w York State Museum Bulletin

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The University of the State of New York

New York State Museum

JOHN M. CLARKE, Director

GLACIAL GEOLOGY OF THE SARATOGA QUADRANGLE

BY

JAMES H. STOLLER

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THE UNIVERSITY OF THE STATE OF NEW YORK

1916

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The University of the State of New York
Science Department, June 5, 1915

Dr John H. Finley
President of the University

SIR:

I beg to transmit to you herewith and to recommend for publication as a bulletin of the State Museum, a manuscript, together with the necessary illustrations and maps, relating to the *Glacial Geology of the Saratoga Quadrangle,* which has been prepared by Dr James H. Stoller for the use of this Department.

Very respectfully
JOHN M. CLARKE
Director

THE UNIVERSITY OF THE STATE OF NEW YORK
OFFICE OF THE PRESIDENT

Approved for publication this
7th day of June 1915

President of the University

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INTRODUCTION

This report deals with the deposits of the glacial or Pleistocene period of geological history as they occur on the area of the Saratoga quadrangle. In general, these deposits consist of the aggregate of materials which overlie bedrock. The sands and clays which make up the body of the soils and subsoils, the coarser fragments, gravel, cobbles and boulders, are materials derived from the ice sheet of the glacial period. To these glacial deposits slight accessions have been made in the recent epoch, namely, the alluvial deposits of streams, low hills of blown sands and the accumulations of vegetable debris in swampy areas. Brief mention of these recent deposits is also made in this report.

The thickness of the mantle of materials overlying bedrock varies in different portions of the area from nothing (where patches of bare rock occur) to more than 200 feet. Its modes of arrangement, whether heaped up in masses, where deposited from moving ice, or laid down in even horizontal layers, where deposited in waters accumulated from the melting of the ice, have determined generally the minor features and in places the bolder and characteristic forms of the landscape. The nature of the country as fitted to be the abode of man has likewise been determined largely by the composition and distribution of the glacial deposits. The kinds of soils and their tillability, the location of springs and lakes, the courses of the streams and the occurrence of falls as sources of power, are almost wholly results of conditions and agencies that prevailed during the glacial period. The purpose of the present work is, first, to describe the glacial deposits in regard to their composition, distribution and topographic forms and, second, to deduce from these data the steps of geological history recorded.

PHYSICAL GEOGRAPHY

The surface distribution of the glacial deposits, especially those laid down during the epoch of flooded waters, was determined largely by bedrock topography. A brief description of the general physiographic features of the area included within the quadrangle will be therefore first given.

The area presents marked contrasts in topographic features. The southeastern portion, including a strip along the middle eastern margin, lies within the general valley of the Hudson. It bears the character of a sand plain and is continuous with the extensive region of like character which prevails north and south in the Hudson valley. The village of Saratoga Springs is built upon this plain. The general elevation of the plain is about 320 feet except in the southern portion where, in the paths of late glacial water-courses, the sands have been swept away. A portion of Saratoga lake, the elevation of which is 204 feet, occupies the southeastern corner of the quadrangle. Rocks outcrop along the shore of the lake and it is inferred that the bed of the lake is an old erosion valley.[1]

West of the Hudson Valley plain and lying within the township of Milton is a level, sandy tract some 6 square miles in areal extent which stands at 400 feet elevation. It is separated from the Hudson plain by a slope of low pitch but distinct and continuous and clearly indicated by the contour lines of the map. As will be shown later, this Milton plain originated under conditions differentiating it from the lower level plain.

In contrast with the low elevation of the Hudson plain area are two regions of highlands. One of these lies in the northeastern and middle eastern portions of the quadrangle and includes in its southern development the hilly and in large part forested country north of the village of Saratoga Springs. On its eastern border it is sharply separated from the plain area by a steep slope which in

[1] Woodworth, *Ancient Water Levels:* N. Y. State Mus. Bul. 84, p. 76, 1905.

its geological origin is a fault scarp. Farther to the north the country exhibits more distinctively the characteristics of the Adirondack mountain region. The highest elevation is attained in the summit of Mount McGregor, 1120 feet, crossed by the edge of the sheet about 3 miles south of the northeastern corner. The

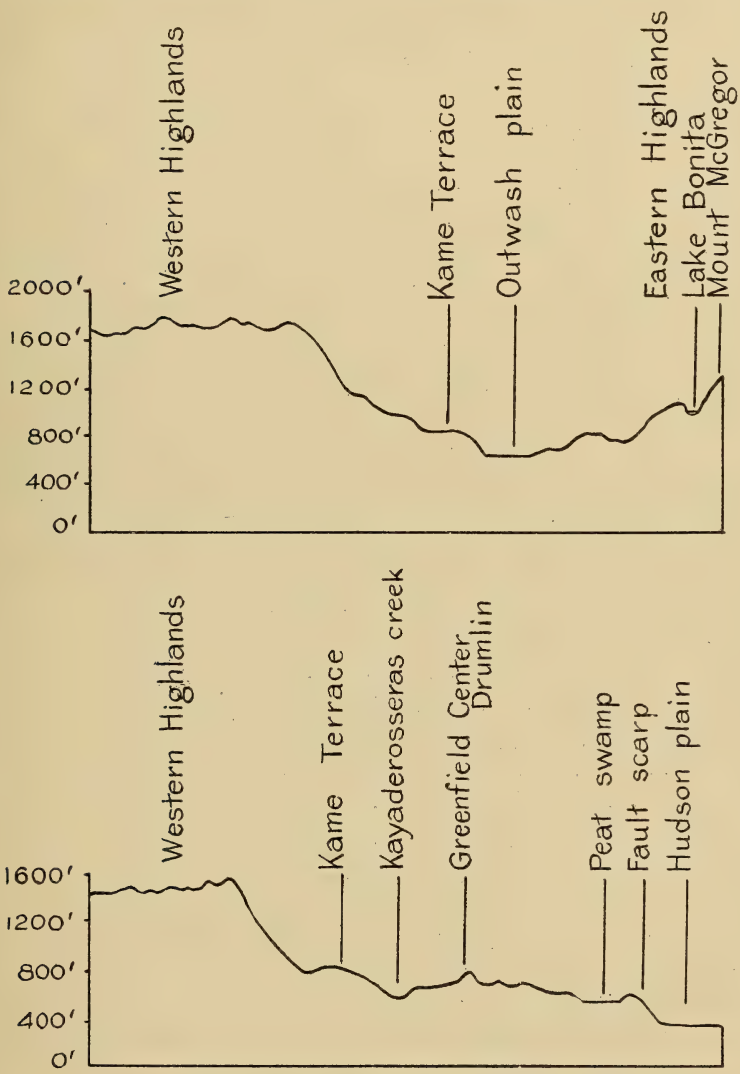

Fig. 1 Showing the surface contours in east-west section across the Saratoga quadrangle — Horizontal scale, 1 inch = 4 miles; vertical scale, 1 inch = 1600 feet. The location of the sections on the map may be determined by the notations.

region is marked by a small lake, Lake Bonita, which occupies a rock depression at the elevation of 860 feet. Its drainage is northward to the Hudson river. The highlands are deeply trenched, in the northeastern portion of the quadrangle, by the Hudson river which at Corinth turns abruptly eastward in its course and after several sharp bends emerges from the mountainous district upon the Hudson Valley plain in the tract near Glens Falls. As stated by Wright[1] and Miller,[2] this portion of the Hudson valley has been formed since preglacial times. The conditions and factors which determined its origin and development will be discussed later in this report.

The second region of highlands occupies the northwestern portion of the sheet extending southward as far as East Galway. It belongs to the general territory of the Adirondacks and possesses the typical physical features of the low mountainous portion of the Adirondack country. The general elevation approaches 2000 feet, the highest point being 2025 feet. From the mountain crests the country falls off sharply to the east, forming a steep slope facing the central basin described below. Beyond the crests to the west the region has somewhat the character of a mountainous plateau, broken by hills and depressions. Many of the latter are occupied by small lakes or swamps. The drainage of this portion of the area is toward the west, the creeks ultimately discharging into the Sacandaga river. This region is sparsely populated or uninhabited, the soil being generally untilled and covered with second-growth forests.

Lying between the two highlands regions is a broad basin underlaid by stratified rocks of the lower Paleozoic series. This basin is continuous with the general valley of the Hudson north of Corinth and is evidently identical with the latter in geological origin. The rock floor of this erosion channel is now generally covered with deposits of glacial age and the exact course of the preglacial stream, heading in the upper Hudson valley, can not be traced southward beyond Corinth. The topography of the basin itself becomes obscured by heavy drift toward the south and becomes entirely lost in the southern portion of the sheet.

The general level of the bottom of the basin may be stated as 600 feet. A low divide occurs near South Corinth, the elevation here being 636 feet. The principal drainage stream of the Saratoga

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[1] Science, November 22, 1895, p. 675.
[2] Bulletin of the Geol. Soc. of America, 22:185.

quadrangle, Kayaderosseras creek, rising on the slopes of the Adirondack mass to the west, turns southward at the divide forming the drainage axis of the basin to the south, while Sturdevant creek, rising in the vicinity of the divide and flowing northward, forms the extension of the axis to the north. Both these streams traverse, for the most part, broad and flat sandy tracts which, as is shown below, are aggradation plains developed in late glacial times.

In addition to the topographic regions thus far described, there is to be noted the hilly uplands area of the southeastern portion of the quadrangle. This area is underlaid by stratified rocks and, as determined by the slope of the underlying rock surfaces, would probably be found to belong to the Paleozoic erosion basin referred to above. But on account of heavy glacial deposits which extend from near Greenfield southeasterly across the sheet, the area in question, in respect to its surface topography, becomes differentiated from the basin just described. Its drainage is into Kayaderosseras creek where that stream in its course from near Middle Grove to Ballston Spa has cut into the thick mantle of Pleistocene deposits, in many places to bedrock and in the vicinity of Ballston Spa into the underlying shale rock, forming a gorge.

The further course of the Kayaderosseras may here be noted. At Ballston Spa it emerges from the rock gorge and pursues a meandering course, bordered by broad flats, across the lower sand plain region. It receives as a tributary Coesa creek (not named on the topographic sheet) which drains the greater portion of the sand plain area to the north as well as the southern slopes of the highlands north of Saratoga Springs and the hilly region south of Greenfield. The Kayaderosseras empties into Saratoga lake, which has as its outlet Fish creek which discharges into the Hudson river near Schuylerville.

DIRECTION OF MOVEMENT OF THE ICE

The direction of movement of the continental glacier across the area is well indicated both by the glacial striae and by the long axes of the numerous drumlins. Striae are commonly present on the surfaces of the limestone formations that form the bedrock immediately north of Saratoga Springs and westward across the quadrangle. They were observed in the following localities:

1 One-half mile north of Kings Station, on limestone, near schoolhouse, 16° west of south. Other striae were observed in this locality with a direction averaging about 48° west of south.

2 Three miles southeast of Kings Station, on sandstone, along highway, 54° west of south.

3 Near the northern limits of the village of Saratoga Springs, on limestone rocks in quarry, 56° west of south. Scratches are conspicuous on surface of rock on east side of quarry.

4 About half a mile northwest of the village of Saratoga Springs, along the line of the Adirondack railway where crossed by east-west highway, on limestone, 48° west of south.

5 About a mile north of the last-mentioned station, along line of railroad, in limestone quarry, 37° west of south.

6 Two miles northwest of Saratoga Springs, near junction of road running westward from Woodlawn Park with north-south road, on limestone, 63° west of south.

7 About 1¼ miles southwest of the locality just mentioned in abandoned limestone quarry, 26° west of south.

8 Near the old stone mill along creek 2 miles east of North Milton, on limestone, 30° west of south.

9 About a mile north of the last-named locality along highway, on limestone, 54° west of south.

10 A short distance east of Greenfield station near railroad cut, on limestone, 36° west of south.

11 At South Greenfield, near church, on limestone 33° west of south.

12 Near Rock City Falls on upper area of bare limestone rock, 58° west of south.

13 At crossroads 1 mile west of Kayaderosseras creek on road leading from Rock City Falls to East Galway, on limestone, 52° west of south.

14 One mile east of Middle Grove, north of crossroads, on limestone, 38° west of south.

The readings as here given are true north.

