The following maps accompany P. MacClintock's Manuscript # 2:

4107 d2-46	4107 t-9
4107 d2.1-5	4107 t-10
4107 d5.4-16 glacial geol.	

Barrington Quadrangle

By Paul MacClintock

about 1921

(field work 1921 – rept. prob. later)

DEPARTMENT OF
REGISTRATION AND EDUCATION
M. F. WALSH, DIRECTOR
SPRINGFIELD

STATE OF ILLINOIS
STATE GEOLOGICAL SURVEY DIVISION
M. M. LEIGHTON, CHIEF
305 CERAMICS BUILDING
UNIVERSITY OF ILLINOIS CAMPUS
URBANA

Answered July 10 31

June 18, 1931

OK

Dr. Paul MacClintock
116 Prospect Avenue
Princeton, New Jersey

Dear Paul:

The field work on the Elgin and Geneva quadrangles has been completed and a manuscript on the Geneva quadrangle has been prepared by Powers. The advantages of publishing a single report on the Barrington, Elgin, and Geneva quadrangles are obvious. I should like to submit for your consideration the plan of having Powers compile the combined report this summer, the title of the proposed report to be:

GEOLOGY AND MINERAL RESOURCES OF THE BARRINGTON, ELGIN, AND GENEVA QUADRANGLES

Barrington quadrangle by Paul MacClintock
Elgin and Geneva quadrangles by M. M. Leighton and W. E. Powers
Bedrock formations by L. E. Workman

I am enclosing a copy of the proposed outline.

I should appreciate knowing whether the plan of a single report on these areas is agreeable to you, and please also let me have any comments or suggestions which occur to you.

I am sure that you and Betty are having a wonderful time. Our best wishes to you both.

Cordially yours,

M M Leighton.
Chief

P.S. Our new program, I believe, is to go thru. The bill is now in the hands of the Governor.

M. M. L.

GEOLOGY AND MINERAL RESOURCES OF THE BARRINGTON, ELGIN, AND GENEVA QUADRANGLES

Barrington quadrangle by Paul MacClintock
Elgin and Geneva quadrangles by M. M. Leighton and W. E. Powers
Bedrock formations by L. E. Workman

For Leighton. On Barrington rept.

(1) No separate chapter on "Historical Geology" for it seems much more logical in this presentation to work the history into the discussion of the formations. A chapter on history would then be only a repetition of what has already been said.

(2) From recent survey work could you give the draftsman the data for distribution of Wisc. moraines in N.E. Illinois.

Bloomington
Marseilles
Gilberts
Minooka etc.

Probably you are drafting one such for the Elgin & Aurora regions & we all might use the same one.

Outline.

Introduction.
    Location and Extent of region.
    Index map (Also showing Wisc. invasions) ← Drainage - Rivers + Lakes.
    Table of geologic periods and eras.

Chapter I Rock.
    Bed rock (found only in drilling)
        Description and history.
    (Igs. and Metas.) found in drift. mixture
        Description and history.

Chapter II. The Glacial Period in North America.
    Map of Ice Sheet USGS.
    Evidence of glaciation.
        Erosion
        Deposition
            The drift, 1) Till 2) Gravel — fill
            Topographic expression. 1) Terminal, 2) Ground, 3) Outwash.
    Distribution and History.
            Pre-K
            Kansan + interglacial periods.
            Illinoian
            Iowan
            Wisconsin with the substages
                Early Wisc
                    Shelbyville
                    Champaign
                    Bloomington
                    Marseilles
                Late Wisc.
                    Valparaiso
                    Lake-~~Margin~~ Border

Chapter III. The Glaciation of the Barrington Quadrangle.
    Early Wisconsin.
            Bloomington.
            Crystal Lake Gravel
    Erosion Period. Fox River Valley.
    Late Wisconsin
            ~~Terminal~~ Morainic ridges
                    Ridgefield
                    Cary
                    Honey Lake
                    Zurich
                    Palatine
            Intermorainic areas
                    Spring Creek
                    Flinn Creek (Barrington)
                    Salt Creek

Valparaiso Morainic System

            Outwash
                    Cary
                    Spring Creek
                    Fox River Terraces
                    Poplar Creek
                    Palatine (south)

Chapter IV Post-gl. changes, Erosion, deposition, soil.

Chapter V. Ground Water and drainage.
            Wells in 1) Till, 2) gravel, 3) bed-rock, 4) Artesian
            Springs.
            Swamps, peat, and methods of drainage.
                Drainage projects.
            Lakes + Rivers

Outline.

Introduction.
- Location and extent of the region.
- Index Map.
- Table of geologic periods and eras.
- Columnar section.

Chapter I Rock.
- Bed rock. (found only in drilling)
  - Description and history
- ~~Igneous, sedimentary, and metamorphic rocks (in drift)~~
  - ~~description and history~~.

Chapter II. The Glacial Period in North America.
- Map of the ice sheet.
- Evidence of glaciation.
  - Erosion (elsewhere)
  - Deposition
    - The drift i) Till, ii) Gravel. iii) Rocks.
    - Topographic expression
      - 1) Terminal moraine
      - 2) Ground moraine
      - 3) Outwash
- Distribution and history.
  - Pre-Wisconsin invasions
  - Interglacial formations.
  - Wisconsin.
    - Early Wisconsin
      - Shelbyville
      - Champaign
      - Bloomington
      - Marseilles
    - Late Wisconsin
      - Valparaiso
      - Lake Border

Chapter III. The Glaciation of the Barrington Quadrangle.
- A. Early Wisconsin
  - Bloomington
  - Crystal Lake Gravel.
- B. Erosional Period/ Fox River valley.
- C. Late Wisconsin.
  - Valparaiso Morainic ~~System~~. ridges
    - ~~Morainic ridges~~.
      - West Chicago moraine
      - Cary
      - Fox Lake
      - Zurich
      - Palatine
    - Intermorainic areas
      - Cary
      - Spring Creek
      - Flinn Creek
      - Poplar Creek
      - Palatine
      - Salt Creek

Location ?
Width
Topography
Composition.

6 pl C
10 pl C + SC
10 pl SC
8 pl C

Outwash.
- Cary
- Spring Creek
- Fox River terraces
- Palatine (south)
- Salt Creek

ChapterIV. Post-Glacial changes.
- Weathering
- Erosion
- Deposition

Chapter V. Ground water, wells, and drainage.
- Wells in -
  1) Till
  2) Gravel
  3) Bed-rock
- Artesian wells
- Springs
- Swamps and peat
- Methods of drainage and drainage projects.

Appendix.
- Well records.
- Water analysis.

Barrington Quadrangle.

Thompson ? Fisher ?

Illustrations

Outline.

Introduction
- Location and extent of region.
- Index map. (Also showing Wisconsin invasions)
- Table of geologic periods and eras.

Chapter I. Rock. (Very briefly)
- Bed rock (found only in drilling)
  - Description and history.
- Igs. and Metamorphics (found in drift) Seds.
  - Description and history.

Chapter II. The Glacial Period in North America.
- Map of ice sheet USGS.
- Evidence of glaciation.
  - Erosion. (elsewhere)
  - Deposition
    - The drift i) Till, ii) Gravel.
    - Topographic expression.
      - 1) Terminal
      - 2) Ground
      - 3) Outwash
- Distribution and history.
  - Pre-Wisconsin invasions. (briefly) Duting(?).
  - Wisconsin
    - Early Wisc.
      - Shelbyville
      - Champaign
      - Bloomington
      - Marseilles
    - Late Wisc. +
      - Valparaiso
      - Lake ~~Margin~~. Border

Chapter III. The Glaciation of the Barrington quadrangle.
- A. Early Wisconsin
  - I Bloomington
  - II Crystal Lake Gravel.
- B. Erosional Period. Fox River Valley.
- C. Late Wisconsin.
  - Valparaiso Morainic System.
    - Morainic ridges.
      - ~~Ridgefield~~ West Chicago
      - Cary
      - ~~Honey Lake~~ Fox Lake
      - Zurich
      - Palatine
    - Intermorainic ~~ridges~~ areas.
      - Spring creek. ← Cary
      - Flinn Creek (Barrington)
      - Salt Creek ← Poplar Creek, Palatine
    - Outwash.
      - Cary
      - Spring Creek
      - Fox River terraces
      - ~~Poplar Creek~~
      - Palatine (south)
      - Salt Creek.

Chapter iv. Post-glacial changes.
- Erosion → Weathering
- Deposition
- ~~Soil~~.

Chapter V Ground Water ~~and~~ Wells. and Drainage.
- Wells in -
  - 1) Till
  - 2) Gravel
  - 3) Bed-rock
- Attesian wells
- Springs
- Swamps and peat.
- Methods of drainage and drainage projects.
- Oil.

Appendix.
- Well records
- Water Analyses.

Note. Locations.

The symbol (Cook 0511.09) is a convenient way of locating points on the map. The word "Cook" is the name of the County; e.g. Cook, Lake, McHenry, etc. The next two numbers, in this case 05, designate the township within the county. For this purpose the townships are all numbered. In this case it is Barrington Township which is number 5. Since it is more convenient to have the same number of digits in all locations and since there are more than 10 townships in most counties, this township number is written 05. The next two numbers refer to the number of the section, for each township is normally divided into 36 sections. In this case it is section number 11. And lastly the two numbers on the right of the decimal point designate the location within a section. For this purpose a section may be considered divided into 10 east-west and 10 north-south parts; the first one, commencing in each case at the lower left corner, is numbered 0 and the last one 9. Then writing the horizontal space first and the vertical space second, as a decimal number, the location of a point is accurate to within 1/10 of a mile in either direction. In the present instance the point is within the first space east and west and is in the topmost space, making it in the north-western corner of the section.

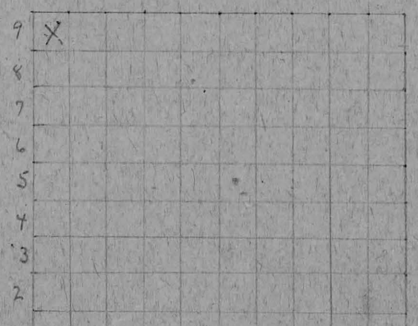


Diagram of a section divided by coordinates.
Location of X is .09

(1)

Note. Locations.

The accurate location of points is given by their index numbers.

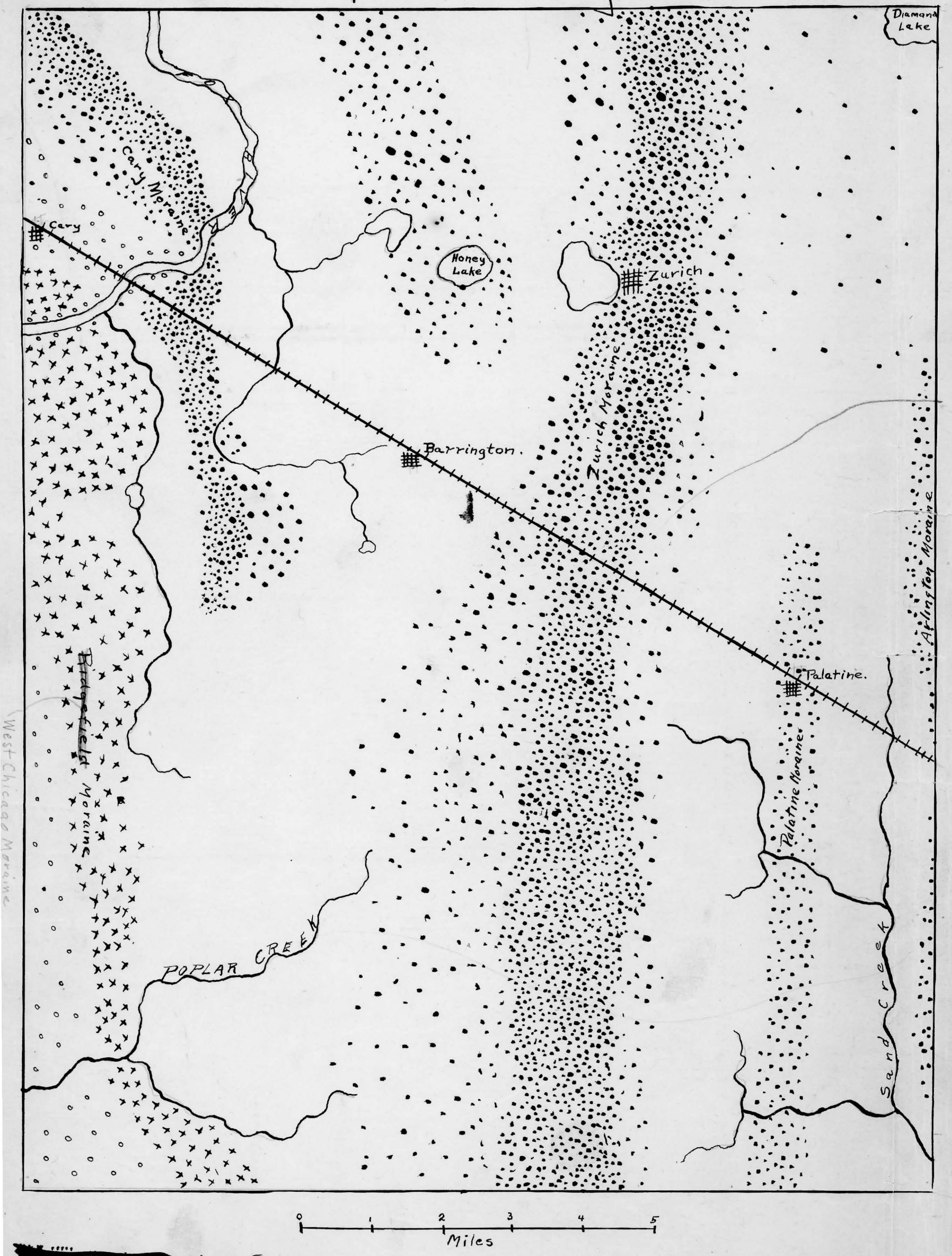
(1) For this purpose the townships within each County are numbered consecutively. These township numbers constitute the first two digits of the index number. (i.e. the first township is written 01 while the twenty fifth is written 25)

(2) Each township is subdivided into thirty six sections, also numbered consecutively. These section numbers constitute the second two digits of the index number. Thus the third section of township twenty five would be written 2503.

(3) And finally, for more accurate location, each section is thought of as being divided into ten spaces east-west and ten spaces north-south. These spaces are numbered, in each case, from 0 to 9 beginning in the southwest corner of the section. The space in an easterly direction is written first while that in a northerly direction second. This number is written as a decimal fraction. To illustrate; - A point lying three spaces to the east and two spaces to the north would be written .32 And a point thus located in the foregoing example, namely ~~in~~ three spaces to the east and two spaces north in section three of township twenty five, would be written 2503.32 .

Plate I

Barrington Quadrangle



[redacted].
[redacted]e.
[redacted]h.

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18. ✓ Kame on the West Chicago moraine.

19. ✓ Esker on the West Chicago moraine.

Missing 20. Eskerine ~~tract~~.

Missing 21. Glacially modified Marseilles gravel, 1 mile south of Cary. (looking north across Fox River

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42. ✓ Alluvium in the bottom of a depression in the Cary moraine. The auger penetrated 10½ feet of alluvium without striking gravel or till.

43. ✓ Diagram to show how Flynn Creek has alternately cut and filled to make itself a uniform gradient.

44. missing Peat terrace marking the base of the Marseilles gravel along the south side of Fox River valley.

45. missing "Walls" formed by ice-shove on the northwest shore of Lake Zurich. Note the people walking on an older and

larger "wall"; while a younger and smaller one is seen at the present edge of the lake.

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Illinois Geological Survey

Urbana, Illinois.

Geology and Mineral Resources of the Barrington Quadrangle.

By Paul MacClintock

Chapter I Introduction

Location and extent

The Barrington quadrangle comprises an area of approximately 227 square miles (i.e. about 13 x $17\frac{1}{2}$ miles) lying mainly in the northwest part of Cook County, but including the southwest corner of Lake County and small parts of Kane and McHenry counties (fig. 1). The central point of the area is about thirty miles northwest of the heart of Chicago.

fig. 1

Culture

The quadrangle includes the towns of Palatine, Barrington, and Cary on the Chicago and Northwestern Railway, and Zurich three miles northeast of Barrington, besides several small villages. Just beyond the western boundary lies the city of Elgin, while beyond the eastern one is Arlington Heights.

The area is largely one of up-to-date farming communities, specializing in dairy products. Its lakes and woods make parts of it inviting for recreational purposes, and afford an accessible and much-used playground for the people of Chicago. In addition, there is a growing number of commuters whose families enjoy the wholesome rural environment.

Excellent rail transportation is afforded by the Chicago and Northwestern Railway, crossing in a northwest southeast direction through the center of the area, and by the Elgin, Joliet and Eastern Railroad, crossing in a northeast southwest direction through Barrington and Zurich. A third, small, railroad connecting Wauconda, Zurich, and Palatine has been recently abandoned in favor of the rapidly growing automobile traffic. Likewise motor transportation is facilitated by many excellent concrete highways traversing the area in various directions, as well as by the numerous well-gravelled secondary roads.

Purpose and scope of the report.

This report is based on a study of the region during the summer of 1921, augmented subsequently by several short trips and conferences. The study has two main purposes: (1) to ascertain the geologic history of the region, both for the development of the science and for its application to the solution of definite problems such as those connected with water supply, with land drainage, or with highway construction; and (2) to discover and evaluate actual or potential economic resources.

It has been the aim in writing this report to make it both intelligible and interesting to the lay reader, as well as useful to the expert. While obvious difficulties are encountered in such a presentation, it is hoped that their solution has been at least moderately successful.

Acknowledgments.

To the late Professor R. D. Salisbury of the University of Chicago, the writer wishes to acknowledge gratitude, not only for suggesting and helping to plan the field work, but for numerous valuable discussions and helpful criticisms during its prosecution. To Frank De Wolf, the former chief of the State Geological Survey, and to various colleagues on the Survey who have rendered assistance, thanks are expressed. But to M. M. Leighton, chief of the Survey, particular indebtedness is gratefully acknowledged. Not only has his interest and inspiration stimulated progress, but many of the ideas and interpretations which appear in this report are either his or were formulated together with him in the field. His careful studies in the areas to the west of this quadrangle have furnished the key to the solution, otherwise impossible, of many knotty problems. Deep appreciation is expressed for his painstaking labor and helpful criticism in the thankless job of editing and criticizing the text of this report. Furthermore, kindly thoughts are here expressed toward the local inhabitants who, to the last man, were most helpful and generous in giving information about wells, gravel deposits, soils, etc., without which information a complete understanding of the geology would be impossible.

CHAPTER II - TOPOGRAPHY

Relief.

The region in general is a rolling plain consisting of hill after hill of long gentle slopes, interrupted in certain areas by steep-sided hills or depressions either isolated or in groups. The country rises from an altitude of 670 feet along Salt Creek in the southeast corner of the quadrangle to about 850 feet along the north-south divide in the middle of the area, where several of the higher points surpass 900 feet. From this divide the country gradually falls westward to 730 feet along the Fox River drainage, only to rise at the west margin of the quadrangle to 900 feet, with the highest point 950 feet near the northeast corner of Kane County. The area, consequently, has a maximum relief of 280 feet, though the average of normal height of the hills is more like 100 feet above adjacent depressions.

Character of the topography.

The character of the topography may be described in various ways. First of all, the hills may be grouped into four kinds: (a) the wide and high hills, a quarter to a half or, in some cases, a mile wide, and 50 to 60 feet high; (b) wide and low hills, the same width as (a) but only 10 to 20 feet high; (c) narrow and high hills a hundred yards across and 40 to 50 feet high; and (d) narrow low hills, a hundred yards across and only 10 to 20 feet high. While all four kinds are found together in many places in the area, it is true that the central part of the area is made up largely of the first kind, i.e. the wide and high, giving to the topography a massive aspect. It is furthermore true that the southeastern part exhibits the second type largely, i.e. the wide low hills, in the neighborhood of Palatine and thence southward to the boundary of the area; while the third type dots the landscape in the western portion, particularly near Fox River Grove and in a belt near the west margin of the quadrangle. The fourth type is scattered promiscously over the area, usually as minor features on the surface of one of the other types.

On the other hand the depressions, both large and small, fall naturally into two groups: (a) those with steep, high walls, and (b) those with gentle sides. The former abound in the western half of the quadrangle, with only a few in the eastern one and these few confined to the northeastern part; while the latter prevail in the eastern half and are less typical of the western. The depressions in which Spring Valley, Goose Lake and Honey Lake lie are typical of the former, while the low marshy tracts near Palatine represent the latter. It is our purpose later to give some ideas of how and why these various types of topography were formed.

Topographic arrangement.

The key note to the topographic arrangement of the land forms in this area is <u>irregularity</u>. Aside from a very crude general north-south alignment of some of the major features, there is no rhyme nor reason to where the hills and depressions are, nor to their shapes or sizes. The topography is quite obviously the result of piling up of material in irregular masses, rather than cutting out of valleys in the orderly process of stream erosion. It is technically known as <u>constructional</u> topography, as contrasted with <u>destructional</u> topography. It is our hope to explain these phenomena later in the discussion.

Drainage.

The Fox River, crossing the northwest corner of the quadrangle, in a fairly deep narrow valley, flows southward a few miles west of the western boundary through Algonquin, Carpentersville, Dundee, and Elgin. Flynn and Spring Creeks, draining the northwestern part of the area, join the Fox River near Fox River Grove; while Poplar Creek, in the southwestern part, joins it near Elgin . Indian Creek and its tributaries in the north, and Salt Creek with its tributaries in the south, carry off the surplus water from the eastern half of the area. It is to be seen that the higher land through the middle of the quadrangle forms the watershed between the eastward-flowing streams which are tributary to the Great Lakes and St. Lawrence drainage basin and the westward-flowing ones tributary to the Illinois and Mississippi system to the Gulf of Mexico. This divide consequently is one of the most important ones of the continent. As in the case of the topographic arrangement of the land-forms, so it appears with the streams that they are flowing in valleys quite irregular in size, shape, and direction. Spring Creek Valley is wide in its upper course, and narrows to a ravine near its junction with the Fox. Flynn Creek flows northwest from Barrington, as though it were to join Spring Creek, only to turn, when within a quarter of a mile of this objective, veer off at 120°, and flow northeast and north to join the Fox four miles above the debouchure of Spring Creek. Poplar Creek rises in a broad open depression in the lower middle part of the area, but leaves it in the southwest corner through a deep narrow valley. It is obvious that the streams did not carve the valleys in which they are now flowing, but are rather flowing through depressions formed in some other way. It will be our duty to inquire into this haphazard drainage arrangement later in the discussion.

In addition to the many small lakes, ponds, and marshes which dot the landscape, there are three lakes of considerable importance for their scenic and recreational value. Lake Zurich, the largest of the three, lies in the north central part of the quadrangle. Honey Lake lies a mile west of Lake Zurich, and Diamond Lake occupies the extreme northeast corner. All three are shallow, simply occupying gentle depressions among the rolling hills. Soundings in Lake Zurich showed it to be 5 to 10 feet deep, though in the very middle one measurement showed 30 feet of water. The fact of the many lakes, ponds, and marshes all occupying basin-like depressions bears witness to a constructional rather than a destructional origim of the topography.

CHAPTER III - BED ROCK

Introduction

The surface of the quadrangle is mantled with from 100 to 330 feet of glacial drift, composed of clay, sand, gravel, and boulders. In places sand and gravel prevail; elsewhere stony clay is in evidence. Boulders are seen lying on the surface and scattered through the drift. Nowhere within the area does bed rock outcrop; but not only does it appear at the surface in surrounding areas, but numerous water wells within the area have penetrated into it.

The bed rock of this area belongs in the long series of formations formed during the various periods of the earth's history. From study of the rocks of the earth in many districts, the following subdivisions of geologic time have been established and named:

Table 1

Principal geologic eras, periods, and epochs

Eras	Periods	Epochs within the Barrington Quadrangle
Cenozoic	(Quaternary	(Recent (Pleistocene
	(Tertiary	
Mesozoic	(Cretaceous	
	(Comanchean	
	(Jurassic	
	(Triassic	
Paleozoic	(Permian	
	(Pennsylvanian	
	(Mississipian	
	(Devonian	
	(Silurian	(Niagaran (Alexandrian
	(Ordovician	(Richmond (Maquoketa) (Galena and Platteville (St. Peter (Prairie du Chien ("Lower Magnesian")
	(Cambrian	Potsdam Group
Proterozoic	Huronian	Found as boulders in the drift.
Archeozoic	(Gneiss series (Schist series	

Since, as has been said, no bed rock formations are exposed in the Barrington Quadrangle, their interpretation and description is based on study of the rocks where they do outcrop in other parts of northern Illinois and southern Wisconsin, augmented by information from well-logs within or near to the quadrangle. The formations, as they are now known in northeastern Illinois, are given in the columnar section (Fig. 3). They are seen to be rocks of Cambrian, Ordovician, Silurian, and Pleistocene ages. They are variously composed of sandstone, limestone, dolomite, and shale.[1/] Fossils in them show that they are of marine origin, having been deposited in shallow marine embayments that spread over the continent. Most of these formations are separated by unconformities, which are erosional breaks showing that the lower formation was exposed to subaerial erosion before submergence and re-invasion of the sea allowed the deposition of the next overlying formation. This situation means that the thicknesses of the several formations vary from place to place, not only because each was deposited on an irregular surface, but because the top of each was eroded unequally from place to place. A simple diagram may serve to make this idea more clear (Fig. 4).

