

# THE OHIO JOURNAL OF SCIENCE

VOL. XXX

NOVEMBER, 1930

No. 6

## PREGLACIAL, INTERGLACIAL AND POSTGLACIAL CHANGES OF DRAINAGE IN NORTHEASTERN OHIO WITH SPECIAL REFERENCE TO THE UPPER MUSKINGUM DRAINAGE BASIN.\*

GEORGE N. COFFEY, Ph. D.,  
Wooster, Ohio.

The advance of the ice brought about many changes of drainage and this seems to be especially applicable to the State of Ohio, where so many streams are running either in new channels or the direction of flow has been reversed. Many of these changes have already been explained but there is still much work to be done before a complete and satisfactory explanation of some of these problems can be presented.

My personal interest in these questions was aroused by observations made during the progress of the Reconnaissance Soil Survey of Ohio and attention was called to a few of these in a brief article in the October 23, 1914 issue of *Science*. Absence from the state for several years and the taking up of other work since my return has not permitted the following up of those suggestions as I had planned to do. Killbuck Creek, which rises north of Wooster and flows southward, offers one of the most puzzling problems of any of the streams and I have been especially interested in trying to find a satisfactory solution of the drainage in this particular section, since there is now available in the numerous borings for oil and gas positive evidence that its deep channel was not made by a stream flowing northeastward toward Orrville as suggested by Todd.† This study, however, has necessarily led me to consider, in a limited way at least, this entire section of Ohio and to some

\*Paper read before the Geological section of The Ohio Academy of Science at Columbus, Ohio, April 19, 1930.

†Todd, J. H., Ohio Academy of Science, Special Papers No. 3, 1900, page 52.

extent the entire State. The subject is so large that I can only hope to offer a few suggestions, which I trust may be of help to others in the solution of these drainage problems.

#### IMPORTANCE OF INTERGLACIAL EROSION.

In the article in *Science*, referred to above, attention was called "to the probable interglacial rather than preglacial origin of many old valleys in Ohio." Further study has tended to confirm this suggestion and, in fact, has led to the conclusion that *practically all of the deep valleys in this northeast section of the state, and probably in other sections as well, are of interglacial or postglacial rather than preglacial origin.* In other words the western extension of the plateau into Ohio had, before the beginning of the ice age, been reduced to a peneplain and the fairly stable conditions then existing were disturbed by the first advance of the ice and each successive advance caused further disturbances and changes in the drainage and resulted in rejuvenating the forces of erosion and the carving out of deeper valleys, which in many places, show little or no relation to those which existed in preglacial time.

If this suggestion represents a true interpretation of the preglacial conditions and the results brought about by the coming of the ice then it necessarily follows that it will be extremely difficult in many sections, and especially where radical changes in the drainage took place, to determine the exact location and direction of the preglacial streams. There are, however, some facts obtainable which will aid us in our investigation of this subject.

#### GENERAL ELEVATION AND SLOPE OF UPLANDS.

Perhaps the most important factors, which should be considered, are, (1) the general elevation and slope of the uplands, (2) the location of the main divides, valleys and streams and (3) the angle at which the tributaries enter the present stream channels, particularly in those sections where the streams were least disturbed by the ice. Topographic sheets, covering this section of the state, are now available from which it is possible to know the elevation in every part of the area. An examination of these topographic sheets shows that a very large percentage of the country lies at an elevation of from 1100 to 1300 feet. A few high points rise above 1400 feet and some of



the valleys fall below 800. Nearly all of the country below 1100 feet in elevation is in the more important valleys or on the immediately adjoining slopes. The so nearly uniform height of the uplands is very strong evidence that the country was reduced to a peneplain with a surface sloping gently from the higher divides toward the broad valleys. If we can locate these old divides and valleys we will have made some definite progress in our determination of the preglacial drainage.

