SUMMARY OF GEOLOGICAL HISTORY

of the

CAYUGA LAKE BASIN

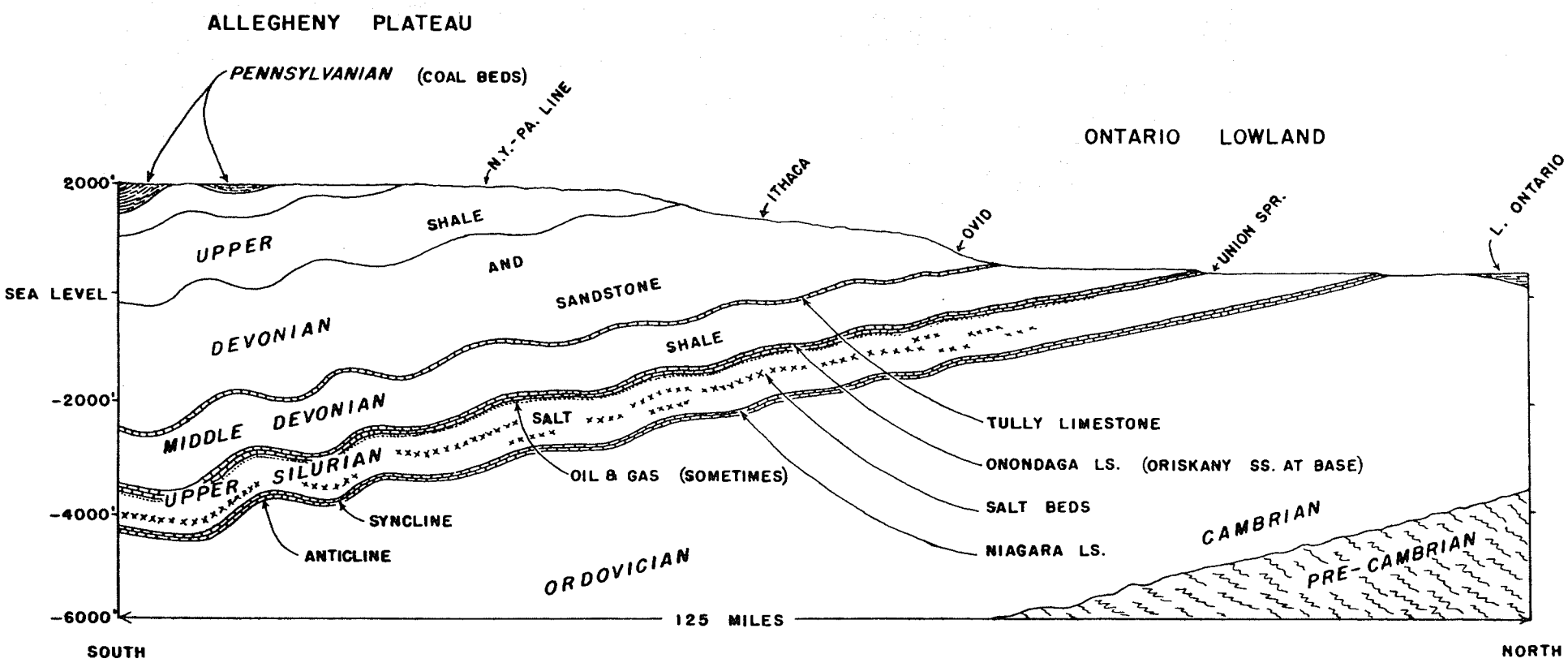
During the Paleozoic Era this region lay in the western part of the Appalachian geosyncline (Miogeosyncline: Cambrian-Ordovician; exogeosyncline: Silurian-Devonian) and was more or less continuously covered by a shallow sea into which sediments were carried from the tectonic and volcanic lands ("Appalachia") to the east. The sediments were dominantly clastics with lesser accumulations of carbonate muds and oozes. Clastics dominated during the Cambrian, carbonate during the Early and Middle Ordovician, clastics during the Late Ordovician and Early Silurian, carbonates and evaporites during the Middle and Late Silurian, carbonates during the Early Devonian, and clastics during the Middle and Late Devonian, depending on the rates of subsidence of the seaway and elevation of the sources to the east. The total thickness of Paleozoic rocks (Cambrian-Devonian) in the basin is about 9000 feet, but only some 4000 feet of the latest Silurian and Devonian rocks are now exposed, outcropping in order from north to south (see geological map opposite, and section on page 2), following the southerly regional dip of about 50 feet per mile. In places, especially in the southern part of the basin, low folds whose axes trend northeast-southwest, interrupt the otherwise simple structure. These are the outermost of the Appalachian folds.