Since there are only two wells within the Barrington area that penetrate deeply into the underlying rock, and these only to about 900 feet, records are given also for what wells have been drilled in the

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1/ For a discussion of the processes and results of erosion, sedimentation, diastrophism, vulcanism, organic evolution, etc., the reader is referred to any of the standard text-books on general geology available in local libraries and bookstores.

Fig. 5 large sheet

Fig. 8. Large sheet

near vicinity (Fig. 5). Elgin is situated just west of the southern part of the area, Norma ($1\frac{1}{2}$ miles west of Desplaines) is 5 miles east of the southeastern corner of the area, Park Ridge is 10 miles east thereof, while Grays Lake lies 8 miles north of the northeast corner. Since the formations are continuous beneath the Barrington area, these records give a fairly accurate picture of the bed rock succession.

Cambrian System

The deepest wells in the vicinity penetrate into the Cambrian rocks. They are known, by paleontologic evidence, to be Upper Cambrian or Croixan in age. What lies below these formations in this district is not known; but 100 miles to the north in Wisconsin, where they outcrop, they lie on Proterozoic quartzites of great thickness. It is fairly safe to infer, therefore, that deep enough drilling would discover these same Proterozoic rocks below the Barrington area. The Cambrian rocks consist of two thick sandstone formations, the Mt. Simon below and the Dresbach above, with the impure Eau Claire between. 1/

1/ Thwaites, F.T., Stratigraphy and geologic structure of Northern Illinois. Rept. of Investigation No. 13, Ill. State Geol.Surv.,1927.

The Mt. Simon is a fine- to coarse-grained gray to pink sandstone. The Elgin well shows it to be more than 580 feet thick, while a well at Dixon has penetrated 842 feet into it without reaching its bottom. It contains thin beds of shale of erratic distribution. It is commonly a source of abundant water, though there are some fine-grained zones that carry little water.

The Eau Claire formation consists of a variety of fine-grained, dolomitic, gray and pink sandstones, calcareous red, gray, and greenish shales, and sandy or shaly grayish dolomite. As may be inferred from this variable composition, it is noted for its changeability, for no two well-logs show precisely the same succession of materials. Its thickness ranges from 100 to 400 feet.

The Dresbach is a medium-grained, pure white to yellowish sandstone. Its thickness varies from 100 to 250 feet, though near Waukegan it is only 30 feet. It is one of the best water-bearing formations in northern Illinois.

The accumulation of these Cambrian sandstones and sandy shales took place in a shallow arm of the sea which spread over this area in Upper Cambrian time. Into this body of water sand and mud were washed from adjacent lands which appear to have existed in Wisconsin and southern Canada at this time. Waves and currents distributed the sediments along the ancient shores and out into the body of water. (Silica, lime, and iron, either deposited along with the sediments or subsequently brought in by circulating ground water, together with the pressure exerted by subsequently deposited superincumbent beds, have gradually cemented the particles and grains into solid rock.) The sea then withdrew, due to a lowering of sea-level or an uplift of this area, and the Cambrian rocks were subjected to prolonged subaerial erosion by wind and running water. Their upper surface was dissected into hills and valleys. When the sea re-advanced into this region, sediments filled valleys and overlay hills in such a way as to preserve the evidence of an erosional break in the sedimentary succession. Such a break is known as an unconformity.

Ordovician System

The Ordovician period is commonly divided into three epochs: the Lower (Prairie du Chien), the Middle (St. Peter, and Galena-Platteville), and the Upper (Richmond or Maquoketa). The system is not only unconformable at its bottom and top, but contains within it three unconformities.

Prairie du Chien Series

This ~~system~~ series, like the Cambrian, is divided into three formations: the Oneota dolomite below, the Shakopee dolomite above, and the New Richmond sandstone between. The lower 80 to 150 feet of the Oneota has been called the Mazoneanic formation. It is a glauconitic sandstone so heavily cemented by dolomite that it resembles closely the overlying dolomite and has been separated therefrom in only a few well records. The absence of unconformities within the Prairie du Chien series shows that there was continuous deposition through this epoch. The dolomites are commonly light gray in color, though buff and even pink is seen in places. Thin beds of bluish shale are not uncommon in both the dolomites and the sandstone. In the vicinity of the Barrington area the thickness is about 300 feet, though elsewhere in the state it is recognized to be as much as 520 feet.

This thickness of calcareous sediment must have been deposited in water free from clastic material (sand and clay) except for an occasional influx of sand and mud. Two extreme conditions may be pictured to account for this situation: either the site of deposition was so far from shore that no sand or mud got to it, or that the shore and land was so low and covered with vegetation that little or no clastic material entered the sea. The probability is that a combination of these ideas more correctly pictures the conditions; namely, fairly far from a fairly low land-mass. At any rate both chemical and organic processes evidently caused the precipitation from sea water of fairly pure lime mud ($CaCO_3$) which was subsequently altered to dolomite ($CaMgCO_3$) by the addition of magnesium from the sea water. The silica, precipitated at the same time as the lime mud, has subsequently been aggregated into chert concretions and quartz geodes, both of which are abundant in some places.

St. Peter Sandstone

The St. Peter is a fine- to medium- to coarse-grained sandstone. In most places in this part of the state it is composed of remarkably pure white quartz sand, the grains of which are very well rounded. Not uncommonly conglomerate of rounded quartz and chert pebbles is seen in the lower part of the formation. Likewise shale seams are encountered in its lower part in many places. In this area its thickness varies from 50 to 200 feet, though elsewhere it is known to be 500 feet or more.

The conditions of deposition of this sandstone have been one of the interesting problems of geology. Its great purity in places, its perfection of cross-bedding, as seen in outcrops as at Starved Rock along the Illinois River, and its lack of fossils in this region, lead early workers to consider it a deposit of wind-blown sand formed under desert conditions. But more recent work 1/ in other regions indicates

1/ Dake, C.L., The problem of the St. Peter sandstone. Univ. of Mo., School of Mines & Metallurgy, vol.6, No. 1, p.194, 1921.

a marine origin for the formation.

The deposition of the underlying Shakopee dolomite was brought to an end by the emergence of the region. The emergence must have been considerable, for subaerial erosion cut deep valleys into the Prairie du Chien rocks, and in places even cut through them into the underlying Cambrian. Over this eroded surface spread the sea in St. Peter time. During this transgression the pebbles, sand, and clay which lay on the land as the sea encroached were washed about, sorted, and deposited to make the basal conglomerates, sandstones, and shales. The source of the beautifully rounded quartz grains of the middle and upper part of the formation is still something of a question, but it seems to be evident that they came from the erosion of some pre-existing sandstone, which in turn was formed by the reworking of some still older sandstone. Such a history is depicted because the grains seem to be too much rounded to have been shaped by abrasion during a single episode of transportation from land into the sea. The cementing material, commonly silica, is present in such a small amount that the whole formation is very porous and, on the outcrop, is commonly crumbly. It is a good water-bearing horizon; one of the best in the north-central part of the state. Due to the oxidation of pyrite, which is present in the upper part of the formation, the water from this horizon commonly contains noticeable amounts of sulphate.

Galena and Platteville Formations

The deposition of sand was brought to a close by another emergence of the region. Erosion again cut into the upper part of the newly deposited formation. Then followed a readvance of the sea. But conditions of sedimentation were different, for now no clastic material was deposited and only lime mud accumulated on the shallow bottom to form the Galena and Platteville formations. Since these two can not be differentiated in the well-logs in this part of the state, they are commonly grouped together. In some well-records a sandy dolomite (the Glenwood formation 1/) is recognized as a distinct formation. In the western part of the state this formation is brown and green shale and sandstone. The thickness of the combined Galena and Platteville formation ranges from 300 to 450 feet.

1/ Bevan, Arthur, The Glenwood as a horizon marker at the base of the Platteville limestone: Ill. State Geol. Surv., Rept. of investigations No. 9, p. 6, 1926.

Maquoketa Formation.

Emergence and erosion followed the deposition of the Galena-Platteville. This was followed by a readvance of the sea. Into this sea mud was swept to form the bluish gray to greenish gray Maquoketa shale. Some lime was deposited along with the mud to produce the dolomitic shale encountered in many wells. The formation varies from 50 to 250 feet in thickness.

Emergence and erosion closed this episode of deposition, as well as the Ordovician history of this district.

Barrington Twp. (NW $\frac{1}{4}$, NE$\frac{1}{4}$, NW$\frac{1}{4}$, sec. 1, T.42 N., R.9 E. Cook County)

Drift	200'
Limestone (Niagaran)	115'

(Center S$\frac{1}{2}$, NW$\frac{1}{4}$, sec. 28, T.42 N., R.9 E. Cook County)

Blue clay	75'
Fine sand	15'
Limestone (Niagaran)	122'

It ranges in thickness up to 200 feet in the near vicinity, though it is known to be as thick as 400 or 500 feet elsewhere in the state. It represents a long episode of quiet. clear seas in which organisms lived, extracted lime from the sea-water to build their shells, and, when they died, contributed their shells to the accumulating sediments on the bottom. Waves comminuted these shells to form the lime mud. Chemical precipitation doubtless contributed some lime also. The addition of magnesium from the sea-water converted large parts of this lime into dolomite.

Post-Niagaran - Pre-Pleistocene History

No bed rock is preserved within the Barrington area to record the events of this long interval; but Devonian rocks are known in southeastern Wisconsin, and are found in fissures in the Niagaran in several places in northeastern Illinois. It is therefore confidently inferred that Devonian rocks originally covered the Barrington area and have subsequently been stripped away by erosion.

Several boulders have been found in the glacial drift near Chicago in which there are fossils which are identified as of Mississippian age. Since the glacier could have transported these boulders only in a southerly direction from the outcrop of the formation, it is a tenable inference that Mississippian rocks may have covered the area and possibly been present in the Barrington Quadrangle. If so, they, like the Devonian, have been entirely removed by subsequent erosion. Nothing is known of the history of the region during Pennsylvanian and Permian time, but it is inferred that erosion was in progress. Erosion appears to have continued through the entire Mesozoic and Tertiary times, for no evidence of deposition has been found.

In the Barrington area this erosion cut valleys into the Niagaran limestone, making the topography generally one of gentle relief, though several valleys are more than a hundred feet deep with steep walls (see ~~Fig.~~ Bed-rock Topographic map.). Southwest of Barrington two wells passed from the drift directly into Maquoketa shale, showing that the Niagaran had been entirely eroded away in that neighborhood.

Log of well drilled by Ray Rieke
1½ miles southwest of Barrington.

	Thickness Feet	Depth Feet
Clay	275	275
Gravel	20	295
Shale	160	455
Limestone	165	620
Sandstone at bottom		

This may be easily explained since the strata of the region have a gentle eastward dip and that here, near the western edge of the Niagaran rocks where they have been reduced to a thin irregular edge, it was easy for erosion to cut through them into the underlying formation. Coupled with this situation, it is to be noted that the Niagaran was deposited unconformably on the eroded surface of the Maquoketa. The Niagaran was evidently thinner over a Maquoketa hill than in a Maquoketa valley, and hence might be eroded off to expose Maquoketa rocks, while surrounding territory might still retain Niagaran above the Maquoketa. Such a disposition of formations is known as a <u>fenster</u> (window). A fenster is likewise produced in many places where an anticline has been eroded to expose the older formations. There may possibly be a very gentle anticline west of Barrington, but there is no proof of one, and the phenomena may equally well be explained otherwise. Another similar fenster is reported southeast of the quadrangle near Desplaines.

CHAPTER IV - THE GLACIAL PERIOD IN NORTH AMERICA

Evidence of Glaciation

Fig 7

During the Pleistocene period about 3,000,000 square miles of North America were covered by a continental ice cap (Fig. 7) similar to those which now cover the larger parts of Greenland and Antarctica. That this ice-sheet existed where now green fields and forests lie, is shown by the abundant evidence found in the characteristic marks of erosion left upon the bed rock as the ice-sheet spread from its center; and in the drift found where the melted ice deposited its accumulated load.

Erosion

There are no exposures of bed rock in the Barrington quadrangle; but in other areas covered by the ice, wherever the solid rock is exposed, its surface is found to be smoothed, grooved and scratched (striated), and in places highly polished, indicating that some fairly rigid, heavy body bearing tools with which to gouge, polish, and scratch, had ridden over it. Here can be recognized the work of the moving ice with its embedded drift. The hills of the glaciated area have a characteristic shape, in that the side against which the ice impinged as it advanced is gentle in slope, while the side away from the advancing movement of the glacier is steep. Since there are no exposures of bed rock in the Barrington quadrangle, no such ice-shaped hills or other direct evidences of erosion are to be seen; but it is evident that a large amount of erosion must have taken place somewhere to have produced the immense quantity of drift present in the quadrangle.

Deposition

Over the larger part of the area, once covered by the ice-sheets, is spread a mantle of unconsolidated material, varying in thickness from a few inches up to five or six hundred feet. It is clearly of transported origin, for it contains materials that did not arise from the decay or disruption of the underlying bed rock. In the Barrington quadrangle, for instance, the bed rock is mostly limestone, yet the drift contains scores of different kinds of rocks such as granites, basalts, and schists. And further, the drift is deposited in many places regardless of the original topography. It is found in valleys, on the sides of hills, and even on the tops, so that the agent which deposited it must have spread over hills and valleys alike.

The drift is made up of particles of various sizes, ranging from those of ultra-microscopic size up to boulders 10 feet and more in diameter. There are, in general, two kinds of drift, unstratified and stratified, found either in separate deposits or in more or less intimate association.

The unstratified drift is called <u>till</u>. It is both physically and lithologically heterogeneous; physically heterogeneous in that it is made up of material ranging in size from the finest particles, through sand grains, to pebbles and boulders many feet in diameter; and in that these different materials are mixed together quite independently of size or shape (Fig. 8). It is lithologically heterogeneous in that the drift

Fig. 8

contains a great number of rock varieties, many of which must have come long distances, mixed together. A piece of granite, whose nearest parent bed rock outcrop is several hundred miles away, may lie next to a cobble of Niagaran limestone derived from a near-by source. The great body of the till is made of boulder clay or very fine material made by the grinding up of rock, not by its chemical disintegration.

The stratified drift is composed chiefly of gravel and sand. It shows clear evidence of having been deposited by water which was formed by the melting of the ice. In carrying the sediments along, this running water has sorted them according to size, shape, and specific gravity so that the coarse material is found more or less separated from the fine. In any one place the power of the water varied from time to time depending upon the rapidity of melting. The amount and kind of load carried by the water varied with the amount and kind of load the glacier contained, and with the volume and velocity of the water. Stratification resulted from the combination of forces: fine material was deposited during time of slow water, as in winter when little melting was going on; coarse material was deposited when the currents were strong, as in summer when the ice was melting rapidly. Interbedding of coarse and fine material is the result as shown in Figure 9. The stratified, or <u>fluvio-glacial</u> drift, while not notably heterogeneous physically, is yet heterogeneous lithologically, being composed of a variety of rocks and minerals.

Topographic expression

The drift, deposited by ice, has a characteristic surface expression not produced by any other geologic agent. Under the edge of the glacier, where it remained more or less stationary for a long time, a thickened belt of drift, known as terminal moraine, accumulated. Under the body of the ice a thinner sheet of drift accumulated, called ground moraine, while beyond the margin of the ice glacial waters deposited sand and gravel in a sheet, designated as outwash plain, or, if concentrated into a valley, filled the bottom of the valley to make a valley train (fig. 10).

Terminal moraine

The position of the edge of the ice at which the terminal moraine is deposited is determined by a balance between the rate of forward movement of the ice and the rate of melting. If the body of the ice is moving forward faster than the edge is melting backward, the edge will advance. On the other hand, if the melting is more rapid than the forward movement of the ice, the margin will recede. For instance, if there were a long, cold winter followed by a short, cool, rainy summer, the autumn would find the ice margin farther out than if there had been a short winter and a long hot summer. Also, if there were a period of great snow-fall the glacier would grow, while if there were a deficiency of snow, it would recede. In fact, the edge of the glacier fluctuates from time to time and from place to place, and any particular place at which the edge stood one season might be over-ridden the next. Deposition under the edge of the ice was naturally very irregular, and it was made more irregular because the ice carried an unequal amount of load at different times and at different places. These considerations account for the fact that the surface of the terminal moraine, where well developed, is hummocky, bumpy, rough, a veritable maze of small steep-sided hillocks and deep abrupt undrained depressions. The term "knob and kettle" or "kame and kettle" characterizes this type of topography where the moraine is of pronounced type (fig. 11).

Distinct hills composed of gravel on or associated with the terminal moraine are called kames. They are made of fluvio-glacial material and were deposited by water when it issued from the ice. Cracks, crevasses, and irregularities of the ice margin cause the deposition to take irregular shapes resulting in steep hills and abrupt depressions after the ice melted (fig. 13). A typical terminal moraine is composed partly of till and partly of fluvio-glacial drift.

Ground-moraine

That part of the drift deposited under the ice back from its margin, or under the margin of the retreating ice, is known as ground-moraine. It is composed chiefly of till, but may have stratified material on its surface deposited as the ice finally melted from the area. The topography is much less uneven than that of terminal moraines. Hills of ground-moraine may be as high as those of the terminal moraine, but they are much wider and the slopes are much more gradual, making a gently rolling surface. The hills may be 40 or 50 feet high but they are a mile or two wide. The name applied to this type of topography is "swell and swale" (fig. 14).

Outwash

The drift deposited beyond the edge of the ice by glacial waters is called outwash. It is composed of stratified material -- mostly sand and gravel. Where the edge of the ice stood on flat country, the outwash is a plain, sloping away from the terminal moraine. This plain has a comparatively flat surface, marked here and there by shallow stream channels where the glacial streams flowed, and by pits where blocks of ice lodged and were surrounded or covered by outwash, only to melt later and leave a deep, steep-sided depression.

Where the glacier stood across a valley, as it did across Fox River near Cary, the sediment-laden waters flowed down the valley, filling up its lower part to form a valley train.

Rocks of the drift

There are many different kinds of rocks in the drift, for as the ice-sheet moved southward from its centers in Canada, it picked up and carried along fragments, large and small, of the various kinds of rocks over which it passed. When the ice melted, these fragments were left as part of the drift. The rocks (boulders) of the drift fall into three general classes, i.e., sedimentary, igneous, and metamorphic.

Sedimentary rocks were formed by the accumulation of sediments beneath bodies of standing water. There are four principal varieties. Sandstone is solidified and cemented sand, formed near the shore of the ancient seas much as sand is collected today near the shores of lakes and oceans. Conglomerate is solidified gravel, and represents conditions of shore deposition where coarse material is being worked by the waves. Shale is hardened mud and clay, and represents deposition which took place where the waters were more quiet. This might have been either farther from the shore or in places where the land was low and the streams so sluggish that they transported only fine mud. The material of these three kinds of sedimentary rocks is called clastic, because it came from the breaking up of the rocks of the land. The fourth kind of sedimentary rock found in the drift is limestone. This was formed by the deposition, in parts of the sea where no clastic sediments were present, of lime mud, -- ground up shells, coral, et cetera, which subsequently became hardened to solid rock. The calcium carbonate was extracted from the sea water by animals and plants to build their shells or other hard parts, or rarely by chemical precipitation.

Igneous rocks are solidified lava, and hence do not contain either fossils or bedding planes as do the sedimentary rocks. There are three main types of igneous rocks: (1) the coarse-grained rocks, in which the individual mineral crystals may be seen with the eye, were formed by the intrusion of lava which cooled very slowly deep below the surface and so gave the crystals time to grow large (granite, syenite, and diorite are examples of this kind); (2) the fine-grained rocks, where the crystals are too small to be seen by the unaided eye, were formed of lava which was extruded upon the surface and hence cooled more quickly (basalts, rhyolites, and in general "greenstones" are examples of extrusive rocks); (3) the third type is roughly a combination of the two previous ones, in that it has both large and small crystals, the large crystals being scattered through a fine-grained ground-mass. The origin may readily be inferred. The large crystals must have had abundant time to grow, and so must have formed while the lava was still deep in the earth and cooling slowly. The fine crystals, on the other hand, imply rapid cooling and must have formed when the lava was at or near the surface. These rocks, which show two generations of crystals, are called porphyries. A typical example is seen in the Barrington Quadrangle in the reddish quartz- or rhyolite-porphyries common as boulders or cobbles in the drift.

Metamorphic rocks are those sedimentary or igneous rocks that have been subjected to great pressure, accompanied by more or less heat, resulting in the formation of banded and foliated structure. This structure is produced by the recombination and recrystallization of the minerals of the original rocks so that they are parallel in arrangement. A tendency to break in certain directions, characteristic of metamorphic rocks, is known as cleavage. Schists have foliated structure and some of them show intimate crumpling. Gneisses have banded structure showing recrystallization and segregation of the minerals. (Fig 15)

Distribution and history of glaciation

General statement

The ice sheet of North America radiated from three centers as shown in fig. 7. Its southern limit lies, roughly, along a line from New York City on the east, across northern Pennsylvania, down the Ohio, up the Missouri, and thence westward to Puget Sound on the west. The whole area was not covered by ice at any one time, but successive invasions and fluctuations covered this territory with a great sheet of drift. The history of the glacial period is not a simple one. There are evidences of five distinct invasions of the ice, interspersed with four interglacial epochs during which the ice melted far back, and, when climatic conditions comparable to those of today obtained, deep soil was produced by weathering the top of the drift. In some places the next succeeding invasion failed to erode the soil completely, but instead deposited fresh unweathered drift on top of the soil layer, thus preserving it as an interglacial soil. The following table gives the Pleistocene succession as it is now recognized in North America:

Table ~~#~~ 2

<u>Table of glacial and interglacial sub-epochs of the Pleistocene epoch.</u>

Wisconsin	fifth ice invasion
Peorian	fourth interglacial interval (relatively short)
Iowan	fourth ice invasion
Sangamon	third interglacial interval
Illinoian	third ice invasion
Yarmouth	second interglacial interval
Kansan	second ice invasion
Aftonian	first interglacial interval
Nebraskan	first ice invasion

Glaciation of Illinois

Older drifts

Of these five drift-sheets, all but the Iowan are found in Illinois. The Illinoian drift practically covers the southern part of the state, except for the hill country in the extreme south which lies beyond the limit of glaciation. Beneath this blanket of Illinoian drift, and exposed to view only in valleys and other excavations, lie the Kansan and Nebraskan drifts.

Wisconsin sub-epoch

The Wisconsin invasion of Illinois was made up of a series of advances and retreats of the ice-edge, with some shifting and re-forming of the marginal lobes. The result was to form a series of moraines and morainal belts more or less concentric about the southern and southwestern part of the Lake Michigan basin. Leverett, in his classic early work 1/ divided the Wisconsin into two divisions. This was done

1/ Leverett, Frank, Illinois Glacial Lobe; U.S. Geol. Survey, Mon. 38, 1899.

on the basis of a considerable withdrawal, some erosion, and a readjustment of the ice lobes in the next advance. Since that time he and others have thought best to divide the Wisconsin into three subdivisions: an early Wisconsin, a middle Wisconsin, and a late Wisconsin; these subdivisions likewise being based on the same criteria as mentioned above. There is some tendency, however, at present to look upon the Wisconsin as a long succession of advances and retreats, not yet fully worked out.

~~and~~ What is known is too complex to enumerate here. For present purposes it is sufficient to recognize the three-fold division.

Fig. 16

In figure 16 will be seen the morainal ridges in receding order as follows:

Early Wisconsin	(Shelbyville moraine (Champaign moraine (Bloomington moraine (Gilberts moraine (Marseilles moraine
Middle Wisconsin	(Minooka moraine (Rockdale moraine (Manhattan moraine (Valparaiso morainic system: (West Chicago (Barrington (Cary member (Palatine member (Arlington Heights (Lake Border moraine
Late Wisconsin	(Not found in Illinois

As will be brought out in more detail later, the distinction between early and middle Wisconsin is significant to the present discussion, for the valley of Fox River was cut to approximately its present depth following the deposition of the Marseilles drift and before the Minooka.

CHAPTER V. GLACIATION OF THE BARRINGTON QUADRANGLE

The Barrington quadrangle is everywhere covered with a thick mantle of glacial drift. Due to the fact that this drift was deposited at different times and at different stages of the ice advance, stand, and retreat, it is complex in constitution. While the five different drift-sheets, mentioned in the preceding chapter, are present in the upper Mississippi basin region, only two of them, i.e. the Illinoian and the Wisconsin, are known to be present in the Barrington area, and only the latter of these is seen at the surface.

