

XXXII. SPIRIFER HORIZONS OF THE OHIO MID-DEVONIAN

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The middle Devonian of Ohio is composed of the Columbus limestone with an average thickness of eighty feet, the Delaware limestone with an average thickness of forty feet, and the Olentangy shale with an average thickness of thirty feet.

The Columbus limestone has a lower division of dolomite called the Bellepoint member, four feet of coral layer and an upper division of conchoidal blue-grey limestone which can only be separated from the Delaware limestone by the presence of the so-called "bone bed". The limestone has a thickness of 105 feet at Columbus, 80 feet at Delaware, 40 feet at Bellefountaine, 70 feet at Sandusky, and 32 feet in Ontario along Lake Huron. In Ontario the correlated strata is the Onandaga, which is a continuation of the New York phase. The limestone in Ohio was first called Corniferous by Hall and correlated to the Onandaga, but later was called Columbus by Newberry. The name Delaware was given to the upper portion of the lime above the "bone bed" by Winchell who took the type location near that town. The section of the Marble Cliff quarry at Columbus has been divided into zones and it is according to these zones that the *Spirifer* horizons have been correlated.

The first zone called "A" is a basal conglomerate and has a thickness of one foot. zone "B" (35 feet) is the Bellepoint dolomite member, zone "C" is composed of four feet of coral layer, zone "D" is the first zone of abundant fossils and contain a variable four feet of chert being present for twenty five miles south of Delaware but seen only in Ontario to the north of Delaware, zones "E, F, G, and H" contain an unusual abundance of fossils, the zones being divided lithologically.

The *Spirifer macrothyris* zone is found in zone "E". These *Spirifers* are generally large individuals and very numerous about two to six to a square yard. The shells are generally excellently preserved and show a bluish color in the matrix of gray limestone. The layer is about six inches thick and persistent so that its position can be used as a reference plane. There are many scattered individuals above and below the zone but the abundance in the zonal layer is the rule.

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low the "bone bed". The fossils are not noticeably abundant but are common. The horizon is persistent over all of Ohio with the exception of the region south of Sandusky.

The *Spirifer acuminatus* generally lies within a few feet of the "bone bed". It is very persistent as far north as Radnor and then begins to vary. The horizon divides and drops below its accustomed level, the top layer making its horizon about ten to twelve below the "bone bed". The "bone bed" is variable too, being a foot, an inch, or not present. The division of the Columbus and the Delaware must therefore be made upon the *acuminatus* and the *duodenarius* horizon. The area where the bone bed is absent is where the *acuminatus* bed varies while the *duodenarius* remains constant up to the edge of Lake Erie. Here the *acuminatus* is always below the *duodenarius* while in the south it was always above the *duodenarius*. However another horizon of *acuminatus* occurs where the first change began and parallels it the Lake. By means of these two layers and the *duodenarius* it is possible to divide the two limestones to within a few feet. In Ontario the two beds are intermingled with no regard for horizon both *Spirifers* being found at all levels from ten to fifty feet below the top, sometimes in proximity to the *macrothyris* bed.

These three horizons are the most definite but there are other forms which are not confined to any particular layer. *Spirifer gregarius* is exceedingly abundant occurring in zones "E, F, and G" mostly in the five feet of zone "F", so much so that it is often called the *gregarius* zone even though it cannot be used as definite horizon. *Spirifer macrus* and *manni* are in "E, F, G, and H" chiefly "E and H". *Raricosta* is invariably in the upper two feet zone "G". *Varicosus*, *divaricatus*, and *grieri* are scattered throughout all the formation but the top zone.

Most of the *Spirifers* occur in the Columbus but I will say a few words on the Delaware and upper bed. The fauna of these two formations is typically Hamilton. The break shows best in Ontario where the Marcellus shale lenses between the Onandaga and the Delaware. The lower part of the formation in Ohio is thin bedded and has numerous shaly partings which in Ontario becomes the true facies of the Marcellus as found in New York. *Spirifer macrus* continues upward from the Columbus, but a new form is developed which is called *consobrinus*. It is very abundant with no definite zone, though there is a layer where it is unusually thick.

The next bed and the last of the Mid-Devonian is the Olenetangy shale. It is a soft blue shale sometimes called "soapstone" by drill-

ers. It has a few thin layers, six to eight inches, of limestone which at times grades into concretionary nodules. The only *Spirifer* is *pennatus*, and it is rare.