The directions of the long axes of the drumlins correspond in a general way with the directions of the striae on the rock surface. On the whole they show a less angular direction to the west than the glacial striae. It is to be considered that the former indicate the latest general movement of the ice sheet, while the scratches may record movements of earlier stages also. It is further to be considered that striae may often indicate variations in direction of movement due to local irregularities of surface. In general it may be said that the orientation of drumlins affords the more reliable indication of the direction of movement of the ice sheet in its latest general advance, while the striae indicate exactly direction of movement of the ice in the localities where they occur and at that stage of glacial history when the striae were formed.

The data given above show a movement of the continental glacier in the region under consideration in the general direction of about 42° west of south. This is in accord with the statement of Chamberlin[1] to the effect that the ice moved around the southeastern border of the Adirondack region and thence westerly in the Mohawk valley. It is also shown, on the evidence of the drumlins, that this was the direction of movement of the ice at the time of its latest general advance (Wisconsin stage).

The data afford evidence of the influence of local topography on the direction of ice movement. The striae pointing 16° west of south at locality no. 1, as well as the direction of the well-defined drumlin about a mile to the north of this locality may indicate that the deeper portion of the mass of ice lying over the Hudson plain was controlled in its direction of movement by the fault scarp. Comparing locality no. 3 with the former, it appears that as soon as the ice pressing against the fault scarp passed this barrier it became deflected to the west, its movement thus merging with that of the general glacier. It is evident, however, that this control of movement by the scarp was not constantly effective, inasmuch as at the same locality (no. 1) there are other striae pointing about 48° west of south. It is possible that it was only during the waning of the ice sheet, when the mass had thinned or disappeared on the highlands, that the scarp controlled the direction of motion of the persistent ice occupying the Hudson plain.

The direction of movement of the ice in the central basin, as indicated especially by the long axes of the drumlins, trended progressively to the west of south. In this a general parallelism with the line of the base of the slope of the Adirondack spur west of the basin is exhibited. It is inferred that the flow of the deeper portion of the mass of ice occupying the central depressed region conformed to the lay of the slope.

EROSIVE EFFECTS OF ICE MOVEMENT

There is evidence of vigorous ice action over the eastern highlands region, and on its southern slope. Along the road running from Kings Station to Kings there are frequent exposures of knobs and knolls of smoothed rock. In many cases the exposed surface faces northward, or northeastward, indicating that the abrasion is

[1] U. S. Geol. Survey, 3d Ann. Rep't, p. 361–65.

due to ice, the stoss side of the rock mass, against which the ice moved, having suffered more wear than the lee side. Similar exposures of rock, showing in their shapes and surfaces the effects of glacier erosion, were observed in other localities; for example, along the road that crosses the mountainous tract south of Lake Bonita. Also on the southern slope of the highlands, in Woodlawn park and westward, along the line of the railway, outcrops of worn rock are frequent.

The crystalline Precambric rocks of the highlands region were resistant to ice erosion but there is evidence that the soft shale rocks which underlie the village of Saratoga Springs, in its southwestern portion, were deeply gouged out by the ice. The records of borings made by one of the companies formerly engaged in pumping carbonic acid gas show that at points near South Broadway, about a mile southwest of Congress park, shale rock lies at a depth of 162 and 140 feet below the present surface.[1] Taking into consideration that the harder limestone (dolomite) rocks appear at the surface immediately north and west of Saratoga Springs it is inferred that as the deeper ice of the Hudson plain passed beyond the wall of the scarp and merged with the general mass, changing its direction of movement to the southwest, the soft underlying shales were powerfully eroded.

The effects of glaciation are in places conspicuous on the southward facing slopes of the Greenfield tract. An interesting work done by the ice is the exposure and planing down of the remarkable Cryptozoon reef beds of the limestone by the roadside near the Hoyt quarry, 2½ miles due south from Greenfield Center. A photograph of this exposure is given in New York State Museum Bulletin 173.[2]

DESCRIPTION AND INTERPRETATION OF THE DEPOSITS

Unmodified till. Materials derived from the ice sheet and left at the time of melting now overlie bedrock and form the surface mantle of soils and rock fragments of the uplands region generally. The composition of the till varies markedly in different regions and

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[1] These data were obtained through the courtesy of Mr Frederick G. Edwards, engineer for the Commissioners of the State Reservation at Saratoga Springs. They were taken from the well book of the company formerly operating, the book being now in possession of the commission. See also page 17 of the present report.

[2] Since the above was written this area has become the property of the New York State Museum and has been named Lester Park.

clearly shows the local origin of much of the rock debris. In the mountainous areas and in the northern portion of the central basin the till is characterized by a relatively large amount of sand entering into its composition. In these regions the soils, lacking the clay constituent, are of loose texture and are poorly adapted for agriculture. Boulders and cobbles of gneissic and other crystalline rocks are abundant. These features of the till are clearly to be connected with the source of the materials from the Precambric rocks to the north.

In the southern portion of the central basin where the underlying rock is limestone and in the southwestern portion of the quadrangle where the bedrock is shale and shaly sandstone, the clay element in the till is in larger proportion and the lands are capable of productive cultivation.

The thickness of the till varies widely in different localities, ranging from zero, where bare rock surfaces occur, to more than 200 feet, as measured by the height of the highest drumlins. In the eastern highlands region the till is for the most part thin; thus along the roads running eastward from Greenfield Center to Kings Station there are numerous exposures of bare rocks. In many places, especially along the more northerly of the two roads, the till is of such slight thickness as to have been washed away from the roadside gutters.

In the southern portion of the central basin and extending southwestward across the quadrangle there is a heavy mantle of till, showing in places a thickness of 200 feet. A natural section of the till is afforded near Rock City Falls where Kayaderosseras creek has cut through the formation to bedrock. The mass of till (which forms a drumlin in its upper portion) south of the creek shows an elevation of 240 feet above bedrock.

This marked difference in respect to the thickness of the mantle of till, as between the two regions just referred to, is evidently due to the influence of topography in determining the deposition of debris carried by the ice sheet. As the ice moved across the highlands it scoured off the preexisting soils and rock fragments and at the same time broke off and to some extent ground down projecting ridges and ledges of rock. The materials thus gathered were deposited by the advancing ice sheet in the old valley, the course of which lay across the path of ice movement. The effect was to reduce the general relief of the older topography, the western slope of the highlands having been somewhat smoothed down, while the old valley was obliterated, having been filled in with drift. At the same time the newer topography exhibits a much greater variety in minor features, due to the heaping of the deposits and the intervening depressions.

Mention may here be made of a remarkable boulder of which a photograph and description by Cushing[1] is here reproduced: "We can not leave Pleistocene matters without calling attention to one detail, the impressive glacial boulder shown in plate 1. It stands on the summit of a low drumlin 3 miles due west from Saratoga and is a conspicuous object. Viewed from a distance it looks like a monument, a simple shaft. It consists of a huge slab of Little Falls dolomite about 15 feet long, stood up on end. Some exfoliation has taken place, due to frost attacks, but on the whole it has suffered comparatively little damage from the weather. For the glacier to leave a block of such shape in such position in such commanding situation is highly exceptional, and is one of the most striking objects of the kind that we have had the privilege of becoming acquainted with."

Drumlins. Many of the hills of till in the region just referred to possess characteristically the forms and orientation of drumlins. In the Greenfield locality they form conspicuous and imposing features of the landscape. The largest of them are about three-fourths of a mile in length and have an elevation, measured from the immediate base, of about 100 feet. A considerable range of forms as dependent upon ratio of width to length is exhibited. Some are broadly oval; others, more typical, are about three times as long as wide; a few are narrowly oval, approximating a ridge-like form. Not all the drumlins have been indicated by color on the map. Those designated possess a rather marked regularity of form and some are noticeable for their strikingly smooth and evenly carved outlines. In some of the hills it was determined by observation that the materials of which they are composed are of the nature of till.

Lake Albany deposits. The materials of the sand-plain region in the southeastern quarter of the quadrangle vary in different localities, as seen at the surface, from coarse sands to fine-grained sands and clayey sands. There are sufficient exposures in section, along creeks and in sand pits and excavations for highways, to establish the stratified arrangement of the materials. They are

[1] Geology of Saratoga Springs and Vicinity, by H. P. Cushing and R. Ruedemann. N. Y. State Mus. Bul. 169, p. 147.

Plate 1

H. P. Cushing, photo, 1910

Glacial boulder of Little Falls dolomite on the summit of a low drumloid hill, 3 miles west of Saratoga. The boulder stands on end and from a distance bears a strong resemblance to a monument shaft.

Plate 2

J. H. Stoller, photo, 1913

Drumlin one-half mile southeast of Greenfield station.

clearly deposits made in static waters. As a body the sands are continuous with formations of like character which extend north, east and south in the general valley of the Hudson. It has been shown by the work of Woodworth and others that these sands and clays are deposits made in the extensive body of glacial waters named Lake Albany.[1]

In the present account it will be convenient to distinguish between the Lake Albany deposits which form the lower plain at average elevation of 320 feet (which may be called the Saratoga plain) and the upper or Milton plain with elevation of 400 feet. The materials of the Saratoga plain, while varying in different localities, consist predominantly of fine-grained sands with admixture of clay. Over a considerable portion of the area the soils are of the type commonly described as sandy loam and afford excellent farming and gardening lands. The State forest nurseries located southeast of the village of Saratoga Springs occupy lands of this formation.

The thickness of the deposits of the Saratoga plain as exposed where Coesa creek has cut through them to bedrock (near where the railroad lines cross the creek, 2 miles southeast of Saratoga), is about 40 feet. About 1 mile to the north of this point the records of borings made by the gas-pumping company referred to above indicate a thickness of 95 feet of sands and clayey sands. The records of these borings as taken from the well books of the company are as follows:

	Well no. 1 feet	No. 2 feet	No. 3 feet
Soil and common sand	49	54	54
Quicksands	28	31	29
Putty clay	18	10	9.5
Blue clay	32	21	19.5
Dark gray sand and gravel	35	24	....
Slate rock	38	43	....
Lime rock	23	....	....

It is evident that the first three divisions of strata (together 95 feet in thickness) comprise Lake Albany deposits and that the fourth and fifth divisions represent glacial till. As already explained, the glacial deposits here occupy a depression in the underlying rocks.

[1] According to Fairchild, the body of waters in which the Hudson valley clays and sands were deposited was at sea level and at its highest development formed a strait connecting the oceanic waters which then occupied the Saint Lawrence valley with the ocean at New York. *Pleistocene Geology of New York State; Science,* Feb. 21, 1913, p. 295.

At other places on the Saratoga plain a thickness of not less than 40 feet of sand is shown. For example, the valley plain of Coesa creek, where the more northerly of the two roads running west from Saratoga Springs crosses the stream, is sunk about 40 feet below the level of the general plain and there are no boulders in the bed of the creek, the stream not yet having cut through the sand to the underlying till. Also the depth of the valley of the outlet stream of Loughberry lake, northeast of Saratoga Springs, shows a thickness of the sands of more than 40 feet.

The Saratoga plain represents an accumulation of sediments which were deposited in this portion of Lake Albany by currents moving in the general body of the lake. It does not stand in relation to the mouth of a large stream which discharged into the lake as in the case of the Milton plain (described below) and the Schenectady plain at the mouth of the Mohawk. In other words, the plain was not built up as a marginal delta but by sedimentation from the currents of the lake itself. In regard to their source and the conditions of their deposition in the lake, the following considerations may be pertinent: As Lake Albany formed, the gathering waters spread over the materials left from the melting ice sheet. These materials were in part the debris of the ground moraine and in part the somewhat assorted deposits of the streams issuing from the ice sheet at its front or from its surface. As these deposits became covered by the waters of the lake they were subject to the work of waves and currents. Shore waves leveled and spread out the materials as the growing lake advanced its margin. The inflow of waters from the flooded streams discharging into the lake caused strong lake currents in the direction of the outlet of the lake. Where these currents became established they degraded, in places, the deposits forming the bed of the lake and transported the finer materials to more quiet waters, filling bottom depressions and lateral expansions of the lake. These currents were subject to shiftings of position and fluctuations of volume and velocity according to varying seasonal, climatic and other physical factors. Thus the deposits derived from the ice sheet were generally redistributed and through the sorting power of water laid down in stratified arrangement.

The sediments derived from the drainage of the land surfaces surrounding the lake were, in part, also distributed by lake currents; but the building of deltas at the mouths of the larger streams was a notable fact in the history of Lake Albany. One of these delta formations is now to be described.