At the close of the Paleozoic the Appalachian Revolution, with its lateral pressures from the southeast, produced the gentle folds, small faults, joint systems, and regional dip. It is likely that the igneous dikes of the region were intruded at the same time.

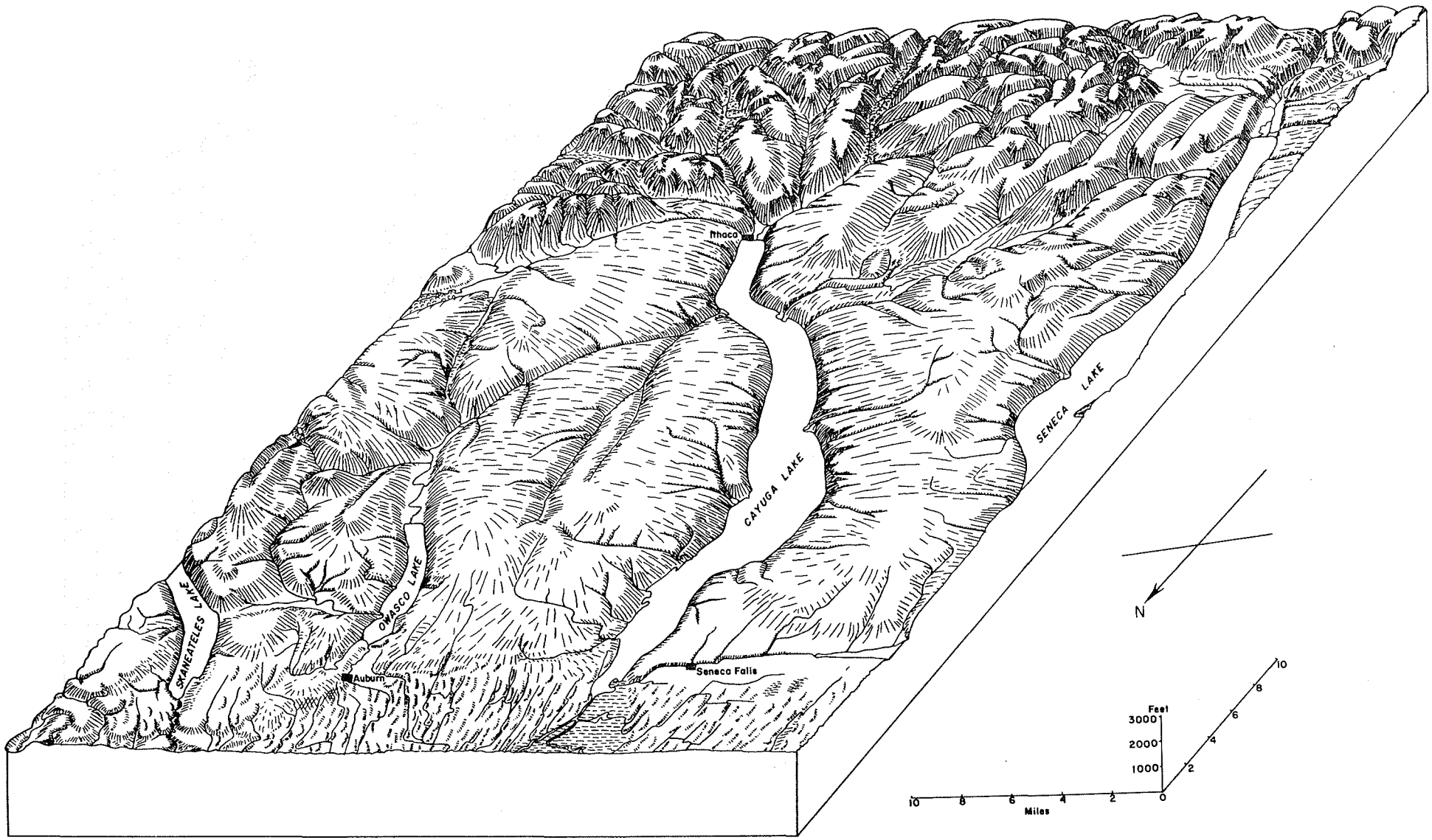
During the succeeding long period of relative quiet the streams, aided by various weathering agencies, slowly wore away the rock. This condition continued long enough for the whole region to be eroded to an essentially flat plain near sea level, called a peneplain. It was probably completed sometime during the early or middle part of the Cenozoic era.

