

TEXAS AGRICULTURAL EXPERIMENT STATION.

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MAY, 1890.

PEAR STOCKS.

SOME PARASITIC FUNGI OF TEXAS
WITH NOTES.

AGRICULTURAL AND MECHANICAL COLLEGE,
College Station, Brazos County, Texas.

BY ORDER OF THE COUNCIL: F. A. GULLEY, DIRECTOR.

Illustrated



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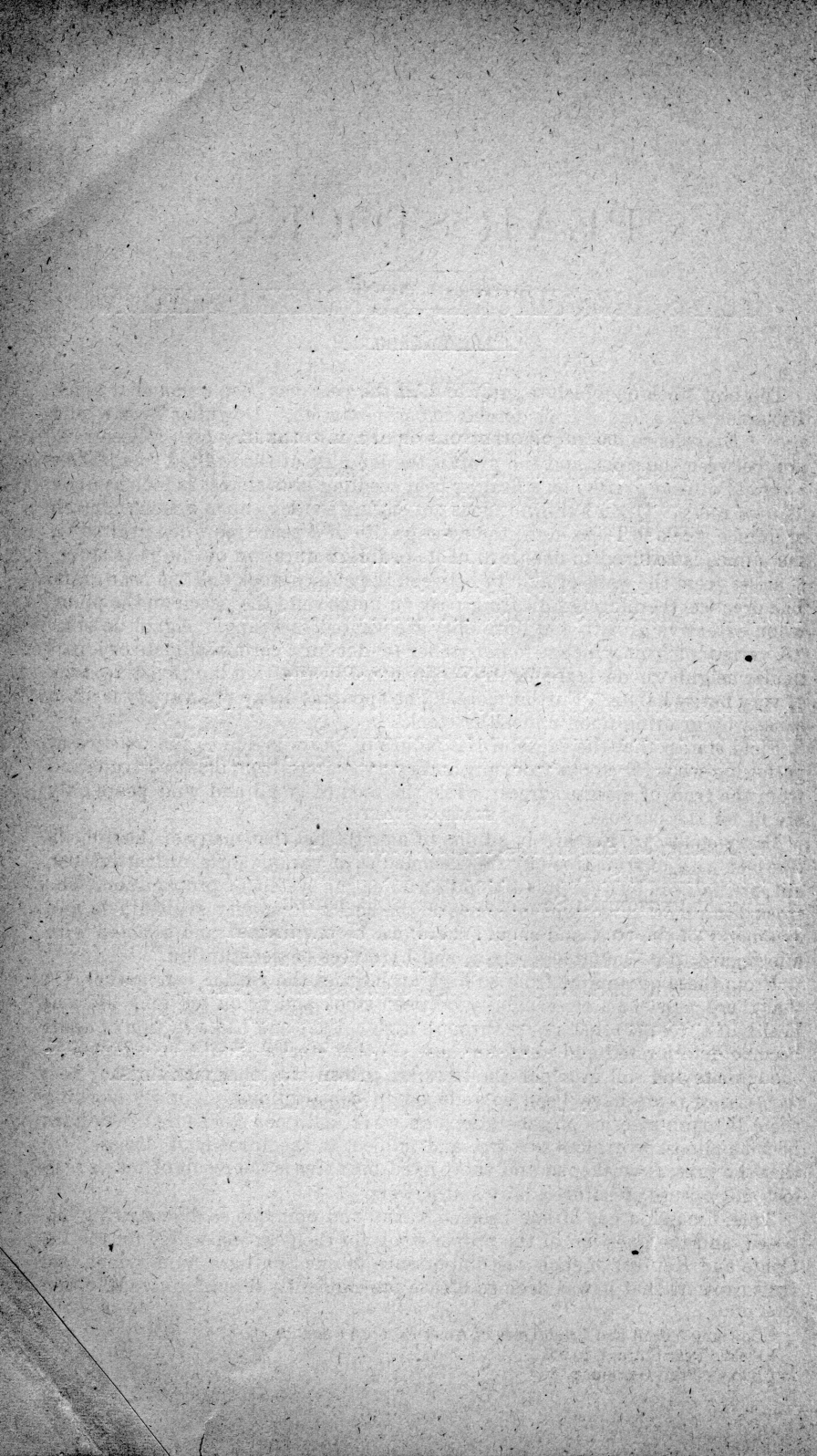
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PEAR STOCKS.

BY THOS. L. BRUNK.

MAY, 1890.

The best stock on which to graft or bud the pear has been a theme of much discussion and a line of considerable experimentation. Downing* wrote long ago: "Experience has proved that in proportion to the likeness or close relation between the stock and the graft is the long life of the grafted tree. Thus a variety of pear grafted on a healthy pear seedling lasts almost as long as upon its own roots. Upon a thorn it does not endure so long; upon a mountain ash or quince stock still less, until the average life of a pear tree when grafted on the quince is reduced to one-third of its ordinary duration on the pear stock. It arises from the want of affinity between the quince stock and the pear graft. The practice, therefore, of grafting pear on quince and the peach on the plum, when extensive growth and durability are wanted, is wrong." Again he says: "A variety of fruit which is found rather tender for a certain climate or a particular neighborhood, is frequently acclimatized by grafting it on a native stock of very hardy habits." Furthermore, "The apparent decay of a variety is often caused by grafting upon unhealthy stocks."

Field states† that the cause of the failure of pears is due to the practice of gathering seeds for stocks from any and every source; from diseased fruits and from the fruit of diseased trees; while the seed of small and wild pears only are fit for the purpose.

Barry states‡ "It scarcely admits of a doubt but that many of the difficulties met with in fruit tree culture, as maladies of various sorts, unfruitfulness, etc., are induced by a careless and indiscriminating system of propagation. The stock has a most important influence on the health, longevity, fruitfulness, and symmetry of the tree, and should therefore be propagated and selected with due regard to its soundness, vigor, and hardness of constitution."

From these quotations from so high authorities the reader can gather, (1) that there must be a close affinity between stock and scion for long life and health of a tree; (2) that stocks through high culture and bad selection of seeds become deteriorated and unfit for use; (3) that stocks should be adapted to the climate and soil in which the trees are grown; (4) that many of our best varieties of pears have been so reduced in constitutional vigor by working them through a series of generations on weak and poor stocks that they have become almost worthless as a tree and subject to the inroads of disease; (5) that the present weakened and short lived pear tree is the result of man's neglect and misuse of nature's laws and powers.

This discussion has of late been so warm, and opinions so diametrically opposed, and the question of the proper stock for the pear (especially for the Le Conte and Keiffer) of such vast importance to our Southern nurserymen and fruit growers that it was deemed a case pre-eminently fitted for careful obser-

* Downing's Fruit and Fruit Trees of America, pp. 11 and 29.

† Field's Pear Culture, p. 90.

‡ Barry's Fruit Garden, p. 80

vation and experimentation. Last fall the work was begun by making a number of visits to orchards in several parts of the State, and by sending out letters of inquiry to all parts of the State and throughout the South. During the past winter all the stocks on which pears are "worked" as standards were procured and placed in the experimental grounds, and on them were worked the LeConte and Keiffer and several other pears. The stocks include the LeConte and Keiffer grown from cuttings from "pedigree" trees, French seedling pears, Mikado pear seedlings, and apple seedlings. The grafts were made so as to force the scion in every case to grow on the roots of the stock only. These grafts are all growing nicely, and we will be able to throw more light on this subject, or prove the conclusions drawn in this bulletin, which is only a report of our observations and the testimonials we have received from experienced growers. While I may answer other questions more or less, yet the one of first importance to decide is which is the best stock for the LeConte and Keiffer pear trees, the Oriental (i. e. the LeConte or Keiffer on their own roots) or the French pear seedling. Before going into the details of our observations, I will state briefly the claims of the advocates of both these stocks.

The claims of the friends of the French pear seedling or well grown American pear seedlings from European pear seed as a stock for the Le Conte and Keiffer pear trees are as follows:

1. The trees make fully as good growths as those grown on their own roots.
2. They come into bearing one or two years sooner.
3. They are fully as prolific or more so.
4. They do not sucker or sprout from the roots any more than other fruits on seedling stocks of the same species.
5. Are less subject to blight.
6. The affinity between Oriental pears and the French stock is close, but the Oriental pear being a more vigorous grower than the American or European pears, they influence the stock to the extent of forming enlargements, which do no harm.

The friends of the "pedigree" Le Conte and Keiffer stock for these two pears claim:

1. That these pears on their own roots make a far better and more uniform growth than those on French stock.
2. That while they do not always come into bearing quite as soon as a rule as those on the French stock, yet when they do begin to bear they produce more per tree, and continue to increase year after year, while those on French stock die early and do not bear uniformly, some bearing profitable crops and others none.
3. That those on their own roots never sucker from the roots, while the sprouts from the roots of the French stock are so numerous and persistent that they become a great nuisance to the cultivator, necessitating high pruning to get at them.
4. That those on French stock are more subject to disease than those on their own roots.
5. That the affinity of the French stock for the Oriental pear is not close, as the stock becomes much enlarged below the place of graft, and also throws out excrescences of abnormal tissue near the top of the stock.

After visiting a number of orchards in North, Central, and Southern Texas and examining the roots (often over three feet below the surface) of grafted and ungrafted trees, removing some entirely from the soil and splitting open the trunk and finding the original graft, noting the comparative growth between trees of the same age and under the same treatment, and making a few sketches of specimens showing the exact conditions of stock and scion after

several years' growth, I am able to give what I believe to be a pretty full exposition of the facts involved in this question.

