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GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

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REPORT

ON THE

TIMBERS OF THE TRADEWATER REGION

CALDWELL, LYON, CRITTENDEN, HOPKINS,  
WEBSTER, AND UNION COUNTIES.

BY LAFAYETTE H. DEFRIESE.

PART IV. VOL. V. SECOND SERIES.

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

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## INTRODUCTORY LETTER.

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NEW YORK, September 17, 1877.

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

I submit herewith a report upon the timbers of the Trade-water River Region of Northwestern Kentucky. Owing to the favorable situation of this region, to its geological character and the minute but important changes in its surface soils and to the drain which has been made upon its timbers within the last few years, which is liable to increase rather than diminish in the future, I know of no part of Kentucky that furnishes a more interesting or important field for the study of some of the problems connected with the growth, decay, and succession of timbers. Such of these problems as my limited time and opportunity would permit me to consider, I have briefly discussed in the following pages.

I wish to acknowledge my indebtedness, and that of the Survey, to the Elizabethtown and Paducah Railroad for facilities of travel afforded, as well as to the many private individuals who, by their kindness, have helped to forward my labors.

Very respectfully yours,

LAFAYETTE H. DEFRIESE.

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REPORT ON THE TIMBERS OF THE TRADEWATER REGION—CALDWELL, LYON, CRITTENDEN, HOPKINS, WEBSTER AND UNION COUNTIES.

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GENERAL REMARKS.

I need say but little in regard to the method of timber study pursued in these counties, as it is almost identical with that described in a former report on the timbers of neighboring counties.\* In speaking of and tabulating the characteristics of the timbers of different localities, it will be noticed that I have changed my points of study to suit the changed conditions of the timbers. For instance, where there is a heavy drain constantly made upon the forests by cutting and floating out timbers, I have tried to find out about the rate at which valuable timbers are disappearing, and to compare that with the character and growth of the young forest trees, in order to arrive at the effects of such drain upon the future forests of Kentucky. Again, in another locality, where some other cause is operating to produce other effects, or where similar effects are produced by different means, I have paid especial attention to this changed condition of things and so on.

The valuable timbers in this part of Kentucky are chiefly the following, which are important in the order given: white oak, liriodendron (yellow poplar), white and black ash, white hickory (or second growth hickory of any variety), white elm, black walnut, post oak, sweet gum, bartram oak, and cotton tree. And when I say that these timbers are important in the order given, I take into consideration their value as a source of wealth to the State, which depends upon three things: the market value of the timber, the amount of it found in the

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\* Report in volume II, this series.

country and the use to which it is put. Of course, the market value of walnut is greater than that of any other timber in Kentucky, and, if that alone were considered, walnut would head the list of valuable timbers; but the comparatively small quantity of it now found in the country places it low in the scale. White oak must, therefore, be considered the most valuable timber of the Kentucky forests. In this part of Kentucky, it is the principal forest tree along all the streams, and on the more or less level, sandy soils. But, as a rule, in these counties it is not spread over the hills as in some parts of the State. On lands not more than twenty-five to forty-five feet above local drainage, and on loose sandy soils at almost any height above drainage, the white oak forms about 40 per cent. of the forest timbers. In hilly regions, however, the white oak usually gives way to black oak, scarlet oak, and post oak, at a height of about forty-five feet above local drainage. But not all of this white oak, scattered along the streams and through the woods of the interior part of the State, is available at present; nor is it likely to be for years to come. A large part of it must be looked upon merely as a reserve for the distant future, when the more convenient forests shall have been stripped of their white oak wealth by the enormous drains now made upon them. And in the following pages, unless the contrary is distinctly stated, I shall confine my discussion of the rate of disappearance of white oak timber from the forests to available white oak—that is, to white oak that is sufficiently convenient to some railroad, or to some stream large enough to float it out, to be procured without too great outlay. It should be kept in mind that the supply of this timber, which is too remote from present means of transportation to be considered here, inasmuch as there is no drain upon it and cannot be for years to come, is almost without limit. This possible reserve, however, should not be allowed to blind the people to the dangers that threaten the white oak in all places where it is exposed to heavy drains. For, after all, the expense of reaching timbers so distant from means of conveyance would cause a necessary resort to them to be almost as

great a calamity as the total disappearance of those timbers. Besides, whenever a resort to such timbers *does* become necessary, then the same rates of disappearance will apply to them which are now found to apply to those timbers subject to a present drain. For the present, therefore, I shall speak chiefly of available white oak, and from this point of view.

The valuable white oak timber of the Tradewater region is to be found within one or two miles of Tradewater river, on either side, and low down on the larger tributaries of that river, where the streams are of sufficient size to float out the logs. The same may be said of all the other timbers which I have given as the valuable ones, with the possible exception of the post oak, which grows abundantly along all the hill-tops. The question of immediate interest is, therefore, what is the *present* timber supply, and what the rate of consumption in these available localities? If the supply seem inexhaustible to one who rides hurriedly through miles and miles of massive white oak, sweet gum, hickories, etc., all the more impressive, if not alarming, is the truth which closer investigation forces upon him. Especially is this so of the white oak and liriodendron (yellow poplar). A careful calculation, extending along the whole available part of the Tradewater river and its tributaries, convinced me that about 30 per cent. of the valuable white oak, which forms so large a proportion of the forest timbers in these localities, has been cut out within recent years, while the young forest will furnish only about 5 per cent. of this timber to take its place. So that, since the drain upon the timber resources of the Tradewater region commenced, about 25 per cent. of the entire available white oak timber has disappeared. And even of that left standing, the timber found is larger and more valuable in proportion to its distance from a stream capable of floating it.

The effect of this drain upon the liriodendron (yellow poplar) is still more striking. In all the St. Louis limestone regions of Caldwell, Lyon, and Crittenden counties, along streams where yellow poplar ought to flourish, only now and then could a tree be found. When I inquired if it did not

grow in this region, I was invariably informed that there once was a great deal of poplar in these localities, but that it had all been cut out. The same is true, to an alarming extent, throughout the whole Tradewater country. High up on the Tradewater river, and on small and inconvenient tributaries, considerable quantities of liriodendron are to be found; but I know of no convenient locality in which any considerable body of really valuable yellow poplar timber now exists. It is perfectly safe to say that fifty per cent. of all the available timber of this kind has been cut out.