Crustal disturbances then elevated the peneplain, probably very slowly, several hundred or a few thousand feet. Streams flowing over this plateau-like country developed valley systems which dissected the uplifted peneplain. Those portions which escaped destruction may be recognized today as a succession of hilltops at about the same elevation.

One of the streams on the peneplain followed approximately the course of the present Cayuga Lake and is referred to as the Cayuga river. The bottom of this pre-glacial valley was at about the elevation of the Cornell campus. The river was fed by many tributaries whose courses are indicated by the upper portions of such streams as Fall, Cascadilla, Six Mile, Buttermilk, Enfield, and Taughannock creeks. At that time there were no waterfalls and gorges, the streams being well graded.



NORTH-SOUTH SECTION IN CENTRAL NEW YORK



PHYSIOGRAPHIC DIAGRAM, CAYUGA LAKE BASIN

At the beginning of the Pleistocene, a great ice sheet began to move slowly southward from its center in eastern Canada, overwhelming the northern part of this country and extending as far south as New York City and into Pennsylvania. Its thickness, although unknown, was sufficient to cover the highest hills in this region. The slowly moving glacier found the Cayuga river valley a convenient course. The flow was therefore concentrated in the valley and resulted in about 1000 feet of erosion, so that the valley bottom is now below sea level. This valley has the U-shaped cross section typical of all glacial valleys. The tributary streams, being crosswise to the direction of ice movement, were not greatly eroded. When the ice ultimately melted they were left isolated far above the new bottom of the main valley, so that they are now hanging valleys. As the streams in these valleys reached the steep slopes of the deepened main valley they formed a series of rapids and cut into the rock, developing waterfalls and gorges (Fall and Cascadilla Creeks, the north and south boundaries of the Cornell campus).