Illinoian drift

Leverett 1/ cites evidence from many wells in the quadrangle that suggests an older, probably Illinoian, till below the Wisconsin.

1/ Leverett, Frank, Illinoian Glacial Lobe; U.S. Geol. Surv. Mon. 38, pp. 581, 583, and 586, 1899.

The evidence is of two kinds: (1) much harder, denser, and more compact drift, and (2) a bed of peat or interglacial soil. A good example of the latter is seen in the following well 2/ (also see appendix):

2/ Leverett, Frank, Ibid, p. 586.

Section of a well in the northwest part of Schaumberg Township (T.41N.,R.10E.)

	feet
Yellow till	10 - 15
Blue till	125
Black soil	4
Sandy till	50
Gravel with water	2
	195

An exposure [1] in the highway cut 2½ miles south of Elburn, Kane County, not more than 15 miles southwest of the Barrington area,

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1/ Aurora Quadrangle, Ill. State Geol. Survey (in preparation).

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shows Illinoian till and gumbotil in the following section:

	feet	inches
Till, Bloomington	6	6
Loess, calcareous, fossiliferous, Peorian, ...	---	8
Loess, leached, late Sangamon, ...	2	8
Gumbotil, Illinoian, ...	2	4
Till, calcareous, Illinoian, ...	10	0 +

It is evident from this section that Illinoian ice, which is known to have come from the northeast, crossed the Barrington Quadrangle and undoubtedly deposited drift over most or all of it. This exposure is also important in showing that there is no Iowan drift in northeastern Illinois, for the Peorian loess lies directly on Late Sangamon loess.

Sangamon interglacial interval

The exposure south of Elburn shows 2-1/3 feet of gumbotil on the Illinoian drift. This gumbotil is the product of long weathering of the surface of the till under conditions of poor drainage. [2]

2/ Kay, G.F., New term in Pleistocene Geology, Science, N.S. XLIV, November, 1916.

It shows, then, that Sangamon time was very long. This same exposure contains, furthermore, Sangamon loess to a thickness of about 3 feet, which was obviously deposited, during the latter part of the interval, on top of the gumbotil. The loess, in turn, was weathered and completely leached prior to the end of the interval. Since weathering and loess deposition are neither confined to narrow geographic boundaries, both must have taken place during the Sangamon interval in the Barrington Quadrangle.

Peorian loess

The presence of almost a foot of Peorian loess in the Elburn exposure makes it entirely likely that this same loess-sheet once covered the Barrington area.

Early Wisconsin

Bloomington till

Underlying a gravel formation in the southwestern part of the quadrangle, a very calcareous, or limy, till outcrops along the valley of Poplar Creek. The best exposure is in the NW. $\frac{1}{2}$, sec. 20, Hanover Twp., Cook County. On the southeast side of the valley, the stream is undercutting the valley-wall, exposing this till for a height of 25 feet above the stream level. The exposure extends only about 50 to 75 yards along the stream, but dissections within this stretch by several small gullies makes it quite accessible to study. Its outstanding characteristic is its "pinkish" color. It is not indeed pure pink, but rather a gray-mauve to drab-tan, there being a slight tinge of purple present. This is not the reddish or brownish color of oxidized drift, but is the tint of the fresh drift. Examination of the material under the binocular microscope shows that the pink color is limited to the fine clay-like material which, from estimate, forms about 30 to 40 per cent of the till. When this clay-like material was treated with acid and the solution neutralized with ammonium hydroxide, iron hydroxide was formed in considerable amount, suggesting that coloring matter in the drift may be its iron content. Another exposure of the same drift is seen in a gully half a mile directly north of the first-mentioned, where again the "pinkish" color is quite distinctive.

Pebble count from Bloomington till

Size 1/2 inch

Determination with acid

	Per cent		Per cent
Dolomite) Limestone) a/	80	Ironstone	4
		Granite	2
Sandstone	6	Chert	2
Basalt	5	Greenstone	1

a/ The limestone is commonly dense and dark colored.

The correlation of this till with the Bloomington is based partly on its color, which is strikingly characteristic of the Bloomington throughout the northern part of the state, and partly on the work of Leighton and Powers in the Elgin and Aurora quadrangles.

Further east along the valley of Poplar Creek, in the eastern part of sec. 17, T.41 N., R. 9 E, terraces composed of peaty material, where a zone of springs lies along the valley walls, occur at an altitude of about 770 feet, or at about 15 feet above river level. The springs are also present in places where no terrace has accumulated. This zone of springs lies at the contact between gravel above and till below, which till is noticeably pinkish to reddish in color, and most probably is the Bloomington.

While these are the only good exposures of the Bloomington till within the Quadrangle, there is indication in several places of a sheet of this till lying below the gravel formation. In the pit of the Chicago Gravel Company (~~Cook 0650.64~~ SE1/4, NW 1/4, sec. 30 T.41 N., R.9 E.) excavation shows that the gravel lies on a light blue-gray till, which may be the blue-gray lower part of the Bloomington till-sheet, but the exposure is so limited in extent that the correlation of the till is not feasible.

The Bloomington till characterized by the typical "pinkish" color occurs at a depth of 92 feet, or about 718 feet above sea-level, in the Cary town well (See ~~Table 2~~ appendix). Two other wells, two miles farther east, show "pink" till at about this same elevation. In the gravel pit one quarter of a mile southeast of Fox River Grove a "till boulder" about a foot in diameter with rounded and distinct outlines, composed of the pink Bloomington till, is embedded in gravel of younger age. This occurrence signifies that the younger ice rode over Bloomington till, picked up a block of the frozen material and incorporated it into the gravel formation much as it would have done a limestone boulder. Therefore Bloomington till is known to have underlain the region even farther east than this locality.

Marseilles till

In the small valley ($SW\frac{1}{4}$, sec.24, T.43 N., R.8 E), on the south side of Fox River, buffish to bluish-gray till is exposed below a gravel formation. The till is thought to be Marseilles because of its stratigraphic position below the gravel and because it does not have the "pinkish" color characteristic of the Bloomington till in northeastern Illinois. At its contact with the overlying gravel formation, there is a large spring which supplies abundant water to the Turners camp. Along both the north and the south walls of Fox River valley and the west wall of Spring Creek valley in Algonquin township, there is a zone of such springs, with the accompanying swampy vegetation (Fig. 11), similar to those in Poplar Creek, at an altitude of approximately 800 feet. These springs mark the contact between the Marseilles till below and the Marseilles gravel formation above, and owe their large volume and persistent flow to the wide distribution of this gravel formation as an aquifer. At river-level along the constricted lower part of its valley (WC., SE$\frac{1}{4}$, sec.19, T.43 N., R.9 E, McHenry County), Spring Creek exposes 8 to 10 feet of buff drab till similar to, and probably to be correlated with, the Marseilles.

Marseilles Gravel formation

To the west of the Barrington Quadrangle, along Fox River valley and northward to Crystal Lake, is an extensive and thick formation of gravel. This gravel formation is to be seen within the quadrangle, exposed as a surface formation, only in the southwestern part of the area. And even here it is probably overspread by West Chicago outwash, from which it is generally indistinguishable.

The Marseilles gravel formation is composed of both coarse and fine horizontally bedded gravel, containing numerous cobbles and even boulders up to 1$\frac{1}{2}$ feet in diameter. However, there is intermixed with the larger material much sand, coarse and fine, varying in amount from place to place. At Dundee and at Algonquin the gravel pits produce 3 to 4 carloads of gravel to one of coarse, or torpedo, sand; while at the Chicago Gravel Company's pit near Spaulding in sec. 30, T.41 N., R.9 E., the ratio is about 1 to 1. At this latter pit, the gravel formation is 12 to 20 feet thick and capped by 5 to 8 feet of leached, brownish-buff, silt-loam. At many places, however, in the southwest corner of the quadrangle, the loam is absent, the gravel appearing at the surface. North of Algonquin the gravel formation thickens to 30 or 40 feet, is much coarser, and is overlain by 0 to 15 feet (averaging 5 to 6 feet) of the brownish-buff loam which is calcareous near the bottom of some of the thicker parts. The surface of this gravel plain has an undulatory topography, cut by broad, shallow valleys, presumably made by glacial waters after the loss of some of their original sediment. These valleys are more or less irregular in size, shape, and direction, but trend in general toward the west and south. "The gravel is so extensive in Kane and Kendall counties and so small in amount farther down the Fox River as to suggest that it forms an extensive delta in northern Kendall and southern Kane counties, and that free drainage or escape of the waters down the Fox River had not been established".1/

1/ Leverett, Frank, The Illinois Glacial Lobe: U.S. Geol.Survey Mon.38, p. 313, 1899.

Pebble Count at Chicago Gravel Company's pit

(NW$\frac{1}{4}$,SE$\frac{1}{4}$,sec.30, T.41 N.,R.9 E)

Size 1/2 inch

Determination made without acid

	Per cent
Limestone and dolomite	76
Granite	8
Diorite a/	5
Basalt	5
Felsite	3
Chert	3
Sandstone	2
Gneiss	1

a/ Note. Diorite includes all coarse-grained dark colored igneous rock.

While not exposed widely as a surface or uppermost formation within the quadrangle, this great gravel formation plays a very important role in the western part of the area. As shown by the zones of large springs mentioned above, and in occasional exposures, it is found to be present below the West Chicago moraine, not only in Fox River and Poplar Creek valleys but along the west side of Spring Creek valley for practically its whole length. The steep valley walls of the three western branches of Spring Creek are seen to be made of this gravel, somewhat disturbed by the overriding West Chicago ice. At the eastern end of the deep part of Poplar Creek valley through the West Chicago moraine

(SE.$\frac{1}{4}$, SE.$\frac{1}{4}$, sec. 17, T.41 N., R.9 E) a gravel pit, elevation 775 to 780 feet, exposes coarse gravel up to 8 to 10 inches maximum diameter, below which is a 3 foot layer of horizontally bedded fine gravel cemented by lime into a rather strong conglomerate. The pebbles range from 1 to 2 inches in diameter. Such cementing is not uncommon elsewhere in the Marseilles gravels, but has not been seen in any other gravel of the general region. In the railroad cut 300 yards northwest of this same pit, West Chicago till 10 to 15 feet thick is seen to overlie the coarse gravels. Wells in the West Chicago moraine, furthermore, record thick water-bearing gravel below a comparatively thin layer of till. A good exposure of this relationship is seen in a gravel pit on the West Chicago moraine (NW.$\frac{1}{4}$, NW.$\frac{1}{4}$, sec. 32, T.43 N., R.9 E, McHenry County), where the following section was measured:

	Thickness	
	feet	inches
Soil, brown loam, pebbly	0	6
Till, leached, buff	1	6
Till, calcareous, light buff	5	6
Gravel, horizontal, rounded, and stratified, calcareous, sharp contact	7	0

From this general distribution it is rather confidently inferred that the Marseilles gravel formation originally extended from the general location of Spring Valley, Ski Hill, and the west side of Fox River to the north edge of the Quadrangle, westward across the present site of Fox River Valley to the Marseilles moraine, as a continuous sheet of gravel. Leverett's suggestion of a delta fails to fit the situation, for the prevailing structure of the gravel is horizontal in bedding without a single example of delta-bedding, so far as the writer is aware.. The most plausible inference is that the formation is an extensive outwash plain formed during the recession, or at a recessional stand, of the Marseilles ice. Such a postulate is rather unique, for outwash plains are more commonly formed at time of maximum stand of the ice, rather than in recession. It might be proposed that this is the outwash of an ice-stand later than the Marseilles. But there is no known ice-stand with which it can be correlated. For following the recession of the Marseilles ice, as will appear more fully shortly, there was a considerable period of erosion during which the Fox River Valley was cut to virtually its present depth down through the Marseilles gravel plain, through the Marseilles till, and well into the Bloomington till. This cutting is known to have occurred at this time, for the Minooka ice, the first advance of Middle Wisconsin time, descended into the valley already cut and deposited therein distinctive morainal features. Consequently it is here held that the gravel was produced during the waning stages of the Marseilles ice. Since this region occupied a reëntrant position in the Marseilles ice-margin, it may well have been a region where drainage from a considerable part of the ice was concentrated to give rise to such abundant outwash.

Erösional Period

As previously stated, it appears that the Marseilles gravel formation was once continuous as a plain across the site of the present Fox River valley, and that the valley was cut after the deposition of this formation. If this were the last event in the history, the topography of the valley walls should show it to be the result of erosion of running water. There should be systems of ravines and tributary gullies leading down to the river. But where the Minooka and West Chicago moraines cross the valley, morainic topography is found, not only on the uplands, but descending into the valley itself. Knobs, kettles, and other typical features of glacial deposition are to be seen along the upper half of the valley walls. This type of topography is found from the valley top down to an elevation of 760-765 feet, 30 to 35 feet above normal river-level, below which subsequent erosion has removed it.

Fig. 17

The fact that the Minooka and West Chicago moraines descend into the valley shows that the erosion which excavated the valley took place before these moraines were deposited. 1/ Erosion of so large a

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1/ The writer owes this suggestion to Dr. M. M. Leighton. Elgin Quadrangle, Ill. State Geol. Survey (in preparation).

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valley as that of the Fox River, with Spring Creek valley as a tributary, implies a considerable retreat of the glacier and a considerable lapse of time, for the cutting, even of unconsolidated material, must have been slow because the streams doubtless had low gradients. It may be, however, that an ice-dammed lake, similar to one of the ancestral Great Lakes, was ponded to the east and had its outlet through the Fox River valley. In such a case the cutting would have been relatively rapid.

The evidence of an erosional interval, combined with the presence of the Great Marseilles gravel formation, separates clearly in this region the Early from the Middle Wisconsin drifts. The Minooka moraine is then the first of the ~~Late~~ Middle Wisconsin moraines.

Middle Wisconsin

Minooka drift 1/

1/ Leverett, Frank, "The Illinoian Glacial Lobe", U.S. Geol. Surv. Mon. 38, p. 319, 1899.

The first ice advance of Middle Wisconsin time crossed, in the neighborhood of Elgin, the newly excavated Fox River valley to deposit the Minooka moraine. This moraine lies just west of ~~the~~ Elgin, but shortly swings northeastward across the Fox River valley and enters the Barrington quadrangle in sec. 25, T.42 N., R.8 E, where it makes a single conspicuous hill on the western margin of the sheet. In fact this is the northernmost exposure of the Minooka drift at the surface, for east of this hill the Minooka drift has been overridden and buried by the West Chicago moraine. It may well be that the high massive drift deposits east of Spring Creek valley in sections 10, 15, 16 and 17 of Barrington township (T.42 N., R.9 E.) are composed largely or in part of overridden and buried Minooka moraine. Possibly what is being mapped as the Cary member in this report may, to a considerable extent, owe its thickness to buried Minooka moraine.

The Minooka drift is largely composed of stony clay, buff to tan in oxidized exposures and bluish-gray below. However, in the NW$\frac{1}{4}$,SE$\frac{1}{4}$, sec. 19, T.41 N., R.9 E., a kame stands 20 feet above the surrounding gravel plain, and is thought to be of Minooka age. Two hundred yards south and southeast of this kame is an esker, or at least an esker-like ridge, composed of gravel containing many cobbles, boulderettes, and boulders up to 2 and 3 feet in diameter. This esker is likewise considered to be a feature of the Minooka episode.

Outwash of Minooka age has not been identified in the area.

Valparaiso morainic system

Leverett 1/ proposed the name Valparaiso system for the great massive moraine 2/ that passes through Valparaiso, Indiana, sweeps around

1/ Leverett, Frank, Op. cit., p. 339.

2/ Third Ann. Rept., U.S.Geol. Surv., 1881, pp. 322-325.

the south end of Lake Michigan, and passes north and south through the middle of the Barrington area. Topographic maps were not available for detailed study in this area, and no subdivisions were pointed out. Such study now reveals that the Valparaiso system is composed of three moraines important enough to be given appropriate names. These moraines in order of age (i.e. from west to east) are (1) the West Chicago moraine; (2) the Barrington moraine, with its two small members, the Cary member and the Palatine member, located respectively in the northwestern and the southeastern part of the area; and (3) the Arlington Heights moraine.

In order to be identified as a terminal (or recessional) moraine the feature must have at least one, and preferably several, of the following characteristics:

(1) Continuity. There must be a ridge or belt of material traceable, with only small gaps if any, for a considerable distance. A morainic belt might be scarcely recognizable in one area; but if it can be traced in one or the other, or preferably both, directions into characteristic terminal moraine, the relatively indistinct feature may then be called part of the moraine.

(2) Topography. The topographic features should show distinct knob-and-kettle topography.

(3) Kames should be present.

(4) Elevation. The moraine should rise as a ridge or series of mounds, showing a noticeable rise from at least one side, forming a break in the topography of the region, and in many places along its course form a stream divide.

(5) Thickness. The feature should be a thickened belt of drift.

(6) Boulders. There should be a concentration of boulders, commonly erratics of distant origin.

(7) Outwash. There should be outwash sand and gravel, not only in the moraine itself, but flanking it on the outer margin and correlated with it in age.

(8) Arrangement. It should fit into the arrangement of other moraines of the general region, and harmonize with what is known or inferred to be the ice movement of the district.

(1). West Chicago Moraine

Location. The West Chicago moraine, the westernmost ridge of the Valparaiso system, may be traced from the central part of the Joliet Quadrangle, northwest across the Wheaton Quadrangle, through West Chicago and along the western part of the Barrington Quadrangle. It leaves the Barrington Quadrangle a mile west of Cary.

Width. The moraine varies from a fraction of a mile to three miles in width.

Topography. This moraine stands as a fairly conspicuous ridge rising abruptly from Spring and Poplar Creek valleys on the east, and from the flattish country of the Marseilles gravel plain on the west. The topography is in general rolling, with numerous fairly steep-sided hills interspersed with undrained depressions, four of which contain small lakes. In overriding the Marseilles gravel formation, the West Chicago ice has produced in places a rough topography somewhat resembling knob-and-kettle topography. Most of the hills, however, are not kames, but rather the result of gravel having been overridden, while most of the depressions seem to have been produced by glacial erosion. The larger part of the areas of this kind of topography shows a thin veneer of till 2 to 10 feet in thickness, some of which is quite clayey while some is very gravelly; so much so in the latter case that it is easily mistaken for water-laid gravel, but it invariably contains fine calcareous material that proves it to be till. What seem to be true kames may be found within such glacially modified gravel areas. A large area of this nature is found along the south bank of the Fox River valley, another west of Spring Lake, and several more along the moraine to the south edge of the quadrangle. Within these areas the topography is very rough, with small steep-sided hills and deep undrained depressions.

There are several kames on the moraine, notably in the southwestern part of Barrington Township (T.42 N.,R. 9 E.). The individual kames form conspicuous features in the landscape, resembling, from a distance, large haystacks. (Fig 18)

Fig 18

~~Photo. Figure 15 (Kame)~~

The largest feature, which is mapped as a kame, lies in the southwest part of section 17, Barrington Township (T.42 N.,R.9 E.). It is a large hill composed of coarse gravel. The one excavation into it is a gravel pit on the eastern side of the hill about half-way down the slope. In this pit the material is seen to be coarse, poorly stratified gravel, with a large percentage of cobbles and boulderettes. The stratification is seen to dip westward at 20° to 30°. Such a dip and such large size of material implies deposition against the ice-edge as in the case of a kame. An alternative suggestion is tenable, namely that this was the ice-edge during the deposition of the Algonquin gravel and that this hill marks the eastern extent of that formation against the ice. However, no definite evidence is at hand to settle the question.

Two eskers of West Chicago age are to be seen within the quadrangle. Fig. 19 The northern one lies in the SE.$\frac{1}{4}$ of sec. 13, T.43 N.,R.8 E., half a mile southwest of Cary on the summit of the moraine. On its eastern end stands the water tower for the town. It is some hundred and fifty yards long by 40 to 50 yards wide, and rises 40 to 50 feet in height. Its western end drops off steeply into an elongate depression, evidently a feature of glacial drainage. The second esker is found at the west Fig 20 end of the blunt tributary valley to Spring Creek, west of Spring Lake, in section 1, T.42 N., R.8 E., Kane County. This esker and associated eskerine tract (Fig. 20. ~~#55 - #29~~) is found in the bottom and going up the west end of the valley. It is composed of small knolls and slight ridges of irregularly bedded and disturbed fine gravel and sand (~~Photo #53 - #29~~).

Fig. 21

A most peculiar bit of topography is seen in the Fox River valley south of Cary in sections 13 and 24 (T.43 N., R.8 E.) McHenry County. When viewed from the south side of the valley (~~Photo~~. Fig. 21 ~~#61 - 129~~) it looks like a flat-topped terrace of outwash gravels standing at an elevation of 800 to 810 feet, or approximately 50 feet below the skyline of the West Chicago moraine. The material, upon close inspection, is seen to be entirely of horizontally stratified sand and gravel. But the feature is not an outwash terrace, for it is in reality a group of hills, elongate, round, oval, and irregular, whose summits come approximately to the same level. Between and among the hills are valley-like depressions, undrained pockets, holes, and other features which could only have been made by sub-glacial waters. It is postulated that this was a place of very active sub-glacial drainage below the West Chicago ice, and that the topography was thus produced by scouring into the underlying Marseilles gravels, which had not been removed from this part of the valley by the post-Marseilles episode of erosion. If the features under discussion were composed of Cary outwash they would not have the distinctive topography which they exhibit, but would, instead, be dissected only by normal gullies and small valleys. The significance of this interpretation will be discussed in connection with the Cary outwash.

<u>Composition</u>. The kames are composed largely of sand and gravel, deposited evidently at, or very near, the edge of the ice. (Fig. 22) The eskers and eskerine tracts, likewise, are composed of gravel and sand. The overridden Marseilles gravel areas likewise exhibit large quantities of gravel. But, although much gravel is present, the remainder of the material of the moraine is mostly till, which, as seen in the available cuts and in auger borings, is brownish buff in color, contains predominance of local dolomites and limestones, and is much more silty, sandy, and pebbly than the till farther east. A striking feature of the moraine, and the feature in which it differs from other moraines of the area, is the large number of boulders, chiefly of distant origin, that almost everywhere strew its surface. Along the east-west road which passes through the southern part of sec. 25, Algonquin Township (T. 43 N., R. 9 E.), McHenry County, 510 boulders larger than one foot in diameter were counted in a distance of two miles; while in a mile stretch of the east-west road through the middle of this same section, 641 boulders were found. A boulder count from the road corner at the west central part of this same section (sec. 25) to the northern corner of the section, discloses a vast predominance of foreign boulders. In this distance -- half a mile -- 561 boulders, larger than a foot in diameter were found. Doubtless many of these were dragged to the roadside from the adjoining fields.

Table 3.

Boulder count on the West Chicago moraine

Kind of rock	Number of boulders of various sizes				Total number of boulders
	1 foot	2 feet	3 feet	4 feet	
Diorite-gabbro	92	125	76	5	298
Granite	52	72	40	2	166
Gneiss	8	23	15	1	47
Basalt	7	11	4	0	22
Limestone	5	3	0	0	8
Rhyolite-porphyry	1	4	3	0	8
Felsite	0	4	2	0	6
Syenite	1	1	2	0	4
Peridotite					1
Schist					1
Grand total					561

The notable features of this boulder count are three: first, more than one half of the boulders are, by field classification, diorite-gabbros; second, over one-third of the boulders are granites; and third, there is a surprisingly small number of limestone boulders. Not only does no other part of the quadrangle show so many boulders, but what is equally significant, no other moraine shows so large a proportion of foreign boulders. A suggestion might be made to account for this concentration of erratic boulders on this moraine.

As the ice-edge was advancing, the forward movement of the body of the glacier was faster than the melting constantly taking place at the margin. Boulders, broken from the parent outcrops, might be moved to the edge of the ice and there dropped as the surrounding ice melted away from them. But the glacier as a whole was advancing, so that many of these same boulders would be picked up and moved forward again. This would happen time after time, gradually concentrating the more resistant foreign boulders at the outermost stand of the ice. There would hence be a larger percentage of them in the outermost moraine than in the subsequently made recessional moraines. In harmony with this view is the fact that these erratics are noticeably rounded and are composed of resistant material. These facts lead to the conclusion that the West Chicago moraine belongs to the Valparaiso system, and hence is its outermost member first to be deposited. And here, incidentally, beyond the point of the overriding of the Minooka moraine, is the outermost member of the Middle Wisconsin series.

Relation to the Marseilles Gravel formation. The large amount of gravel in the West Chicago moraine suggests that it was deposited by ice overriding the earlier gravel formation. Weight is added to this view by the numerous exposures of gravel all along the west side of Spring Creek valley, overlain by till on the uplands. A good exposure of till lying on gravel has already been cited in the gravel pit in the northwest corner of sec. 32, Algonquin Township (T.43 N., R.9 E.), McHenry County.