Plate 3

J.H. Stoller, photo, 1913

The Saratoga plain. Grounds of the State Forest Nursery in Geyser Park one mile southeast of the village of Saratoga Springs

Plate 4

J. H. Stoller, Photo 1912

The Milton delta as exposed in a sand pit north of the village of Ballston Spa. The inclined layers in the middle portion of the section (somewhat hidden by sand that has fallen from above) possibly represent the fore-set beds of the delta.

The Milton plain is an area of well-defined physiographic features. In the greater portion of its expanse its surface approximates a dead level. The road running nearly due north from the village of Ballston Spa traverses 4 miles of sandy and in part barren and desertlike lands. The east-west road from Milton Center crosses the same tract, measuring a distance of about 3 miles. This area is practically destitute of streams, the rainfall sinking into the porous soils. The plain has a clear relief of 80 feet above the Saratoga plain. The transition from the upper to the lower plain is a slope of irregular and broken surface but in its larger outlines, as shown by the map contours, having marked lobate features. Along these slopes there is a series of springs whose waters are obviously derived from the sands of the plain and represent its drainage. They are of considerable volume and constitute the source of public water supply for the village of Ballston Spa.

The southern extension of the Milton plain is crossed by Kayaderosseras creek which, as stated above, has cut through the sands and, in its lower course, through the underlying till into bedrock. The 400 foot level of the plain is shown in a portion of the area beyond the creek but farther to the south the elevation of the plain becomes reduced. Its limit to the south is about a mile beyond the edge of the sheet where it forms two lobes which gradually thin out at their margins (see map of Schenectady sheet accompanying New York State Museum Bulletin 154). The two lobes were, however, originally one, the division having been made by a late glacial water course, the channel of which is now occupied by Mourning kill which flows northward to the Kayaderosseras about a mile east of Ballston Spa.

The Milton plain is clearly a delta built into Lake Albany by a stream coming from the north and which in its lower course followed the valley now occupied by Kayaderosseras creek. It will be shown farther on in this report that this stream was a portion of the Hudson river which in the time of flooded waters was diverted southward from the present Hudson valley at Corinth.

In addition to its level surface and its lobed margin, evidence that the Milton plain is a delta in origin is afforded by the arrangement of its materials. In a sand pit near the northern limits of the village of Ballston Spa an exposure of about 35 feet of the upper portion of the formation is shown. The sands are stratified, mainly in inclined layers, representing, apparently, the fore set beds of the delta. The layers vary in respect to size and sharpness of grain of the sands, indicating fluctuating currents.

Kame terraces. Along the base of the western Adirondack spur massive accumulations of sand and gravel, intermixed with some cobbles and boulders, occur. They are conspicuous features of the landscape when viewed from the opposite (eastern) slope of the central basin, appearing as elongated and approximately flat-topped hills against the background of the mountain slope. The most extensive development of this formation occurs west of South Corinth and extends northward to the edge of the sheet, forming a continuous mass 6 miles in length and varying in width from half a mile to nearly 2 miles. This body of materials does not possess, however, a uniform elevation and represents rather an elongated and irregular bank rather than a definite and continuous terrace. The elevation is greatest in that portion which lies west of South Corinth where, a short distance back from the mountain slope and separated from it by a gulley, the summits of the broken surface are at the 900 foot level. Farther to the north the elevation of the mass of gravels is less and that portion crossed by the Adirondack railway west of Corinth stands at 700 feet. Here, west of the railway, there is an approach to uniformity of elevation which gives to this portion of the formation a topography approximating that of a terrace.

Another extensive accumulation of sand and gravel in like relation to the mountain slope occurs southeast of Porter Corners. In this case the mass is developed eastward to the valley plain along Kayaderosseras creek, the surface sloping, though in an irregular way, from the mountain base to the border of the creek. Farther to the southeast a series of sand and gravel hills, separated by stream courses, follows the mountain base and, in similar relations, a larger area extends farther southeastward, terminating near the village of East Galway.

Considered as to the details of surface topography, these formations present characteristic features. Well-defined kames occur, especially in the Corinth areas. They are hills, composed of sand and gravel, of varied sizes and shapes but in general of moundlike aspect. In regard to arrangement of materials they partake of the stratification common to the mass of which they form a part. Excellent exposures are shown along the recently constructed macadamized road running northward from South Corinth. Also in numerous gullies there are exposures showing the layered arrangement of the materials.

The depressions between the kames are often kettle holes and in

Plate 5

J. H. Stoller, photo, 1912

Kame terrace about one mile north of South Corinth. The Adirondack mountains appear in the right background. Near the tree at the left of the picture is a large isolated boulder. The depression in which the boulder lies and which extends as a broad channel to the foreground of the picture is due to erosion by flooded waters of late glacial times.

Plate 6

J. H. Stoller, Photo, 1912

A view of a portion of the kame terrace west of South Corinth, showing that the sands and gravels of which they are composed are easily eroded and gullied.

the area crossed by the railway three lakelets without outlets occur. Other depressions are in the form of conspicuous broad channels, on the valleyward slope of the formation, with dry bottoms thickly strewn with cobbles and boulders. They are evidently the results of erosion by flooded waters of late glacial times. An example occurs about one-half of a mile north of South Corinth, the lower end of the channel being crossed by the highway. About 2 miles south of Porter Corners two parallel dry erosion channels occur, separated by an intervening ridge. They are indicated by the contour lines of the sheet.

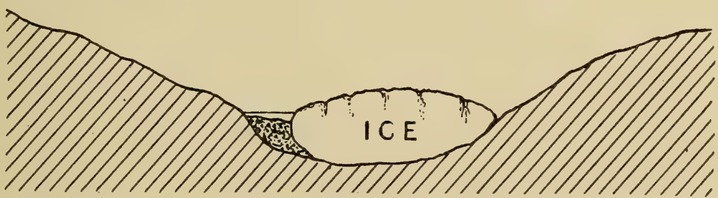


Fig. 2 Diagram illustrating mode of origin of kame terraces, as described in the text. (Adapted from Salisbury)

A kame terrace has been defined as "a terrace of sand and gravel, deposited by a glacial stream between valley ice (generally stagnant) and the rock slope of the valley."[1] The kame terraces here considered are in accord with this definition. While a thick mass of ice still lingered in the central basin, the mountain to the west became freed of ice. Between the base of the bared rocky slope and the lateral margin of the ice lobe a valley formed, due to the more rapid melting of the ice where exposed to the higher temperature of the bared slope. Waters derived from the melting ice to the north, following the lowest line of drainage, occupied this valley. The stream thus formed deposited along its course more or less of the sand and gravel transported by it. As the ice continued to melt, the stream shifted more and more valleyward, thus building a broad mass of deposits, somewhat of the form of a terrace. The varied factors involved in the construction of the mass, as changing currents, irregularities of ice margin, detachment and subsequent melting of ice blocks, washing out and slumping of the deposits, account for the present structural and topographic features of the formations.

It is interesting to note that a miniature kame terrace was developed on the eastern slope of the eastern Adirondack highlands,

[1] Salisbury: Geol. Sur. of New Jersey, 5:123. 1902.

about 2 miles north of Kings Station. Farther to the north beyond the limits of the sheet at the foot of the eastern slope of Mount McGregor and Palmertown mountain there are extensive developments of kame terraces.[1]

There are a number of isolated groups of hills composed mainly of sands and gravels and of the hummocky aspect characteristic of kame topography. Their locations are shown on the accompanying map. The group of largest areal extent lies about 2 miles northwest of Milton Center. This appears to be, definitely, an area of isolated, or extramorainal, kames. Another area of hills of sand and gravel of characteristic kame topography is located north of Middle Grove and east of Kayaderosseras creek. It seems probable that this area was originally connected with the massive sand formation on the opposite side of the creek and which is continuous with the kame terrace at higher elevation, as described above. It would seem that over this entire region there lay a mass of stagnant ice and that accumulations of sand and gravel took place both at its western edge (thus forming the kame terrace) and at its southern margin, thus forming a belt of kames, the southernmost extension of which is the group of hills under consideration.

Recessional moraine. About 3 miles south and southeast of Corinth there is a region marked by the topography characteristic of terminal moraines. The surface of the country is made up of hillocks and hollows, or ridges and troughs, without order of arrangement but forming collectively an irregular belt, extending in a general east-west direction and having a length of about 6 miles. The western end of this belt is now separated from the kame terrace formation above described by the valley of Sturdevant creek and by a leveled terrace, thickly strewn with cobbles and boulders, east of the creek. This leveled area is unquestionably a portion of the moraine reduced by stream erosion. In its eastward extension the moraine stretches to the base of the region of highlands of which Mount McGregor is the center. Thus, taken in connection with the kame terrace, the moraine originally formed a continuous belt of elevation across the central depressed area.

The general shape of the moraine in its surface distribution and considered as a whole is that of a series of lobes pointing southward, that is, in a direction corresponding roughly to the direction of movement of the ice. In all, there are four lobes. The reentrant angle south of the moraine between the first and second

[1] Woodworth, *op. cit.* p. 140.

Plate 7

J. H. Stoller, photo, 1912

The recessional moraine, showing the kame hills and hollows which are the characteristic surface features of the western portion of the morainic belt

Plate 8

J. H. Stoller, photo, 1912

The recessional moraine. In this portion, near the cross-roads, about three miles southeast of Palmer, it bears the character of a boulder moraine

lobes, in order from west to east, is a low swampy area and may be due to the gathering of debris around an ice block.

On the northern border of the moraine, in its western half, there is a sandy tract described below, under head of Lake Corinth deposits. The eastern half is bordered on the north by a stony till, except that the terminal eastern lobe is bordered by a stretch of sand which is terracelike in its relation to the river and will be considered later in this report.

The width of the moraine, measured along the line of the crest of the western lobe, is about 1 mile; the average width may be stated at one-half of a mile. The elevation of the moraine above the general level of the areas bordering it is nowhere above 40 feet, as indicated by the contour lines of the sheet. To the observer the elevation is best appreciated by noting the steep front of that portion of the moraine which lies parallel with the road that crosses the east branch of Sturdevant creek. This front, however, represents a section of the moraine due to stream erosion. The coarse gravel, cobbles and boulders that are thickly strewn over the level space between the road and the base of the steep slope are proof of the work of strong currents. Back of the front the unmodified surface of the moraine shows in its characteristic features. There are in this locality a number of kettle holes, one of which contains standing water.

The materials of the moraine differ considerably as between the western portion and that farther to the east. The former is made up of sand and gravel together with many cobbles and boulders. In the eastern extension, comprising that portion of the moraine which is bordered on the north by till, there is a less proportion of the finer materials and the formation takes on the characters of a boulder moraine. In this portion, while the hills are lower, the surface becomes exceedingly rough and stony. In general the boulders have the appearance of being less worn than the ordinary boulders of the till, some being marked by considerable angularity of form. The largest one observed measured about 9 feet in height and 55 feet in circumference. On one side a joint face was discernible. It could scarcely be questioned, however, that these fragments are erratics, since they are heaped together in a manner which shows the agency of ice transportation. The portion of the belt showing boulder moraine features comes to an end at Stony Brook and is there succeeded by hills of sand and gravel of typical kame features. The moraine ends somewhat abruptly in a steep slope facing the river. It is evident that it originally extended farther to the east and has been cut away by river erosion.

The interpretation placed upon the facts pertaining to the moraine, above reported, is as follows: When, in the final retreat of the lobe of ice occupying the central basin, the ice front stood in the line of the present moraine, a halt or stationary phase in its recession supervened. The causes which determined this may have been general, that is, climatic, but it seems probable that local conditions were at least contributory factors. The moraine lies in that part of the depression where the mountainous highlands to the east and west are at their greatest elevation. Between the present level of the basin in its lowest part and the highest point of the eastern highlands (Mount McGregor) there is a relief of 505 feet, while the western highlands show a maximum relief of 1390 feet. These figures indicate the greater thickness of the ice lying over the depression as compared with the ice covering the uplands during the period of general glaciation. As the rate of movement (flowage) of glacier ice depends upon the pressure or " head " of the ice mass, this thicker valley ice moved faster than the ice of the uplands. If we suppose that, at the time of the melting of the ice, when the ice front stood in the line of the present moraine, this differential motion of the valley ice had not been entirely dissipated — the persistent mass of ice to the north still supplying " head " — it would follow that the front of the valley ice lobe would become stationary whenever the increment of advance became a deciding factor in effecting a balance between the movement of the ice and the loss by melting.

