GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

REPORT

ON THE

TIMBERS OF THE NORTH CUMBERLAND: BELL AND HARLAN COUNTIES.

BY LAFAYETTE H. DEFRIESE.

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INTRODUCTORY LETTER.

Professor N. S. SHALER, *Director Kentucky Geological Survey:*

DEAR SIR: I herewith send you a report on the timbers of the North Cumberland, which is a continuation, both in method and purpose, of a previous report on the timbers of four counties of Western Kentucky. The study upon which the present report is based was made during July and August, 1876, and was sufficiently exhaustive to insure accuracy and a reasonable degree of completeness.

Very respectfully,

LAFAYETTE H. DEFRIESE.

NEW YORK, March 20, 1877.

REPORT ON THE TIMBERS OF THE NORTH CUMBERLAND—BELL AND HARLAN COUNTIES.

The method of study pursued in investigating the timber of the North Cumberland necessarily differed somewhat from that indicated in a former report on the timbers of Grayson, Breckinridge, Hancock, and Ohio counties.* The reason is, that the latter counties are comparatively level, are largely settled, and their timbers had to be studied with reference to the effects which clearing away the old forests would have upon the future timber growth of the counties. In the present report, on the contrary, the country is almost impassably mountainous; comparatively a very small proportion of land has been cleared, and the mountains are still crowned by their vast and primitive growths. The end to be attained in this report is, evidently, to give a conception as clear as possible of the present condition of these timbers. I have, therefore, not done so much plotting of ground and numbering of trees as was given in the former report; for it is manifestly very difficult, if not impossible, for the mind to pass from the consideration of a few detached and poorly representative plots of ground, of a few hundred square yards each, to the comprehension of a vast forest whose area comprehends millions of acres.

Another difficulty lies in the way of giving a clear impression of the timbers under discussion. They grow upon a perfect net-work of mountains. There is no regular gradation of timbers on these mountain chains; so no fairly representative one can be chosen and studied which will give data for a report upon, and a clear comprehension of, the whole. On the contrary, the mountains are sharply divided into those whose forest must rank among the finest in this or any other coun-

*See report on the timbers of those counties in volume II of this series.

try and those whose timbers are, at best, only tolerably good, often mediocre. There are no intermediate chains. To the former class belong the Black Mountain and its spurs; to the latter class, the Brush, Pine, and Cumberland mountains. I tried to find out the reason of this extraordinary difference in the timbers of mountain ranges which are all intermingled, and whose geological composition is essentially the same. My opinion is, that the difference is due to the position of the underlying rocks. In the Pine, Cumberland, and Brush mountains these rocks have an average dip of 14° to 25°. The result is, that in passing up one face of the mountain we climb directly up the dip, which so nearly coincides with the slope of the mountain that the beating of summer rains and the action of winter snows keep the soil washed off nearly down to the rocks themselves, leaving no ground for the roots of a massive forest growth to take hold and flourish in. The result is a stunted growth of hardy trees, whose roots are spread out on the surface of the barely covered rock below, such as mountain chestnut oak and rather small sizes of chestnut, red oak, pin oak, and the various pines. On going down the opposite side of these mountains, the continual masses of outcropping rocks, forming a steep and precipitous descent, leave no room for other timbers than the *Rhododendron* (wild rose bay), *Kalmia latifolia* (American laurel), and such shrubs as cling to the faces of rocky cliffs.

On the Black Mountain and its spurs, on the other hand, the rocks are horizontal, and the slowly accumulating detritus clings to their surfaces, whose position opposes the slope of the mountain at such an angle as to hold the detritus in place. A loose soil accumulates, in which an abundance of forest weeds spring up, and the decay of leaves and of these annually dying weed-tops constantly adds richness and depth to the soil already in position. The consequence is, that, in the parts of the Black Mountains familiar to me, even on the steepest slopes, there is a rich alluvial soil of from two to four feet in depth. For this reason, there is a growth of chestnut, tulip tree (yellow poplar), black walnut, white and

blue ash, birch, linden, and white hickory, that I have never seen surpassed.

