XII. FOSSILS FROM THE GLACIAL DRIFT AND FROM THE DEVONIAN AND MISSISSIPPIAN NEAR MEADVILLE, PENNSYLVANIA.¹

By William Millward.

This paper falls naturally into two parts, namely, the fossils of the glacial drift, and the fossils found in the bedrock. In dealing with the former phase of the subject the writer has felt free to cover a considerable extent of territory, because of the wide extent of the glacial deposits. Specimens have been collected at Conneaut Lake, Harmonsburg, Meadville, Kerrtown, Saegertown, South Oil City, Reno, Utica, Sugar Creek, Carlton, and from the river gravels at Cheswick. Nearly all of the glacial drift of this section of northwestern Pennsylvania is late Wisconsin. There is, however, on the hills on the east bank of French Creek between Utica and Sugar Creek, an extensive deposit of earlier drift, presumably Kansan or Pre-Kansan. In dealing with the fossils of the bedrock only the immediate region of Meadville has received attention.

The writer takes this occasion to acknowledge his indebtedness to Dr. Percy E. Raymond of the Carnegie Museum, Pittsburgh, for his kindness in checking and correcting the identification of the corals and other fossils from the glacial drift, and of most of the fossils from the bedrock; and for his aid and direction in the preparation of this paper. He is also indebted to Prof. Robert S. Breed, Allegheny College, Meadville, for his direction and oversight in the preparation of the original paper of which this is a revision. Thanks are also due Messrs. W. L. Mould, W. R. Main, Abram Wilkinson, L. W. Sherwin, McNair, Taylor, and First, for specimens contributed or loaned.

The Fossils of the Glacial Drift.

The drift is made up of subangular stones mingled with gravel, clay, and sand. In some places the materials of the drift have been water-worked and are stratified, while in other deposits no stratification

¹This paper is a revised abstract of a thesis which won the second Heckel prize at Allegheny College, June, 1908. A suite of the fossils on which the paper is based has been deposited in the Carnegie Museum.
is visible. Probably less than one per cent. of the pebbles of the drift in this region were derived from Archaean rocks, and the remaining debris consists of fragments of sandstone, chert, and limestone. Pieces of shale and sandstone bearing Chemung fossils are most abundant. These pebbles contain such characteristic species as *Spirifer disjunctus*, *Reticularia praematura*, *Camarotochia contracta*, *Productella lacrymosa*, *Athyris angelica* and *Leiorhynchus mesacostale*. No attempt was made to make a complete collection from this class of pebbles. Less abundant than these sandy pebbles, but still quite common, are fragments of fossiliferous chert, while the pebbles of limestone make up an insignificant portion of the drift. Practically all the fossils in the cherts are silicified, and while many of them are considerably water-worn and rounded, many fine specimens may be obtained. With but few exceptions the cherts have been much weathered since transportation to this region. The flint has decomposed to a white chalky material, and occasionally a delicate coral is found entirely freed from the matrix, a condition in which it could not possibly have withstood the rough usage of ice transportation.