Along the stationary front the earthy materials borne by the moving ice were released by the melting of the ice and deposited. Through the accumulation of these deposits the moraine was built up. While relatively stationary the edge of the ice advanced and receded, within limits, thus spreading the deposits and forming a belt of debris. The edge of the ice was irregular and the larger protrusions, depositing their load along their margins, resulted in the lobed form of the moraine. Through the detachment of massive fragments of ice and the heaping of debris about them, ice block holes, or kettles, were formed. Variations in the amount of materials brought to the edge of the ice at different times and at different points and the control of the deposition of these materials by the irregularities of form and shiftings of position of the edge produced the rounded hills and short ridges which are characteristic surface features of the moraine. The streams issuing from the melting ice bore a part in the distribution and sorting of the finer materials. In places they transported the sands beyond the edge of the ice, building outwash plains.

The difference in composition between the western portion of the morainic belt and that farther east may possibly be accounted for as follows: North of the western end lies the old erosion channel now forming the general valley of the Hudson from Corinth northward. The soils and materials of sedimentary origin which had accumulated on the floor of this channel in preglacial times were dragged or inclosed and transported by the glacial ice and contributed to the materials of the moraine. The portion of the belt farther east was beyond the range of accession from this source. Its materials were the soils and broken fragments of rock from the uplands region to the north of this portion of the moraine. The rugged surface of this region was favorable to the detachment of fragments of the bedrock and many of these as indicated by their angularity, were derived from not distant localities.

The outwash plains. South of the western end of the moraine and marginal to it is a broad plain traversed by Sturdevant creek and extending southward to beyond South Corinth station. This is unquestionably a plain of aggradation. Its materials are sands and gravels more or less stratified in arrangement. At a point a short distance south of South Corinth station, Kayaderosseras creek has eroded its bed to a depth of 12 feet below the general surface. The materials of the plain thus exposed consist of definitely stratified sands and fine gravels. In places, layers of coarse gravels are seen with some pebbles an inch in diameter. The layers are of uneven thickness and limited in horizontal extent. In places, a cross-bedded structure is seen.

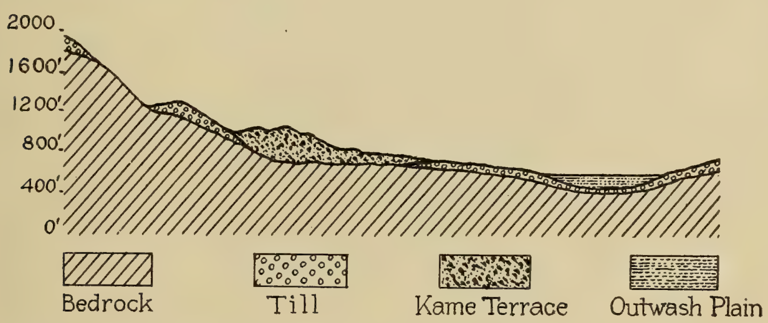


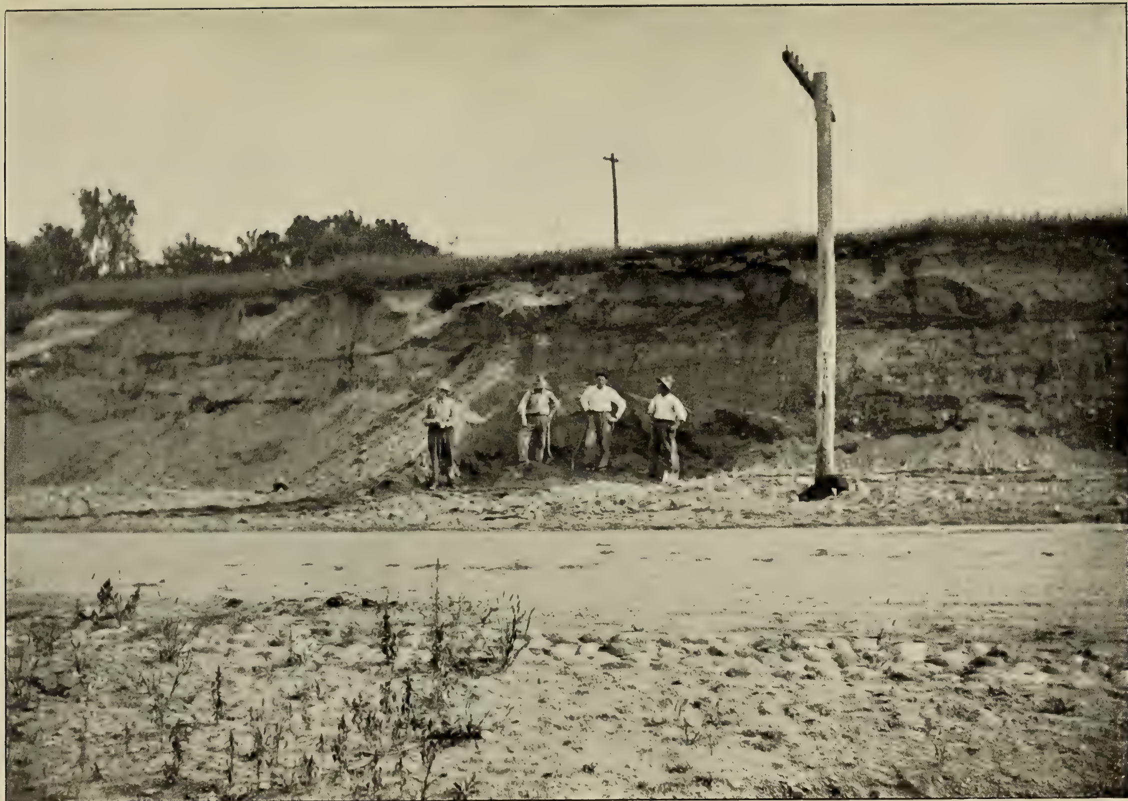
Fig. 3 Cross-section in the locality of South Corinth. Horizontal scale, 1 inch = 1 mile; vertical scale, 1 inch = 1600 feet. The surface line is drawn to scale; the thickness of the deposits is theoretical.

When the ice front stood at the line of the moraine the streams of water issuing from it and carrying debris from the melting ice deposited their excess of load beyond the edge of the ice. The waters emerging from the western end of the ice front, following the lowest course open to them, occupied the preglacial drainage valley in this portion of the basin. These waters, through deposition of sediments, gradually filled in this valley, thus developing an aggradation form. The form may have been of the type of a valley train, or an outwash plain, or of a grade between the two, according to the spread of the materials deposited, as dependent upon the width and slopes of the valley, the number and places of issue of streams from the ice front and other factors. In the early stages of its building its surface sloped toward the south (down stream) because the process of aggradation was most rapid near the ice where the coarser materials were laid down and slower below where the finer materials were deposited. The further aggradation of the plain (it is now approximately level) may have taken place at a later time, that is, after the ice front had withdrawn from the line of the moraine. It is probable that this aggradation plain represents an accumulation of deposits laid down during different stages of the drainage of the region northward to the plain.

Besides the plain just described there are two other level tracts bordering the moraine at its southern margin. One of these is the swampy area forming the reentrant between the first and second morainal lobes and, as suggested above, may represent an ice block hole. It seems probable also that with the melting of the ice, sands were washed in from the debris of the moraine and spread over the area. The third level tract extends southwestward from the point of the third lobe of the moraine. Its surface materials are in general sand with a veneer of vegetable mould. A considerable portion of the area is swampy. It bears the topographic relations of an outwash plain to the moraine and while not a typical formation of this character, it has been thought warrantable to so represent it on the map.

Lake Corinth deposits. The village of Corinth stands at the border of a sandy tract that extends northward beyond the edge of the sheet and southward to the northern border of the moraine. In its southern portion the tract broadens eastward, attaining a width of about 3 miles. The area is generally level except as cut by water courses, the present average elevation being about 640 feet. In the southeastern extension a portion of the plain shows

Plate 9



J. H. Stoller, photo, 1912

Deposits marking the site of glacial Lake Corinth. The materials consist of stratified sands and fine gravels. A boulder till underlies the lacustrine deposits.

an elevation of 660 feet and it is inferred that originally the deposits stood at this level. The materials as seen at the surface consist mainly of coarse sands grading to fine gravels, but in the southeastern extension there is a considerable admixture of clay. In the locality of Corinth the formation is exposed in section in recently graded roads and is seen to consist of a thick mass of sands and gravels well stratified. A good exposure was also seen along the road which crosses the southeastern area, the materials being stratified grayish sands weathering to yellow.

These deposits are evidently of lacustrine origin. It is clear that after the period of a stationary ice front had passed and the glacier resumed its retreat to the north the moraine acted as a barrier to the flow of waters derived from the melting ice. As the ice sheet continued to withdraw to the north a lake developed, bounded by the belt of moraine on the south and having the ice front as its northern margin. This body of glacial waters, which may be named Lake Corinth, received sediments from the melting ice and from the streams issuing from the edge of the ice and from the drainage of the slopes lying to the east and west of the lake. These sediments, abundant in quantity and borne by strong currents, were widely distributed over the floor of the lake. They continued to accumulate until the mass of stratified sands and gravels, described above had been laid down.

The overflow waters of the lake followed lines of depression across the belt of moraine forming the dam. Through differences in rate of erosion, a single outlet stream became established. The present topography, as well as the distribution of the materials of sedimentary origin, shows that the main outlet became established across the western end of the moraine. This outlet stream, after its passage across the moraine, debouched upon the outwash plain and formed a channel or channels in the plain. The materials picked up by the currents may have been deposited farther south, thus resulting in a redistribution of the materials of the plain and a further aggradation of it in its southern extension. It may thus be inferred that the lowering of the waters of Lake Corinth, due to the cutting down of the morainic dam by the outlet stream of the lake, was partly counteracted by the aggradation of the plain in the South Corinth locality.

Other lacustrine deposits. North of the group of kame hills which form the easternmost portion of the morainic belt, lies an area of sands. Its present topographic form is that of a terrace, normal to the river. (The contour lines of the sheet are erroneous in that they do not indicate this terrace form.) The upper limit of the area is near the 640 foot level and from this it slopes gently toward the river, terminating at the top of the river bluff. The materials of the bluff are till.

Another area of sands, smaller in extent, occurs on the opposite side of the river. Its elevation at the highest part of the surface is 640 feet.

These sands are interpreted as lacustrine deposits made in a body of waters impounded behind the eastern end of the morainic belt. The moraine evidently originally extended to the foot of the Luzerne mountain around which the present river flows. As the ice sheet withdrew to the north, waters gathered in a depression back of the dam made by the moraine where it abutted against the southward-extending slope of the mountain. At a later time the river established its course through the lake and eventually swept away the greater portion of the deposits made in the lake and cut through them into the underlying till, resulting in the existing topography.

It is possible that the waters of this eastern lake were in fact continuous with those of Lake Corinth. Assuming that the latter stood at 660 feet elevation, the contour lines of the sheet indicate that a connection between the two may have existed. There is, however, no proof of this in the present distribution of the deposits.

THE DEVELOPMENT OF THE HUDSON CHANNEL FROM CORINTH EASTWARD

Reference has already been made (page 10) to evidences derived from topography that in a former geological period a stream occupying the course of the present Hudson north of Corinth then flowed southward across the area of the Saratoga quadrangle, following the trough of the Paleozoic basin. Miller[1] has shown that this stream was not the preglacial Hudson, but had its source on the south side of a divide at Stony Creek (about 16 miles north of Corinth) which then separated the drainage basin of the upper Hudson from that of the southward flowing stream (named by Miller the Luzerne river). During Pleistocene times the Hudson river — the Stony Creek divide having been breached by erosion — took possession of the channel of the Luzerne river as far as Corinth and there became diverted into its present course from Corinth eastward to near Glens Falls, where it entered its old preglacial channel.

[1] *Op. cit.*, p. 185.