As no mountain could be chosen for study which would fairly represent the timber of the country, my method was to make sections across Black Mountain and its spurs, and also across Brush and Pine Mountains. I chose some as nearly representative locality as possible at which to cross the mountains, and at every hundred barometric feet in height, more or less, I noted the proportion, size, and condition of growth of all the timber distinctly visible from that point. This method will, of course, give the height above drainage at which any species disappears or is introduced. I tried also to get the proportional effects of alluvial soil and of nearness to water upon what are known as swamp timbers. It is well known that some timbers are found only on bottom lands, and never appear very high above water-level; but, whether this fact is due more to the presence of the detritus from the hills, which always forms an alluvial soil along the streams, or whether the presence of water is absolutely essential to their growth, I was not able to determine. In the former case, the same timbers would grow on such soils, whether close to water or not. An experiment, showing whether these swamp timbers will grow on alluvial soils high above water, or whether they will grow near water without an alluvial soil, would be very interesting. My own opinion is, that the soil, not the water, is the essential part with most of them. I was led to this opinion by noticing that little benches, high up on the mountains, where there is no constant drainage, but where deep alluvial soil has accumulated, grew most of the swamp timbers; but, as a certain amount of water always found its way during rains into these depressions, it was impossible to get data enough to warrant more than a mere conjecture.

In regard to the relation between the old and the young forest growths in this region, with the exception of walnut timber and of other timbers in certain localities, I see no reason why the present proportions between the two should be materially changed in the near future.

The walnut timber is as ruthlessly destroyed in Eastern as in Western Kentucky. I saw a magnificent walnut tree, forty inches in diameter, with a trunk of more than fifty feet in length, cut for rails—a tree worth hundreds of dollars sacrificed for a few panels of fence. No care whatever is taken either to preserve the old forest walnut now standing or to encourage the young growth. Besides this, except in certain localities, there is a practice of yearly "burning off the woods," which is doing almost irreparable injury to the forests in those parts of Black and Brush mountains where the timbers are finest. Especially in the Black Mountains, there is a very heavy growth of weeds that yearly die down, and, with the fallen leaves, make a perfect mass of highly combustible material. Late in the fall, when these are driest, they are set on fire, and the heat is great enough to kill every bush that has appeared during the year. As this is done year after year, there is no chance whatever for a young forest growth to start. The consequence is, that in those parts of Black Mountains where the present forests are most dense and valuable, there is not a single young tree or bush to be found. In many places this practice has been going on so long that the old forest is rapidly dying out with age, and there is nothing coming on to take its place. If the practice of burning off the mountains is not stopped immediately, at any rate long enough for a new forest to get a permanent hold, so that fire cannot destroy it, before many years a mountain as rich in valuable timbers as any I know of in this country will be almost, if not entirely, stripped of its precious products. Some extra care should certainly be taken to preserve and perpetuate so rich a forest of such timbers as black walnut, black, white, and blue ash, white hickory, tulip tree, black birch, etc. So valuable are the ashes and the white hickory now becoming, that a Paris carriage manufacturing firm is thinking seriously of establishing a spoke factory in some part of Kentucky, where these timbers can be most easily obtained. Already there is a very large trade going on in *Liriodendron* or tulip tree (called yellow poplar) timber,

logs of which are cut from the mountains and floated down the Cumberland in immense numbers every winter. However, I see no reason to apprehend any near exhaustion of this timber, if more care is taken to prevent the killing of the young growths by fire, which certainly should be done. At least a dozen species of the most valuable timbers in the markets of the world now grow in large quantities on the Black Mountain ridges. Their extinction would be even more than a State calamity. In fact, Kentucky alone might, at the expense of a few hundred dollars, have exhibited at Philadelphia, in 1876, a collection of timbers which would have rivaled the timber exhibit of any foreign country in the quality, variety, and value of its woods.

I deem it best, before commencing a more minute consideration of the effect of different soils, height above drainage, etc., upon different timbers, to refer generally to some peculiarities that struck me, in the distribution and growth of certain varieties of trees. As black walnut is the most valuable of the timbers, I shall commence with that. I made a section across Black Mountain, starting on the Cumberland river, at Hezekiah Hall's, not far from the dividing line between Bell and Harlan counties. My barometer, at the starting point, stood 1,870. At a height of about 1,300 barometric feet above the datum point, and about 500 barometric feet below the crest of the mountain, I found a remarkable belt of the finest old-forest walnut timber that I have ever seen. The trees are more scattering now in this belt than they have been; for the trunks of several of the finest, which had fallen during the year, were still lying there. There is no undergrowth of any kind whatever to be found within the compass of this belt, owing to the practice before mentioned of burning off the woods yearly. The belt to which the walnut timber is almost wholly confined, here, is only of the width covered by a height of a little more than 100 barometric feet; that is, at the lower edge of the belt my barometer registered about 3,100, and at the upper edge about 3,240. On a steep mountain side this forms a very narrow strip of ground. About

