A Reconsideration of the Age of Certain Outliers in Linn and Jackson Counties

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A RECONSIDERATION OF THE AGE OF CERTAIN OUTLIERS IN LINN AND JACKSON COUNTRIES

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At Bertram in Linn county and at Canton in Jackson county are found deposits of sandstone, shale and clay, called by courtesy outliers, though very limited in area and thickness, which carry Devonian fossils. Their importance lies in the fact that if their assignment to the Devonian by the writer ¹ in 1893 is correct, they imply a significant transgression of the Devonian sea over east central Iowa.

It may be recalled that at Bertram the outlier consists of shale and sandstone, containing numerous worn and fragmental Devonian fossils, filling a narrow crevice and its burrowing branches in the Bertram dolomite.

At the Canton outlier there are exposed along the road for forty paces barren layered sandstone and shale upon which rest at the surface a thin gray unctuous clay, in places sandy, with plentiful Devonian fossils for its entire length of twenty paces. Here were found also eight boulderets of weathered Devonian limestone, the largest sixteen inches in diameter, and six quartz nodules with carious surfaces, reaching a diameter of fourteen inches. Both nodules and boulderets are characteristic of certain Wapsipinicon terranes.

So far as known the Bertram outlier has been visited by no geologist since 1893. At the Canton outlier Devonian corals were collected by Lonsdale and placed in the museum of the Iowa Geological Survey soon after its organization. Savage ² in his survey of Jackson county found the fossiliferous beds concealed and after quoting at length Norton’s description of the outlier adds “The sandstone and shale do not differ in any appreciable way from those seen in outcrops that are unhesitatingly referred to the Des Moines stage. Professor Norton has also stated a great difficulty in this connection in that these Devonian corals and other fossils do not normally occur associated with such beds of sandstone and shale. Inasmuch as Professor Norton studied this deposit

under much more favorable conditions of exposure than the writer it seemed best to give the interpretation of the facts as he presented them."

Ladd, finding the outcrop better exposed by road work than even in 1893 was able to corroborate the facts presented in Norton's paper with considerable added detail. He concludes, "It seems to the writer that the facts are to be explained by the suggestion which Norton put forth, but thought unworthy of serious consideration; namely, by '... a fortuitous mingling of Devonian drift from the northwestern outcrop with the sandstone and shale of a Carboniferous outlier.'"

In view of this difference of opinion it is the purpose of this paper to reconsider the question of the age of both so-called Devonian outliers and the method of their deposit.

It hardly need be said that fossils are not an infallible criterion of the age of the strata they occur in, as witness Cretaceous fossils in the drift and Devonian corals in the sandbars of Cedar River.

Certain abnormalities may be noticed as to the relations of the fossils and the deposits. The fossils are fragmentary and worn as if by transport or long weathering. Both outliers are associated with neighboring sandstone outliers of Pennsylvanian age. Sandstone terranes of Devonian age are unknown in Iowa, although basal sand layers occur at Fayette resting on the Silurian, and considerable sand is found in the matrix of the Wapsipinicon breccias. In both of these cases, however, the sand is composed of particles of chert to a considerable extent. And as already noted, the Devonian species of the outliers do not find their normal habitat in sands.

Using the method of multiple working hypotheses we may consider:

(1) DEPOSITS BY A TRANSGRESSING PENNSYLVANIAN SEA

The transgression of this sea over eastern Iowa is a well-established fact. We may easily believe that it found the waste mantle over Devonian rocks in places rich in Devonian fossils, and admit the possibility that such may have been washed along with shore sands into crevices in the bottom rocks. The Bertram outlier is so near the present outcrops of fossiliferous Devonian strata, that no great distance of transport is required.

The Canton case is different. It is incredible that the Pennsylvanian sea spread upon its basal sands and shales clays filled
with Devonian fossils as thickly as are a number of outcrops of Devonian fossiliferous shales and also brought and laid the Devonian boulderets in immediate association. If the sandstone of the outlier is the product of the Pennsylvanian sea, the cause of the presence of the Devonian material must be sought elsewhere.

(2) DEPOSITS BY A TRANSgressING DEVONIAN SEA

It is highly probable that the Devonian sea extended far beyond the present frontiers of the Devonian system in Iowa. The Devonian rocks of Iowa contain no shore deposits. Only a slight subsidence would have brought the Devonian sea in widely over the adjacent areas of outcrop of the older rocks, so little are they deformed. And the vast denudation of subsequent geologic time must be considered. In this connection the well known Devonian outlier in Niagara rocks at Elmhurst, near Chicago, will be recalled. Like that at Bertram, this outlier consists of a narrow crevice with an arenaceous fill containing Devonian fossils in abundance. The nearest Devonian outcrops to the west are at Rock Island 130 miles distant, and to the north at Milwaukee, a distance of 80 miles. So far as known Weller's conclusion that the Elmhurst crevice was filled directly from the floor of the Devonian sea has never been questioned, nor the wide extension of the Devonian sea to which it testifies.

