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ART. LVII.—*On the Physical Structure and Hypsometry of the Catskill Mountain Region;* by ARNOLD GUYOT, Princeton, New Jersey.

IN a former paper on the physical structure of the Appalachian system, I noted the fact that, though extending through the most populated and civilized part of the United States, that system of mountains was still among the least known of our country. This remark applies with double force to the Catskill Mountain region.

Situated in the old and flourishing State of New York, only one hundred miles from its metropolis, in full sight and within a few miles of the great artery of travel, the Hudson River; visited every summer by thousands of tourists in search of the beauties of nature and of the cool air of its high valleys and plateaus, its real mountain region has been thus far almost a sealed book to the geographer and the geologist as well as to the transient visitor. It seems a matter of legitimate surprise that to this day no physical map of the Catskills, deserving the name, could be found. True, there are county and township maps which trace with tolerable accuracy the water courses, the roads, the villages and the scattered farms; but they all end with the cultivated portions of the valleys and leave the mountains either in blank or give them in very inaccurate and unintelligible outlines.

For one, however, who has visited that part of the country, with the view of studying its physical conformation, the cause of the sad condition of its cartography is no mystery. The whole region was originally an unbroken forest, and, with the

exception of the bottom and slopes of a few valleys and of some portions of the northeastern plateaus, it has remained so to this day.

The wilderness of the Adirondacks is more extensive but hardly more complete than that of the pathless forests of the Southern Catskills, the habitual haunts of numerous bears, wild cats and occasional panthers. Add to this the fact that most of the mountain tops, not to say all, are not sharp peaks, but extensive thickly wooded flats from which no distant views can be obtained and it may readily be understood what difficulties lie in the way of the topographer and why ordinary surveys stop short of the mountain chains.

And still several features of the Catskills are well calculated to excite in a high degree the curiosity of the scientific investigator, and to call for a thorough study of its plastic forms. Though situated in the midst of the Appalachian system, and evidently a part of it, it appears in it as an anomaly. While the Appalachian ranges, throughout the system, invariably trend from the southwest to the northeast, all the chains of the Catskills run in an opposite direction from the southeast and east to the northwest and west.

I have shown elsewhere in this Journal, the existence of transverse chains, in the Appalachians of North Carolina and Georgia, reaching 5000 and 6000 feet between the Blue Ridge and the Great Smoky Mountains. But these two great border-chains at least retain the normal direction, while, in the Catskills, even the border-chains run at right angles to the system. Again, while the neighboring Appalachian chains, the Kittatinny, or Blue Mountains, in New Jersey, hardly reach 1800 feet, and their continuation, the Shawangunk, rarely exceed 2000 feet (Sam's Point 2341), the group of the Catskills suddenly rises to double that height. On the east, beyond the valley of the Hudson, the Green Mountain ranges remain lower by 1000 and 1500 feet. On the north, beyond the deep valley of the Catskill Creek, the plateaus average less than 2000 feet and on the west the swells of land, around the sources of the Delaware and Susquehanna, do not much surpass that average, their highest points seldom reaching 2400 feet. The Catskills stand as a mighty citadel overtowering by 2000 feet all the surrounding country.

These apparent anomalies in the otherwise regular structure of the Appalachian system need an explanation. The first step toward it was to obtain a correct idea of the topography and orography of the region, and of the direction and altitude of its mountain chains and valleys, which no existing map could give. To this work the writer has devoted several summer vacations, from 1862 to 1879. The results of these observations are

mostly embodied in a map, now engraved* which is believed to furnish the first accurate delineation of these mountains. A few words on the manner in which these results have been obtained may not be amiss here.

The map, of which Plate XIX gives a reduced sketch, was drawn by my assistant, E. Sandoz, and engraved on the scale of one inch for three miles. It covers a surface of about 4000 English square miles, of which the mountainous part proper occupies somewhat more than one half, or about 2400 square miles. The position of all the mountain peaks was obtained by means of a theodolite and a sextant, both reading to a minute of a degree; the points of the triangulation of the Coast Survey along the Hudson River serving as a base.

From the nature of the case none but natural signals could be used; but the very large number of "tours d'horizon" observed from every prominent point, with profiles regulated by angular positions, render errors of any consequence extremely improbable. I was, therefore, hardly surprised, but much gratified, to find that the position of the only point the map has in common with the triangulation of the New York State Survey, the Utsayantha, near Stamford, though determined entirely independently, was in close accordance with that assigned to it by this carefully conducted survey.

The Hydrography was taken from the most recent county and township maps of Greene, Ulster, Delaware and Schoharie counties and has been regulated by the position of the mountains.

The altitudes have been measured by mercurial barometers with the aid of assistants, all trained by myself; in only a few of the less important points the aneroid was used to obtain a preliminary measurement. Among my most useful assistants I must mention E. Sandoz for all the Northern Catskills, Wm. Libbey, Jr., for observations and computations in the Southern Catskills, John Reid and Samuel E. Rusk for the eastern portions. Most of the aneroid observations I owe to H. Kimball, the most indefatigable and skillful mountain climber of the Catskills.

The formula used in the computations is, as in my other measurements, that of Laplace, in connection with a table of corrections for the influence of the hour of the day and the barometrical coefficient, which I have derived mainly from the elaborate reduction of the meteorological observations of Geneva and St. Bernard by Plantamour.

The altitude of five points, not more than ten miles apart, was determined with great care from the Hudson River and the Delaware and Ulster Railroad, and each served as a base for

* The map is for sale by Charles Scribner's Sons, and B. Westerman, New York City.

the measurement of the neighboring heights. They are "the Vista," at Haines' Falls, for the east, Molyneux's farm for the southern Catskills, Lexington Village and Windham Center for the central region and Vaughn's Highland House for the north and west. They have been tested by reciprocal observations among themselves. The altitudes are reduced to the mean tide level in New York harbor, assuming this to be about 2½ feet below mean tide in the Rondout and Catskill Creeks.

The name Catskills is said to have been given to this wilderness by the first settlers, who were of Dutch origin, on account of the numerous wild cats inhabiting its forests. To the same settlers are due the geographical appellations of *kill* for stream, *clove* for gorge, and *vly* or *vlaie* for swamp, so frequently met with in the Catskills. The boundaries of the region to which the name applies, however, are not well defined. But confining it between the Hudson River and the sources of the Delaware, from east to west, and the Catskill Creek and the sources of the Navesink and Rondout Creeks, from north to south, we enclose the mountain district which has the special characters above indicated; and this is the portion comprised in the new map. It must be said, however, that the inhabitants of the plateau region north of Catskill Creek, to the Helderberg Mountains and west to the sources of the Susquehanna, claim to be still in the Catskills.

The mountain region is divided by the Esopus Creek into two groups differing considerably in their physical structure, one on the north, the northern or Catskills proper, situated mainly in Greene county; the other on the south, the southern Catskills or Shandaken Mountains, in Ulster county.

The *Northern* or *Catskills proper*, between the Esopus and Catskill Creeks, form a massive plateau having the shape of an irregular parallelogram, extending from S.E. to N.W., and shut up between two high border chains, ten to fifteen miles distant from each other, running about in the same direction. The southwest border is formed by what may be called the central chain of all the Catskills, the other by the northeast border chain. The southeastern end is closed by the short chain of the High Peak; the northwestern by the high swell of plateaus which divide the headwaters of the Delaware and Susquehanna from those of the Schoharie Creek and the Hudson. Inside of this highland three secondary ranges, starting from the northeast border chain and running nearly west, almost to the foot of the central chain, fill the inner space, enclosing deep valleys in which flow the waters of the Schoharie Creek and its tributaries.