The sweet gum seems to be plenty, and the white elm more or less so; but it was impossible to form any idea of the future forests of these timbers. The drain upon them now, though considerable, is largely local. The black walnut is now mostly second growth, and seems to be small, rough, and limby. The reason is, I think, that it grows up only in open places, where it does not have to compete with other timbers. It is therefore confined to fence-rows and road-sides, where the ground is hard-trodden, or else to waste places where the soil is exceedingly poor. This gives it the character of a dwarf or scrub timber, which the old forest growth did not have.

#### DRAINS ON TIMBERS.

The principal drain upon timbers of the Tradewater region at present, outside of the local saw-mills to be found along all the streams where good timbers abound, is made by the spoke factory of Booth, Dulaney & Co., at Kuttawa, Lyon county. It is called a spoke factory, though in reality the firm manufactures, in addition to wagon and buggy spokes, hubs, felloes, axles, etc., nearly all modern implements used about the farm, such as axe-handles, broom-handles, ox-yokes, ox-bows, etc. A large part of the rived spoke timber (white oak) used by the factory is obtained from the Tradewater region. I was informed by a gentleman who has had many years of experience in that branch of business, that the best and most durable white oak timber in the United States comes from the Tradewater and its tributaries,



Probably the reason of this is, that the white oak which comes from too far south grows up rapidly, and, exposed to long summers and short winters, is too sappy for the best wagon timber, while, on the other hand, that obtained from too far north, owing to slow growth and exposure to long winters, is too brittle for long wear. This is merely a suggestion, however. At any rate, the timbers from this part of Kentucky are in great demand; and while I was in Kuttawa I met Mr. S. N. Brown, of Dayton, Ohio, who owns one of the largest hub and spoke factories in the West, who was then in Kentucky preparing timbers to ship to his factory.

Messrs. Booth, Dulaney & Co. use post oak altogether for heavy wagon hubs now, and say it outwears any other timber that can be used. Certainly their supply of that is unlimited. A hill variety of white elm is used for buggy hubs, and white hickory alone for buggy spokes and rims. White hickory is also used for wagon axles, double-trees, etc., and the white oak for spokes, bolsters, sawed felloes, etc. The firm employ one hundred men constantly, thirty of whom are engaged in cutting and floating logs, the products of which are shipped to nearly every State in the Union. They pay from \$5 to \$7 per thousand feet for logs rafted to them, or from \$10 to \$15 per acre for good timber lands. Except the white oak, they bring most of their timbers from up the Cumberland; but when one considers what an amount of white oak timber is here worked up into wagon materials monthly, he can easily see what an enormous drain is made upon a region whose available timbers are limited. Add to this the almost countless little saw-mills scattered along on every branch and creek in this whole region of country, which can easily shift from place to place as the timber is exhausted, and one can readily comprehend what a sweeping destruction of forest timbers is going on. Strangely enough, as yet the great factories of Paducah have not turned their attention toward the Tradewater as a convenient source of timber supply for them; but we may expect this as soon as the Cumberland and the Tennessee river timbers begin to be exhausted. When this time comes, should

it ever come, an additional drain of 6,000,000 feet of timber per year will be made upon the Tradewater country. It is needless to say that, with such an additional demand upon it, the valuable available timbers of this part of Kentucky would be exhausted in a few years. For I shall show, further on in this report, that there is little hope of a young forest which can take the place of the old one now passing away.

#### SPECIAL TIMBER VARIATIONS.

It should be noticed that in a former report\* I spoke of a peculiar, and, in many respects, remarkable belt of timbers crossing the Hartford and Cloverport road, about twelve miles from Cloverport, and running a slightly varying east and west course across Breckinridge and Ohio counties. The ground is high and nearly level, and the soil a loose, damp, sandy formation. The belt is about five miles wide. In passing down the Tradewater I found a timber belt, which, from its width, the formation of the soil, and the character of the timbers, I believe to be a continuation of the belt formerly spoken of. It is about six miles wide and crosses Hopkins county between Garnettsville (now Dalton) and Providence. In this strip of woods the white oak, liriodendron (yellow poplar), white and blue ash, white hickory, black walnut (most of which has been cut out), are unsurpassed in size and beauty. They form a marked contrast to the timbers on either side of the belt. If these two belts be the same, as I believe them to be from similarity of characteristics, we have the remarkable phenomenon of a belt of the finest timbers extending, so far as observed, for more than one hundred miles, through other forests where the timbers are good, but not extraordinary, and following the general course of the Ohio river, though at no point, so far as I know, nearer to the river than ten miles. The belt is certainly not a level-topped, sandy range of hills bordering the Ohio, for there are numerous hills and hollows between it and the Ohio, on none of which is the timber especially noticeable.

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\*See report volume II, this series, page 7.

But there is one difference between this timber belt east of Green river, and the same (if it be the same) west of that river, which deserves especial attention: that is, the belt east of Green river is remarkable for its massive chestnut timber, often more than five feet in diameter, which forms a large percentage of the forest trees. West of Green river, however, I was not able to find a single chestnut in all the counties passed through, and all those of whom I inquired said that they had never seen a chestnut on the west side of Green river in that part of Kentucky. Certainly this is remarkable. The geological formation on the opposite sides of Green river is exactly the same, so far as I could determine, and is, so far as the surface is concerned, mostly the sandstone of the coal measure group. The regular pebbly conglomerate seldom appears here, even on the hill-tops. Certainly, in the belts spoken of, I could detect no difference whatever. Both (if they be two, and not, as I think, the same) are high, level, or nearly so, damp and sandy, and the massive timbers of the two are exactly the same, with the exception of the chestnut. If it be true, as I was informed (and it certainly is, as far as I was able to investigate), that no chestnut is found in this part of Kentucky, west of Green river, the reason why the chestnut should jut up against this river, and find in it a perfect barrier to its westward course, is worthy of investigation. With the limited time for study at my command, I could discover no cause for such a phenomenon.