Evidences that the present Hudson channel from Corinth eastward is of recent geological origin are as follows: (1) at Corinth the river enters a gorge cut into stratified rocks of the Cambric period whose vertical walls (as seen on the south side) are about 60 feet high; (2) there is a fall of 220 feet in the bed of the river from Corinth to the place where the river emerges from the Adirondack region upon the level tract of the Hudson plain, a distance of about 12 miles; (3) the valley is in general narrow, with steep slopes, and all the tributary streams are small and have steep gradients; (4) the river has cut away the eastern end of the morainic belt and divided the lacustrine deposits north of it; (5) "the present course of the Hudson from the eastern edge of the Adirondacks to Fort Edward is evidently of postglacial origin, for the river runs over ledges at Fort Edward, at Baker's Falls, at Sandy Hill and again at Glens Falls, dropping from the 300 foot contour at the edge of the mountains to about 130 feet at Fort Edward."[1]

There are, however, other features of the valley which constitute evidences that it is not wholly postglacial in origin, that is, has not been formed wholly since the latest withdrawal of the ice to the north: (1) Although the river intersects a mountainous region, there has been but a slight development of rock gorges. Excepting the gorge at Corinth and a shallow rock channel at Spiers falls (located about a mile below the mouth of Stony brook) the valley walls are nowhere vertical and cut in rock, as is typically the case with postglacial streams; for example, the Mohawk river at Little Falls and at Aqueduct, 3 miles below Schenectady. In general the valley is V-shaped in cross-section. (2) The river has cut its valley largely in till. Beginning at the lower end of the gorge, at Palmer, the valley walls for several miles are composed of till, with few exposures of the underlying Precambric rocks. The creek that flows from Palmer down the slope to the river has its bed on till. Below the mouth of the creek the valley wall, especially at its lower levels, is thickly strewn with boulders. In places the wall of the valley is somewhat terraced and many boulders of large size lie on the terrace faces. In other places the valley wall slopes to the margin of the river and along the shore are many large boulders which have accumulated from rolling or sliding. The materials of the slopes of the river, farther on in its course, are till; excepting that near the bend, at the upper level of the slope, on the right bank of the river, the terrace of lacustrine deposits, already referred to, occurs, and south

[1] Woodworth, *op. cit.*, p. 75.

of it, the kame hills. From the bend on to Spiers falls the slopes consist of till but with frequent exposures of jutting masses of rock. At one place on the right slope, at an estimated elevation of 800 feet, or 480 feet above the level of the river, there is a conspicuous mass of bare rock with steeply inclined surface facing the river. At Spiers falls the upper two-thirds of the valley wall, on the right bank of the river, consists of bare or nearly bare rock (thinly wooded) facing the river at an angle approximating 45 degrees. Below this rocky steep the materials of the slope are largely till and the surface much less inclined, except that at the water's edge and rising steeply for about 20 feet, rocks are exposed. The opposite slope of the river, on its left bank, at Spiers falls, consists largely of till, except at the water's edge where rocks are exposed, as on the right bank. About a mile below Spiers falls and on either side of the river there are distinct boulder-strewn terraces. These terraces are at an elevation, as roughly measured, of 25 feet above the level of the river and extend back, at their widest places, at least 500 feet, to the foot of the valley slopes.

In regard to the materials which compose the bed of the river, no observations could be made in that portion of the river above Spiers falls because of the dam which makes deep water as far as beyond the mouth of the creek below Palmer. At Spiers falls the river runs over rock; but a short distance below the rapids the bed of the river is on till, as indicated by the boulders lying in the channel and as shown in the locality of the boulder terraces where the stream has cut through till to a depth of 25 feet.

The fact that the river occupies a deep valley cut in till is scarcely compatible with the view that the valley is wholly postglacial in origin. It is to be inferred, rather, that the valley was existent prior to the last advance of the ice sheet, that it was partly filled in with the ground moraine of the ice sheet and that the present river has cut its channel in the till since the last retreat of the ice.

We may now consider briefly the several interpretations that might be proposed to account for the facts pertaining to the Hudson valley from Corinth eastward (named by Woodworth the Adirondack-Hudson) and to the region lying south of Corinth.

1 *The Adirondack-Hudson valley is a preglacial valley and was occupied then, as now, by a river flowing southward from the Luzerne region.* As against this view we have the fact of the topographic and lithologic unity of the broad rock valley (or basin) south of Corinth with the general valley of the Hudson north of

Plate 10

J. H. Stoller, photo, 1912

The Hudson river at Corinth. In the middle background is seen the south wall of the gorge which the river here enters.

Plate 11

J. H. Stoller, photo, 1912

The Hudson river looking northward from the bend in the river one mile above Spiers Falls. The valley walls are largely covered with glacial till. In this portion of the river the waters are dammed by the masonry constructed at Spiers Falls.

Corinth. Also we have the facts, above stated, that constitute evidence, hardly to be questioned, that the valley is of recent geological origin.

2 *The Adirondack-Hudson valley is wholly postglacial, that is, has been formed and occupied by the river only since the withdrawal of the ice of the latest, or Wisconsin, epoch.* It may be supposed that in preglacial times a stream heading somewhere in the course of the present Adirondack-Hudson flowed westward and emptied into the Luzerne river at Corinth and that a correlative stream heading in the same locality and separated from the former by a divide, flowed eastward to the Hudson plain. The courses of both these streams were in the lines of intermountain depressions, due to rock structure and rock weathering such as occur generally in the Adirondack region. Thus a continuous valley, except as interrupted by a low divide, extended from Corinth to the Hudson plain. At the close of the Wisconsin epoch the Luzerne river became diverted into the course of this valley and reduced the divide, thus initiating the present conditions. We have to note that according to this view there should occur in the course of the present river a rock gorge at the place where the divide was located. At Spiers falls, which is near the middle portion of the course of the Adirondack-Hudson, a rock channel occurs, as already described. The elevation of the bed of the river at this place is 320 feet, or about 200 feet below that at Corinth. We should therefore expect to find a rock gorge with walls having a height of 200 feet plus the elevation of the divide above that of the river at Corinth. No gorge of this character occurs.

The lower slopes of the valley at Spiers falls, moreover, are covered with till, and below Spiers falls where the valley widens, forming relatively broad terraces, the bed of the river is on till. The till in this locality is unquestionably in situ and was laid down on a rock floor lower than the bed of the present river at that place.

3 *The Adirondack-Hudson Valley is interglacial in origin.* During an interglacial epoch a stream from the north, following the course of the preglacial Luzerne river, was diverted from the old channel at Corinth and initiated the present Hudson valley from Corinth eastward. The conditions determining this change of course of the interglacial stream are unknown but may be assumed to be heavy accumulations of drift south of Corinth. With the readvance of the ice sheet, at the close of the interglacial epoch, this newly excavated valley became partially filled in with till. With

the last withdrawal of the ice sheet to the north, the present Hudson river (under conditions presently to be stated) entered the valley, cutting a channel into the till and eventually producing the existing features as above described.

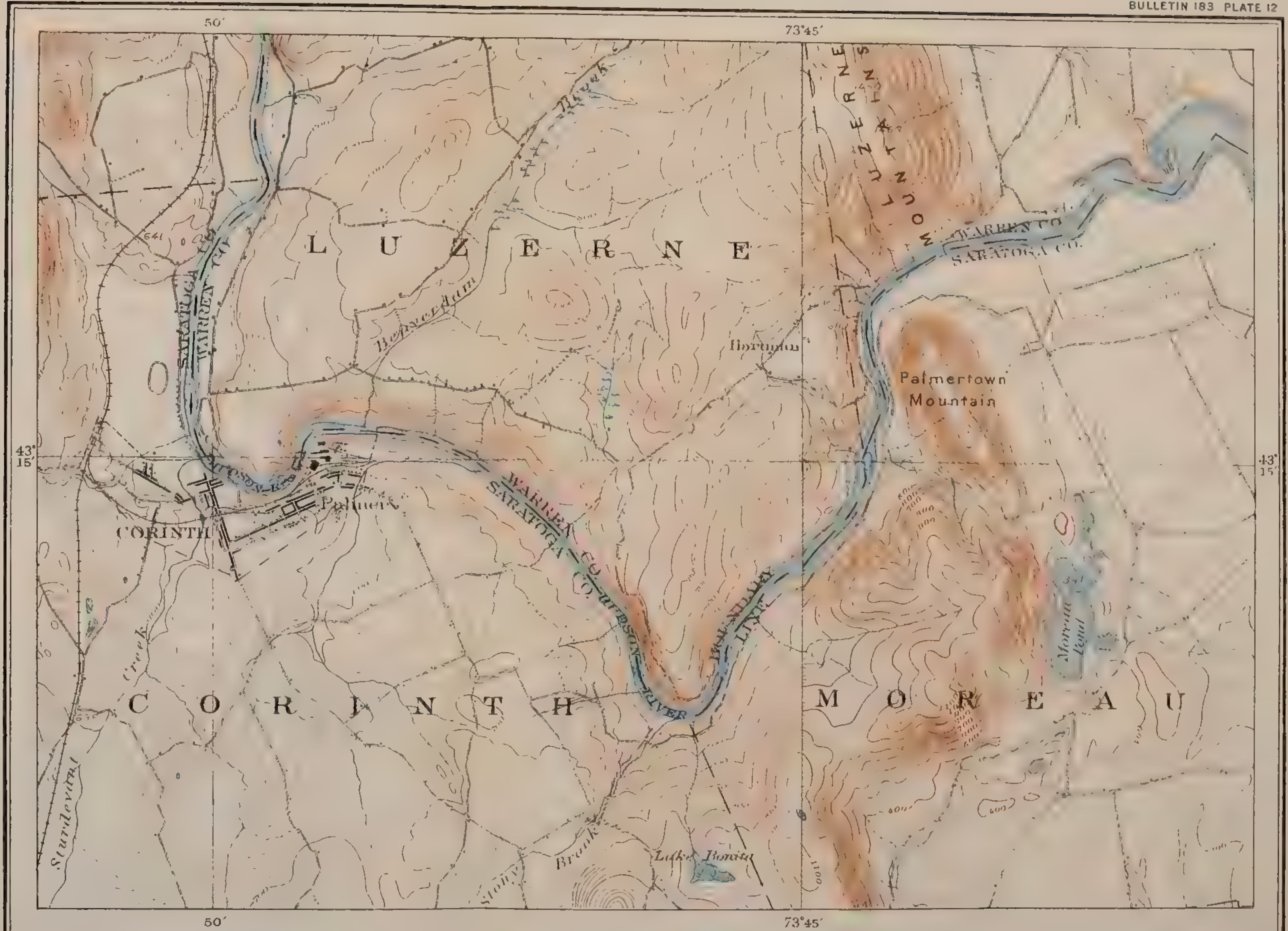
The writer believes that the last of these three interpretations is the true one. A somewhat fuller statement may now be given.

EVIDENCES OF AN INTERGLACIAL EPOCH

In preglacial times the Luzerne river occupied the Paleozoic rock valley north and south of Corinth.

A preglacial stream having its source near the western base of Mount McGregor discharged into the Luzerne river at Corinth. A portion of the valley of this stream is still open to inspection. Just east of Corinth an old stream channel communicates with the present river channel at the upper end of the gorge on the south side. Except for a short distance back from the river it is filled in with till but it can be traced as a depression, bordered on the east side by a gradually diminishing slope, about one-eighth of a mile back from the river. This depression is indicated by the contour lines of the sheet. Where it joins the river channel the old channel has the character of a gorge with bed and walls of sandstone rock. The east wall is here a nearly vertical cliff and is continuous with the south wall of the river gorge. It is evident that the gorge end of the channel has been scoured out and its walls undercut by the currents of the river. Its bed now stands at about 10 feet above the level of the river, or at 530 feet elevation. The width of the channel at the gorge end is about 50 feet.

We may note in passing that the existence of this old stream channel affords a datum for the elevation of the bed of the preglacial Luzerne river in the locality of Corinth. Assuming it to have been approximately the same as that of its tributary where the channel of the latter is exposed, we have 530 feet. Rock exposures in the beds of existent streams are in accord with this determination. At Luzerne, 6 miles above Corinth, at the foot of the rapids over bedrock, the level of the river is 540 feet. South of Corinth the present drainage streams of the central basin have their beds on glacial sands and clays or on glacial till, as far south as Middle Grove, where in the bed of the Kayaderosseras, rock is exposed at the level of 520 feet. These data indicate a moderate and somewhat uniform fall in the bed of the preglacial river, as would be the case in an old stream.



Topographic map showing that portion of the Hudson river valley which crosses the southeastern Adirondack region. At Corinth the river turns from the preglacial valley and occupies a valley cut in till filling an underlying rock valley. Parts of Saratoga, Schuylerville, Lucerne and Glens Falls (U. S. G. S.) quadrangles.

