occurrence: Pageau Farm and Dalton Mountain.

Geologic location: Upper part of Littleton formation in Littleton quadrangle, and base of Littleton formation in Whitefield quadrangle.

Geographic distribution: Somerset County, Maine (upper part of Moose River sandstone of Camden age), northern New Hampshire.

Figured specimens: MCZ 8678 A, C, 8679 A, H. USNM 125509, 125514 A, 125514 B.

Unfigured specimens: MCZ 8679 C-G.

Genus **EODEVONARIA** Breger, 1906*Eodevonaria* cf. *E. arcuata* (Hall, 1857)

Plate 3, figures 10-13

Remarks.—Highly convex chonetids possessing finely costellate radial ornamentation and a denticulate hinge line occur in the Littleton formation. The form, in addition to the denticulate hinge line, indicates that this material should be assigned to *Eodevonaria*, the most similar species being *E. arcuata*.

Occurrence: Pageau Farm, Mormon Hill, and Dalton Mountain.

Geologic location: Upper part of Littleton formation in Littleton quadrangle, and base of Littleton formation in Whitefield quadrangle.

Geographic distribution: Eastern North America.

Figured specimens: MCZ 9412, USNM 125515, 125521.

Genus **AMPHIGENIA** Hall, 1867*Amphigenia* cf. *A. parva* Clarke, 1907

Plate 3, figures 14-20

Exterior.—Smooth, biconvex, elongate to subcircular in outline, brachial valve gently convex, pedicle valve carinate.

Pedicle interior.—Well-developed spondylium supported by a median septum composed of medially convergent dental plates evident in material from New Hampshire.

Brachial interior.—Long crural plates support a perforate cardinal plate. Adductor muscle field narrow and split into four subparallel impressions, separated by low ridges.

Occurrence: Pageau Farm and Dalton Mountain.

Geologic location: Upper part of Littleton formation in Littleton quadrangle, and base of Littleton formation in Whitefield quadrangle.

Geographic distribution: Eastern North America.

Figured specimens: MCZ 8681; USNM 125506, 125508 B, 125511, 125517 A, 125522, 125523 B.

Genus **PRIONOTHYRIS** Cloud, 1942*Prionothis?* sp.

Plate 3, figures 21-25

Exterior.—Subcircular outline, surface smooth except for concentric growth lines, subequally biconvex with pedicle valve having greater convexity, anterior commissure rectimarginate.

Brachial interior.—Short crural plates support cardinal plate which is surmounted by terminally bifid cardinal process. Detailed form of cardinal process not known, but suggests *Prionothis*; is similar to an undescribed species from upper part of Moose River sandstone. Cardinal plate imperforate. Narrow, medial

adductor field weakly impressed and divided medially by low myophragm.

Pedicle interior.—Dental plates obsolete. Muscle field elongate, subovate, divided into a small pair of medial adductor scars entirely surrounded by large, more deeply impressed diductor field. Myophragm divides muscle field medially.

Occurrence: Pageau Farm.

Geologic location: Upper part of Littleton formation in Littleton quadrangle.

Geographic distribution: Eastern North America and Colombia.

Figured specimens: USNM 125500 B, 125504 A, 125512 B, 125516, 125527.

Unidentified pterineoid pelecypod

Plate 3, figures 29–31

Pterinea radialis Cleaves, 1934 [not Clarke], Am. Jour. Sci., v. 28, pp. 436–437, pl. 2, figs. 5–7.

Remarks.—A few left valves of a pterineoid pelecypod have the external ornamentation and form of *Actinopteria textilis*, but the material is too poorly preserved for positive identification. Pelecypods of similar aspect have been found in the upper part of the Moose River sandstone.

Occurrence: Pageau Farm.

Geologic location: Upper part of the Littleton formation.

Figured specimens: MCZ 15056, 15057, 15058.

Unidentified pelecypod

Plate 3, figure 28

Remarks.—A single impression of the interior of a right valve belonging to a strongly keeled pelecypod with prominent growth lines, and a subrectangular outline was found at Dalton Mountain. The general form is goniophorid, but the specimen is too poorly preserved to be generically identified.

Occurrence: Dalton Mountain.

Geologic location: Base of the Littleton formation.

Figured specimen: USNM 125502 B.

Genus TENTACULITES Schlotheim, 1820

Tentaculites sp.