The first important fact to be noted from my observations is that where the Le Conte or Keiffer were grafted upon the French stock or apple stock, and were set deep enough, the scion invariably threw out its own roots; and from the various stages of growth examined I found that the scion made an effort proportionate to its strength and hold upon the soil to throw off the stock, and in several cases had succeeded in doing it, as is shown in Figures 2, 4, and 7, pages 12, 13, and 14. It had almost thrown off the apple stock, as shown in Figure 3, page 12.

This tendency to make its own roots and discard the French stock and grow thriftily when the point of graft is set below the surface of the soil has led some to the erroneous belief that the Le Conte grows as well on the French stock as on its own roots. The proportion of French roots to the Le Conte roots could in every case be told by the growth of the tree, for in every case where the French roots were present the growth of the tree was less than those on their own roots only.

It is no sign or proof that a tree is growing on a particular stock simply because it was grafted upon it. We have two Clapp's Favorite trees here some fourteen years old and both grafted on the quince stock. One of them has about two-thirds of its own roots, and the other has nearly all quince roots. The first one is far larger than the one depending on the quince stock for a food supply. It seems clear to me that it is far better, and in fact the only right way when vigor and growth are considered, either to grow the Le Conte and Keiffer from cuttings, or side graft a piece of a root of a pear or apple seedling to support the cutting till it sends out its own roots, and in the fall when removed from the nursery, cut off the grafted root.

It is a grave mistake to believe, as Wickson states,* that roots from a cutting spread out horizontally and irregularly in all cases and do not give the tree a deep, strong hold on the soil. This is especially so with the Le Conte pear. I have seen roots from Le Conte cuttings at the end of the first season that had penetrated the hardest joint clay to a depth of over four feet and at nearly a vertical angle. By comparing Figures 3, 5, and 7, pages 12, 13, 14, with Figure 4, page 12, it will be seen that the Le Conte penetrates the soil at a more vertical angle than the Keiffer.

The second feature of growth observed was that where the Le Conte and Keiffer and other varieties were planted so shallow that they were forced to grow upon the French or apple stock, that the stock outgrew the scion in every case, forming an ugly enlargement (Figs. 1 and 6, pp. 11 and 14) from the point of graft downwards, and in all cases they threw up sprouts (see Figs. 1 and 6). These sprouts make it difficult to cultivate an orchard, as an incessant amount of labor is necessary to keep them down, and it requires high pruning of the limbs that they may be reached.

Another peculiar growth, that proves more than any other the lack of affinity between the Le Conte scion and French stock, are excrescences thrown out on the top of the stock. These are bunches of abnormal growths of both bark and wood, often nearly as large as a hen's egg. Such growths never occur where the circulation of the sap is not impeded in some way. They are not the work of insects, as there are no signs of their presence. They were observed only on the Le Conte and Keiffer grown on French stock. I was told that not long after these growths appeared the roots died and the trees above remained green to the last.

*California Fruits, p. 101.

These enlargements and excrescences are certainly signs of non-affinity.

Lindley,* one of our highest authorities, says: "Whenever the stock and graft or bud are not perfectly well suited to each other, an enlargement is well known always to take place at the point of their junction, and generally to some extent either above or below it." It will be noticed, in reading the opinions of the correspondents appended, that they are nearly unanimous in believing these enlargements to be signs of non-affinity.

In the third place, it was observed that grafted trees *forced to grow only on the French stock* were far less vigorous and less uniform in their growth than those on their own roots. Some of the grafted trees are more than double the size of other grafted ones, while those on their own roots are symmetrical and uniform to a high degree. As to time of coming into bearing and prolificness of grafted and ungrafted Le Conte and Keiffer trees, there is no doubt that the grafted tree bears younger in most localities, but it never bears as heavily as the tree on its own roots. The time when the Le Conte on its own roots begins to bear varies with the conditions of soil, latitude and culture. I found Le Conte trees in North Texas on their own roots struggling for an existence on ground which consisted of about twenty inches of a sandy loam over a reddish yellow clay, with considerable sand intermixed. This subsoil was wet and soggy, although it had not rained for over four weeks. The roots of the Le Conte trees in this soil did not spread out in the sandy soil (see Fig. 5) as did several Keiffers near by, but plunged down into the wet clay, the first root being fourteen inches from the surface. Only two of the six Le Conte trees that had been set ten years before remained. They had never borne but few pears. They had all been attacked by pear blight, and those that remained were badly affected. But the roots at a depth of three feet had a black epidermis, and in many places were covered with a fungous growth, apparently saprophytic. No doubt all of these trees were affected at the roots first. Near by these Le Contes were some eight-year old Keiffers that had been grafted on the French stock. But after a careful examination of the roots and collar, no sign of the French stock could be found. The trees had formed their own roots, killed and thrown off the French stock, spread their roots out into the soil (as shown by Fig. 4), had borne heavy crops for several seasons, and had not blighted. It seems evident that the whole difference in growth between these Le Contes and Keiffers, apparently under the same conditions, was due to the fact that they fed entirely in two different fields, as it were, although one was on top of the other. The one lived in the rich loose soil, the other in the wet subsoil. The same subsoil, if well drained, will no doubt raise good Le Conte trees. The owner of these trees, Dr. W. W. Stell, in his letter on page 17, states that 25 per cent of his young grafted Le Conte trees are affected with what he believes to be root-rot. These trees were all set deep and have formed their own roots, which, like all Le Conte roots, have gone down into the subsoil. On his place it seems to hold too much water too near the surface, and the trees die. The soil is deep, and the apple trees, etc., he speaks of surrounding the orchard spread their roots out like the Keiffers, above, and therefore thrive.

On the other Le Conte trees on their own roots, in Central Texas, at Nava-sota, about two hundred miles south of these mentioned above, on a similar top soil, but not so deep, and having a heavy joint clay subsoil with a better natural drainage, on the 2d day of April, 1889, I counted as high as 243 young pears nicely set upon a single tree. These trees were just entering their third summer's growth and had borne a few pears the summer before. In other parts of the State, as down on the coast prairie and on the black waxy lands,

*Lindley's Horticulture, p. 226.

they do not begin to bear till five and six years old. Evidently there are localities far better adapted to the highest development of the Le Conte than others. These places largely remain yet to be found. When found they should be carefully placed upon a map for proper reference. In Germany they have made such an exhaustive study of the adaptability of certain varieties of fruits for the several parts of that country that nearly every square mile has its own special varieties that it can mature and develop to a higher degree of perfection than can be done on the adjacent lands. Every State in the South, and especially Texas, could well afford to have at least one man in the field to collocate and map out the facts regarding the adaptability of certain fruits for certain localities. We annually plant thousands of trees on various soils and under varying conditions, and expect profitable results in every case. Every section of a State has certain kinds and varieties of kinds of fruits it can grow more or less to perfection, and those should be more carefully sought out and grown, to the exclusion of all worthless and unacclimated fruits.

Mr. William Jennings, of Thomasville, Georgia, claims that it is unpruned and uncultivated trees that bear at three and four years of age, and when properly pruned and cultivated they will not bear till seven years old, but these at nine and ten will bear from five to fifteen bushels to the tree.

I believe my observations as to pruning bear him out in his statements, as the young trees at Navasota on which so many pears were counted had not been pruned at all, as the owner did not believe in pruning the Le Conte. They were, however, well fertilized with cotton seed meal and barn manure, and were well cultivated.

Reports from Missouri, North Georgia, and Tennessee show that the Le Conte blooms too early to be prolific, and is subject to severe attacks of pear blight. The Keiffer in these States has proven far more hardy and prolific. William Jennings also states in his pamphlet on the Le Conte pear: "We have seen them thriving on all kinds of soil that we have in Georgia, except wet land." T. V. Munson, in American Garden, states: "Light deep sandy pine ridges will grow Le Conte and Keiffer pears."

So far as I have observed and inquired, I am confident that the Le Conte thrives best in every respect in a strip of territory not over a hundred miles wide, and lying next to the Gulf from Texas to Florida inclusive. Also that it must be grown on well-drained lands, and best on a heavy clay subsoil with a shallow soil above.

As to the Le Conte or Keiffer being more subject to diseases on a particular stock, I will say that it depends on soil, latitude, and culture. As already shown, the Le Conte and Keiffer are far less subject to blight on well drained soils in the Gulf region on their own roots than on the French stock.

Professor J. P. Campbell, of Georgia, in a most carefully prepared paper* on the subject of pear blight, says: "The first precaution which should be observed is to plant only those trees which are proven by experience not to blight readily, and so far as I can learn the Le Conte and Keiffer seem to be most nearly exempt."†

In higher latitudes they seemed to blight on their own roots about as freely as other pears. But in the Gulf region there is a disease which affects the roots of cotton, sweet potatoes, apples, figs, and several other plants on certain spots of ground. This disease has been termed "root-rot" by Prof. Pammel.‡ The pear tree dies on the same spots of ground. and I believe from the same fun-

*Proceedings Fourteenth Annual Meeting Georgia State Horticultural Society, page 24.

†See numerous other testimonials appended.

‡Texas State Agricultural Experiment Station Bulletin No. 4, p. 11.

gus agent as that which causes cotton root-rot (*Ozonium aunicomum*, Lk). In his investigations of the cotton root-rot Prof. Pammel has this to say about the disease affecting the pear.* "The pear is said also to be affected. Specimens sent to me from Burnet County had plenty of *Ozonium*, but the trees had evidently been dead for some time. In the pear orchard of Mr. R. D. Blackshear [Navasota] the leaves of trees covering an area of several acres became yellow and soon died. The pear trees alongside of this patch were perfect, showing no signs whatever of yellow leaves. The roots of the trees with yellow leaves were examined carefully, but no fungus was found on the roots except in advanced stages, where numerous threads of the *Ozonium* were present; but I think in those cases the fungus was simply a saprophyte. * * * I am unable to account for this disease. The leaves of the young apple trees affected with root-rot suddenly wilt, become black, and in a short time perish."