The only access to this interior highland is through the deep and wild gorges called cloves, of which there are but few; all

renowned for the picturesque beauty of their torrents and cascades, and for their ice caves.

A striking peculiarity of the plastic forms of the northern Catskill group is that while its western end is, as it were, buried in the general plateaus of western New York, its mountains rising but moderately above their surrounding base, its eastern end stands isolated on three sides by deep and broadly open valleys, projecting, in all its height, as a mighty promontory, to within ten miles of tide water in the Hudson River.

The very base of its mountains rarely exceeds 600 feet above tide. The altitude of Woodstock at the base of the Overlook Mountain is 594 feet; the entrance of the Plaaterkill Clove, at West Saugerties, 660 feet; the entrance of the Kaaterskill Clove, 600 feet; Kiskatom, near the foot of the North Mountain, 687; Acra, not far from the base of Blackhead, 546 feet; Cairo, 347 feet. No wonder that the aspect of the Catskills is no where more imposing than from the Hudson River and the surrounding lowlands, from which their whole height is seized at a glance, and that it has been thus far believed that the highest points were found among the mountains of the eastern end. It is thus that the Round Top of the old geographies, now called the High Peak, at the head-waters of the Schoharie Creek, retained for over half a century the undeserved reputation of being the culminating point of the Catskills. This deception was common even to the inhabitants of the interior, and nothing but actual measurement could convince them of their error.

The panorama of mountains, viewed from Catskill village, extending from the Overlook Mountain, on the south, through the High Peak, the North Mountain, Black Head and Windham High Peak, is not a single chain, but rather the eastern end of the border chains together with that of the short range bearing the High Peak, which rises between the two. It is, therefore, but the abrupt termination of the whole mass of the Highlands toward the great gap to the Hudson Valley, as a description of the orographic structure of the plateau will show.

To make this description clear, a few preliminary remarks on the general geological structure of the Catskills, and the characteristic features of their topography seem to be desirable. We have not to look in the chains of the Catskills for a series of anticlinal and synclinal folds or arches, or fragments of arches, as in ordinary mountain chains. Throughout the region the strata of which they are composed are nearly horizontal from the bottom of the valleys to their top, or have a dip rarely exceeding four or five degrees. The same is true of the plateaus.

The mountains, therefore, whatever be their external forms, as well as the surrounding plateaus, are masses of piled up strata, with a slight inclination to the south or southwest and northwest, often hardly perceptible. A greater disturbance from the horizontal position is seldom observed and, when found, is only local. To this disposition of the strata and their tendency to break by the joints at right angles to the planes of stratification we must trace the occurrence of those abrupt ledges which are so frequently encountered by the traveler, and are often a cause of serious difficulty and no little danger to the inexperienced mountain climber. This also explains why the tops of the mountains are not pointed peaks but mostly flat surfaces, often of considerable extent, and why it is only at the edges of these that are found the perpendicular ledges which border precipices of vertiginous depth and disclose the splendid views which have rendered the Catskill Mountain House and the Overlook Mountain so celebrated. To the same cause, again, and to the peculiar mode of disintegration of the strata by successive steps, are due the numerous cascades which are so characteristic of the Catskills, and one of their greatest attractions.

Most of the peaks measured were, as usual in American wildernesses, without names. I had to find some fitting appellations. Those in use, such as Roundtop and High Peak, North and South Mountains, are so often repeated in all parts of the Catskills that to prevent confusion it was sometimes necessary to change or to qualify them. In the new ones I tried to avoid the fanciful names so much in vogue, and to derive them when possible from their geographical location. To Roundtop at the head of Little Westkill I applied the old Indian name of the region, Ontiora. Roundtop at the head of Drybrook became Doubletop, a name which from its form is more appropriate; South Mountain close to it is called on the map Graham Mountain, in honor of its owner, one of the old settlers of that district. In the Catskills nearly all valleys and passes are called *hollows*.

The *Central Chain* is, as before mentioned, the longest, the most massive, and plays the part of a back bone for the whole Catskill region. It forms at the same time the southwestern border chain of the Northern Catskills. Its total length from the Overlook Mountain, its southern end, to the Utsyantha, near Stamford, its northwest termination, is somewhat over thirty-five miles. Its direction is not uniform: in the first half to the Deep Hollow gorge its trend is west-northwest; at that point it turns sharply to the northwest. It descends in long slopes and heavy spurs toward the south and west, while it falls abruptly toward the interior to the northeast.

The central chain is divided into four, almost equal, portions by three deep gorges or cloves which give access to the interior valleys; the Stony Clove, summit of road 1700 feet, reaching the Schoharie basin near Hunter village; the Deep Hollow, summit 1973 feet, near Westkill, and the Grand Gorge Railroad depot, 1570 feet, near Moresville.

1st. The first part, from the eastern end to the Stony Clove, is about ten miles in length. It begins with the Overlook Mountain, and turning north reaches the Plaaterkill Mountain with which it forms a horse shoe having its convexity to the east and enclosing to the west the valley of the Sawkill with Shue's, or Echo, lake at its head.

From the Plaaterkill Mountain it stretches 20° north of west to the Stony Clove, along the valley of the Plaaterkill and Schoharie Creek. The prominent points from east to west are the Indian Head, with three peaks increasing in height toward the west, followed by the two Schoharie peaks rising from one mass, the higher one on the northwest of the other; then comes the Mink Mountain, with a broad rounded shape and a prominent projection to the north; still beyond is the long, flat, table-like Stony Mountain which falls by precipitous ledges into the Stony Clove. The flat summit of the last is so regular that the measurements of six points along the ridge did not show a difference exceeding a score of feet. Except for the Overlook, I found no current names for these various well-defined mountain tops. Those which I here propose are mostly suggested by their position.

The Plaaterkill Mountain is at the south entrance of the Plaaterkill Clove. Indian Head was a name given to me by an old hunter of the locality. The Schoharie Peaks are at the head of Schoharie Creek. Mink Mountain borders the Mink Hollow of the old settlers; and Stony Mountain is next to Stony Clove.

The altitudes, as shown in the following table, increase regularly westward to Hunter Mountain.

TABLE.

Overlook Mountain,	3150	Schoharie Peak, N. W.,	3650
Plaaterkill "	3280	Mink Mountain,	3807
Indian Head, East peak,	3380	Stony Mountain, East end,	3844
" Middle peak,	3510	" Center,	3823
" West peak,	3581	" West,	3789
Schoharie Peak, S. E.,	3583	Hunter Mountain,	4038

Two passes cross this first part of the chain, the Indian Pass, from the head waters of the Schoharie and Plaaterkill, east of the Indian Head, to the Sawkill valley and the Overlook, the elevation of which is 2694 feet; and the Mink Hollow, between the Mink and Stony Mountains, with a wood road whose summit is 2629 feet. This last is said to be the trail by which the

first settlers gained an entrance into the interior of the Catskills; for, though being over 900 feet higher than Stony Clove, it is more easy of access than that wild and rocky gorge. Stony Mountain sends to the southwest a high, massy spur of considerable elevation, between the Stony Clove and the Beaverkill, where it bears the name of the Oleberg, or Olderbargh Mountain.

The Overlook Mountain, on the southeast, and the South Mountain, near the old Mountain House, on the northeast, are two great promontories of the Northern Catskills, both terminating in perpendicular ledges; two natural observatories, from which the most extensive views are obtained over the broad valley of the Hudson, the chains of the Highlands and the Green Mountains. The Overlook can boast besides of a fine panoramic view of the high chains of the Southern Catskills.

