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Unpublished review and correspondence re: "Farmdale drift in northwest Illinois" and draft of unpublished paper on glacial geology of the Wisconsin-Illinois border. 1956-1957

Thwaites, F. T. (Fredrik Turville), 1883-1961
[s.l.]: [s.n.], 1956-1957

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Shaffer's report on northwestern Illinois describes the drift outside the known Wisconsin moraines as a pre-Iowan substage of the Wisconsin rather than Illinoian as it had long been correlated. The report deserves careful attention because not only of this change in correlation but of the proposed definite recognition of the drift of a generally unrecognized substage of the Wisconsin Stage of glaciation.

The writer is in a position to evaluate this report because in 1907 he was field assistant to W. C. Alden in this area and has subsequently visited not only the part in Wisconsin but also that in Illinois many times on field trips with students in glacial geology. He also spent two field seasons in road material work in central Illinois, the type locality of the Illinoian drift. A day in 1957 was spent with Prof. R. F. Black in reviewing the phenomena on both sides of the state line.

In the historical summary of earlier work in the area Shaffer ^{qu}otes two papers by Alden which throw considerable light on the problem of age correlation. In 1904 Alden described the pre-Cary drift east of Rock River in Wisconsin and suggested that it might be of Iowan age. In 1909 Alden discussed in detail the problem of fixing the age of a glacial drift by degree of weathering and erosion. ^{Since} this paper was not published by the U. S. Geological Survey it is likely that it escaped the usual censoring to meet orthodox views. This paper considers the formation of what would now be called "soil profiles" where the original slope of the land led to erosion during their formation. It was pointed out that the original drift slopes are related to preglacial topography. In this northern area the high position of the St. Peter sandstone led to a rugged landscape which was not entirely buried by drift as is the case in central Illinois. In fact the country west of Rock River in Wisconsin is so rough that it gives little visible evidence of glaciation. It was often suggested that had Fenneman been more familiar with this district than he was he would probably have included it in his Driftless Section rather than in the Till Plains. Alden's final conclusion was that erosion concurrent with weathering made this drift in northwestern Illinois and southern Wisconsin appear much younger than it is for the weathered zone was eroded as it formed. He correlated the drift as Illinoian.

It should be noted that Alden carried no tools to dig or bore. His observations of depth of carbonate leaching were made almost wholly in shallow road cuts on hill-sides. It was not until Leighton carried the use of the soil auger from Iowa to Illinois that authentic measurements of this depth were possible. Test holes could then be located on uplands and divides where postglacial erosion is at a minimum.

When Alden wrote erosion and transportation was wholly ascribed to slope wash. Horton discovered that important wash does not extend to divides for there is not a large enough area to gather rain enough to overcome the resistance to erosion of the soil. However, this theory does not take mass movement or creep into account. Divides can not be lowered without such a process. ^{It} may occur on quite low slopes provided the climate is favorable. Climatic changes during the Pleistocene could have made mass movement more rapid than it now is but the exact nature of these climatic changes is still debatable. Unfortunately we cannot easily check depth of weathering or amount of mass movement today for the road cuts made when the roads were first graded are now heavily grassed over.

The averages of depth of leaching reported by Leighton include the mantle of loess which is widespread in this area. The difference between the maximum and minimum measurements is large, about 6 times. The writer in his field trips found very few examples of deep weathering and these could be regarded as filled kettles.

Shaffer seems to have been more interested in the succession of different materials than he was in depth of leaching. His approach is that of stratigraphy and some readers have wondered just how he arrived at some correlations of thin layers encountered in auger holes. It is certain that he does not discuss the pitfalls in the practical application of the stratigraphic method to the results of boring. He mentions neither the relation of color to mechanical composition nor that older materials were plowed up by glacial movement. The importance of the phenomena described cannot be ignored nevertheless.

A much more serious omission is the lack of mention of the "drift dams" or local drainage diversions which caused postglacial erosion of narrow valleys out of harmony with the normal preglacial landscape where the streams resumed the pre-drift courses. The sides of nearly all of these valleys although steep are not cliffed. Their occurrence certainly demands consideration for it has generally been assumed that they indicate a longer postglacial interval than do the relatively shallow soil profiles. It has been suggested that perhaps rainfall was heavier than it now is during part of this interval and that erosion went on faster than it does now. Some of the valleys could have been eroded by glacial meltwater but this is not true of all of them.

Another point which is not clear is Shaffer's correlation of all weathering of bed rock as preglacial. Since over large areas weathering extends through the thin residual drift into the bedrock the phenomenon could indicate a longer postglacial interval than would otherwise be concluded.

Shaffer accepts Flint's conclusion that the gravel deposits of the area have their original topographic form. In Wisconsin at least this is debatable and the present topography can be explained by the greater resistance to erosion of gravel compared with that of the surrounding till.

A point which demands much more explanation is the difference of the drift material in northern Illinois and southern Wisconsin from that of central Illinois. In the north the drift was derived from sandstone and dolomite whereas farther south a much larger proportion came from shale. It is not easy to decide what part this difference had on permeability and postglacial weathering. Certainly it is most difficult to compare the conditions of the central Illinois plains which concealed almost all the rock topography with those of a rugged country which was never so deeply covered with drift.

A point which seems very important in correlation of the northern drift is its relation to the overlying loess. In central Illinois it is easy to see that there are two distinct loess deposits which lie upon drift which was deeply weathered prior to the formation of the older loess. In the north only one loess can be found and where it is thick enough to be fresh at the base this lies on unweathered till. The question arises could the weathered zone in the till have been removed by erosion before the loess was deposited?

If we place the proposed Farmdale on a map of Illinois difficulty arises. It was obviously the product of a very much expanded Lake Michigan Lobe which brought pebbles of the Niagara dolomite to the borders of the Driftless Area. Only two times are known when such expansion occurred. One is in the Illinoian stage and the other during the Tazewell^{sub} stage of the Wisconsin stage. Horberg's maps of deposits concealed under the Wisconsin drift does not suggest an extent of the proposed Farmdale till to the south.

Shaffer's argument for the pre-Iowan age of the Farmdale till rests upon its relation to the previously named Farmdale loess which he regards as the dust from Farmdale valley trains plus his own previous correlation of the Shelbyville

Tazewell moraine as Iowan. This is not the place to debate these points neither of which has met with complete acceptance. In conclusion the writer feels that the age of the border drift of northern Illinois and southern Wisconsin is younger than Illinoian but that it is not yet proved that there is an exposed Farmdale drift of pre-Iowan age.

References not in Shaffer's report.

- Alden, W. C., The Delavan glacial lobe-----: U. S. Geological Survey Prof. Paper 34, pp. 18-20, 1904
- Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage relations: Jour. Geology, vol. 17, pp. 694-709, 1909
- Fenneman, N. M., Physiography of Eastern United States, McGraw-Hill, 1938
- Horton, R. E., Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology: Geol. Soc. America Bull. vol. 56: pp. 275-370, 1945
- Thwaites, F. T., The development of the theory of multiple glaciation in North America: Wisconsin Acad. Sci. Trans., vol. 23, pp. 41-164, 1928
- Thwaites, F. T. Outline of glacial geology, pp. 58-72, 78-79, 1957

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STATE GEOLOGICAL SURVEY DIVISION

JOHN C. FRYE, CHIEF
121 NATURAL RESOURCES BUILDING
UNIVERSITY OF ILLINOIS CAMPUS
URBANA

October 10, 1957

Mr. F. T. Thwaites
41 North Roby Road
Madison 5, Wisconsin

Dear Mr. Thwaites:

Thank you very much for the revised mapping along the Wisconsin-Illinois state line. I have passed the copy on to George Ekblaw and he believes that we can make a satisfactory blending of the two maps with this new data.

I am glad that you favor a Wisconsin age for the area previously mapped as Illinoian. As we are not attempting to differentiate Wisconsin substages, but rather to map the ~~terminus~~ terminus of major readvances, the nomenclature problem may not arise. In any case, your reservation as to the specific correlation of the drift will be retained.

I agree that you should not attempt to compile a revised copy. Perhaps Mr. Hanson will wish to delegate someone else to do that. If no one is available, I shall be glad to make the copy and submit it to you for approval.

We will also need some references and bibliography to be used in a pamphlet similar to that which accompanied the Glacial Map of North America, but I shall write you more specifically about that later.

I am glad to have a reprint of your article on pitted outwash. It certainly should be differentiated wherever possible.

I am sorry that the Door peninsula map did not come up to your expectations. It seems effective to me. I was glad that the GSA decided to publish it in color.

Sincerely yours,

H. B. Willman

H. B. Willman
Geologist and Head
Section of Stratigraphy
and Areal Geology

cc: Mr. George F. Hanson

41 N. Roby Road,
Madison 5, Wis.
26 Sept., 1957

Dr. H. B. Willman,
Illinois Geological Survey,
Natural Resources Bldg.,
Urbana, Illinois

Dear Dr. Willman:

I hope you will pardon the long delay in answering yours of 2 April. I wanted Dr. Black to work with me in the field and he could not go until just before he went into the field for the summer. I wrote up the report and drew the map but could not get his approval until classes started this week. Enclosed are (you may keep all of them): (1) a revised version of my review of Shaffer's ~~paper~~ paper, (2) copy of my paper on pitted outwash, and (3) copy of report and map on "Operation State Line," the resurvey of the area east of Walworth, Wisconsin.

With regard to your second paragraph I think our mapping near St. Croix Falls is correct. We separated pitted outwash from endmoraine in the later work. It is interesting that Mint does not seem to recognize such a thing as pitted outwash. Perhaps it is not well developed in the east or in South Dakota. It was described on Long Island long ago.

With regard to the bottom of your first page I think you must mean Sugar River not creek. If you will study the quadrangle (forget its name) just south of Janesville, Wisconsin you will find that the outwash of the Rock made a definite dam across the south of the Keweenaw. West of there this valley is very flat with very intricate meanders. I never bored to test the sediment but am confident it is a lake deposit. The outwash along the Sugar never joined with that of the Rock. Being confined to Wisconsin Alden missed this relation.

With regard to lakes north of the glacial margin we have little definite data. But they simply must have existed and the fact that shorelines were not found is matched by the weak shorelines of some Cary lakes or even of some Viaders lakes. We have to get levels from delta fronts and not from shorelines.

With respect to Farmdale drift I wish to thank you for your comments. Dr. Black and I thought that the case for Tazewell age of the supposed Illinoian in Wisconsin is reasonably good. But we do not agree to mapping it as Farmdale. The matter of ice lobation is important. Glaciers were not wild animals which could move in any direction. Lobation was governed by definite physical laws. Pending a paper by Leighton I am holding the question open. Soils men tell me that the clay fraction of the loess came from the west and not from glacial drift. I have not seen any of this work published.

Since I was laid off the first of July I am no longer connected with the Survey and should be addressed as above. I am not at all sure I can do any more work on the project. Certainly I do not want to undertake any more fine drafting. I mean fine texture not quality. My eyes will not permit much fine work.

It is too bad my map of the Door Peninsula is so poor. I never had a second proof. The red color is entirely too weak.

I do not intend to publish the Shaffer review as Leighton is working on the problem and writing a paper on it. That is unless he desires me to.

Sincerely yours,

26 Sept., 1957

Dr. M. M. Leighton,
611 West Pennsylvania Ave.,
Urbana, Illinois

Dear Dr. Leighton:

Thank you for your letter of the 15th. I am enclosing herewith revised copy of a review of Shaffers paper on Mendota drift. You may keep it. I do not intend to publish it unless you desire for you are writing along the same lines as I understand it.

Soils men tell me the fine or clay fraction of loess in Illinois is not derived from glacial drift but from the west. I have not gone on to this. I do not think it is yet published. The matter of location of the ice is a fatal point against Shaffers mapping. Glacials were not wild animals which could go in any direction but obeyed physical laws in spreading out. Dr. Black and I agreed that the evidence favors a Tazewell age for the drift in Wisconsin. I did have two deep holes to calcareous material which may be filled kettles. I think Shaffer tried to make his report short but it then does not state his case clearly. I am holding my opinion open pending seeing your paper.

Sincerely yours,

Its too bad my map of the Door Peninsula is so poor. I never had a second proof.

MORRIS M. LEIGHTON
611 WEST PENNSYLVANIA AVENUE
URBANA, ILLINOIS

Sept. 19, 1957

Dear Thwites:

I have your card. If you would like to have me read your revised criticism of Shaffer's paper, inasmuch as you have made changes, I should be glad to do so. Since I commented on your first criticism I have spent some time in field review. I agree with him that there was Farmdale glaciation but much more limited than he proposed. Some highway cuts and augur borings on the divides reveal weathered Illinoian drift under Farmdale loess, and there is a tell-tale of geomorphic evidence consistent with the stratigraphic. I am now writing it up.

Sincerely yours,

Morris M. Leighton

26 Sept., 1957

Dr. Paul R. Shaffer,
Department of Geology,
University of Illinois,
Urbana, Illinois

Dear ^U P. Shaffer:

I am enclosing for your files a copy of the revised review of your recent report on Escudale drift. It was written primarily for argument with Willman on the correlation of this area in Wisconsin on the new glacial map. It is not for publication unless Dr. Leighton wants it. I understand he is writing a paper along the same lines. I am sending him a copy.

I feel that your case for post-Illinoian age of the drift drift is good but think that the matter of erection of a new substage could be explained much more clearly. There are serious objections to it which I just cant explain here including the source of the loess. Soils men tell me a quite different story on that. Leighton told me he did not agree about the Shelbyville drift correlation.

It is too bad my map of the Door Peninsula is so poor. I never had a second proof.

Sincerely yours,

Dr. H. B. Willman,
Illinois Geological Survey,
Natural Resources Bldg.,
Urbana, Illinois

Dear Dr. Willman:

The problem of answering yours of April 2 has remained with me all summer. The field work which ~~was done~~ Dr. Black and I did was just before he went in the field so that I have had no good opportunity to talk it over with him until school reopened. Enclosed are: (1) a revised version of the review of Shaffer's paper and (2) a report on the resurvey of the Illinois-Wisconsin state line east of Walworth.

With regard to your second paragraph I think our map is correct on the matter of pitted outwash. ^{it is now full} We are handicapped in using this word because it occurs neither in the legend of the new map nor in Flint's book. Apparently it does not occur in the same way in eastern United States as it does out here although it was described on Long ~~Island~~ Island long ago.