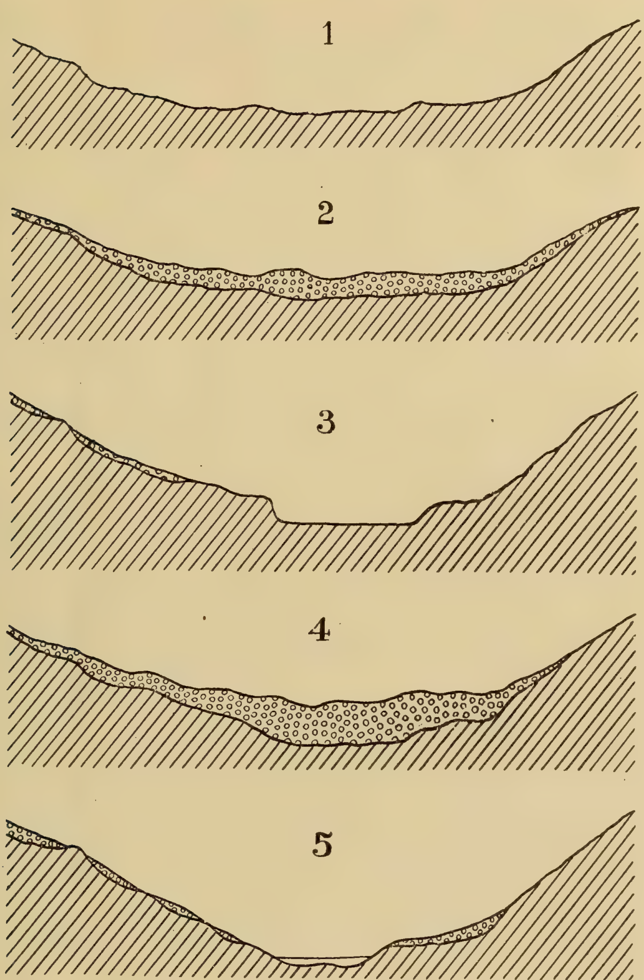


Fig. 4 Diagrams illustrating the development of the Adirondack-Hudson valley. Diagram no. 1 shows the contour in cross-section of the preglacial intermountain depression, in the locality of Spiers Falls. No. 2 shows the condition at the beginning of the interglacial epoch; the floor of the depression is covered with till produced by the earlier glaciation. No. 3 shows the condition at the end of the interglacial epoch; the till has been swept away from the floor of the valley and a channel cut into the rocks by the interglacial river. No. 4 shows conditions after the last retreat of the ice sheet, or end of the Wisconsin stage. The walls of the channel and the slopes have been worn down by the ice erosion of the last glacial epoch and the valley has been filled with till left at the final withdrawal of the ice. No. 5 shows present conditions. In postglacial times the river has swept away most of the till from the floor and slopes of the valley and has cut (at Spiers Falls) a channel in bedrock.

During Pleistocene times, with a retreat of the general ice sheet to the north, a thick body of drift was left lying across the broad valley south of Corinth. The elevation of this drift at its lowest point was higher than that of the divide which separated the sources of the stream above referred to from that of another preglacial stream which flowed easterly to the Hudson plain.

Due to the drift barrier, Luzerne river was diverted into the course of the channel of the preglacial tributary stream at Corinth and the waters, flowing over the divide, followed the course of the eastward flowing preglacial stream, thus initiating the original Adirondack-Hudson. This condition continued during an interglacial epoch. During this time the divide was reduced and the channel of the river lowered to the level of the present rock floor of the valley upon which undisturbed till rests, as where the terraces above described occur.

With the readvance of the ice sheet, marking the end of the interglacial period, two general effects were produced in the Adirondack-Hudson valley; first, the walls of the valley were somewhat reduced and smoothed by the moving ice and projecting ledges and angles at the summits of cliff walls were broken and worn away; second, the valley was partly filled in with the materials of the ground moraine.

When, in the final withdrawal of the ice sheet, the ice front stood at Corinth, a connection between Lake Corinth and the eastern lake which occupied the region southeast of Palmer was permitted. It is evident from the correspondence in elevation of the deposits made in the two lakes that they stood at approximately the same level. It will be assumed, however, that prior to their union there was some difference in the level of their waters. As soon as their junction took place the outlet of the lower lake became the outlet of the consolidated body of waters. If the eastern lake were the lower then the outlet stream of the common waters naturally followed the course of the interglacial river, occupying the already formed, though now partly till-filled, valley. If on the other hand Lake Corinth were the lower, the drainage was southward, over the aggradation plain, and thence in the course of the present drainage axis. In either case the conditions thus established continued until the epoch of flooded waters.

As bearing on the question of the occurrence of an interglacial epoch in the southeastern Adirondack region, it may be here noted that Miller[1] has reported evidences of an interglacial epoch in the cutting of the gorge at Stony creek in the course of the Hudson, and also in the case of the gorge at Conklingville in the course of the Sacandaga river.

THE EPOCH OF FLOODED WATERS

There are conclusive evidences that after the ice had disappeared from the area of the Saratoga quadrangle an epoch ensued characterized by a flooded condition of the principal drainage streams of the region. The old drainage axis extending from Corinth southward across the quadrangle was again occupied by a river — a stream of large volume and powerful currents. This stream swept away a portion of the morainic dam south of Corinth and, following the course of the present Kayaderosseras creek, eroded a broad channel in the glacial till and, in places, cut through the till to bedrock. The stream discharged into Lake Albany at West Milton, there depositing its sediments and building an extensive delta, now represented by the Milton plain.

At the same time flooded waters occupied the newly opened Hudson channel from Corinth eastward. They rapidly reduced, through erosion, the impeding barriers in the bed and on the slopes of the nascent valley, shaping it to its present features.

We have now to consider the evidences of the occurrence of these flooded streams of late glacial times:

1 **Portion of recessional moraine eroded and leveled by powerful currents of water.** The road which crosses Sturdevant creek, 2 miles south of Corinth, after ascending the slight hill to the east of the creek, crosses a level area the surface of which is thickly strewn with cobbles and boulders. Many of the stones have been gathered, in clearing the ground for cultivation, and thrown together in heaps, or used in making walls for fences. In some places, however, they have been left in their natural distribution and lie at the surface of the ground in great numbers. In general they have the smoothed and rounded forms of water-worn cobblestones. At its eastern limit the leveled area is sharply marked off from the hills of the morainic belt; in part, by a somewhat steep and straight bluff composed of the morainic materials.

It is evident that this leveled area is a portion of the moraine that has been reduced by the work of currents, the finer materials

[1] *Op. cit.*, p. 183 and p. 186.

having been swept away. The direction of these currents was southward, as indicated by the line of the bluff which marks the eastern limit of the flood channel.

2 **Flood deposits.** South of the leveled area of the moraine lies the broad aggradation plain already described under the head of outwash plains. As stated, this plain was originally a plain of the outwash type normal to the moraine. Afterward its materials were subject to redistribution through the work of streams and the plain

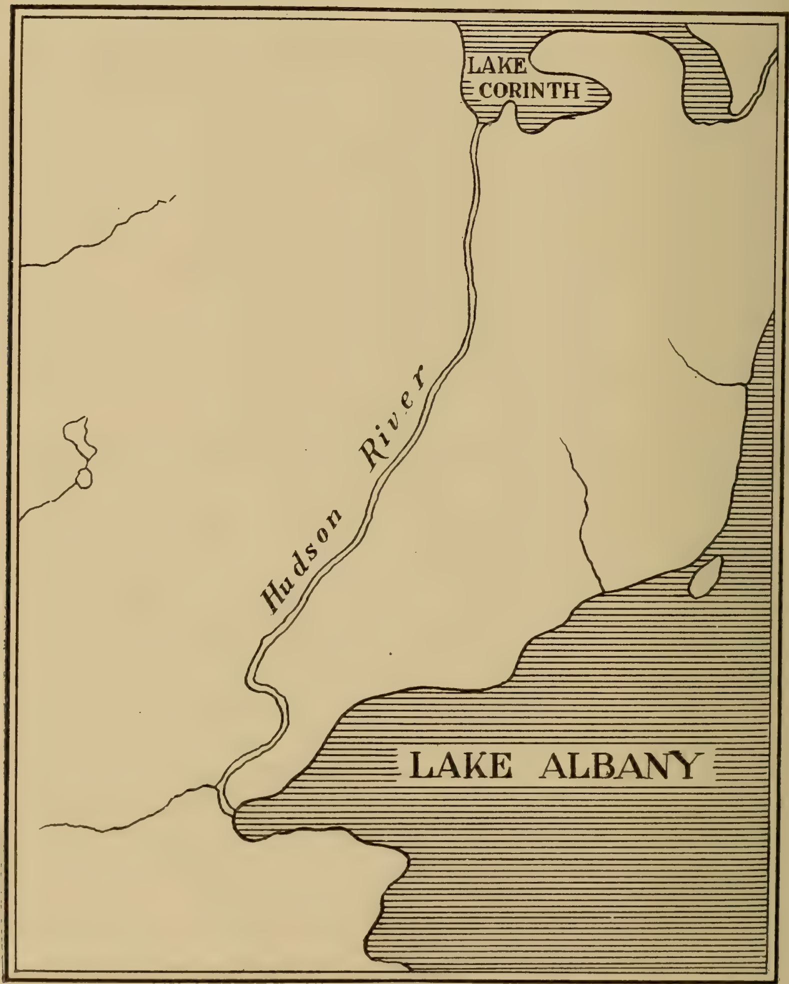


Fig. 5 Sketch map showing the distribution of land and water on the area of the Saratoga quadrangle during the epoch of flooded waters

may have been further extended by deposits made by the streams and derived from sources beyond (north of) the moraine. At the present time there is an approximately dead level aggradation plain extending for nearly 3 miles south of the morainic area. This level plain is continuous with a valley plain bordering Kayaderosseras creek but gradually falling in level correspondingly with the fall in the bed of the creek. North of North Greenfield, where there is a fall of more than 20 feet a mile, the valley plain is comparatively narrow, but south of the same place the plain expands to an exceptional width. At Kings it is approximately 1 mile in width and the broad flat has a north-south extension of about 2 miles. The materials of the flat lands consist predominantly of sand with a considerable amount of vegetable debris at the surface. Beyond this area, bordering the creek in its further course, deposits of stream origin occur. In places they are somewhat marked in development, extending considerable distances back from the creek, and rising to a level of perhaps 20 feet above the creek. This statement applies to deposits as they occur along the creek only as far as the village of Ballston Spa.

It is not to be supposed that these deposits have been laid down by the present drainage streams since the close of the glacial period. At South Corinth station the plain extends without interruption across the divide between the two creeks. The great mass of deposits at Kings is within a few miles of the sources of the creek traversing its surface. Farther south deposits occur, as just noted, relatively high above the present flood level of the creek. The deposits, therefore, are attributable to late glacial floods.

3 **Eroded till.** The slopes of the valley of Kayaderosseras creek show water-swept features. The till has been eroded and in places, especially at Rock City Falls, entirely swept away, leaving areas of bare rock. The eroded surfaces are marked by loose boulders, which occur in greater numbers than in the uplands. In places, the effect of powerful currents in shaping the present slopes is evident. Thus west of Rock City Falls on the south side of the stream, there is a steep bluff of till where the currents impinged against the sides of two drumlins having axes lying in the same line. On the opposite side of the creek at the same place the slope is gentle and the somewhat evened surface shows water-worn features. North of West Milton, embraced by a curve in the stream, is a plateaulike area of eroded till, delimited sharply on its east side from a group of sand hills of distinctive kame features. It is evident

that strong currents swept away the western portion of the original kames area, exposing and leveling the underlying till.

4 **The building of the Milton delta.** Evidences that the Milton plain is of delta origin have already been given (page 19). The location of the plain with reference to the valley now occupied by Kayaderosseras creek, shows clearly that the materials of the delta were brought to Lake Albany by a stream occupying this valley. The expanse of the delta and the thickness of its deposits (approximately 80 feet as measured by the difference in level between the Milton plain and the Saratoga plain) indicate the volume and carrying power of the delta-forming currents. It is certain that a stream of the magnitude of a large river, of high velocity of flow and bearing a heavy load of sands, once coursed through the present valley discharging into Lake Albany at West Milton. Its sediments were spread widely into the lake, building a fan-shaped delta with, however, a prominent southward-extending lobe. The direction of growth of the latter, it may be inferred, was determined by the general southward course of the currents moving in Lake Albany.