The second portion of the central chain, between the Stony Clove and Deep Hollow, a distance of 10 miles, is composed of two chains and contains the culminating points of the whole. It begins, on the east, by the broad mass of the Hunter Mountain, the highest point of the Northern Catskills, 4038 feet. This sends to the north a long and rocky spur terminating opposite Hunter village in the precipitous and rocky ridge bearing the name of the Colonel's Chair, 3037 feet. It expands similarly to the southwest into a broad ridge. To this is attached the Westkill chain, which, from its direction and greater altitude, may be considered as the true continuation of the central chain; while the Lexington chain attached to the northern spur is but a secondary feature. Between these two chains lies the deep valley of the Westkill, nine miles long, with the abrupt sides of the mountains turned toward it. The Westkill chain, like the Stony Mountain, descends toward the southwest in long and gradual slopes which look more like an inclined plateau deeply furrowed by a few narrow valleys, such as the Peck Bushkill valley, the Broadstreet and Forest valley, the Ox Clove; all tributaries of the Esopus. This, in truth, is the outer margin of the north Catskill plateau. The Lexington chain, between the Westkill and Schoharie Creeks, falls abruptly on both sides.

The altitudes of both ranges decline regularly from Hunter Mountain westward, but more rapidly in the Lexington chain, which terminates rather suddenly in the Lexington Flats; while the Westkill chain retains its preëminence and continues the main chain. In the last the Big Westkill rises to 3896 feet and at the west end the Deep Hollow Mountain still measures 3500; while in the Lexington range Rusk Mountain is only 3626 and Lexington Mountain, at the west end, 2930 feet. The gaps in these two chains are indentations

without depth. Jones' Gap, between Hunter and Rusk Mountains, is the only one through which a wagon road passes. The Broadstreet Gap, in the middle of the Westkill chain, has hardly more than a mountain trail. The Hollow Tree Gap, near Hunter Mountain, and Peck's Gap, in the western half, are even less accessible. All this district between the Stony Clove and Deep Hollow gorge, the Esopus and Schoharie Creek, is still one of the wildest and least known of the Catskills.

The third part of the central chain, between the Deep Hollow and Grand Gorge, is the longest—11 miles—but its elevation gradually diminishes. Its general direction changes abruptly, at the Deep Gorge, from west 10° north to north 30° west. It begins on the east by the Beech Ridge with a slightly undulating top reaching in the Vlaie Mountain 3531 feet; is depressed in the Halcott Gap to 2725 feet, beyond which it rises again to the height of 3545 feet in the Bear Pen. It somewhat declines in Pond Mountain and the Ontiora, or Roundtop, at the head of the little Westkill, 3458 feet, and terminates by Jones Mountain, hardly lower than Ontiora, and the Irish Mountain near Grand Gorge.

Ontiora deserves a special mention for the great beauty and extent of the view it affords from its summit.

It is one of the two or three mountain tops which are free from trees. From this high observatory the eye takes in at one glance almost the totality of the Catskills including the Slide Mountain on the extreme south; High Peak and Black Head, on the east; Windham High Peak, Pisgah and Ashland Pinnacle, on the northeast; Utsyantha, on the northwest; and the innumerable hills of Delaware county, on the west and south. It has besides the merit of being easy of access by a well graded road from Prattsville and Batavia Kill, passing within half a mile of its summit at an elevation of 3180 feet.

This portion of the central chain unlike the preceding one has, on its southwestern slope, long and broad valleys—the Halcott Bushkill, Batavia Kill and Roxbury—whose waters form the east branch of the Delaware; and between which are ridges, sometimes full as high (such as the Red Kill Mountain 3540 feet) as the main chain with which they are connected.

The northeastern, or interior, slope is much less abrupt than in the Westkill chains. The only indentation of importance is the valley of the little Westkill.

The fourth and last division of the central chain, from Grand Gorge to Utsyantha, six miles, begins with the Bald Mountain near the Grand Gorge Depot of the Ulster & Delaware Railroad, continues by the slightly higher chain of the Moresville Mountains and, beyond a gap of moderate depression, terminates suddenly in the Utsyantha Mountain, near Stamford, with

an altitude of 3203 feet. This is also nearly the height of the Moresville range.

Utsyantha, at the head of the West branch of the Delaware, may be considered as the end of the Catskills in this direction; beyond it all high mountains disappear and the chains lose themselves in plateaus which increase in height on all sides. The following table shows the regular decline from Hunter Mountain to the end of the chain.

TABLE.

Hunter Mountain,	4038	Utsyantha,	3203
Big Westkill,	3896	*Lexington Range.*	
Deep Hollow Mountain,	3500	Rusk Mountain,	3626
Vlaie Mountain,	3531	Beeline Mountain,	3300
Bear Pen,	3545	Pine Island Mountain,	3086
Ontiora,	3458	Lexington Mountain,	2930

From the foregoing description it will be seen that, if we connect the mountain tops along the central chain by an ideal plane, it will gradually rise from the east end one-quarter of the distance to Hunter Mountain and thence descends still more gradually to the northwest end, no local peaks interrupting its normal slopes. The two ends, the Overlook Mountain, 3150 feet, and Utsyantha 3205 feet, are nearly equal in altitude.

Hunter Mountain is by far the most remarkable in the whole range. It is owing to its broad massive form, with no well defined peak rising from its uniform summit, that its superior height was not discovered nor even suspected by the inhabitants of the valley, while the High Peak looming up, isolated and in full view from the Hudson, gained a reputation for preëminence though, in fact, nearly 400 feet lower.

2d. *High Peak Range.*—High Peak, or the old Roundtop, so long celebrated as the culminating point of the Catskills, is the highest part of a short range running between the two head branches of the Schoharie Creek, parallel with the central chain and connecting it with the northeast border chain. Its mass fills all the space between the Plaaterkill and Kaaterskill Cloves, in the depths of which it falls in precipitous slopes, adorned by leaping cascades. On the east it descends more gently in terraces toward the plain. Its summit is capped, as many others in the Catskills, by thick layers of a hard conglomerate, which, having better resisted the destructive agencies of the atmosphere, stand distinct as a round head nearly 800 feet high, on the broad shoulders of the mountain, and suggested its first name, which ought to have been retained. The direction of this range is west 30° north; its length only six miles. High Peak, its eastern end, rises to 3664 feet; a second peak, hardly a mile distant to the west, now called Roundtop, is still 3500 feet; but farther on the chain descends rapidly, termina-

ting in Clum Hill, 2372 feet, near the confluence of the two branches of the Schoharie Creek.

From its central position this last hill affords a most instructive panorama of the interior chains.

3d. The northeast border chain appears more like the outer wall of the Highlands, falling from the top of the mountains to the valley of the Catskill Creek. Though its general direction is to the northwest, the individual parts show a succession of alternate north and northwest trends.

From the South Mountain, near the Catskill Mountain House, to the North Mountain the direction is north; from North Mountain to Black Head, northwest; from Black Head to Acra Point, north; from Acra Point to Windham High Peak, west 30° north; from the last point to East Windham Gap, northwest; from the Gap along Mt. Zoath, due west; from Zoath, through Mt. Hayden, Pisgah and the northwest terminal chain, northwest again.

The altitudes along that chain follow the same order as in the central chain opposite, but are somewhat lower. South Mountain at the Star Rock, near the Coast Survey Signal, is 2497 feet; North Mountain, east end, 3285 feet, and its highest point 3442; Black Head, the highest of the range, 3945; Acra Point approximates to 3085 feet; Windham High Peak, 3534; Mt. Hayden, 2900; Pisgah, 2905; in the terminal range Sutton Hill, 2573 feet; High Knob, 2654; Barlow Hill, 2651 feet; Leonard Hill, 2649 feet.