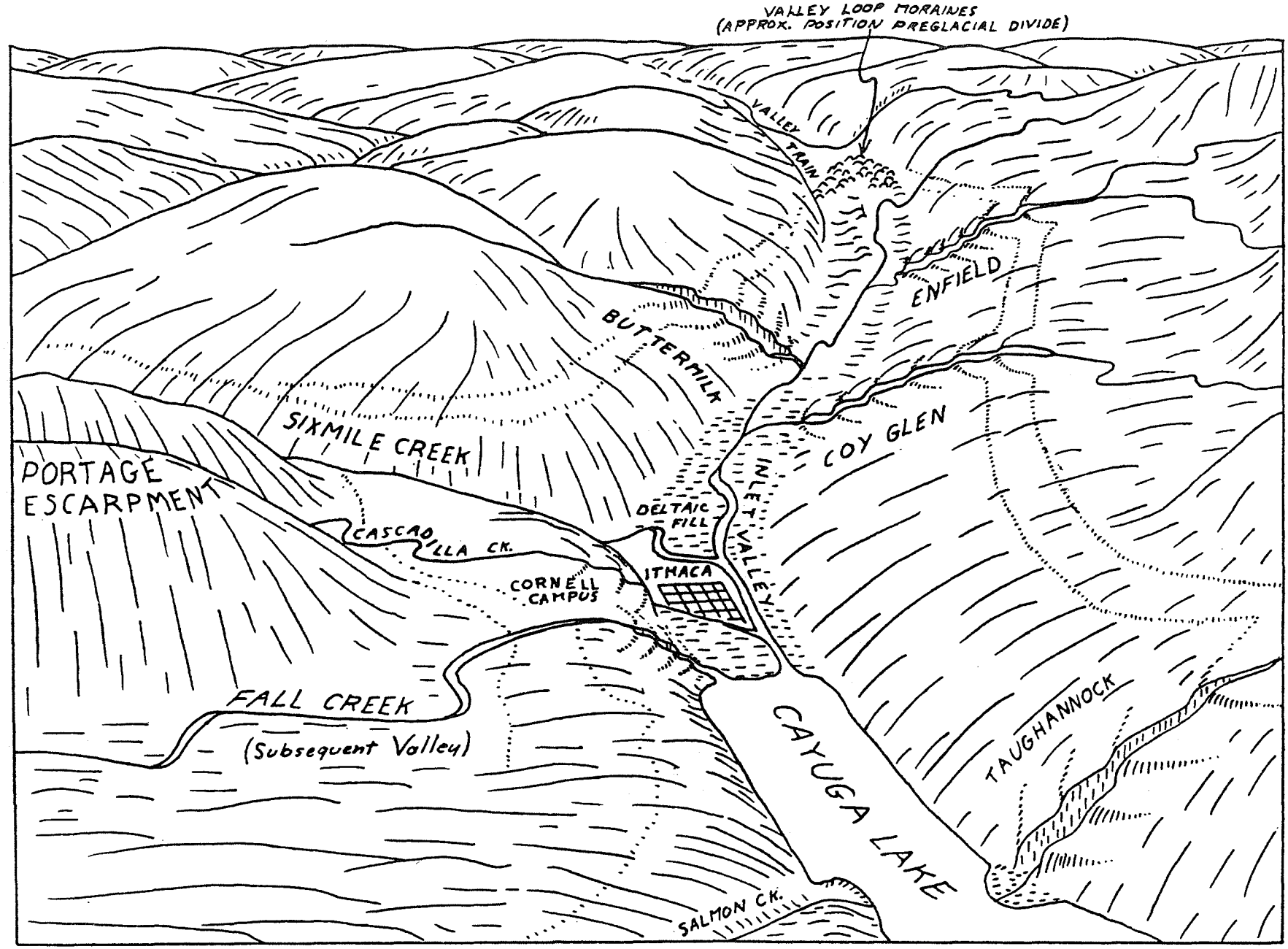
In this region the ice age was interrupted by at least one warm inter-glacial period which was of much longer duration than our present post-glacial warm period. Gorges cut by the inter-glacial streams are generally broader and with more gently sloping sides than those cut since the melting of the last glacier. The inter-glacial valleys are largely filled with glacial till left by the last ice sheet and are exposed only locally where the post-glacial streams have partially re-excavated them. The post-glacial gorges and waterfalls have been formed within the twenty or thirty thousand years since the last ice sheet disappeared. Because the valleys were irregularly filled with moraine material, the new streams had to pick their way from one low point to another over the rough surface, and their courses only locally correspond with the inter-glacial gorges (Enfield Gorge, southwest of Ithaca).

The general slope of the land in this region is to the north. As the ice front melted back, the glacial waters were ponded between the ice to the north and the high land to the south, and overflowed southward into the Susquehanna river. As the ice continued to melt northward, it uncovered lower outlets and allowed the lake to drop to successively lower levels. At each level the incoming streams built deltas with the loose material which they were removing from the land surface. These abandoned high level deltas are called hanging deltas. The flat on which the city of Ithaca has been built is a delta which has been formed at the present lake level by material brought there by such streams as Cascadilla, Fall, Six Mile and Inlet creeks.