The description above of how this disease affects the apple tree agrees more nearly with my observations of what I believe to be the same disease of the pear. A tree will start out seemingly perfectly healthy in the spring and make a vigorous growth, but bears no fruit; and at any time during the summer or fall the leaves will suddenly wilt and turn black, and drop off within a few days, and black spots appear all over the tree, which gradually enlarge till the whole tree turns black and dies. All these visible stages develop within a month. Some of these dead trees stood on a reddish-yellow clay subsoil, some on a slate-colored clay subsoil, and others on a gray clay full of particles of the limestone rock, a stratum of which is but a few feet beneath. On digging up the roots, in every case they were found to be rotted and generally clothed with a white fungus growth. It is not my purpose, however, to prove or disprove that the Le Conte pear dies by an organic disease on spots of ground where cotton and other plants die. But whether organic or some poisonous chemical in the soil, the Le Conte and Keiffer on their own roots or other stocks are sure to perish when planted on those spots of ground. I can say that I never saw a pear tree die with this disease planted on a heavy red or joint clay subsoil. The Le Conte and Keiffer grafted on the French stock will not live more than about seven years if forced to grow only on that stock. The stock seems to be inadequate to the demands of the vigorous scion, and in a few years the tree becomes stunted in growth, throws up numerous sprouts from the roots, sends out the soft, spongy excrescences described above, and finally the roots die while the top remains green† to the last. On the same grounds on which the grafted Le Conte and Keiffers were found dying on the French roots, they were growing on their own roots and planted on a stiff joint clay subsoil which in the lower end of the orchard cropped out. A finer, more uniform, luxuriant, and healthy lot of trees I have never seen anywhere else.

In all of my correspondence only three recommend the use of the French stock for the Le Conte and Keiffer pears, while many, without solicitation on my part, stated that they believed the Le Conte to be the best stock for European pears.

I can not leave this question without referring to some commendable work undertaken by Mr. William Jennings, of Thomasville, Georgia, in connection with the Le Conte stock for other pears. In his pamphlet, "Pears and Pear Trees for the South," he states: "A few years ago we selected over thirty varieties (European pears), such as were likely to be valuable in the Southern States, with a view of trying to reinvigorate them by working them repeatedly on Le Conte stocks. Our plan has been to work the same variety several

* Texas State Agricultural Experiment Station Bulletin No. 7, p. 12.

† See also letter of Mr. H. M. Stringfellow, p. —.

times, each time taking grafts from the last tree worked and a fresh Le Conte. We have followed this up from year to year with a number of the European varieties. There is no longer any doubt but that an improvement has been made and that we will ultimately have strains of comparatively healthy trees. In other words, the final result is likely to be that we will have strains of trees of the European kinds as able to resist blight as the Asiatic varieties."

This is a line of work we had begun at this Experiment Station before we learned of this advanced investigation. We, however, shall go on with the work, that we may be able before many years to substantiate or explode the validity of Mr. Jennings' experiments. As to the use of the apple seedling for a pear stock, my observations confirm the idea that they are even worse than the French pear seedling to sucker, and the trees are short lived. The Le Conte scion rejects them the same as it does the French seedling, as is shown in Figure 3. But as apple seedlings are plentiful and cheap, it may be a good plan, on soils where the Le Conte and Keiffer do not root easily, or a profitable percentage of the cuttings do not grow, to use them or pieces of them to side-graft on Le Conte cuttings as a nurse to aid in keeping the cutting alive till it forms its own roots. In the fall, when the trees are removed from the nursery, the apple root can be removed and the tree left on its own roots.

FIGURES AND EXPLANATIONS.

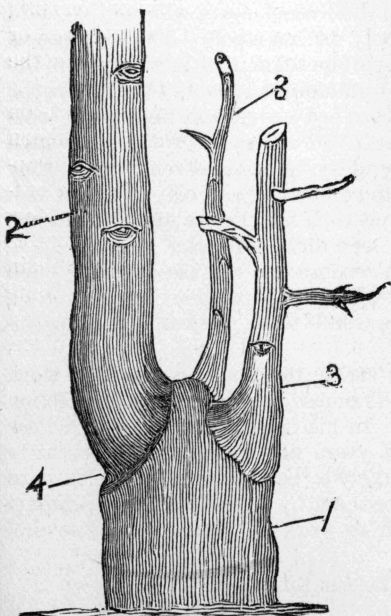


FIG. 1.

1. French Pear seedling stock.
2. Le Conte scion 3 years old from bud, and $3\frac{1}{2}$ inches in diameter.
- 3, 3. Sprouts from the French stock.
4. Place where bud of Le Conte was inserted.

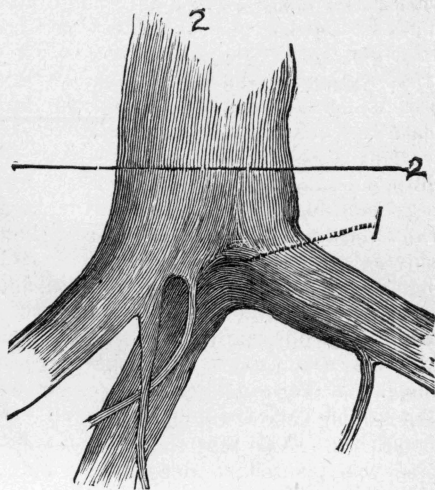
This sketch was taken from a tree at Sherman, Texas, on Mr. J. S. Kerr's fruit farm. It can readily be seen that the French stock is about double the diameter of the Le Conte scion. There was no possibility of the scion in this case to make its own roots. There were several more sprouts than are shown in the cut. Original.

FIG. 2. A LE CONTE ORIGINALLY GRAFTED ON A PIECE OF AN APPLE ROOT.

The apple root was 4 inches long and the Le Conte scion about 8 inches long. The scion was set 6 inches deep into the soil, and hence formed its own roots, as no trace of the apple root could be found, as shown at 1.

2. Surface of ground.

Tree four years old and $7\frac{1}{4}$ inches in diameter. It was never removed from the nursery row. Taken on Mr. J. S. Kerr's place, at Sherman, Texas. Original.



3

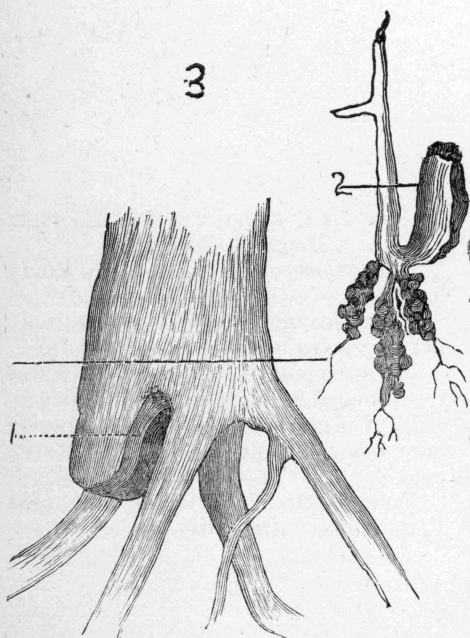


FIG. 3. LE CONTE ON APPLE.

1. Socket in Le Conte tree or scion from which was taken the remains of the apple stock.

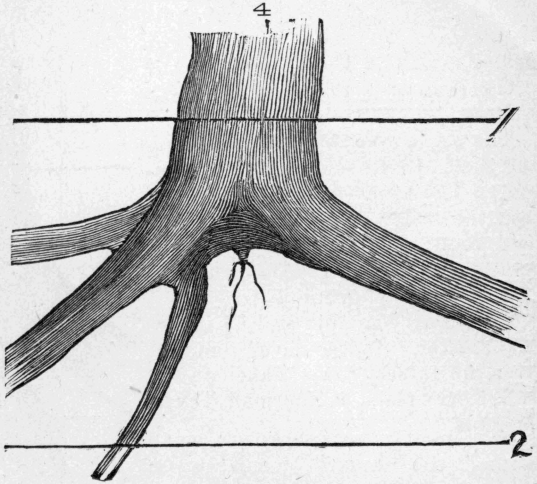
2. Remains of apple stock on which this Le Conte had been grafted four years before. The apple stock was totally on the outside of the tree and had a few knotty roots and a few sprouts, as shown in the figure. All the main roots were from the Le Conte scion.

Taken on Mr. J. S. Kerr's place, at Sherman, Texas. Original.

FIG. 4. KEIFFER ON FRENCH STOCK.

1. Surface of ground.
2. Extent of the sandy soil, which was 20 inches deep.

This figure was made from a tree eight years old that had been grafted on the French stock, but had thrown it off completely. All the roots shown in the cut are from the Keiffer scion. It will be noticed also that the roots spread out in the sandy soil above the reddish-yellow wet clay beneath 2. Also that this tree was planted so deep



that the Keiffer scion was several inches in the soil. This tree bore several heavy crops. Taken at Dr. W. W. Stell's place, near Paris, Texas. Original.