Applying this hypothesis to the Bertram deposit, we find that it probably involves an unconformity between the Bertram dolomite and the Upper Davenport beds, an erosion interval during which the crevice was developed by solution. The worn condition of the fossils also implies considerable wear in transportation along shore, or from deeper water off shore a few miles to the west, where fossiliferous limestones were being laid.

At Canton, it must be supposed that the barren shales and sandstones are the basal deposit of the transgressing Devonian sea, and that as the shore line advanced eastward and the sea deepened the known sequence of the Wapsipinicon beds was laid. After uplift to form land secular decay is left to reduce fossiliferous limestones to an unctuous clay plentifully set with partially dissolved and silicified fossils, and to produce boulderets of weathering with fossils and breccia fragments in relief and the carious quartz nodules whose pitting is due to the removal by solution of intercrystallized calcite.

(3) Deposits of Devonian or Carboniferous Streams

A number of the sandstone outliers of eastern Iowa are set in narrow valleys with rather steep sides of the country rock. This suggests that their deposits may have been laid by streams, aggrading because of the subsidence which was to bring in the sea.

But it is highly improbable that at Canton surrounded with fossiliferous Niagara rocks a stream could have so limited its deposits to the Devonian material in question.

(4) Deposits by Carboniferous Sea and by Glacial Ice

This duplex hypothesis can not apply to the Bertram crevice fill, where arenaceous matrix and fossils were evidently deposited together.

As to the Canton outlier it is favored by the fact that this area was within range of glacial ice or of its outwash. A few feet above the outlier on the hillsides there rests on the Niagara limestone a thin ferretto charged with residual flints, and pebbles of the drift, some of the latter faceted and scored. Within the limits of the Devonian material there were also observed a few rounded drift pebbles, a fraction of an inch in diameter.

Nor does any difficulty inhere in the size of the Devonian blocks and the their lack of glaciation. As Ladd pertinently observes "Perhaps the boulders of Devonian limestone are larger than the drift boulders of igneous rock because the former have been transported but a relatively short distance. To be sure they show no evidence of such transportation, but only a small percentage of local glacial boulders do this." And, it may be added, the destructive effect of long weathering on surface markings on limestone blocks may be considered.

The grave objection to the hypothesis favored by Ladd that the Devonian blocks at Canton are glacial boulders and that the fossils have also been brought by glacial ice lies rather in the theory of chances.

To the writer it is far beyond the limits of probability that the Kansan ice sheet picked up more than a dozen Devonian boulderets from different Wapsipinicon horizons, carried them at least thirty miles, together and practically unmixed, and laid them down in a little group within the limits of 20 paces, and precisely over a little sandstone outlier on the Canton hills. It is still more difficult to imagine the transportation at the same time by the ice of the numerous detached fossils, with or without the clay in which they lie.

Ladd, H. S. Loc. cit., p. 345.
The only form in which this hypothesis does not violate the theory of probabilities is that which postulates a single large Devonian erratic set down exactly upon the little sandstone outcrop. Such indeed would be a far shot and a bull's-eye hit, but it is not impossible. Such an erratic, structurally weak and of easily soluble rock, may be then left to break up and waste away under long weathering into the Devonian residual material in question.

Yet even in this suggested modification certain difficulties remain. The Devonian material of the outlier does not come from a single terrane. The quartz nodules are characteristic of the Kenwood shales (a more calcareous and unfossiliferous phase of the Independence). Some of the boulderets are brecciated, some not, some are Lower Davenport, some are Upper Davenport, while the detached fossils come from a horizon at least as high.

A boulder which embraced all these beds would reach at least the maximum size of Iowa erratics. Even the number of quartz nodules would require a sizable block of the Kenwood according to their average distribution in it. The boulder composed of these various beds would be structurally so weak that it could hardly endure the strains of transportation. If broken up in the ice the fragments would not be expected to remain grouped so closely together, that they could be set down within the length of a few paces. With some acquaintance with the outcrops of the Wapsipinicon, I do not recall a locality where such an inclusive block could have been picked up, without exceeding the size of our largest boulders.

It appears to the writer that both the Canton and the Bertram deposits are sea laid, that the Bertram outlier may be either Devonian or Pennsylvanian and the Canton deposits may be safely dated by the Devonian residual material they include.

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