GEOMORPHOLOGY

The Cayuga Lake Basin (see physiographic diagram opposite) lies chiefly within the Southern New York section of the Appalachian Plateaus Province which Fenneman (1928) characterizes as a mature, glaciated plateau of moderate relief. A more complete statement of the topographic stage would be:

> A mature plateau region of cuestaform type in an n + 1 cycle of erosion with features of topographic youth superimposed on it by the accident of continental glaciation.



DIAGRAMMATIC SKETCH OF ITHACA REGION LOOKING SOUTH

The uplands are beveled by the Allegheny (Schooley) erosion surface (Fridley, 1929; Cole, 1938) below which occur straths of the Niagara (Harrisburg) erosion surface and into which were carved the floors of the preglacial valleys. The preglacial valleys in turn have been modified variously by glaciation and locally by postglacial erosion.

Two fundamental topographic types are seen with clarity in any comprehensive view of the region: (1) the preglacial features, of which an outstanding example is the east-west trending Portage escarpment dominating the uplands, whereas (2) the glacially modified terrains, of which the overdeepened and steepened trough of the Cayuga valley is a classic example, are characteristic of the lowlands. A combination of pre-, inter-, and post-glacial features is found in the valley of Fall Creek which flows along the base of the Portage escarpment for the last few miles of its course.

This is a subsequent valley of preglacial origin and retains in the large view its original configuration, but in detail it has been modified by a masking of glacial deposits and by the development within its confines of inter- and post-glacial valleys. Although the large subsequent valley must be viewed from a distance, the development of the various gorges is displayed on the Cornell campus in the vicinity of Beebe Lake which occupies a portion of the inter-glacial gorge which has been re-excavated post-glacially. Another inter-glacial gorge can be traced at Enfield Glen.

The major erosive work of the ice occurred along north-south lines in the area, and was selective. Pre-glacially, the Cayuga trough was occupied by a stream which carved a valley that was north-sloping. The continental ice crowding down through this valley eroded it to such a degree that the present floor of the trough is at least 54 feet below sea-level, whereas the ice rode over the east-west valleys and intervening uplands with slight, if any, erosion (see diagram, p. 6).

In consequence of this selective activity, the valleys joining the Cayuga trough show progressive degrees of hanging. Inlet valley which is in the southern continuation of the Cayuga trough had its floor reduced in level so that it joins the Cayuga trough at an accordant level.

Six-Mile valley which trends southeast from the Cayuga trough was eroded moderately, whereas Cascadilla and Fall Creek valleys were largely undisturbed. Therefore, from south to east there is a progressively greater hanging relationship as these valleys join the Cayuga trough.

Cayuga Lake is the final (for the moment) lake in a long series of lakes which developed as the ice retreated northward (Fairchild, 1934). After the recession of the ice over the divides at the heads of Inlet and White Church valleys, lakes were formed in front of the ice. With progressive retreat of ice, successively lower outlets for the lakes became available. However, after a new outlet developed, the lake became stabilized for a period of time before a new outlet formed.