The Illinois line problem is fully discussed in our report with map.

With regard to the paragraph at the bottom of your first page I think you must mean Sugar River. If you study the quadrangle just southwest of Beloit you will find that the Rock outwash blocked the mouth of the Pecatonica making a lake. The Sugar meanders intricately in this area. We have not seen it in the field. recognizable outwash extends down south of Brodhead in Wisconsin. The lakes outside the drift border existed. They simply had to but the shorelines which were never well developed are unmappable. We checked one of them by a boring which found lake clay under peat. For that matter shorelines of Cary lakes are very poorly shown in central Wisconsin. We get levels from delta fronts.

I was laid off July 1 and am no longer connected with the Survey. So if you want any more work done ~~it cannot be by me.~~

I am not sure I can do it.
Sincerely yours,

*The review of Shaffer paper is enclosed ~~and~~ has been reviewed
you may keep this copy. It will not be published unless
Dr. Ferguson thinks it should.*

Dutton
1954

Sandale drift in northwestern Illinois, Paul R. Shaffer, Illinois Geological Survey Report of Investigations No. 196, 1956

Shaffer's report on northwestern Illinois describes the drift outside the known Wisconsin terraces as a pre-Iowan substage of the Wisconsin rather than Illinoian as it had long been correlated. The report deserves careful attention because not only of this change in correlation but of the proposed definite recognition of the drift of a generally unrecognized substage of the Wisconsin stage of glaciation.

The writer is in a position to evaluate this report because in 1907 he was field assistant to W. G. Alden in this area and has subsequently visited not only the part in Wisconsin but also that in Illinois many times on field trips with students in glacial geology. He also spent two field seasons in road material work in central Illinois, the type locality of the Illinoian drift. A day in 1957 was spent with Prof. R. F. Black in reviewing the phenomena on both sides of the state line.

In the historical survey of earlier work in the area Shaffer cites two papers by Alden which throw considerable light on the problem of age correlation. In 1904 Alden described the pre-Guy drift east of Rock River in Wisconsin and suggested that it might be of Iowan age. In 1908 Alden discussed in detail the problem of fixing the age of a glacial drift by degree of weathering and erosion. Since this paper was not published by the U. S. Geological Survey it is likely that it escaped the usual censoring to meet orthodox views. This paper considers the formation of what would now be called "soil profiles" where the original slope of the land led to erosion during their formation. It was pointed out that the original drift slopes are related to preglacial topography. In this northern area the high position of the St. Peter sandstone led to a rugged landscape which was not entirely buried by drift as is the case in central Illinois. In fact the country west of Rock River in Wisconsin is so rough that it gives little visible evidence of glaciation. It was often suggested that had Rousseau been more familiar with this district than he was he would probably have included it in his driftless section rather than in the Till Plains. Alden's final conclusion was that erosion concurrent with weathering made this drift in northwestern Illinois and southern Wisconsin appear much younger than it is for the weathered zone was eroded as it formed. He correlated the drift as Illinoian.

It should be noted that Alden carried no tools to dig or bore. His observations of depth of surficial leaching were made almost wholly in shallow road cuts on hill-sides. It was not until Leighton carried the use of the soil auger from Iowa to Illinois that authentic measurements of this depth were possible. Test holes could then be located on uplands and divides where postglacial erosion is at a minimum.

When Alden wrote erosion and transportation was wholly ascribed to slope wash. Norton discovered that important wash does not extend to divides for there is not a large enough area to gather rain enough to overcome the resistance to erosion of the soil. However, this theory does not take mass movement or creep into account. Divides can not be lowered without such a process. It may occur on quite low slopes provided the climate is favorable. Climatic changes during the Pleistocene could have made mass movement more rapid than it now is but the exact nature of these climatic changes is still debatable. Unfortunately we cannot easily check depth of weathering or amount of mass movement today for the road cuts made when the roads were first graded are now heavily grassed over.

The averages of depth of leaching reported by Leighton include the mantle of loess which is widespread in this area. The difference between the maximum and minimum measurements is large, about 6 times. The writer in his field trips found very few examples of deep weathering and these could be regarded as filled kettles.

Shaffer seems to have been more interested in the succession of different materials than he was in depth of leaching. His approach is that of stratigraphy and some readers have wondered just how he arrived at some correlations of thin layers encountered in sugar hole. It is certain that he does not discuss the pitfalls in the practical application of the stratigraphic method to the results of boring. He says nothing with respect to the relation of color to mechanical composition nor that older materials were placed up by glacial movement. The importance of the phenomena described cannot be ignored nevertheless.

A much more serious omission is the lack of mention of the "drift dams" or local drainage diversions which caused postglacial erosion of narrow valleys out of harmony with the normal preglacial landscape where the streams resumed the pre-drift courses. The sides of nearly all of these valleys although steep are not cliffed. Their occurrence certainly demands consideration for it has generally been assumed that they indicate a longer postglacial interval than is the relatively shallow soil profiles. It has been suggested that perhaps rainfall was heavier than it now is during part of this interval and that erosion went on faster than it does now. Some of the valleys could have been eroded by glacial meltwater but this is not true of all of them.

Another point which is not clear is Shaffer's correlation of all weathering of bed rock as preglacial. Since over large areas weathering extends through the thin residual drift into the bedrock the phenomenon could indicate a longer postglacial interval than would otherwise be concluded.

Shaffer accepts Flint's conclusion that the gravel deposits of the area have their original topographic form. In Wisconsin at least this is debatable and the present topography can be explained by the greater resistance to erosion of gravel compared with that of the surrounding till.

A point which demands such more explanation is the difference of the drift material in northern Illinois and southern Wisconsin from that of central Illinois. In the north the drift was derived from sandstone and dolomite whereas further south a much larger proportion came from shale. It is not easy to decide what part this difference had on permeability and postglacial weathering. Certainly it is most difficult to compare the conditions of the central Illinois plains which concealed almost all the rock topography with those of a rugged country which was never so deeply covered with drift.

A point which seems very important in correlation of the northern drift is its relation to the overlying loess. In central Illinois it is easy to see that there are two distinct loess deposits which lie upon drift which was deeply weathered prior to the formation of the older loess. In the north only one loess can be found and where it is thick enough to be fresh at the base this lies on unweathered till. The question arises: could the weathered zone in the till have been removed by erosion before the loess was deposited?

If we place the proposed Rendale on a map of Illinois difficulty arises. It was obviously the product of a very much expanded Lake Michigan lobe which brought pebbles of the Niagara dolomite to the borders of the Driftless Area. Only two times are known when such expansion occurred. One is in the Illinoian stage and the other during the Cassin Stage of the Wisconsin stage. Norberg's maps of deposits concealed under the Wisconsin drift does not suggest an extent of the proposed Rendale till to the south.

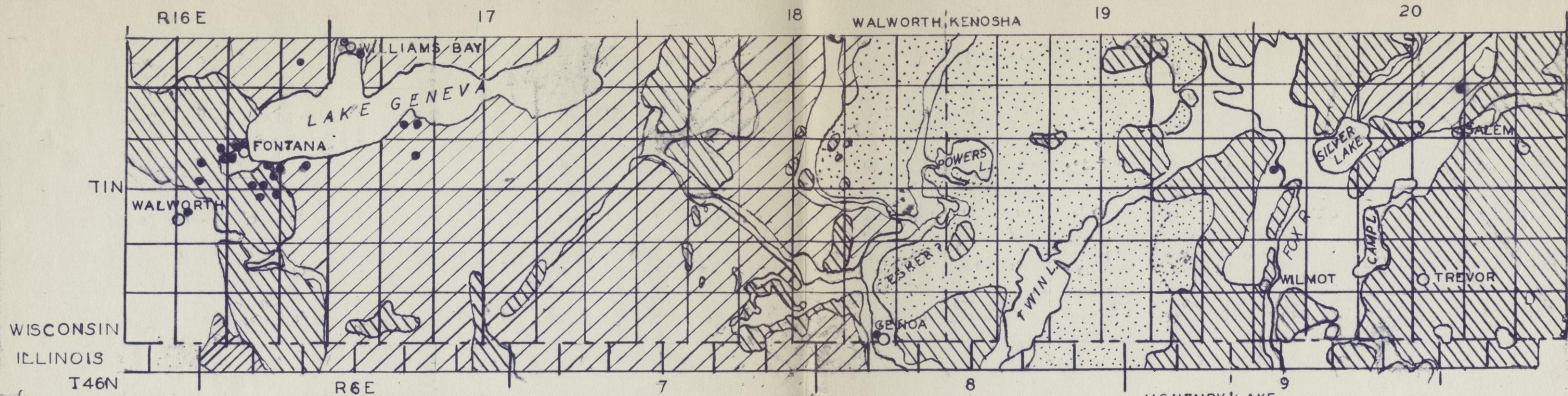
Shaffer's argument for the pre-loess age of the Rendale till rests upon its relation to the previously named Rendale loess which he regards as the dust from Rendale valley trains.






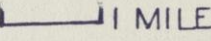
plus his own previous correlation of the Shelbyville

Taguacil moraine as Iowan. This is not the place to debate these points neither of which has met with complete acceptance. In conclusion the writer feels that the age of the border drift of northern Illinois and southern Wisconsin is younger than Illinoian but that it is not yet proved that there is an exposed Kankakee drift of pre-Iowan age.

References not in Shaffer's report.

- Alden, W. C., The Wisconsin glacial lobe-----: W. S. Geological Survey Prof. Paper 34, pp. 15-20, 1904
- Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage relations: Jour. Geology, vol. 17, pp. 604-702, 1909
- Penck, A., Physiography of Eastern United States, McGraw-Hill, 1908
- Horton, R. H., Development of streams and their drainage basins: hydrophysical approach to quantitative morphology: Geol. Soc. America Bull. vol. 56: pp. 275-370, 1931
- Twinn, F. T., The development of the theory of multiple glaciation in North America: Wisconsin Acad. Sci. Trans., vol. 25, pp. 41-104, 1925
- Twinn, F. T., Outline of glacial geology, pp. 58-73, 78-89, 1927



END MORAINE, TAZEWELL  ENDMORAINE, CARY  GROUND MORAINE  PITTED OUTWASH  DRAINAGEWAYS  WELL LOGS •  1 MILE

"Operation State Line "

Glacial geology of the Wisconsin-Illinois state line east of Walworth, Wis.

Introduction. When the glacial map of Wisconsin was compiled by Thwaites in 1956 it failed to agree with either the map of Illinois^{map} or the earlier maps of Wisconsin chiefly that by Alden (Alden, 1904, 1918). Problems raised by this fact comprise: (1) interpretation of soil profiles and soils maps, (2) use of terms for glacial and glacio-fluvial deposits, (3) the relative importance of topographic forms versus sediments in glacial mapping, and (3) the existence of a "Delavan Glacial Lobe" as a distinct feature. All of these problems have been under discussion in the course of field trips to this area over many years but the field mapping necessary to their solution was not attempted until late^{June} May of 1957 when Thwaites and Black spent slightly over one day in the area. Borings, soil profiles and air photographs were neglected in this study for lack of time. Nevertheless many changes were made in the classification of the glacial deposits as shown in the accompanying map.

Conditions of earlier work. Glacial mapping of this area was severely handicapped in the earlier studies of the area by several factors: (1) assignment of areas ~~to cover~~ made to Chamberlin, Leverett, and Alden appear to have been limited by the state boundary which they were not at liberty to cross to any material extent, (2) topographic maps of mediocre quality were available only in Wisconsin and those of Illinois were very crude reconnaissance surveys, and (3) the interpretation of the conditions of origin of sediments (sedimentation) was then very slightly developed. It seems probable that Alden, a very careful and conscientious worker, could have been impelled to accept the results of his predecessors (plates 1 and 3, 1904). Another fact which must be remembered is that all the early geologists^{many} worked on foot. They could not transport equipment for digging or boring. Road cuts and gravel pits were then very slightly developed. When a horse was used it was often difficult to find a place to hitch it while the geologist got out to examine an exposure. Many exposures did not pass through the weathered zone and soil profiles were then poorly understood.

It is small wonder that the geologists of 1957 reach different conclusions and this is no discredit to their predecessors.⁵⁵

Soil maps. The entire area was covered by soil maps which were published in 1923 and 1924 (Whitson and others, 1923, 1924). These maps are of considerable value for they give the results of many shallow borings (probably limited to 3 feet) but perusal of the reports show that the mappers must have had a very limited knowledge of glacial geology. In fact they were not encouraged to learn much of that branch of science. It seems likely from the descriptions that the Miami soil series is thin loess on weathered till. The Carrington series appears to have somewhat thicker loess mainly on till. An exception may be the deep phase of the Miami silt loam where coarse material is absent. This may be loess on assorted drift. The Fox and Waukesha series are obviously on outwash with either thin loess or no loess. The Rodman series represents kames and eskers. Miami stony loam is similar and it is far from clear how it was distinguished. The poorly drained soils, Clyde and Genesee series, call for little comment. The soils maps cannot easily or definitely be translated in terms of geology. The statement that the soils men were not encouraged to use geology is based on a conversation by Thwaites with the late A. R. Whitson who was in charge of the soil mapping.

TAZEWELL DRIFT

Marengo Moraine. The only part of the area mapped herewith which can safely be ascribed to the Tazewell substage of the Wisconsin drift is the small triangular tip of a ridge west of the higher moraine southeast of Walworth, Wisconsin. This is the continuation of the Marengo Moraine of Illinois which has been studied by Thwaites as far south as its type locality at Marengo, Illinois. The ridge is slightly gullied and consists of pink-gray till. The depth of weathering is slight. Similar till was distinguished by Thwaites in samples from several wells in Wisconsin but present knowledge does not permit of mapping its subsurface extent in Wisconsin.

GARY DRIFT

All the remaining drift of the area mapped by Thwaites and Black can be classified as deposits of the Gary substage of the Wisconsin drift.