Here again, as in the central chain, a general plane carried through the summits would show a comparatively rapid rise to Black Head, one quarter of the distance, and a much more gradual descent from Black Head to its termination. As in the central chain the two ends, east and west, the South Mountain, 2497 feet, and Leonard Hill, 2649 feet, have about the same altitude. It would be still more alike if instead of the Star Rock, on the border of the ledges, we took the real culminating point of South Mountain, a short distance farther west.

The general slopes of the border chain toward the valley of the Catskill Creek are steep, rarely less than 25° to 28°; but reaching the foot of the mountains, they change quickly to gentle undulations descending by a slope of 6° to 8° to the Catskill Creek, making the valley very broad and open. In the interior the slopes are equally steep, but much shorter, as the bottoms of the valleys are 2000 feet and over above the sea-level. The passes which afford an entrance into the interior valleys are about as high as in the central chain. In Pine Orchard, the Catskill Mountain House lies 2225 feet above tide; the Summit House, in East Windham Notch, 1940 feet

in the northwest terminal chain, Sutton Gap, 2236 feet; Potter's Hollow Gap, 1966 feet; Bennet's Notch, 1997 feet.

4th. The highland between these two main chains has, as remarked before, the shape of an irregular parallelogram. Its length is about twenty-seven miles; its width, between the Plaaterkill and South Mountain, only six miles. It increases to ten miles between Stony Mountain and Black Head, reaches its maximum—fifteen miles—between Deep Hollow and Pisgah, and is reduced to 12½ miles between Grand Gorge and High Knob. The central part is filled by three ranges, separated by valleys in which flow the tributaries of the Schoharie Creek: 1st. The Eastkill and East Jewett Range starting from the North Mountain and running a few degrees north of west, 12½ miles long; 2d. The Black Head Range, from Black Head due west, continued by the West Jewett Range, sixteen miles long; 3d. The Pisgah Range running west 10° south, a distance of ten miles.

The Eastkill and East Jewett Range, between the main Schoharie Creek and the Eastkill, is divided into two parts by the Parker Notch, 2415 feet. The first detaches itself from the North Mountain, 3442 feet, and descends rapidly to the Star Rock of Parker Hill, 2545 feet. The second to the west rises again to 3190 in the Eastkill Mountain, and 3146 in East Jewett Mountain; both north of Hunter village, on either side of a deep notch.

The Black Head Range runs from Black Head nearly due west for five miles, gradually descending to the Big Hollow Gap road. Its great height, its massive forms, its fine rounded summits, whose aspects vary from every new point of view, make it the most conspicuous of these inner chains and a prominent feature of the landscape. The central part, the long and symmetrically shaped Black Dome, attains the height of 4003 feet. It is cut off from its neighbor Black Head with its steep and rocky slopes, by the Lockwood Gap, 3446 feet; while the following peaks to the west: Mt. Kimball, 3960; No. 4, 3566, and No. 5, as yet nameless, are only separated by slight depressions.

Between the Big Hollow and Henson Gap roads, 1800 feet, rise two rounded hills, 2500 feet high, cultivated to the top, and from which one of the most varied and extensive panoramic views of the Catskills may be obtained. On the same line, farther west, the Jewett Range has an altitude of 3025 feet, at its culminating point, just above Windham Center; and of 2931 feet in the conical Tower Mountain, above Ashland. This Black Head Range, with its continuation, separates the valleys of the Eastkill and Bataviakill, the two main tributaries of the Schoharie Creek.

The third and most northern of these transverse chains begins at Mt. Pisgah, 2905 feet, and stretches west 10° south for about ten miles between the Bataviakill and the Manorkill. Unlike the others it grows in altitude westward. Next to Pisgah the wooded summit of Richmond Peak is 3202 feet high; Strawberry Knob, 2975, and Sister Mountain, 3002 feet; while Ashland Pinnacle, with its 3420 feet of elevation, rivals the high peaks of the central and border chains. The two slopes are very unequal. On the south they descend gently, almost plateau-like, for five or six miles to the Bataviakill; on the north they fall rapidly to the Manorkill Valley, reaching the same level within a mile from the ridge.

Beyond the Manorkill, both on the east and west side of the deep Schoharie Valley, the high mountain chains disappear. Plateaus from 1500 to 2000 feet of elevation become the prominent feature. The series of hills, of 2650 feet, forming the northwest end of the border chain, hardly rise more than 500 or 600 feet above their apparent base, and soon lose themselves in the surrounding plateaus, before reaching the valley of the Schoharie.

On the west side of the valley a long and high swell of land, starting from the Utsyantha, near Stamford, stretches directly to the north, dividing the waters of the Schoharie from the head waters of the Delaware and Susquehanna, and joining the plateaus which border the Mohawk River. North of Stamford this table land bears a group of hills, among which Mine Hill, the highest, measures over 2800 feet. Wood Chuck and Potter Mountains are but little lower. Farther north the plateaus culminate in Summit at the height of about 2400 feet.

Drainage.—A glance at the map will teach still better than any description that the interior highlands of the Catskills proper are drained, from beginning to end, alone by the Schoharie Creek and its tributaries. They thus form a unique hydrographic basin.

It is true that the Kaaterskill derives the main part of its waters from the inner amphitheatre formed by the South Mountain, the ridge on which stands the Mountain House, and the North Mountain Outlook, at the bottom of which they collect in the Catskill Lakes; but this can scarcely be regarded as an exception; for after a course of not much more than a mile they suddenly leap into the deep gorge forming the beautiful cascade of the Kaaterskill and joining the other branch which descends from Haines' Falls, their rivals in wild beauty, they hurry together in rapids through precipitous chasms out of the mountains. The whole distance from Haines' Falls, at the head of the valley to its outlet, at Palenville, is only three miles. The same may be said of the Plaaterkill Creek, which flowing from

the Indian Head precipitates itself almost immediately into the deep clove bearing its name, from which its roaring waters issue only two miles below. Both properly belong to the outside slopes.

The main Schoharie Creek originates at the foot of the Schoharie peaks, near the head of the Plaaterkill Clove, from which it is hardly separated by a slight swell in the swampy valley bottom. It follows closely the foot of the central chain and receives just below Tannersville its first affluent, also coming from swampy meadows near Haines' Falls, at the head of the Kaaterskill Clove; these two head streams embracing the chain of the High Peak. The creek, keeping the direction of the central chain to the west-northwest, flows through Hunter village 1609 feet to Lexington, 1320 feet, where it turns with the chain to the northwest, to the mouth of the Beaverkill Creek, beyond Prattsville, 1164 feet.

Here it leaves the central chain and, running almost due north to the confluent of the Manorkill, it enters the mass of the northwestern plateaus, cutting from Gilboa 1033 feet, to Middleburg 640 feet, a deep and narrow valley, the bottom of which is from 1000 to 1300 feet below the general level of the country it traverses, while the occasional flat bottoms in it at Blenheim, Breakabeen, Fultonham and Middleburg, rarely attain more than half a mile in width. Its course from Blenheim, through Middleburg, Schoharie and Central Bridge, where it receives the Cobbleskill Creek, is alternately to north-northeast and north. From this place, instead of following the broad valley through which runs the Albany and Susquehanna Railroad, it leaves it and cutting its way at right angles through the high hills which border the Mohawk, it finally enters that river near Fort Hunter, after a course of over seventy-six miles.

All the main tributaries of the Schoharie Creek in the mountain region, the Eastkill, the Bataviakill, the Manorkill, come from the northeast border chain and flow almost due west toward the central chain, on the opposite side, where they enter the main creek; the Eastkill, three miles above Lexington, the Bataviakill just above Prattsville, the Manorkill at Gilboa. Like most valleys of erosion they offer, in their upper and middle course, a succession of flat and open basins from which they fall through narrows, in rapids and cascades, into the valley of the main creek. The left affluents from the central chain, the Westkill, Little Westkill and the Beaverkill, are all inconsiderable in length and volume. In the region of the plateaus another Westkill, on the west, at Blenheim, and the Keyserskill on the east, at Breakabeen, are hardly more than mere torrents.