300 barometric feet below this walnut belt I noted a bed of outcropping coal sixteen inches thick. The walnut itself is growing on a very rich loamy soil, partly detritus and partly decayed vegetable matter, about two feet deep, almost entirely devoid of undergrowth of trees, but perfectly matted with a rank growth of forest weeds, fully ten feet high in places. This walnut-growing belt winds along the mountain as far as I had time to trace it (which was not very far, however), always at about the same height above the river below. I noticed that it was just under the top crest of the mountain, and crossed precisely at the heads of the various little streams that flowed from under that crest and made their way to the river below. One of the many magnificent walnut trees that I found in this peculiar belt was fourteen feet six inches in circumference, with a curling but straight and beautiful trunk, sixty feet in length. In an area of twelve hundred and fifty square yards in this belt the principal timbers were:

Black walnut	6;	average diameter	40 inches.
Buckeye	5;	"	29 "
White ash	3;	one of them with diameter	34 "
Linden	6;	average diameter	23 "

But this plot of ground was a choice one. There is not such an average of walnut as that even in the belt here spoken of.

Another case of peculiarity in the growth of certain timbers which I noted, is that of the hemlock (*Abies canadensis*) of Eastern Kentucky. In this part of the country the hemlock is confined wholly, so far as I know, to Conglomerate formations; so that the presence of this timber, in any locality in this part of Kentucky, is a guarantee that the geological formation there is Conglomerate. Of course, in other parts of the country, hemlock grows on other than Conglomerate soils; and of course, too, not all Conglomerate soils of Kentucky grow hemlock. Through all the coal regions of Western Kentucky I never saw a single tree of it. But not only is the hemlock of Eastern Kentucky confined to Conglomerate formations; it is also never found very high above local drainage. In the whole course of Cumberland river, from Cumberland Gap to near its head waters, and on all the

various small streams that rise in Brush, Black, Pine, and Cumberland mountains, and flow into Cumberland river, I have never seen a single hemlock more than one hundred barometric feet above local drainage, except in one spot. That was shortly after crossing the Harlan county line in ascending the Cumberland, where I found some hemlock trees on top of the bluff, that here rises precipitately from the river to a height of two hundred feet. But even in this case, although the trees are two hundred barometric feet above the river, on the opposite side of the hemlock from the river is a considerable depression, through which a branch runs most, if not all, of the year; so that this is not strictly an exception to the statement that I never saw a hemlock, in this part of Kentucky, growing more than one hundred feet above local drainage. So far as my observation extends, therefore, the presence of a hemlock tree in Kentucky proves two things: Conglomerate formation, and water, present part of the year at least, within one hundred barometric feet.

The last peculiarity of growth that I shall notice here, is that of the white oak. In a former report on the timbers of some parts of Western Kentucky (volume II, page 339) I mentioned the want of hardihood in the white oak, inferred from the fact that Spanish oak, red oak, pin oak, etc., when left to free competition with the white oak, in the course of time choke it out and supplant it. In Eastern Kentucky, where the mountains are sufficiently high for exposure to different points of the compass to produce a marked effect on the timbers, I found a confirmation of my former opinion in regard to the comparative sensitiveness of the white oak. In making a section across Black Mountain, along what is called Hall's branch, not far from the Harlan county line, the hills on either side of the hollow are quite steep and high, and form a synclinal, one face of which is exposed to the north, the other to the south. The formation and soil of the two faces were exactly the same, so far as I could see, and both were heavily timbered. But on the hillside exposed to the south about forty-five per cent. of the whole timber was of

the most massive and splendid white oak, often four feet in diameter and ninety feet high. Here there was less than one per cent. of *Liriodendron* (yellow poplar, so-called). On the northern exposure opposite, on the contrary, about thirty-five per cent. of the timber was massive *Liriodendron*, many trees of which were six and seven feet in diameter, with trunks sixty to eighty feet high. Here the white oak formed less than one per cent. Of course this is a very striking example, and it could not be said that difference of exposure everywhere in these mountains produces such a marked effect upon the white oak. But altogether, my observations convinced me beyond a doubt that the white oak is not so hardy a tree as it is often supposed to be.

There are not many valuable timbers in Eastern Kentucky which I have not already noticed in a former report on Western Kentucky timbers. Of course the black walnut, already noticed, and the black birch, of which there is a considerable quantity scattered through the Black and Brush Mountains, are the most valuable timbers. But, as in Western Kentucky, the people seem to attach very little importance to either. The *Liriodendron* is largely floated out every winter, as I mentioned before, for lumber. The white hickory and black and blue ash rank next in value; and they all abound, in the Black Mountain especially. Owing to the abundance of water-power, the accessibility, in large quantities, of these timbers, and their great demand in carriage-making, I see no reason why the near future should not see many spoke factories, ax-handle and hammer-handle factories, and carriage factories, in this part of Kentucky. Already the eyes of some large carriage factories are turning toward these timbers, and they only need to be better known in order to become a good source of revenue to the people. The red maple, which is growing more and more into favor in cabinet work, also abounds in Bell and Harlan counties. The linden (*Silia Americana*) is also found in large quantities through these mountains, and is very valuable in cabinet work, paneling, etc. The pines, especially the pitch pine (*Pinus rigida*)