Darien Moraine. The Darien Moraine was named by Alden. It is recognized as the margin of the Gary drift of Wisconsin and was not traced ~~far~~ into Illinois by its discoverer. Later mapping by Illinois geologists has demonstrated that it extends south of the border in a direction more southeasterly than that of the Marengo Moraine as is well shown on the 10 foot interval Harvard quadrangle of Illinois. This overlap at an angle of about 30 degrees demonstrated a shift of ice source toward the west so that different materials were picked up by the ice from those found by the westward-moving Hazewell ice. The relations of the two moraines are shown in the portion of the Harvard quadrangle published by Thwaites as Fig. 51, ~~40~~ (Thwaites, 1956, p. 40) the Darien moraine has variously been called West Chicago and Valparaiso in Illinois (Alden, 1932, pl. 2, Horber, 1953, fig. 2) The map published by Thwaites demonstrates the occurrence of non-pitted outwash in the reentrant angle between the moraines southeast of Harvard, Illinois. This fact demonstrates a lapse of time sufficient to melt all the residual ice masses left in the wastage of the ice which deposited the Marengo Moraine. Such a lapse of time is enough to demonstrate a different substage. It does not check Alder's mapping which shows Early Wisconsin drift in the vicinity of Twin Lakes

Apparently the significance of pitted outwash and even the use of the term are unknown to many glacial geologists. It is not mentioned in either Flint's book of 1957 or on the legend of the glacial map of United States now in preparation. Pitted outwash was fully described in a paper by Thwaites (Thwaites, 1926) a copy of which is enclosed. It is best developed in a plains region and is not present in large areas in rough topography. In such regions deposits alongside the ice in valleys are called "kame terraces" or "ice-contact deposits." In the plains space between kettles is larger and deposits may cover entire counties. In places the kettles or pits are arranged in chains which must record pre-outwash valleys in which the ice

lingered longest because of its thickness. If there are no pits in an outwash plain it is clear that the only process which could destroy residual ice masses is a lapse of time sufficient to melt them. Hence the distribution of non-pitted outwash shows the borders of drift of separate substages such as the Cary substage. Alden's mapping is impossible. The till of the Darien Moraine is higher in stone content than that of Marengo Moraine probably because the ice readvanced over older outwash deposits. A contact of the Darien till on outwash is well exposed in the large commercial gravel pit at Fontana. This locality has been visited by many classes in glacial geology. Kames are more common in the Darien Moraine than in Marengo Moraine.

Ground Moraine. East of the Darien Moraine is a considerable extent of what the present writers term "ground moraine". This is gently rolling except along the slope south of Lake Geneva where it is dissected by ravines which lead down to the lake. Many of the ravines contain springs. The basin of Lake Geneva is a kettle due to the melting of an ice remnant which probably lay in a preglacial valley which indents the border of the Niagara dolomite. The ice must date from an advance earlier than that which deposited the Darien Moraine yet the collapse of the surface appears to be post Cary for the basin was not smoothed by moving ice. The extent of the outwash below the Darien till is not definitely known for the distribution of wells which demonstrate outwash below till is limited. It could be that a large portion of the upland south of Lake Geneva is an overridden outwash plain like that at Fontana but this hypothesis cannot be regarded as proved. Throughout the area there are small kames and other marginal features which apparently led Alden to map much of it as endmoraine. The present writers, however, regard these rough stony areas simply as stray marginal deposits formed during the wastage of the Darien ice. The soils maps classify this area as Miami and Carrington silt loams, the basis of division apparently due to difference in amount of loess cover. These soils appear to have all been formed by weathering of till below the loess cover.

Genoa Moraine. Alden mapped a Genoa Moraine which extends from the Darien Moraine just south of the state line and thence east and north of east to a reentrant in

southwestern Kenosha County. This moraine was the basis of the Delavan Glacial Lobe which was described in Alden's Professional Paper of 1904. The only part of this tract which at all suggests an endmoraine to the present writers is just northwest of Genoa. There the north side of a plateau slightly higher than the rest of the country has a north-facing slope of about 60 feet. The high area to the south of the gravelly north slope which Alden regarded as an icecontact slope, is at an elevation of over 920 feet. On the soils map this area is mapped as Carrington silt loam. To the west the McHenry Quadrangle with 10 foot interval fails to show any suggestion of an endmoraine. None was observed in the field. To the northeast the marginal moraine was mapped along the kettles of ~~kettles~~ of Powers, Twin and Fell lakes. No suggestion of marginal deposits could be observed along this line. To explain the difference of opinion it is necessary to recall that Alden regarded all kettles as indicators of marginal deposits. This statement is based on what Thwaites learned from him during the field season of 1907. Abandonment of the hypothesis of the Genoa Moraine does not explain the high area west of Genoa. It could be due to topography which antedated the Darien advance or might be associated with the esker mapped by

Alden northeast of Genoa and here described below. It lines up well with the Alden admitted that the Genoa Moraine is "weak rather equivocal" (Alden, 1904, p. 31) supposed esker.

Delavan Glacial Lobe. The data presented above make a strong case against the existence of such a marked Delavan Glacial Lobe as that mapped by both Chamberlin and Alden. Acceptance of such a lobe would make the Darien-Genoa ice cross the basin of Lake Geneva at right angles. Such a southerly ice motion is not supported by either striae (there are no outcrops in the area) or drumlins (also rare if present at all). It certainly does not fit with the pitted outwash plain of the region around Twin Lakes or the recent mapping of moraines in Illinois (Alden, 1932, Horberg, 1933). The cause of the lobation ascribed by Alden, the preglacial Troy valley, appears to the present writers as inadequate. It is high time that the Delavan Glacial Lobe as a distinct feature be forgotten.

Pitted outwash. East of the Darien ground moraine there is an extensive pitted outwash plain which buried most of the preexisting topography. Only small remnants of this landscape project through the covering beds of sand and gravel. Most of these are marginal deposits or kames. Some, judging from the mediocre topographic maps could be southwest-trending drumlins. This area is mapped as Waukesha and Fox soils. A considerable area east of Twin Lakes is shown on the soils map as the deep phase of Miami silt loam. Although that soil series generally rests on till it appeared to the present writers that this area is relatively thick loess on outwash. Exposures were seen which show this condition. The boundary between this possibly till-covered area and the area of Fox soil which was recognized as outwash by Alden is shown by a fine dotted line on the map. The course of this border does not suggest the margin of an overriding glacier. The legend of the soils map records that the borings on which it was based did not find any coarse material below this silt. In those days most borings did not go deeper than three feet. An area just east of Genoa was mapped by us in the field with no visible exposures as ground moraine. This may be an error for part of the area is shown as Waukesha on the soils map. If so, the outwash plain is continuous east of Genoa. Borings are needed to settle this point, as well as the true nature of the Miami silt loam area farther east. However, there is no question of the interpretation of the area around Twin Lakes and to the north and northwest. This plain slopes gently south from elevation above 900 feet to about 360 feet ⁱⁿ its southern part. Precise elevations are not given on the old topographic maps and would be hard to discriminate because of the loess cover. This area is obviously Cary drift and cannot be Early Wisconsin as shown by Alden. There is no evidence of an overridden outwash plain.

Esker? Alden mapped the gravel ridge which trends northeast-southwest just north of Genoa as an esker. It is situated in pitted outwash but its southwest extension is the supposed ice contact face of Alden's Genoa moraine west of Genoa. The two

may be parts of the same deposit. More field work is needed to see ^p if there is any evidence on this point. The gravel where examined in a pit near the north end is very bouldery and dips toward both flanks of the ridge. It could be either a true esker formed between ice walls or a crevasse filling laid down ^{during} the early phase of the adjacent pitted outwash when large masses of ice remained. On our map this area is shown only by a dotted line. Certainly it is not like normal eskers which occur in ground moraine.

Valparaiso Moraine. East of the pitted outwash plain described above is the Valparaiso Moraine as the term was used by Alden. It is very difficult to discriminate the western border of this moraine for it grades into the coarser phase of the pitted outwash and is much cut up by later erosion channels which branch and reunite among the morainic hills. Much of the moraine proper is composed of true kames. Such deposits are much more irregularly bedded and coarser than is common in true outwash but there is every gradation to the crevasse fillings formed in cracks between residual ice masses and the much pitted outwash deposited on top of such residual ice masses. Flint appears to use the term "ice contact deposits" for both types with no attempt at discrimination. ^{the} present writers excluded from the moraine the remnants of the outwash plain which are large enough and free enough ^{from} to make distinct plate[✓]-like hills. A large part of Alden's mapping was followed on our map, ~~however~~ ^{data} in the way of exposures and well logs is not available ^{to} tell whether or not the Valparaiso Moraine was a readvance of the ice. If it were the time lapse was much less than that ~~which~~ which preceded the formation of the Darien-West Chicago Moraine and did not mark a distinct substage of the Wisconsin glaciation. It shows ice which moved almost due west up the dip slope of the Niagara dolomite. It gives no hint of a Delavan glacial lobe.

Drainage ways. On the map the term drainage ways has been applied not only to channels eroded by glacial meltwaters but also to unpitted outwash south of Walworth. The change from deposition to erosion by the meltwaters need not here be discussed. There was some local erosion by the water from melting isolated ice masses. Such was the origin of the lowlands around ~~the~~ large kettles such as the plain at Fontana. No separation was made on the map. The drainage channels show only a few kettles but Silver Lake, Camp Lake and a number of smaller lakes lie in these erosion lines suggesting that all ice residuals had not melted by the time of the later meltwater erosion. No attempt was made to trace these channels to the north but apparently they carried drainage from Alden's Third Terrace of the series at Eagle, Wisconsin (Alden, 1904). The existing maps are not accurate enough to work out this problem for they show no instrumental elevations. The borders of the channels are not everywhere clear cut and easy to map. Fox River (not to be confused with the Fox River of northeastern Wisconsin) is only incised a few feet below the channel bottoms.

Conclusion. Mapping by the writers (1) increased the area of mapped ground moraine at the expense of Alden's terminal or endmoraine and what was shown as pitted outwash on the first draft of the new glacial map, and (2) disposed of the idea of a Delavan Glacial Lobe leaving only a slight bulge in the border of the Lake Michigan Lobe to represent this feature.

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"Operation State Line"

glacial geology of the Wisconsin-Illinois state line east of Walworth, Wis.

Introduction. When the glacial map of Wisconsin was compiled by Thwaites in 1956 it failed to agree with either the map of Illinois or the earlier maps of Wisconsin chiefly that by Alden (Alden, 1904, 1918). Problems raised by this fact comprise: (1) interpretation of soil profiles and soils maps, (2) use of terms for glacial and glacio-fluvial deposits, (3) the relative importance of topographic forms versus sediments in glacial mapping, and (3) the existence of a "Delavan Glacial Lobe" as a distinct feature. All of these problems have been under discussion in the course of field trips to this area over many years but the field mapping necessary to their solution was not attempted until late ^{June} May of 1957 when Thwaites and Black spent slightly over one day in the area. Borings, soil profiles and air photographs were neglected in this study for lack of time. Nevertheless many changes were made in the classification of the glacial deposits as shown in the accompanying map.

Conditions of earlier work. Glacial mapping of this area was severely handicapped in the earlier studies of the area by several factors: (1) assignment of areas ~~to cover~~ made to Chamberlin, Leverett, and Alden appear to have been limited by the state boundary which they were not at liberty to cross to any material extent, (2) topographic maps of mediocre quality were available only in Wisconsin and those of Illinois were very crude reconnaissance surveys, and (3) the interpretation of the conditions of origin of sediments (sedimentation) was then very slightly developed. It seems probable that Alden a very careful and conscientious worker could have been impelled to accept the results of his predecessors (Plates 1 and 3, 1904) another fact which must be remembered is that all the early geologists ^{many} worked on foot. They could not transport equipment for digging or boring. Road cuts and gravel pits were then very slightly developed. When a horse was used it was often difficult to find a place to hitch it while the geologist got out to examine an exposure. Many exposures did not pass through the weathered zone and soil profiles were then poorly understood.

It is small wonder that the geologists of 1957 reach different conclusions and this is no discredit to their predecessors.

Soil maps. The entire area was covered by soil maps which were published in 1923 and 1924 (Whitson and others, 1923, 1924). These maps are of considerable value for they give the results of many shallow borings (probably limited to 3 feet) but perusal of the reports show that the mappers must have had a very limited knowledge of glacial geology. In fact they were not encouraged to learn much of that branch of science. It seems likely from the descriptions that the Miami soil series is thin loess on weathered till. The Carrington series appears to have somewhat thicker loess mainly on till. An exception may be the deep phase of the Miami silt loam where coarse material is absent. This may be loess on assorted drift. The Fox and Waukesha series are obviously on outwash with either thin loess or no loess. The Rodman series represents kames and eskers. Miami stony loam is similar and it is far from clear how it was distinguished. The poorly drained soils, Clyde and Genesee series, call for little comment. The soils maps cannot easily or definitely be translated in terms of geology. The statement that the soils men were not encouraged to use geology is based on a conversation by Thwaites with the late A. R. Whitson who was in charge of the soil mapping.

TAZENWELL DRIFT

Marengo Moraine. The only part of the area mapped herewith which can safely be ascribed to the Tazenwell substage of the Wisconsin drift is the small triangular tip of a ridge west of the higher moraine southeast of Walworth, Wisconsin. This is the continuation of the Marengo Moraine of Illinois which has been studied by Thwaites as far south as its type locality at Marengo, Illinois. The ridge is slightly gullied and consists of pink-gray till. The depth of weathering is slight. Similar till was distinguished by Thwaites in samples from several wells in Wisconsin but present knowledge does not permit of mapping its subsurface extent in Wisconsin.

All the remaining drift of the area mapped by Thwaites and Black can be classified as deposits of the Gary substage of the Wisconsin drift.