5

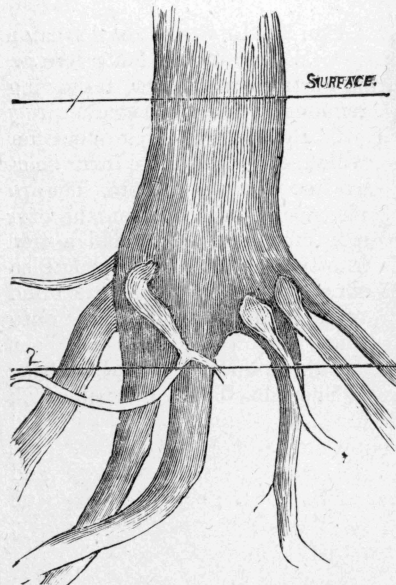


FIG. 5. LE CONTE ON ITS OWN ROOTS, IN A DISEASED CONDITION.

1. Surface of soil, which is a sandy loam.

2. Surface of wet reddish clay subsoil, twenty inches below surface.

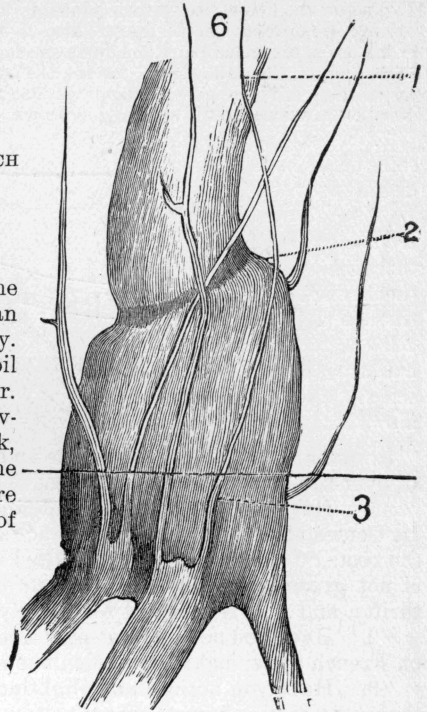
It will be noticed that the roots of this tree plunged down deep into the clay subsoil. The tree is ten years old, and never bore but a few pears. Referred to on page 8.

Taken at Dr. W. W. Stell's place, near Paris, Texas. Original.

FIG. 6. BARTLETT PEAR ON THE FRENCH STOCK.

1. Bartlett scion.
2. Place where bud was set.
3. Sprouts from the French stock.

The line indicates the surface of the ground. The scion is much smaller than the stock, showing a lack of affinity. Tree four years old; on black waxy soil at McKinney, Texas, on the farm of Mr. E. W. Kirkpatrick. On this place several Bartletts died on the French stock, while others on Le Conte stock were fine specimens of luxuriant growth, and were without the "maul" or enlargement of the stock.



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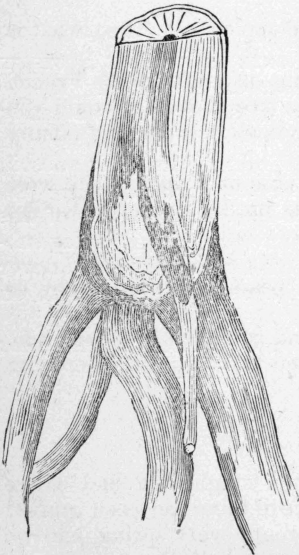


FIG. 7.—This figure shows a vertical section through the base of a three-year-old Keiffer tree that was grafted on the French stock, showing the original graft, the stock of which was entirely dead and decayed, but not grown over by Keiffer wood so as to be hidden. The original cut surfaces of the graft were plainly visible, as shown in the cut. This tree was set deep enough for the scion to throw out its own roots, which soon overpowered those of the stock, and finally killed them. Two Keiffers at this same place were found growing entirely on the French stock, and they were about half the size of those that had been able to throw out their own roots and kill the French stock. Those also on the French stock were tall and slim in their habit of growth, and leaves of a lighter shade of green than of those on their own roots, which had a more stocky and shorter branched habit of growth. Taken on the farm of E. W. Kirkpatrick, McKinney, Texas. Original.

NOTE.—These figures illustrate the same characters found on pear trees in other parts of the State. I am especially indebted to Messrs. J. S. Kerr, E. W. Kirkpatrick, and Dr. W.

W. Stell for the liberal use of their orchards for making observations, and the sacrifice of several more or less valuable trees. Also to Mr. H. M. Stringfellow, of Hitchcock, Texas, for the use of his orchard and numerous specimens of diseased and other trees, and to R. D. Blackshear, of Navasota, Texas, for the use of his large orchard and the liberal sacrifice of several trees. We are under obligations also to those who have furnished us valuable information in answer to the several queries we sent out.

ANSWERS TO INQUIRIES

SENT OUT FROM THE HORTICULTURAL DEPARTMENT.

In order to get the observations and opinions of prominent pear growers all over the South, the following set of questions was sent out:

"1. Have you observed any difference in the growth or productiveness of Le Contes and Keiffers on the French and Le Conte stock? Please examine the roots of the thriftiest tree grafted on French stock, and note if the tree is not growing almost wholly on its own roots; examine one of the least thrifty, and note if it is not fed largely from the French stock.

"2. Have you noticed that pear trees sprout from the roots when growing on French roots, making it difficult to cultivate the ground?

"3. Have you noticed any blighting or dying of Le Contes or Keiffers on their own roots, on spots where cotton dies, or any other places? Please examine roots of a dying tree, if at hand, and note if disease began at the roots first. Please send me small pieces of dead parts of roots, and section of wood with diseased bark.

"4. Have you had any experience with pears on apple roots; if so, what is your opinion of their value?

"5. Have you noticed enlargements at the point of graft on the French stock, making the stock larger than the body of the tree above? Would you consider such enlargement of the root stock an indication of perfect affinity of the stock and scion?

"6. Have you noticed that grafted trees or those on French stock were more diseased, or subject to the same, than those on Le Conte or Keiffer roots?

"7. What is your soil and subsoil?

"Any other information on Le Conte or Keiffer pears, and pear blight, or root-rot, would be of value to me."

To these queries I received some very valuable and convincing information. Deeming it of special interest to the nurseryman and fruit grower, I herewith append extracts from each letter.

GEORGIA.

J. N. McKinnon, Thomasville, Georgia: When we bought the land where we live there were 200 Le Conte trees on it. Twelve of them had been grafted on French or some other stock. These put up sprouts every spring, and we find them very troublesome. The trees are only about half the size of those on their own roots.

We have had considerable blight in our county on the Le Conte on the same patches of land that rust collects. The blight commences in the limbs and runs down. Will mail you a piece to-morrow. [Limb was received and it was genuine blight]. I have had no experience with apple roots. Our soil generally sandy. Subsoil yellow clay, mixed with sand.

William Jennings, Thomasville, Georgia: You ask for dead Le Conte pear tree roots from Thomasville or vicinity. I doubt if any can be found. I have been told that a few grafted Le Contes near Boston, in this county, died apparently of the blight that has prevailed here for the past two years, but none either "pedigree" or grafted have died within eight or ten miles of Thomasville, that I know of. There are many thousand Le Conte trees within a few miles of my residence, and none of them have been seriously injured by the blight. The body and roots are never affected. The trouble begins in the tender twigs and ends there.

You ask for evidence as to the value of the Le Conte as a stock for other pears. I can only say that I have been growing pear trees in Georgia for thirty years, and never had any success with the European varieties until I began several years ago to graft or bud them on the Le Conte stocks or other stocks of the Asiatic race. After the first year or two those on Le Conte stocks grew far ahead of those on French stocks, and the result is a much thriftier and larger tree. I have them growing near each other under the same conditions, and the appearance is marked in favor of those on Le Conte. I also find the "wildings" or thorny seedling pears of Japan most excellent as stocks for the European race of pears.

P. J. Berkman, Augusta, Georgia, January 6, 1890: In reply to your queries of December 26, I beg to answer as follows: In the controversy which lately appeared in the Southern Horticultural Journal between Messrs. Stell and Stringfellow, in which I am quoted at length by my friend Stell, I fully endorse him on every point which he holds.

1. I have grown the Le Conte pear on imported seedling stocks perhaps in larger quantities than any nursery in the United States, and for a longer period, and for our section and stiff red soil we decidedly give preference to trees grown upon such stocks.

2. Our trees do not sprout from the stocks.

3. We have noticed for several years past, and in several localities in Georgia, many cases of disease on Le Conte and Keiffer grown upon their own roots, the past season, however, being free from the appearance of this scourge in this section. Not having any dying trees on hand, I can not comply with your request to send you pieces of same.

4. We have had much experience with trees grafted upon apple root, this dating back for more than forty-five years, and find such stock utterly useless for trees; while they grow for a year or two quite thriftily, they soon accomplish their career of growth.

5. Your question as to the enlargement of the stock on the point of graft making the stock larger than the body of the tree, depends entirely upon the variety which is grafted upon such stock, as it is a well known physiological fact that the graft influences the stock at a much greater ratio than the stock influences the graft. Hence by grafting Le Conte, Keiffer, and other of the Oriental pears upon seedling pear stocks, the latter increases in diameter at a much greater rate than it would when grafted with Bartlett or other slow growing sorts.

6. Question to No. 1 will answer this: We have a variety of soils, from gray lands to very stiff clay, gravelly loam, and rich bottom lands. The up-

lands mainly underlaid with red clay and the bottom land with a lighter colored subsoil.

G. W. Stoner, Jewella, Louisiana, January 10, 1890: In answering the questions you ask, will first state that last winter and the previous winter I had all except five of my Le Conte trees top-grafted with Howell, Lawson, and Madeline. The Lawson grafts all did well, and a few Madeline, but only about one in twenty-five of the Howell are doing any good. Now to your questions: My Le Contes all grew off fairly well; those on their own roots making, I think, slightly the most growth; but noticed no difference in their coming into bearing. So far as I have examined, all have put out roots from the Le Conte scion. I have noticed that some pear trees sprout from the roots very badly on French stocks, and have also several Le Conte trees on their own roots that have sprouted badly.

