
GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

REPORT ON

THE TIMBERS

OF THE

DISTRICT WEST OF THE TENNESSEE RIVER,

COMMONLY KNOWN AS THE PURCHASE DISTRICT.

BY L. H. DEFRIESE.

PART VI. VOL. V. SECOND SERIES.

STEREOTYPED FOR THE SURVEY BY MAJOR, JOHNSTON & BARRETT, YEOMAN PRESS, FRANKFORT, KY.

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INTRODUCTORY LETTER.

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

DEAR SIR: In the following report on the timbers of that part of Kentucky lying west of Tennessee river, some distinctive features of that district will be noticed. First, that the timber changes are due not, as in the parts of Kentucky previously studied by me, to geological changes, but mostly to topographical changes. Second, that the whole of the Purchase is comparatively level. Third, that a very small change of level usually produces a marked effect upon the timbers, and thus prevents the monotony which might be expected. Fourth, that no other part of Kentucky offers such facilities for studying the ultimate effects upon the timbers of the fires by which the woods were regularly burned for a great number of years. I have endeavored to make the most of my limited opportunity for observation in all these directions.

I wish to tender my thanks to the people of the Purchase for kindness shown me while I was among them.

Very respectfully,

LAFAYETTE H. DEFRIESE.

NEW YORK, November, 1877.

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REPORT ON THE TIMBERS OF THE DISTRICT WEST OF THE TENNESSEE RIVER.

GENERAL REMARKS—GEOLOGY AND TOPOGRAPHY.

There is probably no part of Kentucky where topography has more, and geology less, to do with the distribution and general character of the timbers than in what is known as the Purchase—that is, that part of the State lying west of the Cumberland river. From this it may be inferred, at once, that the species of timbers met with are pretty much the same throughout the entire seven counties which go to make up the region under discussion. There are upland timbers and lowland timbers, but there are few of those marked changes in forest growth which one meets with where timbers are more influenced by geological structure than by topography. Of geological change, if we except one or two spots where the limestone extends across the Cumberland river, there is none sufficient to affect timber growth. The whole of this Purchase region, with the exception mentioned, is apparently of tertiary age, and consists of more or less rounded whitish or reddish pebbles. In what may be called the bed-rock of the region, these pebbles are cemented together with clay, containing a good deal of iron, into an extremely hard and tough reddish conglomerate, called by the people *iron cement*. Overlying this cemented rock there is a bed of loose pebbles and sand varying from a few inches to fifty feet thick. Where the pebbles themselves form the surface of the soil, it is needless to say that the timbers consist of black jack and scrub oak. There are no mountain axes in this part of Kentucky to diversify the topography, but, owing to the peculiarity of the formation, a difference of level of only a few feet will, in most localities, completely change the character of the timber. From this it follows that the number, size, and distribution

of streams are of the greatest importance in considering the present and future value of these Purchase timbers. The streams are important in considering the *future* value of the timbers, because, as I have previously shown,* wherever the white oak is the principal forest tree, other timbers are succeeding it as fast as it is cut away. This succession takes place much slower on bottom lands than elsewhere, for there are few swamp timbers to supplant white oak, and there is no danger of upland timbers doing so along streams. The water timbers are strongly marked, and it seems impossible that they could ever be supplanted by upland timbers. So there is far less tendency in swamp white oak to disappear along the streams, than there is in the upland white oak to disappear from the body of the Kentucky forests. The same may be said of other swamp timbers, so that the number and character of the streams are very important.

A glance at the map of this part of Kentucky will show that, in these seven counties, there are no less than five streams of importance, along all of which the timbers are very fine indeed, and are likely to remain substantially the same in kind. Besides these large streams, smaller creeks and branches form a perfect net-work over the greater part of the region. Leaving out of consideration the timbers along these streams, the forest growth varies considerably in these counties. Speaking generally, the timbers through the eastern parts of Marshall and Calloway counties are good, as are also those through the western parts of Hickman and Ballard.

A belt extending directly through the Purchase country, embracing less than one third of it, with its centre line passing through Mayfield, will contain about all of the poor timber to be found in this entire corner of Kentucky. And, inasmuch as Mayfield creek passes through almost the entire length of this central belt, and its tributaries and those of Little Obion river ramify through it in every direction, along all of which streams the timbers are very fine, it will be seen that **this**

*See Report on Tradewater Timbers, vol. V, this series.

comparatively poor strip of forest country is not devoid of valuable timber growth. There is an area of more or less flat table land lying south of Wadesboro, between East Fork of Clark river and the head waters of Mayfield creek, in which, if we except a few small streams, no water is to be found. I call especial attention to the position of this strip of table land here, for it becomes of importance further on in the Report, in the discussion of the succession of timbers.

DRAINS UPON THE TIMBER AND THE TIMBER RESOURCES OF THIS DISTRICT.

At Paducah there are several extensive timber establishments, the principal of which are those of Langstaff, Orm & Co., and McKnight & Co. The former firm claims to have the fastest saw in the world, with which they cut 8,204 feet of lumber per hour. They average 80,000 feet of lumber per week the year round, and keep their yard stocked with 2,000,000 feet of ready-sawed and dried lumber. The principal timbers cut are, of course, white oak and liriodendron (yellow poplar); but, in addition to these, are also elm, ash, hickory, sweet gum, cotton tree, yellow pine, cypress, walnut, cherry, etc. The white oak, gum, and cypress are obtained, to a considerable extent, from the State of Kentucky, from which they get about one third of their timbers. The value per thousand feet of these timbers, in the log, at Paducah, is as follows: Oak, \$6 to \$10; poplar, \$5 to \$8; walnut, \$10 to \$15; white hickory (second growth), \$10; sweet gum, \$3 to \$5; cotton-wood, \$3 to \$5; pine, \$8; cherry, \$10 to \$15, and so on. McKnight & Co. saw 2,000,000 feet of lumber annually, about 50,000 feet of which is walnut. More than two thirds of all the timber sawed in Paducah is brought down the Tennessee river, which forms a convenient and cheap means of transportation for the vast forests that crowd its banks from its mouth to its head. However, the Paducah lumber establishments have largely drained the lower Tennessee district, and the timbers are now floated down from far above. The time will come, though I think not soon, when the Purchase

region and the Tradewater country will be called upon to furnish the timbers which are now furnished by the upper Tennessee. The only practical difficulty in the way is, that Clark river, the only stream penetrating the Purchase which is available for floating timber to Paducah, is so flat and sluggish, and has so little fall, that the floating of any considerable raft of timber upon it will be a matter of some difficulty. The admirable timbers that grow all along the smaller streams of the Purchase country can be reached only by local saw-mills or by railroad. Lumber establishments at Hickman can float timbers down Mayfield creek and Obion river.