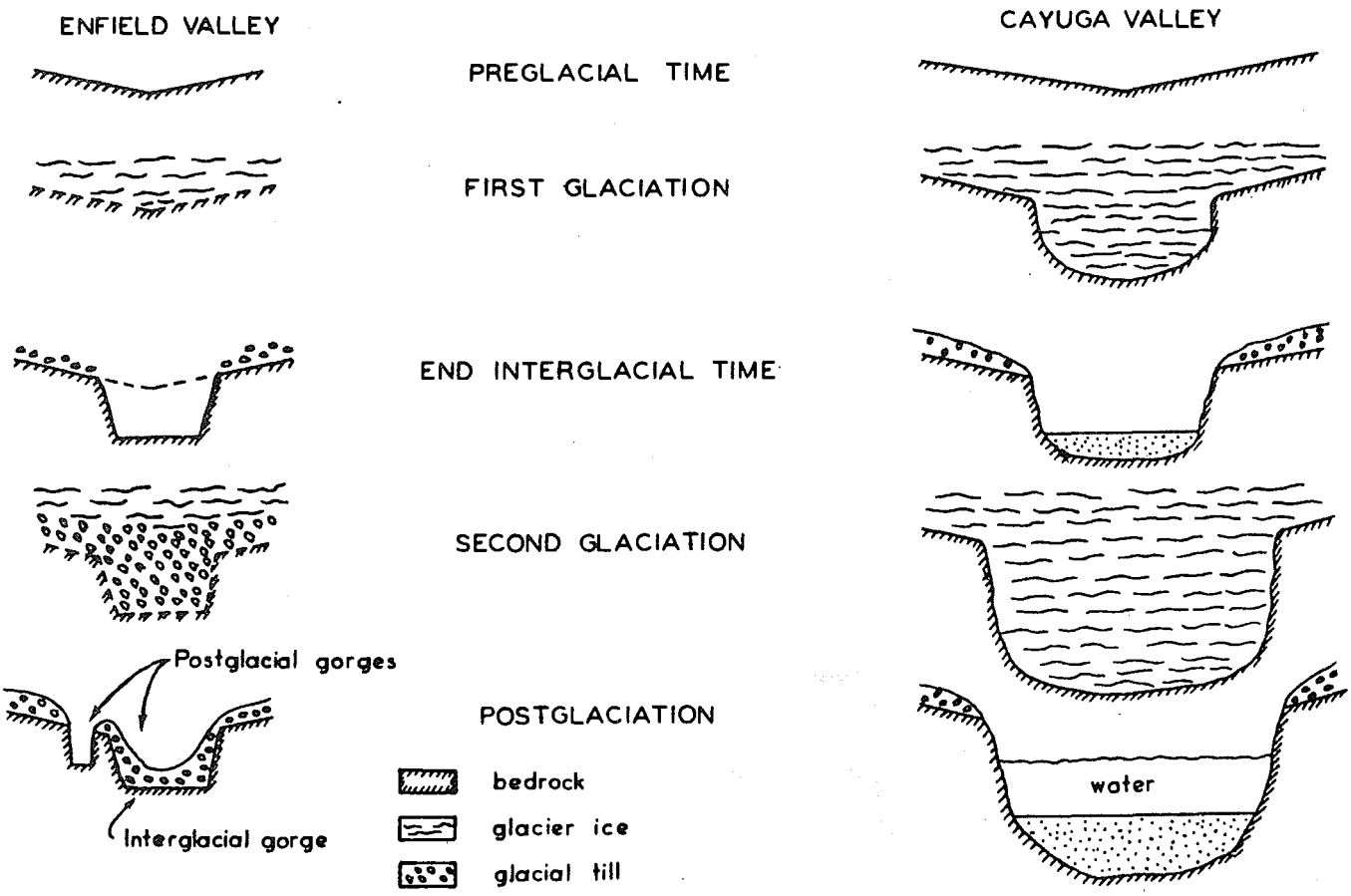
At each stand of the lakes, the inflowing streams built deltas similar in every respect to the modern delta at the mouth of Taughannock (Taghanic) Creek. Every time the lake level dropped the deltas of that