X

Sufficient well records are not available to prove whether or not the moraine is generally underlain by a continuous sheet of gravel, though 12 of the 14 well records obtained give water-bearing gravel below 30 to 60 feet of till. Probably the gravel formation was so much disturbed by the overriding ice that definite recognition of thickness and distribution has become difficult. But the weight of evidence points to a continuous sheet of gravel below the West Chicago moraine.

Outwash. From the West Chicago ice stand considerable quantities of outwash sand and gravel were swept westward across the gravel plain in the extreme southwestern part of the quadrangle and down the Fox River valley. This gravel is seen in terraces along the valley as far north as Algonquin, where the moraine crosses the valley, which are interpreted as remnants of a former valley train. It is also inferred as forming the uppermost part of the gravel plain, though this gravel has not as yet in this area been distinguished from the underlying Marseilles gravel where the one lies directly on the other. Lines of glacial drainage and outwash channels are seen beyond the western ends of the two western tributary valleys to Spring Creek.

(2) Barrington Moraine

The Barrington moraine occupies the larger part of the quadrangle. It extends from Spring Creek and Cary on the west to the eastern margin of the sheet. As far as the evidence shows, it is a single massive moraine formed during a single episode of the glaciation. It, however, is diversified to some extent by morainal features of comparatively local distribution and significance. Thus from Barrington to the northwest corner of the sheet the outer border of the moraine rises as a conspicuous feature, set off from the main part of the moraine by the lower Flynn Creek and Fox River lowland. This outer ridge is designated as the Cary member. It appears not to be a frontal moraine in the common sense of the term, but rather a phenomenon of sub-glacial and englacial deposition. There are several eskers and eskerine tracts, and most of the kames are of the moulin type. It is not only exceedingly gravelly, but what till is present is comparatively thin. Likewise from Palatine southward lies a ridge distinct enough to be specified as the Palatine member.

(a) Cary member

Location. The Cary member of the Barrington moraine extends as a distinct feature from the northwest corner of the quadrangle southeastward, crossing the Fox River two miles east of Cary, to a point about two miles west of Barrington. Here its trend becomes southerly for about three miles. Thence southward, to the margin of the quadrangle, it loses its identity as a distinct member and becomes only the outer part of the Barrington moraine.

Width. In its northern part, this morainic belt is about two miles wide, narrowing to a mile where it crosses the Fox River, extending again to about two miles in that part west of Barrington. The boundaries of the member are in certain places quite sharp, in others so indistinct that no definite line can be drawn.

Topography. The topography of the Cary member is the most typically morainic of the whole region. There are considerable areas characterized by kame-and-kettle topography, in which the land is made up of one steep-sided hillock after another separated by deep undrained depressions, or kettles (Fig. 17). Such an area at Fox River Grove is half a mile wide and over a mile long. With Ski Hill, its highest point, at the east, it presents an extremely rough topography all along the southern outskirts of the village. This area, as well as two others farther north, as in the West Chicago moraine, is found to be made of gravel (Marseilles) which has been overridden, moulded by glacial action, and largely strewn with till. At several places in the Fox River Grove area exposures show contorted gravel overlain by till. The Ski Hill massive is covered with till, except for the small summit hill which is made of gravel to its top. This summit hill, conical and very steep-sided, is looked upon as a moulin kame formed in a circular hole or "moulin" in the ice after the latter had become stagnant. Another moulin kame is seen on the crest of the moraine north of Fox River (SE.¼, sec. 8, T.43 N., R.9 E., McHenry County). This latter kame furthermore passes into an esker trending off to the southwest into a valley-like depression formed by subglacial water. Another kame and esker lies at the very margin of the quadrangle in the southern part of sec. 1, T.43 N., R.8 E. Farther south there are numerous kames, either individual ones or groups of two or three, some of which make conspicuous features of the landscape. ~~(Fig. 18).~~

Two well developed eskers are to be seen on the moraine. One lies a mile and a half northeast of Cary (SW.¼, NW.¼, sec. 8, T.43 N., R.9 E, McHenry County). It is about ¼ mile long, 100 to 150 feet wide, and rises to an undulating crest some 30 to 40 feet above its base. A gravel pit at its southern end shows it to be made of fairly coarse gravel and sand with a fairly good suggestion of stratification dipping with the slope of the hill. A second esker is to be seen on the east side of Spring Creek in section 32, T.43 N., R. 9 E.,McHenry County. This esker trends southwest and lines up with the esker tract previously mentioned in the west tributary of Spring Creek. The suggestion is that this was a fairly persistant line of subglacial drainage.

Even aside from the kames and kame-like areas, the topography of the moraine is noticeably rougher than that of the country on adjoining sides. The hills, though made of till, are commonly 30 to 50 feet high, and the intervening depressions are deep and fairly abrupt. Many of these depressions contain small lakes and ponds, such as Twin Lakes two miles west of Barrington. A half mile south of Goose Lake, in the same vicinity, the topography and lacustrine material in the bottom of a small valley show that a small lake once existed there and has been drained during post-glacial time.

Composition. The Cary member, while composed largely of till, contains a notable amount of gravel and sand. Practically all the well records show gravel. A probable interpretation of these reports, since till is very widespread at the surface, is that gravel, being the important water-bearing formation, impressed the well drillers and the well owners in their search for water. Therefore when a well is reported to be in gravel, the probability is that the lower part of the well is in gravel. At any rate, it is significant that there is so much gravel, for it may mean that the moraine was deposited by ice overriding an extensive gravel and sand formation, -- possibly Marseilles gravel, though this is speculative. (Fig. 29)

Such records may indicate that the Cary moraine was deposited over an older extensive gr. fm., possibly the Algonquin.

An accurate record of the well on Mr. Bell's farm, $2\frac{1}{4}$ miles west of Barrington, shows the kind of material below the surface.

Log of well on Mr. Bell's farm, NE.$\frac{1}{4}$ sec.4, T.42 N., R. 9 E.

Cook County

Description of strata	Thickness Feet	Depth Feet
Yellowish oxidized till	40	40
Blue till	50	90
Sand	100	190
Gravel	1	191
Limestone	22	213

The yellowish brown color reported here is characteristic of the upper part of the till over the whole moraine. From the average of six auger borings, made on flat upland surfaces where the till has been little eroded, the depth of leaching is 2.5 feet. One of these borings shows only 8 inches of leached till, suggesting that probably part of the leached zone has been removed by erosion. If this boring were rejected the average would be 2.8+ feet. A representative boring located near the center of N. line of sec. 4, T.42 N., R.9 E, shows the following section:

	Thickness Ft.	Thickness In.
Soil, brown loam		8
Clay-loam, leached, buff	2	4
Till, calcareous, buff		6

The pebbles of the till are striated much more commonly than those of the gravel.

The gravel of the kame areas is in some places coarse, as that exposed near the station of Fox River Grove ~~(Fig. 19)~~, and in some places fine, as at the west end of the same village in the NE.$\frac{1}{4}$ sec. 19, T.43 N.,R.9 E., McHenry County. Like variation in size is shown in the material throughout the entire moraine.

The following pebble-count gives the relative proportions of different kinds of rock in the coarse material, composed of 20 per cent sand, 30 per cent gravel, and 50 per cent oversize, found in the gravel pit mentioned above. One inch pebbles were used and the determinations made with acid.

	Per cent
Dolomite) Limestone)	93
Diorite	2
Granite	2
Basalt	1
Quartzite	1
Chert	1

The stones are predominantly rounded and appear water-worn. Dozens of the coarse-grained igneous rocks are so weathered that they crumble under the pick.

In another pit three miles southwest of Barrington, located in the NE.$\frac{1}{4}$ sec. 16, T.42 N., R.9 E., the material of a kame, composed of 60 per cent sand, 20 per cent gravel, 10 per cent cobbles, and 10 per cent boulders, shows the following composition:

	Per cent
Limestone) Dolomite)	94
Diorite	2
Chert	1
Sandstone	1
Ironstone	1

A boulder count taken along the north-south road a mile north of Cary shows a preponderance of foreign material, but also a larger percentage of local boulders than is to be found in the West Chicago moraine.

Table 4

Boulder count. Cary member.

Along north-south road, sec. 1, T.43 N., R. 8 E.

Kind of rock	Number of boulders of various sizes 1 foot	2 feet	3 feet	4 feet	Total number of boulders
Diorite	34	47	17	3	101
Granite	22	16	7	0	45
Basalt	5	4	3	0	12
Gneiss	0	4	1	0	5
Schist	1				1
Rhyolite-porphyry		1			1
Limestone and dolomite	9	5	2	0	16
Quartzite	1				1
Sandstone			1		1
Grand total					183

(B) The main Barrington Moraine

Location. The main part of the Barrington moraine in the northern half of the area extends from the Fox River and Flynn Creek lowland to the eastern margin of the sheet, while in the southern half it stretches from the Spring Creek lowland to the latitude of Palatine, a width of 5 to 6 miles.

Topography. The topography of this moraine may best be typified as being massive (Fig. 31). It is composed of large hills of drift - large for glacial topography. Several of these hills rise 80 to 90 feet above their surroundings, while many of them exceed 50 feet. They are exceedingly irregular in size and shape, but commonly have gently rounded summits. Slopes are likewise very irregular, some as steep as the material will stand, while others are comparatively gentle. There are two notably rough patches; one in the neighborhood of Honey Lake north of Barrington, and the other in the Cook County Forest Preserve between Barrington and Palatine (Fig. 32). Numerous depressions, either roundish, irregular, or elongate dot the surface of the moraine, in the bottom of most of which peat and muck have accumulated, though in several of them small lakes are to be found. Diamond Lake and Lake Zurich, each almost a mile across, occupy shallow depressions in the moraine. Honey Lake, Grassy Lake, Goose Lake, and numerous smaller unnamed ones are of the same character.

Composition. The material as exposed at the surface, in shallow cuts, and in auger borings is the typical brownish-buff to drab-buff till so widely seen in the Valparaiso system. It is characteristically a fairly dense boulder clay, though small deposits of gravel are seen here and there, either at the surface or as lenses or pockets within the body of the till. In the Forest Preserve, 3 miles east of Barrington (SE.¼ sec. 4, T.42 N., R.10 E.) a 20 foot bank shows till, oxidized to buff color, to a depth of 15 to 18 feet, below which the till is bluish-gray in color. Few boulders and relatively few stones occur in the drift below the surface, for a count of the stones and pebbles revealed only 15 to 20 per square foot on the surface of the exposure. The pebbles are markedly angular and many are striated. The till in the oxidized part commonly breaks into angular fragments, when it is dry, while that in the unoxidized portion is entirely massive in structure. Well-records show that the blanket of till varies from 50 to 100 feet in thickness and commonly lies on sand and gravel. In the neighborhood of Lake Zurich there appears to be a large and thick deposit of sand below the surface layer of till. Specimens of coniferous wood were found in this sand at a depth of 225 feet at the Vickery Kennels, half a mile south of Honey Lake, suggesting an interglacial origin for this sand formation.

The composition of the pebbles composing the till is seen from the following pebble-counts:

Pebble-counts from the Barrington moraine

Till. Sec. 24, T.43 N., R.9 E. Cuba Twp. Bar. quad.

	Per cent
Limestone) Dolomite)	86
Basalt	4
Sandstone	2
Shale	2
Diorite	1
Felsite	1
Granite	1
Chert	1
Rhyolite	1
Graywacke	1

A similar count from a gravel pit 2 miles north, in SE.$\frac{1}{4}$ sec. 2, T. 43 N., R. 9 E., is as follows: Cuba Twp, Bar. quad.

	Per cent
Limestone) Dolomite)	91
Basalt	3
Granite	3
Chert	1
Sandstone	1
Diorite	1

A pebble-count in the till 2 miles southeast of Barrington in NW. ¼ sec.8, T.42 N.,R. 10 E., Cook County, gives the following results:

	Per cent
Dolomite	50
Chert	18
Granite	8
Basalt	7
Sandstone	6
Gneiss	2
Graywacke	2
Greenstone	2
Quartzite	2
Diorite	1
Syenite	1
Quartz	1

A deposit of lacustrine material in the moraine is seen in the north central part of Cuba Township in Lake County, in NE.¼ sec. 3, T.43 N., R.9 E., where the highway is cut through a small steep-sided knoll. On the north side of the cut the section shows about a foot of soil underlain by about 2 feet of leached buff till, below which is exposed 6 to 9 feet of light buff laminated sand and silty clay. These laminae are almost horizontal, undulating only slightly. In the laminated material are small pockets of gravel and till, under several of which the laminae bend downward, suggesting the deposition of the gravel and till while frozen in ice blocks. The layers vary in thickness from paper-thin up to 5 inches. Many of the thicker layers are made of very fat, smooth and sticky, gray-buff clay, and break into little angular bits. The deposit is evidently lacustrian in origin. On the south side of the road the laminated material is not so thick or continuous, and till is present not only at the top but at various places in the cut. Probably the deposit was formed either near the edge of the ice in a peculiarly quiet pool into which sediment was washed very quietly and probably slowly, or was made in a local basin on top of the ice. Such superglacial basins, occupied by lakes at times of melting and showing lacustrine sedimentation, are not uncommon in the Antarctic glacier today.

Another, but larger, area of lacustrine clay is found 5 miles SSW of Barrington (sec. 34, T.42 N., R.8 E.). Here close to a square mile is covered with fine, fat clay and silt, which in several borings contained no pebbles. The surface looks almost flat to the eye, with broad swells only 5 or 6 feet high. No boulders or stones are seen on the surface. A well (center, SW.¼, sec. 34, T.42 N., R.9 E.) reports 40 feet of "water" clay over 10 feet of gravel and 150 feet of "hardpan". Three auger borings illustrate the character of the material.

<u>NW.¼, SE.¼, sec.34, T.42 N., R.9 E.</u>

	Thickness Ft.	In.
Soil, dark buff brown loam		6
Leached clay loam	1	6
Buff, drab, mottled, calcareous clay, very fat, 3 small lime concretions about 7 feet from the surface. No grit.	8	8

SE.$\frac{1}{4}$,SW.$\frac{1}{4}$,sec.34, T.42 N.,R.9 E.

	Thickness Ft.	In.
Very dark clay loam soil	1	6
Buff drab clay	6	
Fine sand, buff at top,grayish at bottom	2	
Bluish gray, fat clay	1	

NE.$\frac{1}{4}$,NE.$\frac{1}{4}$,sec. 33,T.42 N., R.9 E.

Soil	1	6
Fine sand with pebbles at bottom	2	6

A third area of lacustrine clay is found in secs. 24,25 (T.41N.,R.9E.) and secs 19,30, (T.41N.,R.10E.) It is roundish in shape and about ½ mile across.

Beside the Higgins Road along the southern edge of this area, as elsewhere, till is exposed in numerous cuts. The areas may consequently be interpreted as lacustrine material deposited under conditions where the waters were quiet, and the sediment was fine enough to allow the smooth clay to be laid down to a thickness of 40 feet in one place. An interesting exposure beside the road 3 miles southwest of Palatine in SW.$\frac{1}{4}$ sec. 32, T.42 N., R.10 E. shows 8 inches of soil over 1 foot 2 inches of much weathered and leached till, below which is 2 feet 6 inches of calcareous gray clayey till. When dry, this till breaks up into chunks several inches in diameter with flat faces and sharp angles. Scattered patches of pinkish till occur, the color probably being due to alteration locally. It is possible that the ice riding over "pink" Bloomington till may have picked up some of this earlier till. But the "pink" color here grades so gradually into the surrounding till as to render this suggestion unlikely. Small fragments of shale are common in this exposure.

In the southwest corner of the same section the following material occurs:

	Thickness Ft.	In.
Soil, buff clay loam		6
Light buff weathered gravel	$1\frac{1}{2}$ - 2	
Gravel	6	

The gravel is peculiar for it is composed of approximately 50 per cent shale that is so rotten it crumbles in the fingers. When the pit was opened the gravel was saturated with water, issuing at the base of the hill in 9 springs. It was necessary to tile the pit for drainage before excavation could proceed. This may well be part of the water-bearing stratum of the Palatine district to be discussed later.

Boulders are rather sparsely distributed over the surface of the moraine, averaging probably not more than a dozen per square mile, though there are places, such as that south of Honey Lake, where they are fairly numerous. However, the largest boulder seen in the region lies on this moraine in section 3, Cuba Township. It is a big block of Niagaran limestone measuring 10 x 8 x 3 feet exposed (Fig. 35). The vast majority of the surface boulders are composed of rock foreign to the region, such as diorite, granite, or rhyolite.

Gravel is to be seen at the surface in many small and widely scattered places. Examples may be cited as: SW.$\frac{1}{4}$ sec. 33, T.44 N., R.10 E., Lake County, SE.$\frac{1}{4}$, sec. 17, SW.$\frac{1}{4}$, sec. 32, T.42 N., R.10 E., Cook County, and at several places along Poplar Creek in eastern Hanover Township. The Flynn Creek lowland, extending from Barrington northwestward to the Fox River, contains a considerable amount of gravel. There are three kame areas, two small ones along the creek in sec. 22, T.43 N., R.9E., and one large one near the mouth of the creek in sections 9 and 16 of the same township. The two southern areas show typical kame-and-kettle topography, while the northern and largest one has a large gently rounded crest covered with gravel and gravel exposed to view in two gravel pits. In addition to the kame areas , there are small patches of thin gravel along the creek in several places. Near Flynn Creek School, in northern part of section 15 (T.43 N.,R. 9 E.) a well is 65 feet deep said to be mostly in gravel, but southward for a mile the eastern bank of the stream is seen to be made of gravel only a few feet thick and horizontally bedded. It is evidently outwash material deposited during the recession of the ice. In section 27 of the same township, four gravel pits have opened to view horizontally bedded sands and gravels of the same general character. Along the eastern margin of the Flynn Creek lowland, as in sections 2, 14, and 23, local deposits of sand and gravel are to be seen here and there. They have relatively small areal extent and, in all probability, small thickness, though no data were available on this latter point.] Some of this gravel belongs to the kames and other morainic deposits, & some is outwash. The Flynn Cr. lowland contains a consid. amt of gr. of both types.

Palatine Member

Location. The Palatine member is a low, rather indistinct ridge, with a north-south trend, lying about two miles west of the eastern margin of the quadrangle. It is fairly well developed in the southeastern part of the area, but merges with the main moraine about two miles north of Palatine. To the South it continues as a [more] conspicuous morainal ridge southward across the Wheaton quadrangle, through Lombard and Downers Grove, forming the east side of the valley of the east branch of Dupage River. In the Bos't quad Its western side slopes gently to a north-south depression occupied by small streams which cross the ridge in narrow post-glacial valleys to join Salt Creek. Its western side slopes gently to the flat bottom of Salt Creek valley.

Width. At no place is the morainic ridge more than two miles in width, while in places it narrows to a half mile.

Topography. The hills are rarely more than 30 feet high and the depressions are correspondingly shallow, thus presenting a very gentle topography. It supports only one kame and that lies a mile from the southern border of the quadrangle, in the center of sec. 25, T.41 N., R.10 E., Cook County. This kame is about half a mile long by a quarter of a mile wide, and exhibits both a characteristic kame-like topography and also a typical kame-like composition of sand and gravel below the surface. ~~(Fig. 24).~~

Composition. Where the stream crosses the moraine in the southeastern part of Palatine Township several good exposures of the material are seen. In one of these $12\frac{1}{2}$ feet of buff oxidized till overlies 4 feet of blue-drab clay till. Along certain cracks, the oxidation penetrates this lower bluish till for several feet. Elsewhere the till of this moraine is the typical brownish buff color. It is leached commonly to a depth of about $2\frac{1}{2}$ feet. Boulders are scarce upon its surface. An exceptional feature of the material in the kame in SW.$\frac{1}{4}$ sec. 25, T.41 N., R.10 E., Cook County, is the large amount of shale present. From a pebble count and an estimate of the material throughout the whole kame, shale makes up almost 50 per cent of the drift. Commonly the particles are small and flat weathered to gray on the surface, but dark greenish brown to black on fresh surfaces. So soft is this material that when moistened and ground up in the palm of the hand it makes a coherent sticky ball.

The elongate lowland area west of the Palatine member, i.e. between it and the main Barrington moraine, continues southward from Palatine to the southern margin of the quadrangle, and thence southward across the Wheaton Quadrangle through Meacham, to form the valley of the east branch of Dupage River. Within the Barrington Quadrangle it is largely floored with till, though there are considerable patches of fine outwash gravel and sand, evidently deposited during the local stand of the ice margin. One of these areas of outwash extends southward from Palatine for three miles, while another fills the bottom of the depression from the Higgins Road to the south edge of the quadrangle, a distance of 3 miles.

One gravel pit a mile south of Palatine (NW.¼, SE.¼, sec. 22, T.42 N., R.10 E.), Cook County, will serve to give an idea of the character of the outwash material. Three or four feet of gravel is exposed on the side of a low hill. The pebbles are typically very small in size (rarely over half an inch in diameter), commonly angular, and an estimate shows about 5 per cent of them to be striated. There is much clay in the deposit. The bedding dips slightly to the south. Several boulders of limestone and granite lie on the bottom of the pit. A pebble count of ¼ inch size shows a remarkably large percentage of shale.

	Per cent
Limestone) Dolomite)	60
Shale	25
Chert	8
Quartz	3
Rhyolite	2
Granite	1
Basalt	1

In another gravel pit 1½ miles farther south on the crest of a hill beside the stream, the material is small fine gravel and coarse sand. It is well stratified, dipping southwest, and contains a notable amount of flat shale pebbles averaging about one-fourth inch in size. The presence of so much shale and clay in the outwash makes it poor for concrete work. Consequently the gravel is used only for local purposes ~~on dirt roads.~~ such as road metal.

Barg. Outwash

(3) Arlington Heights moraine

Location. The Arlington Heights moraine lies for the most part east of the Barrington quadrangle, though only the western slope of its western slope lies within the area, in secs. 17 and 20, T.41 N., R.11 E., and secs. 6, 7, and 18, and 20, T.42 N., R.11 E., Wheeling. This moraine is seen to form a distinct ridge on the west side of Desplaines River in the Waukegan Quadrangle. Thence it passes southward through Libertyville, Long Grove, and Arlington Heights, forming the eastern side of Salt Creek valley almost to the Desplaines River sag. Stream courses trend north and south along its western margin, i.e. in the depression between it and the Barrington moraine, save where they cross eastward through it, to the Desplaines River, in narrow, young, post-glacial valleys. Such streams are Indian Creek, Buffalo Creek, and Salt Creek.

Size. This moraine ranges from one to two miles in width, & rises from Further study in regions to the east and south may show that a wider tract may belong to this moraine. The crest areas along the moraine rise commonly 50 to 60 feet above the lowland on the west and the lower rolling country on the east.

Topography. The topography of the moraine is not very striking. Subdued slopes, low hills, and gentle undrained depressions are the characteristic features. However, along the eastern margin of the

a few sharp kames 20 to 25 feet in height are present. One of these appears in Sec. 6 of Wheeling Twp on the Bar quad.

Barrington Quadrangle in section 6, T.42N., R.11 E, is seen a steep little kame. Two others lie in the same section just beyond the quadrangle in the Wheeling map. They rise 20 to 25 feet above their surroundings. The northern one of the three has been excavated for gravel.

Composition. The material of the moraine is largely clayey till, though the few kames are composed of gravel. A well on the moraine along the Higgins Road near the east margin of the Barrington Quadrangle (NE.$\frac{1}{4}$, SE.$\frac{1}{4}$, sec. 20, T.41 N., R.11 E.) in Elk Gr. map shows 20 feet of till over 40 feet of gravel, with till at the bottom.

Valparaiso intermorainic areas.

Included in the Valparaiso system within the Barrington area are two conspicuous north-south lowland tracts or intermorainic areas. They serve to separate the three moraines of the system.

Cary - Spring Creek. From the vicinity of Cary southward through the valley of Spring Creek, part of Poplar Creek with its southern tributary, to the south margin of the quadrangle, lies an intermorainic lowland area. Cary is situated in the northern part of this intermorainic area at an altitude of 760 feet. Fine gravel is seen at the surface, but the town well shows blue till at a depth of only 22 feet (see appendix). Since the Marseilles gravel formation is found to the east below the Cary member at a higher elevation than Cary, it is inferred that this area was reduced somewhat by glacial waters prior to the invasion of West Chicago ice (Fig. 36). Subsequently it has been modified by glacial waters flowing south along the margin of the Cary ice, grading the surface to its present expression.

~~Spring Creek.~~ The depression occupied by Spring Creek is an intermorainic tract lying between the Cary member and the West Chicago moraine. It varies from one to two miles in width and is about 7 miles long. It is constricted at the northern end by a part of the Cary member which almost blocks it. Fig 37. In fact, there may have been a small lake in the northern part of this depression, dammed by morainic material, through which Spring Creek has cut a small post-glacial valley. Such cutting, however, was not more than 8 or 10 feet deep, and since no important lacustrian deposit is found by auger borings in the bottom of the Spring Creek valley depression, where such a lake might have stood, the inference is that if a lake existed it was very shallow and short-lived. There is present the embankment of a small artificial dam, extending from the eastern side half way across the outlet. If ever completed, this dam has long since been abandoned. But the pit from which material was excavated for the embankment, while badly slumped, still shows fine gravel. A nearby small gravel pit exposes similar fine gravel with horizontal bedding. Near the creek, just upstream from the old embankment, appear ledges of cemented gravel 10 feet above water-level. This cemented gravel is of medium size not unlike the cemented Marseilles gravel along Poplar Creek. Above this cemented gravel, digging uncovers a layer of fine calcareous silt, suggestive of lake deposition.