While speaking of timber variation, I wish to notice the question of the succession of forests in Kentucky and to mention the results of some observations made by me in that direction.

In the report before referred to (vol. II, this series), I gave my reason for believing that the present forests of white oak will be supplanted, in the future, by black oak, red oak, Spanish oak, and such timbers, of which black oak will be the leading timber. Two questions present themselves to me in this connection for solution: 1. Is it merely the white oak that is supplanted by the black oak, while of other timbers each will

be succeeded by one differing from itself, but not necessarily black oak; or is black oak taking the place of all timbers alike? In other words, will the future forests of Kentucky consist of about the same timbers as the present forests, except that each timber will appear in the place of some other, and in a different locality, or will some one timber supplant all alike, and be the leading forest tree of Kentucky in the future? 2. In case it should be found that no regular rotation of forests is taking place, but that some one timber is supplanting all others, in what way can the present distribution of timbers be best secured?

In reference to the first question, I noticed that in all those localities along the Tradewater, if the immediate borders of the streams be excepted, where the white oak forests are now finest, but where the present timbers are fast disappearing on account of the drain constantly made upon them, that the undergrowth has about the same per centage of black oak that the present forest has of white oak—on an average about 40 per cent. Very little white oak, indeed, will appear in the future forest, even in regions where now it most appears. I then noticed carefully localities where the present predominant timber is black oak, red oak, post oak, or hickory, and in each case I found that the undergrowth contained from 25 to 40 per cent. of black oak, while no white oak at all appeared. It seems to be an inevitable conclusion, therefore, that the present valuable timbers of Kentucky are disappearing, and that the comparatively worthless black oak is to be the universally predominant tree of the future. This is not true of the hickory, of which there will be as large per centage in the future as there is in the present forests; while of white elm and white ash, on account of the comparatively small proportion of these timbers, except in somewhat low lands, I found it impossible to obtain data enough to warrant a conclusion. My opinion is, that they, too, will almost disappear when those in the present forest are removed or die down. Of the swamp timbers proper, such as sweet gum, sycamore, red elm, maple, etc., I see no reason to expect a change; but of the white oak

and liriodendron (yellow poplar), which, after all, are the great staple timbers of Kentucky, I believe the time will come, and that far sooner than those who have not investigated the subject suspect, when they will disappear entirely from our forests, unless some earnest effort is made to avoid such a calamity.

The second question then presents itself, viz: How can the present variety and distribution of Kentucky timbers be maintained? I have two methods to suggest, neither of which will, I fear, be acted upon until the people become alarmed at the condition of their forests, and show more energy in caring for and perpetuating them than they have shown in the past. One of these methods is to plant trees of the same kind as rapidly as the old timbers are cut away, or as the land is exhausted and "turned out," and to keep down other growths until the planted trees get a start. This needs no discussion. It is the method that *must* be adopted in introducing a new variety of timber into a forest, as well as in perpetuating some varieties. I believe that the black walnut, for instance, can be preserved only in this way.

The second method, which can be employed only where, as is the case to a large extent in Kentucky, the present forest is the kind desired, is perhaps the more available of the two. It is well known to all observers of timber growth, that if a tree be cut down toward the spring of the year, just before the sap begins to rise, a large number of shoots or "sprouts" will spring from the stump of the fallen tree. If those who are cutting timber to float out would cut as late in the winter as possible consistently with meeting the spring freshets, the sap rising in the stumps of the lately cut trees would cause this growth of shoots. Then if the undergrowth of the different varieties, which already have such a start as to soon smother the tender bushes springing from the stumps of the fallen trees, were merely cut away, these bushes would get such a start as to hold their ground, and the present forest timbers would be preserved in about their present proportions. This would really require very little labor; and, while I have never seen the experiment tried on a large scale, I believe it

would be entirely successful. Certainly, if the present forests of Kentucky can be preserved by so small an outlay of thought and labor now, it is of the highest importance to the people to see that this source of wealth to the State is not allowed to waste away. Otherwise, their descendants of a few generations hence will be compelled to go through the slow and laborious process of planting and cultivating those very timbers which are so abundant to-day, and which, by a little care on the part of their forefathers, might have been left to them as a rich inheritance.

#### SOME EFFECTS OF TIMBER CLEARING.

It is a lamentable practice in most farming regions of Kentucky, when a piece of ground becomes somewhat exhausted, to clear another piece and tear down the fence of the former to inclose the latter, leaving the worn-out lands exposed to the ravages of stock, in addition to washing rains. The consequence is, that cattle eat down each little bush or weed, on the lands thus suddenly exposed, as fast as it appears. As the soil has been lately cultivated, and is comparatively loose, a few heavy rains start myriads of "gullies" in the ground, whose only protection against such washes was removed by "turning the land out," and allowing the cattle to eat down the little herbage and bushes that might otherwise have cemented the surface soil. A few years of such exposure gives the "washes" such a start that no amount of care and labor can preserve the land from utter destruction. If one reflects upon how many farmers there are in Kentucky, and that the vicious system of culture pursued by them consists, in the greater part of the State, in thus clearing a piece of land, working it without manure or much rotation of crops, year after year, until exhausted, a process which, on an average, requires only five or six years, when they abandon it and clear new ground, one can realize how many acres of the land of Kentucky are thus annually "turned out." Aside from the destruction of valuable forests entailed by such a system of cultivation, the effects upon the soil and climate of the regions thus cleared are very

serious. Granted that in the course of years other forests will spring up in such districts, I have elsewhere shown that these new forests will be comparatively valueless, so far as the timbers are concerned. Of course, their presence would prevent the further washing of the soil and change of climate produced by barrenness, but nothing more. In fact, however, I see little hope of a worn-out soil thus exposed ever reclothing itself with timbers of any kind. Timber growth upon such exhausted soils is so slow that its battle with washing rains would be doubtful, even with the best protection that could be given it; but when to the washing of rains is also added the ravages and trampling of cattle, and other such things incident to a totally exposed piece of once cultivated soil, I believe that the chances of a new forest growth are exceedingly poor. I have myself seen a piece of exhausted land that had stood thus, as I was informed, for twenty years. In it I measured washes fourteen feet deep and twelve feet wide, while almost every square yard was crossed by a "rut" or "gully" of greater or less size. A few scraggy persimmon bushes occupied the still unwashed spots; but it seemed to me inevitable that the entire two hundred acres of once fertile ground would soon have its surface soil completely washed away. If the farming lands of Kentucky were level prairie lands, the facts here spoken of would not be so serious; but, on the contrary, the ground is hilly or rolling, and the effects of reckless destruction of forests on such lands are always fatal. I have not seen these effects better stated than in the *London Spectator* of June 16, 1877, which says:

"The evidence that the great floods which have from time to time, during the last half century, been so destructive in Switzerland, and in many districts of France and Italy, have been mainly caused by the felling of the forests on the high grounds, appears to be overwhelming. In the department of the Loire especially, it was universally remarked, that the wooded grounds suffered no change, while in the denuded districts, the whole soil of cleared and cultivated fields was swept away, and the rocks laid bare. The same was seen in

the upper Rhine in 1868. The clearings in the province of the Ardeche have produced the most melancholy results within the last thirty years, one third of its area having become barren; and new torrents had, in 1842, destroyed 70,000 acres of land, an evil which has been going on ever since that time. The denudation of the crests of the Vosges has done infinite harm in Alsace. Many places in Provence, rich and inhabited half a century ago, have become deserts. Thousands of torrents have been formed within the last dozen years on the southern flank of the Piedmontese Alps and in Dauphiny, and grassy slopes have been converted into stony chasms by the cutting of the woods above. In the department of the lower Alps, between 1842 and 1852, 61,000 acres went out of cultivation from this cause. In Italy, the demand for Italian iron during the wars of Napoleon I, the trade with England being cut off, necessitated vast cuttings of wood for fuel, and the effects are felt to this day, especially in the valley of the Po. In fact, there is scarcely a country on the continent of Europe in which the reckless destruction of forest has not been admitted, both in popular belief and by the verdict of science, to have been the cause of misery, of the amount of which the majority even of well-informed persons in England have little conception."

Change the names in this article to those of the hills and mountains of Kentucky, and the process now going on in our State will be startlingly described.

Another result of the reckless clearing up of forests and destruction of timbers is the effect produced upon the climate. I shall have little to say upon this subject, for it lies without the proper sphere of my inquiry. It is a fact, thoroughly proved by experience, that in the far West, as civilization pushes itself backward, clearing up the forests as it goes, the change in climate brought about in a few years is very marked. The winters grow bleaker and colder, the springs later, and the summers drier and more subject to alternations of violent storms and long droughts. The reason for this I believe to be as follows: Heavy forests produce two effects upon cli-



mate in winter—they break the cold, bleak winds that sweep over the country, and give it protection in that way; and they add actual warmth to it from what I believe to be the fact, that the temperature of a living tree never falls quite so low as that of the surrounding atmosphere in exceedingly cold weather. Let the difference be ever so slight, where a country is thickly studded with trees, each one a very little warmer than the atmosphere about it, the effect of the whole upon the climate will be very appreciable. In summer, too, where millions of trees are drawing up water from their deeply-set roots to be evaporated from the leaves, the atmosphere must always be more moist and pure than it would be were it to receive no such water supply to give back in dews at night. This moisture prevents, to some extent, the long droughts to which a country without forests is subject, and, added to the purity of an air washed in fresh dews nightly, tends to prevent the violent storms of wind and lightning which result from a long heated and impure atmosphere. I am well aware that Mr. Meehan, and others equally profound and scholarly, argue that “forests are the result, not the causes of climate,” and I am also aware that there are many obvious facts which point, in a certain degree, to that conclusion. Thus, for instance, one might mention the difference between a tropical forest and that of a temperate or frigid climate, or even point to the difference between timbers at different heights, and therefore different temperatures, on the same mountain. Such arguments, however, only go to show that certain timbers are best adapted to certain climates, and that originally there would be no forest at all on a piece of ground not naturally adapted to a forest growth, or that whatever forest did appear, would be the one best adapted to the soil, temperature, and other conditions of growth. But they by no means show, or tend to show, that a given wide range of country would be exactly the same, so far as climate is concerned, whether it were barren or covered with heavy forests. This subject, in its details, however, even were it properly a part of my discussion, is too complicated for further notice, and demands more investiga-

tion than I could give to it. A course of long and careful inquiry in this direction, by some able meteorologist and botanist, would be of almost incalculable benefit.

#### TIMBER IN DETAIL.

I shall now proceed to give in detail an account of the timbers to be found in the counties under discussion, and their local variations. In the immediate vicinity of Princeton the principal timbers noted were bartram oak, white ash, red oak, black oak, swamp white oak, sugar-tree (black), black hickory, white hickory, and liriodendron (yellow poplar). Bartram oak is seldom found, except in low, damp soils, or along streams; but near Princeton considerable quantities appear in a flat woodland quite high and dry. A large percentage of white ash also appears in the same woodland, which lies about one mile from Princeton. With the exception of this woodland, the timbers are mostly cleared away for two or three miles around. The formation is Sub-carboniferous limestone, of Chester Group on high ground, and of St. Louis limestone on low grounds.

In going toward Eddyville, the principal swamp or lowland timbers are, in addition to those given above, yellow birch, pin oak, sweet gum, white and red elm, sycamore, black walnut, and such small growth as flowering dogwood, pith elder, redbud (in small quantities), etc. These alternate with the hill timbers, which are white oak, black oak, scarlet oak, black hickory (scrub), post oak, etc., with some laurel oak, on both low and high grounds, though in the latter case it is always along fence-rows. There is probably 20 or 25 per cent. of white oak among the forest timbers here; but among the bushes and young trees little or no white oak is to be found. The timbers remain essentially the same in all the region of country between Princeton, Eddyville, and Milledgeville, the swamp timbers being quite good along South Fork and the other small streams in the neighborhood. There is little present drain upon the forests through here, except where the timbers are cut for local saw-mills.