At present, so far as I am aware, the drain upon the timbers of the Purchase region comes from the establishments at Paducah and from local mills. The two Paducah firms mentioned above saw an average of 6,160,000 feet of lumber annually. Not more than one third of this amount is obtained from Kentucky, and, at most, not more than 2,000,000 feet of it can come from the Purchase. If we count an average of ten good lumber trees to an acre, which would be a low average along the streams in this part of Kentucky, and allow 500 feet of sawed lumber for each tree, which would also be a low average, we shall have 5,000 feet of good lumber in each acre of ground. At that rate, these two firms, to obtain their 2,000,000 feet of lumber, annually strip 400 acres of ground of its valuable timbers. That is very little, compared with the hundreds of thousands of acres of fine timbers lying along all the streams in this part of Kentucky. It is impossible even to estimate the amount of timber used by the local saw-mills, which are scattered along all the streams wherever a good body of timber is to be found, and which change their location as the timber is exhausted. I think it safe to say, though, that they saw from 3,000,000 to 5,000,000 feet of lumber annually. If this be true, at the estimates given above, they now clear-up from 500 to 800 acres of timber land yearly, and something like an annual timber drain of 1,200 acres is made upon the Purchase country. This tim-

ber, in the unsawed log, is worth about \$50,000. There are not less than 500,000 acres of land in the Purchase which will come within the above estimate of timber production; so, at this estimate, only about one four hundredth of the valuable timbers is now cleared-up annually. At this rate, the timbers can easily reproduce themselves, and the drain is not at all an alarming one. At the same rate, considering one third of the land to be under cultivation, the present forest of the Purchase alone would be worth \$10,000,000 or \$15,000,000. Even if the present drain upon the Tennessee river country were all turned to the Purchase, less than 2,500 acres of timber annually would be destroyed, or only about one two hundred and fiftieth of the whole. The forests could easily reproduce themselves at that rate, except in the upper woodlands, where, as I have elsewhere shown,* other timbers take the place of the white oak as that is cut away. Of course, all this timber wealth is not immediately available, and it is well that it is not so. Upon the whole, there is not much to be feared in regard to the present or future timber supply of the Purchase region. It is scarcely possible that a greater demand than the last estimate will be made upon it at any time in the near future. When such demand is made, however, it will probably be concentrated along the Clark river, where the facilities for cheap transportation are best, and, in that case, a few years would suffice to strip this stream of its most valuable forests. But the reserve supply of timbers, as I have shown above, is so great that no prospective demand can cause a dearth of them.

There is one great difficulty, as I have previously hinted, in getting at the splendid forests of the Clark river region, and that is, that the stream is comparatively shallow, its bottom very flat, and the water sluggish. The difficulties of rafting on such a stream are greater than they would at first seem. For instance, the lumber establishments at Paducah desire their logs brought to them in their entire length, varying from thirty to seventy feet, so that they can cut from them plank of

* Report on Tradewater Timbers, vol. V, this series.

any length demanded by their customers. The finest timbers on Clark river are hickory and white oak; but a green hickory or white oak log, forty to sixty feet in length, will not float and it takes great buoying power to keep it up. Not only is Clark river too shallow for such logs, but it is not wide and open enough to allow the passage of rafts large enough to support them. On the Tennessee river, a wide raft of tens of thousands of feet is formed, in which such logs as these alternate with seasoned poplar, which is sufficiently buoyant to support the whole. The stream is broad and deep enough, and has sufficient fall to allow of the easy transportation of these enormous rafts. Of course the only way out of the difficulty is to form small rafts, of only a few logs; but as it is comparatively a good deal more expensive to float a small raft than a large one, we need not expect to see much demand for the Clark river timbers, until those along the Cumberland and Tennessee rivers have become sufficiently scarce and inconvenient of access to render the cost of procuring them as great as that of floating the Clark river timbers.

TIMBER VARIATIONS.

The timbers in this part of Kentucky differ very little, in kind, from the timbers on the older formations of the State. The only new timber met with is the cypress (bald cypress), which is now found immediately on the banks of all the larger streams, on all marsh lands and swampy grounds. Its presence is not due to the formation, for it appears elsewhere from New Jersey southward, on various formations. Why it does not appear in other parts of Kentucky, I do not know, unless it be that a low, level, moist country is required for its growth. But changes of timbers are often, so far as can be discovered, capricious. Magnolias are found in great abundance on the upper Cumberland; down towards the Ohio I have not met with a single one. So it may be, so far as regards geological formations, with the cypress. The timber is light, fine-grained and durable, and

the trees along the large streams, in this part of Kentucky, grow to a height of eighty to one hundred feet, with trunks from three to seven feet in diameter.

There is a marked peculiarity in regard to the growth of the beeches in the Purchase. They are not found in great numbers along the large streams, as they are in the Rough creek region, along the North Cumberland, and in nearly every other part of Kentucky. Along the principal streams, here, very few beeches are met with, and they can hardly be said to form a part of the timbers along Clark river, Little Obion river, and Mayfield creek. They are scattered through the bottoms of small streams, but are not conspicuous even there. A Kentucky swamp without beeches strikes one peculiarly. I could not see any reason for their general absence from the bottom lands of this part of Kentucky.

The abundance of Spanish oak in the Purchase country is worthy of note. Nowhere else, here, have I seen that timber form so conspicuous an element of the forest growth.