Fig 37

This Spring Creek lowland has three striking tributaries from the west which appear to have had the same general history. They are each wide, flat-bottomed, steep-walled, and blunt-nosed. In each the lower part of the walls is composed for the most part of Marseilles gravel, while the upper part is made of West Chicago till. At the western end of the northern tributary, west of Spring Lake, an eskerine tract extends from the bottom of the valley up the western end and over the crest of the West Chicago moraine. Being formed, as it was, by West Chicago sub-glacial drainage it shows that this depression was in existence before West Chicago time. Similar evidence is present in the middle of the three tributaries. At its western end three kame-like areas are found, while a well-defined glacial drainage-line leads off to the southwest. The southern of the three tributaries likewise has kames at its western end and a drainage-line leading westward to Fox Valley. It seems evident, therefore, that the whole Spring Creek lowland was present at the time of the West Chicago ice invasion. Two possibilities for its origin present themselves. (a) The western side of the depression was the ice-contact face of the Marseilles gravel formation, i.e., the withdrawn Marseilles ice stood here while the Marseilles gravel was deposited westward. But it seems unlikely that such a stand of the ice would not have built a moraine instead of leaving a depression in the site of Spring Creek. Stagnant ice-blocks or elongate ice-masses might have been present, over and around which outwash was deposited, so that the depression would be left when such blocks finally melted. But again this assumption stretches the credulity, for it seems unlikely that so long and narrow an ice-mass would have been left parallel to the retreating ice edge. Furthermore, an extensive gravel and sand formation, most plausibly referred to the Marseilles gravel formation, is seen in well-records to lie below the Cary member on the east side of the Spring Creek valley in its northern part. (b) The valley was excavated by Spring Creek at the same time the Fox River valley was cut (i.e., was a tributary valley to the larger one), in post-Marseilles and pre-West Chicago time. In overriding such a valley, cut by stream erosion to more or less dendritic shape, the West Chicago ice could well have rounded it out and modified its western side to produce the topography seen today, while deposition of Cary and Barrington drift could easily have moulded its eastern side into the present topography. Whether erosion was great enough during the erosion period to allow so large a valley to be excavated without the aid of a large quantity of water, as from a glacial lake, is a matter of concern. While the present gradient of the valley, ten feet per mile, is enough to promote vigorous erosion, there is no valley of this size, so far as the writer knows, which has been cut even in post-glacial time by so small a stream as this one, and the erosion interval here discussed was certainly vastly shorter than post-glacial time. It therefore seems most plausible to consider the Spring Creek valley as having been formed partly by ice-blocks, giving rise to depressions and partly by stream erosion during the erosional interval having enlarged and connected these depressions into a valley.

Between the headwaters of Spring Creek and the mid-course of Poplar Creek extends a depression two miles long and $\frac{1}{4}$ to $\frac{1}{2}$ mile wide. It not only separates the West Chicago from the Barrington moraine, but seems to have been a passageway for glacial waters. Likewise from Poplar

Creek southeastward to the southern edge of the map, another glacially constructed depression between the two moraines seems to have been a drainage line for glacial waters during the Barrington stand. The present course of Poplar Creek seems not to have been opened during Cary time, for in the lower part of Poplar Creek valley, in southeastern Elgin, Cary outwash coming down the Fox Valley built a delta into the Poplar Creek valley with the bedding dipping eastward, i.e. up Poplar Valley. Consequently glacial waters of the Barrington stand, when the ice was most extended, flowed southward east of the kame (SW.$\frac{1}{4}$, sec. 16, T.41 N., R.9 E.) and thence either through the col in the West Chicago moraine (altitude 795 feet) in the northwestern part of section 27, T.41 N., R.9 E., and thence to the Fox River, or through the pass in section 35 (T.41 N., R.9 E.) and into the west branch of Dupage River. Since the altitude of this latter pass is also 795 feet, it is likely that both drainage lines were used at least part of the time. Poplar Creek valley through the West Chicago moraine seems to have been cut in late Cary time and graded to the level of Cary outwash in the Fox Valley.

Salt Creek. Between the Palatine member and the Arlington Heights moraine lies the valley of Salt Creek. This valley is a broad, flat, intermorainic tract composed largely of till though outwash gravel and sand are found in small patches here and there. The largest area of this material is seen in the southern part of sections 19 and 20, and northern 29 and 30, T.41 N.,R.11 E. One well in this area reports 50 feet of gravel, though probably the average is much less than this.

Valparaiso Outwash

During the various stands of the Valapraiso ice, gravel and sand were deposited as outwash beyond its edge. Near the ice-edge the material commonly was coarse, while farther away it was fine.

West Chicago outwash. During the West Chicago stand, glacial waters flowed westward and southwestward into Fox River valley, depositing the surface material of the gravel plain along the southwestern margin of the quadrangle. In the Fox River valley beyond the limits of the quadrangle, these waters deposited material to form a valley train, now seen as terraces along the valley sides. During the late stages of the West Chicago stand the glacial waters, due to increased volume or lessened load, eroded into the newly deposited outwash trenching it to a considerable extent. Fox River at this time was also an eroding stream,for the West Chicago valley train was trenched probably to at least the depth of the present valley.

Cary outwash. In the valley of Fox River below Algonquin, outwash terraces are found intermediate in altitude between those of West Chicago outwash and those low (Fox Lake) ones to be discussed later. This intermediate outwash lies unconformably against the eroded West Chicago features, and so represents an episode of deposition following the trenching of the West Chicago gravels and prior to the deposition of the low or Fox Lake outwash. It is inferred that this intermediate outwash came from ice standing in the position of the Cary member. In fact the differentiation of the Cary member as a distinct moraine, and the consideration of its formation as a distinct episode in the history of the region, is a to a considerable extent based on this line of evidence.

The outwash associated with the Cary stand presents a difficult and puzzling problem. From the town of Cary south to the river and thence west for a mile, lies the strange bit of topography previously described. The hills, composed of horizontally stratified gravel, are interspaced with depressions, many of which are undrained, which seem to have been formed by sub-glacial waters. No other explanation will account for their distribution, arrangement, and shape. If this topography could have been made by sub-aerial waters, this deposit of gravel would most easily be explained as Cary outwash. But, as was suggested in the discussion of the West Chicago moraine, the only tenable hypothesis is that they are features eroded from Marseilles gravel by sub-glacial waters of the West Chicago stand, i.e., glacially modified outwash gravel. This suggestion, however, leaves an additional problem. In the Fox River valley below Algonquin appear the intermediate terraces of sand and gravel; the eroded remnants of a valley train formed during Cary time. Furthermore, between Cary and Algonquin the West Chicago morainal topography descends the slopes of the valley to a level well below the upper level of this Cary valley train. The problem thus presents itself of transporting Cary outwash from the Cary moraine to Algonquin without leaving recognizable remnants. Furthermore, the bottom of Spring Creek valley is lower than the projected Cary Valley train, and so should have received outwash and been filled to this 800 foot level. It may be urged that the morainal drift down at the mouth of this valley may have effectively blocked the incursion of outwash. But the dam rises only to an altitude of 770 to 775 feet, and is therefore not high enough to perform the duty.

At the west base of the Cary member, one mile east of Cary, the steep bluff of the river shows 30 feet of very coarse gravel above 30 feet of lacustrine or slack-water sand on 20 feet of gravel. The upper coarse gravel is evidently Cary outwash deposited near the ice-edge. The lacustrine or slack-water sands, which rise to an elevation of 800 feet, were evidently deposited upstream from some obstruction. The West Chicago valley train, or ice blocks in the lower part of the valley upstream from Algonquin, may have furnished such an obstruction.

The hypotheses which present themselves to explain the virtual absence of Cary outwash in this part of the quadrangle, while it is abundant farther down the river, are: (1) that ice blocks may have been present in this part of the valley, stranded from the West Chicago stand; (2) that glacial waters passed through this part of the valley with such volume and strength that little or no deposition took place; and (3) that Cary waters were underloaded with sediment as they started their journey, acquired a load on the way to Algonquin, and deposited it farther south. Since the depressions have more elongate shapes than those commonly have which are left by the melting out of ice blocks, this first hypothesis seems less likely than one of the others. There are some objections to unreserved acceptance of either the second or the third hypothesis, so that the problem in its details still remains an open one.

~~Spring Creek.~~ The depression occupied by Spring Creek is floored very largely with gravel and sand. From the Cary member on the east down to the bottom of the depression lies an extensive gravel formation. It is in most places too irregular in topography to be called a typical outwash plain, but the stratification, in many places dipping toward the west, shows that it was deposited by waters issuing from an ice front to the east. The presence of kame-like hills on its surface, suggests that it was deposited, partly at least, as the ice was retreating from this area. The bottom of the depression, where not covered with peat and muck, as well as the west side, shows also abundant gravel not only at the surface but in well records.

~~Salt Creek~~. In the valley of Salt Creek, there are several areas of sand and gravel, one near the southeast corner of the quadrangle, one in the northern part of Elk Grove Township, and a third a mile east of Palatine. In none of these places, however, is the outwash material large enough in area to form a topographic feature. It appears rather to be local deposits made in the complex conditions of the ice retreat. Again the large amount of shale, and the small size of the pebbles, are the two striking features of the deposits.

Fox Lake terrace. In the Fox Valley above the Cary moraine there are patches of low terraces standing 8 to 10 feet above the flood plain of the river, or between 740 and 745 feet in altitude. There is one large area of this terrace level on the east side of the river near the northern boundary of the sheet, and several smaller ones on the west side. In the region of Fox Lake, farther north, there are considerable areas of this terrace. Silt, sand, and small gravel commonly make up the material. These sediments as a rule ~~being~~ are stratified. These terraces were doubtless deposited as outwash by a huge glacial stream of low gradient from the Valparaiso ice after ~~it~~ the latter had retreated from the Cary stand.

At the Goldfish ponds 2 miles north-northeast of Cary (SW.$\frac{1}{4}$, SE.$\frac{1}{4}$, T.44 N., R.8 E.), McHenry County, excavations and auger borings show laminated marl and silt as follows:

		Feet
Peaty loam	....	1½
Light brown greenish clay marl	......	1
Light buff marly clay, laminated	......	8

Throughout the section large numbers of gastropod and pelecypod shells are found. In fact, some of the marl appears to be made up largely of fragments of these small shells. These deposits suggest the existence of a lake over the area, dammed by the Cary moraine and its valley train. But since the lake deposits are so limited in extent, it is unlikely that the lake was long-lived or a very important element in the geologic history of the region.

Resumé of the Pleistocene history of the Barrington Quadrangle.

After the close of the marine sedimentation of the Paleozoic and the long erosion of the Mesozoic and Tertiary, the Pleistocene epoch was inaugurated by a climatic change which brought on widespread continental glaciation. In North America the ice-sheets, radiating from centers in Canada, invaded the United States five times. After each invasion the climate so ameliorated that the glaciers were melted off and temperate climates persisted through the interglacial intervals. Of the five glacial invasions, two are known to have entered the Barrington Quadrangle. These two are the Illinoian and the Wisconsin. Since pre-Illinoian drift has been found north, west, and south of this area [1], it seems inevitable that pre-Illinoian ice must have crossed the area of the quadrangle. But no evidence has come to light to show the

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1/ Cady, G.H., Geology and mineral resources of the Hennepin and La Salle quadrangles: Illinois State Geol.Survey Bull. 37,pp.70-72, 1919. Leverett, Frank, The Illinois glacial lobe: U.S. Geol. Survey Mon.38, 38, pp. 105-118, 1899.

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presence within its boundaries of pre-Illinoian drift. It may be that more accurate well-records might show such drift to be present.

Illinoian invasion

From well-records and the exposure southwest of the quadrangle, it is known that Illinoian ice invaded the region and spread a mantle of drift over it.

Sangamon interval

The Illinoian drift was deeply weathered during this interglacial interval. Evidence in the Elburn exposure shows, by the presence of over two feet of gumbotil, that the period was very much longer than all post-glacial time. Evidence in this same exposure shows that late in the Sangamon interval there was an episode of loess deposition during which several feet of wind-blown material was spread over the district. This loess in turn was weathered so that it was leached of its original calcium carbonate content. In certain other parts of the state, where this loess sheet is thick, its lower part is still calcareous.

Iowan invasion

The Iowan ice did not invade this area.

Peorian interval

During the early part of Peorian time a second sheet of loess was deposited over the district. It in turn was somewhat weathered prior to Wisconsin time.

Wisconsin invasion

Early Wisconsin. Bloomington ice crossed the quadrangle from east to west, mantling it with the "pinkish" till seen at the surface in Poplar Creek valley and reported in many well-logs. Bloomington ice must have receded to a considerable distance, for when the Marseilles ice invaded the region it seems to have come from a somewhat different direction as the drift which it deposited is strikingly different in color from that left by the Bloomington. After depositing a sheet of till and the marginal moraines, the Marseilles ice retreated. During the retreat a great outwash plain of sand and gravel was formed. This gravel deposit buried the newly deposited Marseilles till, filling up such depressions as may have existed to form a fairly level plain marked by gentle drainage lines. One such depression thus filled seems to have been the present valley of Fox River south of Cary; for here the Marseilles gravel is seen to extend lower in altitude than the top of the Marseilles till in the nearby valley slopes. This gravel formation was deposited as far east as the west side of Spring Creek valley, Ski Hill, and the west side of the Fox River valley to the north border of the quadrangle.

Erosion interval. After the deposition of the Marseilles gravel formation there followed an interval of erosion during which the Fox River valley was cut to at least its present depth and size. This cutting may well have been accomplished by water issuing from a glacially-dammed lake standing to the east of Ski Hill. There is some suggestion of a lake, though the evidence is not conclusive, in the presence of lake sediments overlain by till (NE.$\frac{1}{4}$, NE.$\frac{1}{4}$, sec. 3, T.43 N., R.9 E.). During the period of cutting there was an early stage during which water flowed not only through the main valley past Ski Hill, but also south along the depression where Cary now is situated. Both trenches were graded to the same level. A later stage witnessed the ascendancy of the Fox River in cutting down its channel, the lowering of the lake, and the abandonment of the Cary channel.

Middle Wisconsin. The first invasion of Middle Wisconsin time was that of the Minooka. It crossed the newly excavated Fox Valley just north of Elgin, and the end of its recognizable moraine is to be seen near the middle of the western margin of the quadrangle. The ice-sheet then seems to have retreated somewhat and to have re-arranged its margin, for the next ice-stand, which gave rise to the West Chicago moraine, was less extended (i.e., rested farther east) in the southern part of the quadrangle and more extended in the northern part. It crosses the older stand about the middle of the western side of the area. This West Chicago invasion overrode and modified in notable manner the Marseilles gravel. It likewise deposited typical morainal features down into the Fox Valley, and built a valley train in its bottom. From this stand an outwash plain was spread in the southwestern part of the quadrangle. The Cary trench was modified by the action of sub-glacial waters and by deposition of glacial features in some places. Sub-glacial waters likewise modified and moulded the Marseilles gravel along the north side of the Fox Valley near Cary into the peculiar topography seen there today.

The ice then was melted back from the West Chicago stand. In melting back large volumes of water were produced, which trenched the West Chicago outwash plain and valley train. The lower part of Poplar Creek valley shows an upper level of West Chicago outwash, an intermediate terrace level of degraded West Chicago gravel, and a lower terrace made of Cary outwash gravel with bedding dipping eastward, showing that the West Chicago outwash was trenched to at least the level of present drainage before Cary time.

During the Cary-member ice-stand the moraine was built east of Cary and east of Spring Creek valley. Outwash gravels were washed into the Cary trench to modify and obscure such West Chicago morainal features as had been present. Sub-glacial waters issued through the Fox River valley north of Ski Hill and through the glacial drainage line south of Fox River Grove. They swept tumultuously down the Fox Valley, sweeping away the morainal knolls of the West Chicago moraine up to an altitude of 760 to 770 feet; and only beyond Algonquin had their rush so diminished that they deposited bars, deltas, etc. along the sides of the valley. Less water seems to have issued from the ice-front in the southern half of the quadrangle, and this was carried off in the drainage-line to the south. Just when Poplar Creek established its present course across the West Chicago moraine is not known, but it was clearly after Cary time and may well have been when large amounts of water were produced in the melting back from the main Barrington stand.

The main Barrington moraine represents a long stand or time of gradual fluctuation of the ice margin back and forth across the central part of the area. The relatively small amount of outwash material suggests slow melting under quiet and rather uniform conditions. Uniform recession took place across the northern half of the quadrangle, while a minor ice-stand south from Palatine gave rise to the Palatine member.

After withdrawal beyond the eastern edge of the quadrangle, with the deposition of considerable gravel in the Salt Creek valley, there was a readvance of the ice and the deposition of the Arlington Heights moraine.

CHAPTER VI. POST-GLACIAL CHANGES

<u>Weathering</u>. Weathering is the unobtrusive process by which rock is caused to crumble and decay. It may be either (a) physical or (b) chemical. (a) When the sun shines, the surface of the rock is heated; but since rock is a poor conductor of heat, only the outer portion is heated. At night, the outer portion cools off more than the inside. Hence the outer part of rocks exposed to the sun expands and contracts, while the inside does not. This process gradually loosens parts of the surface which scale off. Rocks in this way gradually crumble. Also, where there is a crack, water will freeze and wedge the crack wider and wider till the rock is split. Roots of plants may do the same thing by growing into cracks and wedging them apart.

(b) The three gases of the atmosphere, oxygen, carbon dioxide, and water vapor, slowly unite with the minerals of the rocks to cause them to crumble. The union of oxygen with another substance is called oxidation. A familiar example of this is seen in the rusting of iron. In this case the oxygen of the air combines with the iron, in the presence of moisture, to form the brown iron oxide, rust. The union of carbon dioxide with other substances is called carbonation. When this gas is dissolved in water, a very weak acid called carbonic acid is formed, which, however, in the course of time, is effective in the solution of rocks which otherwise would be practically insoluble. The leaching, transportation, and deposition of lime is accomplished in the presence of this acid. Union of the water of the atmosphere with other substances is called hydration. This process of chemical disintegration, combined with the action of plants which produce humus, makes soil. 1/ In the Barrington Quadrangle, the soil varies from a few inches to several feet in thickness, averaging about

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1/ See University of Illinois Agricultural Experiment Station Soil Reports on Cook, Kane, McHenry, and Lake Counties.

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a foot and a half. On flat upland areas where running water has neither added nor taken away material, to any measurable extent, auger borings and excavations show that the process of leaching has removed the calcareous content of the till to a depth ranging from 2½ to 2-3/4 feet. It is the process of weathering that prepares rock for transportation by wind and running water.

Erosion. Prior to the covering of the region by vegetation, wind was probably effective in picking up and blowing about the loose material of the surface of the drift. This material was drifted by the wind and piled in protected places, for here and there loess-like material is found below the soil and above the drift. Also, some of the soil itself is loessial in character. But since vegetation has protected the underlying material, wind work has not been noticeable.

When rain falls on a slope, part of it soaks into the ground to form subsurface water, part of it evaporates, and a third part runs down the slope as run-off. This run-off, if the slope is uniform, may flow as a sheet which carries away loose material lying on the surface; but more commonly, due to irregularities on the slope, it collects in rivulets and streams, picking up and carrying along small particles of material en route.

Thus small depressions are started. The next rain enlarges the little depressions to form gullies. This process gradually continues, the gullies growing larger and deeper, the bigger ones absorbing the smaller ones adjacent, till in turn ravines and valleys are formed.

Numerous gullies are to be seen in the Barrington Quadrangle. Wherever a slope is left bare to the processes of erosion, gullying begins and, if not stopped, will eventually destroy the land for agricultural purposes by eroding away the soil. It is estimated that the whole Mississippi basin is eroded at the rate of a foot in 3500 years. This estimate means that, since it took roughly 30,000 years to weather the soil, the land is being eroded away ten times as fast as soil is being made; and since so much of this basin is low and flat and consequently not being eroded, it must be that the higher parts are being eroded faster. It appears very clear that unless the soil is conserved by the careful use of cover-crops, the planting of timber on steep slopes, and the adoption of the method of contour plowing, always turning the furrow up-hill, the soil will be gone in a very short time and the country will be a barren waste.

Several valleys within the region have had a somewhat different history. When a depression in the surface of the drift became filled with water, as was true of relatively water-tight ones, the stream flowing through the outlet cut the latter into a valley. In some cases within the quadrangle lakes or ponds have been completely drained. In other cases, glacial drainage inaugurated a valley and post-glacial erosion has only sufficed to enlarge and deepen it. The two narrow valleys across the Palatine member are evidently post-glacial in the portion where they cross the ridge. Most of the valleys within the quadrangle, however, were not produced by stream erosion but are entirely constructional in origin.

Deposition. At the base of steep slopes where the velocity of running water is checked, the sediment carried in suspension is dropped, gradually building an alluvial deposit, commonly in the form of an alluvial fan. Also in the undrained depressions in the moraines, alluvial material collects in places to considerable depths.

A series of borings along Flynn Creek, three quarters of a mile north of Barrington, show that this stream has alternately eroded and deposited in order to make itself a uniform gradient. Such processes of cutting and filling have doubtless modified to a considerable extent the original glacial topography of the region.

Along the walls of Fox River, the west wall of Spring Creek valley in Algonquin township, and both walls of Poplar Creek valley through the West Chicago moraine is a zone of springs, with accompanying swampy vegetation. The accumulation of peat has produced distinct terraces ranging from several feet to several scores of feet in width and two or three times as great in length. Their surfaces are flattish and generally made bumpy by the tramping of cattle. A sample auger boring into one of these terraces reveals their composition.

NE.$\frac{1}{4}$,SE.$\frac{1}{4}$, sec. 24, T.43 N., R. 8 E.

	Thickness Inches
Swampy vegetation	6 - 8
Black peat and muck bearing numerous shells .	24
White sand	2
Black peat	6
Gravelly sand	3
Gravel	6
Peat	1
Till at the bottom	

The peat, sand, gravel and till are all highly calcareous. In fact, the spring water carries so much calcium carbonate in solution, leached from the overlying drift, that it deposits considerable amounts of travertine in many places (Fig. 12).

Walled lake

The northwestern shore of Lake Zurich is hemmed with a low wall or ice-pushed rampart (Fig. 45.). It is 2 to 4 feet high and varies from about 10 to 20 feet in width. It is composed of gravel and sand for the most part, though several cobbles and small boulders were seen on its surface. Its origin is to be found in the pushing of the lake ice as the temperature rises and falls during the winter. After the lake has frozen over, if a very cold spell comes, the ice-blanket will contract, as do all solids when the temperature falls.

and crack open

The ice will then pull away from the shores[, as well as crack open] else-
where. Lake water [thus exposed] promptly freezes, [to] make again a con-

rises into these openings & · ing

tinuous sheet of ice [from shore to shore.] As the "cold snap" passes and the temperature rises, say to 30°F., the ice will expand and crowd up a few feet on the shores. [Having] beach material frozen into its shoreward edges[, the pushing ice will pile this material into the ramparts.] will be pushed up to form a ridge or rampart. Thus was formed the rampart of L. Zurich

CHAPTER VII. ECONOMIC GEOLOGY

Resources of economic significance are relatively few within the Barrington Quadrangle. Of these, the soil is of paramount importance. But since this subject is treated fully in the reports of the University of Illinois Agricultural Experiment Station, and since no detailed study of it was made in this present investigation, it is treated here only in a summary fashion. Sand and gravel for building, ballast, and road metal, and ground water for domestic and municipal supplies, are of major importance. Clay, peat, and moulding sand are at present of possible, though doubtful, value.

Sand and gravel

The Barrington area contains an abundant supply of sand and gravel for local uses, and in the past has furnished material for use outside its confines. The accompanying map is seen to be studded with sand and gravel pits. Most of these were excavated by hand, the material loaded into wagons, hauled a short distance, and used for local purposes of construction or spread upon the roads. Three pits, however, have been developed with mechanical excavators on a considerable scale. The map shows areas of outwash sand and gravel in which numerous pits are located; but it likewise reveals the fact that small pits (now commonly abandoned) are scattered widely over the moraines. This latter fact brings out the point that was made earlier in this report, that small and local deposits of outwash material occur scattered at random over the surface of the moraines. True, they are more common in some districts than in others, but on the Valparaiso moraines within the area small deposits are quite common. However, most of them are of low-grade gravel, for they usually contain enough silty and clayey material to make the majority of them useless for concrete aggregate. Washing will eliminate these impurities, but only in the case of a large deposit close to good transportation could a washing plant be profitably constructed.