#### LOCATION OF PRINCIPAL DIVIDES.\*

Geologists are pretty generally agreed that there was a preglacial divide on the present Ohio River between New Martinsville, West Virginia and Sardis in southeastern Monroe County, Ohio. From this divide the drainage was northward through the Grand River Valley to the Lake Erie basin and southward into the old Kanawha River. From the Ohio River the divide, forming the western boundary of the old Grand River drainage basin, extended northwestward to Woodsfield, thence almost directly north by Barnesville and Cadiz, passing southwest of Alliance, thence north by Ravenna, beyond which its course is somewhat uncertain as the original divide may have turned a little northeast to Middlefield, Huntsburg and Thompson or have run more nearly north near Mantua, Auburn Center and Chardon to Thompson.

The crest of this divide from near the Ohio at New Martinsville to south of Alliance is everywhere above 1200 feet and much of it is more than 1300 feet. From Alliance northward to beyond Ravenna none of it is above 1300 feet while a considerable part is between 1100 and 1200 feet. The lowest point is just south of Ravenna where it falls a little under 1100 feet, although in the valleys between Garrettsville and Mantua and Parkman and Hiram Rapids the elevation is only slightly above 1120 feet. In general the elevation from Ravenna increases northward until several points again rise above 1300 feet.

---

\*In the presentation of this paper topographic sheets, covering almost the entire area, were used and the location of the divides was brought out by coloring the areas above the 1300 foot contour line blue and those between the 1200 and 1300 foot contours red, but it is not practicable to publish these sheets in connection with this article. The accompanying map shows the present drainage and probable location of some of the preglacial and interglacial streams, divides and cols and will be of assistance in understanding the paper, although the reason for some preglacial and interglacial stream locations can only be seen by a detailed study of the topographic sheets.

From the above divide there branches off near Barnesville another one, which runs northwest to the Tuscarawas River between Port Washington and Gnadenhutten, where it is cut through by this stream; thence continues on northwestward by Baltic beyond which it divides, the main branch apparently extending westward across Doughty Creek at Troyer's Mill and is intersected between Millersburg and Killbuck by Killbuck Creek; thence continues westward south of Nashville, crossing the gorge cut by the Mohican River and following fairly closely the northern boundary of Knox County but turning a little more northwest to the plains between Mt. Gilead and Galion.

Most of the crest of this divide rises above 1200 feet and the portion south and west of Nashville often attains an elevation of 1300 feet and sometimes more than 1400 feet. A few points near Baltic and also toward Barnesville are above 1300 feet but most of the country bordering the Killbuck Valley is below 1200 feet although there are a few points less than a mile from the stream which rise above this elevation.

The other branch of this divide turns northward by Berlin to Calamoutier, where the elevation is more than 1300 feet and there are also points southwest and northeast of Winesburgh and south of Mt. Eaton which rise above this height. From Calamoutier a more or less dissected area extends northeastward almost to Dalton, beyond which its extension is uncertain for reasons which will be brought out later. The line of hills running northward from Doylestown and spreading out into a high plateau between Wadsworth, Medina and North Royalton and rising to more than 1300 feet at West Richfield and a few other points may represent its northern extension at some earlier time.

From Calamoutier the present divide turns northwestward by Weilersville, about half way between Wooster and Orrville, but the old divide may have branched off near Mt. Hope and run southwest of Fredericksburg and west of Apple Creek to Weilersville. From here it turned more to the northwest, crossed the Killbuck near Armstrong and at present swings on westward by Savannah, north of Shelby and then on southwestward and joins the highlands east of Galion. If the suggestions made in this paper are true the portion from Wayne County westward does not represent a preglacial divide but rather an escarpment, which was changed into a divide by the ice.

The evidence from the general level of the uplands seems to show that the portion of Ohio now drained by the upper branches of the Tuscarawas, Cuyahoga, Killbuck and Mohican represents an area with most of the higher portions on the south, east and north and a gentle slope from these directions toward the center and west. Differences in the hardness and dip of the rocks seems to have been the main factor in determining the general level of the uplands. *The general direction of the preglacial streams was from the southeast northwestward toward the broad plains to the west rather than from the edge of the plains southeastward into the hills as so many of them do at the present time. The former would certainly seem to be a more natural development than the latter.* If the preglacial topography was that of a peneplain, with most of the country still above an elevation of 1100 feet, such a system of drainage could have existed. This would mean that the present valleys have been very largely carved out since the coming of the ice, which hypothesis is supported by the steep slopes along nearly all the principle streams and the general youthful appearance of much of the topography and especially by the evidence of a preglacial col on the Tuscarawas near Port Washington, on the Killbuck south of Millersburg and the Mohican near its entrance into Knox County.