Hickory does not form a large percentage of the upland forest timbers, and one will often travel for a mile or two without seeing a single hickory tree. Along the streams and on low grounds, however, the hickory is very fine and valuable. I know of no finer bodies of hickory timber in this country, than are to be found along Clark river and Mayfield creek. The shagbark, pignut, and white hickories are the finest varieties, and of these I have often counted, within sight of where I stood, a dozen which would average ninety feet in height, with diameters of from two to four feet.

Chestnut, whose unaccountable presence on one side of Green river, and absence on the other side, I noticed in a former report (*Tradewater Timbers*, vol. V, this series), seems to be as arbitrarily distributed in the Purchase as anywhere. About five miles from Benton there is a little creek running into East Fork of Clark river, called Chestnut creek. It heads up between two high hills, whose faces form a topographical synclinal. On these two hill slopes, facing each

other, a few chestnut bushes are found; but they stop absolutely and abruptly at the tops of these two slopes, and on the other sides of the same hills not a chestnut bush is to be found. Nor is there any chestnut in any other part of this section of the country. I was told that there were a few bushes five or six miles off on Middle Fork, but I did not see any. How these chestnut bushes came to grow upon the faces of these two hills I cannot imagine; for they could not have come from seeds floated down the stream, inasmuch as the mountain above the head of the stream has no chestnut on it, and never has had any so far as I could find out. The people have recognized the peculiarity of the growth, as is indicated by the name of the stream. A few chestnut bushes were found in one or two other spots in the Purchase, whose presence and limited distribution are as hard to account for as those of the Chestnut creek timbers.

There is a considerable amount of black walnut scattered through the Purchase country, most of which is found high up on the heads of streams. There is more or less of it found on the head waters of all the streams, but an especially large quantity is met with on Brush creek and on the streams that form the North Fork of Obion river. There is no market for walnut timber in this part of Kentucky and no value is attached to it. It is ruthlessly cut and sawed by the little saw-mills that spring up wherever there is a local demand for lumber. It sells for about three dollars a tree, and a piece of walnut timber that would bring \$150 in New York is considered dear at \$4 or \$5. There is an amount of improvidence shown by Kentucky people in dealing with their forests which would astonish any other civilized people. It is not shown in regard to the walnut alone. In the wide flat woods south of Paducah there is considerable valuable white oak, which is all the more valuable because it is within a few miles of its best market; but I constantly noticed the people cutting this white oak for fuel, notwithstanding the woods are full of Spanish oak and black oak, which make fully as good fire-wood, and are valuable for nothing else. As a rule, the tree nearest to the house

of the owner is the first one sacrificed, regardless of its value. Within a few years, by the time the timber establishments of Paducah turn to the Purchase for their supplies, this flat woods will be almost stripped of its white oak timber, and only the Spanish oak and black oak, which are everywhere succeeding the white oak, though comparatively valueless, will be left as "brands snatched from the burning."

The distribution of the liriodendron (poplar) timber in the Purchase is about the same as that of the white oak. It is found in great abundance on nearly all the streams, large and small, and the principal demand for it is that made by local mills, which, of course, waste large quantities of it. But the reserve supply for future use is so great that no present apprehension need be felt. The finest body of upland white oak and liriodendron in this part of Kentucky is probably between Dublin and Clinton, near the line of the two western railroads across the Purchase. To this statement a rather curious exception must be made. About six miles from Clinton the white oak suddenly disappears, even from low grounds, and on a belt about one mile wide it is almost wholly absent. Here, black and Spanish oak are very fine and heavy, and with them are liriodendron, white elm, etc. About seven miles from Clinton the white oak abruptly begins again, and forms, as it did before, about forty per cent. of the forest growth. I cannot account for this gap in the white oak, unless it be that long ago a hurricane passed through the region and destroyed all the timber in its track, in which case, as I have elsewhere shown, Spanish and black oak would succeed the white oak in the new forests.

In the flat woods south of Paducah, referred to above, the timbers often alternate most curiously. Here white oak is the principal, almost the only, timber; two hundred yards distant, Spanish oak and black oak have succeeded the white oak; at the same distance further on, these timbers have disappeared, and only post oak or hickory is to be seen, and all this without the slightest change of level, or the least apparent reason therefor. In places, all these timbers grow

together; again, they grow only in streaks. After passing this flat woods, there are two principal causes of change in the timbers: one is change of height above drainage, which always produces corresponding changes in the species of timbers; the other is change in the position of the gravel beds relative to the surface of the ground. Underlying the whole of the Purchase country is a bed of pebbles, whose thickness I could not accurately ascertain. This pebble bed is, in some parts of the country, as much as fifty feet below the surface of the ground; in others, for miles, it is on a level with the surface, whose whole formation consists of these pebbles. I did not have the time or the means to investigate the course of these pebble beds, but wherever they lie near to, or form the surface soil, the timbers are very poor, and consist mostly of black-jack and scrub oak. The fine timbers are always found where these beds are at a considerable depth below the surface soil.

I might call attention here, in passing, to two irregular marsh-ponds of the Purchase, one a few miles south of Paducah, the other a few miles north of Mayfield. They are low, undrained marsh lands, the former irregularly round, the latter oblong, and both heavily timbered with swamp timbers. Buzzard pond, as the one near Paducah is called, contains a great deal of bartram oak, over-cup, the people call it. Cypress pond, near Mayfield, takes its name from its principal timber. It is one of the cypress swamps often found in the Southern States.

SUCCESSION OF TIMBERS.