and the yellow pine (*Pinus mitis*), are very abundant in parts of the mountains, particularly Pine Mountain. They are too well known to need especial mention, except to say that not a pine is to be found in those counties of Western Kentucky, on which my former report was made, so far as I could discover. I know of no especial reason for their total absence from that part of Kentucky. Certainly the want of mountains in Western Kentucky is not a sufficient explanation; for pine woods are often low and flat, though I do not know of any in Kentucky that are so. Other timbers found in Eastern Kentucky, that do not grow in such parts of Western Kentucky as I have studied, are the magnolias (*Magnolia acuminata, M. umbrella*, and *M. fraseri*), hemlock, *Rhododendron* (*maximum*), and American laurel (*Kalmia latifolia*).

I shall now proceed to give in detail the most important of the sections made, in the order in which they were made. Between ten miles above Pineville and Browning creek the exposure of the mountain facing the river shows *Liriodendron*, hemlock, beeches, chestnut, red oak (called often water oak by the people), the three magnolias given above, *Rhododendron* (*maximum*), American laurel, red and white maple, trident red maple, white oak, pines (*mitis* and *rigida*), the various hickories (mostly shell-bark), dogwood, sourwood, and Stuartia (*Stuartia virginica*).

A section was made up Browning creek to Brush Mountain, and across Brush Mountain to Cumberland Mountain. Up Browning creek, to the last crossing before starting up Brush Mountain, the timbers noted were white oak (which predominates), pin oak, pig hickory, chestnut oak, mulberry, red elm, buckeye, papaw, sycamore, shag hickory, white walnut (in considerable quantities), black walnut (small quantity), white ash (very fine and large), grey birch, linden (*Tilia Americana* and *T. heterophylla alba*), white elm, black cherry (only one or two), winged elm, white hickory, the magnolias, hemlock, sweet gum, and black sumach. I should say here that, in making sections through the mountains, I give the timbers, not in the order in which they probably predominate, but in

the order in which they are met with. This is very necessary, especially in going up a steep mountain side, as it marks the height above drainage at which different timbers grow.

In starting up Brush Mountain, the timbers remained substantially the same for a barometric height of four hundred and sixty feet. They are the magnolias, chestnut, hemlock (for the first fifty feet only), black gum, white oak, white maple, beech, tulip tree, black hickory, grey birch, black oak, pin oak, red oak, white hickory, sycamore (along Middle Branch), black walnut (in small quantities), white walnut, holly, black locust, red elm, shag hickory, and red maple (very large). The formation is conglomerate. At a height of four hundred and sixty feet chestnut oak is first seen. There are also black ash, red oak, witch hazel, and scattering pines.

Timbers.	Height in barometric feet.	Remarks.
Pines, chestnut, chestnut oak, black gum, and rock maple .	720	The absence of all the other timbers here is due not so much to height as to vicinity of a slide, which had precipitated the crest of the mountain down to nearly this height.
Pines (*P. mitis* and *P. rigida*) . .	965	Here we come to a bluff that has fallen from the top of the mountain, and hence the absence of all timber except dwarf pines. This throw lasts for a height of three hundred feet.
Black locust, chestnut, chestnut oak, black birch, magnolia cucumber, pin oak, *Liriodendron*, sweet pepper, etc.	1300	At this height the fall from the mountain top is crossed, and we again find the timbers that normally belong to the mountain side. All of these timbers are very heavy.
Chestnut oak almost entirely . .	1600	Here we meet with another slide from the mountain top, which normally belongs just below the one at a height of 965 feet. Very evidently that was originally the mountain crest, and fell first. This underlay it, and fell at a later date. Geology shows plainly that both have fallen; but their relative positions originally I argue from the botany alone.

Timbers.	Height in barometric feet.	Remarks.
Pin oak, black oak, pig hickory, *Liriodendron*, chestnut, and chestnut oak	1940	The mountain top here is level and broad, showing the slide of the rock cliffs that once capped it. So the timber here is not that which geologically belongs to the top of the mountain.