#### PROBABLE PREGLACIAL DRAINAGE.

The section of the area not covered by the ice should furnish the most positive evidence of preglacial drainage as shown by the streams. There seems to be no reason to doubt that Conotton and Stillwater creeks, which rise in northwestern Belmont and eastern Harrison counties and flow northwestward to join the Tuscarawas, represent streams whose direction and location are the same as in preglacial time and that they formerly flowed on northwestward, the latter along the present channel of the Tuscarawas River and Sugar Creek, at least as far as Brewster, and the former along the present channel of the Tuscarawas, at least as far as Navarre. The old Stillwater may have turned northeastward by Justus and joined the old Conotton, flowing northward along the present Tuscarawas or the Stillwater, at least may have flowed northwestward across Wayne County to the present Chippewa Valley or more nearly westward by Kidron and Apple Creek to the Killbuck drainage. If one or both flowed northward by Massillon they may have

turned westward along the Chippewa valley or continued northward to the Cuyahoga. The southwestward course of the upper Cuyahoga and the southeastward direction of many of the tributaries of the Cuyahoga beyond Akron, as well as its failure to develop a broad valley like the Grand River, raise a question as to the Cuyahoga outlet as the earliest development of the drainage. On the other hand there seems to have been an old plain several miles in width developed along the Cuyahoga with an elevation around 1000 to 1100 feet, which seems to have been later cut into by the Cuyahoga, forming its present narrow gorge-like valley. The relatively small basin drained, as compared with the Grand River, might explain why the valley was not cut out wider and that of the present Upper Cuyahoga is probably a later glacial development.

The old divide may have extended northward from Dalton to Doylestown and the break through this west of Clinton may not have occurred until the first advance of the ice. The dip in the general level of the uplands from Medina southward and the rise again beyond Ashland seems to indicate that the drainage of a considerable area was toward the northwest along the Chippewa Valley either by Chippewa Lake or Lodi or both. The tributaries on the south side of the Chippewa Valley, as well as some other valleys in this section, practically all flow northward while those on the north side flow almost exactly in the opposite direction and it may be that the River Styx valley, Chippewa Lake and Lodi each represent separate preglacial channels which were connected together when the Grand River drainage flowed westward by Ravenna as will be explained later.

The angle at which the smaller streams enter the Tuscarawas Valley above and below Port Washington as well as an elevation of more than 1200 feet on the immediately adjoining uplands, as already pointed out, furnish very strong, if not conclusive, evidence of the existence of a preglacial divide between Port Washington and Gnadenhuten. The existence of such a divide at this point together with the narrow gorge east of Canal Dover would be absolute proof that the deepest erosion in the Tuscarawas and associated valleys took place during interglacial rather than preglacial or postglacial time and apparently at neither the first or the last advance. From this old divide the drainage was westward toward Coschocton and from there possibly westward along the Walhonding and Kokosing but

more probably along the old channel by Newark. The Kokosing and Walhonding valleys are evidently older than the Mohican, which was probably not formed until the last advance of the ice.

The Killbuck drainage is difficult to determine, as probably most of its channel has been made since the first coming of the ice. The angle of its tributaries, as well as the elevation of the uplands, seems to show the presence of an old divide south of Millersburg from which the drainage was northward at least as far as Kauke and might have flowed on by Wooster, Apple Creek and Orrville as suggested by Conrey\* to the Chippewa Valley but the direction of the tributaries around and beyond Wooster as well as the unnatural turning back towards the hills seems to be against this course. The former channel through the hills to Orrville as suggested by Todd must be abandoned as data from numerous wells and ravines show this to have been impossible. The more probable channel seems to be northwestward by Millbrook and along Jerome Fork of the Mohican by Ashland and Savannah, or possibly by the Muddy Fork through the old valley, which Conrey found east of West Salem, into the valley at Lodi.