**List of Fossils Found in the Limestone and Chert Pebbles of the Wisconsin Drift.**

- *Stromatoporella granulata*,
- *S. tuberculata*,
- *Stromatoporella sp.*,
- *Favosites hemisphericus*,
- *F. canadensis*,
- *F. clausus*,
- *F. emmonsi*,
- *F. epidermatus*,
- *F. limitaris*,
- *F. nitellus*,
- *F. plcacentus*,
- *F. tuberosus*,
- *F. turbinatus*,
- *Favosites 2 sps.*,  
- *Aulopora cornuta*,
- *A. serpens*,
- *Romingeria umbelisera*,
- *Syringopora hisingeri*,
- *Cystiphyllum sulcatum*,
- *C. varians*,
- *Eridophyllum verneuilanum*,
- *Synaptophyllum simcanse*,
- *Streptelasma 3 sps.*,  
- *Heliophyllum corniculum*,
- *H. halli*,
- *Zaphrentis convoluta*,
- *Z. elegans*,
- *Z. gigantea*,
- *Z. prolifica*,
- *Z. simplex*,
- *Z. spissa*,
- *Stropheodonta perplana*,  
- *S. hemisphaerica*,
- *S. inequistrata*,
- *Leptana rhomboidals*,
- *Schuchertella chemungensis*,
S. maclurei,  
S. perelegans,  
S. tabulata,  
Syringopora sp.,  
Chonostegites clappi,  
C. ordinatus,  
Chonostegites 2 spp.,  
Michelinia convexa,  
Cladopora cryptodens,  
C. pulchra,  
Striatopora linnaeana,  
Pleurodictyum styloporum,  
Halysites catenulatus,  
Acrisularia davidsoni,  
Philipsastraea verneuili,  
Crepidophyllum colligatum,  
Acrophyllum oneidaense,  
Blothophyllum decorticatum,  
Cyathophyllum conatum,  
C. robustum,  
Cyathiphyllum conifollis,  
Chonetes sp.,  
Camarotoechia tethys,  
Delthyris raricosta,  
Spirifer gregarius,  
Atrypa reticularis,  
Anopllothere acutilicicata  
Dalmanella lenticularis,  
D. testudinaria,  
Plectambonites sericeus,  
Callonema bellulata,  
Platystoma lineatum,  
Platycceras dumosum,  
Tentaculites scalariformis,  
Calymene platys,  
Encrinurus sp.,  
Acidaspis callicera,  
Prodictus sp.,  
Phacops cristata,  
P. cristata var. pipa,  
Phacops sp.,  
Cornulites sp.

Of these fossils thirty-six species are found in the Onondaga, thirteen in the Hamilton, one in the Niagara, two in the Trenton, nine in both the Onondaga and Hamilton, two in the Onondaga and Chemung, one in the Onondaga, Hamilton, and Chemung, one in the Oriskany, Onondaga, and Hamilton, and two are fossils which range all through the upper part of the Paleozoic.

**The Source of the Drift.**

In the Second Geological Survey of Pennsylvania, 1881, Vol. Q4, p. 31, Dr. I. C. White states that the direction of glacial scratches on thirty or forty hill-tops in Erie and Crawford counties is uniformly about S. 30° E. College Hill, Meadville, is one of these hills. Ice coming in the direction indicated by these scratches, would, in crossing the province of Ontario, pass over strata of Hamilton, Onondaga, Niagara, and Trenton age and this would account for the presence of these fossils in the glacial drift of northwestern Pennsylvania.

Of the corals listed above, ten species are reported from Ontario and not from New York, while but two species are reported from New
York and not from Canada. The other species listed are found in both regions. The evidence of the corals is then in favor of Canada as the source of the drift of this region. The Chemung fossils have no special value in this connection, as they could have been brought from anywhere in the region immediately to the north of Meadville.

The presence of granitic pebbles also indicates the Canadian origin of the drift, for Archaean rocks are not found native to New York, save in the northeastern part of the state.

**Fossils of the Older Drift.**

The older drift (Kansan or Pre-Kansan), referred to above was not found to be so fossiliferous as the Wisconsin. The boulders are largely of local origin, many being of Sharon conglomerate. Only one piece of fossiliferous chert was found, and the granitic pebbles were few in number.

**The Fossils of the Bedrock.**

The formations exposed at Meadville are as follows, in descending order, the section being that given by Dr. I. C. White in the Report on Erie and Crawford counties, cited above:

<table>
<thead>
<tr>
<th>Formation</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Sharon conglomerate</td>
<td>45 ft.</td>
</tr>
<tr>
<td>16. Shenango shale</td>
<td>50 ft.</td>
</tr>
<tr>
<td>15. Shenango sandstone</td>
<td>25 ft.</td>
</tr>
<tr>
<td>13. Meadville upper limestone</td>
<td>1 ft.</td>
</tr>
<tr>
<td>12. Meadville lower shale</td>
<td>40 ft.</td>
</tr>
<tr>
<td>11. Sharpsville upper flags</td>
<td>50 ft.</td>
</tr>
<tr>
<td>10. Meadville middle limestone</td>
<td>1 ft.</td>
</tr>
<tr>
<td>9. Meadville lower limestone</td>
<td>2 ft.</td>
</tr>
<tr>
<td>8. Sharpsville lower flags</td>
<td>12 ft.</td>
</tr>
<tr>
<td>7. Orangeville shale</td>
<td>75 ft.</td>
</tr>
<tr>
<td>6. Corry sandstone</td>
<td>20 ft.</td>
</tr>
<tr>
<td>5. Cussewago upper shale</td>
<td>5 ft.</td>
</tr>
<tr>
<td>4. Cussewago limestone</td>
<td>2 ft.</td>
</tr>
<tr>
<td>3. Cussewago middle shale</td>
<td>30 ft.</td>
</tr>
<tr>
<td>2. Cussewago sandstone</td>
<td>25 ft.</td>
</tr>
<tr>
<td>1. Riceville shale</td>
<td>80 ft.</td>
</tr>
</tbody>
</table>

