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SIGNIFICANCE OF CARBONIFEROUS AND LATE DEVONIAN MATERIAL WITHIN THE IOWA DEVONIAN

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It is a well known characteristic of the Devonian limestones that to an extraordinary degree they have been affected by the destructive work of percolating water through solution. This is, no doubt, in part accounted for by the comparative purity of these limestones. The chemical process of dolomitization which is characteristic of the Silurian beds is here at a minimum, and rapid solution by meteoric waters has been the result. It is apparent also that the diastrophic movements that have affected the Devonian terranes have facilitated this destructive process. Wherever there are exposures of these beds, either natural or artificial, the results of this destructive work may be seen in the form of crevices, fissures, widened joints, and passage ways of various kinds. Sometimes these are open, sometimes filled with crystalline deposits, sometimes by detritus brought down by the water from above and subsequently dropped.

The limits of this paper will not permit discussion of the various geological phenomena that result from these processes. Springs, artesian wells of the non-flowing type, and sub-surface outliers of younger strata are some of them. In 1893 Dr. Norton published a paper on "Some Devonian and Carboniferous Outliers of Eastern Iowa" (1). Additions have been made to Dr. Norton's list since that date. Dr. A. C. Trowbridge thus refers to those at Davenport, Iowa:

> At one of the piers of the bridge between Davenport and Rock Island, Pennsylvanian sandstone was found beneath Wapsipinicon limestone. Again when this site was cored and later excavated to receive the footings for the navigation dam, the same situation was encountered. The core drill penetrated limestone and found Pennsylvanian sandstone and shale beneath it. In excavations for the new dam at Le Claire, also, Pennsylvanian sandstones and shales were found beneath Silurian limestones. (2).

In Linn County, in addition to the Pennsylvanian outliers mentioned by Norton, between Marion and Kenwood Park, which rest unconformably on Devonian beds, several others have been noted, in each case below the Devonian surface. Some time ago the writer was asked to examine an exposure of dark colored shales in the north bank of Bear Creek north of Palo and southeast of

Shellsburg. An option had been taken on the adjacent land in the belief that it contained coal. A shaft had been opened farther back from the stream and filled up. The report was current that the shaft had struck the dark colored shale. The material examined contained pyrite but no identifiable fossils. It was believed to be Pennsylvanian but may have been Independence. In quarries at Alice, Lafayette, and on a natural slope in a ravine at Camp Hitaga, east of Troy Mills, the writer has found material of the Des Moines sandstone type all below the Devonian surface.

Dr. M. A. Stainbrook of Texas Technological College reports; "At Lafayette is a quarry and in a pit toward the south and below the Gyroceras beds of Calvin is a blue shale carrying fossils of the Independence shale. The same is true of other localities"(3).

In a quarry about five miles north of Cedar Rapids, near the village of Robins, Mr. R. B. Van Cleve recently noticed an exposure of sandstone and shale near the base of the limestone wall of the quarry, and called the attention of the writer to it. The interesting character and location of the material itself, which proved to be Pennsylvanian, the numerous similar instances that have been reported in our Iowa Devonian and the light they throw upon certain important stratigraphic problems furnish the basis and reason for this paper. Dr. Leonard R. Wilson of Coe College collaborated in the study by making a collection of the fossil flora of the beds. He will make a report of the species that he has identified.

The quarry referred to had been opened on the north slope of Dry Creek valley to obtain rock for road surfacing. At the time mentioned the rock had been removed from an area approximately a half acre in extent. Since that time the quarry floor has been considerably enlarged and most of the outlier has been removed. How much had been removed before the observations began is unknown.

The rock had been taken out to a depth of about 30 feet but the surface slopes toward the creek so that the outlier referred to is about 25 feet below the surface. The quarry rock is the Fayette breccia. The part surrounding the outlier is unfossiliferous, but in other parts of the wall the fauna of the Upper Davenport beds appears.

The sandstone and shale extended along the basal part of the wall for a distance of about thirty feet. Its lower limit was obscured by debris. The upper limit was irregular and about four and a half feet above the quarry floor and thinned out toward the

ends. The shape of the area exposed would suggest a cave-like opening or an underground waterway.

The filling material is in part gray sandstone which becomes lighter on drying, and in part a dark fissile shale. The sand is fine and silty and does not show the yellow and brown colors of the typical Des Moines outliers. It separates readily into thin layers. No cross bedding is seen. It contains many fossils consisting chiefly of fruits and fragments of leaves and stems. The species are not closely related to the Calamite flora of the Marion-Kenwood Park surface outlier. It is clearly a deposit from descending water. If this material was carried down by water from its original position and deposited in a cave or in the bed of an underground channel or other sort of opening in the limestone rock, its source is an interesting question, as it is not genetically Des Moines of the usual type in the surface outliers.