The contrast of the broad open valleys between the mountain chains above described, and the narrow and deep cut of the Schoharie Creek when passing through the plateau region is a feature to be noted.

This drainage which sends the waters of the Catskills all the way around to the Mohawk to come back by the Hudson, after a course of 175 miles, to within 10 miles of their starting point is certainly remarkable, and betokens a very peculiar physical structure. This is made more striking by the fact that on both sides of these highlands the waters of the valleys of the Catskill and Esopus Creeks flow, as we might have expected, from the western plateaus directly to the Hudson River. These three streams, which are so near each other, flow in opposite directions, and it seems as if this plateau of the Catskills had been lifted up on its eastern part to a higher level from which its waters were sent in the opposite direction.

From the nearly horizontal position of the strata which is common to the mountains and the surrounding plateaus and from the peculiar features of the drainage, we are led to admit that the plastic forms of the Catskill region are the work of the erosive forces which have been so long active since the time of their first upheaval. Neither of these mountain chains, the central no more than the transverse ranges, have the character of anticlinal axes of elevation, nor are the valleys synclinal folds. These orographic features therefore are not due to the ordinary dynamic process which has folded and shaped into southwest and northeast mountain ranges, the other portions of the Appalachian system, and do not constitute an exception to the rule. The idea of a series of axes of elevation, the principal of which is prolonged on the northwest to Little Falls, on the Mohawk, and is often represented as connecting the Catskills with the southern chains of the Adirondacks, has thus no foundation whatever in nature. The nearly continuous heights, up to 2000 feet and more, which form the water-shed between the Schoharie Creek, the Mohawk and the various branches of the Susquehanna are but the swelled border of the plateaus falling rather abruptly into the Mohawk valley. We may, therefore, conceive the original form of the Catskills to have been that of a high plateau, a mass elevation, forming a part of the Appalachian plateau region which extends west of the Alleghanies from South Virginia, and fills nearly all the western portion of the State of New York, south of Lake Ontario and the Mohawk River. The lowest altitude of the primitive plateau is marked by the ideal plane which would pass through the mountain tops, and its superior elevation on the east would account for the flow of the waters, the gradual scooping out and the sloping of the valleys in the direction

they now have. This may also explain the possibility of the creek, below Prattsville, cutting through the western plateau a thousand feet higher than its level, when we conceive that the erosion was begun by a stream coming from a higher level than the present plateau.

The Southern Catskills are far from having the regular features which characterize the Northern group; nor are the boundaries as well defined, except along the Esopus valley. The central mass containing the most continuous and elevated chains, from which flow the head waters of the Esopus on the north and of Navesink and Rondout Creeks on the south, occupies the townships of Shandaken and Denning. It is flanked on the east by several high chains running north and south, in Olive, and on the west by long ridges, extending to the southwest and northwest into the Delaware Basin, in Hardenburg. The extent of this mountain tract from the Esopus at Olive City to the Delaware near Margaretville, at the end of the Drybrook ridge, is 25 miles; its width from the Esopus at Shandaken to the southwestern boundary of Denning is about 16 miles.

We find here no interior plateau enclosed between high border chains. The massive central chain, which bears the highest summit is accessible from all the surrounding valleys without crossing any high pass; but the roughness of the wild mountain torrents and the unbroken primitive forest make that access anything but an easy task. Though the direction of the main chain is about the same as in the northern Catskills, viz: west-northwest and northwest, several important ridges run to the north and northeast, almost at right angles, a direction never found in the first group, and imparting considerable irregularity to the physical structure of the Southern Catskills.

The main chain, beginning with the Slide Mountain, stretches west 22° north for 8 miles to the broad knob of Eagle Mountain, from which it turns at right angles, north 30° east, 4 miles to Balsam Mountain, and changes again, beyond the Lost Cove, to north 40° west in Belle Ayre where it terminates. The first two parts form a dark, high, unbroken wall of 12 miles, densely wooded, crossed by a single wood road, in the Big Indian, or Helsinger Notch, 2677 feet. Few summits rise much higher than the general crest. They are, from east to west, the Slide Mountain 4205 feet, Hemlock Mountain, Spruce top 3567 feet, Fir Mountain, about the same height, Eagle Mountain 3560 feet, Balsam Mountain, south end, 3601 feet. Belle Ayre has a milder aspect and descends to 3394 feet in its highest portion.

The Slide Mountain, the culminating point of the Southern, and the highest of all the Catskills, is in many respects quite remarkable. It terminates abruptly on the northeast toward the deep valley of Woodland, or Snyder Hollow, showing signs

of a slide of fallen rocks which suggested its name. From its broad triangular top it sends a ridge toward the southeast, which divides the waters of the Esopus from those of the Rondout, and terminates in the Lone Mountain 3670 feet, by which it is almost connected with the Wittemberg chain. Another high ridge descends toward the south and nearly reaches the high group of Table Mountain 3865 feet, and Peak-o'-Mouse 3875 feet, which separates the head waters of the Rondout from those of the East branch of the Navesink. It thus becomes the main hydrographic center of the region, sending its waters to the northwest by the Esopus; northeast to the same by the Woodland Creek; south by the Rondout to the Hudson; southwest by the Navesink to the Delaware. At 500 feet from the top, steep ledges, suddenly breaking the evenness of the ridge, mark the base of the cap of hard Subcarboniferous conglomerate (No. 10 of the 1st Pennsylvania Survey, according to James Hall) which crowns the king of the Catskills. An easy ascent is found by taking the road from Big Indian to the Helsinger Notch, from which the ridge, just beyond the Navesink waters, leads to the top by a regular and gentle slope.

On the east several chains not yet well studied run from the neighborhood of the Slide between the Woodland Creek and the middle course of the Esopus. The most important is the rough chain of the Wittembergs. The highest points are from south to north, Cornell Mountain, 3681, near Lone Mountain and on the line of the Slide; Friday Mountain and Great Wittemberg 3778 feet. Further to the east, and south of Shokan, High Point, celebrated for the beauty of its panorama, rises almost isolated from a low ridge to the altitude of 3098 feet.

Between the Slide and Balsam range, on the south and west, and the Wittemberg chain, on the east, lies the central plateau of the Pantherkill, 7 miles wide each way, wild and wooded, entirely surrounded by the waters of the Esopus and the Woodland Creek. It is surmounted by a long ridge running nearly due north from Slide Mountain with two prominent peaks, the highest of which, the Pantherkill Mountain, rises to an altitude of 3828 feet. It is deeply scooped out by torrents which pour their waters, on the west directly, and on the east by the Woodland Creek, into the Esopus.

On the southwest of the angle formed by the Fir and Eagle Mountains, but hardly connected with the main chain, rise two mountain peaks of still greater altitude, Graham Mountain, 3886 feet, and Double Top, 3875 feet, called respectively, by the few settlers South Mountain and Round Top. I have already said that my reason for changing these names was to avoid the confusion arising from their frequent repetition. These two high peaks, closely connected together, are situated,

in regard to the main chain, as Table Mountain and Peak-o'-Mouse are at the east end, south of the Slide; and both groups are of the same elevation. The Graham Mountain group is a remarkable hydrographic center sending many branches to the Delaware; the Drybrook and the Millbrook to the north and west; the Beaverkill and Navesink west branch to the south-west and south. Graham Mountain is also the head of a long ridge in which reappears the normal trend of the Appalachian chains, which is also indicated by the course of the Navesink and of the upper Rondout Creek. But all that region lies beyond the pale of my observations and requires further investigation.