A great deal of interest lies in the interruption of the *suodenarius* and more so of the *acuminatus* horizon. The rocks beginning near Columbus are lensing to the north and the west. At Bellefontaine outlier. The uplift continued into late Paleozoic times, and at Bellevue the zone "E" lies upon the conglomerate over Silurian Monroe dolomite. The limestone here is about fifty feet thick. The sediments are thinning out toward the shore of an old island caused by the Cincinnati uplift. This area is now called the Bellefontaine Outlier. The uplift continued into late Paleozoic. That there was a land area is suggested by the lensing of the sediments to the west. In the outlier the Columbus limestone is about forty feet thick and lacks the dolomite layer. The Delaware lime is not typical in fauna or in composition and the Olentangy shale is entirely absent, the Ohio or Huron black shale resting directly upon the limestone. The fossils are not common, poorly preserved, the sediments are shaly and impure, all of which indicate an agitated region with a shore line near. As the emergence along the Cincinnati axis progressed the bed was lifted and the sediments lense out due to the shallow basin. Then in later upper Devonian times, the mass having been eroded considerably, and the sea having deepened more than at mid-Devonian, we have the black shale deposited covering the edges of the lower beds. The shale gives evidence of muddy water near shore in changing conditions, with a certain amount of carbonaceous matter, and suggests overlap since it interbeds with Olentangy, at contact, near Delaware, rests upon the Delaware at Bellefontaine, and upon the Silurian in the south of Ohio. Another series of black shale closes the period in turbulence and uplift, an unconformity marking the close. The upper Devonian shale are called Genesee by Newberry, Orton, and Kindle, but Ulrich wishes to call them Mississippian.

To the north of this at Bellevue the beds begin to thicken reaching seventy feet at Sandusky but they do not take on the lower beds which had lensed out in the south. Here zone "E" still overlies the Silurian dolomite. Across Lake Erie beds lense in above the Olentangy giving the Mid-Devonian a thickness of 350 to 500 feet compared to the 75 to 175 in Ohio.

The rocks in Ontario underlie the Huron shale and outcrop to the east and west beneath the edges of it. The anticlinal axis slopes down from the Bellefontaine outlier and has not allowed the Huron

beds to be eroded. The rocks in Ohio are exposed as the limbs of an anticline. The uplift was steady and the small thickness in Ohio is due as much to the lack of sediments and shallow water, being close to shore, as to uplift. The sea was advancing but the uplift was slightly faster and later became much more rapid, the increase beginning with the Hamilton and going to the Huron shale of upper Devonian, the land mass was now encroached upon by a sea more rapidly than the uplift and the Upper Devonian and following Mississippian deposits laid. The emergence caused land mass a consequent thinning of sediments as the mass rose. The thickness and the overlap in the Ontario basin point toward a Devonian island or peninsula in a shallow sea, of which the outlier is the evidence. The Michigan strata dip away from the region at one to five degree angles. The present distribution is due to an eroded anticline caused by the emergence continuing into late Paleozoic, but the thickness is due to progressive uplift of the same area earlier.

The irregularities of the *duodenarius* and the *acuminatus* beds may be attributed to their adjustment to environment as the uplift progressed. They require a certain depth, certain food, certain other conditions and if these were changed they moved or changed their characteristics. They did not change their characteristics or they could not be recognized as the species allowing for individual peculiarities.

The faunal elements originated from three sources, from Europe across James Bay, thence into Ohio and New York, from South America across the southern states into Illinois and Ohio and from evolution of contemporary forms, those left over from earlier seas. Corals, goniatites, and cephalopods were numerous to the north and in Europe, rare in South America. Migration of these forms must therefore have come from the north. The deposits in the St. Lawrence valley point to another route and the fauna around James Bay suggest that passage. The brachiopods migrated from South America. *Spirifer duodenarius* and *macrothyris* is found in the Illinois branch of this Devonian sea, and other species in the Oriskany of Illinois, Ohio, New York, and South America are kindred sometimes identical, and have passed upward into the succeeding layers. The open sea branched from South America into Illinois and Iowa, and into Ohio and thence to New York. The meeting of the two faunas, one from the north the other from the south may have resulted in a conflict with a subsequent readjustment and survival of the fittest.

The confusion of the *Spirifer* beds may then be attributed to

changes in conditions of sedimentation, with a consequent change in environs, to migrations of the species northward, and to other organisms from elsewhere which would influence them.

The Spirifers constitute no vital problem in faunal relations but they bring up many facts of interest and lead to real problems in stratigraphy of which Ohio still has many.

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