Between Murray and Mayfield there is a considerable area of more or less flat table land, through which no water passes, except the extreme head waters of West Fork of Clark river, and a few other little branches, most of which are dry nearly all the year. I was surprised, after leaving Benton and passing into this table land, to find that the woods consisted only of saplings or tall, slim, young trees, from forty to seventy feet in height, but not more than twelve to twenty inches in

diameter. At a distance, this forest appears very heavy on account of the height and extreme density of these young timbers; but on nearer approach, not an old tree can be found. This peculiar growth extends beyond Murray, and, as I afterwards found, occupies the entire table land, to which I have previously called attention. I examined closely this young forest, and found that its principal timbers are black oak and red oak, and that scarcely a single white oak is to be found. My study of the Tradewater timbers had convinced me, that wherever the present forests of Kentucky are, by any means, destroyed, white oak does not form an element of the new forest growth, but that it is wholly supplanted by black oak and red oak. (See Report on Tradewater Timbers, vol. V, this series.) I at once concluded that the whole forests of this table land had been destroyed thirty or forty years ago, and that the new forest had succeeded that universal destruction of timbers in which the white oak had perished forever. I then passed off into the head waters of West Fork of Clark river and those of Mayfield creek, and noticed that as soon as these streams became large enough to have considerable bottoms, and to have water in their beds the year round, that in these bottoms the old forest timbers, consisting of white oak, poplar, and other timbers commonly met with, still exist. But these timbers are limited strictly to the swamp, at whose margin they give way abruptly to the young forest. Of course, the mystery was at once solved. Fire is the only agency that could destroy the forests over such a wide area, and leave none but the timbers in damp places standing intact. I had before studied the effects of burning off the woods upon the forest timbers, and had pointed out the fact that the people living along the foot of the Black Mountains of Kentucky are rapidly destroying some of the finest timbers in the United States, by pursuing this practice year after year. (See Report on North Cumberland Timbers, vol. IV, this series.) It immediately suggested itself to me that the

cause I had seen in operation in the Black Mountains had completed its work in this part of the Purchase.

I called on Mr. Waterfield, one of the oldest residents of this part of Kentucky, who lives about six miles from Murray, for information. He told me that thirty years ago this whole region of country was a perfect prairie, in which not a single bush was to be found, except along the streams, and that this result was due, as I had suspected, to the practice of burning off the woods yearly, in the late fall or early spring, for the sake of the "range." This practice, when continued year after year, produces two results, both of which I pointed out in speaking of the Black Mountain timbers: it kills off the old forest growth more rapidly than it would be removed by the ordinary agents, by burning and crisping the outer bark every year, and exposing the body of the tree to dampness and decay and the ravages of worms, and it destroys, every fall or spring, the bushes which have grown up since the preceding spring, and which have not yet attained sufficient size to withstand the heat. Evidently, if this process is kept up long enough, the old forest will have passed away, and no new one will have come on to take its place. Suppose this stage to have been reached over an extensive area of almost unwatered country: of course, during the next summer, after the last old tree had passed away and the young bushes had been burned down in the fall or spring, leaving the country absolutely bare, many other young bushes would spring up from seeds and roots still buried in the ground, and, if let alone, would form such a forest as we now see in this part of the Purchase. But if we suppose the process of burning to be continued year after year, it is evident that, before a great many years had passed, the last of the buried seeds would have sprouted, and the last root have exhausted itself and died. We should then have a vast expanse of country, not only without a tree or bush, but without a single seed or root from which one could come. Such are now the great prairie lands of the Western States, and such has been the cause which, in my opinion, led to their barren-

ness of forests. These prairie lands were deprived of their primeval forests by a long continuance of the practice which the Indians pursued of burning off the woods yearly for the purpose of gathering nuts and hunting game. The calamity is irreparable, and Illinois, instead of boasting of the \$300,000,000 worth of timbers such as now form the glory of Kentucky, must go through the slow and expensive process of planting and culture to replace the forests which she has so lamentably lost. I am inclined to think that the burning of the woods in the strip of country under discussion did not go so far as to exhaust the buried seeds and roots of the timbers; for, although the strip burnt over is comparatively so small, and so surrounded by heavy forests, that, had such been the case, seeds from these forests would quickly have spread over the burnt area, nevertheless it seems that, in that case, the young trees nearer the margin of the surrounding woodlands would be larger and older than those in the centre of the burnt district. To a certain extent, this is actually the case; but, from a close examination, I came to the conclusion that this appearance was due, not to the fact that the buried seeds and roots over the whole area had been killed and new supplies been furnished from the surrounding forests, but to the fact that, as settlements pushed into these burnt areas, the limits burned over became more and more restricted every year until the burning ceased entirely. This process would give to the present young forest the appearance of being regular and heavy, and yet of gradating into somewhat older growth as one approaches the limits of the burnt district. Besides, inasmuch as the country here slopes toward the north and all the streams flow in that direction, if the forest destruction had been complete and the seeds of the new forest had been furnished from the surrounding old forest, the trees of the new forest would have grown gradually larger as one approached the *southern* limit of the burnt area. The exact opposite is the case, and the young forest trees grow larger as we approach the old forests on the *north* of the burnt district. This shows that the present irregularity of the

young trees is due to the fact that settlements pushed southward in this part of Kentucky, and that the limit of the burnt area was pushed a little further south each year for some years before the burning ceased altogether.

Luckily for the prairie lands of the United States, they are nearly all level, or the loss of their timbers would have led to so great a destruction of the lands themselves, by torrents, that no amount of human labor and ingenuity could ever have retrieved them. If the same process of forest destruction goes on in the mountainous regions of the North Cumberland, until the timbers there are entirely destroyed, nothing can avert from that country the calamity which reckless destruction of forests is now producing in the mountain regions of some parts of Europe. (See Tradewater Timbers, vol. V, this series.)

One of the most important results to be reached from a study of this once burnt district of the Purchase is, however, that my former conclusions in regard to the disappearance of the white oak are correct. Here is a strip of country, surrounded on all sides by vast forests of white oak, such as once evidently occupied this district itself, which is suddenly entirely stripped of its forest growth, except that immediately along its streams. In the new forest which succeeds this destruction scarcely a single white oak is to be found. This, taken in connection with previous observations which showed that the white oak is wanting in the young forest growth in all parts of Kentucky, whatever the character of the old growth, seems to prove conclusively that the white oak cannot hold its own in competition with black oak, red oak, and such timbers.

TIMBER IN DETAIL.