Cary pits. Between Cary and Fox River lie the most extensive gravel pits in the quadrangle. From them vast quantities of sand and gravel have been excavated. They now are a mile long and from one-quarter to one-half mile wide. From here came the gravel to ballast the Chicago and Northwestern Railway, and from here have been shipped large quantities of gravel for structural purposes in Chicago. Today the pits are worked only occasionally, as the large production has shifted to the west and northwest of this area. The material of the Cary pit , west of the railway when recent production has been carried on by the Fox River Gravel Company, is medium coarse outwash gravel, horizontally stratified, well-rounded pebbles, and is made up of about 50 to 60 per cent sand. Oversize is present as cobbles and boulders (several, two feet in diameter) to about 10 per cent of the total. There is an overburden of 3 to 8 feet of silt and fine sand.

Excavation is accomplished by two steam shovels working against a 40 foot bank of gravel. The material is washed, screened, and loaded into freight cars. Water for the washing plant is pumped from the Fox River. A pebble count from this pit illustrates the character of the material:

	Per cent
Dolomite) Limestone)	74
Chert	12
Granite	5
Sandstone	4
Basalt	3
Diorite	1
Quartzite	½
Gneiss	½

The Chicago Gravel Company's pit near Spaulding, in the southwest corner of the quadrangle, is likewise a large pit, now not being worked, excavated in the Marseilles gravel and the West Chicago outwash. A large amount of gravel has been taken from this pit in the past, but active operation is now confined to ~~the~~ other pits two miles farther west. The Marseilles esker (SW.¼, SW.¼, sec. 20, T.41 N., R.9 E.) has in the past been excavated along both its northern and its southern slopes in the production of gravel.

Along the valley of Spring Creek, gravel is excavated from deposits on both sides. In section 4 and the eastern part of section 5 of Barrington Township (T.42 N., R.9 E.) six pits are to be seen. So much clayey material is present, however, that only after washing is the product suitable for concrete.[1] In the southwestern part of section 32 (T.43 N., R.9 E.), 4 miles west of Barrington, a pit is now being worked in the contorted gravels of the Marseilles gravel formation. It is a fairly coarse gravel of disturbed stratification. It is excavated by power shovels, screened in rotary trummels, and largely trucked to Barrington. In Fox River Grove several pits supply the local demand. A large kame one quarter of a mile south of the railroad station contains a working pit. The material is coarse gravel, well stratified, with the strata dipping westward at an angle of 20°. At many places in Fox River Grove gravel is seen below 2 to 10 feet of till. Three hundred yards east of the station a pit reveals the following section:

	feet
Till, leached, drab-buff	2
Till, calcareous, drab-buff	2
Sand and gravel, fine, calcareous	10

Along the valley of Flynn Creek there is considerable outwash sand and gravel. It is neither continuous nor very thick, but serves as a supply of gravel for local consumption. Along the Chicago and Northwestern Railway several pits have been opened up, chief among which are those about 2 miles northwest of Barrington (NE.¼,SW.¼, sec. 27, T.43 N., R.9 E.), Lake County. The gravel varies in composition within short distances. One pit is being worked on a 200-foot face, 10 feet high, and producing about 50 per cent torpedo sand. This deposit extends back from the face about 300 feet. About a hundred yards farther southeast the face of another pit shows:

1) Mr. Feank Donlea (SC. SE1/4, Sec. 5, T42N., R9E.) has extracted 10,000 cu. yds. with a power drag scoop, from an oval pit 200X100 ft. with a 30 foot working face. He sold the product at 25 per cu. yd. to the county for road gravel. An estimate indicates 150,000 to 200,000 cu. yds. still avaliable as reserve. Screen tests show the material to be 20-25% sand, 55-60% gravel, and 15% oversize. Oversize is crushed at the pit in an Aurora jaw crusher.

	Feet
Leached soil	1 to 1½
Coarse sand and gravel	1 to 4
Loess-like silt	8

The laminations of this silt are interestingly contorted by ice-shove, as the glacier in its fluctuations pushed against the deposit.

Moulding sand

Moulding sand, used for lining moulds in foundry practice, is a high fusion, relatively pure sand which contains enough clay or clay-like material to make it "bond" or pack firmly and retain its shape in the mould. It is most commonly a sand of fluvio-glacial or eolian origin which has been weathered enough both to free it of such fluxing impurities as lime and ~~enough~~ to produce the bonding materials necessary. In McHenry and Kane Counties there are several pits in operation. 1/

1/ Littlefield, M.S.; Ill. Geol. Survey Bull. 50, 1925.

Within the quadrangle, however, only one locality has been noted. "On the farm of Mr. Henry Louis, 4½ miles southwest of Barrington (NE.¼, SW.¼, sec. 9,T.42 N.,R.9 E.) there is exposed a three-foot layer of excellent sand. Overburden of 3 to 5 feet thick is present, and the distance from a shipping point seems prohibitive of development." 2/

2/ Littlefield, M.S. Ibid, p. 110.

Clay

The till of the Barrington region could be used for common brick making were it not for the presence of so many stones. ~~in it.~~ It might, therefore, be possible to use the stoneless clay in section 34 of Barrington Township for this purpose. It however is a mile from the nearest railroad, is calcareous, and of only moderate thickness. Furthermore, it is so far from a market that exploitation would appear to be uneconomical at present in competition with the brick yards much closer to Chicago.

Water resources

Subsurface water. Water in the ground (ground water) is supplied by rainfall. Part of the water that falls on the land soaks into the pores of the soil and rocks and becomes subsurface water. The amount of this water which enters the ground depends upon various factors: Other things being equal, the steeper the slope the less water will soak in; the less the vegetal covering, the less water will soak in; the less pervious the soil, either from dense texture or from being already full of water, the less will soak in; and the more concentrated the rainfall, as in a cloud burst, the less will soak in; and finally, if the air above is very dry, much water will be evaporated and hence less will soak in. So in order to have the maximum water entering the soil, the conditions should be flat country, heavy vegetation, open and pervious soil not filled with water, gentle rainfall, and moist air.

After the water enters the ground, it seeps downward through the pores till they all become filled with water. There is then a level below which the pores are all filled with water. This level is called the water-table. Above the water-table, the soil is only partially saturated with water, there being moisture adhering to the grains but not enough to fill the pores. The water-table varies in depth with the topography, being deeper from the surface under the hills. It also varies with the seasons, being lower after a long dry spell than after a wet one. The lowest water-table in the driest season is called the permanent water-table. The wells which penetrate below the permanent water-table will not go dry in the dry seasons.

Ground water moves slowly through the pores of the rocks. It soaks outward toward the valleys where it feeds the streams (Fig. 35). It is also extracted from the ground by capillary attraction which draws it up through the minute tubes among the grains of the soil, whence it evaporates from the surface. When soil is plowed after a rain, these tubes are broken and the moisture is forced to stay in the ground to supply the needed water to the roots of plants. The more pervious the rock, the more rapidly will ground water move. Water travels much more rapidly through sand or gravel than it does through clay. Also, the more porous the rock, the more water it contains when saturated. The combination of these factors accounts for the best wells being in gravel and the next best in sand. And a well in clay is "dry" because water enters the hole too slowly for any practical purpose. A well in gravel not only finds more water at first, but as pumping continues, water is distributed more rapidly from the surrounding area than in the case of a well in sand or clay.

Wells. In the Barrington Quadrangle, wells are either in till, sand and gravel, or in bedrock. In the first case the well is likely to supply only a small amount of water, scarcely enough for domestic purposes alone. In the second case, if the sand is very fine (called "quicksand" by many well drillers) again the supply of water is very limited, due to the slow inflow through the fine material. But if the sand is coarse, or if the well is in gravel, then an abundant supply of water is secured. From the consideration of the manner in which the drift was deposited by fluctuating ice-sheets, it is evident that the distribution of sand, gravel and till below the surface is commonly extremely irregular. The constitution of the drift not only varies with depth but also varies from place to place. In some cases this variation is very marked. Two wells on the same farm may strike entirely different kinds of material. One may, for instance, penetrate a good water-bearing horizon of gravel at 60 feet from the surface, while the other one may have to be drilled 160 feet and even then may not obtain a good supply of water.

In the third case, wells in bedrock commonly obtain an adequate supply of water within the first 10 or 15 feet of rock. The water in this case is in the cracks of the rock, and as soon as a large enough crack is struck the well is a success. But if no such large crack is encountered, the well may have to be drilled for a considerable distance in bedrock before an opening will supply enough water. The chances, however, are all in favor of striking a good water supply within the first few feet of bedrock -- in fact, many of the well drillers report the best water supply right at the top of the rock. (See appendix for detailed well-records.)

In all probability a large supply of water could be obtained by drilling to the St. Peter sandstone, which should be encountered at a depth of something like 1000 feet. The well at Elgin enters this sandstone 640 feet from the surface, which means the top of this formation is about 100 feet above sea-level. 1/ The Potsdam sandstone, 300 feet

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1/ Anderson, Carl B., The artesian waters of northeastern Illinois: Illinois State Geol. Survey Bull. 34, pp. 167

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deeper, also supplies large amounts of water in parts of northeastern Illinois.

<u>Artesian wells.</u> 2/ Artesian wells, while defined differently by different people, are in general deep wells in which the water rises

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2/ See also Anderson, C.B., The artesian waters of northeastern Illinois: Ill. State Geol. Survey Bull. 34, 1919.

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above the water-table. If the water rises so much that it flows from the top of the well, it is a <u>flowing well</u>. The conditions necessary for a flowing well are shown in Fig. 36. There must be a pervious layer, capped by an impervious bed, outcropping high enough above the site of the well to give a "head" of water which will cause the well to flow. In the eastern part of the Barrington Quadrangle, there are flowing wells coming from the drift. At staples Corners (SW.¼, SW.¼, T.42 N., R.10 E.), Cook County, a well 200 feet deep flows to a height of 6 feet above the ground. South and southwest of Palatine there are numerous flowing wells. As early as 1887 there were 25 such wells in the district, and since then many more have been drilled. The structure of the drift is apparently a pervious bed of sand or gravel outcropping on the crest of the Barrington moraine. On the east flank of this moraine a capping of impervious till holds the water down. So when the capping is punctured by a well the water flows out because of the pressure of water entering on the crest of the moraine a mile or so farther west and a hundred feet higher.

Springs. The ground water is constantly issuing into valleys where they are cut below the water-table. It usually emerges as seepage but here and there the water is concentrated in a local channel and flows out as a spring. Along the Fox River Valley, the springs are found at the contact between Marseilles gravel and the underlying till; showing that the water, soaking down through the gravel, strikes the impervious till and instead of penetrating it, flows outward and emerges in the Fox Valley. Some of these springs are very important as a source of water. The one at Mr. Hertz's farm is said to flow 400 gallons per minute, and the Minerva Spring in Cary flows 35 gallons per minute the year round.[1] The Minerva Spring (altitude 800 feet above sea-level) is being used locally in the manufacture of soft drinks and is also shipped as table water to Chicago. (See appendix for production and analysis). Several houses in Cary have excellent springs in their basements at about this elevation. Similar conditions hold elsewhere in the region where there are springs.

One spring was seen in the Palatine artesian basin (SW.$\frac{1}{4}$, NW.$\frac{1}{4}$, sec. 34, T.42 N., R.10 E.) Cook County, issuing from the top of a small hill. The water doubtless rises under pressure from the water-bearing stratum through a crack or channel in the drift. The principle of the flow is the same as in an artesian well.

Swamps and Peat. Scattered over the entire quadrangle are numerous undrained or poorly drained depressions in which peat and muck have accumulated. The deposits are commonly small, averaging about a quarter of a

(1) Springs in Cary issue from Cary outwash on West Chicago till.

square mile, but the one just northeast of Barrington is about a square mile, while those along the Fox and Spring Creek valleys are even larger. In some of the small depressions the peat is only 3 or 4 feet thick, but in the large ones it is thicker than $10\frac{1}{2}$ feet, the length of the test auger. In the small area half a mile southwest of Barrington (SW.$\frac{1}{4}$, NE.$\frac{1}{4}$, sec.2, T.42 N., R.9 E.), Cook County, now drained by tile, $10\frac{1}{2}$ feet of peat were struck in boring. It was fibrous at the top, becoming gelatinous at the bottom. This is the common occurrence, for peat is made of vegetable material which upon falling in swamp-water, where aseptic conditions prevail, is preserved. Partial disintegration may take place to form this jelly-like substance before preservation becomes complete. The peat is usually very calcareous and, when examined closely, commonly shows fragments of shells. In some places, the peat is made up of a large percentage of lime, shells and marl. It is possible that this peat may become some day a source of fuel for heat and power.

Land drainage. The lowland tracts, if properly drained, contain excellent soil for agriculture. Such drainage is accomplished commonly by straightening the stream channels already present and cutting through minor irregularities so as to produce a uniform gradient. In the valley of Salt Creek, this has been done with great success. Spring Creek Valley might well be drained by a similar project. There is a fall of 39 feet from Spring Lake to Fox River in a distance of about 4 miles, giving an average gradient of about 10 feet per mile -- ample for drainage purposes. Goose Lake and the surrounding swamps could also be drained. Drainage is also accomplished, in the case of upland fields which are too flat for rain water to flow off them, by laying tile pipes so that the ground water will be carried off to a surface drainage channel.

Appendix

Analysis of mineral content of wells[a]

Barrington, Town well

		Parts per million	Grains per gallon
Potassium Nitrate	KNO_3	0.8	.05
Sodium Chloride	KCl	3.0	.17
Sodium Sulphate	Na_2SO_4	79.9	4.66
Ammonium Sulphate	$(NH_4)_2SO_4$	2.9	.17
Magnesium Sulphate	$MgSO_4$	29.6	1.73
Magnesium Carbonate	$MgCO_3$	121.1	7.06
Calcium Carbonate	$CaCO_3$	135.8	7.92
Iron Carbonate	$FeCO_3$	.6	.03
Alumina	Al_2O_3	.6	.03
Silica	SiO_2	23.9	1.39
Nonvolatile		2.3	.13
	Total	404.4	23.57
	Error +3.6		

[a] Illinois State Water Survey

Rest of appendix in pocket at back

Figures for Barrington Report

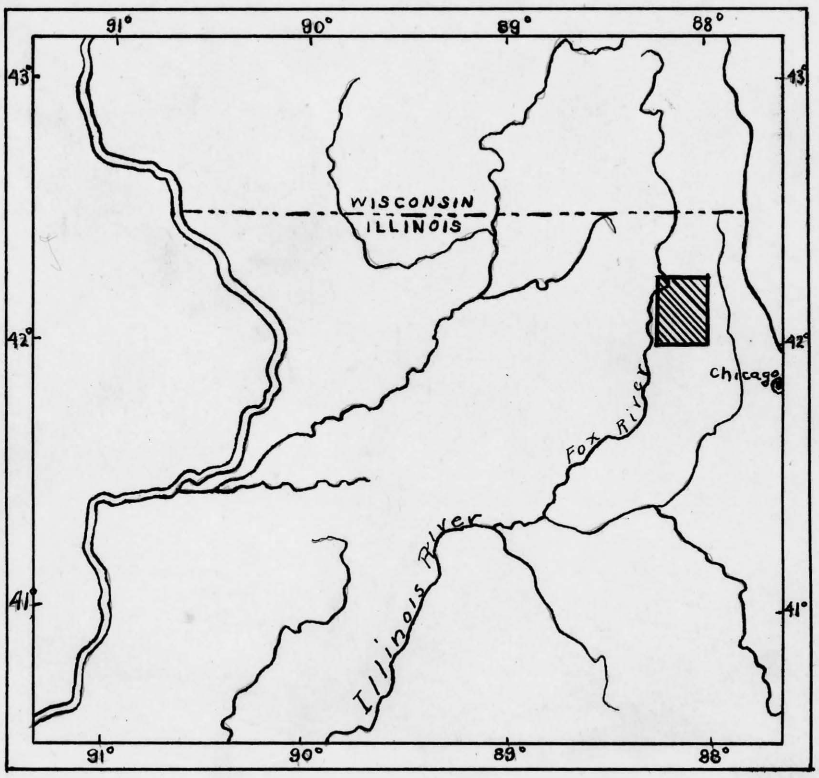


Fig 1. Index Map. of Northern Illinois
showing location of the Barrington Quadrangle.

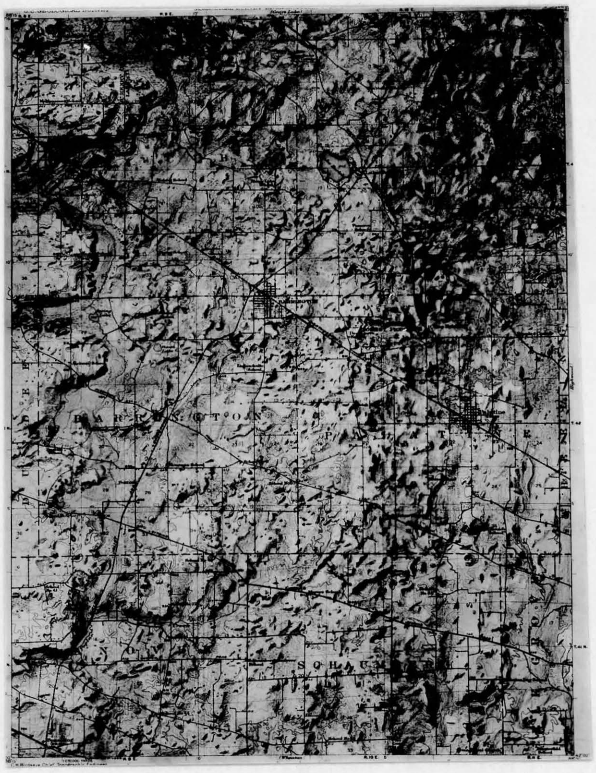
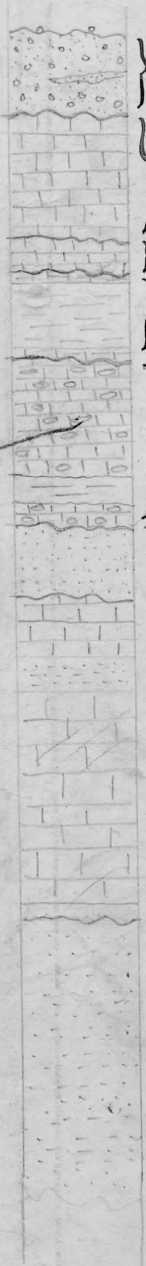


Fig 2.

Topography of the Barrington Quadrangle.

Columnar Section
Northern Illinois.



Glacial drift.
(Boulder clay, gravel, and sand) 100 - 350' feet. [200]

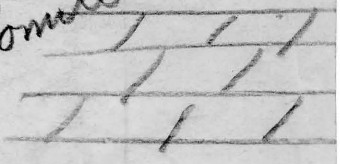
Niagaran
(dolomitic limestone) 20 - 420 ft. [200]

Alexandrian series (mostly limestone) 75 feet.

Richmond (Maquoketa)
(Shale with shaly limestone in upper and lower parts) 50 to 125 feet.

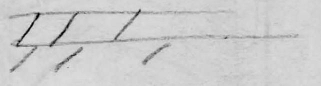
Galena and Platteville
(mostly dolomitic limestone) 300 to 440 ft.

Dolomite



St. Peter
(sandstone) 100 to 220 ft.

Prairie du Chien group.
("Lower Magnesian limestone)
Shakopee Shakopee
(dolomitic limestone) 10 - 186 ft.
New Richmond
(sandstone) 80 to 150 feet
Oneota
(dolomitic limestone 175 to 250? feet.



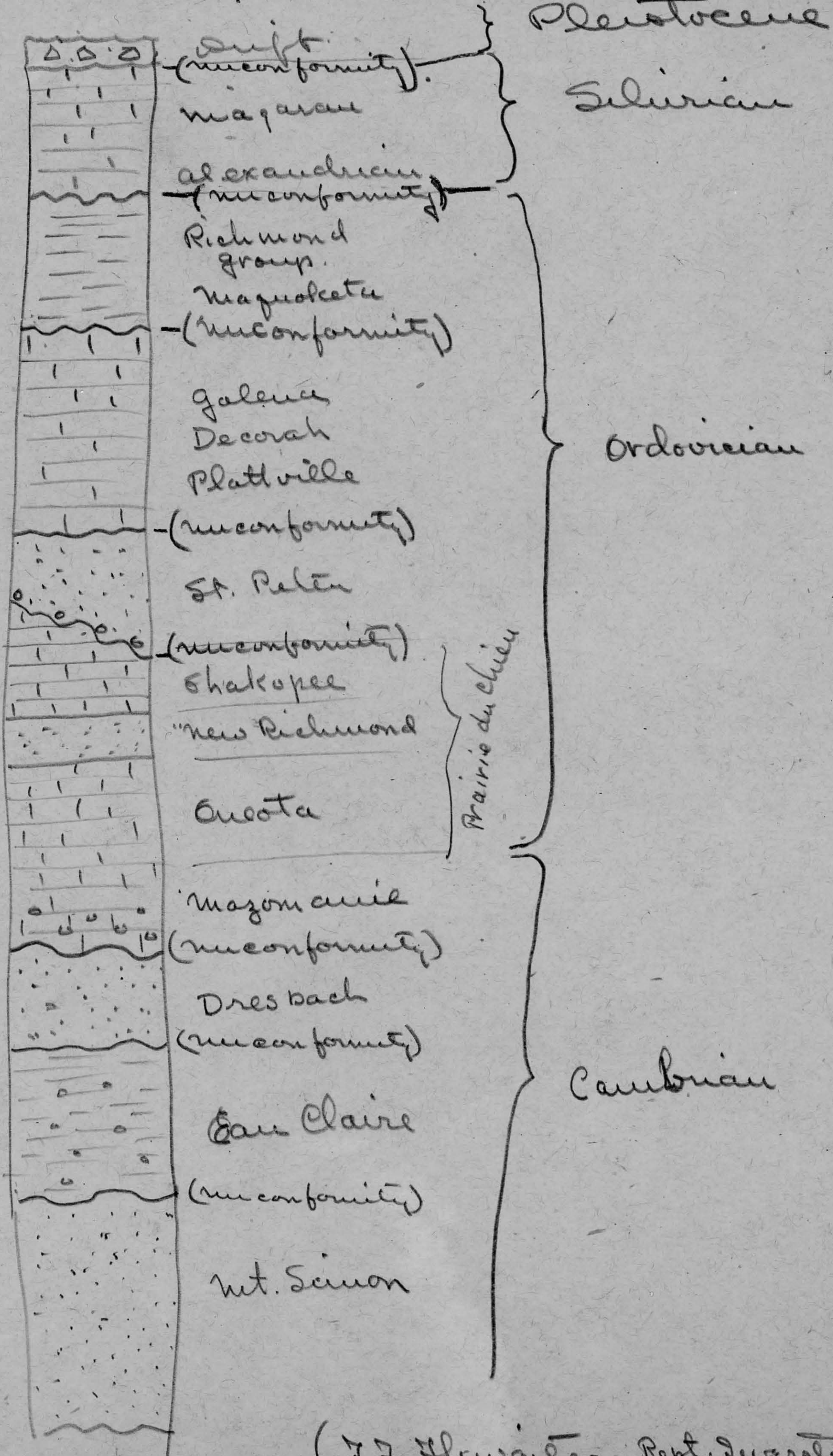
Upper Cambrian (Potsdam)
(sandstone) 1000 ft. Known only in well borings.

Fig. 3.

Barrington

(Fig 3.) From Thwaites Rept. Invest. #13.

Diagrammatic columnar section of northeastern Illinois after F.T. Thwaites.