The Black Fork of the Mohican is also believed to have flowed northwest and apparently also carried the waters of Clear Creek. The drainage from Loudonville was apparently eastward to Lakeville and thence northward into the Killbuck drainage but from Loudonville westward to Perrysville was probably into Black Fork. The Mansfield drainage is also thought to have been northwestward toward Shelby. The valley, which is followed by the Pennsylvania Railroad from Mansfield to Shreve, is probably mostly of interglacial rather than preglacial origin and apparently formed the principal line of drainage for this section at the time when the valleys were being cut deepest.

#### THE COMING OF THE ICE.

The advance of the ice was from the northeast along the Lake Erie basin from which it spread southward, the tendency being to flow around the higher parts of the country and spread out like fans from the larger valleys. When the ice advanced far

---

\*Conrey, G. W., Geological Survey of Ohio, Fourth Series Bulletin No. 24, page 20.



enough southward to encounter the northern end of the divide, forming the western boundary of the Grand River basin, it blocked the northward drainage and formed a large lake extending many miles southward. This lake continued to rise until it reached the level of the lowest point in this divide, which we have already seen is just south of Ravenna. In the article referred to in *Science* it was suggested that the Pittsburg drainage first broke over at this point and that the overflow at New Martinsville was at the time of one of the later glaciations. Leverett\* gives a well record at Campbellport about two miles southeast of Ravenna, which with a head of 983 feet, failed to reach rock at 230 feet, or an elevation of 753 feet above sea level. Prof. G. F. Lamb of Mt. Union College in private correspondence informs me that he has traced this old valley southwestward by Fritch Lake to the Portage Lakes. Recent well records, obtained from the Kemrow Company, show depths of 400, 404, 407 and 499 feet to rock in Sections 7 and 18 just east or south of Mud Lake, which means that the old valley floor is here around 600 feet above sea level, or little if any above the present level of Lake Erie. Another possibility was from Campbellsport somewhat northwestward along Congress Lake outlet to the Cuyahoga. From Portage Lakes an old valley extends both north and south, in fact there seems to be a network of these old valleys in the section between here and Akron, Barberton, Clinton and Canal Fulton. One of these along Nimisila Creek apparently carried the Pittsburg drainage during the earlier advances of the ice, as the narrow gorge-like valley of the Ohio seems to indicate that the present channel of this stream was not formed until later glacial time.

As the ice advanced farther west and south it blocked the drainage of other streams, which drained the plateau to the northwest, although it seems probable that the waters, which flowed across the divide near Ravenna, followed the present Chippewa valley westward by Creston and Lodi until the ice moved far enough south to force them to seek another outlet. Whether this was at the first advance of the ice has not been determined but as soon as it happened the waters from the streams coming from the southeast were dammed up and broke over the old divide on the Tuscarawas near Port Washington and flowed southwestward by Coschocton and Newark and

---

\*Leverett, Frank Mon. XLI, U. S. G. S., page 462, 1900.

joined those from the old Kanawha, although it is possible that the first break over was along the line of the Killbuck, which might have carried the Ohio drainage until it was forced farther to the southeast.

The northwesterly flow of other streams, which drained the old plateau, were also blocked and forced to seek a way around the ice, which was found by breaking over the old divide south of Millersburg, joining the Tuscarawas at Coschocton. This Killbuck drainage seems never to have again been northward, although the Old Grand River plain was so low that the Ohio drainage probably returned to its former channel after the retreat of the ice and continued northward during one or more interglacial periods. There is also evidence for thinking that the Tuscarawas likewise drained northward by Akron into the Cuyahoga during an early interglacial period and, in fact, may have furnished an outlet for the Kanawha drainage along the old valley from Circleville northeastward by Newark to the Tuscarawas at Coschocton and then along the line of this stream and the Cuyahoga to the Lake Erie basin at Cleveland.

The Scioto valley above Portsmouth is relatively much wider than the Ohio valley below this point. The elevation of the old Kanawha valley, whose floor is about 100 feet above the present Scioto, where it joins it at Waverly, shows that the Scioto could not have been of preglacial origin. Some obstruction may have caused the Kanawha to break over a low divide between Portsmouth and Sciotoville so that it flowed northward along the Scioto and joined the Tuscarawas as suggested above, during the interglacial period in which the deep valleys were formed. Only by a careful study of well records will it be possible to determine the slope of the rock floor of this old Scioto-Tuscarawas-Cuyahoga Valley and it may be that it was reversed in part of its course during different interglacial periods.