Starting out from Paducah southward along Clark river, for some miles there is found a flat table land with grayish soils, the curious alternation of whose timbers I have previously noticed. Upon this very little undergrowth is found, and what little there is consists almost wholly of black oak and Spanish oak.

In the Clark river bottom, four miles from Paducah, considerable cypress is found. The shag hickory, sweet gum, and white oak, even this near to Paducah, are very fine and heavy, and vary from twenty-four to forty inches in diameter. A good deal of liriodendron, often four feet in diameter, is also found, as well as some white ash, redbud, etc. Black locust and iron-wood are also met with. Six miles from Paducah, about thirty per cent. of the timbers is white oak, and about six per cent. of them liriodendron. Black oak forms about fifteen per cent. of the old forest growth, and of the young forest growth, which is very heavy, about thirty-five per cent. Black, shag, and pignut hickories and Spanish oak are the other forest timbers. These timbers remain essentially unchanged, with the exception of local alterations, for a distance of five miles. Here the road becomes a more or less bare, white sandy ridge, with Clark river off to the right. Along the road, the timbers for some miles are not valuable, and consist nearly altogether of black oak, Spanish oak, black-jack, post oak, and black hickory. On Clark river, the bottom is wide and the timbers are very valuable. On Tennessee river, off to the left of the road as I traveled towards Benton, the valuable timbers are nearly all cut out. White oak and liriodendron, as well as white ash, are found on nearly all the small streams.

About five miles from Benton the country becomes more hilly, and the timbers more sharply divided into upland and lowland timbers. The former are Spanish oak, black oak, post oak, black-jack, and black hickory; the latter are white oak, white ash, liriodendron, white elm, shag hickory, sycamore, and red birch. Bartram oak is also found along all streams. The hilly character of the country continues for about one mile, when the East Fork of Clark river is reached. The swamp land, or bottom, here, is fully two and one half miles wide, and the timbers throughout the whole are of the very finest. The white oak is often four feet in diameter, with height in proportion, sweet gum forty inches in diameter, black and shag hickory thirty-six inches in diameter, with beautiful trunks, sixty feet in height without a limb.

Bartram oak is very heavy, and white elm is good and plenty. Liriodendron is not very large, nor are white and black ash. The best have been cut out right along the road by a small saw-mill near the crossing. But those timbers are very fine all through the Clark river bottom, and as this is usually from one to three miles wide, there lies along it a vast body of exceedingly valuable timbers.

Between Benton and Watch creek, two miles from Benton, towards Murray, the road is hilly and the timbers poor, consisting of red oak, black oak, and post oak, black-jack and black hickory. On Watch creek, the usual lowland timbers are found—white oak, liriodendron, black walnut, sycamore, birch, white elm, and red elm, with some shag hickory. After crossing Watch creek, for a distance of five miles, there is alternate hill and level. The surface soil in these levels is composed of whitish gravel, which is not cemented together. The timber is almost wholly black-jack. Even on Wade's creek there is little change in these timbers. Immediately along the banks of the creek, most of the swamp timbers are found, but they are not large nor valuable, except near the mouth of the creek, where they become similar to those of East Fork of Clark river. If we except along Rockhouse and Bee creeks, on both of which good liriodendron, white oak, black and white ash, white hickory and black walnut are found, the timbers are very poor through the high, hilly country from Wade's creek to Murray. The timbers along East Fork are very valuable even this high up; but the river bottom is growing much narrower, and the body of timber along it much smaller. The timbers remain essentially unchanged from Murray to the Tennessee line.

In turning from Murray, back toward Mayfield, one enters upon the level sandy table land before referred to, where the entire forest consists of bushes. These bushes are tall and slim, and stand so thickly on the ground that the forest could never be worth very much even if the timbers were valuable in kind; but this they are not. Of these timbers, black oak forms about forty-five per cent, red oak and scrub hickory

fifteen per cent. each, post oak thirteen per cent, Spanish oak nine per cent., and white oak two per cent. Black-jack alternates with black oak, and in some places is the only timber met with. From this composition we can form an instructive idea of what is to be the future forest of Kentucky, in case no action is taken to perpetuate the present distribution of timbers.

The monotony of this young forest growth is broken on reaching West Fork of Clark river, where timbers very similar to those of East Fork are found, except that the bottom of West Fork is narrow, and the timbers are proportionally small and unimportant. White oak, sweet gum, and liriodendron are its most valuable timbers. After crossing West Fork, the country is somewhat more broken; but the same young forest is met with until one nears Farmington. Here the timber, though still all young and of the same composition, is evidently older than that between Farmington and Murray, and clearly shows that the practice of burning off the woods ceased here before it did in the latter locality.

About five miles from Mayfield the old forest growth is reached again, with considerable white oak, laurel oak, and pig hickory in the lower grounds, and post oak, black oak, Spanish oak, and black-jack in the higher grounds. A change of level of fifteen feet is sufficient to produce this change in the timbers. About three and a half miles from Mayfield, Mayfield creek is reached, and the timbers become very valuable. They consist of white oak and liriodendron, which, together, form about forty per cent. of the swamp timbers, sweet gum, shag and white hickory, black ash and white ash, cypress, bartram oak, winged elm, and swamp laurel oak. A small saw-mill near the creek crossing does a great deal of local work. The timbers along Mayfield creek are every where very fine, and as the bottom is wide and the creek very tortuous, running through more or less of five counties of the Purchase, the body of timber that lies along it is very valuable. It will be difficult, however, to float out a large part of this timber, because, during a

considerable part of its course the creek is not large enough to float out timber, and even where it is large enough, the sluggishness of its waters is a practical difficulty.