The Milton delta plain fixes the time of the epoch of flooded waters — as occurring in the drainage axis of the Saratoga quadrangle — as subsequent to the withdrawal of the ice sheet and prior to the time when Lake Albany began to subside. An idea of the length of time represented by this epoch may be obtained from the dimensions of the delta deposit.

The elevation of the Milton delta plain, 400 feet above sea level, is higher than that of the Mohawk delta plain at Schenectady. Woodworth[1] places the latter at 350 feet, but from observations made by the writer of exposures recently made in the grading of streets, the stratified Lake Albany deposits occur at Schenectady up to the level of 360 feet. This makes a difference in elevation of 40 feet as between the two delta plains. As it is probable that the deltas in both localties were originally built up to the surface of the waters of Lake Albany, the present difference can be accounted for only by postglacial deformation, or regional warping of the earth's surface. The Milton plain, measured at its portion immediately north of Ballston Spa, is about 16 miles northward from Schenectady. This gives a deformation of 2½ feet a mile of northward upwarping which agrees well with the estimate made by

[1] *Op. cit.*, p. 130.

Fairchild[1] who states: "The average northward uplift of the marine plain in the Hudson-Champlain valley appears to be about 2¼ feet a mile."

5 **Eroded till east and southeast of Corinth.** Evidences of flooded conditions in the Hudson channel east of Corinth may here be further noted. The slopes of the river on both sides are made up at the surface largely of eroded till. At the upper reaches of the slopes there are frequent exposures of bedrock presenting the appearance of ordinary weathered rock, but at the lower levels the valley is cut in till. The boulders lying on the slopes, especially where terracelike stretches occur, are of large size, showing clearly the sorting action of powerful currents. The sloping surface of the terrace, 3 miles southeast of Palmer, likewise attests the existence of powerful, eroding currents, subsequent to the time of lacustrine conditions. The deposits which had been built up to near the 640 foot level in the lake were graded down, producing the present surface gently declining from the outer margin of the terrace toward the river. The same currents swept away the eastern terminal portion of the moraine, producing a well-defined bluff continuous with that which lies east of the terrace facing the river. The top of this bluff is estimated at 200 feet above the level of the present river.

There is also an area of eroded till extending southward from the river at Corinth and Palmer. It marks the course of the currents which, moving southward, swept away the western end of the morainic belt and produced the further effects described above.

SOURCE OF THE FLOODED WATERS

It does not seem probable that a river of the magnitude requisite to produce the effects above described could have resulted from the ordinary gathering of waters from the melting of the ice. During the development of Lake Corinth — through the accumulation of waters in front of the slowly retreating ice sheet — comparatively quiet and stable conditions as regards depth and movement of waters prevailed, as is shown by the fact that the morainic dam held the waters in check. The Lake Corinth deposits extend northward beyond the edge of the sheet and, as well as could be determined by a cursory inspection, continue as far north as Luzerne. It may be inferred that the relatively quiet conditions lasted until the ice front reached Luzerne.

[1] *Pleistocene Geology of New York State*, Science, February 21, 1913, p. 297.

At Luzerne the Sacandaga river, flowing from the west, empties into the Hudson. When, in late glacial times, the ice front had receded as far as Luzerne, the Sacandaga waters began pouring into Lake Corinth. It is believed that the access of these waters produced strong, southward-moving currents in the lake, sufficient to sweep away a portion of the morainic dam and to produce the erosive and delta-building effects above described.

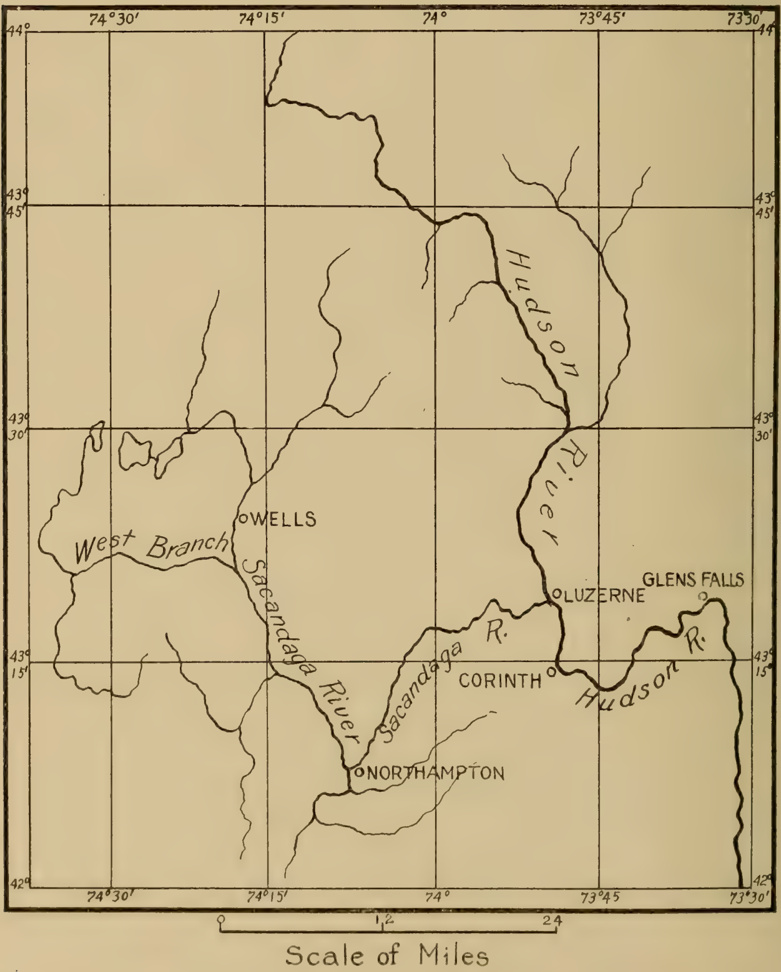


Fig. 6 Sketch map showing the drainage basin of the Sacandaga river

The present Sacandaga drainage area covers the south central portion of the Adirondack region and also a portion of the Paleozoic basin lying south of Northville. The course of the river from its Adirondack sources is southward to Northampton and then northeastward to its mouth at Luzerne. At Northampton it receives the drainage from the Paleozoic basin just referred to. Something like one-half of its drainage area lies south of Luzerne. It may be inferred that when the ice front stood at Luzerne this southern portion of the area was already freed from ice and that its drainage waters, together with those from the melting ice to the north, discharged through the open Sacandaga at Luzerne.

The influx of the Sacandaga waters produced an equal increase in the outflow of waters from the lake. If at this time the outlet of the lake was through the channel eastward from Corinth, this exit, as yet partially developed, was insufficient in capacity to contain the suddenly increased volume of waters and the excess was forced to the earlier outlet across the morainic dam. If the latter outlet had continued, after the junction of the two lakes, it now received similarly the new rush of waters. The strong currents sweeping through the long and narrow lake cut down the bed of this outlet and enlarged it in lateral extent. Thus was formed the area of leveled moraine. The currents also reduced the aggradation plain south of the morainic dam. Sweeping on, partly finding and partly making their channel, the erosive effects along the slopes of the present Kayaderosseras creek were produced. Discharging into the quiet waters of Lake Albany, the checked currents dropped their load, building the Milton delta.

It is believed that at least during the early stage of the flooded epoch a portion of the waters found passage through the channel east of Corinth, thus producing the erosive effects already described. It is certain that prior to the union of the two lakes the eastern one had its outlet in the line of the interglacial valley, over the surface of the till partially filling the valley. The channel thus opened was occupied and enlarged by the flood waters. It is possible that after the morainic dam south of Corinth was reduced, the waters of the Lake lowered sufficiently to divert the entire flow to the southern outlet, thus temporarily suspending the northern one. In this case, at a later time, when the flooded conditions were passing and the south Corinth plain had been again aggraded, approaching its present level of 636 feet, the waters backed and again entered the channel eastward from Corinth, thus producing the present drainage conditions.

THE CLOSING STAGES OF THE GLACIAL PERIOD

Subsequent to the epoch of flooded waters there is a well-defined stage of glacial history marked by the subsidence of the waters of Lake Albany. This stage is recorded by the present features of the valley of Kayaderosseras creek from West Milton to Saratoga lake. At West Milton the slopes of the valley, which rise to a height of about 40 feet, consist of eroded till at the lower levels and the delta sands of the Milton plain at the higher levels. Farther east, beginning about 1 mile below West Milton, the till alone shows on the slope at the right bank of the stream, while on the left, beyond the strip of eroded till and at a higher level, the sands continue. These relations of the deposits on the valley slopes continue to the head of the gorge which begins about 2 miles from Ballston Spa. In this portion of its course the creek is bordered by bedrock, or by eroded till, back of which, on both sides of the valley, lie the delta sands. For the most part the bedrock rises as cliffs gradually increasing in height downstream and forming a gorge with walls 60 feet high at Ballston Spa. There is a fall of 160 feet in the creek in the distance of 3 miles, affording power for many industries.

It is evident that when Lake Albany began to subside and the delta plain emerged as land surface, Kayaderosseras creek (probably while still receiving waters from the Hudson channel) cut into the delta deposits at West Milton, eroding a broad, shallow channel in the sands. Farther on, the stream, choosing the course of least obstruction, followed for about 3 miles the line of boundary between the sands of the delta and the clayey materials of the till. It then again cut into the sands, dividing the southward-extending lobe of the delta from the fan-shaped mass to the north. At Ballston Spa the stream flowed over the marginal slope of the delta, there discharging into Lake Albany and so continuing during the time of the subsidence of the lake waters from the 400 foot level to the 320 foot level. As the subsidence progressed the stream cut deeper into the deposits, gradually removing the sands and sinking its bed into the underlying till and, in its lower course, into bedrock. At the place of discharge, at Ballston Spa, a waterfall formed, due to the stream passing over a bluff of rock which marks the boundary of the depressed area, ontinuous with that in which Saratoga lake lies, of the southeastern portion of the quadrangle. Through erosion of the soft shale rocks this waterfall gradually receded up stream, thus contributing to form the existing gorge.

When at length Lake Albany had subsided to the 320 foot level, thus causing the Saratoga plain to emerge as land, Kayaderosseras creek began to flow across the surface of this added area. Coursing northeastward from Ballston Spa the stream, still of considerable magnitude and of powerful currents, swept away the sands from a broad path, laying bare the underlying till, and discharging into the shrunken Lake Albany. At a later time when conditions of comparatively quiet waters had ensued the stream began to aggrade its channel and the deposits of alluvial character, forming the broad area of valley flats, through which the creek now pursues a meandering course, were laid down.

Another stream whose origin was incident to the subsidence of Lake Albany is Coesa creek (unnamed on the map) which gathers its waters from sources in the highlands north of Saratoga Springs and from the Greenfield hills and flows southeasterly emptying into the Kayaderosseras. The stream, with its branches, has cut broad trenches in the expanse of the Saratoga plain and where it passes over the slope, bounding the depressed area, has cut into the rocks forming a gorge. The western branch of Coesa creek, taking its rise near North Milton, has lowered its bed to rock, exposing the limestone at the site of the old stone mill, 1½ miles east of North Milton. The erosive work of these streams was largely accomplished in late glacial or early postglacial times, accompanying the subsidence of Lake Albany.

A notable event in the late glacial history of the Mohawk-Hudson region, also incident to the subsidence of Lake Albany, was the diversion of powerful currents from the flooded Mohawk northward through the Ballston channel.[1] Waters from this source, following the courses indicated by the present streams, Mourning kill and Drummond creek, swept across the southeastern portion of the Saratoga quadrangle, removing from their path the Lake Albany deposits, and leaving the areas of eroded till now forming the surface materials in that quarter.

RECENT DEPOSITS

Alluvium. Reference has been made above to the extensive flats bordering Kayaderosseras creek, especially in the neighborhood of Kings and in the depressed area east of Ballston Spa. It is probable that these flats represent in part alluvial deposits of the recent epoch, that is, sediments laid down by the stream at high water

[1]Stoller. N. Y. State Mus. Bul. 154, p. 31.

stages when overflow from the banks has taken place. Considering, however, the thickness of the deposits and the extent of their spread, it is evident that in the main they were laid down under conditions of floods to which the stream has not been subject in the recent epoch. Accordingly, as a formation, they have been referred to the epoch of flooded waters that marked the passing of the glacial period and are designated on the map as of the deposits of that period.

