

ON SOME FOSSIL UNIOS AND OTHER FRESH-WATER SHELLS
FROM THE DRIFT AT TORONTO, CANADA: WITH A REVIEW OF
THE DISTRIBUTION OF THE UNIONIDÆ OF NORTHEASTERN
NORTH AMERICA.

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The United States National Museum has recently received from Mr. A. P. Coleman, of the School of Practical Science of Toronto, a number of fossil Unios and other fresh-water shells from the drift of that city, the former of which are highly important in their bearings on the distribution of certain species of that genus. They were obtained from a bed of sand between two glacial beds in a railway cut on the Belt Line, north of Winchester street, 20 to 25 feet above the River Don.

Eight species and one variety of Unios and six species of other fresh-water shells were sent, all of which are living at the present day. All the Unios are characteristic forms of the Mississippi Valley, but of these only three species have ever been reported from Canada.

The material was received in rather bad condition; in the case of the Unios the valves were all more or less broken and somewhat crumbled, yet I have been able to identify with certainty most of the specimens.

It may be well before giving a list of these specimens, and stating the range which they at present occupy, to briefly outline the distribution of the *Unionida* of Eastern North America. I shall not go into details regarding this matter, which I have treated at length in a paper recently published in the *American Naturalist*.*

Suffice it to say that at the present time a common assemblage of the Naiades inhabits the entire Mississippi Drainage Area, to the almost absolute exclusion of all other forms. Within this region is found the most magnificent development of the Unionidæ of any part of the world. It is an ancient fauna, having descended in a no doubt unbroken line, and through forms which have in some cases scarcely changed, from the Cretaceous period. The species and individuals are exceedingly numerous; they are often very large and ponderous, ornamented with beautiful and odd patterns of color and sculpture. Unione life seems to have run riot here, and there is only one other area in the world at all comparable to it in this respect—that of China—which has no doubt received a part of its stock from the same source as the territory in question.

While many species actually found within this area, and others belonging with groups having their metropolis here, have spread far out

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into other regions, I know of but a single species belonging elsewhere that has been found within this basin, a case that I shall refer to later.*

The streams of Texas are almost wholly peopled with these and closely related forms, which, in some cases, extend well into Eastern Mexico, and even Central and Northern South America. To the northward and eastward a number of characteristic Mississippi Uniones have extended into the Red River of the North, the Saskatchewan, the Mackenzie, to the Hudson Bay Territory, Michigan, and Canada. It is probable that one of these species is even found in the Columbia River, *Unio luteolus*, where it is known by the name of *U. oregonensis*. It will be therefore seen that the Naiades of this region are vigorous and aggressive.

The waters that drain into the Atlantic are inhabited by a totally different set of Uniones, which, as a rule, are moderate in size, of rather frail structure, and not remarkable for color or sculpture. The Appalachian chain acts as an almost total barrier to the mingling of the forms of the two areas, and, so far as is known, only a very few of these eastern species extend westward to the headwaters of the St. Lawrence.

The following is a list of shells sent by Mr. Coleman:

Unio phaseolus Hild. Six valves. An abundant, widely distributed species, whose recorded northern limits are western New York, Cheboygan County, Michigan, near the Mackinaw Straits, and St. Peters, Minn.

Unio occidentalis Lea? Part of a right valve. It is found living as far north as Ottawa, Canada.

Unio pustulosus Lea. Six valves in bad condition, which I believe to be typical *pustulosus*. Not reported outside the Mississippi area. It extends north to St. Peters, Minn., and southern Wisconsin.

Unio pustulosus var. *Schoolerafti* Lea. Four valves and the posterior part of a pair. It occurs north to Grand Rapids, Mich., and Lake Erie.

Unio undulatus Bar. Part of a left valve in bad condition, but undoubtedly this species. Mississippi area into Texas, north to Ottawa, and Red River of the North.

Unio rectus Lam. Right valve of a young specimen. Widely distributed, extending to Ottawa and the Red River of the North.

* No. 85981 of the Isaac Lea collection, now in the National Museum, was sent to Mr. Lea from the ponds of the Wabash by Dr. Lewis, and labeled by the latter "*Unio subrostratus* Say." The former changed it to *nasutus*. No. 85938, same collection, Foote's Pond, Gibson County, Indiana, was labeled *U. nasutus* by Lea. I have carefully examined these shells and unhesitatingly pronounce them to be *U. subrostratus*, a form closely resembling *U. nasutus* at times, but always more inflated and differently shaped in the ventral region. There are authentic shells of *U. nasutus* from Ohio in Dr. Lea's collection, but they are all from streams that fall into Lake Erie. One *Unio* in the Museum collection (No. 26060), from J. A. Lapham, is labeled *U. radiatus*, Pine, northeast boundary of Wisconsin. Pine County is in Minnesota, near Lake Superior, and is drained by the St. Croix River, a tributary of the Mississippi. I am inclined to refer this specimen to the very nearly related *Unio luteolus*, a common Mississippi Basin species.

Unio trigonus Lea. Fourteen valves. Its northern limits are western New York, southern Michigan, and St. Peters, Minn.

Unio solidus Lea. Eleven valves. Not hitherto reported outside the Mississippi Basin.

Unio clavus Lam? Five valves in bad condition, which, after the most careful and exhaustive comparison, I refer to this species. It is confined to-day to the Mississippi area, reaching north into western New York.

Quite a number of specimens of the other fresh-water shells were received in bad condition. These are *Pleurocera elevatum* Lea, *P. subulare* Lea, *P. pallidum* Lea? and an undetermined species; *Valvata sincera* Say, remarkably depressed, and *Spharium striatinum* Lam. All of these are now found living in Canada, except the first mentioned species, which is, I believe, confined to the Mississippi area.