An irregular spur of the Black Mountain, almost at right-angles to the last section, gives, on its southern exposure, the following timbers:

Timbers.	Height in barometric feet.	Remarks.
Sweet gum, beech, red maple, shag hickory, black hickory, white oak (very massive), holly, *Liriodendron*, black locust, magnolia umbrella, black gum, white walnut, grey birch, black oak, and chestnut	base.	The character of the undergrowth here is somewhat different. It consists of azaleas, mountain oak, red oak, chestnut, dogwood, and some white oak, hickory, etc.
Liriodendron, white oak, shag hickory, water beech, black oak, red maple, black hickory, white maple, chestnut, june-berry . . .	100	It will be noticed that sweet gum, the magnolias, and holly disappear during the first hundred feet.
White oak, water beech, chestnut, witch hazel, *Liriodendron*, june-berry, black locust, black oak, pig hickory, rock maple, post oak, sourwood, dogwood, etc.	200	The shag bark hickory here disappears.
Mountain chestnut oak, black oak, white and rock maple, *Liriodendron*, white oak, pig hickory, dogwood, etc.	300	Here the undergrowth becomes very heavy, black oak and red oak predominating. Mountain chestnut oak makes its first appearance also.
Rhododendron maximum, mountain chestnut oak (in great quantities), pine (*mitis*), black hickory, American laurel, sourwood, etc.	330	A cliff of horizontal sandstone here changes the character of the timber almost completely.

Timbers.	Height in barometric feet.	Remarks.
Dwarf chestnut oak, dwarf pine, dwarf and post oak, rock maple, sourwood, and American laurel	400	The sandstone cliff here still continues, but at a dip of 14°. It evidently belongs to the mountain top, but has slid down, for the rocks of Black Mountain are horizontal in their normal position.
White oak, chestnut oak, chestnut, black gum, and pin oak are the old growths	560	These timbers evidently belong to a position geologically below the 400-foot level.

In passing up the Cumberland from White Rock toward Mount Pleasant, the timbers are mostly white oak, beech, chestnut, red oak, Spanish oak, maple, etc., except where a ridge of the mountain juts down to the river, when pin oak, pines, mountain chestnut oak, black oak, etc., are introduced. Shag and white hickories are plenty along the bases of the mountains, pig and black hickories higher up. Hemlock abounds all along the little streams, to a height of fifty barometric feet above drainage.

After crossing over into Harlan county, I made a section to the top of Black Mountain, up Gray's branch, and came down a different way, so as to get two sections. The results are here given in detail:

Timbers.	Height in barometric feet.	Remarks.
White oak, black oak, red oak, black gum, black walnut, maples, beeches, etc.	base.	The walnut timber here is only young growth, confined to open spots.
Beech, sugar maple, white maple, *Liriodendron*, red oak, linden, black gum, white oak, white hickory, shag hickory, grey birch, and blue ash	100	The mere list of trees here gives no idea of the splendor of the forest. The *Liriodendrons* are five to seven feet in diameter, with trunks sixty to eighty feet long. The white oak timber is also extremely heavy, and the blue ash as fine as any I ever saw.

TIMBERS.	Height in barometric feet.	REMARKS.
Grey birch, beech, white maple, *Liriodendron*, blue ash, buckeye, red oak, black gum, spicewood, magnolia umbrella, etc. . . .	200	No perceptible change in the splendor of the forest.
Liriodendron, chestnut, shag hickory, red oak, beech, white oak, linden, maple, dogwood, etc. .	340	The linden is yet scattering, as it is found mostly in this part of Kentucky high up on the mountain side. The timbers are all heavy.
Liriodendron, chestnut, shag hickory, red bud, red maple, linden, june-berry, etc.	480	The *Liriodendron* remains as heavy as ever. The shag hickory is also very fine.
Growth same as above, with the addition of ironwood.	580	The linden first becomes very abundant at this height in ascending the mountain.
Liriodendron, chestnut, white ash, white hickory, red oak, linden, buckeye, ironwood, dogwood, etc.	700	Linden, chestnut, and *Liriodendron* are the chief timbers at this height.
Liriodendron, chestnut, white ash, blue ash, and most of the 700-feet timbers	850	At this height a sixteen-inch vein of coal crosses the hollow. The blue and the white ash are very fine indeed.
Black walnut, chestnut, *Liriodendron*, white hickory, linden, buckeye, etc.	1050	The splendor of the forest here can hardly be imagined. The belt of walnut before mentioned begins to show itself here, while the *Liriodendron*, chestnut, and white hickory are of the finest.
Black walnut, buckeye, *Liriodendron*, white ash, sugar maple, linden, white hickory, etc. . .	1250	At this height crosses the curious belt, 25 per cent. of whose timber is old forest walnut. In size and quality these trees have no superior in this country, so far as I know.
Chestnut, red oak, rock maple, black locust, pig hickory, etc.	1375	The walnut timber gives out below this height, and a ledge of rock here gives high mountain timbers. Linden gives out above this height.