Plate 3, figure 27

Tentaculites schlotheimi Cleaves, 1934 [not Koken], Am. Jour. Sci., v. 28, p. 437.

Remarks.—A single poorly preserved tentaculitid was found in the beds at Mormon Hill, but it is too poorly preserved to be specifically identifiable.

Occurrence: Mormon Hill.

Geologic location: Upper part of the Littleton formation.

Figured specimen: MCZ 27907.

SUMMARY

The slightly metamorphosed slaty sandstone and conglomerate of the Littleton formation, which rests unconformably upon pre-Silurian strata at the north-eastern end of Dalton Mountain, in the Whitefield quadrangle are of Camden age as is the upper part of that unit in the adjacent Littleton and Moosilauke quadrangles. The lower 2,000 feet of the Littleton formation in the Littleton and Moosilauke quadrangles is unfossiliferous but is bracketed between strata of Silurian and late Early Devonian (Camden) age as are equivalent black slates on the northwest side and southwest end of Dalton Mountain. Paleontologic evidence suggests that the metamorphosed rocks assigned to the Littleton formation on Mount Clough are of post-Early Ordovician age. The correlation of the unmetamorphosed Littleton formation with the metamorphosed rocks assigned to this unit must be made wholly on the basis of similar stratigraphic sequence and lithology as Billings concluded (1937).

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[Italic numbers indicate descriptions]

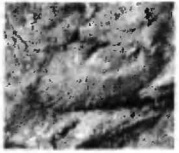
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PLATES 1-3

PLATE 1

FIGURE 1. Unidentified orthoid brachiopod (p. 47).

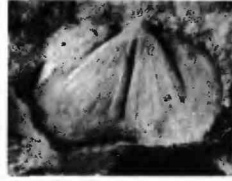
- Impression of the interior; probably of a brachial valve ($\times 2$). This specimen is too fragmentary to be assigned generically with any degree of assurance. Pageau Farm. Upper part of the Littleton formation. MCZ 8679 B.
- 2-14. *Rhipidomelloides muscolosa* (Hall, 1857) *solaris* (Clarke) (p. 46).
2. Impression of the interior of a pedicle valve ($\times 1$). Note the flabellate diductor impressions, and the paired adductor impressions located toward the posterior of the specimen. A median septum divides the muscle field. Dalton Mountain. Base of Littleton formation. USNM 125526.
 3. Impression of the interior of a pedicle valve ($\times 1$). Note the nature of the muscle field and the impression of the crenulations on the anterior margin. Dalton Mountain. Base of the Littleton formation. USNM 125518 A.
 4. Impression of the exterior of a pedicle valve ($\times 1$). Note the origin of the costellae largely by bifurcation. Dalton Mountain. Base of the Littleton formation. USNM 125519.
 5. Impression of the interior of a brachial valve ($\times 1$). Note the quadrilobate impressions of the adductor muscles. Dalton Mountain. Base of the Littleton formation. USNM 125503.
 6. Impression of the interior of a brachial valve ($\times 1$). Note the disposition of the cardinal process, brachio-phores and median septum impressions. Dalton Mountain. Base of the Littleton formation. USNM 125528.
 7. Partially exfoliated brachial valve ($\times 2$). Note the crenulations along the anterior margin and the impression of the broad median septum. Pageau Farm. Upper part of the Littleton formation. MCZ 8677. Pl. 1, fig. 8 of Billings and Cleaves, 1934.
 8. Anterior three-quarters of impression of interior of pedicle valve ($\times 2$). Note the median septum and the crenulation of the anterior margin. Pageau Farm. Upper part of the Littleton formation. MCZ 8675. Pl. 1, fig. 5 of Billings and Cleaves, 1934.
 9. Impression of the interior of a pedicle valve ($\times 1$). Note the flabellate impression of the muscle field and the elongation due to deformation. Pageau Farm. Upper part of Littleton formation. MCZ 8667. Pl. 1, fig. 3 of Billings and Cleaves, 1934.
 10. Anterior three-quarters of impression of interior of pedicle valve ($\times 2$). Note the crenulations on the anterior margin, and the impression of the pyrite porphyroblast. Pageau Farm. Upper part of the Littleton formation. MCZ 8676. Pl. 1, fig. 7 of Billings and Cleaves, 1934.
 11. Interior of pedicle valve ($\times 2$). Note the dental plates and the secondary material extending anteriorly from them. Pageau Farm. Upper part of the Littleton formation. MCZ 8666. Counterpart of fig. 12.
 12. Impression of the interior of a pedicle valve ($\times 2$). Note the impression of the pedicle callist and the paired adductor scars. Pageau Farm. Upper part of the Littleton formation. MCZ 8666, Pl. 1, fig. 6, of Billings and Cleaves, 1934.
 13. Impression of the interior of a pedicle valve ($\times 2$). Note the impression of the dental lamellae. Pageau Farm. Upper part of the Littleton formation. MCZ 8668. Pl. 1, fig. 2 of Billings and Cleaves, 1934.
 14. Impression of the exterior of a pedicle valve ($\times 2$). Note the origin of the costellae largely by bifurcation. Pageau Farm. Upper part of the Littleton formation. MCZ 8680.
- 15, 16. *Costellirostra* sp. (p. 47).
15. Impression of the interior of a brachial valve ($\times 2$). Note the thin median septum. Dalton Mountain. Base of the Littleton formation. USNM 125686.
 16. Impression of the interior of a pedicle valve ($\times 2$). Note the elliptical diductor impressions surrounding the minute adductor impressions. Dalton Mountain. Base of the Littleton formation. USNM 125513.
17. *Atrypa "reticularis"* (Linnaeus) (p. 48).
Impression of the interior of a pedicle valve ($\times 2$). Pageau Farm. Upper part of the Littleton formation. MCZ 8681.
- 18-20. *Euryspirifer* cf. *E. atlanticus* (Clarke) (p. 48).
18. Internal impression of a pedicle valve ($\times 2$). The lateral portions of this specimen are missing. Pageau Farm. Upper part of the Littleton formation. MCZ 8682 B. Pl. 1, fig. 10 of Billings and Cleaves, 1934.
 19. Internal impression of a brachial valve ($\times 2$). Note the lack of crural plates. Pageau Farm. Upper part of the Littleton formation. MCZ 8682 D. Pl. 1, fig. 11 of Billings and Cleaves, 1934.
 20. Internal impression of a brachial valve ($\times 2$). Pageau Farm. Upper part of the Littleton formation. MCZ 8682 A. Pl. 1, fig. 13 of Billings and Cleaves, 1934.