The theory founded by Agassiz and elaborated by Dawson, Upham, Gilbert, Tyrrell, and others, that during the glacial period the archæan region of Canada was elevated from 1,000 to 2,000 feet above its present level, and that it was covered with an ice mantle from 3,000 to 6,000 feet thick, a mantle which in the eastern part of the United States extended down to latitude 38° or 40°; that in the Champlain period which followed there was a subsidence over this area, during which great lakes were formed by the melting ice, whose northern shores were the yet remaining wall of ice, and whose southern borders were the land that sloped northward; and that they drained into the Mississippi system, is most strongly confirmed by the evidence of these fossil Unios, and by every fact of the distribution of the Naiades in this general region to day. It is believed that the entire system of the present Great Lakes was united, and that at one time it covered a considerable part of lower Michigan, and extended well into Ohio, Indiana, and Illinois. What has since become the Red River of the North, which at that time was an arm of the great lake Agassiz, no doubt had its outlet into the Upper Mississippi from the small Bois des Sioux River, which rises in Lake Traverse, and from this connected with Big Stone Lake, near by, the head of the Minnesota River.* The waters of the St. Lawrence, dammed with ice, could only escape into the Mississippi system.

It is quite probable that if the species of Naiades which now are found on the Atlantic slope inhabited any considerable part of the upper St. Lawrence and northern drainage systems previous to the glacial period, the great cap of ice grinding over the country, together with the rigorous climate, nearly or quite exterminated them in this area. As evidence in this direction, the case of *Margaritana margaritifera* may be cited. It is an oriental species, having its metropolis in northern Europe and Asia, which has crossed over into North America in all

* Geological and Natural History Survey of Canada, new series, Vol. VI, 1888-'89, p. 5. E.

probability by a now submerged landway, and to-day is found in British Columbia, Washington, Oregon, northern California, and in the upper waters of the Missouri. It is again met with in eastern Canada, New England, Pennsylvania, and New York, but has not been reported from any of the intervening territory. The suggestion made several years ago by Prof. A. G. Wetherby* that it had been destroyed in this region by glacial action seems the most reasonable, and it is possible that at the eastern side of the continent it might have survived in the area not covered by the ice cap or that it may have been driven to the southward before it. This is the only naiad now found living within the Mississippi drainage area that may said to belong to the Atlantic system, and it is undoubtedly an immigrant. It probably entered the Missouri through streams which connected that river with the North-western lake system.

Unio radiatus, a characteristic Atlantic drainage form, has been reported from Lake Winnipeg and the Nelson River,† but it approaches so near to *Unio luteolus*, a common Mississippi shell, that the identification may be considered somewhat doubtful. *Unio complanatus*, another characteristic Atlantic area species, has, on the excellent authority of Mr. Bryant Walker, been found in the southern peninsula of Michigan, and *Unio nasutus*, a third abundant and widespread eastern form, is frequently met with in that state, and in streams in northern Ohio that drain into Lake Erie. But the Red River of the North, so far as is known, is peopled wholly with Mississippi Valley Naiades, and some of them extend to the Mackenzie River.

At the time during the Champlain period when the waters of the northern lake region overflowed into the Mississippi Basin, many of the hardier, more vigorous, and characteristic species of the latter territory migrated northward and established themselves; most of them remain in the streams that now drain northward and northeastward, but a few have possibly retreated, while others, including three of those received from Toronto, are to-day in all probability confined to the Mississippi Valley. The lower peninsula of Michigan is almost exclusively inhabited by these forms, as well as the Great Lakes, and they extend well down the St. Lawrence and north and east into Canada.

To briefly recapitulate, then, the *Unio* fauna of the Mississippi Valley is remarkably distinct, being nearly related only to a part of that of northeastern Asia. It is an old fauna, dating back through an almost unbroken series of species to the Laramie group of the Cretaceous, and it is remarkably developed in large, vigorous species and numerous individuals. That these forms are dominant is proven by the fact that they so exclusively occupy this vast area, and that they have spread so widely into other regions, through a great variety of climate and conditions.

* JI. Cin. Soc. Nat. Hist. July, 1881, p. 7.

† Land and fresh-water shells of Manitoba. Robert Christy.

The *Unionida* of the Atlantic slope are far less vigorous and aggressive, and evidently are not fitted to take possession of wide and diversified areas. If they occupied any considerable part of the great British American plain before the drift period, it is not at all improbable that they were well-nigh exterminated by the onward movement of the great cap of ice, which relentlessly ground its way from north to south over the face of the country. At the close of the ice age, when this great glacial sheet began to melt away at its southern border, the water of this great region, which sloped to the northward and eastward, dammed up by the great ice wall in that direction, was forced over into the Mississippi through various outlets, and the *Unionids* of the latter territory, finding an easy entrance into a region almost or quite destitute of other forms, rapidly worked in and became the dominant fauna when the great wall had melted away and the streams resumed their normal courses.

The absence of the Atlantic species to day throughout a large part of the upper St. Lawrence region may perhaps be accounted for by supposing that they have never been able to cope with and dispossess their more persistent relatives from the Mississippi Valley, though the evidence afforded by the fossils described in this paper would go to show that, to a certain extent, some of them, at least, had retreated.

Mr. Dall has called my attention to the important bearing which these fossils may have (if the geological facts stated be fully confirmed by further exploration) upon the theory of a mild interglacial period, preceded and followed by an advance of the ice. If the ice receded to the vicinity of Toronto, allowing these Mississippi species to attain to that region, the fact that they did not establish themselves there would be easily accounted for by the subsequent advance of the ice and the destruction of the colony. The final melting and disappearance of the ice cap, being complicated by changes in the direction of the drainage, might not afford a second opportunity for the immigration of the species in question.