Darien Moraine. The Darien Moraine was named by Alden. It is recognized as the margin of the Gary drift of Wisconsin and was not traced ~~far~~ into Illinois by its discoverer. Later mapping by Illinois geologists has demonstrated that it extends south of the border in a direction more southeasterly than that of the M_orengo Moraine as is well shown on the 10 foot interval Harvard quadrangle of Illinois. This overlap at an angle of about 30 degrees demonstrated a shift of ice source toward the west so that different materials were picked up by the ice from those found by the westward-moving Tazewell ice. The relations of the two moraines are shown in the portion of the Harvard quadrangle published by Thwaites as Fig. 51, ~~51~~ (Thwaites, 1956, p. 40) The Darien Moraine has variously been called West Chicago and Valparaiso in Illinois (Alden, 1932, pl. 2, Herber, 1953, fig. 2) The map published by Thwaites demonstrates the occurrence of non-pitted outwash in the reentrant angle between the moraines southeast of Harvard, Illinois. This fact demonstrates a lapse of time sufficient to melt all the residual ice masses left in the wastage of the ice which deposited the Morengo Moraine. Such a lapse of time is enough to demonstrate a different substage. It does not check Alden's mapping which shows Early Wisconsin drift in the vicinity of Twin Lakes

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lingered longest because of its thickness. If there are no pits in an outwash plain it is clear that the only process which could destroy residual ice masses is a lapse of time sufficient to melt them. Hence the distribution of non-pitted outwash shows the borders of drift of separate substages such as the Cary substage. Alden's mapping is impossible. The till of the Darion Moraine is higher in stone content than that of ^Marengo Moraine probably because the ice readvanced over older outwash deposits. A contact of the ^Darion till on outwash is well exposed in the large commercial gravel pit at Fontana. This locality has been visited by many classes in glacial geology. Kames are more common in the Darion Moraine than in Marengo Moraine.

Ground Moraine. East of the Darion Moraine is a considerable extent of what the present writers term "ground moraine". This is gently rolling except along the slope south of Lake Geneva where it is dissected by ravines which lead down to the lake. Many of the ravines contain springs. The basin of Lake Geneva is a kettle due to the melting of an ice remnant which probably lay in a preglacial valley which indents the border of the Niagara dolomite. The ice must date from an advance earlier than that which deposited the Darion Moraine yet the collapse of the surface appears to be post Cary for the basin was not smoothed by moving ice. The extent of the outwash beneath Darion till is not definitely known for the distribution of wells which demonstrate outwash below till is limited. It could be that a large portion of the upland south of Lake Geneva is an overridden outwash plain like that at Fontana but this hypothesis cannot be regarded as proved. Throughout the area there are small kames and other marginal features which apparently led Alden to map much of it as endmoraine. The present writers, however, regard these rough stony areas simply as stray marginal deposits formed during the westward of the Darion ice. The soils maps classify this area as Miami and Carrington silt loams, the basis of division apparently due to difference in amount of loess cover. These soils appear to have all been formed by weathering of till below the loess cover.

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STATE OF ILLINOIS
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STATE GEOLOGICAL SURVEY DIVISION

LOCATED ON THE CAMPUS OF THE UNIVERSITY OF ILLINOIS

JOHN C. FRYE, CHIEF
NATURAL RESOURCES BUILDING
URBANA

May 23, 1957

Mr. Fred T. Thwaites
Wisconsin Geological and
Natural History Survey
University of Wisconsin
Science Hall
Madison, Wisconsin

Dear Mr. Thwaites:

I have read your review of Dr. Shaffer's paper on the Farmdale drift in northwestern Illinois, which you gave to me at Bloomington, Indiana, and I am enclosing a copy of my comments.

Because of your long familiarity with the region, I am particularly concerned that you do not agree. Therefore, I have discussed your paper at considerable length in the hope that I can clarify some of the most troublesome points. Some points are not of great importance, but as you are contemplating publishing the review, I feel that it is better to clear up in advance as many details as possible.

Dr. Shaffer's restudy of this problem convinced him, and others of us, that the previous evidence on which the Illinoian age of the drift was based is not sound, and that the drift occupies the same stratigraphic position as the Farmdale loess. Dr. Shaffer does not consider the issue as closed "beyond reasonable doubt." The last word on correlation problems is never spoken, but hypotheses that seem to best fit the evidence should be advanced.

*with
Gryger*
The Illinois Survey currently has several active projects concerned with this problem, and we are continuing to look for new evidence and to study alternatives. Dr. Shaffer is helping with this work. We are looking particularly for field evidence, and we will greatly appreciate it if you can refer us to any exposures in Wisconsin that might indicate a pre-Wisconsin age.

So far as the glacial map is concerned, we anticipate that major differences in opinion will have to be presented to the Glacial Map Committee as a whole, but in all cases where the problems cannot be resolved, the opinions

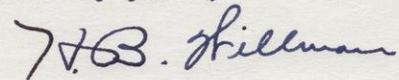
Mr. Fred T. Thwaites
Page 2
May 23, 1957

of the authors will be clearly stated.

It was good to be in the field again with all the Friends of the Pleistocene.

With best regards, I am,

Sincerely yours,

A handwritten signature in cursive script that reads "H. B. Willman". The signature is written in dark ink and is positioned to the right of the typed name.

H. B. Willman
Geologist and Head
Division of Stratigraphy
and Areal Geology

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STATE GEOLOGICAL SURVEY DIVISION

JOHN C. FRYE, CHIEF
121 NATURAL RESOURCES BUILDING
UNIVERSITY OF ILLINOIS CAMPUS
URBANA

March 29, 1957

Dr. F. T. Thwaites
41 North Roby Road
Madison 5, Wisconsin

Dear Dr. Thwaites:

Your card of February 12 was duly received, and a day or two ago your criticism of Shaffer's publication arrived. I have read it with interest.

Your first sentence erroneously states that Shaffer proposes a new substage of the Wisconsin. The Farmdale substage was proposed much earlier. The name was first proposed by me for the "pro-Wisconsin" loess in a paper given before the GSA at its meeting in Chicago in 1946, and in 1947 used in our "Itinerary of State Geologists' Conference on the Loess Deposits," and then used by me in 1949 as the name of the first Wisconsin glacial substage in "Itinerary of Field Conference, Late Cenozoic Geology of Mississippi Valley." Later it was used in "Loess Formations of the Mississippi Valley," by Leighton and Willman, in Jour. Geol., Vol. 58, No. 6, 1950. I have never been satisfied that the drift in northern Boone County and eastern Winnebago County was as old as the known Illinoian drift, but when I wrote my 1923 paper there was no category for it in the known Wisconsin. So my naming of the Farmdale substage did imply a glacial valley train from a glacier whose drift sheet was as yet unknown. That was one of the reasons why I assigned Shaffer that area in 1953.

I have noted a few minor points by marginal notes.

In connection with my current preparation of a critical synthesis of our knowledge of the Pleistocene geology of Illinois, I have been devoting some time during the fall and winter to a review of northwestern Illinois, particularly the matter of the relationship of the glacial deposits to both the source rocks and to the geomorphology of the area.

It seems that you and I are thinking along the same lines, at least for portions of northwestern Illinois.

Sincerely yours,

Morris M. Leighton

M. M. Leighton
Chief, Emeritus

Enclosure

Wulmer

Comments on the review by F. T. Thwaites (March 27, 1957) of "Farmdale drift in northwestern Illinois:" Paul R. Shaffer: Illinois Geological Survey Report of Investigations 198, 1956.

Paragraph 2:

W, not full pp 34

Concerning the omission of reference to Alden's 1909 paper; Shaffer makes full reference to Alden's ideas on pages 7 and 19. These quotations are from the 1918 report and should represent Alden's latest thoughts. The term References Cited was used and there was no attempt to list all the publications dealing with the problem.

Concerning the fact that the area shows little obvious sign of glaciation in its topographic forms: This is generally true, but glacial features with relief sharper than usually present on the Illinoian are present in places, as near Freeport. In many areas the drift is thin and the bedrock surface rough, so that glacial topography would be subordinate regardless of age. The contrast with Cary drift is certainly great, but Farmdale drift would be twice as old, and it would have been subject to erosion when the Shelbyville ice bordered it to the south and east and again when Cary ice bordered it on the east.

yes

This raises the question of whether erosion could have removed the upper part of the Sangamon profile leaving a degraded profile that approximates the Wisconsin profiles. However, Shaffer found that the profiles conform to the present topography--that is, in many places they follow down the slopes, which is contrary to any possibility of erosion of profiles. If the profiles are Sangamon, then there has been very little erosion since Illinoian time. If the profiles are Wisconsin, the only way that the drift can be Illinoian or older is to assume that (1) the Sangamon profile was not developed in the area, or (2) it was entirely stripped from the drift at the beginning of the Wisconsin.

Concerning the first alternative: Shaffer notes that relatively flat upland areas are present, as near Mt. Morris, and these are not greatly different from areas covered by Illinoian drift farther south where the typical Sangamon profile was developed. Also, the Sangamon profile is well developed on the Illinoian in other areas where the drift mantles an area of high relief, as at places in western and southwestern Illinois.

Concerning the second alternative: Shaffer made an exhaustive search of roadcuts and pits and made many auger borings in flat upland areas, but failed to find a single profile on the drift that could be called Sangamon. Several people have thought they had exposures of gumbotil in this region, but Shaffer checked all reported occurrences and found that they were local humic-glei soils showing no appreciable decomposition of easily weathered silicates. Although the soils resemble gumbotil in general appearance, they could have developed in a small fraction of Wisconsin time. Until a gumbotil or similar old soil is found, it hardly seems logical to call Illinoian a drift which everywhere seems to have a profile of weathering no greater than early Wisconsin.

Paragraph 3:

4/2

Shaffer did give great attention to the depth of leaching and records it all in of the 31 sections described in the report. He did not find it to average as great as 8 feet. He believes that Alden's estimate of 5 to 6 feet may even be a little high.

Shaffer's identification of the sequence of materials encountered in the borings and outcrops is entirely consistent with the practice followed in our

area for many years. The sequences are readily observed and are repeated many places. We may be wrong on correlations, but I see no basis for criticizing the method. Your inference that this type of differentiation cannot be done because the glaciers plowed up older deposits should be checked against the field evidence.

Paragraph 4:

The evidence of composition and topographic position and of thickness and grain size variations so overwhelming indicates that the loesses of Illinois were derived from the major valleys and the glacial valley trains in them, that we no longer refer to the hypothesis that the loess came from the dry west.

The probability that a pre-Iowan Wisconsin ice advance existed to account for the Farmdale loess underlying the Iowan loess was recognized many years ago, and we have been looking for a drift in that position ever since. That seems to be a scientifically sound mental process.

The name Peorian is used for undifferentiated Wisconsin loess younger than the Farmdale loess. It embraces loess of several substages, but not necessarily all of them, and the name, therefore, is frequently not shown in classification tables.

Paragraph 5:

So far as I can find, Shaffer uses the word preglacial only once (p. 15, line 6 under Thickness of the Ice). He is using it there in the sense of "before the glaciation of the area discussed," not pre-Pleistocene. This seems to be clear from the context. The word preglacial is very commonly used with that meaning because it saves a lengthy phrase, but it is a questionable practice. It does not generally cause confusion because there is no way to differentiate the pre-Pleistocene and the early glacial stages in the weathered zones. It seems to me that you use the word preglacial in the same meaning as Shaffer in lines 13 and 14 of paragraph 6 and again in line 2 of paragraph 7. You also use post-glacial in the same manner -- to mean post-melting of the ice -- in paragraphs 3, 5, 6, and 7.

Paragraph 6:

Shaffer endorsed Flint's conclusion that the gravel deposits of northwestern Illinois are constructional land forms only after examining many of them to consider various hypotheses. The position of many of these gravel deposits as ice-contact terraces along the sides of valleys and in eskers crossing valleys makes it difficult to advocate any major widening or deepening of the valleys since the deposits were laid down. In some areas the relief of the gravel deposits may well have been increased by their resistance to erosion.

You place more emphasis than we do on the influence of the bedrock of the immediate area in controlling the composition of the overlying till. This may be much more effective in an area of active erosion such as yours, but in our area the amount of erosion does not seem to be so great, particularly in the outer 50 miles or so of each ice sheet, as shown by Horbert (Our Report of Investigations 165). The Farmdale and Shelbyville tills of Shaffer's area have textures which are essentially the same as the texture of tills in central Illinois. The differences are mostly in the character of the pebbles and boulders.

The question of whether the drifts of northwestern Illinois and south-central

Illinois can be of the same age and the differences in the profiles on them result from differences in topography is partially answered in the discussion of your paragraph 1. It certainly is possible that continuous erosion would prohibit development of strong profiles, but the odds against it happening throughout a large region and ending very sharply along the line of the Green River (Shelbyville) lobe seem very great.

As the drift Shaffer calls Farmdale is not leached where overlain by Iowan loess and Shelbyville till, your suggestion would require complete erosion of the Sangamon profiles along the north side of the Green River lobe but very little on the south side.

As the profile on the Farmdale shows about the degree of leaching and decomposition that we would expect on earliest Wisconsin drift, it would also be necessary to advocate that continuous erosion prevented soil development until the beginning of the Wisconsin, and then for some reason erosion stopped and weathering took over throughout the area.

Paragraph 7:

By Shaffer's interpretation even the Apple River Canyon is an early Wisconsin feature. Diverted rivers loaded with glacial debris and a favorable gradient might erode such features in a relatively short time. Very coarse gravels indicating torrential flow are found along the margin of the drift and are described by Shaffer.

Paragraph:

More important even than the depth of the profiles is that decomposition of silicates in the northern area is not even close to the degree found on the Illinoian drift to the south.

We feel that the weight of the evidence at present is in favor of an early Wisconsin age:

- W. J. Willman*
- (1) The degree of weathering of the drift in no instance is greater than might be expected on early Wisconsin drift.
 - (2) The till is not leached where overlain by loess that is either pro-Shelbyville or Iowan in age.
 - (3) The presence of the Iowan loess shows that a Sangamon profile was not removed by erosion of the Shelbyville ice.
 - (4) The till directly underlies the Iowan loess in the position occupied by the Farmdale loess farther south.
 - (5) The till is mostly pinkish, which we would expect if it correlates with the pinkish Farmdale loess.

H. B. Willman
May 23, 1957

First draft

Farmdale drift in northwestern Illinois: Paul R. Shaffer: Illinois Geological Survey
Report of Investigations No. 198, 1956

Since Shaffer's report on northwestern Illinois proposes a new substage of the Wisconsin Drift, which has long been much subdivided, it deserves careful consideration. This report affects the correlation of the extra-moraine drift of southern Wisconsin, an area in which the present writer was field assistant to Willima C. Alden in the field season of 1907. Since that time he has visited both the Wisconsin and Illinois portions of this drift many times and demonstrated to students some of the criteria for age determination of glacial drifts.