I have had six out of the first twelve Le Conte pear trees that I put out to die outright from blight. They were on their own roots. For the past two seasons I have had no blight in my orchards. I have quite a number of pear trees on apple roots, but have never had any of them to make fruit.

As all the trees that I examined have put out roots from the Le Conte stock, I did not look below to see if there was any enlargement of the stock. From my experience in top-grafting the Le Conte, I have come to the conclusion that the affinity is not perfect with our old standard sorts.

I have not noticed that grafted trees were any more liable to disease than those on their own roots. In fact, I have lost more from blight that were on their own roots than of grafted trees. I have only 120 Le Contes in my orchard. Soil sandy with a red clay subsoil.

R. J. Winn, Judsonia, Arkansas, in *Fruit Growers' Journal*, January 1, 1890: "Some orchards of the Le Conte pear have blighted, especially where the trees are from four to five years old. As a consequence the Le Conte enthusiasm is waning."

Samuel Miller, Bluffton, Missouri, wrote me as follows: "While I am done with this pear tree, as far as raising fruit here is concerned, I believe there is a wide field for it in the way of stocks to work others on in the ground. If it grows so easily from cuttings, why don't they grow it so plentifully in the South as to supply the place of the French pear stocks?"

TEXAS.

Dr. W. W. Stell, Paris, Texas: Le Contes grafted on first class French and Belgian pear seedlings make fully as good growth with me as those grown on their own roots, and come into bearing one to two years sooner, and are fully as prolific, or more so. I have no Keiffers on Le Conte roots. I have not dug down to examine the roots, because I do not believe any one can tell for a certainty, by an examination of the roots, whether an eight or ten-year-old pear tree is on its own roots or on the stock it was grafted on. I do not believe because a central tap-root is wanting that that is any indication that the tree is not on the original roots it was grafted on. Many seedling pears, apples, etc., that are used as stocks are so branched when worked that they have no central tap-root to begin with. My grafted Le Contes and Keiffers are generally of a uniform size; where one is larger or smaller it can be explained by local causes widely different from what you indicate as the cause. I have observed all my life that pears when grafted or budded on pear seedlings do sprout from the stocks at times, and so do apples, Japan persimmons, etc.; but my Le Contes and Keiffers sprout less than the old sorts of pears. I am firmly of the opinion when pear trees are old enough to send up sprouts from the

stocks they should not be cultivated any longer. I know of no Le Contes or Keiffers, on their own roots or those grafted, planted where cotton dies. But I do know of a certainty that three out of five of my ten-year-old Le Contes that were propagated on their own roots—and bought at Thomasville, Georgia, where it would be considered a high crime to propagate any other way—did blight this year, and that badly, one so bad that the blight reached the ground and it was rooted up. The other two were cut off about four feet above ground, and twelve or fifteen inches below the affected parts, and the stumps of these two are perfectly sound to-day, and have made each from twenty to forty sprouts from two to four feet long.

There are several other fruit trees, viz., peaches, plums, quince, and Japan persimmons, within ten to thirty feet of these blighted pear trees, every one of which is as sound as a twenty-dollar gold piece. Six Le Conte trees are all I have on their own roots.

I have but little experience with pears on apple roots; but will say that one of my neighbors had a lot of pears grafted on apple roots that blighted and died the first or second year. Apple sprouts came up around them as thick as hops.

I have noticed the enlargements you refer to on the French stock, but do not believe it shows a non-affinity of the Le Conte for the French stock. It would certainly be a strange sight to see the stock of a pear tree smaller, or as small as the body. It would be abnormal, to say the least. There is nothing peculiar whatever in first class French pear stocks being larger than the tree above ground. It is the case with all kinds of fruit trees, grafted, budded, grown from cuttings or from seeds. Nature has wisely provided that the stock or foundation of a tree should be larger than the body. When first class French or Belgian pear seedlings are used as stocks, my experience is that they do not grow out of proportion to the bodies of the trees. It must be remembered, in all I have ever written on this subject, I have tried hard to impress the great importance of using only first class French and Belgian pear seedlings as stocks for all kinds of pears, and warned against the use of "Cheap John" stocks, such as the little wild pear growing all over France, and which does put in the most of its time in growing stumps and sprouts, and which can be bought for a mere song.

In a European trade catalogue I notice first class pear seedlings are worth there \$10 per thousand, which will cost laid down here about \$18 per thousand. And in the same catalogue I can buy pear stocks at \$10 per ten thousand, or \$1 a thousand. The temptation is great to take the latter. Man is but a weak animal at best.

I have no pears grafted on Le Conte or Keiffer stocks, but I have over 200 bearing Le Contes that were grafted on French stocks. About 5 per cent of these blighted this season, and about 25 per cent are affected with what I suppose to be root-rot. They are perfectly black from the ground up from one to six feet, with the same dark spots on the limbs as the Le Contes on their own roots have.

From my experience with the Le Conte, both on its own roots and grafted, if I ever become convinced that first class French and Belgian pear seedlings are unsuited as stocks for pears, I will grow stocks from the Keiffer to grow the Le Conte and other varieties on. The more I see of the Le Conte the more I am convinced of its unsuitableness as a stock for other varieties. Returning again to my orchard of 200 trees, I will say that it is badly situated, as the land does not drain well. Their surroundings are as follows: About thirty feet to the north is a row of Ben Davis apples running full length, twenty feet to the west a row of Keiffer pears on French stock, twenty feet to

the south a row of Japan persimmons, sixty-five feet east a row of mulberries. There is not a single diseased tree in all these adjacent rows.

H. M. Stringfellow, Hitchcock, Texas: 1. All my grafted trees have the Le Conte and Keiffer entirely above the ground. In productiveness I see no difference between grafted trees and those on their own roots after they come into bearing; but with me the Keiffer on its own roots fruits abundantly the fourth year, while on Le Conte or French stock it takes five or six years, and with some trees longer.

2. My grafted trees (on French stock) are a perfect nuisance, on account of suckers springing up everywhere, between the rows as well as around base of trees. This is probably more the case with my trees that were grafted high up than with those who have them set deeper.

3. Have never seen a Le Conte or Keiffer die after it gets to growing, except on certain very salty spots that occur on the coast. Root or top blight is unknown here.

4. No experience with apple roots for pear stocks.

5. Nearly all my trees on French stock show a very great enlargement of the stock, which amounts in many cases to a monstrosity, and the trees most affected are the smallest and least thrifty.

6. I have never seen a diseased Le Conte or Keiffer on its own roots, but have had nine grafted trees to die before they were six years old, and six or eight more badly diseased now, and in every instance the stock has been the only part of the tree affected, the Keiffer and Le Conte remaining green to the last. I saw twenty-five Le Contes on French stock at the Bayland Home, near Houston, about nine years old, last summer, and several had died just as mine did, and all were stunted and undersized, as well as suckering. I would advise all parties having these grafted trees planted shallow, if four years old or under, to take them up carefully, prune tops back severely, and set fifteen to eighteen inches deep. Both Le Conte and Keiffer transplant when old as easily as a cottonwood; and having moved four-year-old trees of both kinds, I see no harm done except the loss of a season's growth.

My subsoil is yellow clay, very compact, with water six to eight feet beneath the surface.

F. F. Ramsey, Mahomet, Burnet County, Texas: 1. We have noticed that Le Conte on its own roots is much more thrifty. Three years ago we planted one row of eleven trees of grafted Le Conte, and one of Le Conte cuttings. They have had the same treatment. Of the grafts but two are living, while all those on own roots are living and are fully twice as large as the grafts. We mention these two rows because we raised every tree of each row, and considered them an average.

2. A chance tree on French root sprouts.

3. We have had no Le Contes or Keiffers to die on Le Conte root.

4. We have not noticed any difference in the hardiness of apple roots. We have not noticed the difference, if any, of the growth of other pears grafted on Le Conte and on French stocks.

5. In a few instances we have noticed the body of the tree larger than the stock below it. We do not think this any evidence as to the affinity or non-affinity of the two pears, but indicates that that particular stock is a slow growing variety, and to that extent is evidence against the use of French stocks.

6. We believe we have never lost a Le Conte on its own root, nor have we any other variety on Le Conte roots, but they (the others) are all young. We have had Le Contes lose several leading limbs from a disease that a writer in the Southern Journal of Horticulture describes and calls blight, but the trees seem as healthy now as ever. We supposed at the time that their death was caused

by caterpillars or sudden freezes, as we had been afflicted with both just before. We believe if a lot of French stocks were grafted with Keiffer and several of the old varieties of pears and planted on our soil, there would be a smaller per cent of the Keiffer alive at the end of six years than there would be of the other varieties at the end of fifteen or twenty years.

J. M. Alexander, Rockdale, Texas: 1. As far as my observation goes, the Le Conte and Keiffer on the Le Conte stock have been more vigorous with us than when on French stock. No pedigree Le Contes bearing here yet. A few trees on French stock bearing well. I find none of grafted Le Conte with any roots above the graft (three years since they were set). The first year they made no growth scarcely—very dry; the second year a very fair growth; and this year a thrifty growth, and about equal to Le Conte on own roots.

2. I have noticed some sprouting around eight-year-old trees grafted on French stock, but no serious case of it in our community.