#### DEEP VALLEYS OF INTERGLACIAL ORIGIN.

The old Tuscarawas-Cuyahoga valley was apparently from 250 to 500 feet deeper than at the present time and this depth enabled the tributary streams like the Kokosing, the Killbuck, which then carried the Mohican, and the Chippewa to cut out deep channels also. At Cleveland the rock floor is about 500 feet below the present valley, or less than 100 feet above sea level. East of the Portage Lakes it is around 600 feet

and would probably be lower in the center of the Lakes. A well record southeast of Easton in Section 21 Chippewa Township, Wayne County, struck rock at 443 feet and another one near the same place in the northeast quarter of Section 20 entered rock at 417 feet. The elevation of the present valley here is about 950 feet so the rock floor is apparently below the present level of Lake Erie. Further west in the Southwest quarter of Section 14 Milton Township the depth was 275 feet and in the southeast corner of Section 5 of the same Township it was 262 feet. Mr. Cummings of The East Ohio Gas Company states that he drilled a well near Strassburg in Tuscarawas County 400 feet before he struck rock. Leverett reports about 250 feet or more to rock at Newark and records in Killbuck valley south of Wooster in the middle part of the northwest quarter of Section 21, Township 15, Range 13, show 206 feet although other wells only a short distance away show 82, 110, 126 and 142 feet to rock. As the present Killbuck valley is around 850 feet, while Orrville is 150 feet or more above it, the valley at Orrville would have had to have been more than 350 feet deep to have received the Killbuck drainage. While wells were found east of Wooster in Section 7, Township 16, Range 12 which had depths of as much as 227 and 240 feet the surface elevation at their heads would still make the rock floor as much as 100 feet above that of the Killbuck while almost immediately east in the same sections the depth was 44, 118, 120, 160 and in Section 8 only 42 and 90. Records in Sections 3 and 4, Lawrence Township, Stark County gave 248, 260, 265 and 277 feet. A well in Section 32, Prairie Township, Holmes County, showed 298 feet but it is apparently on a gravel terrace to the west of the present valley.

It is not possible in this paper to go into any further discussion of these old valleys, which were carved out to such unusual depths, apparently during some interglacial period. The evidence given seems sufficient to show that Killbuck valley was cut out by a stream flowing southward when the Tuscarawas at Coschocton was probably 250 feet or more below its present level and not by a northeastward stream.

#### DRAINAGE CHANGES DURING LATE GLACIATION.

The drainage, which existed when these old valleys were formed, was disturbed by another advance of the ice, probably either the Illinoian or the Wisconsin. If the former extended

as far toward the southeast as indicated by Leverett then the change of the Ohio, Muskingum and Licking to their present channels must have resulted not later than that advance. The Wisconsin glaciation went far enough southeast to cause the drainage of the upper Mohican, which formerly flowed eastward by Big Prairie and probably Shreve to the Killbuck, to cut a gorge through the hills south of Loudenville to the Walhonding, Clear Creek being forced to abandon its course by Perryville and break through the hills to join the Mohican. By climbing the hills east of Beach City this glaciation was also probably responsible for the Tuscarawas breaking through the hills east of Dover, where it runs through a gorge across the old ridge separating the old Conotton and Stillwater valleys. The narrowness of this gorge, as compared with the width of the valleys which it connects, is one of the most striking evidences of the long period of time which passed between its formation and the breaking through the old divide near Port Washington.

Whichever advance of the ice blocked both the northern and southern flow of drainage along this old Scioto-Tuscarawas-Cuyahoga valley, forcing a new outlet through the hills along the present course of the Muskingum, with a channel much above that of the old valley, caused a damming of the streams, a filling of the valleys and the bringing about of sluggish drainage in streams like the Killbuck.

Many other interesting possibilities and details might be pointed out, if space permitted. While some of the suggestions offered may seem at first rather radical I believe that further study will show that they offer a more logical explanation of the conditions than has hitherto been presented. I trust that some of the suggestions may prove of assistance in solving the many puzzling drainage problems of northeastern Ohio.