(F.T. Thwaites; Rept. Investigations No. 13, Ill. State Geol. Surv. 1927)

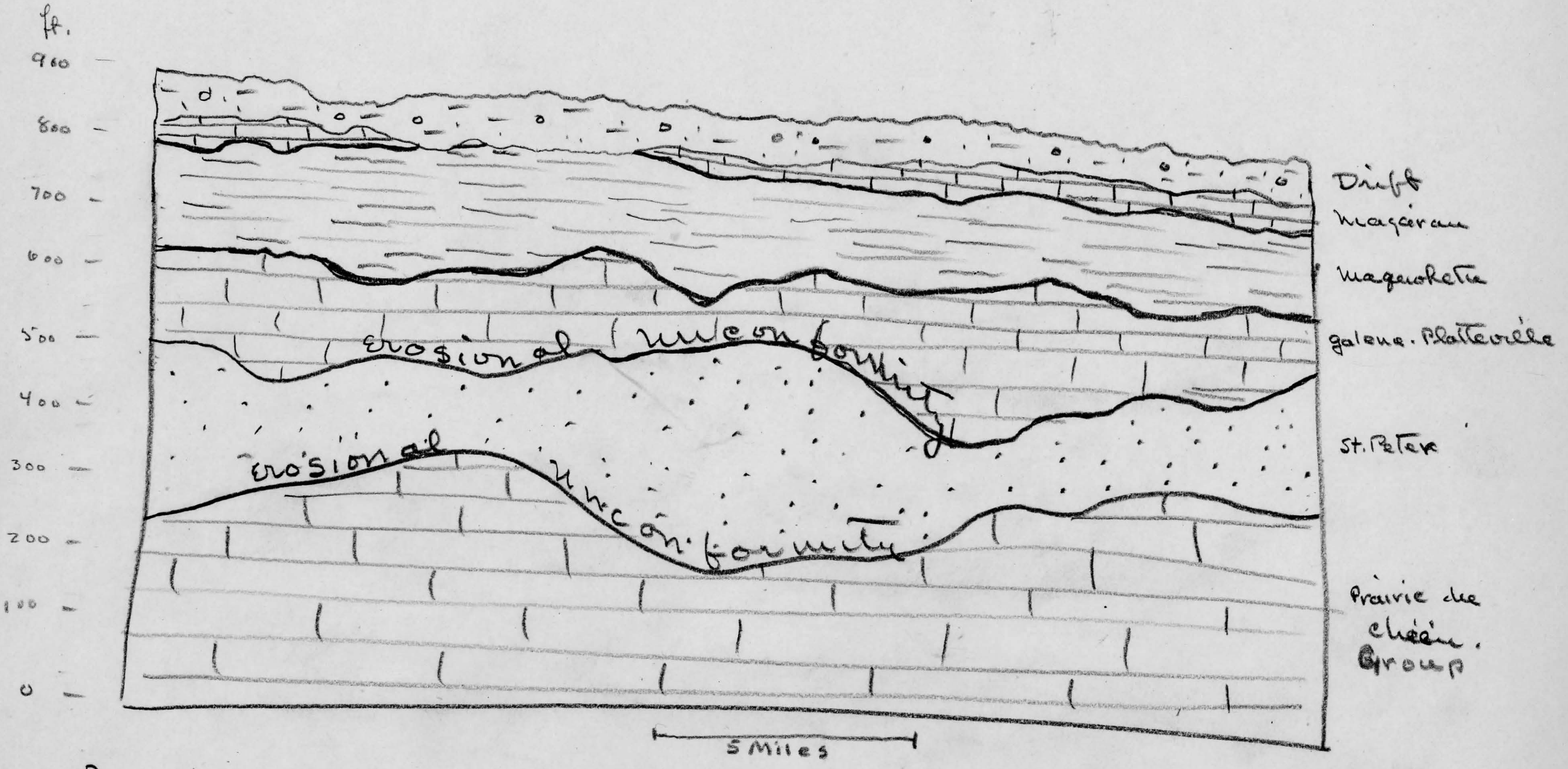


Fig. 4. Diagram to illustrate erosional unconformities and the varying thicknesses of formations.

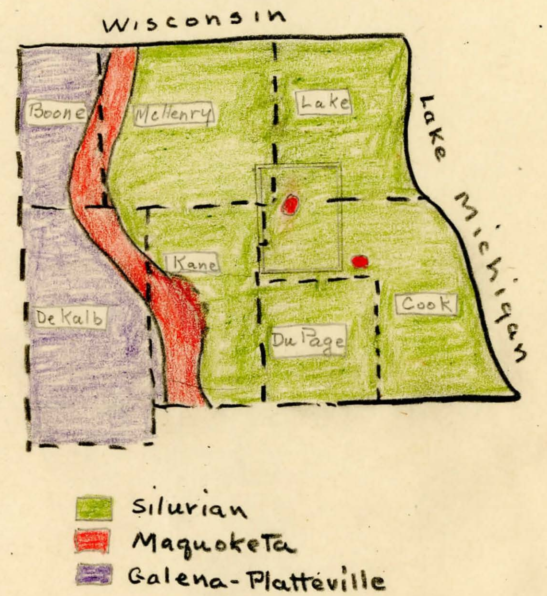


Fig. 6. Map of northeastern Illinois showing the areal geology and the location of the Barrington Quadrangle.

(Modified after T.F. Thwaites, Rept. Investigations No. 13, Ill. State. Geol. Surv.)

Fig. 9. Outwash, sand and gravel, ½ mile south of Cary.

Use Fig. 14, of Kings Quadrangle
by J. H. Bretz

Fig. 10. Block diagram to show the margin of a retreating glacier. ~~Outwash at edge of glacier~~ –

(Use Fig 14 in Bretz's report on King's Quadrangle)

Fig. West Chicago till on Marseilles gravel.

(NW 1/4, NW 1/4, Sec. 32, T. 43 N, R. 8 E., McHenry County.)

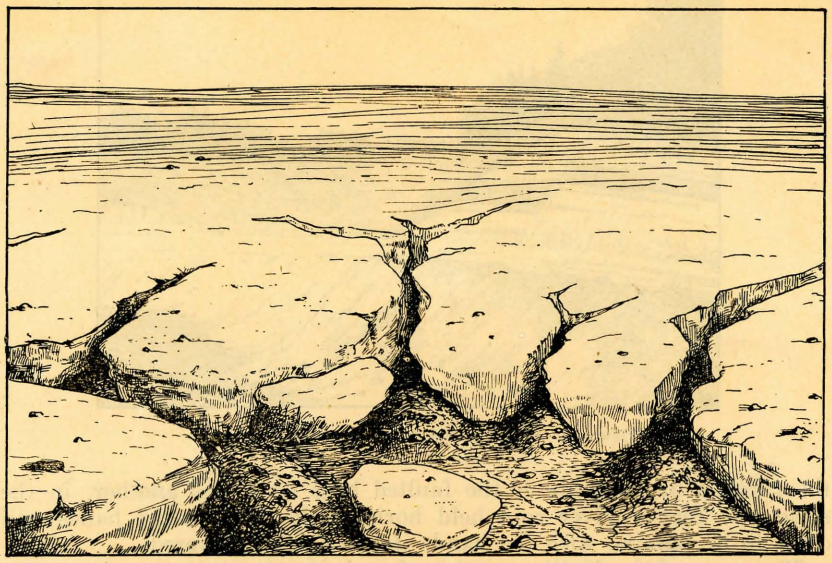


Figure ~~13.~~ Diagrammatic sketch to show how kame-areas are formed in connection with a much fissured ice edge.

Fig. 13.

13

Cut in drawer 2, case 2.

(Fig. 13 Bull. 19 S. G. S. bull.

Fig. 14.

Barrington moraine 5 miles south of Barrington.

Fig. 15. Typical erratic boulder on West Chicago moraine. (Kane 0124.73). 24-42N-8E.

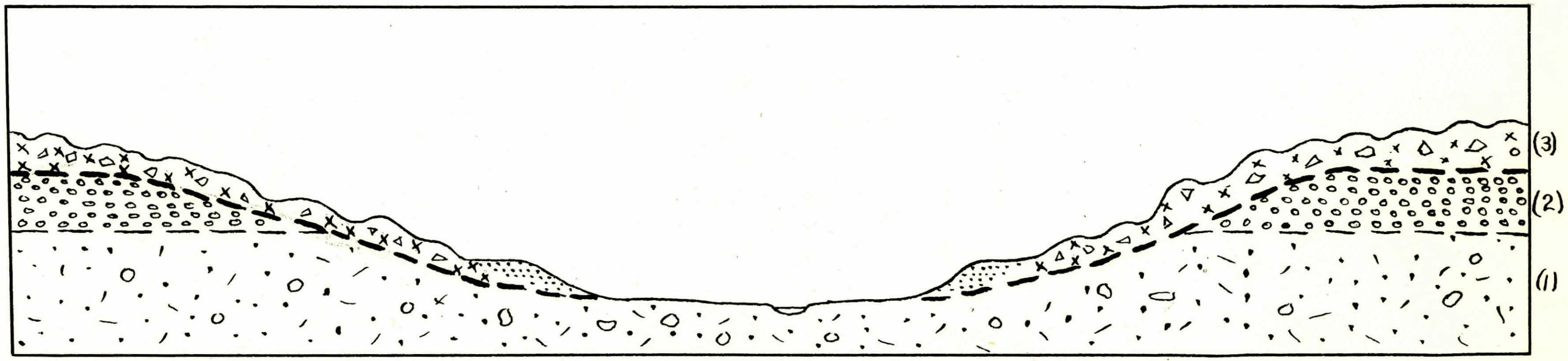


Fig 17. Diagrammatic cross section of the Fox River valley where it is crossed by the West Chicago moraine 2 miles west of Cary. (1) Early Wisconsin drift, (2) Marseilles gravel, (3) West Chicago drift.

Fig. 18. Kame in West Chicago moraine.

Fig. 19.

Esker on the West Chicago moraine. 1/4 mile west of Cary.

Fig 22 The material of a West Chicago kame.
(SW. 1/4, Sec. 30, T. 42 N., R. 9 E.)

Fig. 23

Fig 23. Terminal moraine topography south of Fox River Grove.

Fig. 24

Fig 24. Terminal moraine topography, 1/2 mile west of Cuba.

Fig. 25

~~Fig 25~~ Ski Hill, 1 mile east of Fox River Grove.

26.

Moulin kame in the Elgin Quadrangle -

(note to surveyiter. Guess who the bow-legged "hombre" is!)

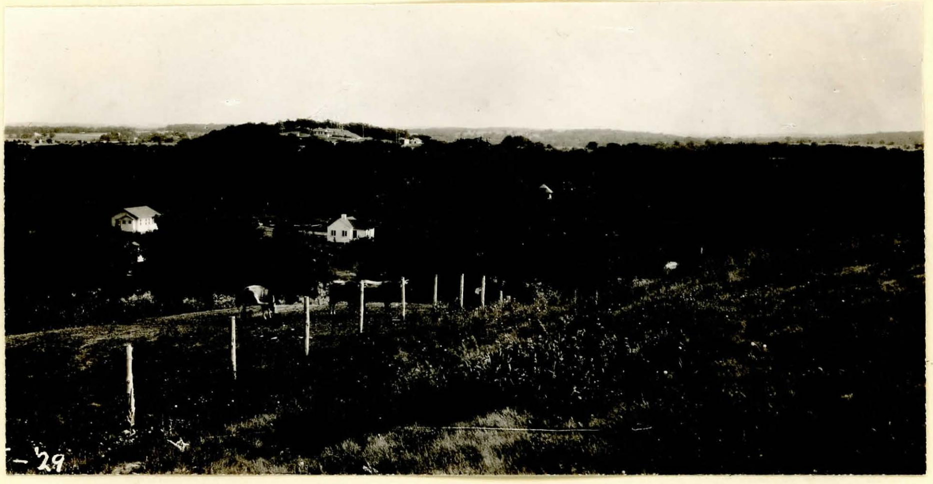


Fig. 27

~~Fig. 27.~~ Looking south across the Fox River Valley to Ski Hill.

Fig. [illegible]. Lake in the Cary moraine.
" 28. 4 1/2 mi. NW of Barrington, Ill.
(Lake County, 1328.34)

Fig. 31

~~Fig 31~~ Barrington moraine 2 miles north of Barrington, looking north.

Fig. 33. Massive morainal topography, looking northwest across the Barrington golf course. (SE1/4, Sec. 34, T. 43N., R. 9 E.)

Fig. 35. Large glacial boulder of Niagaran dolomite in NW¼ sec. 3, T.43 N., R.9 E.

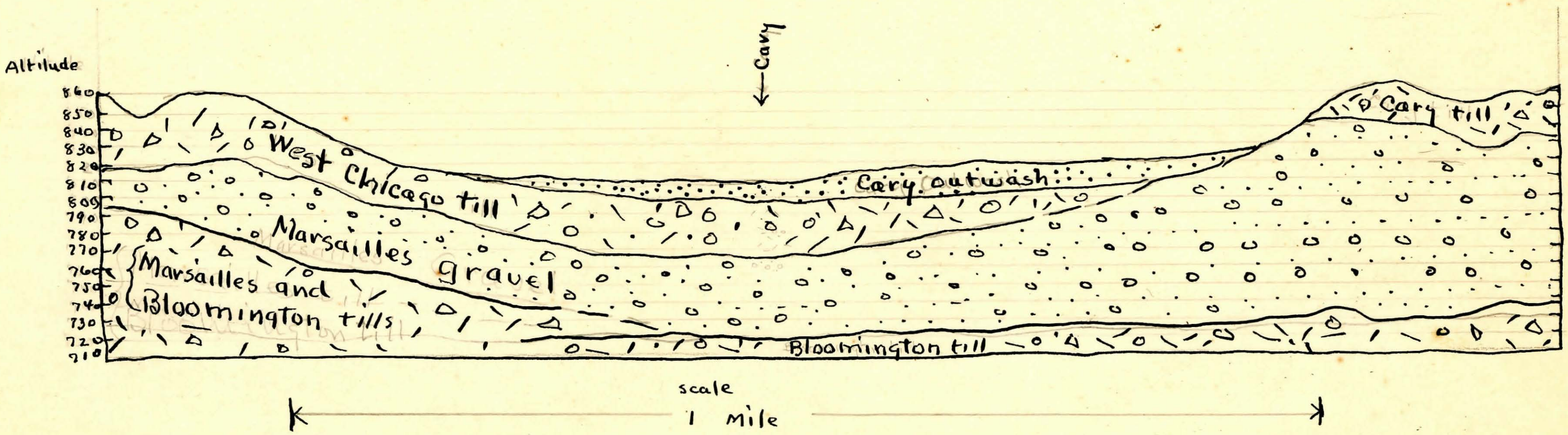


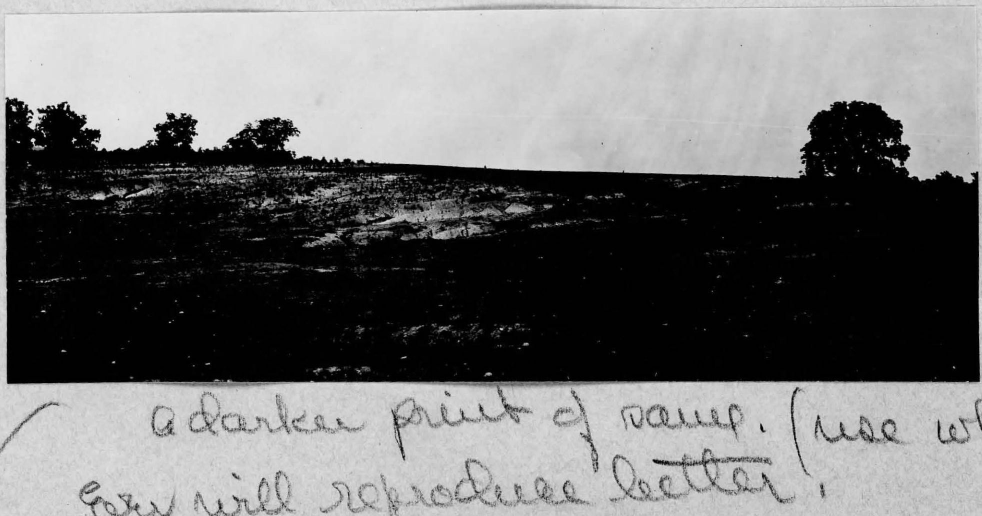
Fig 36,

Northeast - Southwest section through Cary.

Fig. 39. Till leached down to the head of the hammer, 2 miles north of Barrington. (N. 1/2, SW. 1/4, Sec. 25, T. 43 N., R. 9 E., Lake County) Darker buff subsoil lies on lighter buff calcareous till.

Fig. 40

~~Fig 40~~ Gullies developing in a field north of Lake Zurich.



(a darker print of same. (use which ever will reproduce better!)

Fig. 42. Alluvium in the bottom of a depression in the Cary moraine. The auger penetrated 10½ ft. of alluvium without striking gravel or till. (N.W. 1/4, SE 1/4 sec. 20, T.43 N., R.8 E., McHenry County)

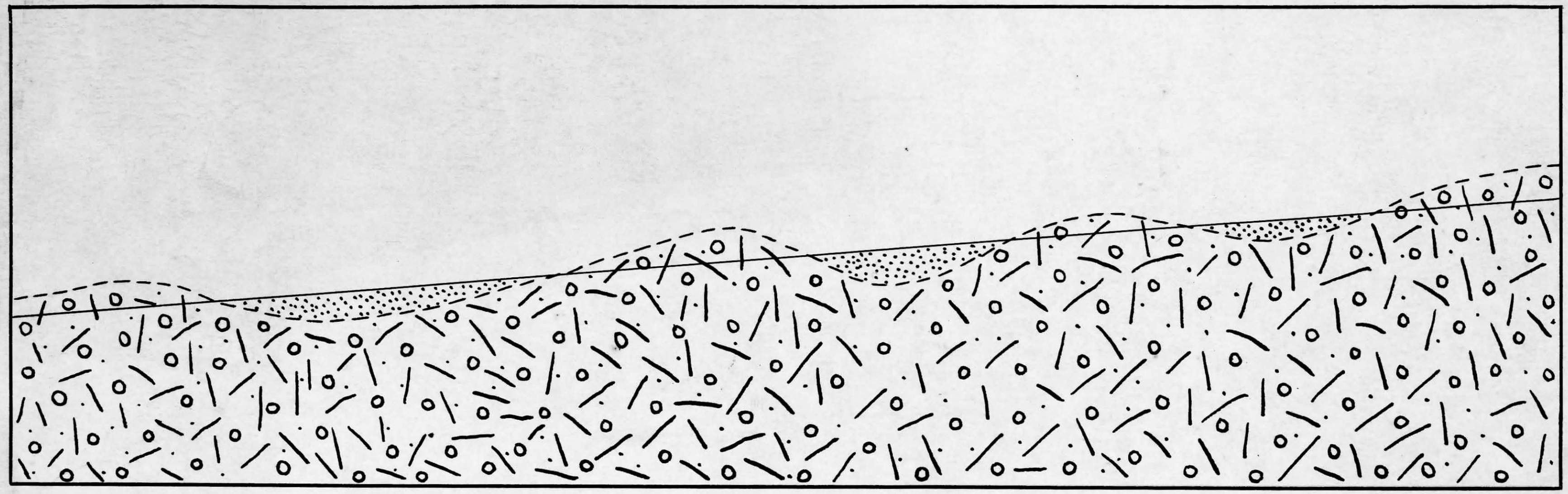


Fig. 43 Diagram to show how Flynn Creek has alternately cut and filled to make itself a uniform gradient.

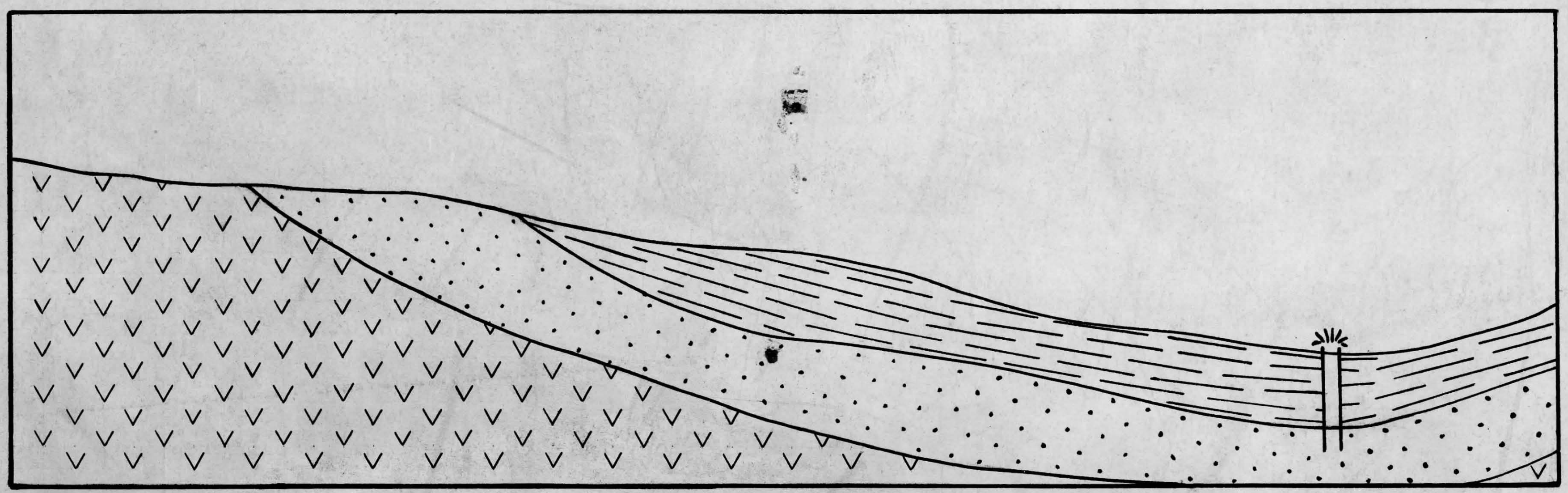


Fig. 49 diagram showing the conditions for a flowing well near Palatine

Appendix

90'

Well records

No.	County	Township	Section	Coordinate	Depth feet	Log From top to bottom	Altitude bedrock	altitude
1	McHenry	Nunda, 44 N., 8 E.	31	.30, SE SW	65	Clay 6', gravel, sand 15', white clay, gravel 44'		825
3	McHenry	~~Algonquin~~ Cary ok	1	.69, NW E	40	Gravel		815
4	McHenry	~~Algonquin~~ Cary ok " "	1	.54, NW SE	30	10' till, 20' gravel		835?
5	McHenry	~~Algonquin~~ Cary ok	13	.97, S~~E~~W NE NE	307	Cary town well depth 12' fine clayey gravel 22' blue till 32' gravel with clay adhering 42' blue gray till 52' gravel, fine 62' gravel 72' gravel 82' gravel 92' pinkish calcareous till 152' pinkish calcareous till 162' limestone 307' limestone	645	805
~~6~~	McHenry	~~Algonquin~~ Cary ok " "	24	.84, NE SE	48			—
7	McHenry	~~Algonquin~~ Cary ok " "	25	.98, NE NE	48	Clay, gravel		857
8	McHenry	Algonquin 43N 9E	7	.15, SW NW	185	Rock at 100' (?)	765?	865
~~9~~	McHenry	Algonquin	7	.65, SW NE	200	?		870
10	"	"	8	.85, SE NE	60	Till to gravel		815?
11	McHenry	Algonquin	17	.78, Cen. N. 1/2 NE	40	Till 10', gravel 30'		795
2	McHenry	~~Cary~~ algonq. T.43N., R.8E.	1	.40, SE SW	90	Till 20', gravel, 40', Till 10', gravel 20'		865

$13'

No.	County	Township	Sec.	Location	Depth	Material		Altitude
								altitude
12	McHenry	Algonquin	17	.66 Cen. SW NE	60	Gravel to "pink" till		740
13	McHenry	Algonquin	17	.65, S. 1/2 SW NE	55	Gravel and "pink" till		730
14	McHenry	Algonquin	18	.97, SE NE NE	100	Sand		820
15	McHenry	Algonquin	18	.57, SW NE NE	100	Sand		820?
16	McHenry	Algonquin	18	.84, NW NE SE	shallow.	Gravel to quicksand		730
17	McHenry	Algonquin	19	.77, Cen. NE	20	Clay to gravel		760?
18	McHenry	Algonquin	30	.54, NW NW SE	40	Gravel		872
19	McHenry	Algonquin	30	.34, N. 1/2 NE SW	50	Gravel		882
20	McHenry	Algonquin	29	.51, W. 1/2 SW SE	40	Sand to gravel		793
21	McHenry	Algonquin	31	.33, NE SW	160	Till to gravel to sand		875
22	McHenry	Algonquin	32	.93, NE SE	80	Gravel and sand		794
23	Lake	Wauconda, 44N., 9 E.	33	.43, NE SW	35	Gravel		740
24	Lake	Wauconda	34	.96, SE NE	78	20' clay, gravel 58'.		770
~~25~~ 906	Lake	Wauconda	35	.54, NW SE	172	(?)		~~783~~
26	Lake	Wauconda	35	.75, SE NE	130	Blue clay, coarse gravel		793
27	Lake	Cuba, 43 N., 9 E.	1	.15, SW NW	218	Blue clay, quicksand Rock at 212	600	812
28	Lake	Cuba	3	.35, SE NW	148	Gravel		760
29	Lake	Cuba	3	.64, NW SE	60	Clay 10', gravel, rock (?)	690?	750?
30	Lake	Cuba	3	.96, SE NW	28	Gravel		740?
~~31~~	Lake	Cuba	11	.20, SW SE SW	60	(?)		—
32	Lake	Cuba	12	.00, SW SW SW	72	Till, gravel		820
33	Lake	Cuba	12	.86, Cen. SE NE	235	To rock	600	840
34	Lake	Cuba	15	.48, SE NE NW	65	Gravel		765
35	Lake	Cuba	15	.74, NE NW SE	90	Till		775

								altitude
36	Lake	Cuba	21	.54, NW NW SE	90	Till to gravel		800
37	Lake	Cuba	21	.50, SW SW SE	40	Till to sand		800
38	Lake	Cuba	22	.00, SW SW SW	(?)	Till		780
~~39~~	Lake	Cuba	22	.46, E. 1/2 SE NW	100±	(?)		775
40	Lake	Cuba	22	.84, NW NE SE	190	Till		782
41	Lake	Cuba	22	.91, SE SE	173	Gravel		800
42	Lake	Cuba	23	.09, NW NW NW	162	Gravel		770
~~43~~	Lake	Cuba	23	.39, NE NW	(?)	Flowing		
~~44~~	Lake	Cuba	24	.49, NE NW	130	?		
45	Lake	Cuba	24	.23, Cen. N. 1/2 SW	140	Gravel		850
~~46~~	Lake	Cuba	25	.73, Cen. N. 1/2 SE	182	Rock (?)		
47	Lake	Cuba	26	.95, SE SE NE	229	Gravel		845
48	Lake	Cuba	27	.94, NE NE SE	40	Till to gravel		800
49	Lake	Cuba	28	.39, N. 1/2 NE NW	184	Gravel		810
50	Lake	Cuba	28	.44, NE NE SW	152	Till to sand to gravel 3' rock	655	804
51	Lake	Cuba	28	.85, S. 1/2 SE NE	150	Gravel		790
52	Lake	Cuba	28	.13 Cen. NW SW	223	Gravel		800
53	Lake	Cuba	28	.12, NW SW	259	To rock	~~576~~ 546	805
54	Lake	Cuba	33	.71, S. 1/2 SE	113	Gravel		825?
~~55~~	Lake	Cuba	34	.94, NE NE SE	172	(?)		
56	Lake	Cuba	34	.64, N. 1/2 NW SE	162	Clay to sand and gravel hardpan at 140 (Illinoian)		800
57	Lake	Cuba	34	.70, SW SE SE	140	To rock	675	820