3. I sold W. M. Fergusson, of our town, five hundred Le Contes on their own roots (pedigree), on which he has two years very vigorous growth since planting. The first year eight of them, after making a fine growth, died suddenly in the latter part of summer—bark turned black, and tree was brittle and easily broken before winter. This was on a spot where cotton dies some every year. Three or four others have died this year. We don't believe it to be regular pear blight, but think it the same thing which causes cotton to die. I have lost only two or three trees on my own place in three years; all of them were pedigree. They seemed to be affected in same manner. I had two very sick this year—leaves wilted and bark shriveled. I removed the earth and some bones I had around the roots, poured a half bucket of weak lye around them, and about same amount of wood ashes; then gave the body and branches two thorough washings with concentrated lye strong enough to bite my hands a little, and then threw back some fresh earth from a distance; all of which restored them to a normal state of health. One of them began a new growth in ten days; both made a good fall growth. As far as I have observed, the disease begins in the roots. One of the trees mentioned above had been set three years, the other set last spring.

4. I have never used any pear and apple roots except the whole seedling stock for grafting.

5. The French stock on which my three-year-old Le Contes are grafted are nearly all larger below the point of graft than the tree, and a few of them a fourth larger. I do not consider such condition an indication of perfect affinity between the stock and scion.

6. There are eight or ten Le Contes on their own roots in and around my town to one on French stock, and I know of no one on its own roots that has failed to make from a fair to a most vigorous growth; but it is common to see them on French stock that have set two or three years without making scarcely any growth.

My subsoil is a rich red clay, with a gray to a light sandy soil, and all trees thrive well on it.

G. A. McKee, Mount Selman, Cherokee County, Texas: Le Conte pears blight occasionally with us, but are not so subject to blight as some other varieties.

Soil here varies from stiff clay soil to a sandy loam, with a stiff red or yellow subsoil eighteen inches to three feet below the surface.

H. C. Hamilton, Whitesboro, Texas: The Le Conte shows some blight in some places, though not very much; mostly leaf blight. Root-rot is caused by a mineral substance coming up from below. The best preventive of this is under drainage.

D. G. Gregory, Alleyton, Texas: Out of 300 Le Conte trees I had three or

four that partially blighted in 1889. The dead limbs have thrown out new shoots near the trunk and seem to have recovered. I consider it bacterial and only temporary. My soil is a sandy loam, with a red clay porous subsoil with good natural drainage.

E. M. Kirkpatrick, McKinney, Texas: My experience and observation teaches me that Le Conte and Keiffer pears do best on their own roots. Where these pears are grafted on any other root and planted deep they are disposed to throw out their own roots and ignore the foreign roots.

I have noticed that pear trees sprout badly on the French stock.

I have not noticed any blighting or dying of Le Contes or Keiffers on their own roots. The apple root is as good as any for the pear, if the tree is planted deep enough to ignore the apple root.

I have often noticed the enlargements you speak of, and consider them a sign of non-affinity.

I consider trees more subject to disease and short lived when grafted on the French stock than when grown on the Le Conte or Keiffer roots. The soil is black waxy, with yellow clay subsoil.

J. W. Stubenrauch, Mexia, Texas: Our soil is from ten inches to two feet in depth; subsoil red clay. The difference in growth between Le Conte and Keiffer on their own roots and those on French stock is not material. Have not found any on the French stock that have taken root above graft.

Pear sprouts from the French stock are very numerous and are a nuisance.

Have had as yet no blight on any Le Conte nor Keiffer, neither on own roots nor grafted stock. Apple roots are a failure for pears to grow on.

The enlargement at point of union between graft and stock on Le Conte and Keiffer is frequently present with us, and we certainly deem it a defect in the union.

E. S. Peters, Calvert, Texas: It is my belief and others in this vicinity that our pear trees do not die from pear blight, but from root-rot, as cotton does on some ground in my orchard. I am well pleased with Japan plums and Le Conte pears.

Otto Locke, New Braunfels, Texas: The Le Conte on its own roots makes a growth of eight to ten feet in one year, but on French stocks they make only a growth of one to two feet in one year.

Yes, a few of my pears on French stocks sprout from the roots.

I have not noticed any blighting or dying of Le Contes or Keiffers on their own roots. I have not noticed the enlargements of the French stock you speak of. I believe trees grafted on French stock more subject to disease than those grown on Le Conte or Keiffer roots.

All my trees are young, from two to six years old. I find that all varieties on Le Conte roots grow very rapidly, but on French stocks they make a very poor growth. My soil is black bottom land.

J. S. Kerr, Sherman, Texas: I have not noticed as to which trees fruit most, whether grafted on Le Conte or French stock.

I notice enlargement and tendency to sprout at the union of Le Conte with French stock. Have not noticed any blighting of Le Contes on their own roots.

On four-year Le Contes grafted on apple roots I notice the pear discards the apple root and throws out its own roots above, and the apple root stops growing and is of no effect. The enlargement looks like the want of affinity.

I have not noticed that grafted trees are more subject to disease than those on their own roots.

John B. Long, Rusk, Cherokee County, Texas: Le Conte pears have been grown here about five years, and have shown no blight up to this time. We

have a gray and red sandy soil, red clay subsoil, which has a peculiar and excellent adaptation to the successful growth of fruits.

D. J. Eddleman, Denton, Texas: I have never had a case of pear blight on my place. My Le Contes and Keiffers are now six years old, and up to this time I have not had but one Keiffer pear and no Le Conte. They have set crops for three years, but fall off in a few weeks, while Bartlett and Duchess hold their fruit. The trees grow finely, but they don't bear. My Le Contes were on apple roots at first, but are now on roots put out from above the grafts. My Keiffers are said to be on Le Conte roots, but I think they are on French stock. None of them have sprouted. I have cultivated the orchard for six years in corn and cotton. All the root-rot I ever met came from too much water settling about the roots in hot weather.

C. H. Brossmann, Bellville, Texas: I prefer grafted trees, if graft is set three or four inches below surface of soil; they will grow slow for a few years but will make up for it later, and in time come near the natural form of a seedling pear tree. They bear earlier, and fruit is more uniform and larger than on trees from cuttings. I have fifty Bartlett trees worked on the Le Conte five years old, and last summer during the rainy and windy season I had to cut the tops off to save them, because they had no tap and side roots to hold them. The only objection I have to the Le Conte is its rampant growth. I find it a job to give the tree the needed spreading form by a course of regular pruning to an outside bud before the bearing age. My choice for several years has been the Keiffer. As to sprouts under the pear trees, I will say that I put out some grafted Rostiezer pears in 1867, and by cultivation and rain the soil was washed away from the roots to such an extent that I injured the roots with the plow, and since sprouts have appeared; and I think any other pear tree will sprout under the same circumstances.

My soil is dark sand, with all mixtures of subsoils in different parts of the orchard, except some red clay, which I think best for fruit.

E. Crew, Hempstead, Texas: No Le Contes here have shown any blight, but are vigorous trees. We have a sandy loam with clay subsoil from six inches to ten feet from the surface.

SOME PARASITIC FUNGI OF TEXAS.

WITH NOTES.

BY H. S. JENNINGS,

ASSISTANT IN HORTICULTURE AND BOTANY.

1. *ÆCIDIUM CALLIRRHÆES*, E. & K. On the leaves and sometimes on the petioles and stems of *Callirrhæa involucrata*. Not uncommon in April and May; thickening the tissues and causing them to turn red; sometimes nearly destroying the leaves.

2. *ÆCIDIUM HOUSTONIATUM*, Schw. On Bluets (*Houstonia minima*). Very common after the flowers have fallen, in February and March. Plants affected are somewhat taller than those unaffected, and the growth is noticeably more erect, so that they are easily distinguished.

3. *ÆCIDIUM ZANTHOXYLI*, Pk. Abundant on the leaves of the Prickly Ash (*Zanthoxylum Carolinianum*) in April and May.

4. *ACTINONEMA ROSÆ* (Libert), Fries. Black Spot of Rose. Causes black spots on the leaves of cultivated roses, injuring their appearance and probably harmful otherwise. Observed at College Station in February; very common in many parts of the State.

5. *ASCOCHYTA SMILACIS*, E. & M. On leaves of Green Brier (*Smilax tamnoides*), causing numerous light colored or pinkish spots, noticeable on both sides; common in fall.

6. *CÆOMA NITENS*, Schw. Orange Rust of Blackberry. Exceedingly common and conspicuous on the Dewberry (*Rubus trivialis*) and cultivated Blackberries and Raspberries, covering the lower side of the leaves with the mass of orange colored spores, and bursting through the bark on the canes. Very injurious, and is becoming a great drawback to blackberry culture in this State. Of the common varieties, Kittatinny, Early Harvest, and Erie are most affected. It has not yet been found on the Dallas. On the wild Dewberry this fungus is sometimes itself covered and almost destroyed by the purple spores of *Tuberculina persicina*, Ditm.

7. *CERCOSPORA ALTHENIA*, Sacc. Causing white spots on the leaves of *Modiola multifida*, in February and March. Not particularly injurious to this plant, as it occurs mostly on weakened or dying leaves.

8. *CERCOSPORA BETICOLA*, Sacc. Causing numerous brown spots on leaves of cultivated beet (*Beta vulgaris*) in January. Not common nor very injurious here.

9. *CERCOSPORA BRUNKII*, Ell. and Galw., *n. sp.* On Geraniums (*Pelargonium*, sp.) First noticed in the College greenhouse about the middle of December, 1889, by Prof. Brunk, on many of the Geraniums of different varieties, causing reddish-brown dead spots on the leaves; since that time it has been exceedingly abundant, making it difficult to grow these plants with satisfaction. The disease spread rapidly, the spots increased in size and number until many leaves were destroyed, and some of the plants almost defoliated. Not a single variety seemed to be free from the disease. On the ivy-leaved Geranium (*Pelargonium peltatum*) the fungus varied slightly from the

type, but the outward effects are similar. A *Cercospora* much resembling this does considerable damage to Calla Lilies in the greenhouse also.