In the historical summary of previous investigations of this area in Shaffer's report there is no mention of Alden's paper of 1909 in which the problem of age of the drift of this area is fully discussed. Alden's study involved the relation of what would today be called soil profiles to rock topography and to soil erosion which occurred during their formation by weathering. Alden also discussed the relation of the bed rock topography to the several formations in which it was eroded. East and south of Rock River the weak St. Peter sandstone lies below the present drainage level whereas to the north and west it is high above it and makes a landscape much like that of the Driftless Area farther west and north. In fact it has often been suggested that had Fenneman been more familiar with this region he would have included it in the Driftless Section which includes areas around the Driftless Area which are not much affected by glacial drift. It is certain that this area shows little obvious sign of glaciation in its topographic forms.

One of the most notable events in the history of investigation of glacial deposits was the introduction of the soil auger by Leighton. This method of supplementing the evidence of excavations permitted measurements of the depth of postglacial weathering on divides where post drift erosion has been at a minimum. Leighton tabulated his averages of depths of leaching of carbonates and concluded that north and west of Rock River it is about 8 feet. This is notably more than the averages for the Shelbyville and Iowan drifts where it is about 5 feet. Shaffer continued the use of the auger but appears to have been more interested in the succession of materials than in the depth of leaching. Every section is correlated into deposits of different age to which names are attached. One wonders just how some of these correlations of rather thin layers were made. Certainly fossils could not have been used. Plowing up of older deposits by glacial erosion is not considered. Neither the relation of the glacial deposits to nearby source of material nor removal of material by glacial erosion is mentioned. Shaffer's method of correlation may be termed the stratigraphic approach to the study of drifts. The method is certainly invaluable in many localities but no mention is made of the many pitfalls encountered in its practical application.

A sidelight which may be important in evaluating Shaffer's report is that the Illinois geologists appear from their publications to be convinced that all loess deposits were derived from silt blown from nearby glacial outwash. Derivation from the dry west is not considered. Hence when the lower loess at Peoria was named Farmdale it might have seemed desirable to find a Farmdale till from whose outwash it was derived. The use of the same name for a drift strongly indicates this mental process. Another item is that Shaffer had previously correlated the Shelbyville till of Illinois with the Iowan till of Iowa. It would then follow that a till slightly older than the Shelbyville till would be pre-Iowan. If the Iowan is regarded as an early Wisconsin substage then it should follow that such a pre-Shelbyville till represents a previously undiscriminated Wisconsin substage. It must be noted that some of the names used in Shaffer's report, such as Peorian, are not found in his table of drifts and intervals.

The uplands of the area described by Shaffer are covered with very thin drift which lies on weathered bed rock. He calls all weathering preglacial

How is he sure of this? Was all weathering of bed rock preglacial? The present writer has observed destruction of striae by weathering not only in later Wisconsin drifts but since he started teaching.

Another point of dispute is Shaffer's endorsement of Flint's conclusion that the gravel deposits of northwestern Illinois are constructional land forms. Could not they be due to the greater erosion of the till around them? Gravel is certainly more resistant to erosion than is till. In Wisconsin the residual origin of the gravel hills is certainly a valid hypothesis. Another point is that one looks in vain for a discussion of the physical and chemical nature of the till of northwestern Illinois to its bed rock source. The dolomite and sandstone of this northern area are unlike the shale and sandstone of central Illinois where the present writer once spent two field seasons. What relation did the rolling topography of northwestern Illinois and southern Wisconsin have to the conditions of development of postglacial soil profiles? Central Illinois where the recognized type locality of the Illinoian drift is has a drift plain of very clayey till which completely concealed the preglacial topography over most of the area. The present drainage of central Illinois is clearly superimposed on the preglacial landscape.

In northwest Illinois and southern Wisconsin there are many cases of local diversion of the preglacial drainage by what Alden termed "drift dams". The diverted streams some of them very small have since eroded narrow valleys with steeply sloping although not cliffed sides. No mention of this phenomenon can be found in Shaffer's report. It is true that some diversions also occur in the younger Wisconsin drifts and that some of these postglacial valleys could have been eroded by glacial meltwaters. However, many were certainly made by postglacial erosion for the streams flow toward and not away from the former glacier. Do not these diversions seem to indicate a greater age than do the relatively shallow soil profiles?

In summary, the present writer also failed to find in this marginal drift as deep soil profiles as those of the plains of central Illinois. But one cannot help wondering if this fact might not be due to a different kind of till lying upon a rougher bed rock surface with steeper original gradients. It is very hard to find in this drift area any place where conditions of weathering have been similar to those farther south or where one can be sure that postglacial erosion did not go on concurrent with weathering. The question remains as it has for many years: is this area a comparatively young drift or is it, as Alden concluded, an old drift perhaps Illinoian, which looks young because of the different conditions of postglacial alteration from those of central Illinois? Has the case for a Farmdale drift been proved "beyond reasonable doubt"?

F. T. Thwaites 27 March, 1957

References not in Shaffer's report.

- Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage relations:
 Jour. Geology, vol. 17, pp. 694-709, 1909
- Fenneman, N. M., Physiography of Eastern United States, McGraw-Hill, 1938

Shaffer's report on northwestern Illinois describes the surface distribution of a pre-Iowan substage of the Wisconsin drift. It deserves careful attention not only because ^{it} of definitely increasing ^{as} the list of Wisconsin substages ^{is} but also because it makes the marginal drift of southern Wisconsin and northern Illinois much younger than had formerly been supposed. The writer feels in a position to evaluate this report since he worked in southern Wisconsin as field assistant to W. C. Alden in 1907 ^{and} and has subsequently visited both this area ~~but also that of northern Illinois~~ many times on field trips in glacial geology. During these excursions he tried to demonstrate in the field the criteria of age of glacial deposits which students had learned in the ~~is~~ class room. *He also spent two field seasons in road material work in central Illinois*

In his historical summary of earlier work in the area he describes Shaffer fails to include two important works by Alden. In 1904 Alden describes ^{the pre-Cary} the part of this drift east of Rock River and suggests ^{ed} that its age may be Iowan. In 1909 Alden discussed the problem of age of ^{from the} the drift ^{from} based on depth of weathering and amount of erosion. This paper was published outside the Geological Survey and hence was less censored to meet ^{the} orthodox ideas ^{of} of ~~his~~ ^{U.S.} that time. In this paper the problems of the relation of depth of weathering to erosion which went on during the development of what would now be termed "soil profiles" ^{and of} the relation of amount of postglacial erosion to original slopes of the area ^{and} is ~~also~~ considered. It was pointed out that the rise in level of the incoherent St. Peter sandstone toward the northwest resulted in ^{pe} steeper and steeper original slopes in that direction. These original slopes governed postglacial erosion so that the far ^{of} northwest part of the drift occurs in a landscape which gives little visible evidence of glaciation. In fact the writer has often suggested that had Fenneman been more familiar with this marginal drift he would probably have included the district in his Driftless Section instead of the Till Plains. As a final result Alden concluded that these topographic conditions made the marginal drift appear younger than it actually is and hence it was correlated as Illinoian.

*Send in
Revised
Blank
Shaffer*

*William
Lynch*

^{Since} Alden carried no tools to dig or bore ^{and hence his observations} of depth of carbonate leaching were made mainly ⁱⁿ on hillsides. ^{road cuts} It was not until Leighton carried the use of the soil auger from Iowa to Illinois that authentic averages of this depth could be reached. Holes were ^{on uplands} located where postglacial erosion is at a minimum. However, it is very hard to find any level uplands such as are abundant in central Illinois on which postglacial erosion has certainly been negligible.

One of the most serious criticisms which may be brought against the theory of erosion concurrent with weathering is that slope wash does not extend to divides. This fact was first announced by Horton but fails to take into account removal of surficial material by mass movement. Erosion by creep or solifluction occurs on very little low slopes and is ~~not at all~~ affected by ^{the} size of ^{the} gathering area of rainfall. Today exposures of the weathered mantle are poor, for the cuts made when roads were first improved for automobile ~~travel~~ are now heavily grassed over. Nevertheless, it appears that much material may have thus been removed and that reduction of divides is not accomplished by slope wash. Such mass movement could have been more rapid during ^{parts of} the Pleistocene than it is at present, but the nature of the climatic ^{changes} of that period is still debatable. Leighton's averages of depth of weathering include measurements with wide differences between them and also include the mantle of loess which is thicker in Illinois than on the Iowan drift of Iowa. The writer has found ~~very~~ few examples of very deep weathering, ^{although} one hole ^{was} 18 feet and another over 20 feet to calcareous drift. ^{These} exceptions to the prevailing shallow depths ^{may} be filled kettles.

Shaffer seems to have been more interested in the ^{succession} of different materials, the stratigraphic approach to glacial correlation than he was in depth of weathering. Some readers have ^{determined} wondered just how certain correlations of thin layers encountered in auger holes was arrived at. Certain it is that the various pitfalls in ^{the practical} application of this method are not discussed. ^{The} color of drift deposits is related in part to their mechanical composition and records of borings a short distance apart may differ greatly. ^{In this connection} No mention is made of plowing up of older deposits by ice motion.

discuss

Shaffer does not mention the "drift dams" or local drainage diversions which caused postglacial erosion of narrow valleys. Some of these streams ~~are~~ are now very small and although some could have carried ~~ice~~ meltwaters ^{from the ice} all could not have. The sides ^{nearly all of} of these rock valleys are sloping ^{and} not cliffed. Certainly their occurrence and interpretation demand ^{consideration} mention. Do they indicate a longer postglacial time than does the moderate weathering or was Pleistocene climate greatly different from that of the present?

Another point which is not clear is the correlation of all weathering of bed rock as preglacial. ~~Certainly some is not and it has been suggested that it indicates a longer postglacial interval than does observed weathering of the drift itself.~~ *Certainly this weathering of bed rock beneath the drift may indicate a longer time lapse than does the weathering of the thicker drift deposits.*

Flint's conclusion that the gravel deposits of the area show original topographic forms rather than the result of postglacial erosion is accepted without question. Many of the ~~examples~~ ^{also} of glacio-fluvial deposits in Wisconsin ~~could~~ be explained by greater resistance of gravel to erosion than that of till. ^{this} point requires further study and explanation.

A point which demands much more explanation is the difference ^e of material and topography of the drift of northern Illinois from that of central Illinois.

In the north the drift was derived from sandstone and dolomite. Farther south shale and sandstone were the parent materials. What effect did this have on permeability and depth of postglacial weathering? It is most difficult to compare conditions of the central Illinois plains with those of the more rugged country farther north. *The water spent two field seasons in this southern area.*

A point for the suggested transfer of the age of the northern drift from Illinois to Wisconsin is the relation to the overlying loess which were deep enough to be unleached ^{at the bottom} rests upon fresh till. This is not at all like central Illinois

where over wide areas two loess deposits rest upon previously deeply weathered till. *But perhaps erosion prevented the formation of any unleached zone in the till of northern Illinois or the lower Wisconsin.*

A point against the correlation of the drift as the product of a pre-Iowan glacier is its lobation. It is the deposit of a ^{greatly} vastly expanded Lake Michigan Lobe which brought Niagara dolomite pebbles to the border of the Driftless Area.

There are ~~two~~ known times when the Lake Michigan lobe spread far to the west, the Illinoian and the Tazewell. ^{substage of the Wisconsin} Horbergs maps and sections do not suggest that there could be another Wisconsin substage which could possibly extend so far to the northwest.

Shaffer's argument for the pre-Iowan age of the Farmdale drift rests upon its inferred relation to the previously named Farmdale loess which he regards as the dust from Farmdale valley trains and ⁽²⁾ his previous correlation of the Shelbyville Tazewell moraine as Iowan. ^{err part} The drift of the north of Illinois appears slightly older than the Shelbyville but this equivalence with ^{the} Iowan is not accepted by all. Until that point is explained the erection of a pre-Iowan substage remains not definitely proved. ^{the} The origin of ^{all} the material of loess from outwash is not yet definitely proved.

References, not in Shaffer's report.

Alden, W. C., The Delavan Glacial Lobe---: U. S. Geol. Survey Prof. Paper 34, pp. 18-20, 1904

Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage relations: Jour. Geology, vol. 17, pp 694-709, 1909

Fenneman, N. M., Physiography of Eastern United States, McGraw-Hill, 1909

Horton, R. E., Erosional development of streams and their drainage basins; Hydrophysical approach to quantitative morphology: Geol. Soc. America Bull. vol. 56: Pp. 275-370, 1945

Thwaites, F. T., The development of the theory of multiple glaciation in North America: Wisconsin Acad. Sci. Trans, vol. 23: pp. 41-164, 1928

Thwaites, F. T., Outline of Glacial Geology, pp. ~~61-65~~, 78-79, 1956

58-72,

country. This moraine was the basis of the Delavan Glacial Lobe which was described in Alden's ^aProfessional Paper of 1904. The only part of this tract which at all suggests an endmoraine to the present writers is just northwest of Genoa. There the north side of a plateau slightly higher than the rest of the country has a north-facing slope of about 60 feet. The high area to the south of the gravelly north slope which Alden regarded as an icecontact slope, is at an elevation of over 920 feet. On the soils map this area is mapped as Carrington silt loam. To the west the McHenry Quadrangle with 10 foot interval fails to show any suggestion of an endmoraine. None was observed in the field. To the northeast the ~~margin~~ moraine was mapped along the kettles of Powers, Twin and Pell lakes. No suggestion of marginal deposits could be observed along this line. To explain the difference of opinion it is necessary to recall that Alden regarded all kettles as indicators of marginal deposits. This statement is based on what Thwaites learned from him during the field season of 1907. Abandonment of the hypothesis of the Genoa Moraine does not explain the high area west of Genoa. It could be due to topography which antedated the Darien advance or might be associated with the esker mapped by Alden northeast of Genoa and here described below. It lines up well with the supposed esker.

5

Alden admitted that the Genoa moraine is "weak and never unequivocal" (Alden 1904, p 31)

Delavan Glacial Lobe. The data presented above make a strong case against the existence of such a marked Delavan Glacial Lobe as that mapped by both Chamberlin and Alden. ^aAcceptance of such a lobe would make the Darien-Genoa ice cross the basin of Lake Geneva at right angles. Such a southerly ice motion is not supported by either striae (there are no outcrops in the area) or drumlins (also rare if present at all). It certainly does not fit with the pitted outwash plain of the region around Twin Lakes or the recent mapping of moraines in Illinois (Alden, 1932, Horberg, 1953). The cause of the lobation ascribed by Alden, the preglacial Troy valley, appears to the present writers as inadequate. It is high time that the Delavan Glacial Lobe as a distinct feature be forgotten.

void

reads this page?