Fossils have been found in the Riceville shale, the Orangeville shale, the Sharpsville upper and lower sandstones, the Meadville lower shale, the Meadville middle limestone, the Meadville upper limestone, and the Meadville upper shale.
List of Fossils found in situ.

1. Riceville shales.

Coral, rr.
Calathospongia sp., r.
Fenestella sp., r.
Lingula sp.
Lingulodiscina newberryi, c.
Schuchertella chemungensis, r.
Chonetes setigerus, c.
Productella hirsuta, c.
P. boydi, c.
Productella lacrymosa, c.
Productella sp., r.
Spirifer disjunctus, c.
Reticularia præmatura, c.
Cyrtia alta, r.
Cryptonella eudora, rr.
Leptodesma liopteroide, rr.
Leptodesma sp., r.
Crenipecten glaber, r.
Crenipecten crenulatus, r.

2. Orangeville shale.

Lingula meeki, c.
Lingulodiscina newberryi, c.
Chonetes setigerus, r.

8. Sharpsville lower sandstone.

Lingula sp., r.

10. Meadville middle limestone.

Crinoids. Species not yet determined.

Schizophoria tioga, c.
Schuchertella desiderata, r.

11. Sharpsville upper sandstone.

Lingula sp., c.
Glossina waverlyensis, r.
Lingulodiscina newberryi, c.
Schizophoria tioga, a.
Schuchertella desiderata, c.
Chonetes setigerus, c.

Lyriopecten solox, r.
Aviculopecten patulus, r.
Mytilarca chemungensis, r.
Leioptera chemungensis, r.
Leioptera sp., r.
Pararca neglecta, r.
Pararca sao, c.
Goniophora chemungensis, c.
Paracyclas ignota, r.
Paracyclas rotunda, c.
Glossites lingualis, r.
Euomphalus hecale, r.
Euomphalus cf. laxus, r.
Loxonema sp., rr.
Porcellia sp., rr.
Conularia, sp., r.
Orthoceras pertextum, rr.

Fish remains, r.

2 rr, signifies very rare; r, rare; c, common; a, abundant.
12. Meadville lower shale.

*Productella lacrymosa*, r.  
*Elymella patula*, r.  
*P. boydi*, c.  
*Camarotoechia orbicularis*, c.  
*C. contracta*, r.  
*Spirifer*, sp., r.  
*Orbiculoidea*, sp., r.  
*Glossites depressus*, r.  
*Schuchertella desiderata*, rr.  
*Schizodus chemungensis*, rr.  
*Chonetes setigerus*, r.  
*Pholadella newberryi*, r.  
*Athyris angelica*, rr.  


*Lingulodiscina newberryi*, c.  
*Ceratiocaris*, sp., rr.  
*Camarotoechia*, sp., c.  
*Apedodus priscus*, r.  
*Chonetes setigerus*, c.  
*Cladodus coniger*, r.  
*Conularia victa*, c.  
*Heledus comptus*, r.  
*Proetus*, sp., rr.  
*Helodus gibberulus*, c.  


Crinoids of species not yet determined.

*Lingula*, sp. r.  
*Athyris angelica*, r.  
*Glossina waverlyensis*, r.  
*Leda pandoriformis*, r.  
*Lingulodiscina newberryi*, c.  
*Paleonilo sulcatina*, r.  
*Schizophoria tioga*, r.  
*Modiomorpha tioga*, r.  
*Schuchertella crenistiata*, rr.  
*Bellerophon nactus*, rr.  
*Chonetes setigerus*, c.  
*Conularia victa*, r.  
*Productella boydi*, r.  
*Orthoceras leander*, r.  
*Camarotoechia contracta*, r.  
*Orthoceras 2 sps.*

In addition to the species listed above, three specimens of a new species of *Lepidechinus* have been found near Meadville, but unfortunately not in situ. It is not known from what horizon they came, but it seems most probable that they were from the Riceville shale, although the Sharpsville upper sandstone and the Meadville upper shale are considered as possibilities.