About six miles from Princeton, and not far from the junction of the Hopkinsville and Parkersville roads, a very large spring gushes out from the base of a reddish limestone bluff. Scattered all over this bluff are cedars of various sizes, which I mention as a matter of curiosity rather than of value, as in no other place in this part of Western Kentucky have I seen a member of the coniferous order. A few water poplars (cotton trees) appear along the streams between Princeton and Eddyville, but they are scattering. On the southern slopes of the low hills near Eddyville the white oak is quite good, but not remarkable. Along the Cumberland river, in addition to the timbers already given, hackberry, shag hickory, and honey locust appear. There is quite a marked change in the timbers on the long slopes facing the Cumberland river, near Eddyville. They become very heavy and fine, though the most valuable of them have been cut out. The reason of such change is, that we here pass from the loose rocky or poor shaly limestone of the Chester Group, which is found all along the high ridge road for two or three miles, until the cavernous St. Louis limestone bordering the river is reached.

Another peculiarity noticed in the report in volume II, this series, observation all through this Sub-carboniferous formation confirmed: that is, that the *liriodendron* (yellow poplar) does not grow on the upper or shaly Chester. If found there at all, it is very scattering, as well as dwarfed, and of no value. The dryness and thinness of the upper Chester soil is doubtless the cause of its absence.

After leaving Eddyville and turning toward Dycusburg, one passes from the St. Louis limestone into the thin Chester of the ridges again. *Liriodendron* almost wholly disappears, except on streams, and but little white oak is found for some miles. Bartram oak, some hackberry, white walnut (so characteristic of the Ohio river regions), sycamore, white and red elm, etc., are found along the streams; but the forests are not very valuable between Eddyville and Dycusburg. From this statement we may except the post oak, which forms 40 per cent. of the ridge timbers, and which is now used in making hubs

for heavy wagons. But I noticed that on these ridges the undergrowth was largely black oak and scarlet oak, which seem to be replacing even the post oak. On the limestone formation along Livingston creek there has once been a considerable amount of liriodendron timber; but that has been cut away, so that scarcely any is now to be found.

In going from Dycusburg back toward the head waters of the Tradewater river, there are some very fine bodies of timber, especially white oak and liriodendron. Along all the small streams and on low grounds, as well as on high grounds in some localities, these timbers are found in great abundance, forming together about 50 per cent. of the forest trees, and are massive and valuable. The liriodendron timber here spoken of, though, does not appear until the cavernous St. Louis limestone, within about four miles of Fredonia, is reached; but from this place to Fredonia there is little variation in size, value, or quality of the timbers. They consist of white oak, black and shag hickory, liriodendron, Spanish oak, black oak, and red oak, with bartram oak, white and red elm, beeches, sugar maple, black gum, sweet gum, and small quantities of honey locust and black walnut at a less height above water level. These timbers remain essentially the same for about three miles beyond Fredonia toward Dalton (formerly Garnettsville), where we pass from the limestone to a coarse, reddish, Sub-carboniferous sandstone, the country becomes quite hilly and broken, and the timbers grow more or less strongly marked into upland and lowland timbers, the two alternating with reference to height above drainage. Even on Sinking Fork of Livingston creek, four miles from Fredonia, no limestone is found. The timbers are the usual swamp ones—swamp white oak, white oak, pig and shag hickory, red and white elm, bartram oak, some white ash, etc. These become very fine about six miles from Fredonia, all along the foot-hills, while the ridges furnish post oak, black oak, scarlet oak, black hickory, and other timbers more or less scrubby. The forest, after leaving Fredonia, cannot be considered very valuable until Donaldson creek is reached,

fully ten miles from Fredonia. There are local spots of valuable timbers, but they are in a hilly, out-of-the-way part of the country, and are not available. The Donaldson creek region cannot be said to be convenient of access, but probably before many years the branches that form its head waters will be penetrated for the old forest walnut that is still scattered along them. These walnut trees vary from twenty to forty inches in diameter—one I noted measuring five feet in diameter, with a straight trunk of sixty feet. But they are largely cut away, even now, to supply local demand. The white oak and less valuable timbers need scarcely be taken into consideration in this locality, as no exigency of the near future is likely to compel a resort to resources so remote from means of transportation. It is enough to say, that along all the streams and branches which go to make up the head waters of Tradewater river white oak, bartram oak, liriodendron (yellow poplar), white and black ash, shag and pig hickory, with more or less white hickory, black walnut, red and white elm, and sweet gum, are found, most of them in great abundance and of the finest kind in size and quality. The hills are covered with post oak, black oak, Spanish oak, and the usual hill timbers.

After turning down Tradewater river from Dalton (erroneously marked on the preliminary map "Chalk Level"), not a great deal need be said in a cursory view of the timbers. The sectional tables, which commence on page 23, will have to be relied upon largely for an accurate knowledge of the nature and distribution of the timbers. The rate at which the forests are now cut away could not be exhibited accurately in tables, but that has already been noticed; so I shall do no more here than to note briefly special points of interest connected with the timbers on the Tradewater river between Dalton and the Ohio.

On Lick creek, a few miles above Dalton, among the finest sweet gums found in Kentucky are noted, varying from two and one half feet to four feet in diameter; shag hickory from three feet to three and one half feet in diameter, white oak three and one half feet, and liriodendron four feet, are also

found in great abundance. The formation is a wide and marshy swamp in the coal measures. Black walnut is scarce, and pin oak is large and noticeable immediately on the creek. After crossing Lick creek one enters the splendid "belt" of timbers elsewhere noticed. The ground is high, level, sandy, and moist. The liriodendron and white oak are unsurpassed, and the white, shag, and pig hickories and white ash are of the finest. Bartram oak, which usually grows on low or moist grounds, flourishes. The undergrowth is composed principally of hickory and black oak, of which about equal proportions exist. I have only noticed one other location in Kentucky, of any considerable extent, where the black oak has a rival for the first place among the undergrowth.