1st draft ready by Leighton

Since Shaffer's report on northwestern Illinois ^{describes} ~~proposes~~ a ^{drift from} ~~new~~ substage of the Wisconsin Drift, ~~which has long been much subdivided~~, it deserves careful consideration. This report affects the correlation of the extra-moraine drift of southern Wisconsin, an area in which the present writer was field assistant to William C. Alden in the field season ^{of} 1907. Since that time he has visited both the Wisconsin and Illinois portions of this drift many times and demonstrated to students some of the criteria for age determination of glacial drifts.

see letter

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see these relations pp 34

One of the most notable ^{with Nelson} events in the history of investigation of glacial deposits was the introduction of the soil auger ⁱⁿ by Leighton. This method of supplementing the evidence of excavations permitted measurements of the depth of postglacial weathering on divides where post drift erosion has been at a minimum. Leighton tabulated his averages of depths of leaching of carbonates and concluded that north and west of Rock River it is about ^{4.2} 8 feet. This is notably more than the averages for the Shelbyville and Iowan drifts where it is about 5 feet. Shaffer continued the use of the auger but appears to have been more interested in the succession of materials than in the depth of leaching. Every section is correlated into deposits of different age to which names are attached. One wonders just how some of these correlations of rather thin layers were made. Certainly fossils could not have been used. Plowing up of older deposits by glacial erosion is not considered. Neither the relation of the glacial deposits to nearby source of material nor removal of material by glacial erosion is mentioned. Shaffer's method of correlation may be termed the stratigraphic approach to the study of drifts. The method is certainly invaluable in many localities but no mention is made of the many pitfalls encountered in its practical application.

by Alden and Leighton in their study of the Iowan drift in Iowa 4.2

A sidelight which may be important in evaluating Shaffer's report is that the Illinois geologists appear from their publications to be convinced that all loess deposits were derived from silt blown from nearby glacial outwash. Derivation from the dry west is not considered. Hence when the lower loess at Peoria was named Farmdale, it ~~might have~~ seemed desirable to find a Farmdale till from whose outwash it was derived. The use of the same name for a drift strongly indicated this mental process. Another item is that Shaffer had previously correlated the Shelbyville till of Illinois with the Iowan till of Iowa. It would then follow that a till slightly older than the Shelbyville till would be pre-Iowan. If the Iowan is regarded as an early Wisconsin substage then it should follow that such a pre-Shelbyville till represents a previously undiscriminated Wisconsin substage. It must be noted that some of the names used in Shaffer's report, such as Peorian are not found in his table of drifts and intervals.

not all agree

The uplands of the area described by Shaffer are covered with very thin drift which lies on weathered bed rock. He calls all weathering preglacial

of the bedrock

How is he sure of this? Was all weathering of bed rock preglacial? The present writer has observed destruction of striae by weathering not only in later Wisconsin drifts, but since he started teaching.

not clear } *Some striae have weathered away*
 Another point of dispute is Shaffer's endorsement of Flint's conclusion that the gravel deposits of northwestern Illinois are constructional land forms. Could not they be due to the greater erosion of the till around them? Gravel is certainly more resistant to erosion than is till. In Wisconsin the residual origin of the gravel hills is certainly a valid hypothesis. Another point is that one looks in vain for a discussion of the physical and chemical nature of the till of northwestern Illinois to its bed rock source. The dolomite and sandstone of this northern area are unlike the shale and sandstone of central Illinois where the present writer once spent two field seasons. What relation did the rolling topography of northwestern Illinois and southern Wisconsin have to the conditions of development of postglacial soil profiles? Central Illinois where the recognized type locality of the Illinoian drift is has a drift plain of very clayey till which completely concealed the preglacial topography over most of the area. The present drainage of central Illinois is clearly superimposed on the preglacial landscape.

In northwest Illinois and southern Wisconsin there are many cases of local diversion of the preglacial drainage by what Alden termed "drift dams". The diverted streams, some of them very small, have since eroded narrow valleys with steeply sloping although not cliffed sides. No mention of this phenomenon can be found in Shaffer's report. It is true that some diversions also occur in the younger Wisconsin drifts and that some of these postglacial valleys could have been eroded by glacial meltwaters. However, many were certainly made by postglacial erosion, for the streams flow toward and not away from the former glacier. ~~Do not~~ these diversions seem to indicate a greater age than do the relatively shallow soil profiles? *may*

In summary, the present writer also failed to find in this marginal drift as deep soil profiles as those of the plains of central Illinois. But one cannot help wondering if this fact might not be due to a different kind of till lying upon a rougher bed rock surface with steeper original gradients. It is very hard to find in this drift area any place where conditions of weathering have been similar to those farther south or where one can be sure that postglacial erosion did not go on concurrent with weathering. The question remains as it has for many years: is this area a comparatively young drift or is it, as Alden concluded, an old drift perhaps Illinoian, which looks young because of the different conditions of postglacial alteration from those of central Illinois? Has the case for a Ferrdale drift been proved "beyond reasonable doubt"?

F. T. Thwaites 27 March, 1957

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8/2

I've made a few
suggested changes in
English but otherwise
agree.

RFB

8/6 - Sorry I missed you today. Tried
to call but no answer. I'm going
into the field tomorrow so will send
this to your home

Thwaites
written
Hansen
Felt
Black
5 w/pen

Glacial geology of the Wisconsin-Illinois border east of Walworth.
F. T. Thwaites

Introduction. When the glacial map of Wisconsin was compiled in 1956 by Thwaites

it failed to ^{join agree} agree with the map of Illinois. ~~The~~ problems raised by this fact are ~~in part quite deep.~~ ^{important} They comprise; (1) interpretation of sediments both unaltered and in soil profiles, (2) use of terms for glacial and glacio-fluvial deposits, (3) ~~the~~ relative importance of topographic forms versus sediments in glacial mapping, and (4) the existence of a "Delavan Glacial Lobe". ~~These~~ ^{The} ~~problems~~ ^{of this area} in this area have been

under discussion for many years but ~~no one~~ ^{nobody} was found to undertake the remapping necessary to their ^{Des} satisfactory solution. ^{was not attempted until late May 1957} ~~It~~ ^{which Thwaites and Black spent} slightly over one day devoted by the ^{is} ~~writers~~ to the area, ^{all turned} was entirely insufficient to reach ~~final~~ results. Unfortunately

both of us had to hurry because of pressing engagements elsewhere. ~~The matter of~~ ^{air photos} borings and soil profiles were of necessity entirely neglected. ^{Des lack of time} Nevertheless, it is ^{many changes were made in the recording of glacial deposits} apparent that ~~definite~~ results were attained as shown on the accompanying map.

Conditions of early work. The mapping of the area in early days was severely

handicapped by (1) the fact that none of the geologists, Chamberlin, Leverett, and Alden had authority ^{to any} ~~to~~ cross the state line extensively, (2) topographic maps were ^{and those in Wisconsin still are of mediocre quality} lacking especially in Illinois, and (3) the science of sedimentation, the interpretation of ^{the} conditions which led to the deposits, was then ~~unknown~~ ^{developed} or very slightly known. Alden ~~was~~ always a very careful and conscientious worker ^{but} may have felt impelled to accept the earlier mapping shown on plates 1 and 3 of his ^{al} Profession Paper 34.

2

These early geologists worked almost entirely on foot and did not dig or bore to subsurface study ~~underlying~~ material. *Soil profiles were little understood, soil investigation* Equipment for these purposes simply could not be transported on foot. Geologists must have become so weary by the latter part of a day that they could not appreciate much that they saw. Small wonder is it that the geologists of 1957 reach different conclusions. This is no discredit whatever to ~~themselves~~ their predecessors.

AG

Tazewell drift. *Marengo moraine* The only portion of the area which can be safely ascribed to the Tazewell substage of the Wisconsin drift is the small *triangular* tip of the Marengo Moraine which projects into Wisconsin just *south of Walworth*. This consists of a pink-gray till which has been considerably gullied. *and is not deeply weathered* It extends directly south into

Illinois and has been *ov* folled by Thwaites as far as its type locality at Marengo, *Illinois*. *Thwaites* *it* It has been distinguished by lithology in several well logs in Wisconsin but exact tracing of the buried moraine is as yet impossible. *but called "Velparino" and "Westbrook" in Illinois*

Cary drift-Dairen Moraine. *in Wisconsin* The Dairen moraine *has* named by Alder is recognized as the margin of the Cary substage, *where pink gray* in Wisconsin. It consists of light colored till with many kames and is so well known that no description is necessary. *further*

This moraine *crosses* the Marengo *at* an angle of *perhaps* 30 degrees thus indicating a marked shift in ice movement. *westward* *source* In Illinois the relation of the moraines

is very clear on the Harvard Quadrangle a portion of which is shown as Fig. 51, p. 40, of the "Outline of Glacial Geology" by Thwaites. The occurrence of non-pitted

outwash between this later moraine and the ^{clear} ~~undubitable~~ ^{arengo} Moraine is ~~undubitable~~ proof of marked lapse of time between their formation, a ^{interval} lapse long enough to justify the discrimination of separate ^a substages. Residual ice masses had all melted prior to the readvance which led to the formation of the Darien Moraine, ~~which has been~~

~~called both Valparaiso and West Chicago in Illinois.~~ In this connection it should be

noted that the term "pitted outwash" is not mentioned in Flint's recent book (Glacial and Pleistocene Geology, J. Wiley and Sons, 1957) ^{either}

or in the proposed legend for the Glacial Map now in preparation. Presence of

kettles in the horizontally stratified ~~glacial~~ ^{glacial} ~~fluvial~~ ^{fluvial} deposits of outwash

is obvious proof that the area was glaciated not very long before. Conversely ^{in a plains region} their absence indicates a lapse of time. ^{long enough to melt the residual ice remnants} This matter was fully explained in a paper by Thwaites, published in 1926 a copy of which is enclosed. ^{This term does not apply well in plain country} The till and associated

kame gravels of the Darien Moraine are known to overlie an older outwash

throughout a wide area in Wisconsin apparently extending as far east as the ^{plateau} ~~hills~~ ^{known on the Burlington Plateau.}

west of Fox River. This outwash does not appear to have been weathered prior to the deposition of the Darien Moraine with associated ground moraine. The contact is well

displayed at present in the ^{convenient} large gravel pit at Fontana, Wisconsin, which locality

has been visited by many classes in glacial geology under the direction of Thwaites.

Footnote??
Maybe a word
removed.

Ground moraine. East of the Darien Moraine is a considerable expanse of what the present writers ~~have~~ termed ~~genoa~~ ground moraine. This is gently rolling where not dissected by ravines leading down to the basin of Lake Geneva. The ravines contain

springs and the relatively few wells ~~of~~ from which samples were saved do not demonstrate an overridden outwash plain ~~beyond reasonable doubt.~~ ^{that the entire area is although it could be such.} The basin of Lake

Geneva is apparently the product of a the melting of a mass of ice which ~~lingered~~ ^{lingered} from the ~~advance~~ ^{glaciation} prior to the buried outwash at Fontana through the Darien readvance.

Its survival is probably due to a ~~perglacial~~ indentation of the Niagara Escarpment.

Much of this area was mapped by Alden as endmoraine but the present writers

disagree definitely. It is true, however, that throughout the area there are

small kames of a distinct endmoraine aspect but they are regarded by us as simply

~~stay~~ marginal deposits ~~deposited locally~~ during the wastage of the ~~Darien~~ ice.

The soils of this area are mapped as Miami ^{and Carrington silt loams,} which, judging from the shallow

borings of the day when the soil mapping was done rest on till.

Genoa Moraine. Alden laid much stress on the ~~so~~ ^{so} called Genoa Moraine which

he mapped as ~~curing~~ ^{curving} east from the recognized Darien Moraine just south of the State

Line, passing through Genoa, thence northeast through Powers Lake to a reentrant angle

with the Valparaise Moraine in southwest ^{even Kenosha} Racine County. The only part of this

course which at all suggests endmoraine to the present writers is just northwest of

^{There}
of Geneva ~~where~~ the north side of a plateau which is higher than the country to both north
~~is~~ over 60 feet to an elevation of over 920 feet
and south rises ⁱⁿ what Alden thought ~~to be~~ a n ice-contact slope, On the soil map
this high area is mapped as Carrington silt loam. The northerly slope is ^{stony} gravelly

with several gravel pits at the west end. Neither field examination nor the ^{topographic}
^{maps, including the}

10 foot contour interval McHenry Quadrangle, give any suggestion whatever of this
moraine mapping either to east or west of this high area. ^{small} The northeastern part shown on the
^{It might be a pitted moraine}

Lake Geneva and Silver Lake quadrangles, is obviously pitted outwash. Alden

appears to have regarded all kettles as indicators of terminal moraine although he

did ^{some} agree with what ^{from Alden}
~~id~~ map pitted outwash in other places. This ~~is~~ Thwaites learned when working

^{him in} for Alden during the field season of 1907. Just what the cause of the high area was

could not be determined, It ^{could} may be a portion of the Elkhorn Moraine, ^{or to}

which ^{was} could not be traced definitely across the area which was examined. ^{or pass due to a, partially buried old moraine}

Delavan Glacial Lobe The data presented above make a strong case against the

existence of a Delavan Glacial Lobe, ~~despite its mapping by Hamberlin and Alden.~~

^{does not fit}
This hypothesis is ~~out of line~~ with the position of the residual ice block which gave

rise to Lake Geneva. It is entirely unsupported by glacial striae and in no way agrees

either ^{or}
with the modern mapping in Illinois. ~~nor~~ with the pitted outwash plain around Twin

Lakes on the State Line. The latter demonstrates that there were large ice masses

in this area which could not occur in front of the moraine of a major ice readvance.

It is high time that the hypothesis of a distinct Delavan Lobe be forgotten.

Alden ascribed it to the presence of the ^{appears} preglacial Troy Valley which is inadequate.

Pitted outwash. East of the Darien ground moraine, with some ^{minor} areas of endmoraine, lies an extensive pitted outwash plain which buried almost all of the older topography.