What was said above of the Geological structure of the Northern Catskills is true of the Southern group.

Notwithstanding the greater variety of its plastic forms, which would, at first sight, indicate considerable dislocations, the nearly horizontal position of the strata, which predominates except in a few and limited localities, forbids the belief that they were the ruling element in their formation. The mountain chains are no anticlinals, nor are the valleys synclinals. Erosion and slow disintegration seem to have been the main efficient causes of the conformation of the surface.

If we reconstruct in imagination the original plateau from which these orographic features have been sculptured, by passing a plane through the principal heights, we shall find a law very much like that observed in the Northern Catskills. From High Point, at the eastern border of mountain land, 3098 feet, the plane passing through Lone Mountain, 3670, reaches in the Slide its maximum, 4200 at 7 miles, one third of its total length. It thence descends more gradually through the Eagle Mountain, 3500 feet, down to Belle Ayre, 3400 feet, 14 miles, or two-thirds of the entire distance.

Why it is that, notwithstanding the similarity of general structure, the streams in the Southern Catskills should have taken an opposite course and shaped themselves into an entirely different system, is not easy to say. The absence of border chains and of the eastern projection, so characteristic of the northern group, may partially account for this difference.

Primitive, and perhaps later, dislocations, even when in the shape of simple cracks, may have had a share of influence in bringing about the result. Traces of the great diluvian glaciers are found in abundance throughout the Catskills; but I have seen, in Switzerland, too much of the action of glaciers on the ground over which they move, to attribute to that latest of geological agencies any great influence on the fundamental features of the present topography of the mountains.

I am fully aware that to solve such problems and answer the

geological questions raised by the topographical features, indicated in this paper, requires a careful and exhaustive stratigraphical study which it was impossible for me to undertake while the arduous topographical and hypsometrical work demanded all my time and attention. This must remain for future investigation. Meanwhile, however, I will add here a few preliminary suggestions.

The masses of rocks forming the Catskill Mountains were deposited in a gulf of the Devonian Sea comprised between the Adirondack plateau and the Green Mountain range, including the low Silurian ridges between the Hudson and the foot of the Catskills, all of which were probably emerged when the Devonian age began. Most of New England was also above the level of the ocean. The thickness of the sediments shows that the bottom of this gulf gradually subsided during that time to a depth of some 5000 feet, constantly making room for new deposits.

The presence of the gray conglomerate capping the highest hills proves that the deposition of these sediments continued into the Subcarboniferous period, after which they were upheaved above the level of the ocean, before the deposit of the Coal-measures, and have remained emerged ever since.

The slight southward dip indicates that during the Devonian age a general and gradual rise of the continent took place from the north, which raised successively above water parts of the Lower and Upper Silurian, in the Helderberg and Oriskany sandstone, which were laid dry when the Catskill sandstones and shales were still depositing.

The most notable upheaval of the Catskill region probably took place at the time of the great revolution which raised the main Appalachian system; doubled the size of the early continent and closed the Carboniferous age. But the peculiar situation which sheltered it from the immediate effect of the force which was in play, the lateral pressure arising from the sinking of the bed of the Atlantic, modified the hypsometric form of that portion of the western plateaus.

A glance at the sketch (Plate XIX) will show that, when this great Appalachian upheaval began, the domain of the Catskills was secluded from the ocean by large tracts of preëxisting lands; the Adirondack plateau on the north, New England and the Green Mountain ranges on the east which, though affected themselves in a measure, served as a barrier against a strong action of the upheaving force from those quarters on the region beyond. Farther south, however, no obstacle intervening, the force was free to display its full power; and to this cause, I am inclined to attribute not only the folding of the numerous Appalachian chains, but also the remarkable

bend westward of the whole system, in Pennsylvania, as well as the significant fact that it is in the prolongation of the axis of that convexity that the western plateaus beyond swell to their greatest average height, in the region of the sources of the Susquehanna, Alleghany and Genesee Rivers. To this pushing northwest and northward of the land, and its reflex action northeastward, the swelling of the plateaus of western New York may be, in great measure, attributed. The Catskills would thus have been subjected to a pushing action, from three or four opposite directions, by the rising lands: From the Adirondack plateau on the north, from the Green Mountains on the east and from the rising Appalachians on the southwest and south; and hence, perhaps, their superior elevation above all the surrounding lands.

On the other hand, it might be supposed that the covering of the hard Subcarboniferous conglomerate, which must have been general in the Catskills, protecting the underlying strata of the Catskill formation against denudation, prevented their being swept away, as in the surrounding region, and thus preserved, in a greater measure, their primitive elevation. But the known facts hardly warrant more than a surmise.

In a very interesting paper published in the Proceedings of the American Association for the Advancement of Science, in 1875, James Hall announces, as the result of four years' observation of two of his assistants, the existence in the Catskills of four lines of anticlinals, nearly parallel to each other and running from the southwest to northeast in conformity with the ordinary trend of the Appalachian ranges; the synclinals occupying the summits, the anticlinals the bottom of the valleys. As the map and sections accompanying the paper have not been published, I cannot locate them, but one of the synclinals passes through the Slide Mountain. Notwithstanding the great difficulty of determining such stratigraphical changes in so rough a country when the dip varies but a few degrees, I am quite disposed to acknowledge the reality of a fact observed with so much care. But if the trend of these axes is what it is said to be, far from coinciding with the chains and valleys, they cross them almost at right angles, and were probably posterior to the scooping out of the valleys and mountain chains, on the conformation of which they had so little effect. They were the last effort of the forces which have shaped the main Appalachians.

A hypsometric feature which may refer to this order of facts is that the three maxima of altitudes, above 4000 feet, the Slide Mountain, Hunter Mountain and Black Dome, are situated in a straight line, trending from southwest to northeast.

The short descending plane from this line eastward, which

we have noticed as belonging both to the northern and the southern group, may be due to a subsequent subsidence of the Great Hudson Valley.

This valley during the Champlain Epoch of the Quarternary age was an arm of the sea. The east end of the Catskills was then a series of high marine bluffs, worn out by the action of the waves, which would explain the abruptness of their eastern termination.

I need not repeat that I consider the above suggestions as mere hints for future investigation.

I here add a classified list of most of the points mentioned, reduced to the ground above mean tide level in New York harbor. *B.* means a measurement by mercurial barometer, *Aner.* by aneroid, *P.L.* by pocket level.