On Clear creek a great deal of swamp laurel oak is found, often twenty-six inches in diameter. Near Providence the fine "belt" timber gives out again, one passes from the high, level, sandy soil onto a rolling formation, whose foot-hill timbers are largely white oak, which gives way to post oak, black oak, scarlet oak, and black hickory toward the hill-tops. But little change is noted in the timbers until Crab Orchard creek is crossed. Then one traverses a flat, white, sandy level, where Spanish oak, red oak, post oak, and black hickory form the entire forest. The belt is narrow, and the normal timbers are met with after crossing it. It is worth notice that the western cottonwood is found on Crab Orchard creek, where also the white ash is very fine.

After crossing Crab Orchard creek the road is almost imperceptibly ascending, and one soon reaches the top of a high, level ridge, varying from one to three miles in width, which forms a water-shed that lasts nearly to the Ohio river, with one or two streams cutting across it between Crab Orchard creek and the Ohio. Along the foot-hill exposure of this ridge toward Tradewater the white oak, liriodendron (where it is not cut away), white ash, sweet gum, and other valuable timbers abound. Along the road itself, owing to the naturally high position above drainage, a change of level of a few feet is sufficient to make the white oak give way to post oak and

black oak, or *vice versa*. The white oak is found only in little depressions along the road. After reaching the high hills and deep hollows, upon nearing the Ohio river, the same change of timber with the height above drainage takes place, the only difference being that it takes a much greater change of level to produce a corresponding change in the timbers.

## TIMBER TABLES.

The following tables are given consecutively in the order in which they were taken. The area represented by a table varies from twenty-five hundred square yards to five thousand square yards, more or less.

I call a tree decayed where large and prominent branches are dead, or where the body of the tree is not sound, or where it shows general evidences of unsoundness.

Name.	Number.	Average diameter.	Number dead.	Number decayed.
Bartram oak . . . . .	4	26 inches.	1	1
Red oak . . . . .	4	23 "	0	1
Black oak . . . . .	2	26 "	0	1
Swamp white oak . . . . .	2	18 "	0	0
White ash . . . . .	7	20-28"	1	1
Sugar maple . . . . .	2	24 "	0	0
White hickory . . . . .	2	16 "	0	0
Black hickory . . . . .	1	26 "	0	0

Location, flat woods near Princeton; formation, St. Louis limestone; undergrowth very scarce.

Name.	Number.	Average diameter.	Dead.	Decayed.
Sugar tree . . . . .	15	20 inches.	1	3
Scarlet oak . . . . .	5	19 "	0	1
White hickory . . . . .	3	small.	0	0
White elm . . . . .	3	18 "	0	1
Black walnut . . . . .	3	1-20 "	0	1
Redbud . . . . .	1	14 "	0	1
Sycamore . . . . .	3	small.	0	0

Location, a creek swamp four miles from Princeton. Liriodendron trees are in the vicinity, though not in the section.

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
Black oak . . . . .	17	18 inches.	4	0	2
Scarlet oak . . . . .	2	17 "	0	0	0
Black jack . . . . .	6	14 "	0	0	1
Post oak . . . . .	4	16 "	0	0	1
Black hickory . . . . .	2	14 "	0	0	0

Among the smaller timbers are black gum, flowering dogwood, and pig hickory, with a great deal of upland laurel oak in spots. White oak does not appear in the locality. Location high, level, limestone formation, about seven and one half miles from Eddyville. Cut timber means timber more or less freshly cut; otherwise it would be impossible to classify it.

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
White oak . . . . .	25	23 inches.	8	1	3
Red oak . . . . .	2	20 "	0	0	0
Black oak . . . . .	1	18 "	0	0	1
Liriodendron (poplar)	4	18 "	2	0	0
Pig hickory . . . . .	2	20 "	0	0	0

Dogwood, sassafras, black gum, etc., are small growths. Among the undergrowth black oak and white oak are in the proportion of two to one; while in the old growth it will be noticed their proportion is one to twenty-five. Location, a hill sloping 6° south, situated about five miles from Eddyville.

Name.	Number.	Average diameter.
Black oak . . . . .	22	16 inches.
Spanish oak . . . . .	16	12 "
Scarlet oak . . . . .	7	10 "
Post oak . . . . .	2	
White oak . . . . .	1	

Location, about four and one half miles from Eddyville, on Dycusburg road. The forest out so far is nearly altogether second growth, and the character of the timbers is worthy of



notice, as indicating the nature of the forest that will succeed the one now passing away.

Name.	Number.	Average diameter.	Dead.	Decayed.
Post oak . . . . .	14	17 inches.	0	3
Black oak . . . . .	6	16 "	1	1
Scarlet oak . . . . .	7	14 "	0	2
White oak . . . . .	1	16 "	0	1
Pig hickory . . . . .	1	14 "	0	0
Black hickory . . . . .	2	13 "	0	1

Location, a long-rolling, upper Chester formation, about three miles from Dycusburg. Absence of liriodendron (yellow poplar) on the upper Chester is to be noted.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak . . . . .	14	28 inches.	2	3
Post oak . . . . .	2	18 "	0	1
Black hickory . . . . .	5	20 "	0	1
Pig hickory . . . . .	1	18 "	0	0
Liriodendron (poplar) . . . . .	1	28 "	0	0

White elm, black gum, sassafras, etc., are small growth. Black oak forms 50 per cent. of the undergrowth, although it does not appear in the old growth. Location, a foot-hill about three miles from Dycusburg, on the Fredonia road.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak . . . . .	15	32 inches.	1	2
Liriodendron (poplar) . . . . .	9	38 "	0	2
Black oak . . . . .	3	30 "	0	1
Shag hickory . . . . .	1	28 "	0	0
Pig hickory . . . . .	3	26 "	0	0
White ash . . . . .	1	28 "	0	0

Location, three miles from Fredonia; formation, cavernous, St. Louis limestone, overlaid by a reddish clay. Land very rich. Timber remains heavy on to Fredonia.

Name.	Number.	Average diameter.	Dead.	Decayed.
White oak . . . . .	13	18-30 inches	0	3
Spanish oak . . . . .	5	20 "	0	2
Black oak . . . . .	1	18 "	0	0
Liriodendron (poplar) . . . . .	2	20 "	0	0
Shag hickory . . . . .	1	16 "	0	0
Black locust . . . . .	1	20 "	0	0

Black gum, dogwood, mulberry, and sycamore form the less important timbers.