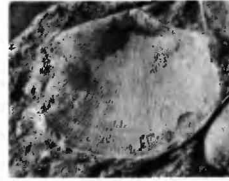
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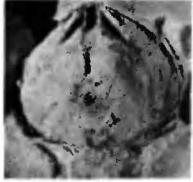
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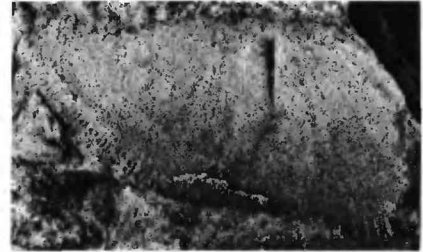
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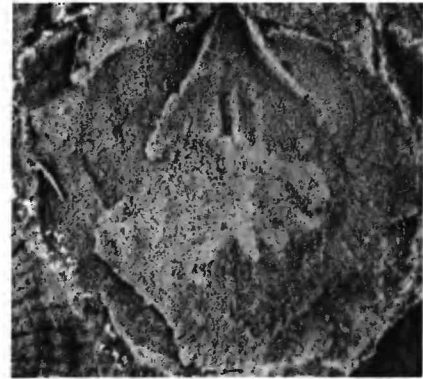
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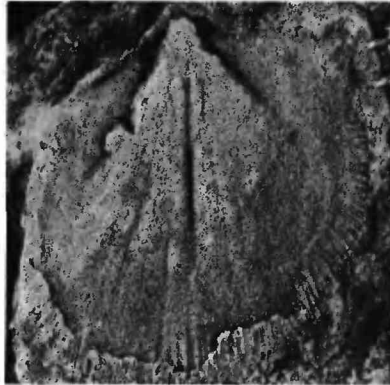
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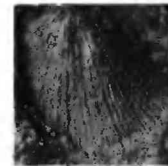
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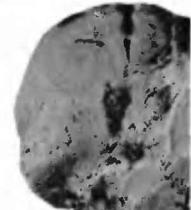
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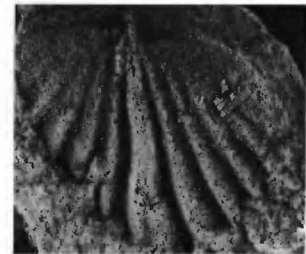
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PLATE 2

FIGURE 1-4. *Euryspirifer* cf. *E. atlanticus* (Clarke) (p. 48).