10. *CERCOSPORA CATALPÆ*, Wint. Causing numerous dark spots on the leaves of the Catalpas (*Catalpa speciosa*) in the College arboretum, in November. The spots become white, from the thinness of the leaf tissue, after a time. Common and considerably injurious.

11. *CERCOSPORA CHENOPODII*, Fres. On leaves of Wormseed (*Chenopodium ambrosioides*, var. *anthelminticum*), causing small white spots; not injuring it appreciably.

12. *CERCOSPORA LIPPIÆ*, E. & E. On Fog fruit (*Lippia nodiflora*), causing small white spots on the leaves. January.

13. *CERCOSPORA OCCIDENTALIS*, Cke. Causing numerous brown spots on the leaves of the Wild Coffee Plant (*Cassia occidentalis*); very abundant in December, 1889.

14. *CERCOSPORA PERSONATA*, B. & C. On Wild Coffee Plant (*Cassia occidentalis*). Not evidently distinguishable, outwardly, from No. 9.

15. *CERCOSPORA SMILACIS*, Thun. On Green Brier (*Smilax tamnoides*), causing light colored spots; not very common or noticeable.

16. *CERCOSPORA TEXENSIS*, E. & G. On leaves of Green Ash (*Fraxinus viridis*), often almost covering them with brown spots, becoming white. Common and injurious, in the fall.

17. *CERCOSPORA TOXICODENDRI*, El. On Poison Ivy (*Rhus toxicodendron*); causing numerous small circular brown spots on the leaves. Common; not particularly injurious.

18. *CERCOSPORA VIOLÆ*, Sacc. On Violet (*Viola cucullata*). Observed in November, 1889, forming large white spots on the leaves. Not common, but very injurious.

19. *CERCOSPORA*, *n. sp.* On Begonia. In December, 1889, a disease appeared on a certain class of Begonias in the greenhouse, forming white spots in the centre of larger brown patches on the leaves, causing the spots to die and rot out or the whole leaf to fall. Considerable damage is thus done. Mr. J. B. Ellis, of New Jersey, to whom specimens were sent for determination, says it is probably a new species of *Cercospora*, but it has not been named.

20. *CLADOSPORIUM FULVUM*, Cke. On Tomato (*Lycopersicum esculentum*). In December, 1889, this exceedingly injurious fungus was noted on a large number of Tomato plants in the greenhouse, of the Dwarf Champion variety; nearly all the leaves being fairly covered on the under side with a thick lavender-colored down. As the disease progressed the fungus turned brown, the leaves soon after turning yellow and beginning to wither; spores falling like dust whenever the leaves were shaken. No tomatoes were produced, and the plants, becoming worthless and nearly dead, were removed and thrown away.

21. *CLADOSPORIUM VITICOLUM*, Viala. Grape leaf blight. This well known pest is exceedingly common on grapes leaves at College Station and in all parts of Texas. It occurs on both sides of the leaves, the irregular brown spots often covering almost the entire surface. It does considerable damage to the foliage, especially in wet seasons, but does not affect the fruit so far as known. It affects the Riparia family of grapes more than any other, the varieties Clinton and Bacchus being affected most.

22. *COLEOSPORIUM ELEPHANTOPODIS*, Sz. Bright yellow "rust" on leaves and involucres of Elephant's Foot (*Elephantopus Carolinianus*). Common in summer.

23. *COLEOSPORIUM IPOMOEÆ*, Sz. On Moon flowers (*Ipomoea bona-nox*) and Morning-glory (*Ipomoea purpurea*). Nearly covering the under side of the leaves

with bright orange spores; very noticeable. Observed in November, 1889, on two plants only.

24. *COLEOSPORIUM SONCHI* (Pers.), Lev. On the lower side of the leaves of Rosin Weed (*Silphium scaberrimum*) in spring. Common.

25. *COLEOSPORIUM VERNONIÆ*, B. & C. On the leaves of Iron Weed (*Vernonia* sp.); similar in appearance to No. 24. Common; September, 1889.

26. *COLLETOTRICHUM BROMI*, n. sp. On leaves of Rescue Grass (*Bromus unioloides*), forming thin spots, on which the black fungus is very noticeable. Weakens the tissues, causing them to break away, leaving dead spots or holes in the leaves. First collected April 2, 1890.

27. *CYSTOPUS BLITI*, Lev. Small elevated white or yellowish spots on the under surface of the leaves of Pig Weed (*Amarantus retroflexus*). Common; somewhat injurious to the plant; June, 1889.

28. *CYSTOPUS PORTULACÆ*, Lev. On Purslane (*Portulaca oleracea*), causing elevated white spots on the upper side of the leaves. Common and of some value, as it is quite injurious to this troublesome weed. June, 1889.

29. *DIORCHIDIUM BOUTELOUÆ*, n. sp. III. On Gamma Grass (*Bouteloua racemosa*). This new species of this rare and interesting genus was discovered on specimens of *Bouteloua racemosa* collected in December, 1889. This genus differs from the closely related *Puccinia* in having the telentospores divided by perpendicular or oblique instead of horizontal septa. In this species the septum arises in the larger number of spores from the end of the pedicel, but as in other species, the position of the septa is not constant, the pedicel arising from any corner of the spore, though so far as observed never from the end, as in *Puccinia*. The sori are elongated, black, and occur on the upper part of culm and sparingly on the leaves. Only the teleutospores were found.

30. *ENTYLOMA PHYSALIDIS* (Klachbr. and Cke.), Wint. Dark swollen spots on the leaves of Ground Cherry (*Physalis pubescens*). April.

31. *ERYSIPHE CICHORIACEARUM*, DC. On Cockle Bur (*Xanthium strumarium*), Rag Weed (*Ambrosia artemisiifolia*), Vervain (*Verbena officinalis*), and cultivated Verbenas. This is exceedingly common, and does considerable damage to Verbenas in the greenhouse. Sulphur dusted on the leaves generally destroys it.

32. *ERYSIPHE COMMUNIS*, Wallr. On *Oenothera sinuata*. Very common.

33. *ERYSIPHE GRAMINIS*, DC. On Rescue Grass (*Bromus unioloides*) and Crab Grass (*Panicum sanguinale*). Very common in March and April on the Rescue Grass, the conidial stage covering the leaves with a white frosty appearance, and by the time the perithecia appear many of the leaves turn white and are dead. Very injurious, where the grass grows in damp or shady places.

34. *EXOASCUS DEFORMANS*, Berk. Leaf Curl. Thickening, curling, and variously distorting the leaves of the Peach. Injurious. Observed on only one tree, in April, 1888 and 1889.

35. *GLÆOSPORIUM DECIPIENS*, E. & E. Causing numerous brown spots and patches on the leaves of the Green Ash (*Fraxinus viridis*). Common and injurious. It occurs mostly on the leaves at the same time as another fungus, *Piggotia fraxini*, B. & C.

36. *GLÆOSPORIUM FRUCTIGENUM*, Berk. Bitter Rot of Apple. Observed in June, 1889, at Tyler, Denison, and Pilot Point; causing yellow spots on the leaves, and often destroying nearly a whole crop by causing the apples to rot. The rot may be known by the ring of small black pustules on the surface of the rotten part. Ben Davis and other fall and winter varieties are most affected; early summer varieties are exempt.

37. *GLÆOSPORIUM LAGENARIUM*, Pass., var. *FOLICOLUM*, E. & E. On Watermelon. This was observed only once at the College, causing numerous

black spots on the leaves of a watermelon vine, and injuring it severely. It is not improbable, however, that this is the disease which has been causing much damage to watermelon vines all over Texas, causing the leaves to die first near the roots and then follow down the vine toward the growing end. It first appears in the latter part of June and continues till frost.

38. *GYMNOSPORANGIUM MACROPUS*, Lk. Cedar Apple. Very common on the Red Cedar (*Juniperus Virginiana*). Causes large bunches about three-fourths of an inch in diameter to form on the limbs; these, in the spring after heavy rains, are covered with long jelly-like tongues standing out in all directions, on which the spores are borne. These spores cause the Apple Leaf Rust known as *Ræstelia pyrata*, Schw.

39. *HELMINTHOSPORIUM RAVENELII*, Curtis. On Smut Grass (*Sporobolus Indicus*), covering the inflorescence with a black spongy mass of spores; scarcely a mature panicle of this grass to be found free from it. Apparently not injurious to the grass as a forage plant, as it is too old and wiry for pasturage when the fungus appears.

40. *HELMINTHOSPORIUM SORGHI*, Schw. Very numerous elongated red blotches on the young fall growth of Johnson Grass (*Sorghum halapense*). Common in December and January; probably would be considerably injurious if the grass were not soon killed by the frost.

41. *HENDERSONIA FOLIORUM*, Fckl. Causing circular white spots on the leaves of the Pear, in November; injurious. Occurs in connection with several other fungi, as *Sphaeropsis malorum*, *Phyllosticta pyrina*.

42. *LÆSTADIA BIDWELLII*, Viala & Ravaz. Black Rot of Grape. Very common on cultivated grapes in Texas, and exceedingly injurious unless its attacks are prevented by the use of the Bordeaux mixture. See Bulletin No. 8, December, 1889. The stage known as Leaf Spot (*Phyllosticta labruscæ*, Thuem.) is very common on wild grapes (especially *Vitis candicans*), and the Virginia Creeper (*Ampelopsis quinquefolia*).

43. *LEPTOTHYRIUM DRYINUM*, Sacc. On the upper side of the leaves of Water Oak (*Quercus aquatica*) and Post Oak (*Quercus obtusiloba*), forming dead spots. Common.