This plain slopes gently toward the west of south from elevation ^{above} ~~about~~ ^{feet} 900 at the northeast to 860 ^{to} ~~or~~ ^{feet} 870 at the south. It is marked by the large kettles of Powers

and Lake, Twin Lake, Pell Lake. A part of it was recognized by Alden, ~~but~~ we excluded

an area east of Genoa as ground moraine. There is no evidence, however, of an overlying

till cover. East of Twin Lake the soils map of ^{Kenosha} Racine County shows a considerable

area of Miami silt loam, mainly ^{The} "deep phase." Judging from exposures seen by us

this is not till but ~~thick~~ ^{which is thicker than normal.} loess. The legend of the soils map says that coarse

material is absent ~~in this soil~~ thus supporting ^{our} ~~the~~ interpretation. It is now known

that loess may occur on drift of ^{any} ~~all~~ ages and is not ~~at all~~ diagnostic of age.

~~Besides~~ ^{The} the border of this silty area does not suggest ~~that of ice~~ ^{margin of ice} which overrode

an older outwash. It is indicated on the map by a fine dotted line.

Esker. Alden mapped the gravel ridge which trends ^d northeast-southwest through sections ^{just north of Genoa} 25 and 26 of T. 1 N., R. 18 E. as an esker. This deposit lines up

with the gravel belt mapped as the north slope of the Genoa Moraine. The gravel is

very bouldery and bedding dips toward ^{both} ~~the~~ sides. The deposit could be an esker nearly

buried by normal pitted outwash on the east. If so it is related to the

gravelly belt to the southwest ^{mapped as endmoraine} which there rests on the edge of a high area of

ground moraine. ^a The area is not separately mapped but is enclosed by dotted line,

It could equally well be ^{the} a filling of a crevasse during the earlier phases of the formation of the pitted outwash before ^{many} most of the ice masses had melted. It is certainly not a typical esker such as occur in areas of ground moraine.

Valparaiso Moraine. East of the pitted plain area lies the Valparaiso Moraine of Alden. It is much cut up by erosion channels including that now followed by Fox River (not to be confused with the Fox ^{River} of northeastern Wisconsin) but our map ^{is} essentially follows that of Alden. Much of this moraine is composed of kames and is hard to distinguish from the outwash which was laid down in narrow channels between ice walls. There is every gradation in such deposits. The ~~xxx~~ term "ice contact deposits" used by Flint applies to both types with no ^{apparent} definite line of demarkation. The term "pitted outwash" is applicable where there is a ^{reasonably} more or less definite plain ~~form~~ ^{may in places} which ^{may occur} may be present ~~in plateaus remnants at present.~~

Sections are not available to tell to what extent the Valparaiso Moraine is due to a readvance of the ice. It reflects control by the dip slope of the Niagara dolomite into the Lake Michigan basin ^{and shows} which preserves no suggestion of a Delavan Lobe outline. ^{Stenewald reports clay near Trevor which may fill a kettle (unpublished)}
Drainageways. Under the title "drainage ways" are included all lines of non-pitted or only slightly pitted outwash ^{largely due to erosion by late drainage meltwater}. It is difficult to separate such glacial drainage valleys from the bottoms ⁱⁿ of large kettles ~~of~~ pitted outwash, ^{or instance,}

The area south of Walworth is the non-pitted outwash of the Darien Moraine whereas ^{the} the area mapped south of Fontana is part of the kettle in which lies Lake Geneva.

Some large kettles lie in the channel complex along Fox River among which may be mentioned

in Silver Lake, ^{and} Camp Lake, ^{as well as} and many smaller ones. Fox River is only incised a few

feet below the adjacent plain. These channels carried glacial melt waters from much

farther north for instance ^{from} Alden's third terrace east of Eagle. ^(Alden, 1904) In general, the

borders of the eroded channels are not ~~very~~ clear and easy to map.

Conclusion. The net result of the mapping by the writers ⁽¹⁾ increases the area of ground moraine at the expense of glacial outwash ^{and} ⁽²⁾ but should dispose of the idea of a Delavan Lobe. ^{which was more than a slight bulge in the border of the Lake Michigan lobe.}

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Fig 2

1st draft read by Willman ??

Farmdale drift in northwestern Illinois: Paul R. Shaffer: Illinois Geological Survey
Report of Investigations No. 198, 1956

Since Shaffer's report on northwestern Illinois proposes a new substage of the Wisconsin Drift, which has long been much subdivided, it deserves careful consideration. This report affects the correlation of the extra-moraine drift of southern Wisconsin, an area in which the present writer was field assistant to Willima C. Alden in the field season of 1907. Since that time he has visited both the Wisconsin and Illinois portions of this drift many times and demonstrated to students some of the criteria for age determination of glacial drifts.

In the historical summary of previous investigations of this area in Shaffer's report there is no mention of Alden's paper of 1909 in which the problem of age of the drift of this area is fully discussed. Alden's study involved the relation of what would today be called soil profiles to rock topography and to soil erosion which occurred during their formation by weathering. Alden also discussed the relation of the bed rock topography to the several formations in which it was eroded. East and south of Rock River the weak St. Peter sandstone lies below the present drainage level whereas to the north and west it is high above it and makes a landscape much like that of the Driftless Area farther west and north. In fact it has often been suggested that had Fenneman been more familiar with this region he would have included it in the Driftless Section which includes areas around the Driftless Area which are not much affected by glacial drift. It is certain that this area shows little obvious sign of glaciation in its topographic forms.

One of the most notable events in the history of investigation of glacial deposits was the introduction of the soil auger by Leighton. This method of supplementing the evidence of excavations permitted measurements of the depth of postglacial weathering on divides where post drift erosion has been at a minimum. Leighton tabulated his averages of depths of leaching of carbonates and concluded that north and west of Rock River it is about 8 feet. This is notably more than the averages for the Shelbyville and Iowan drifts where it is about 5 feet. Shaffer continued the use of the auger but appears to have been more interested in the succession of materials than in the depth of leaching. Every section is correlated into deposits of different age to which names are attached. One wonders just how some of these correlations of rather thin layers were made. Certainly fossils could not have been used. Plowing up of older deposits by glacial erosion is not considered. Neither the relation of the glacial deposits to nearby source of material nor removal of material by glacial erosion is mentioned. Shaffer's method of correlation may be termed the stratigraphic approach to the study of drifts. The method is certainly invaluable in many localities but no mention is made of the many pitfalls encountered in its practical application.

A sidelight which may be important in evaluating Shaffer's report is that the Illinois geologists appear from their publications to be convinced that all loess deposits were derived from silt blown from nearby glacial outwash. Derivation from the dry west is not considered. Hence when the lower loess at Peoria was named Farmdale it might have seemed desirable to find a Farmdale till from whose outwash it was derived. The use of the same name for a drift strongly indicated this mental process. Another item is that Shaffer had previously correlated the Shelbyville till of Illinois with the Iowan till of Iowa. It would then follow that a till slightly older than the Shelbyville till would be pre-Iowan. If the Iowan is regarded as an early Wisconsin substage then it should follow that such a pre-Shelbyville till represents a previously undiscriminated Wisconsin substage. It must be noted that some of the names used in Shaffer's report such as Peorian are not found in his table of drifts and intervals.

The uplands of the area described by Shaffer are covered with very thin drift which lies on weathered bed rock. He calls all weathering preglacial

How is he sure of this? Why all weathering of bed rock preglacial? The present writer has observed destruction of striae by weathering not only in later Wisconsin drifts but since he started teaching.

Another point of dispute is Shaffer's endorsement of Flint's conclusion that the gravel deposits of northwestern Illinois are constructional land forms. Could not they be due to the greater erosion of the till around them? Gravel is certainly more resistant to erosion than is till. In Wisconsin the residual origin of the gravel hills is certainly a valid hypothesis. Another point is that one looks in vain for a discussion of the physical and chemical nature of the till of northwestern Illinois to its bed rock source. The dolomite and sandstone of this northern area are unlike the shale and sandstone of central Illinois where the present writer once spent two field seasons. What relation did the rolling topography of northwestern Illinois and southern Wisconsin have to the conditions of development of postglacial soil profiles? Central Illinois where the recognized type locality of the Illinoian drift is has a drift plain of very clayey till which completely concealed the preglacial topography over most of the area. The present drainage of central Illinois is clearly superimposed on the preglacial landscape.

In northwest Illinois and southern Wisconsin there are many cases of local diversion of the preglacial drainage by what Alden termed "drift dams". The diverted streams some of them very small have since eroded narrow valleys with steeply sloping although not cliffed sides. No mention of this phenomenon can be found in Shaffer's report. It is true that some diversions also occur in the younger Wisconsin drifts and that some of these postglacial valleys could have been eroded by glacial meltwaters. However, many were certainly made by postglacial erosion for the streams flow toward and not away from the former glacier. Do not these diversions seem to indicate a greater age than do the relatively shallow soil profiles?

In summary, the present writer also failed to find in this marginal drift as deep soil profiles as those of the plains of central Illinois. But one cannot help wondering if this fact might not be due to a different kind of till lying upon a rougher bed rock surface with steeper original gradients. It is very hard to find in this drift area any place where conditions of weathering have been similar to those farther south or where one can be sure that postglacial erosion did not go on concurrent with weathering. The question remains as it has for many years: is this area a comparatively young drift or is it, as Alden concluded, an old drift perhaps Illinoian, which looks young because of the different conditions of postglacial alteration from those of central Illinois? Was the case for a Farmdale drift been proved "beyond reasonable doubt"?

F. T. Thwaites 27 March, 1957

References not in Shaffer's report.

- Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage relations:
 Jour. Geology, vol. 17, pp. 694-709, 1909
- Fenneman, N. M., Physiography of Eastern United States, McGraw-Hill, 1938

Shaffer's

Since this report on northwestern Illinois proposes a new substage of the Wisconsin Stage of glaciation, which has already been much subdivided, it deserves careful consideration. In 1907 the present writer was field assistant to W. C. Alden in his survey of the Wisconsin extension of the area described by Shaffer. Since that date he has visited the area many times. These visits included many field trips with students on which ~~an attempt was made to demonstrate~~ criteria which bear on the age of the glacial drifts.

unmentioned

In the historical summary by Shaffer of previous work in the area ~~it~~ there is no mention ~~whatever~~ of Alden's paper of 1909 in which the problem of age of this drift was fully considered. Alden's study involved the relation of what would today be called soil profiles to rock topography and soil erosion which occurred during the formation of these weathered zones. Alden also discussed the relation of the rock topography to the several formations in which it was eroded. East of Rock River in Wisconsin the soft St. Peter sandstone is low and does not outcrop. West of that stream the formation rises well above the present drainage level forming a landscape much like that of the Driftless Area farther west. In fact it was often suggested that had Fenneman been more familiar with the region he would probably have included all the country west and north of Rock River in his Driftless Section which is similar in topography to the unglaciated area to the northwest. Certainly much of the area shows little obvious sign of glaciation.

does it include leaching

One of the most notable events of the history of investigation was the introduction of the soil auger by Leighton. This method of supplementing excavations permitted measurements of depth of postglacial weathering on divides where erosion since glaciation is at a minimum. Leighton tabulated average depths of leaching of carbonate and concluded that the average north and west of Rock River is over 8 feet, notably more than in the Shelbyville and Iowan drifts which showed about the same depth of alteration. Although Shaffer continued this method, it seems as if he placed more emphasis on the succession of materials than on depth of leaching.

One wonders just how Shaffer correlated the several layers reported in his borings. Some of these are ^{very} thin. Few fossils are reported and so far as known these are not diagnostic. Neither the relation of glacial deposits ^{to} of nearby source of material (is not mentioned) nor the removal of material by glacial erosion. ^{in the report} Little mention is made of the change in appearance of materials by weathering. No positive examples of buried soil zones ^{were discovered} are displayed. This method is termed the stratigraphic approach and ~~difficult~~ although invaluable in many localities the numerous pitfalls in its application ^{especially in borings} are not mentioned. In this connection it is well to note that the Illinois geologists appear convinced that all loess deposits were derived by the wind from nearby recently-formed outwash. Hence when the Farmdale loess was named it ~~may have seemed~~ ^r desirable to find a Farmdale till from which it ~~was~~ ultimately derived. It would be surmised, although not definitely stated, that since at its type locality the Farmdale loess is much younger than the Illinoian gumbotil below, ^{it} it should belong in the Wisconsin stage. Another item in correlation is that Shaffer had previously correlated the Shelbyville till of Illinois with the Iowan till of Iowa so that ^{slightly older} a pre-Shelbyville till ^{should} represent ~~some~~ a pre-Iowan division of the Wisconsin Stage. ^{Not all agree with this correlation}

Some of the age names like Peorian are not included in the table ~~of~~ with this report

In his report Shaffer notes the thin residual drift on the uplands which lies on weathered bed rock. How can he tell that this weathering is preglacial and not part of a postglacial soil profile? Was bed rock weathered only in preglacial time?

Another point of dispute is his endorsement of Flint's idea that the gravel deposits of the area are ^{forms} constructional and not residual ^{id} ^{because} ^{greater} from their resistance to erosion than ^{that} of the surrounding till. In the gravels of Wisconsin this point is decidedly debatable. One looks in vain in Shaffer's report for a discussion of the relation of the till of northwestern Illinois to its bed rock source. This was a rolling to rugged land of mixed sandstone and dolomite wholly unlike the ^{subdued} shale-sandstone landscape of preglacial central Illinois. What effect did this have on postglacial weathering?

In central Illinois (the present writer spent two field seasons there) the ^r drift was thick enough to obliterate ^{most all} all remnants of the preexisting topography so that the drainage of today is clearly superimposed on the bed rock surface ^{from a till plain}.

To what extent did this process occur in northwestern Illinois? Long ago Alden found many local diversions of the older drainage which resulted in the erosion of narrow valleys where streams, some of them very small, were forced out of their preglacial courses. ^{by "drift dams"} These valleys ^{on steep rising sides} are a very striking feature of the present topography. Some of them might possibly have been eroded by glacial meltwaters but others require postglacial conditions for the streams flowed toward the ice and not away from it. No mention of this problem can be found.

In summary, the present writer also failed to find ^{in this marginal drift} as deep soil profiles as those on the plains of central Illinois. But one wonders if this might not be due to ~~the combination of~~ a different kind of till lying upon a rougher bed rock topography. It is hard in northwestern Illinois or southern Wisconsin to find places where the conditions of weathering were similar to those of the southern ^{Till plains} region.