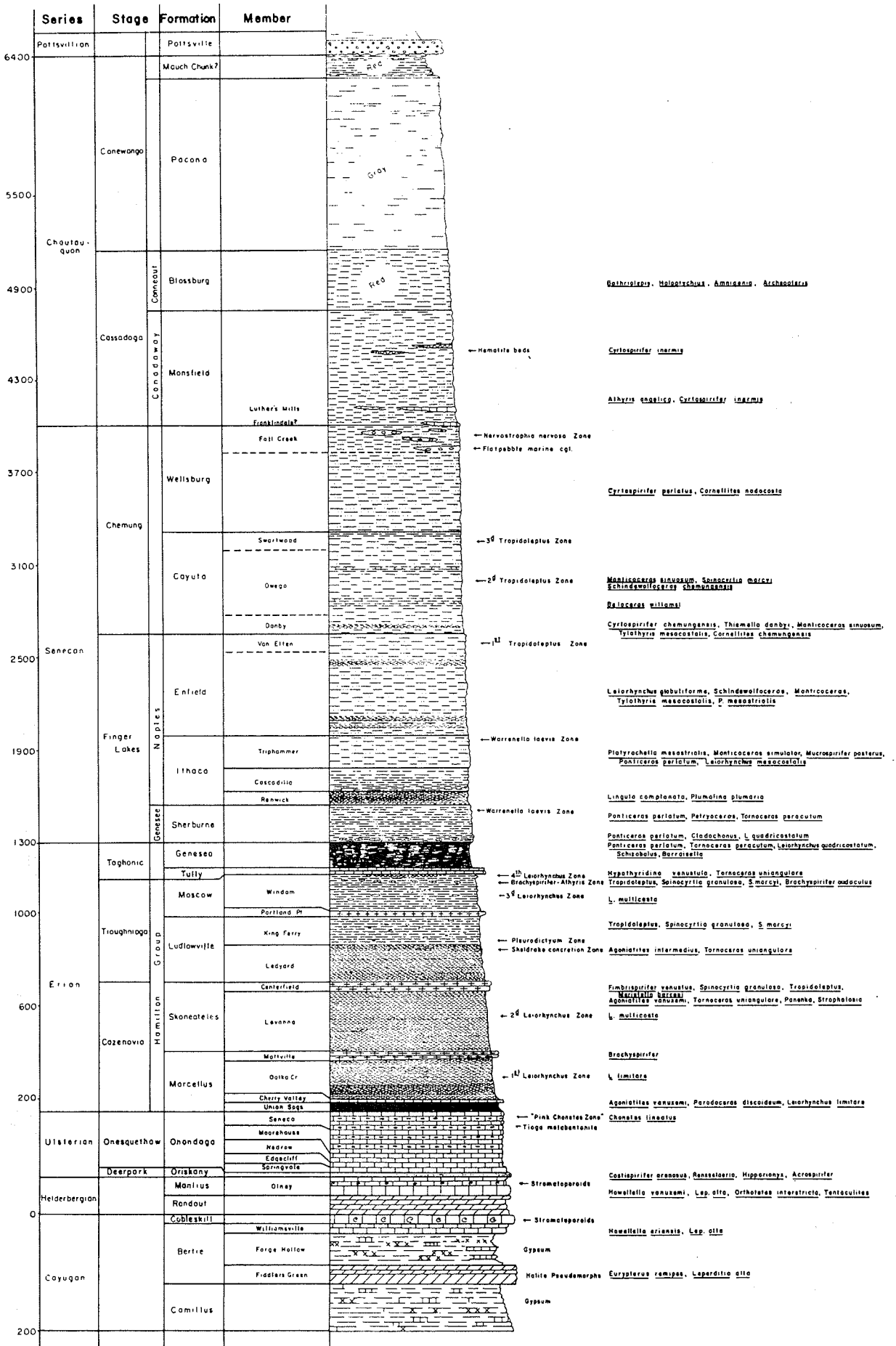
lake would be trenched by the stream which had formed it and a new delta would be formed at the new and lower stand of the lake. Therefore, each stream has built and partially destroyed a series of deltas in post-glacial times (see diagram, p. 4).

The most clearly defined set of hanging or fossil deltas (good sources of gravel) are those associated with Coy Glen which is on the west side of the Cayuga trough about 1.5 miles south of Ithaca (Cole, 1930). However, high-level deltas may be observed at Taughannock Gorge and on the Cornell campus. The chemistry building, Baker Laboratory, is built on such a delta.

Since Cayuga Lake attained its present surface level of 382 feet above sea-level, the streams discharging into the south end of the lake have built a vast delta from about the vicinity of Buttermilk Falls to the present south end of the lake, and it is still being extended. These delta deposits have been covered by floodplain materials, and it is upon these that the main section of Ithaca developed. Later, the city spread to the valley walls, and at present is expanding to the uplands.

VALLEY FORMATION ITHACA REGION





DEVONIAN SECTION, CAYUGA LAKE MERIDIAN