After crossing Mayfield creek, there is a stretch of country about ten miles across, between Mayfield and Clinton, which is very hilly, and whose timbers are not valuable. They consist nearly altogether of black oak, Spanish oak, black hickory, post oak, and black-jack. Very little white oak is found and less liriodendron. This lasts until the head waters of Skegg's Fork and of Bowen's creek are reached. South of this strip of comparatively valueless timbers, however, there is a section of country whose forests are very fine: I mean that belt of country comprising the numerous creeks that form the head waters of Mayfield creek and North Fork of Obion river. This section, about fifteen miles square, is a perfect net-work of creeks, no less than eighteen of which flow across it in some way or other. The timbers along these head-water creeks are very heavy and dense, and the white oak, liriodendron, hickories, etc., are of the finest. Here, too, are found the most valuable old forest walnut trees to be met with in the Purchase. Bayou de Chien creek heads in near this section also, and contains along its bottoms a valuable body of timbers, similar to those of Mayfield creek and Clark river.

Going farther north again, about ten miles from Mayfield, toward Dublin, one enters upon a tract of country where the surface gravel wholly disappears, and is found at a depth varying from twenty to forty feet. Here the general forest timbers become good again, and pignut hickory and white oak extend to the hill-tops. About two miles from Dublin the forest is splendid, and furnishes white oak, liriodendron, hickories, white elm, black locust, redbud, etc. On the high hills black oak, Spanish oak, and red oak are found. The white oak through here forms fully forty per cent. of the forest timbers. Turning northward from Clinton, the timbers remain about the same as those between Dublin and Clinton until North Fork of Obion river is reached. Here the white oak,

hickory, liriodendron, sweet gum, bartram oak, and cypress are unsurpassed. The bottom of North Fork varies from one half mile to three miles in width, and is a broad belt of the most beautiful and valuable timbers throughout the entire length of the river. A great quantity of pin oak and swamp laurel oak is also found on North Fork.

After passing North Fork the country is rather hilly again, until the region of Little Mayfield creek is reached. Through this hilly section, however, there is a great deal of white oak and liriodendron, the latter amounting to an average of probably eight per cent. of the forest timbers. There is a valuable body of timber off to the east of Blandville, on the network of creeks, consisting of Wilson's Fork, Mahon's creek, Sugar creek, and others which are tributary to Mayfield creek. Of course, the bottom lands on Mayfield creek grow wider as we approach its mouth, and the body of timbers along its banks grows more extensive and valuable. But north of Milburn, before reaching the net-work of creeks referred to, there is a section of country where the white oak ceases to be a forest timber. It is found only on the lowest spots of ground, and, elsewhere, is superseded entirely by black oak and Spanish oak.

About thirteen miles from Paducah, on the Blandville road, we again meet with the more or less grayish table land lying south of Paducah, throughout which white oak, black oak, Spanish oak, post oak, and black hickory are irregularly scattered, alternating one with another in a seemingly unaccountable way.

TABLES.

The following are tables of the timbers met with in various parts of the Purchase. The areas usually cover twenty-five hundred square yards of ground, more or less, are chosen at intervals of four to eight miles along the road, and are as nearly representative as such tables could be made. They are given in the order in which they were taken, which will be gathered from the previous section, "Timber in Detail."

Name.	Number.	Average diameter.	Cut.	Decayed.
White oak	16	20 inches.	3	2
Post oak	10	19 "	0	1
Black oak	3	18 "	0	0
Black hickory	3	16 "	0	0

Undergrowth of black oak and black hickory. Small growth of black gum, dogwood, black sumach, and winged elm. Small growth refers to the comparatively small and unimportant timbers, and is distinguished from undergrowth or bushes. Location, two miles from Paducah.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	8	20-32 inches	0	2
Black oak	5	22 "	0	4
Liriodendron	2	28 "	0	0
Black hickory	5	20 "	2	0
Shag hickory	3	18 "	0	0
Pig hickory	2	16 "	0	0

Bushes consist chiefly of black oak and red oak, though about five per cent. of white oak is found among them. Small growth, as in last section. Location, a flat ridge bordering Clark river, about five and a half miles from Paducah.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	2	22 inches.	0	0
Black oak	7	21 "	2	2
Red oak	2	19 "	0	1
White elm	1	20 "	0	0

Black hickory is in the neighborhood, but not in this section. Black oak, red oak, and white oak are about evenly divided among the bushes in this spot—the only place I have noticed where there is a greater proportion of white oak among the bushes than among the old trees. Location, level sandy ridge, about thirteen miles from Paducah.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	16	26 inches.	1	3
Red oak	2	23 "	0	1
Black oak	1	22 "	0	0
Pin oak	1	20 "	0	0

No hickory nor liriodendron in the locality. White elm, black gum, and catalpa are found among the small growth. Location, a depression or hollow about five miles from Benton.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	9	40 inches.	0	2
Bartram oak	3	32 "	0	1
Liriodendron	7	28 "	1	1
Sweet gum	5	35 "	0	1
Black hickory	3	30 "	0	0
Shag hickory	2	28 "	0	0
White elm	3	26 "	0	1
White ash	1	22 "	0	0
Cypress	2	35 "	0	1

The section is on the East Fork of Clark river, four miles from Benton. The swamp here is three miles wide, with timbers as fine all through. Large amount of pin oak, sycamore, red birch, and considerable black ash are also found.

Name.	Number.	Average diameter.	Dead.	Decayed.
Red oak	17	19 inches.	2	4
Black oak	13	20 "	1	2
Spanish oak	3	20 "	0	1

Post oak in this locality, but no hickory. Location, a hill-top, about one mile from Benton.

Name.	Number.	Average diameter.	Dead.	Decayed.
Post oak	8	18 inches.	0	2
Spanish oak	7	14 "	1	2
Black oak	1	16 "	0	0

Among bushes and small growth, in addition, are black hickory, persimmon, dogwood, sassafras, and black-jack. No white oak in the neighborhood at all. These timbers remain unchanged, except on streams and at the bases of hills, till the forest of young timber, previously spoken of, is reached. Location, high ridge, about five miles from Murray.