Timbers.	Height in barometric feet.	Remarks.
Red oak, buckeye, blue ash, white hickory, *Liriodendron*, chestnut, black birch, shag hickory, pin oak, etc.	1600	The ledge of rock above mentioned is crossed before reaching this height. The growth of white hickory so far above drainage is noticeable. It can be met with only on the richest ground at this height.
Chestnut (dwarf), pin oak, white oak (dwarf), black gum, American laurel, rock maple, sourwood, etc.	1790	Here the top of the mountain is reached, as the timbers indicate. The fact that there is so little change of timbers, where the differences of level are so great, shows that the underlying rocks are horizontal and hold the soil, so that it forms a rich loam from the bottom to the top of the mountain.

Notice here that this is not the height of the mountain above the river below, but only its height above the point at which I started up it, which was some three hundred feet above the river level.

In passing down the mountain by a different route, but few variations from the above tables were met with. The "sweet shrub" was one of these. The belt of walnut was found encircling the mountain at about the same height as given above.

The timbers on a spur of Black Mountain shooting off near the last section will suffice to give the differences between the timbers of the main range and one of its spurs:

Timbers.	Height in barometric feet.	Remarks.
White oak, black oak, red maple, beech, buckeye, black hickory, black gum, linden, etc.	base.	The exposure here is south, and white oak is by far the predominant timber. It is not usual to see linden so low, and only one tree was found here.
Buckeye, black walnut, white oak, *Liriodendron*, chestnut, pig hickory, linden, and sugar maple .	120	White oak still predominates. A small amount of black walnut, not more than twenty inches in diameter. Only one linden tree.

TIMBERS.	Height in barometric feet.	REMARKS.
White oak, blue ash, black oak, linden, chestnut, pig hickory, sourwood, chestnut oak, water birch, maple, etc.	250	White oak is here reduced in size and importance. Linden is more plenty, and the first chestnut oak appears.
Chestnut oak, june-berry, black hickory, sourwood, white maple, and black oak	300	Here white oak almost wholly disappears, as well as ash and linden.
Chestnut, chestnut oak, black oak, sourwood, dogwood, black gum, etc.	400	Here the timber is almost wholly chestnut oak, and evidently belongs higher up than that found upon the top of the bench given below.
White oak, white and pig hickory, black locust, black walnut, red maple, black oak, *Liriodendron*, etc.	500	The timber on top of this bench of the spur is fully equal to that at its base. I had not time to cross completely over the spur.

A section made on a spur of Pine Mountain, two miles below Mount Pleasant, gives the timbers mentioned below:

TIMBERS.	Height in barometric feet.	REMARKS.
White oak, beech, black oak, *Liriodendron*, white sugar maple, red oak, sourwood, chestnut, black gum, grey birch, etc. .	100	The timber on Pine Mountain, at its most favorable points, is scrubby and ordinary. It is so even here at its base.
Chestnut oak, chestnut, black oak, *Liriodendron*, dogwood, black gum, sourwood, and grey birch	250	Here the mountain side is a perfect talus mass of fallen stones and débris. Timber more or less dwarf. White oak and beech have disappeared.
Rhododendron (maximum), chestnut (dwarf), sourwood, mountain oak (dwarf), etc.	350	Here there is a vast cliff of sandstone, dipping 22½° west southwest, from which the talus above was thrown. Timbers all dwarf. The cliff is about eighty feet high. *Liriodendron* disappeared at the cliff mentioned above.

Timbers.	Height in barometric feet.	Remarks.
Pine (*P. mitis,*) chestnut and chestnut oak (both dwarf), dogwood, sourwood, and American laurel	500	This is the top of the spur. Timber is all small—pine predominates.

I now give a section across Pine Mountain proper. It is triple-crested at this point (two miles below Mount Pleasant); that is, it is composed of three mountains, as it were, mashed in together, with their tops all distinct. The southern exposure is a very long and gentle slope, so that almost half a mile is sometimes gone over in a single hundred barometric feet.