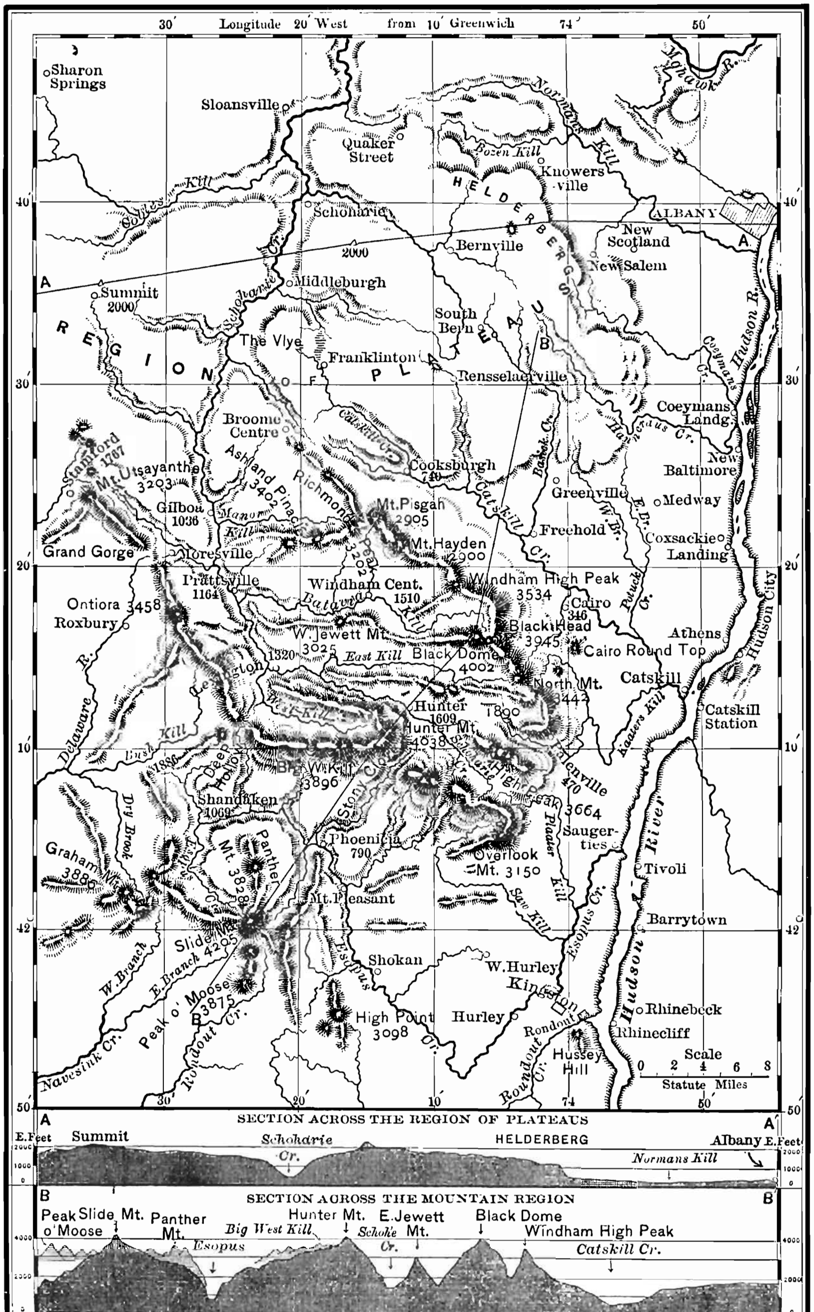
		Feet.
	NORTHERN CATSKILLS.	
B.	Half-way House	286
B.	Palenville—Union Church	470
B.	Entr. of Kaaterskill Clove	609
B.	Palenville Hotel, lower bdg.	680
B.	Morefalls bridge	883
B.	Lakecreek bridge	1217
B.	Haines' Falls, Chas. Haines	1890
B.	Vista, Aaron Haines' Porch	1932
B.	Bridge, Miles Haines	1906
B.	Dixon's Hill	2045
B.	Kiskatom	687
B.	Sleepy Hollow	1290
B.	Catskill Mountain House	2225
B.	Catskill Lakes	2140
B.	Laurel House Piazza	2038
B.	W. Saugerties, Quarrybank	660
B.	Head of Plaaterkill Falls	1855
	Schoharie Creek—Main Valley.	
B.	Headwaters Schoharie Cr'k	1900
B.	Mulford's Summit House	2043
B.	Tannersville Hotel	1926
B.	Hunter Village, Rusk's	1609
B.	Lexington Bridge	1320
B.	Westkill Village	1538
B.	Prattsville Hotel	1164
B.	Gilboa Hotel	1036
B.	North Blenheim, Bridge	800
B.	Breakabeen, Creek	743
B.	Fultonham, Church	714
B.	Middleburg R. R. Depot	640
	Schoharie Creek—Tributaries.	Feet.
B.	Peters Farm. East Kill.	2100
B.	Jewett Heights, Church	1810
	Valley of Batavia Kill.	
B.	Big hollow, Church	1758
B.	Hensonville, Cross road	1646
B.	Union Society, Bloodgood	1670
B.	Windham Center, Hotel	1510
B.	Asland Center P. O.	1435
B.	Redfalls P. O.	1270
	Valley of Catskill Creek.	
B.	Cairo	346
B.	Acra	546
B.	Cornwallville	950
B.	South Durham	969
B.	West Durham	1884
B.	Durham Center	850
B.	Oakhill Bdg., Catskill Creek	609
B.	Cooksburg	756
B.	Preston Hollow	870
B.	Livingstonville	1100
B.	Franklinton	1260
B.	Potter's Hollow	870
B.	Smithton	1268
B.	Highland House, Piazza	1857
B.	Broome Center, Hotel	1973
B.	Makee's Corners	1964
	Central Chain.	
B.	Woodstock, Hotel	594
B.	Mead's House	1789

		Feet.
B.	Overlook Mountain House	2978
B.	Overlook Mountain	3150
B.	Plaaterkill Mt.	3280
B.	Indian Pass	2694
B.	Indianhead, East Peak	3380
B.	" Middle "	3510
B.	" West "	3581
B.	Schoharie East Peak	3583
B.	" West "	3650
B.	Mink Mountain	3807
B.	Mink Hollow, summit road	2629
B.	Stony Mt. East end,	3844
B.	" " Center	3823
B.	" " West end	3789
B.	Stony Clove, approximate	1700
B.	Hunter Mountain	4038
B.	Colonel's Chair, N. end	3037
B.	" " Highest	3165
	Lexington Range.	
B.	Rusk Mt.	3626
Aner.	Evergreen Mt.,	3624
Aner.	Bee line "	3300
Aner.	Pine Island "	3086
Aner.	Lexington "	2930
	Westkill Range.	
B.	Big Westkill Mt.	3896
PL.	Deep Hollow Mt.	3500
B.	Deep Hollow, Summit road	1973
B.	Beech Ridge Gap	3096
B.	Vlaie, or Fly Mt.	3531
	Halcott Gap, Sum. Road	2725
Aner.	Bearpen Mt.	3545
	Summit road to Batavia K.	3180
B.	Ontiora, Little West Kill	3458
B.	Utsyantha Mt. near Stamf.	3203
	Chain of Highpeak.	
B.	Highpeak (Old Roundtop)	3664
B.	Roundtop	3500
B.	Clum Hill	2372
	North Border Chain.	
B.	South Mt., near Mt. House	2497
B.	Palenville Overlook	1660
B.	Sunset Rock	2115
B.	Point of Rocks	2178
B.	North Mountain, Outlook	3100
B.	" " East Peak	3285
B.	North Mountain, W., Stopel	3440
B.	Blackhead	3945
PL.	Burnt Mt.	3170
B.	Windham Highpeak	3534
B.	Grand View Hotel	1970
B.	Cade Mountain	2390
B.	Summit House	1930
P.L.	Hayden Mt.	2960
B.	Pisgah	2905
	East Jewett Range.	
B.	Parkerhill, Star Rock	2545
B.	Parker Notch	2415
P.L.	East Kill Mt.	3190
B.	East Jewett Mt.	3146
	Blackhead Range.	
B.	Blackhead	3945
B.	Lockwood Gap	3446
B.	Black Dome	4003
B.	Kimball Mt.	3960
B.	Westpeak, No. 4	3566
Aner.	Delong Mt.	2540
Aner.	Henson Gap, Summit road	1989
Aner.	West Jewett Mt.	3025
B.	Tower Mt.	2931
	Pisgah Range.	
B.	Pisgah	2905
B.	Richmond Cone	3202
B.	Sister Knob	3002
B.	Ashland Pinnacle	3420
	Northwestern Catskills.	
B.	Sutton Gap, road	2235
B.	Sutton Hill	2573
B.	Potter's Hollow Gap, road	1964
B.	Koni or Pine hill	2337
B.	Bennet Notch	1994
B.	High Knob	2654
B.	Best Hill	2649
B.	Barlow Hill	2651
B.	Gordon Gap, road	2504
B.	Gordon Hill	2629
B.	Leonard Hill	2649
B.	Manorkill	1520
B.	Stone Bridge	1382
B.	Strykersville	1215
B.	Platt Creek Church	1683
Aner.	Mine Hill	2810