One is nowhere quite sure that postglacial erosion concurrent with weathering is certainly absent. It also is not at all certain that the weathering of the bed rock is not postglacial. After all, is the area really a comparatively young drift or, as Alden concluded, ^{it} is an old drift which looks young because of ^{the} net result of the differences from conditions in central Illinois? ^{Has the case for a Fond du Lac drift been proved "beyond reasonable doubt?"}

F. T. Thwaites,

8 Feb., 1957

References (not in Shaffers report.)

Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage relations: Jour. Geology, vol 17, pp. 694-709, 1909

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Since this report on northwestern Illinois proposes a new substage of the Wisconsin Stage of glaciation which has already been much subdivided, it deserves careful consideration. In 1907 the present writer was field assistant to W. C. Alden in his survey of the Wisconsin extension of the area described by Shaffer. Since that date he has visited the area ^{including the Illinois part} many times. These visits included many field trips with students on which an attempt was made to demonstrate criteria which bear on the age of the glacial drift.

In the historical summary by Shaffer of previous work in the area ~~it~~ there is no mention whatever of Alden's paper of 1909 in which the problem of age of this drift was fully considered. Alden's study involved the relation of what would today be called soil profiles to rock topography and soil erosion which occurred during the formation of these weathered zones. Alden also discussed the relation of the rock topography to the several formations in which it was eroded. East of Rock River in Wisconsin the soft St. Peter sandstone is low and does not outcrop at present. West of that stream the formation rises well above the present drainage level forming a landscape much like that of the Driftless Area farther west. In fact it was often suggested that had Fenneman been more familiar with the region he would probably have included all the country west and north of Rock River in his Driftless Section which is similar in topography to the unglaciated area to the northwest. Certainly much of the area shows little obvious sign of glaciation.

One of the most notable events of the history of investigation was the introduction of the soil auger by Leighton. This method of supplementing excavations permitted measurements of depth of postglacial weathering on divides where erosion since glaciation is at a minimum. Leighton tabulated average depths of leaching of carbonate and concluded that the average north and west of Rock River is over 8 feet, notably more than in the Shelbyville and Iowan drifts which showed about the same depth of alteration. Although Shaffer continued this method it seems as if he placed more emphasis on the succession of materials than on depth of leaching.

One wonders just how Shaffer correlated the several layers reported in his borings. Some of these are ^{very} thin. Few fossils are reported and so far as known these are not diagnostic. ^{Neither} The relation of glacial deposits ^{to} nearby source of material ^{is not} mentioned nor the removal of material by glacial erosion. ^{in the report} Little mention is made of the change in appearance of materials by weathering. No positive examples of buried soil zones are displayed. This method is termed the stratigraphic approach and ~~difficult~~ although invaluable in many localities the numerous pitfalls in its application are not mentioned. In this connection it is well to note that the Illinois geologists appear convinced that all loess deposits were derived by the wind from nearby recently-formed outwash. Hence when the Farmdale loess was named it may have ~~seems~~ ^{seem} desirable to find a Farmdale till from which it ^{was} ultimately derived. It would be surmised, although not definitely stated, that since at its type locality the Farmdale loess is much younger than the Illinoian glauconitic below it should belong in the Wisconsin stage. Another item in correlation is that Shaffer had previously correlated the Shelbyville till of Illinois with the Iowan till of Iowa so that a ^{slightly older} pre-Shelbyville till ^{should} ~~represent~~ a pre-Iowan division of the Wisconsin Stage. Some of the age names, like Peorian, are not included in the ~~table~~ ^{with} this report.

In his report Shaffer notes the thin ^{residual} drift on the uplands which lies on weathered bed rock. How can he tell that this weathering is preglacial and not part of a postglacial soil profile? Was bed rock weathered only in preglacial time?

Another point of dispute is his endorsement of Flint's idea that the gravel deposits of the area are ^{forms} constructional and not residual from ^{greater} their resistance to erosion than of the surrounding till. In the gravels of Wisconsin this point is decidedly debatable. One looks in vain in Shaffer's ^{report} for a discussion of the relation of the till of northwestern Illinois to its bed rock source. This was a rolling to rugged land of mixed sandstone and dolomite wholly unlike the ^{subdued} shale-sandstone landscape of preglacial central Illinois. What effect did this have on postglacial weathering?

In central Illinois (the present writer spent two field seasons there) the ^{drift} was thick enough to obliterate all remnants of the preexisting topography so that the ^{drainage} of today is clearly superimposed on the bed rock surface.

To what extent did this process occur in northwestern Illinois/ Long ago Alden found many local diversions of the older drainage which resulted in the erosion of narrow valleys where streams, some of them very small, were forced out of their preglacial courses ^{by "drift dams".} These valleys are a very striking feature of the present topography. Some of them might possibly have been eroded by glacial meltwaters but other require postglacial conditions for the streams flowed toward the ice and not away from it. No mention of this problem can be found.

In summary, the present writer also failed to find ^{in this marginal drift} as deep soil profiles as those on the plains of central Illinois. But one wonders if this might not be due to the ~~combination~~ of a different kind of till lying upon a rougher bed rock topography. It is hard in northwestern Illinois or southern Wisconsin to find places where the conditions of weathering were similar to those of the southern region. One is nowhere quite sure that postglacial erosion concurrent with weathering is certainly absent. It also is not at all certain that the weathering of the bed rock is not postglacial. After all, is the area really a comparatively young drift or as Alden concluded ~~it~~ ^{it} is an old drift which looks young because of ^{the} ~~a~~ net result of the differences from conditions in central Illinois?

F. T. Thwaites,

8 Feb., 1957

References (not in Shaffers report.)

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Farmdale drift in northwestern Illinois, by Paul R. Shaffer,
Illinois State Geological Survey, Rept. Investigations No. 198, 1956

first draft
within

~~Some~~ ^{is proposed as a stage} Proposing a new ^{substage} of the Wisconsin drift which has already been greatly
subdivided Shaffers report deserves close attention. ^{in Wisconsin} The writer was assistant to W. C.
Alden in his study of the extension of the area now described as "Farmdale" in 1907
^{He} and has visited both the Wisconsin and Illinois parts of the area many times since.
These visits included many field trips with students on which borings were made with
a soil auger.

In the historical summary of previous work in the area no mention can be found
of Aldens ~~early~~ paper of 1909 which explains in detail the relation of what would
today be called soil profiles to ^{and soil erosion} the topography and the relation of the topography
of the rock surface to the position of the St. Peter sandstone. ^{Over most of the area} East of Rock River
in Wisconsin ^{the} St. Peter is below the preglacial drainage level. West of that river
it rises ~~far~~ above the present stream levels forming a landscape much like that of the
Driftless Area. In fact the writer has often remarked that if Fenneman had been more
familiar with the area he would probably have included it in the Driftless Section
or thin drift ^{which is the area border adjacent to unglaciated} extension of the true Driftless Area.

One of the most notable events in the history of glacial investigation was the
introduction of the soil auger by Leighton. After this, depths of weathering could be
obtained in areas where soil erosion is at a minimum so that valid comparisons could be
drawn. Shaffer continued this method and besides paid much ~~more~~ attention to the
physical nature of the glacial deposits. The latter ~~i~~ can be classified as ~~a use~~ of the
stratigraphic study of glacial drifts, ^{of tills} which is based on physical nature plus the succession
of deposits, both glacial and non-glacial, including loess.

To understand the new name "Farmdale" it is necessary to ^{explain} say that the view now
current in Illinois geologists is that loess was derived ^{by the wind} mainly, if not wholly, from
^{new} fresh outwash plains and not from the ^{ancient} outwash from the Rocky Mountains which forms the
^{immense} large alluvial fans of Tertiary age. The lower loess of the section east of Peoria, which
overlies gumbotil on the Illinoian drift had been named "Farmdale" and hence it ^{may be suggested that} was
considered ^{it} necessary to find the till from which ^{that loess} it was ultimately derived. Since the ^{Farmdale} loess is
much younger than ^{the} Illinoian ^{till} its correlation as Wisconsin was ~~arrived at~~ ^{concluded}

Another point of importance is that Shaffer, writing in 1954, had suggested the correlation of the Iowa ~~and~~ drift of Iowa with the Shelbyville Wisconsin drift of Illinois.

In the present work Shaffer notes the thin residual drift ^{on the upland, which is} ~~remnants~~ in many places underlain by weathered rock which he concluded is of preglacial age. He ~~is evidently~~ agrees with Flint in ascribing the ~~present~~ topographic form of gravel deposits to original deposition and not to later differential erosion ^{because} ~~of~~ in which gravel ^{is} more resistant than the surrounding till. In the gravel deposits visited by the present writer this point is decidedly ~~undebatable~~. One looks in vain ^{in Shaffer's report} for a clear summary of evidences despite a large amount of factual information. There is ~~no~~ mention ^{neither} of the relation between bed rock source and physical nature of ~~drift~~ till derived therefrom nor of the relation of soil profiles to slope and erosion concurrent with their formation. The many instances of ~~drift~~ diversion ^{of drainage to drift} which resulted in rock ~~gorges~~ ^{narrow} is not mentioned. Some of these ~~gorges~~ ^{narrow (few are true gorges)} could have been formed by glacial meltwaters, ~~and~~ ^{proved} examples of this process are by no means confined to this area. Others appar ently could only have been made by the ^{present} ~~very small~~ postglacial wet-weather streams which flowed toward the direction from which the ice came.

In summary, the present writer has also failed to find as deep soil profiles in this marginal drift as are abundant in the drift plains of the recognized Illinoian drift of central Illinois. ^{Leighton shows, however a greater depth of weathering than in the Iowa or Lower} But could this be due to a ~~combination of a different~~ ^{1/p 2711} till lying upon greater slopes? Could the weathered ~~bed~~ rock below the tin drift be a part of the postglacial soil profile? It is clear that all ~~bed~~ rock was not weathered in preglacial time, ^{because glacial} for striae ~~are~~ ^{are} absent ^{because of} ~~due to~~ postglacial weathering in many places. One may also ask what is the significance ^{of} of the postglacial ~~gorges~~ ^{diversion} or narrows where bed rock has been eroded to considerable depths? After all is the area ^{comparitively} really a young drift ^{as Alden and Chubb does} or does it just look young because of the differences in material and topography between ^T here and central Illinois?

F. T. Thwaiter
31 Jan., 1957

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Alden
Fahnestock
Linton
Shaffer

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Alden, W. C., Concerning certain criteria of discrimination of the age of glacial drift sheets as modified by topographic situation and drainage: Jour. ^{relations} Geology, vol. 17, pp. 694-709, 1909.

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Leighton, M. M., The differentiation of the drift sheets of northwestern Illinois: Jour. Geology, vol. 31, pp. 167-174, 1923.

Shaffer, P. R., Extension of Tazewell glacial substage of western Illinois into eastern Iowa: Geol. Soc. America, Bull., vol. 65, pp. 443-456, 1954.

Comp. changes in comp. ^{some} explained by ^{some} ~~mutual~~
 correlation of thin layers ^{what} - evidence?
 lack of names in section

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URBANA

April 2, 1957

Mr. F. T. Thwaites
Wisconsin Geological and
Natural History Survey
University of Wisconsin
Science Hall
Madison, Wisconsin

Dear Mr. Thwaites:

I am sending under separate cover photostats of the preliminary *summary* glacial maps of Minnesota, Illinois, and northern Michigan for your use in considering boundary line problems with those states. Similar copies of your map have been sent to Herbert E. Wright, University of Minnesota, Helen Martin, Michigan Geological Survey, and George E. Ekblaw, Illinois Geological Survey. Any of the problems may be taken up directly with these people, if you prefer. *7-20*

Dr. Wright has already made several revisions of his map, shown in red ink on the photostat, to improve the mapping of outwash along the St. Croix River. He writes: "The chief differences remaining concern the separation of pitted outwash and end moraine in the St. Croix Falls area. I did not attempt to make any separation through lack of information."

Ekblaw
"The pitted-unpitted outwash problem is resolved for the St. Croix valley by my new lines north from Sunrise, but as I have intimated before remains a difficulty in many places if pitted outwash is included with ice-contact deposits. According to the revision this leaves the Anoka sand plain as ice-contact deposits; true, it is pitted, but it's also a beautiful plain 75 miles across."

not important
I have discussed the problems along the Wisconsin-Illinois line with Dr. Ekblaw. The problem of Farmdale vs. Illinoian I mentioned in my previous letter. As you will note in Shaffer's paper, we put the boundary of the unglaciated area about three miles farther west than you do, but it is indefinite at best and we can draw it back sharply to approach your position, if you prefer.

must be
We believe you are right in showing outwash along Sugar Creek and shall add that, but we are uncertain about showing the lake. This would require an extensive lake in the Pecatonica drainage. We recognize a major fill in the Pecatonica, as a result of aggradation in the

Mr. F. T. Thwaites
April 2, 1957
Page 2

Rock Valley, but have not found definite lake deposits.

At Rock Valley we are not far apart, because the area of the outwash broadens sharply along the State line.

yes
You may wish to add the Shelbyville moraine which Ekblaw shows at Sharon, and the outwash between it and the Marengo ridge appears to extend northward to the Darien front and possibly connects with the outwash you map along the front farther northwest.

special report
The major problem along the Illinois line is the area of the Valparaiso complex which you map as pitted outwash and Ekblaw maps as ground moraine, except for two moraines which may be buried Tazewell moraines. This area has many lakes and pits, but in Illinois is largely mantled with West Chicago-Darien till. It has only patches of gravel, although in places it overlies gravel. Ekblaw did not map it as morainic because it does not have well-defined moraines and in general he considers it ground moraine mantling an older topography in part morainic. It was mostly mapped as ground moraine on the North America map. I seems to me that the region is so rough, the possibility of mapping it as morainic should be considered. A major concern is how this will affect your mapping farther north. *w*

East of the Valparaiso belt, the Tinley moraine needs to be distinguished as you both have it, but the Lake Border moraines, at least at the state line, are too narrow to show and Ekblaw will combine them as you do, and show the crests where possible.

If you attend the Friends of Pleistocene trip at Bloomington, Indiana, perhaps we can discuss some of these problems at that time. Both Ekblaw and Wright plan to attend.

With best regards, I am,

Sincerely yours,

H. B. Willman

H. B. Willman
Geologist and Head
Division of Stratigraphy
and Areal Geology