58	Lake	Cuba	35	.04, NW NW SW	70	(?)		
59	Lake	Cuba	35	.34, N. 1/2 NE SW	170	(?)		
60	Lake	Cuba	35	.01, W. 1/2 SW SW	122	Gravel		850
61	Lake	Cuba	36	.39, N. 1/2 NE NW	238	To rock	627	835
62	Lake	Cuba	36	.37, S. 1/2 NE NW	180	(?)		
63	Lake	Fremont, 44N.,10 E.	32	.24, NE NW SW	242	Clay 14', sand, gravel at bottom		880
64	Lake	Fremont	32	.55, SW cor. NE	326	To rock, 200' quicksand	570	900
65	Lake	Fremont	33	.34, N. 1/2 NE SW	346	To rock	535	875
66	Lake	Fremont	34	.42, SE NE SW	250	To rock	600	835
67	Lake	Fremont	35	.84, N. 1/2 NE SE	150	(?)		
68	Lake	Fremont	36	.44, NE NE SW	160	Gravel and till 80', sand 80'		765
69	Lake	Fremont	36	.45, SE SE NW	145	(?)		
70	Lake	Fremont	36	.81, Cen. SE SE	250	To rock	510	760
71	Lake	Ela, 43 N., 10 E.	1	.44, NE NE SW	196	To rock	569	765
72	Lake	Ela	5	.29, NE NW NW	322	To rock, 200' quicksand	568	875
73	Lake	Ela	5	.33, Cen. NE SW	250	(?)		
74	Lake	Ela	6	.58, W. 1/2 NW NE	281	Clay 125', quicksand 156', limestone	584	865
75	Lake	Ela	6	.34, N. 1/2 NE SW	169	(?)		
76	Lake	Ela	6	.94, NE NE SE	382	Clay 90' Quicksand 212' Limestone 60' (Niagaran) Shale 12' (Maquoketa) Limestone 6' Galena-Platteville)	570	872
77	Lake	Ela	7	.53, W. 1/2 NW SE	200±	(?)		
78	Lake	Ela	8	.59, NW NW NE	210	To rock	655	865

79	Lake	Ela	8	.45, SE SE NW	322	To rock	553	? 870
80	Lake	Ela	8	.67, Cen. W. 1/2 NE	285	To rock	587	872
81	Lake	Ela	8	.94, NE NE SW	275±	(?)		
82	Lake	Ela	10	.08, W. 1/2 NW NW	243	To rock	607	850
83	Lake	Ela	12	.86, Cen. SE NE	235	140' till; 90' quicksand; 5' coarse sand		745
84	Lake	Ela	17	.70, SW SE SE	288	To rock	600	888
85	Lake	Ela	18	.48, E. 1/2 NE NW	173	Gravel		830
86	Lake	Ela	18	.88, Cen. NE NE	350±	To rock (?)		
87	Lake	Ela	18	.74, NE NW SE	155	Gravel		860
88	Lake	Ela	19	.67, Cen. W. 1/2 NE	30	Clay		860
89	Lake	Ela	19	.66, Cen. SW NE	38	Clay		845
90	Lake	Ela	21	.94, NE NE SE	208	Sand and gravel		820
91	Lake	Ela	22	.26, Cen. S. 1/2 NW	124	Clay to gravel		810
92	Lake	Ela	22	.51, W. 1/2 SW SE	219	(?)		
93	Lake	Ela	24	.85, SW SE NE	25	Sand and gravel		750
94	Lake	Ela	25	.32, Cen. E. 1/2 SW	259	66' in rock	580	770
95	Lake	Ela	29	.54, NW NW SE	190	(?)		
96	Lake	Ela	30	.07, SW NW NW	252	To rock	618	870
97	Lake	Ela	31	.10, S. 1/2 SW SW	229	Gravel		850
98	Lake	Ela	31	.70, SE SW SE	267	To rock	583	850
99	Lake	Ela	31	.95, SE SE NE	235	To rock	610	845

(100)	Lake	Ela	31	.50, SW SW SE	267	200' blue clay 30' fine sand and clay stratified 30' fine quicksand 7' Niagaran limestone	583	850
(101)	Lake	Ela	32	.32, Cen. E. 1/2 SW	248	220' clay, 28' fine sand and quicksand		880
(102)	Lake	Ela	32	.33, W. 1/2 NE SW	258	To rock	627	885
(103)	Lake	Ela	32	.64, N. 1/2 NW SE	40	Till to sand		863
~~(104)~~	Lake	Ela	33	.59, NW NW NE	220	(?)		
(105)	Lake	Ela	33	.64, N. 1/2 NW NE	334	Gravel and sand 248', rock 86'	592	840
~~(106)~~	Lake	Ela	33	.85, S. 1/2 SE NE	158	(?)		
(107)	Lake	Ela	34	.08, W. 1/2 NW NW	182	Gravel		805
~~(108)~~	Lake	Ela	35	.27, Cen. NW.	300	(?)		
110 ~~(109)~~	Lake	Vernon, 43 N., 11 E.	19	.19, N. 1/2 NW NW	42	(?)		
(110)	Lake	Vernon	30	.25, SW SE NW	90	Clay		740
(111)	Cook	Barrington, 42 N., 9 E.	1	.29, NW NE NW	315	Drift 200', Niagaran limestone 115'	630	830
(112) → (insert P. 14a)								
(114)	Cook	Barrington	2	.89, N. 1/2 NE NE	197	Gravel		830
~~(115)~~	Cook	Barrington	2	.33, Cen. NE SW	300±	(?)		
(116)	Cook	Barrington	3	.15, S. 1/2 SW NW	140	Gravel		850
(117)	Cook	Barrington	3	.34, N. 1/2 NE SW	140	Gravel		833
(118)	Cook	Barrington	3	.10, S. 1/2 SW SW	275	To rock sandstone (?)	530?	805
(119)	Cook	Barrington	3	.81, Cen. SE SE	140	Gravel		850
(120)	Cook	Barrington	4	.36, Cen. SE NW	90	Till and sand		850
(121)	Cook	Barrington	4	.77, Cen. NE	50	Blue till (unfinished)		830
(122)	Cook	Barrington	4	.76, Cen. S. 1/2 NE	175	Gravel		810 ?

(112) 111 Elev. 830

~~p. 14 a.~~

Cook Barrington. 1. .59 Town well 253

Till 160
Coarse gravel 30
Till, hard, (Ill) 63
Rock.

(113) Cook. Barrington. 2. .35, SE SW NW 890. Elev. 845

17 City well #1 Rieke well drilling Co.

	Thickness	Depth
Pleistocene		
Till	120	120
Sand	140	260
Maquoketa		
Shale, soft, blue	178	438
Galena-Platteville		
Dolomite, light gray, finely crystalline, vesicular to compact.	132	570
Dolomite, light gray, finely to medium crystalline	30	600
Dolomite, light gray with dark spots	20	620
Dolomite, light gray medium	40	660
Dolomite, light gray fine	10	670
Dolomite, light brown, very fine; shale dolomitic, dark brown	8	678
Dolomite, light brown with dark spots, partly argillaceous, very fine	22	700
Dolomite, light brown and light gray, fine to coarse	10	710
Dolomite, gray, very fine	8	718
Dolomite, pinkish brown, fine	17	735
Glenwood		
Sandstone, dolomitic, light brownish gray, medium	15	750
Sandstone, dolomitic, white, medium; shale, dolomitic, bluish gray weak	30	780
Sandstone, dolomitic, fine to medium, light bluish gray	10	780
St. Peter		
Sandstone, white, fine to medium incoherent	35	825
Sandstone, white very fine to medium, incoherent	25	850
Sandstone, white, fine to medium incoherent	40	890

OK

123	Cook	Barrington	4	.78, E. 1/2 NW NE	213	40' yellow till 50' blue till 100' sand 1' gravel 22' rock	640	830
~~124~~	Cook	Barrington	4	.42, Cen. E. 1/2 SW	300	(?)		
~~125~~	Cook	Barrington	5	.68, Cen. NW NE	60	(?)		
126	Cook	Barrington	7	.79, NW NE NE	140	Gravel 70', peat 1', sand and gravel 69'		855
127	Cook	Barrington	7	.88, Cen. NE NE	58	Gravel		840
128	Cook	Barrington	8	.02, NW SW SW	100+	Gravel		825?
129	Cook	Barrington	8	.21, Cen. S. 1/2 SW	35	Gravel		810
~~130~~	Cook	Barrington	9	.29, Cen. N. 1/2 NW	300	(?)		
131	Cook	Barrington	9	.34, N. 1/2 NE SW	200	To rock	590	790
132	Cook	Barrington	10	.66, Cen. SW NE	170	Gravel		?
112 133	Cook	Barrington	10	.96, E. 1/2 SE NE	160	Gravel		860
134	Cook	Barrington	11	.10, S. 1/2 SW SW	180	Till to sand		860
135	Cook 18	Barrington	11	.09, NW NW NW	625	Clay 275' Gravel 20' Blue shale 160' (Maquoketa) Limestone 165' (Galena-Platteville) Sandstone at bottom (St. Peter)		860
136	Cook	Barrington	11	.29, NW NE NW	285	To rock	570	855
137	Cook	Barrington	11	.39, N. 1/2 NE NW	275	To rock	590	865
138	Cook	Barrington	11	.88, Cen. NE NE	300	In rock		850
139	Cook	Barrington	12	.22, Cen. SW	250	To rock	620	887
140	Cook	Barrington	12	.93, E. 1/2 NE SE	243	Till, hardpan 125', quicksand, gravel		870
~~141~~	Cook	Barrington	13	.25, SW SE NW	193	(?)		

142	Cook	Barrington	14	.02, NW SW SW	180	(?)		
143	Cook	Barrington	15	.04, NW NW SW	276	Red clay at about 230'		900
144	Cook	Barrington	15	.11, Cen. SW SW	246	(?)		
145	Cook	Barrington	15	.15, S. 1/2 SW NW	268	Clay to rock	632	900
146	Cook	Barrington	16	.84, N. 1/2 NE SE	167	160' till, 7' gravel		910
147	Cook	Barrington	16	.20, SW SE SW	100+	80' till, gravel		870
148	Cook	Barrington	17	.76, Cen. S. 1/2 NE	45	Gravel		800
149	Cook	Barrington	17	.50, SW SW SE	50	10' sand, 40' gravel		825
150	Cook	Barrington	19	.15, Cen. S. 1/2 SW NW	75	Gravel		855
151	Cook	Barrington	19	.64, N. 1/2 NW SE	65	Gravel and sand		860
152	Cook	Barrington	20	.18, Cen. NW NW	28	Gravel		835
153	Cook	Barrington	20	.52, SW NW SE	50	(?)		
154	Cook	Barrington	21	.99, NE NE NE	172	(?)		
155	Cook	Barrington	21	.20, SE SW SW	211	190' blue clay to gravel, 21' rock	627	838
156	Cook	Barrington	23	.99, NE NE NE	233	To rock	627	860
157	Cook	Barrington	23	.14, N. 1/2 NW SW	200	Blue clay to gravel		872
158	Cook	Barrington	23	.91, E. 1/2 SE SE	159	(?)		
159	Cook	Barrington	24	.95, SE SE NE	177	Gravel		880
160	Cook	Barrington	25	.05, SW SW NW	263	To rock	607	870
161	Cook	Barrington	26	.23, E. 1/2 NW SW	220	Clay 160', sand 50', rock 10'	645	860
162	Cook	Barrington	26	.50, SW SW SE	200	(?)		
163	Cook	Barrington	27	.19, N. 1/2 NW NW	200	70' clay, to gravel		870
164	Cook	Barrington	27	.40, SE SE SW	281	70' clay, sand and clay stratified		850

165	Cook	Barrington	28	.99, NE NE NE	135	Gravel		850
166	Cook	Barrington	28	.26, Cen. S. 1/2 NW	212	75' blue clay 15' fine sand 122' rock	740	830
167	Cook	Barrington	28	.25, Cen. S. 1/2 S. 1/2	110	75' clay, 35' rock Loc. indefinite	755?	
168	Cook	Barrington	30	.70, SE SW SE	80	Till to sand		863
169	Cook	Barrington	32	.58, W. 1/2 NW NE	85	(?)		
170	Cook	Barrington	32	.44, NE NE SW	62	Clay and gravel		842
171	Cook	Barrington	33	.98, E. 1/2 NE NE	145	(?)		
172	Cook	Barrington	33	.55, SW SW NE	145	To rock	700	845
173	Cook	Barrington	34	.07, NW SW NE	195	(?)		
174	Cook	Barrington	34	.33, Cen. NE SW	222	40' "water clay 10' pebbles 150' hardpan 22' rock	657	855
175	Cook	Barrington	34	.21, E. 1/2 SW SW	196	To rock	664	860
rev 176	Cook	Barrington	35	.17, S. 1/2 NW NW	184	Clay		870?
177	Cook	Barrington	35	.00, SW SW SW	198	(?)		
178	Cook	Palatine, 42 N., 10 E.	1	.17, S. 1/2 NW NW	192	To rock	561	750
179	Cook	Palatine	1	.10, S. 1/2 SW SE	deep,	Flowing		735
180	Cook	Palatine	2	.46, E. 1/2 SE NW	194	To rock	566	760
181	Cook	Palatine	2	.99, NE NE NE	178	Gravel	566	755
182	Cook	Palatine	2	.91, E. 1/2 SE SE	194	To rock	546	740
183	Cook	Palatine	5	.75, SW SE NE	267	Gravel		183
184	Cook	Palatine	6	.65, S. 1/2 SW NE	200	Clay		870
185	Cook	Palatine	7	.04, NW NW SW	240	Till, quicksand, rock	625	865

186	Cook	Palatine	8	.28, W. 1/2 NE NW	211	To rock	663	875
187	Cook	Palatine	9	.97, SE NE NE	150	(?)		
188	Cook	Palatine	9	.93, E. 1/2 NE SE	148	(?)		
189	Cook	Palatine	9	.92, SE NE SE	258	122' drift, 136' shale?	658?	780
190	Cook	Palatine	10	.84, N. 1/2 NE SE	201	189' drift, 12' rock	564	755
191	Cook	Palatine	11	.46, E. 1/2 SE NW	207	160' drift, 47' rock	600	765
192	Cook	Palatine	12	.19, N. 1/2 NW NW	145	Gravel, flowing		730
193	Cook	Palatine	12	.37, S. 1/2 NE NW	315	146' drift, 169' rock	571	740
194	Cook	Palatine	14	.16, Cen. SW NW	227	172' drift, 55' limestone	583	755
195	Cook	Palatine	14	.87, S. 1/2 NE NE	178	Drift		745
196	Cook	Palatine	14	.47, SE NE NW	28	Till		750
197	Cook	Palatine	14	.10, S. 1/2 SW SW	57	Gravel		752
198	Cook	Palatine	14	.30, S. 1/2 SE SW	181	In Rock	575	755
199	Cook	Palatine	15	.06, W. 1/2 SW NE	166	(?)		
200	Cook	Palatine	15	.33, Cen. NE SW	167	Gravel, flowing		755
201	Cook	Palatine	16	.94, NE NE SE	210	To rock	575	785
202	Cook	Palatine	17	.40, SE SE SW	212	To rock	615	830
203	Cook	Palatine	18	.35, S. 1/2 SE NW	225	200' drift, 25' rock	680	880
204	Cook	Palatine	18	.34, N. 1/2 NE SW	180	(?)		
205	Cook	Palatine	20	.45, SE SE NW	202	To rock	623	825
206	Cook	Palatine	21	.49, NE NE NW	145	Gravel		785
207	Cook	Palatine	23	.49, NE NE NW	181	Rock		750
208	Cook	Palatine	23	.97, SE NE NE	133	?		

209	Cook	Palatine	23	.15, S. 1/2 SW NW	202	To rock	543	745
210	Cook	Palatine	23	.43, E. 1/2 NE SW	163	To rock	582	745
211	Cook	Palatine	24	.69, N. 1/2 NW NE	67	Clay to gravel		730
212	Cook	Palatine	24	.96, E. 1/2 SE NE	160	?		
213	Cook	Palatine	24	.61, Cen. SW SE	36	?		
214	Cook	Palatine	24	.00, SW SW SW	138	?		
215	Cook	Palatine	24	.90, SE SE SE	60	Clay to gravel		720
216	Cook	Palatine	25	.91, E1/2 SE SE	20	Clay to gravel		710
217	Cook	Palatine	27	.36, Cen. SE NW	60	Drift, flowing		745
218	Cook	Palatine	27	.62, Cen. S. 1/2 NW SE	155	Gravel, flowing		725
219	Cook	Palatine	30	.94, NE NE SE	140	?		
220	Cook	Palatine	30	.70, SE SW SE	85	?		
221	Cook	Palatine	31	.68, Cen. NW NE	150	?		
222	Cook	Palatine	32	.00, SW SW SW	265	?		
223	Cook	Palatine	33	.56, W. 1/2 SW NE	110	?		
224	Cook	Palatine	33	.95, SE SE NE	195	175' drift, 20' rock, flowing	610	765
225	Cook	Palatine	34	.57, SW NW NE	(?)	Flowing		730
226	Cook	Palatine	34	.45, SE SE NW	128	?		
227	Cook	Palatine	34	.53, W. 1/2 NW SE	158	?		
228	Cook	Palatine	34	.33, Cen. NE SW	38	?		
229	Cook	Palatine	36	.96, E. 1/2 SE NE	140	?		
230	Cook	Palatine	36	.94, NE NE SE	121	117' drift, 4' rock	583?	700
231	Cook	Palatine	36	.93, E. 1/2 NE SE	160	148' drift, 12' rock	557	705

232	Cook	Wheeling, 42 N., R. 11 E.	19	.11, Cen. SW SW	170	To rock	555	720
233	Cook	Wheeling	31	.09, NW NW NW	150	Gravel		715
234	Cook	Hanover, 41 N., R. 9 E.	1	.33, Cen. NE SW	190	To rock	645	835
235	Cook	Hanover	12	.43, E. 1/2 NE SW	48	Gravel		805
236	Cook	Hanover	14	.14, N. 1/2 NW SW	162	To rock	643	805
237	Cook	Hanover	14	.00, SW SW SW	200	120' till 30' sand 50' gravel Rock	625	825
238	Cook	Hanover	15	.90, SE SE SE	182	To rock		835
239	Cook	Hanover	16	.23, E. 1/2 NW SW	10	Gravel		765 ?
240	Cook	Hanover	16	.31, Cen. SE SW	140	Till		800
~~241~~	Cook	Hanover	17	.65, S. 1/2 SW NE	38	?		
~~241~~	Cook	Hanover	17	.64, N. 1/2 NW SE	175	?		
242	Cook	Hanover	18	.62, S. 1/2 NW SE	24	Gravel		760
~~243~~	Cook	Hanover	18	.61, Cen. SW SE	180	?		
244	Cook	Hanover	20	.28, W. 1/2 NE NW	20	Gravel to red clay		790
~~245~~	Cook	Hanover	21	.08, W. 1/2 NW NW	20	?		
~~246~~	Cook	Hanover	21	.99, NE NE NE	74	?		
247	Cook	Hanover	24	.97, SE NE NE	192	189½ drift, 3' rock	637	829
248	Cook	Hanover	25	.68, Cen. NW NE	174	To rock	638	812
249	Cook	Hanover	25	.97, SE NE NE	175	To rock	645	820
~~250~~	Cook	Hanover	28	.27, SE NW NW	77	?		
251	Cook	Hanover	28	.37, N. 1/2 SE NW	100±	Till		842
~~252~~	Cook	Hanover	29	.31, Cen. SE SW	80	?		

253	Cook	Hanover	34	.09, NW NW NW	72	Gravel		815
254	Cook	Hanover	36	.97, SE NE NE	160	?		
255	Cook	Shaumberg, 41 N.,R.10 E.	6	.52, SW NW SE	175	Gravel		790
256	Cook	Shaumberg	7	.87, S. 1/2 NE NE	161	?		
257	Cook	Shaumberg	8	.46, E. 1/2 SE NW	142	?		
258	Cook	Shaumberg	9	.22, SE NW SW	152	?		
259	Cook	Shaumberg	9	.42, SE NE SW	152	?		
260	Cook	Shaumberg	11	.59, NW NW NE	133	To rock	612	745
261	Cook	Shaumberg	11	.87, S. 1/2 NE NE	251	190' drift, 61' rock	615	745
262	Cook	Shaumberg	16	.63, Cen. NW SE	58	Gravel		810
263	Cook	Shaumberg	19	.89, N. 1/2 NE NE	195	Rock	650	845
264	Cook	Shaumberg	19	.46, E. 1/2 SE NW	167	Gravel		840
265	Cook	Shaumberg	21	.33, Cen. NE SW	150	To rock	670	820
266	Cook	Shaumberg	22	.55, SW SW NE	112	Gravel		799
267	Cook	Shaumberg	22	.44, NE NE SE	250	?		
268	Cook	Shaumberg	22	.53, W. 1/2 NW SE	91	Gravel		785
269	Cook	Shaumberg	23	.63, Cen. NW SE	20	?		
270	Cook	Shaumberg	24	.97, SE NE NE	40	?		
271	Cook	Shaumberg	29	.86, Cen. SE NE	132	Till, quicksand, to gravel		815
272	Cook	Shaumberg	36	.39, N. 1/2 NE NW	42	Clay to sand		730
273	Cook	Elk Grove, 41 N., R.11E.	7	.11, Cen. SW SW	124	To rock	600	724
274	Cook	Elk Grove	8	.68, Cen. NW NE	118	About 20'loose gravel above rock	577	695

275	Cook	Elk Grove	8	.35, S. 1/2 SE NW	117	To rock	583	700
276	Cook	Elk Grove	8	.94, NE NE SE	105	To rock	591	696
277	Cook	Elk Grove	17	.04, NW NW SW	35	Clay to sand	~~591~~	691
~~278~~	Cook	Elk Grove	18	.05, SW SW NW	70+	?		
279	Cook	Elk Grove	19	.09, NW NW NW	112	Clay, gravel to quicksand		720
~~280~~	Cook	Elk Grove	19	.39, N. 1/2 NE NW	309	?		
281	Cook	Elk Grove	19	.94, NE NE SE	20	Clay		692
282	Cook	Elk Grove	20	.85, S. 1/2 SE NE	65	20' clay, 40' gravel, clay		703
283	Cook	Elk Grove	20	.21, E. 1/2 SW SW	30	Clay		690
284	Cook	Elk Grove	29	.83, Cen. NE SE	50	Gravel		693
285	Cook	Elk Grove	30	.95, SE SE NE	13	Clay to sand		693
286	Cook	Elk Grove	30	.22, SE NW SW	35	Gravel and clay		702
287	Cook	Elk Grove	31	.26, E. 1/2 SW NW	22	Gravel		708
~~288~~	Cook	Elk Grove	31	.86, Cen. SE NE	135±	?		
289	Kane	Dundee, 42 N., R. 8 E.	1	.64, N. 1/2 NW SE	198	88' gravel and sand 60' till 50' gravel Rock at bottom	677	875
~~290~~	Kane	Dundee	13	.73, E. 1/2 NW SE	190	?		
~~291~~	Kane	Dundee	24	.56, W. 1/2 SW NE	195	?		
292	Kane	Dundee	24	.77, SW NE NE	230	Gravel		870
293	Kane	Dundee	24	.96, E. 1/2 SE NE	110	Gravel		860
294	Kane	Dundee	36	.70, SW SE SE	70±	6' clay, 60' gravel		820