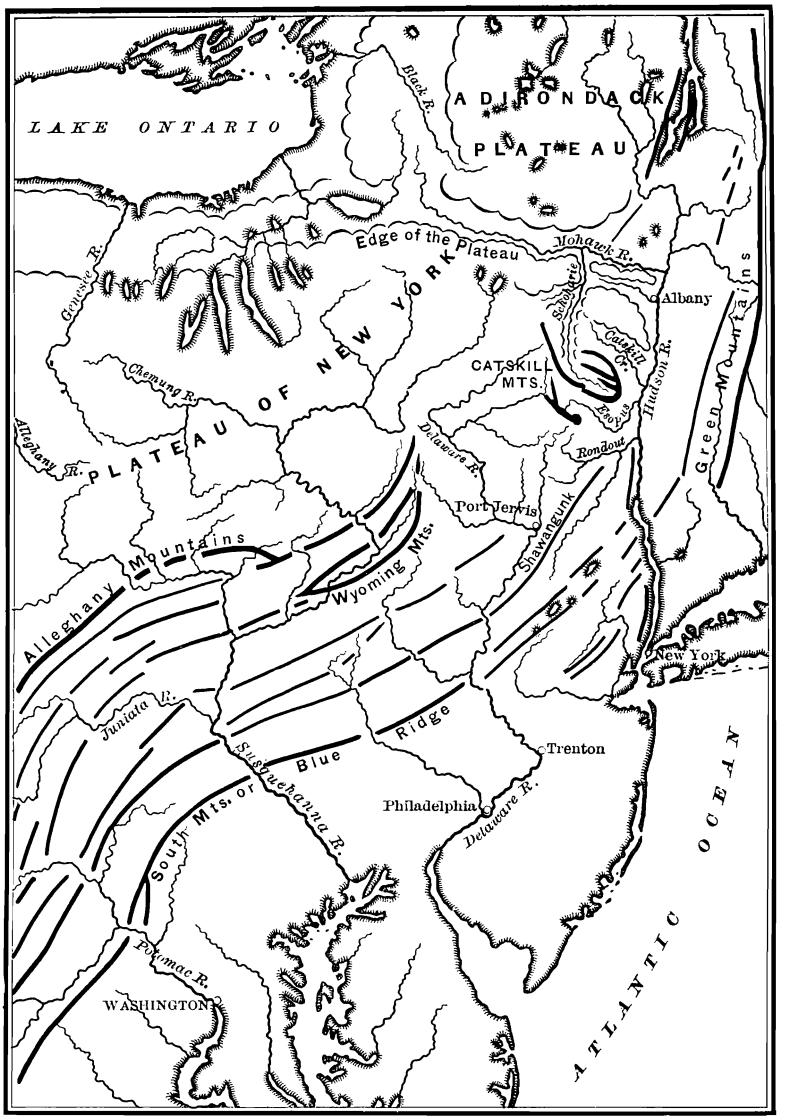
	Southern Catskills.	Feet.
B.	Highpoint	3098
B.	Peak o' Mouse	3875
B.	Table Mountain	3865
B.	Dominie Hammond's House	1945
B.	Lone Mt.	3670
B.	Cornell Mt.	3681
B.	Wittemberg Mt.	3778
B.	Woodland, N.W. Beach's H.	1140
B.	Pantherkill Mt.	3828
B.	Slide Mt.	4205
B.	Helsinger Notch	2677
B.	Sprucetop	3567
B.	Eagle Mt.	3560
B.	Balsam Mt., South End	3601
B.	" " North End	3571
B.	Belle Ayre Mt., max.	3394
B.	Graham Mt.—Dry Brook	3886
B.	Doubletop	3875
B.	Segar's house—Dry Brook	1923
B.	Molyneux House Porch	1315
B.	Guigou's Boarding House	1439
B.	Pine Hill Village	1512
B.	Undercliff	2200
B.	Rose Notch	2743
B.	Birch Kill Notch	2334
B.	Monkey Hill (Mucky)	2489
B.	Halcott Mt.	3504

Elevations above highwater of Rondout, by levels of the Ulster & Delaware Railroad; communicated by Geo. Coykendall, Supt.

	Feet.		Feet.
Rondout	2	Shandaken	1069
Kingston	155	Big Indian	1209
West Hurley	540	Summit	1886
Olive-Branch	511	Griffins' Corners	1516
Brooks Crossing	525	Dean's Corners	1344
Brodhead's Bridge	500	Halcottville	1399
Shokan	533	Strattons' Falls	1456
Boiceville	598	Roxbury	1497
Mount Pleasant	690	Grand Gorge	1570
Phoenicia	790	Stamford	1767
Fox Hollow	996		


Longitude 20′ West from 10′ Greenwich
Sharon Springs
Sloansville
Quaker Street
Knowersville
HELDERBERG
Schoharie
ALBANY
New Scotland
Bernville
New Salem
Middleburgh
Summit 2000
REGION OF PLATEAUS
South Bern
The Vlye
Franklinton
Rensselaerville
Coeymans Landg.
New Baltimore
Broome Centre
Cooksburgh
Stamford 1767
Mt. Utsayantha 3203
Gilboa 1036
Mt. Pisgah 2905
Mt. Hayden 2900
Greenville
Medway
Freehold
Coxsackie Landing
Grand Gorge
Moresville
Prattsville 1164
Windham Cent. 1510
Windham High Peak 3534
Cairo 346
Ontiora 3458
Roxbury
W. Jewett Mt. 3025
Black Head 3945
Cairo Round Top
Athens
Hudson City
Black Dome 4002
North Mt. 3442
Catskill
Catskill Station
Hunter 1609
Hunter Mt. 4038
Big W. Kill 3896
Shandaken 1069
High Peak 3664
Saugerties
Phoenicia 790
Overlook Mt. 3150
Tivoli
Graham Mt. 3885
Panther Mt. 3828
Mt. Pleasant
Barrytown
Slide Mt. 4205
Shokan
W. Hurley
Kingston
Peak o' Moose 3875
High Point 3098
Hurley
Rhinebeck
Rhinecliff
Hussey Hill
Scale 0 2 4 6 8 Statute Miles
SECTION ACROSS THE REGION OF PLATEAUS
Summit
Schoharie Cr.
HELDERBERG
Normans Kill
Albany
E. Feet
SECTION ACROSS THE MOUNTAIN REGION
Peak o' Moose
Slide Mt.
Panther Mt.
Big West Kill
Esopus
Hunter Mt.
Schohe Cr.
E. Jewett Mt.
Black Dome
Windham High Peak
Catskill Cr.

E. Sandoz del.


LAKE ONTARIO
ADIRONDACK
PLATEAU
Black R.
Edge of the Plateau
Mohawk R.
Genesee R.
Albany
Schoharie
Catskill Cr.
CATSKILL MTS.
Hudson R.
Green Mountains
Chemung R.
PLATEAU OF NEW YORK
Esopus
Rondout
Delaware R.
Allegheny R.
Port Jervis
Shawangunk
Wyoming Mts.
Allegheny Mountains
New York
Juniata R.
Susquehanna R.
Blue Ridge
Trenton
Philadelphia
Delaware R.
South Mts. or
ATLANTIC OCEAN
Potomac R.
WASHINGTON