**Conditions of Deposition.**

A number of facts show that the rock-layers of the region of Meadville are shallow water deposits. (1) First among these facts is the nature of the strata, nearly all the formations being sandstones or shales. The only limestones present are very impure. (2) In the Riceville shale, Cussewago sandstone, and the Sharpsville lower sand-
stone very pronounced ripple marks are found. These are usually produced on a shallow bottom. (3) The Sharon conglomerate which has at the base a layer ten feet in thickness made up almost entirely of white quartz pebbles shows a near-shore condition. The Meadville upper limestone is a hard layer composed of pebbles of various sizes and kinds, some containing fossils. These pebbles likewise indicate a near-shore condition. (4) The presence of large numbers of fucoidal seaweeds, not only in the Riceville but also in the Meadville shale, is still further evidence of the shallow water conditions. (5) Worm burrows are found in many of the shales. This is especially true of the Riceville shales, and of the shaly layers in the Sharpsville sandstones. (6) The character of the fauna indicates shallow water conditions with a more or less muddy bottom. *Lingula* are found rather abundantly in all the fossil-bearing layers except the Meadville lower shale. *Lingulodiscinae* are found in all the fossil-bearing layers except the Sharpsville lower sandstone. Both of these animals inhabit near-shore muddy and sandy bottoms. The presence of broken up *Lingulodiscinae* shells and fish remains among the pebbles of the Meadville upper limestone is still further evidence of the near-shore shallow water conditions. The fish remains, which are all dismembered and broken, have been washed in, while the shells of the *Lingulodiscinae* have been ground up by the action of the water and the pebbles. (7) The absence of a deep-sea fauna indicates a near-shore shallow water condition. It is true that a few *Orthoceratites* have been found, but these were in such a condition as to show that they were broken before being imbedded in the matrix in which they were found. It would seem that the empty shells had floated in from a distance. Only two specimens of coral were found, one in the Riceville shale, and one in the Meadville upper shale. Both of these specimens were poorly preserved. This almost complete absence of the corals would indicate that for the most part the bottom was too muddy for corals to grow. In some of the layers crinoid stems have been found, but in all cases, except occasionally in the Riceville shale, these are but small fragments. (8) Several specimens of *crinoids* have been found in the Meadville middle limestone. This layer is not more than six inches thick, and for the most part is made up of nodules. The presence of so few crinoids and the thinness of the layer in which they are found would indicate a fairly deep-sea condition for a very limited time.
Age of the Formations.

The Sharon conglomerate belongs to the Pennsylvanian, and has been assigned a place in the upper part of the Pottsville by David White, *Bulletin Geological Society of America*, Vol. XV, 1905. The other formations of this section, excluding the Riceville, were classed by Dr. I. C. White in the report cited above as the sub-conglomerate formations, which he divided into the Shenango group, Meadville group, and Oil Lake group.

The Shenango and Meadville groups are correlated by Dr. White with the Cuyahoga Shales of Ohio, and the Oil Lake group with the Berea Grit of Ohio, both of which belong to the Waverly (Mississippian). The Chemung facies of the fauna of the Riceville shale was recognized by Dr. White, but the position of the formation was not definitely fixed in the report cited.

In the *Bulletin Geological Society of America*, Vol. XIV, page 177, 1903, Professor Williams has correlated the Shenango, Meadville, and Riceville with the Bedford, Berea, and Cuyahoga of Ohio and the strata between the Chemung and Olean of New York. In regard to the fauna, he states, on page 184, that Chemung species are not found above the Riceville shales, the pure Waverly fauna coming in above that formation.

Professor Stevenson, *Bulletin Geological Society of America*, Vol. XIV, page 42, 1903, places the Shenango and upper Meadville in the Mississippian, and correlates them with the Logan and the Waverly shales (Herrick) of Ohio. The Lower Meadville, Sharpsville, Orangeville, and Oil Lake he places in the Devonian, and correlates them with the Cuyahoga and Berea of Ohio. The Riceville and Venango he correlates with the Chemung of New York.


As may be seen from the above lists of fossils, most of the faunules contain some Chemung species, but those of the strata above the Riceville are closely related to the faunas described from the Waverly of Ohio.

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