Name.	Number.	Average diameter.	Height.
Black oak	18	11 inches.	35 feet.
Red oak	5	11 "	30 "
Spanish oak	7	12 "	34 "
White oak	1	7 "	24 "
Scrub hickory	7	8 "	18 "
Post oak (scrub)	6	20 "	35 "

The young timbers are exceedingly thick, on the ground, all over the country, and the table is a good average of their character. The small amount of white oak, and the large amount of black oak, on low and high ground alike, in these woods, which have grown up within twenty-five years, is worthy of notice and earnest consideration. This is the character of the forests until Mayfield creek, three and a half miles from Mayfield, is reached. Location, six miles from Murray, a nearly level table land, very fertile.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	9	24 inches.	0	1
Liriodendron	8	30 "	1	1
Sweet gum	6	22 "	0	0
White hickory	1	24 "	0	0
Shag hickory	2	20 "	0	1
Pin oak	2	22 "	0	0
Bartram oak	3	26 "	0	1
White ash	1	25 "	0	0

Winged elm, black gum, water birch, maple, sycamore, and cypress are also found in the locality, which is Mayfield creek bottom.

Name.	Number.	Average diameter.	Dead.	Decayed.
Black oak	10	20 inches.	1	2
Spanish oak	8	22 "	0	1
Red oak	4	21 "	0	0
Post oak	4	20 "	0	1
White oak	1	18 "	0	0
Black-jack	1	16 "	0	0
Black hickory	3	18 "	0	0

White oak and liriodendron not numerous in this locality. The oaks in the table alternate as leading timbers here. There is a good deal of white oak in the forest here, but none of note in the locality of the table. Location, more or less level, ridge country, about seven miles from Mayfield, toward Clinton.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	13	20-44 inches.	1	3
Liriodendron	5	40 "	0	2
Sweet gum	6	28 "	0	2
Spanish oak	3	25 "	1	0
Black oak	4	35 "	0	1
Bartram oak	3	30 "	0	0
Pig hickory	2	26 "	0	0
Shag hickory	3	25 "	0	1
White ash	2	24 "	0	0
Black ash	1	22 "	0	0
Red elm	2	28 "	0	0

Cypress exists in great plenty right along the banks of the river. Location, North Fork of Obion river, between Dublin and Clinton.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	12	26 inches.	1	2
Spanish oak	3	24 "	0	1
Post oak	2	20 "	0	0
Black oak	4	26 "	0	1
Liriodendron	2	25 "	0	0
Pig hickory	2	24 "	0	0
Black hickory	1	26 "	0	0

The white oak through here forms about forty per cent. of the forest timbers, the liriodendron about four or five per cent. Hickory is very fine. Undergrowth mostly of black and Spanish oak, with some post oak, considerable hickory, and small amount of white oak. Location, open upland forest, between Dublin and Clinton.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	14	30 inches.	1	2
Liriodendron	7	28 "	0	0
Swamp laurel oak	6	26 "	0	0
Bartram oak	4	28 "	0	1
Red oak	3	27 "	0	1
Sweet gum	7	30 "	1	0
Cypress	2	34 "	0	1

White elm, white and shag hickory, black and white ash, pin oak, etc., are found, but not in this section. Location, Little Obion river, about seven or eight miles north of Clinton. The hickory and white oak are very fine.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak	21	25 inches.	1	3
Liriodendron	8	26 "	0	1
Black oak	1	20 "	0	0
Spanish oak	1	22 "	0	0

Pig and black hickory are in locality, but not in the section. Location, the forest along the net-work of creeks south of Lovelaceville. Dogwood, alder, persimmon, winged elm, etc., are small growths.

Name.	Number.	Average diameter.	Dead.	Decayed,
Post oak	19	21 inches.	0	3
Black oak	5	24 "	0	2
Spanish oak	1	18 "	0	0

No hickory; bushes mostly black oak. Location, an average hill-top in the forest a few miles east of Blandville.

Within twelve miles of Paducah, we pass into a flat, whitish-gray table land, whose timbers are similar to those noted on leaving Paducah and going southward on the eastern side of the Purchase.

From the foregoing tables, some interesting information can be deduced in regard to the timbers of the Purchase country. For instance, taking up the white oak, we form the following general table.

Name.	Average diameter.	Per cent. decayed.	Per cent. dead.
White oak	26 inches.	16 $\frac{2}{3}$ +	5+

That is, the general average of the white oak timber throughout the Purchase shows a diameter of twenty-six inches, with sixteen and two thirds per cent. of the timber decayed.

Similar tables for the other principal timbers are as follows:

Name.	Average diameter.	Per cent. decayed.	Per cent. dead.
Liriodendron	29 inches.	13 nearly.	5+
Black oak	22 $\frac{1}{2}$ "	26 "	7 $\frac{1}{2}$ about.
Post oak	20 " nearly.	16 $\frac{2}{3}$	not 3.
Spanish oak	22 " +	20+	8 nearly.
Hickories	22 "	3+	6+
Sweet gum	28 $\frac{1}{2}$ "	12 $\frac{1}{2}$	4+
Red oak	21 $\frac{1}{2}$ "	25	7+
Bartram oak	30 "	25	not 7.

From these tables, it appears that the bartram oak has a larger average diameter than any other tree in this part of Kentucky, and liriodendron stands next to it. We should expect that, for the bartram oak is a large tree, and then it is never found, except in swamps and low places where the timbers are always larger than on uplands. Post oak has the smallest percentage of dead timbers, and next to it comes the sweet gum, followed by white oak and liriodendron, with the

same percentages. Black oak stands first among decayed timbers, and bartram oak next. Hickories are by far the soundest timbers, and have a smaller percentage among their decayed than among their dead trees. It will be noticed, also, that as a rule, swamp timbers are sounder than upland timbers. This would have been expected.

From the tables already given, other series may also be produced. For instance, the following list shows the relative numbers of different timbers to be met with.

White oak, 121; bartram oak, 13; black oak, 54; liriodendron, 39; hickories, 32; post oak, 43. That is, there are one hundred and twenty-one white oaks to fifty-four black oaks, throughout the old forests, in this part of Kentucky, and so on. I do not think there is as much liriodendron timber as hickory in the woods; but the valuable liriodendron is more plentiful than the valuable hickory, as the table shows. Again, if we consider the timbers given in the "general average" tables above, to be all the forest timbers in the Purchase (and they are at least ninety per cent. of them), white oak forms about thirty-two per cent. of all the forest timbers, and black oak comes next, forming less than fifteen per cent. If the estimate of the value of the standing forests of the Purchase previously given be correct, the white oak alone now standing in this comparatively small strip of Kentucky, is worth from \$3,000,000 to \$5,000,000. It remains for the people, by prudence and forethought, to perpetuate a timber which is, in itself, a fortune to them.