Timbers.	Height in barometric feet.	Remarks.
White oak, black oak, chestnut, maple, *Liriodendron*, hickories, etc.	base.	Along the base of Pine Mountain here the timbers are very good—often, indeed, quite heavy.
Chestnut, chestnut oak, white oak (in small quantities), pin oak, black oak, pine (*P. mitis*), etc.	200	The chestnut here is very large, while the white oak is small and has almost disappeared.
Pine (*P. mitis*), chestnut, chestnut oak, black oak, and other timbers about as last	340	Very little change of timber from the level above, except that white oak has wholly disappeared on the first spur or crest of the mountain.
Mountain chestnut oak, scrub oak, American laurel, chestnut oak, chestnut, black oak, etc. . . .	430	Here there is quite a change in the timbers, chestnut and black oak growing scarce and other timbers coming in. Undergrowth very heavy—pin oak, hickory, black oak, pine, etc.
Mountain chestnut oak, American laurel, black gum, pine, chestnut, etc.	550	Here we reach the top of the first crest. The timber is almost wholly chestnut oak.
White oak, chestnut, black oak, and pine	520	This is a divide between two crests, is lower down barometrically than the last station, and gives very heavy white oak and chestnut timbers.

Timbers.	Height in barometric feet.	Remarks.
Chestnut oak, black gum, sour-wood, pine (*P. mitis,*) etc. . .	790	The timber here is again that of a high mountain side. The mountain slopes only 7° southeast.
Timber precisely the same as above.	1050	Another mountain crest. The slope of the mountain between these two points has been so gradual that no change in timber has taken place.
Chestnut, white oak, black locust, and chestnut oak	1030	This is a low divide between two crests again, and the chestnut and white oak are very heavy.
White oak, chestnut, grey birch, sugar maple, hickories, etc. . .	1185	This is the mountain top at this point; but in reality it is a gap in the mountain where the distance down to Beech Fork, on the north side, is only a few hundred feet.

The south exposure of Pine Mountain, as given above, is a gradual slope, whose steepness is just equal to the dip of its rock, and is about five miles long. On the north side, on the contrary, the rocks jut out, forming an almost precipitous descent to the waters of Beech Fork, at the base of the mountain. On the north side, where the rocks are not too precipitous, red oak, *Liriodendron* (very heavy), ash, and hickories are found. The total absence of *Liriodendron* on the south exposure, except right at the base of the mountain, and the total absence of white oak on the north exposure, deserve careful notice.

By merely glancing through the tables given above, it will be seen that, as a rule, subject of course to exceptions, near the base of a mountain such timbers as white oak, beeches, black ash, the magnolias, *Liriodendron* (yellow poplar), red oak, white and shag hickory, etc., are found. That none of these timbers, except the *Liriodendron*, reaches half way up the mountain, but are gradually replaced by chestnut, black oak, pin oak, pig and black hickory, linden, etc. That most

of these again give out on nearing the top of a mountain, and mountain oak, dwarf chestnuts, the pines (especially *P. mitis* and *rigida*, or yellow and pitch), etc., take their places. That the most marked change dependent upon exposure to different points of the compass is found in the case of the *Liriodendron* and white oak, the former flourishing most on northern exposures, the latter on southern. That the principal change noted in this part of Kentucky, due to geological formation, is furnished by the hemlock, which is found only on Conglomerate soils. These and other minor inferences can be deduced from a study of the tables.

The difference between the timbers of Eastern and Western Kentucky is not marked enough to be worthy of special notice beyond what has been given to it in previous pages. So it only remains to give a table of all the timbers met with in Bell and Harlan counties, which will be found below:

ORDER CUPULIFERÆ—MASTWORTS.

1. *Genus Quercus.*
   - White oak, Quercus alba (L.)
   - Post oak, Q. obtusiloba (Mx.)
   - Chestnut oak, Q. castanea (Muhl.)
   - Red oak, Q. rubra (L.)
   - Black oak, Q. tinctoria (Bart.)
   - Pin oak, Q. palustris (Mx.)
   - Scrub oak, Q. illicifolia (Willd.)
   - Dwarf chestnut oak, Q. prinoides (Willd.)
   - Spanish oak, Q. falcata (L.)
   - Swamp white oak, Q. bicolor (Willd.)
2. *Genus Castanea.*
   - Common chestnut, Castanea vesca (L.)
3. *Genus Fagus.*
   - Common beech, Fagus sylvatica (L.)
   - Red beech, F. ferruginea (Ait.)
4. *Genus Corylus.*
   - Hazelnut, Corylus Americana (Walt.)
5. *Genus Ostrya.*
   - Hop hornbeam, or ironwood, Ostrya virginica (Willd.)

ORDER JUGLANDACEÆ—WALNUT.

1. *Genus Juglans.*

White walnut, Juglans cinerea (L.)
Black walnut, J. nigra (L.)

2. *Genus Carya.*

Pig hickory, Carya glabra (Torr.)
Shag hickory, C. alba (Nutt.)
White hickory, C. microcarpa (Nutt.)
Black hickory, C. tomenlosa (Nutt.)