Location, a foot-hill about three miles from Fredonia, on Dalton road, near a small branch, which forms the dividing line between the limestone and a Sub-carboniferous sandstone. All through to Donaldson creek the timbers are heavy and fine, and a large proportion of white ash is found.

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
White oak . . . . .	17	36-50 inches	6	0	2
Red oak . . . . .	2	26 "	1	0	0
Liriodendron . . . . .	5	30 "	2	0	1
White ash . . . . .	4	18 "	0	0	1
Black hickory . . . . .	4	20 "	2	0	0
Pig hickory . . . . .	1	22 "	0	0	0
Sugar-tree . . . . .	1	20 "	0	0	0

Black walnut, black oak, and white elm are found in the locality. Formation, the sandstone of the coal measures. Location, hill slope, south exposure, just after crossing Lick creek, and on the border of the "belt" of fine timbers spoken of elsewhere.

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
White oak . . . . .	8	26 inches.	1	0	2
Black oak . . . . .	3	20 "	0	0	0
Pig hickory . . . . .	6	18 "	1	0	0

Liriodendron is found in the locality, though all the timbers here are below the average in the country. Location, near Providence, after crossing the "belt" of fine timbers.

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
White oak . . . . .	22	23 inches.	6	0	1
Red oak . . . . .	1	21 "	0	0	0
Pig hickory . . . . .	6	22 "	0	2	1
Shag hickory . . . . .	2	21 "	0	0	0
Black gum . . . . .	4	14 "	0	0	0

Among the undergrowth black oak and white oak are found in the proportion of six to five; but this comparatively large per centage of white oak in the undergrowth is local. Location, a foot-hill about eight miles from Providence.

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
White oak . . . . .	13	28 inches.	5	0	2
Spanish oak . . . . .	7	23 "	0	0	2
Black oak . . . . .	1	20 "	0	0	0
Liriodendron . . . . .	9	21 "	4	0	0
Shag hickory . . . . .	3	22 "	0	0	1
Pig hickory . . . . .	2	21 "	0	0	0
White elm . . . . .	2	18 "	0	0	0
White ash . . . . .	2	23 "	0	0	1

This is a section of a foot-hill about twelve miles from Caseyville; the following is a section about midway up the same hill, and the last is a section on the hill-top. The three are given to show the gradations of the timbers according to height above drainage:

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
Black oak . . . . .	12	19 inches.	0	0	2
White oak . . . . .	3	20 "	0	0	0
Spanish oak . . . . .	5	20 "	0	0	1
Post oak . . . . .	4	18 "	0	0	1
Black hickory . . . . .	3	20 "	0	0	0
Pig hickory . . . . .	1	19 "	0	0	0

Name.	Number.	Average diameter.	Cut.	Dead.	Decayed.
Post oak . . . . .	15	16 inches.	0	0	4
Black oak . . . . .	5	17 "	0	0	2
Black hickory . . . . .	3	15 "	0	0	0

The gradation of white oak into black oak, and black oak into post oak, as leading timbers at different heights above drainage, is well marked. Of the young growth, black oak is the leading timber in all three positions. The hill here given is a good representative of the timbers between this point and the Ohio river.

The numbers given in the foregoing tables include the numbers *cut* also, so that the proportions of sound, decayed, cut and uncut timbers, can be readily seen. Of course, no generalizations from these tables could be relied upon as perfectly accurate; for it is impossible, even with the utmost care, to choose a plot of ground whose timbers are perfectly representative of the locality. Still, the tables were prepared very carefully, and any generalizations made from them can be relied upon as accurate enough for ordinary purposes. By a small amount of computation, a great deal of interesting and important information can be gained from them. I give below a table which shows, at a glance, some of the most important inferences to be drawn from the preceding tables:

Name.	Per cent. un-cut.	Per cent. cut.	Per cent. dead.	Per cent. decayed.
White oak . . . . .	70+	30 nearly.	1.1+	8 +
Liriodendron (poplar). .	70	30	Less than one.	10
White ash . . . . .	99 nearly.	1 +	7 +	14 +
Hickories . . . . .	94.6 "	5.4+	3.6+	7.2+
Post oak . . . . .	100 "	Less than one.	Less than one.	24.4 nearly.
Black oak . . . . .	94.4+	5.5+	1.4 nearly.	14 "
Red oak . . . . .	88 +	11 +	Less than one.	11 +
Spanish oak . . . . .	100 "	Less than one.	Less than one.	18.2
Scarlet oak . . . . .	100 "	Less than one.	Less than one.	14 +

From this table we learn that, so far, at least, as this part of Kentucky is concerned, the hickories are the soundest timbers, and next to them ranks the white oak, while the post oak furnishes the largest per centage of unsound timber. I suspect the reason for this to be, that the post oak is a hill growth almost entirely, and among all timbers there are more decayed branches and unhealthy trunks on high ground than on low ground. This view is partially sustained by the fact,

that although so large a per centage of the post oak timber is decayed, a smaller proportion of it is actually dead than of either hickory or white oak—the two soundest timbers. Few would expect to find the white ash furnishing the largest per centage of dead timbers, but such is the fact. The comparative scarcity of the white ash conceals the relatively large proportion of it that is dying. The most important fact to be noticed in this table, however, is the large amount of white oak and liriodendron that has been cut away within a few years. The loss of thirty per cent. of these two valuable timbers within so short a time, taken in connection with the fact previously noticed, that other timbers are supplanting them as fast as they are destroyed, is alarming. I deem it sufficient merely to call attention to the present rate of loss of the white oak and liriodendron. Any one can realize the calamity which would ensue were they lost altogether to the Kentucky forests.

#### SUMMARY.

The results of a careful study of the timbers in the counties under discussion may be summarized as follows:

1. The valuable walnut has been, to a great extent, cut out, but some is still found along the heads of the streams that help to form the upper Tradewater river, as well as high up on most streams that flow into it.

2. White oak is found all along the streams and branches of this part of Kentucky, as well as along the foot-hills and on low grounds generally. In many localities, even the hill-tops are covered with it; but, generally speaking, it does not extend high up the hill-sides. The best of that in the immediate vicinity of Tradewater river has been cut and floated out, and the present drain upon the timber is directly proportional to its convenience for transportation. That which is available without much expense will, at the present rate of demand, be exhausted in the not distant future.