1. Internal impression of a pedicle valve ($\times 2$). Note the presence of about six lateral plications. Pageau Farm. Upper part of the Littleton formation. MCZ 8682 C. Pl. 1, fig. 12 of Billings and Cleaves, 1934.
 2. Impression of the interior of a brachial valve ($\times 2$). Note the absence of crural plates and the presence of 10 lateral plicae. Pageau Farm. Upper part of the Littleton formation. MCZ 8664. Pl. 2, fig. 4 of Billings and Cleaves, 1934.
 3. Impression of the interior of a pedicle valve ($\times 2$). Pageau Farm. Upper part of the Littleton formation. MCZ 8663. Pl. 2, fig. 3 of Billings and Cleaves, 1934.
 4. Impression of the interior of a pedicle valve ($\times 2$). Note the flabellate muscle field which bears the impress of the external ornamentation. Pageau Farm. Upper part of the Littleton formation. MCZ 8662. Pl. 2, fig. 2 of Billings and Cleaves, 1934.
- 5-7. *Brachyspirifer* cf. *B. perimele* (Clarke) (p. 48).
5. Impression of the interior of a pedicle valve ($\times 1$). Note the nearly obsolete dental lamellae and the sharply demarcated outline of the muscle impressions. Dalton Mountain. Base of the Littleton formation. USNM 125510.
 6. Impression of the interior of a pedicle valve ($\times 2$). Note the deeply impressed muscle field. Dalton Mountain. Base of the Littleton formation. USNM 125508 A.
 7. Impression of the interior of a pedicle valve ($\times 2$). Note the relative width of the sulcus and first lateral plication as contrasted with those of *Euryspirifer* cf. *E. atlanticus*. Base of the Littleton formation. USNM 125524 A.
- 8-12. *Protoleptostrophia* cf. *P. blainvillei* (Billings) (p. 48).
8. Impression of the interior of a brachial valve ($\times 1$). Note the cardinal process lobes, the deeply impressed adductor scars, the pustulose genital areas, the absence of socket plates, and the absence of a large chilidium. Pageau Farm. Upper part of the Littleton formation. USNM 125520 A.
 9. Partially exfoliated pedicle valve ($\times 1$). Note the flabellate impression of the muscle field and the pustulose genital area. Pageau Farm. Upper part of the Littleton formation. MCZ 8671. Pl. 1, fig. 1 of Billings and Cleaves, 1934.
 10. Impression of the exterior of a pedicle valve ($\times 1$). Pageau Farm. Upper part of the Littleton formation. MCZ 8671 A.
 11. Impression of the exterior of a pedicle valve ($\times 1$). Pageau Farm. Upper part of the Littleton formation. USNM 125501.
 12. Exterior of a pedicle valve ($\times 2$). Pageau Farm. Upper part of the Littleton formation. MCZ 8674. Pl. 1, fig. 4 of Billings and Cleaves, 1934.



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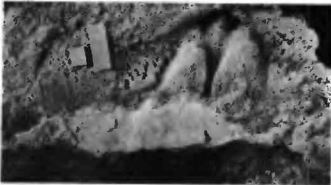
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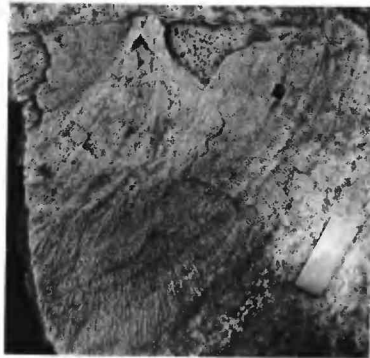
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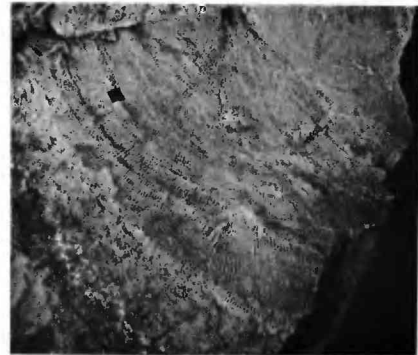
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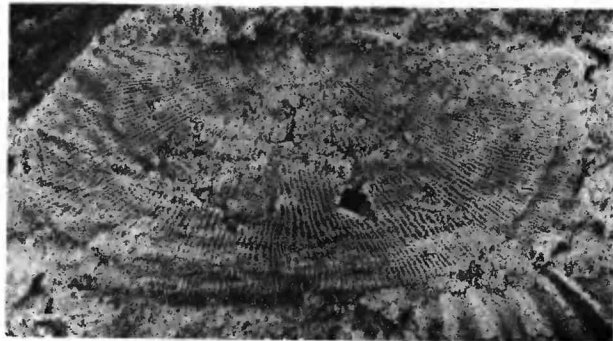
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BRACHIOPODS FROM THE LITTLETON FORMATION