ORDER CONIFERÆ—CONIFERS.

1. *Genus Pinus.*

Pitch pine, Pinus rigida (Miller).
Yellow pine, P. mitis (Mx.)

2. *Genus Abies.*

Hemlock, Abies canadensis (Mx.)

ORDER ACERACEÆ—MAPLES.

1. *Genus Acer.*

Red maple, Acer rubrum (L.)
Var. trident, A. rubrum tridens.
White maple, A. dasycarpum (Ehrh.)
Sugar maple, A. saccharinum (L.)
Black sugar maple, A. nigrum (Mx.)

ORDER MAGNOLICEÆ.

1. *Genus Magnolia* (magnoliads).

Cucumber tree, Magnolia acuminata (L.)
Umbrella tree, M. umbrella (Lam.)
Ear-shaped magnolia, M. fraseri (Walt.)

2. *Genus Liriodendron.*

Tulip tree (yellow poplar), Liriodendron tulipfera (L.)

ORDER OLEACEÆ—OLIVEWORTS.

1. *Genus Fraxinus.*

Black ash, Fraxinus sambucifolia (Lam.)
White ash, F. Americana (L.)
Blue ash, F. quadrangulata (Mx.)

ORDER BETULACEÆ—BIRCHWORTS.

1. *Genus Betula.*
   Black birch, Betula lenta (L.)
   Yellow Birch, B. excelsa (Ait.)
   Red birch, B. nigra (Ait.)

ORDER ERICACEÆ—HEATHWORTS.

1. *Genus Kalmia.*
   American laurel, Kalmia latifolia (L.)
2. *Genus Oxydendrum.*
   Sourwood, Oxydendrum arboreum (D. C.)
3. *Genus Rhododendron.*
   Rose bay, Rhododendron maximum (L.)
4. *Genus Azalea.*
   Azalea, A. viscosa (L.)
5. *Genus Clethra.*
   Sweet pepper, Clethra acuminata (Mx.)

ORDER TILIACEÆ—LINDENBLOOMS.

1. *Genus Tilia.*
   Basswood, Tilia Americana (L.)
   White basswood, T. hetrophylla alba (Vent.)

ORDER ANACARDIACEÆ—SUMACHS.

1. *Genus Rhus.*
   Black sumach, Rhus glabra (L.)
   Mountain sumach, R. copallina (L.)

ORDER ROSACEÆ—ROSEWORTS.

1. *Genus Cerasus.*
   Black cherry, Cerasus serotina (D. C.)
2. *Genus Amelanchier.*
   Wild service or june-berry, Amelanchier canadensis (Torr. and Gr.)

ORDER LEGUMINOSA—LEGUMINOUS PLANTS.

1. *Genus Robinia.*
   Black locust, Robinia pseudacacia (L.)
2. *Genus Cercis.*
   Redbud or Judas tree, Cercis canadensis (L.)

ORDER HAMAMELACEÆ—HAZELWORTS.

1. *Genus Liquidamber.*

Sweet gum, Liquidamber styraciflua (L.)

2. *Genus Hamamelis.*

Witch hazel, Hamamelis Virginiana (L.)

ORDER AQUIFOLIACEÆ—HOLLYWORTS.

1. *Genus Ilex.*

American holly, Ilex opaca (L.)

ORDER LAURACEÆ—LAURELS.

1. *Genus Benzoin.*

Spicewood, Benzoin odoriferum (Nees.)

ORDER CORNACEÆ—CORNELS.

1. *Genus Cornus.*

Dogwood, Cornus florida (L.)

Green dogwood, Cornus alternifolia (L.)

2. *Genus Nyssa.*

Black gum, Nyssa multiflora (Wang.)

Swamp black gum, Nyssa uniflora (Walt.)

ORDER ARTOCARPACEÆ—ARTOCARPS.

1. *Genus Morus.*

Mulberry, Morus rubra (L.)

ORDER PLATANACEÆ—SYCAMORES.

1. *Genus Platanus.*

Sycamore, Platanus occidentalis (L.)

ORDER SAPINDACEÆ—INDIAN SOAPWORTS.

1. *Genus Æsculus.*

Big buckeye, Æsculus flava (Ait.)

Small buckeye, A. pavia (L.)

ORDER ANONACEÆ—ANONADS.

1. *Genus Asimina.*

Papaw, Asimina triloba.

ORDER CAMELLIACEÆ.

1. *Genus Stuartia.*

Stuartia, S. Virginica (Cav.)

ORDER CALYCANTHACEÆ—CALYCANTHS.

1. *Genus Calycanthus.*

Sweet-scented shrub, Calycanthus floridus (L.)