3. The ash is not very plenty, and is scattered generally through the forest on rich spots of ground. There is a

good deal of white ash, but it is widely scattered and does not seem so plenty as it really is.

4. The liriodendron, which is so valuable a timber tree, has largely disappeared from the neighborhood of streams capable of floating it out. Even on the smallest streams, local mills are using it up rapidly. I was informed that the forests were once full of it, where now scarcely a tree is to be seen for miles. Great apprehension is to be felt of a want of this timber even in the near future.

5. White elm is found along all the tributaries of the Trade-water, and is tolerably plenty. I had no means of determining its probable proportion in the future forests.

6. Post oak is plenty, covering all the hills through this part of Kentucky, and extending far down toward the foot-hills. There is no need to fear a dearth of it for years to come, though it does not seem to hold its own in the coming forests.

7. No chestnut is to be found in this part of Kentucky. As it exists in great plenty in other parts of the State, on exactly similar geological formations, I could see no reason for its absence.

#### COMPLETE LIST OF TIMBERS FOUND.

##### ORDER CUPULIFERÆ—MASTWORTS.

##### 1. *Genus Quercus.*

- White oak, *Quercus alba* (L.)
- 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.)
- Black jack, *Q. nigra* (L.)
- Chestnut oak, *Q. castanea* (Muhl.)
- Scarlet oak, *Q. coccinea* (Wang.)
- Bartram oak, *Q. heterophylla* (Mx.)
- Swamp white oak, *Q. bicolor* (Willd.)
- Laurel oak, *Q. imbricaria* (Mx.)
- Swamp laurel oak, *Q. laurifolia* (Mx.)

2. *Genus Fagus.*Common beech, *Fagus sylvatica* (L.)Red beech, *F. ferruginea* (Ait.)3. *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.*Shagbark hickory, *Carya alba* (Nutt.)Mockernut, *C. tomentosa* (Nutt.)Pignut hickory, *C. glabra* (Sorr.)White hickory, *C. microcarpa* (Nutt.)

## ORDER SILICACEÆ—WILLOWWORTS.

1. *Genus Salix.*Basket osier, *Salix riminalis* (L.)Green osier, *S. petiolaris* (Smith.)2. *Genus Populus.*Cotton tree, *Populus angulata* (Ait.)Silver-leaf poplar, *P. alba* (L.)Balm of gilead, *P. candicans* (Ait.)

## ORDER ACERACEÆ.

1. *Genus Acer.*Red maple, *Acer rubrum*.White maple, *A. dasycarpum* (Ehrh.)Sugar maple, *A. saccharinum* (L.)Black sugar maple, *A. nigrum* (Mx.)2. *Genus Negundo.*Box elder, *Negundo aceroides* (Moench.)

## ORDER ULMACEÆ—ELMWORTS.

1. *Genus Ulmus.*Red elm (slippery elm), *Ulmus fulva* (L.)White elm, *U. americana* (L.)Winged elm (Whahoo), *U. alata* (Mx.)2. *Genus Celtis.*Hackberry, *Celtis occidentalis* (L.)

## ORDER 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.)

## ORDER BETULACEÆ—BIRCHWORTS.

1. *Genus Betula.*  
Red birch, *Betula nigra* (Ait.)  
Yellow birch, *B. excelsa* (Ait.)
2. *Genus Alnus.*  
Smooth alder, *Alnus serrulata* (Willd.)

## ORDER ROSACEÆ.

1. *Genus Cerasus.*  
Black cherry, *Cerasus serotina* (D. C.)  
Red cherry, *C. pennsylvanica* (Ait.)
2. *Genus Cratægus.*  
Hawthorn, *Cratægus oxycantha* (L.)

## ORDER LEGUMINOSÆ.

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

## ORDER OLEACEÆ—OLIVEWORTS.

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

## ORDER CAPRIFOLIACEÆ.

1. *Genus Sambucus.*  
Pith elder, *Sambucus Canadensis* (L.)
2. *Genus Viburnum.*  
Black haw, *Viburnum prunifolium* (L.)



## ORDER ANACARDIACEÆ—SUMACHS.

1. *Genus Rhus.*

- Smooth sumach, *Rhus glabra* (L.)  
 Large sumach, *R. typhina* (L.)

## ORDER PLATANACEÆ—SYCAMORE.

1. *Genus Platanus.*

- Sycamore, *Platanus occidentalis* (L.)

## ORDER MAGNOLIACEÆ.

1. *Genus Liriodendron.*

- Tulip tree (called yellow poplar), *Liriodendron tulipifera* (L.)

## ORDER LAURACEÆ—LAURELS.

1. *Genus Sassafras.*

- Common sassafras, *Sassafras officinale* (Nees.)

## ORDER ARTOCARPACEÆ.

1. *Genus Morus.*

- Red mulberry, *Morus rubra* (L.)

## ORDER HAMAMELACEÆ.

1. *Genus Liquidambar.*

- Sweet gum, *Liquidambar styraciflua* (L.)

## ORDER SAPINDACEÆ—SOAPWORTS.

1. *Genus Æsculus.*

- Ohio buckeye, *Æsculus glabra* (Willd.)

## ORDER BIGNONACEÆ.

1. *Genus Catalpa.*

- Catalpa, *Catalpa bignonioides* (Walt.)

## ORDER BERBERIDACEÆ.

1. *Genus Berberis.*

- Berberis, *Berberis vulgaris* (L.)

## ORDER ANONACEÆ.

1. *Genus Asimina.*

- Common papaw, *Asimina triloba* (Dunal.)

## ORDER EBENACEÆ.

1. *Genus Dyospyros.*

- Persimmon, *Dyospyros Virginiana* (L.)

## ORDER ERICACEÆ.

1. *Genus Oxydendrum.*Sorrel tree, *Oxydendrum arboreum* (D. C.)

## ORDER CONIFERÆ.

1. *Genus Juniperus.*Red cedar, *Juniperus Virginiana* (L.)