PLATE 3

FIGURE 1. *Schuchertella?* sp. (p. 49).

- Internal impression of a brachial valve ($\times 2$). Mormon Hill. Upper part of the Littleton formation. MCZ 8670. Pl. 1, fig. 9 of Billings and Cleaves, 1934.
2. *Leptaena "rhomboidalis"* (Wilckens) (p. 49).
Impression of the exterior of a pedicle valve ($\times 2$). Mormon Hill. Upper part of the Littleton formation. MCZ 8673.
- 3-9. "*Chonetes*" cf. "*C.*" *nectus* Clarke (p. 49).
3. Impression of interior of a pedicle valve ($\times 2$). Pageau Farm. Upper part of the Littleton formation. MCZ 8679 A.
4. Impression of exterior of a brachial valve ($\times 3$). Dalton Mountain. Base of Littleton formation. USNM 125514 B.
5. Impression of exterior of a brachial valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 8678 C.
6. Impression of exterior of a brachial valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 8679 H. Pl. 1, fig. 14 of Billings and Cleaves, 1934.
7. Impression of exterior of a brachial valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 8678 A. Pl. 1, fig. 15 of Billings and Cleaves, 1934.
8. Impression of interior of a pedicle valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. USNM 125509.
9. Impression of interior of brachial valve ($\times 3$). Dalton Mountain. Base of Littleton formation. USNM 125514 A.
- 10-13. *Eodevonaria* cf. *E. arcuata* (Hall) (p. 49).
10. Impression of interior of pedicle valve ($\times 2$). Dalton Mountain. Base of Littleton formation. USNM 125515.
11. Impression of interior of pedicle valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125521.
12. Impression of interior of pedicle valve (posterior view) ($\times 2$). Note denticulations on left part of figure. Mormon Hill. Upper part of Littleton formation. MCZ 9412.
13. Impression of interior of pedicle valve ($\times 1$). Mormon Hill. Upper part of Littleton formation. MCZ 9412.
- 14-20. *Amphigenia* cf. *A. parva* Clarke (p. 49).
14. Impression of exterior of brachial valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125517 A.
15. Impression of interior of brachial valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125523 B.
16. Impression of interior of brachial valve ($\times 1$). Dalton Mountain. Base of Littleton formation. USNM 125506.
17. Impression of interior of pedicle valve ($\times 2$). Dalton Mountain. Base of Littleton formation. USNM 125508 B.
18. Impression of interior of pedicle valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125511.
19. Impression of interior of brachial valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. USNM 125522.
20. Impression of interior of pedicle valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 8681.
- 21-25. *Prionothis?* sp. (p. 49).
21. Impression of interior of pedicle valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125504 A.
22. Impression of interior of brachial valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125527.
23. Silicified cardinalia ($\times 3$). Pageau Farm. Upper part of Littleton formation. USNM 125516.
24. Impression of interior of pedicle valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 125512 B.
25. Impression of interior of brachial valve ($\times 1$). Pageau Farm. Upper part of Littleton formation. USNM 12550 B.
26. Brachiopod? (p. 47).
Impression of exterior of questionable brachiopod ($\times 2$). Elevation of 2,670 feet, northern slide, on the east slope of Mount Clough, Moosilauke quadrangle, New Hampshire. Littleton formation. MCZ 8709.
27. *Tentaculites* sp. (p. 50).
Impression of interior ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 27097. Pl. 2, fig. 6 of Billings and Cleaves, 1934.