In the cases of the smaller streams, Coesa creek, Mourning kill and the outlet stream of Loughberry lake, the surface soils bordering their banks and forming valley flats are designated as alluvium of the recent epoch.

Blown sands. On the Saratoga plain, especially in that portion which lies northeast of Saratoga Springs, there are well-defined dunes of sand. The hills, in the area just referred to, are of elongate form and with generally parallel axes, in direction northeast-southwest. It is inferred that their direction corresponds to the prevailing strong winds. The materials of the hills are fine sands. On the expanse of the plain west of Saratoga Springs a few sand hills of evident wind origin occur. On the Milton plain, as far as observed, there are no well-defined dunes. This is probably due to the coarseness of the sands, rendering them too heavy to be easily lifted by the winds.

Peat and vegetable debris. There are numerous swamps in which more or less peat occurs. The most interesting of these, considered both with reference to the apparent quantity of the peat and the accessibility of its locality, is that which lies 3 miles north of Saratoga Springs on the southern slope of the Adirondack highlands. In areal extent it is at least 300 acres. As seen at its southern margin the surface of the swamp is overgrown with sphagnum moss, ferns and other low plants, together with some trees. Beneath the surface layer of dry vegetable debris there is a layer of black mud, 6 or 8 inches in thickness. A sample, when dried, had the appearance of pure, fibrous peat. I am informed by Mr L. C. Robinson, superintendent of the Hilton estate, that farther out from the margin the swamp is soft and tremulous under foot and that a pole can be thrust into the black mud to a depth of from 5 to 9 feet. One portion of the swamp bears the name of "the Devil's pit" and it is said that cattle have been mired in it. He states that few or no trees grow in the middle portions of the swamp.

This swamp, or peat bog, appears to occupy a depression in the Precambric rocks and at its western end there is a conspicuous outcrop of rock, judged to be a dike. I was unable to determine whether the bed of the swamp is rock or till.

In addition to the large swamps occurring in the Adirondack highlands and shown on the topographic sheet, there are many small areas of swampy or partially drained lands, occupying depressions in the mantle of glacial deposits. They represent glacial lakes or ponds which have been filled in by sediments and overrun by vegetation in the recent epoch. The location and areal extent of some of these have been indicated on the map.

REVIEW AND SUMMARY

In the region within which is included the area of the Saratoga quadrangle the glacial period, or Ice Age, was broken by at least one interglacial epoch. This deduction is made from the fact that the Hudson river in its course across the southeastern spur of the Adirondack mountains occupies an indubitably geologically recent valley of trenchlike form and yet one that is cut in till.

The beginning of the interglacial epoch was marked by the withdrawal to the north of the ice sheet which had covered the general region. As the ice melted, it left behind the earthy materials which had been carried at the bottom or inclosed in the ice mass. An accumulation of this debris, or drift, across the Paleozoic basin somewhere south of Corinth, caused a blocking of the drainage and the waters coming from the north, as the ice front receded, found a passage across the Adirondack country east of Corinth, following a line of preglacial intermountain valleys. The location of the drift dam can not be determined, but it may be supposed that the heavy deposits in the Greenfield locality then extended westward across the basin.

The end of the interglacial epoch was marked by a readvance of the ice. The mantle of debris, or ground moraine, left by the melting of the earlier ice sheet, was now largely scraped from the higher rock surfaces and redeposited in the valleys and depressions that had developed, through weathering and stream erosion during the time of absence of ice. The renewed abrasion by ice action also furnished added materials. It is possible, too, that where the previous aggregations of drift lay over depressed areas, as in the basin, the readvance of the ice sheet developed drumlins. This view of the origin of drumlins is favored by the facts of their distribution on the area of the Saratoga quadrangle considered in connection with the evidences of a second advance of the ice.

The general direction of movement of the ice of the last epoch of invasion was, in the region under consideration, about 42° west of south. A control of the direction of movement was evidently effected by regional topography.

When at length the final melting of the ice took place, the two highlands regions were first uncovered, a thick lobe of ice lingering in the central basin. Probably at the same time another lobe of ice occupied the great valley of the Hudson. Presumably close upon the melting of the latter the valley became filled with waters, forming Lake Albany. Eventually the Lake Albany waters covered all parts of the area, the present elevation of which is 400 feet or less above sea level.

The ice lobe occupying the central basin was slowly melted back at its front, leaving in its wake the thick deposits already gathered under the glacier and which to a large extent had been left molded into elliptical hills, or drumlins. At its western margin the ice lobe suffered comparatively rapid melting, due to the heat reflected from the bared, rocky slope of the highlands. The depression thus formed between the ice and the slope became a channel for flowing waters derived from the melting ice to the north. This stream, at times large in volume and of strong currents, laden with sand and gravel, in places dropped its load and, following the lateral margin of the shrinking ice lobe, gradually built up groups of moundlike hills, or kames, and flat-topped stretches of sand and gravel, or kame terraces.

When the central lobe had melted back as far as 3 miles south of Corinth, a balanced condition between recession by melting and advance by the flowage of the ice supervened. Along the stationary or slightly shifting ice front the debris brought by the glacier accumulated, forming a moraine extending all the way across the basin. The waters issuing from the ice front carried the finer materials borne by them beyond the edge of the ice, building outwash plains. The largest of these formed in front of the western end of the morainic belt, extending southward in the line of the preglacial drainage valley.

When the ice front renewed its retreat to the north, waters from the melting ice became ponded back of the moraine, originating Lake Corinth. Also a second lake, farther to the east and beyond a ridge, developed behind the eastern end of the morainic belt where it abutted against the foot of the Luzerine mountain. These lakes received deposits of sand and gravel, now represented by the sand plain south of Corinth and by the areas of sand and gravel on either side of the Hudson river southeast of Palmer.

When the ice front had receded as far as Corinth the two lakes became confluent. The outlet stream of the lake which had previously stood at the lower level (although the difference in level was not great, since the deposits have approximately the same elevation in both, namely, 640 to 660 feet) became now the outlet of the common body of waters. This condition of things lasted until the ice front had further drawn back to the north as far as Luzerne.

When, through the melting of the ice, the mouth of the Sacandaga river had been opened, a great volume of the waters gathered from the drainage basin of that stream and from the dissolving ice to the north poured into Lake Corinth at its northern end, in the locality of Luzerne. The rush of waters, sweeping through the long and narrow lake, produced flooded conditions which probably reestablished the outlet stream of the lake which at the time of the junction of the two lakes had become inoperative. The currents coursing southward from Corinth washed and eroded away a portion of the morainic dam and, as a flooded river, eroded a broad channel through the heavy mantle of till, in places to bedrock, and discharged into Lake Albany at West Milton, building the delta now represented by the Milton plain.

Two facts of general interest are deducible from the Milton plain: (1) that the subsidence of Lake Albany did not begin until after the ice sheet had retreated as far north as Luzerne and such time thereafter as was required to build the Milton delta; (2) that postglacial deformation at the rate of 2½ feet a mile, northward uplift, has taken place, as shown by comparison of the present elevations of the Milton plain and the Mohawk delta plain at Schenectady.

With the passing of the flooded conditions, the level area south of the moraine became aggraded to its present level at South Corinth, causing the river to follow the lower channel from Corinth eastward.

The subsidence of Lake Albany marked the closing stages of the glacial period. With the emergence of the Milton plain as land surface, Kayaderosseras creek developed its present channel from West Milton to Ballston Spa, there discharging into Lake Albany. When such further lowering of the lake waters had taken place as to lay bare the sands deposited broadly in Lake Albany at the 320 foot level, Kayaderosseras creek further extended its course, sweeping away the sands from its path. At the same time strong currents moving northward through the Ballston channel, diverted from the flooded Mohawk, further removed the sands from the depressed area eastward from Ballston Spa. In this way was formed, as a residual part of the lower sand plain in this quarter, the conspicuous islandlike area of sand at the 320–340 foot level.

At a later time Kayaderosseras creek, in its course across the depressed area to its mouth in Saratoga lake, aggraded its channel, forming the flat lands bordering the present stream. The surface of these late glacial deposits has been overspread, to some extent, in the recent epoch, with alluvium.

The sediments laid down by streams at times of overflow of their banks; the occasional low hills of blown sands on the Saratoga plain; and the accumulations of sediments and vegetable debris in lakes and ponds, often converting the latter into swamps, are deposits representing the work of geological agencies during the recent epoch.

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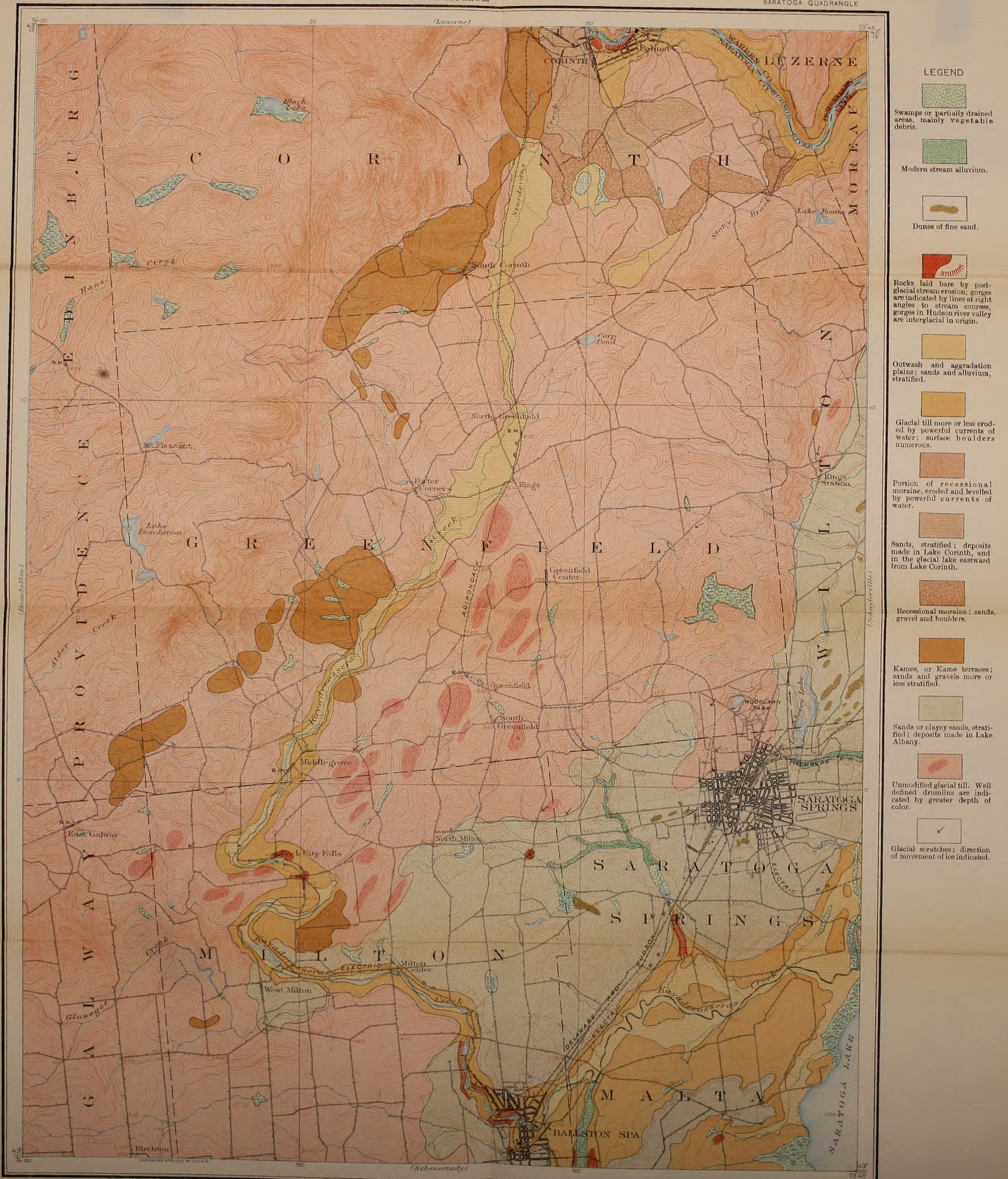
Geologic map of the Saratoga quadrangle



H.M.Wilson, Geographer in charge.
Triangulation by N.Y. State Survey.
Topography by W.H.Lovell.
Surveyed in 1899 in cooperation with the State of New York.

Scale $\frac{1}{62500}$

Contour interval 20 feet.
Datum is mean sea level.

Geology by J. H. Stoller, 1912.