However, similar material has been found elsewhere in Devonian rocks in Linn County, chiefly in wells and quarries. In a well one mile west of Marion on what is now the Manson place the drill penetrated several inches of black shale and some sand at a depth of about forty feet in limestone rock. This was believed to be a pocket of Pennsylvanian. In a well sunk near Lafayette about five miles north of the Robins quarry shale and coal were reported in the limestone (4). In a well one and one half miles south of Marion a dark shale was found, containing a flora somewhat similar to that in the Robins quarry (4). At Bertram the C. and N. W. Ry. has cut through the Bertram limestone into Pennsylvanian sandstone and shale. Southeast of Lisbon shale and sandstone lie beneath Le Claire limestone (5). It would appear from these instances that deposits of shale, sandstone and coal were laid down upon the old Devonian surface, perhaps before the ferruginous sandstone of the surface outliers was deposited. The remnants of this old deposit are now found carried down and redeposited at various horizons in the Devonian beds.

It is believed that all this throws light upon the problems connected with late Devonian history. Toward the close of the period the Devonian sea gradually withdrew from this part of the continent. What had been the sea bottom with its calcareous deposits now became land, but probably at no great elevation above sea level. The usual processes of denudation set in, drainage systems were established, the topography of the surface became rough and uneven and underground waters dissolved openings in the calcareous beds.

Following this period of erosion the Devonian sea made its final transgression upon the area under discussion. It was apparently not continuous, but consisted of embayments into which were carried sediments that became the shales and calcareous beds of the Upper Devonian. There were minor oscillations resulting in deeper and clearer seas and the depositing of alternating limestones and calcareous shales.

Lying unconformably upon the surface of the Middle Devonian of Iowa are the several more or less mutually isolated Upper Devonian terranes. The most extensive and best known are the Lime Creek or Hackberry shales and calcareous beds exposed in the north west area of the Devonian belt, viz., in Winnebago, Cerro Gordo, Franklin and Butler Counties. In Butler County they sink beneath the drift but from well logs are believed to continue under the drift in Grundy County (6). In well logs further south they have not been differentiated from the Kinderhook.

In 1932 the writer reported to this body the discovery of an exposure of Upper Devonian shale and limestone along the highway west of Middle Amana in Iowa County which he believed represented the southeastern extension of the Lime Creek terrane. Lithologically they are similar to certain of those beds. They carry a similar fauna but with some marked differences (7).

In Johnson County the State Quarry limestone beds were found by Calvin to be Upper Devonian and to lie unconformably on the Cedar Valley (8).

In Buchanan County in 1878 Calvin reported a body of dark shale which came to be known as the Independence. He placed them stratigraphically below the Gyroceras beds of the Cedar Valley and correlated them with the Kenwood beds at that horizon in Linn and Cedar Counties (9). This correlation has been generally abandoned by geologists on both lithological and biological grounds. The Kenwood beds are never a "dark shale" and are never fossiliferous while the Independence of Buchanan County is practically always fossiliferous.

In his paper before the Iowa Academy of Science in 1932 the writer stated his reasons for believing that the Independence is Upper Devonian and that it is a deposit from the last invasion of the Devonian sea. Its fauna is very similar to that of the Amana beds, which in turn bear a strong resemblance to that of the Lime Creek shales. It is not the present purpose to repeat those reasons but to call attention to the resemblance of the Independence to outliers of a once continuous terrane.

Remnants of the Independence have been found in Buchanan County near the town of that name and along Pine Creek near Brandon, also in quarries and well logs in northern Linn County and in a ravine in Fayette breccia near Linn Junction. Nowhere is it seen to extend as a continuous terrane. Everywhere it appears to be residual. The materials are very uniform and wherever seen are soft and easily disintegrated. It is believed that when the last invasion of the Devonian sea was at an end this material, perhaps of no great thickness, had been deposited upon the uneven surface of the older beds. During the ages of erosion that followed it was disintegrated and carried away except for scattered remnants in erosion channels and in cavities in the older beds that had previously suffered erosion and solution.

It is possible that the question of the true stratigraphic position of the Independence shales will have to remain one of the unsolved problems of our science. On the other hand new data and new facts that throw light upon the subject have in recent years been found, and more may reward our efforts in the future. At present opinion seems to depend upon the method of approach to the problem. One authority, on the basis of well records, would place them with the Kenwood beds between the Otis below and the lower Davenport above (9). Another authority from the standpoint of paleontology places them immediately below the Cedar Valley (10). Still another, from the standpoint of correlation criteria says: "It now seems to me almost certain that the Independence shale and its fauna have been let down into the Cedar Valley limestone and to be far out of the normal stratigraphic position"(11). It is needless to say that to the writer this statement seems "almost certain" to be correct.

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