SUMMARY.

A brief survey of the foregoing pages shows:

1. That there are vast bodies of valuable timbers lying along all the streams of the Purchase country, but that these streams are not well adapted for floating them out.
2. That as much as two thirds of the upland of this part of Kentucky is clothed with valuable timbers.
3. That there is not, at present, much drain upon the forests of the Purchase, and that not more than one two hund-

red and fiftieth of these forests is likely to be called for per annum, at any time, in the immediate future. At this rate they can easily reproduce themselves, with the exception of the white oak, which does not tend to perpetuate itself. Of course, the *available* timbers will be the ones drawn upon, and they would be exhausted in a few years, comparatively, at such a drain as I have considered possible in the future.

4. The white oak forms about thirty-two per cent. of the forest timbers in the Purchase, and, alone, would be worth, at Paducah, the enormous sum of \$3,000,000 to \$5,000,000. The total forests of the Purchase are estimated at from ten to fifteen millions of dollars in value.

CUPULIFERÆ—MASTWORTS.

1. *Genus Quercus.*

- White oak, *Quercus alba* (L.)
- Swamp white oak, *Q. bicolor* (Willd.)
- Red oak, *Q. rubra* (L.)
- Pin oak, *Q. palustris* (Mx.)
- Spanish oak, *Q. falcata* (L.)
- Black oak, *Q. tinctoria* (Bart.)
- Post oak, *Q. obtusiloba* (Mx.)
- Bartram oak, *Q. heterophylla* (Mx.)
- Black-jack, *Q. nigra* (L.)
- Laurel oak, *Q. imbricaria* (Mx.)
- Swamp laurel oak, *Q. Laurifolia* (Mx.)

2. *Genus Castanea.*

- Chestnut, *Castanea vesca* (L.)

3. *Genus Fagus.*

- Common beech, *Fagus sylvatica* (L.)
- Red beech, *F. ferruginea* (Ait.)

4. *Genus Ostrya.*

- Hop hornbeam or ironwood, *Ostrya virginica* (Willd.)

JUGLANDACEÆ—WALNUT.

1. *Genus Juglans.*

- Black walnut, *Juglans nigra* (L.)

2. *Genus Carya.*

- Shagbark hickory, *Carya alba* (Nutt.)
 Black hickory, *C. tomentosa* (Nutt.)
 Pignut hickory, *C. glabra* (Sorr.)
 White hickory, *C. microcarpa* (Nutt.)

ACERACEÆ—MAPLES.

1. *Genus Acer.*

- Red maple, *Acer rubrum* (L.)
 White maple, *A. dasycarpum* (Ehrh.)
 Sugar maple, *A. saccharinum* (L.)
 Black sugar maple, *A. nigrum* (Mx.)

CORNACEÆ.

1. *Genus Cornus.*

- Flowering dogwood, *Cornus florida* (L.)
 Low cornel, *C. canadensis* (L.)

2. *Genus Nyssa.*

- Black gum, *Nyssa multiflora* (Wang.)
 Swamp black gum, *N. uniflora* (Walt.)

BETULACEÆ—BIRCHWORTS.

1. *Genus Betula.*

- Red birch, *B. nigra* (Ait.)

2. *Genus Alnus.*

- Smooth alder, *Alnus serrulata* (Willd.)

OLEACEÆ.

1. *Genus Fraxinus.*

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

ULMACEÆ—ELMWORTS.

1. *Genus Ulmus.*

- Slippery elm (red elm), *Ulmus fulva* (L.)
 White elm, *U. Americana* (L.)
 Winged elm (whahoo), *U. alata* (Mx.)

ROSACEÆ.

1. *Genus Cerasus.*
Black cherry, *Cerasus serotina* (D. C.)
2. *Genus Prunus.*
Red and yellow plum, *Prunus Americana* (Mx.)
3. *Genus Cratægus.*
Hawthorn, *Cratægus oxycantha* (L.)
Red haw, *Cratægus viridis.*

SALICACEÆ—WILLOW-WIRTS.

1. *Genus Salix.*
Willows—two or three varieties.
2. *Genus Populus.*
Silver-leaf poplar, *Populus alba* (L.)

LEGUMINOSÆ.

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

ANACARDIACEÆ.

1. *Genus Rhus.*
Red sumach, *Rhus glabra* (L.)
Black sumach, *R. typhina* (L.)

CAPRIFOLIACEÆ.

1. *Genus Viburnum.*
Black haw, *Viburnum prunifolium* (L.)

PLATANACEÆ.

1. *Genus Platanus.*
Sycamore, plane tree, *Platanus occidentalis* (L.)

LAURACEÆ—LAURELS.

1. *Genus Sassafras.*
Common sassafras, *Sassafras officinale* (Nees.)

ARTOCARPACEÆ.

1. *Genus Morus.*
Red mulberry, *Morus rubra* (L.)

BIGNONACEÆ—TRUMPET FLOWERS.

1. *Genus Catalpa.*Catalpa, *Catalpa bignonioides* (Walt.)

MAGNOLIACEÆ.

1. *Genus Liriodendron.*Tulip tree, *Liriodendron tulipifera* (L.)

ANONACEÆ.

1. *Genus Asimina.*Common papaw, *Asimina triloba* (Dunal.)

HAMAMELACEÆ—WITCH HAZELWORTS.

1. *Genus Liquidambar.*Sweet gum, *Liquidambar styraciflua* (L.)

EBENACEÆ.

1. *Genus Diospyros.*Persimmon, *Diospyros Virginiana* (L.)

CONIFERÆ.

1. *Genus Taxodium.*Bald cypress, *Taxodium distychnum* (Rich.)