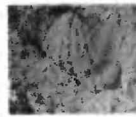
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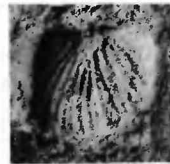
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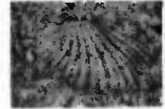
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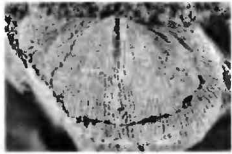
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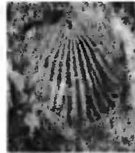
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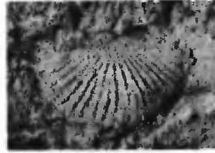
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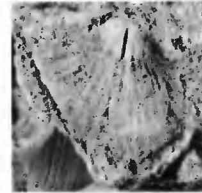
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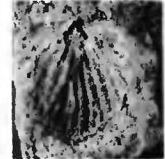
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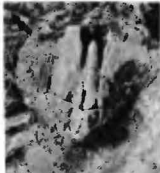
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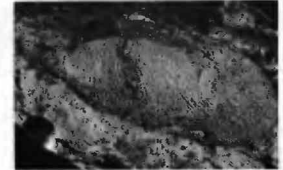
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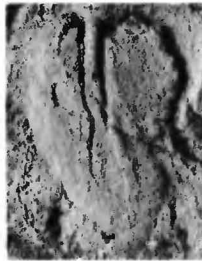
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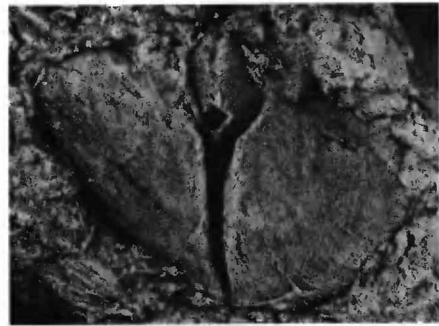
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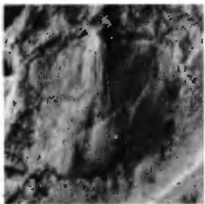
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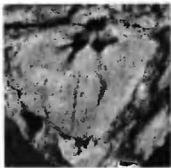
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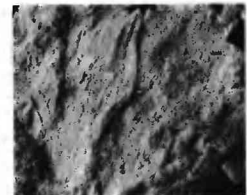
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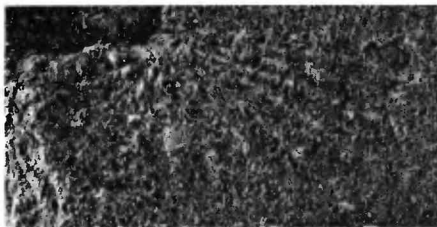
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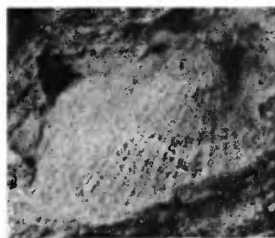
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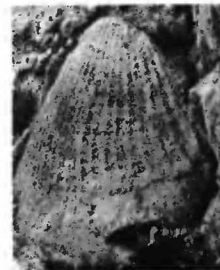
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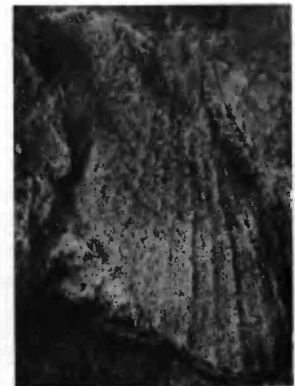
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PLATE 3—Continued

FIGURE 28. Unidentified pelecypod (p. 50).

Impression of interior of right valve ($\times 1$). Dalton Mountain. Base of Littleton formation. USNM 125502 B.

29–31. Unidentified pterineoid pelecypods (p. 50).

29. Impression of interior of left valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 15058. Pl. 2, fig. 7 of Billings and Cleaves, 1934.

30. Impression of interior of left valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 15056. Pl. 2, fig. 5 of Billings and Cleaves, 1934.

31. Impression of interior of left valve ($\times 2$). Pageau Farm. Upper part of Littleton formation. MCZ 15057. Pl. 2, fig. 6 of Billings and Cleaves, 1934.