44. *MELAMPSORA POPULINA*, Lev. On Cottonwood (*Populus monilifera*) and Balsam Poplar (*Populus balsamifera*). Very common in fall, forming very abundant reddish-yellow spots on both sides of the leaves, but much more abundant on the lower side. A species of *Fusarium* parasitic on the sori of the *Melampsora* was found in the specimens from *P. balsamifera*.

45. *MELAMPSORA SALICINA*, Lev. On Black Willow (*Salix nigra*). On both sides of the leaves; similar in appearance to No. 44. Rather common in fall.

46. *MICROSPHÆRA RAVENELII*, Berk. On Honey Locust (*Gleditschia triacanthos*). Covering the upper surface of the leaves of one of the young trees in the College arboretum with the dense white mycelium, interspersed with the black perithecia. November, 1889.

47. *MICROSPHÆRA SYMPHORICARPI*, Howe. On *Symphoricarpos vulgaris*. Very common in May.

48. *PERICONIA PYCNOSPORA*, Fries. Dark spots on the leaves of the California Privet (*Ligustrum Californicum*) and *Hibiscus grandiflorus*; not abundant.

49. *PERONOSPORA CUBENSIS*, B. & C. On Gherkin (*Cucumis anguria*). Appearance first noticeable in October, by yellowish patches showing undefinedly on the leaves; these slowly gathered together, forming yellowish-brown dead spots. Observed only on two large vines growing in shady places; ex-

ceedingly injurious to these, destroying most of the leaves. Will probably become a serious pest if it spreads to the cucumbers, as it has in other places.

50. *PERONOSPORA ENTOSPORA*, B. & Br. On the lower side of the leaves of very young Cone-flower (*Rudbeckia fulgida*). Not common. March.

51. *PERONOSPORA GERANII*, Pk. Covering the under side of the leaves of the Wild Cranesbill (*Geranium Carolinianum*) with a thick white felt, causing them to wither and die; very common.

52. *PERONOSPORA PARASITICA*, Pers. Cabbage Mildew. On pods and stems of Wild Cress (*Arabis*, sp.). Not common.

53. *PERONOSPORA VITICOLA*, D By. Downy Mildew of Grape, Brown and Gray Rot of Grape. One of the commonest diseases of the grape in Texas; exceedingly abundant in the College vineyard last fall. Very injurious, if no means of preventing its ravages are employed. See Bulletin No. 8, December, 1889.

54. *PHLEOSPORA MORI*, Lev. Causing brown, dead spots on the leaves of the Russian Mulberry (*Morus tatarica*) and *Morus multicaulis* in fall.

55. *PHRAGMIDIUM MUCRONATUM* (Pers.) Lk. On Rose. Stage II. Red rust on the lower side of the leaves. Stage III. Black several-septate spores, barely noticeable to the naked eye, appearing later in the same sori with the spores of stage II. Observed at Tyler and McKinney, Texas; common where observed.

56. *PHYLLACHORA GRAMINIS*, Pers. On Wild Oats (*Chrysopogon nutans*), Beard Grass (*Andropogon saccharoides*), and *Panicum dichotomum*. Forming black swollen spots on the leaves; very common, but not particularly harmful, as it appears mostly on leaves which are old and dying.

57. *PIGGOTIA FRAXINI*, B. & C. Small black spots on the lower side of the leaves of Green Ash (*Fraxinus viridis*). Common and somewhat injurious.

58. *PLOWRIGHTIA MORBOSA* (Schw.), Sacc. The well known Black Knot of Plum; rare. Observed once in North Texas and once at College Station.

59. *PUCCINIA CONCLUSA*, Thun. Stages II and III. On Sedge (*Cyperus* sp.). Very abundant in the fall on the leaves and culms of two or three species of *Cyperus*.

60. *PUCCINIA CORONATA*, Corda. Oats Rust Stages II and III. On Oats (*Avena sativa*). Exceedingly abundant with *Puccinia graminis*, the two causing whole fields of oats to turn yellow soon after beginning growth in the spring. These are the principal drawbacks to the cultivation of oats in this section. The crop in 1889 was scarcely fit to cut, even for forage, it was rusted so badly.

61. *PUCCINIA CRYPTOTÆNIÆ*, Peck. Stage III. On Honewort (*Cryptotænia Canadensis*). Observed but once, August, 1889.

62. *PUCCINIA DICHONDREÆ*, Berk. Stage III. On *Dichondra repens*. Very common in spring.

63. *PUCCINIA EMACULATA*, Schw. Stage III. On False Red Top Grass (*Triodia sesleroides*) in fall.

64. *PUCCINIA GRAMINIS*, Pers. Grass Rust. Stages II and III. On Oats (*Avena sativa*), Wild Oats (*Chrysopogon nutans*), Broom Sedge (*Andropogon dissitiflorus*), American Canary Grass (*Phalaris intermedia*), and *Eragrostis capillaris*. Common, and causing great damage to the oat crop.

65. *PUCCINIA PRUNI-SPINOSA*, Pers. Peach and Plum Rust. Stage II. On Peach and Plum (cultivated and wild). Stage III. On cultivated and wild plums (*Prunus chicensis*). A serious pest, exceedingly abundant, causing the leaves to fall prematurely. The Bordeaux mixture has been found efficacious in preventing its injuries. While the *Teleutospore* stage is common on the Plum, it seems never to appear on the Peach. Plums of the Chickasaw vari-

eties are most affected. It has been observed in North, East, and Central Texas.

66. PUCCINIA PURPUREA, Cke. Stages II and III. On common Sorghum (*Sorghum saccharatum*) and Johnson Grass (*Sorghum halapense*). Exceedingly abundant, particularly on the former host, causing very numerous red pustules. Considerably injurious, causing the leaves to wither and die prematurely. November.

67. PUCCINIA SESSILIS, Schneid. Stage I (*Æcidium alliatum*). On *Allium striatum*. Occurring in March on the leaves and scapes. In nearly all specimens found the *Æcidium* itself was almost covered and destroyed by another parasitic fungus, *Tuberculina persicina*, Ditm.

68. PUCCINIA SMILACIS, Sz. Stages II and III. On leaves of Green Briar (*Smilax tamnoides*) Very common. The sori of this fungus are generally infested by another, *Darlucula filum*, Cast.

69. PUCCINIA TANACETI, DC. Stage II. Rust abundant on the lower side of the leaves of the Sunflower (*Helianthus annuus*). July.

70. PUCCINIA VEXANS, Farlow. Stage II. On Gamma Grass (*Bouteloua racemosa*). Not common.

71. RAMMULARIA OBOVATA, Fckl. Causing circular brown, ultimately dead spots on the leaves of Dock (*Rumex obtusifolius*). Occurs mostly on the lower weakened or dying leaves.

72. RAVENELIA TEXANUS, Ell. & Galw. *n. sp.* On an undetermined leguminous plant—collected after the flower and fruit were gone—probably a *Desmanthus* or *Cassia*. A black fungus, entirely covering the lower side of the leaves; conspicuous. November, 1889.

73. RÆSTELIA AURANTIACA, Pk. On the leaves, peduncles, calyxes, and fruit of Hawthorn (*Crataegus spathulata*); swelling and distorting them; abundant in spring, in the spermogonial stage.

74. SPHACELOMA AMPELINUM, D By. Anthracnose of Grape. This well known pest is not uncommon on grapes in the College vineyard and in many parts of Texas. Exceedingly injurious. Attacks rapid, rank growing varieties, such as Black Spanish, Louisiana, Duchess, etc.

75. SPHERELLA FRAGARIE, Sacc. White Rust of Strawberry. Abundant in spring on strawberry plants in the College garden, forming white spots with a brown or reddish border on the upper side of the leaves. Considerably injurious to some varieties. Charleston and Wilson suffer most.

76. SPHEROTHECA PANNOSA, Lev. Rose Mildew. Conidial stage (*Oidium leucoconium*, Desm.) not uncommon on roses, injuring them severely, destroying the young leaves in spring.

77. STIGMELLA PLATANI, Fckl. Giving a brown, rusty appearance to the leaves of Sycamore (*Platanus occidentalis*). Summer, 1889.

78. SYNCHYTRIUM FULGENS, Schrtr. Minute yellow spots on the stem, petioles, and leaves of *Oenothera sinuata*, distorting them and injuring the growth of the plant. Exceedingly common. January to May.

79. SYNCHYTRIUM, *n. sp.* On *Engelmannia pinnatifida*. This may possibly be *Synchytrium taraxaci*, D. By. & Wor.; it was submitted to Mr. Ellis, of New Jersey, and a name is not given till he decides definitely concerning the identity of the two.

80. TILLETIA RUGISPORA, E. & G., *n. sp.* On *Paspalum plicatulum*. Filling the spikelets, but not very noticeable; the spikelets appear of a darker brown and are distorted.

81. UNCINULA CIRCINATA, C. & P. On Maple leaves (*Acer dasycarpum*). Observed at Tyler in October, 1888.

82. UNCINULA SPIRALIS, B. & C. Powdery Mildew of Grape. Not un-

common on leaves of the grapes in the College vineyard. A Golden Chasselas vine in the greenhouse was almost covered by it and nearly all the leaves destroyed in November, 1889. Small black dots on both sides of the leaves; not noticeable except where numerous.

83. *UREDO FICI*, Cast. Small dark-brown powdery spots opening on the lower side of the leaves of the Fig (*Ficus carica*.) Observed only on two young trees in December.

84. *UREDO HELIANTHI*, Sz. Brown pustules on the lower sides of the leaves of the Sunflower (*Helianthus annuus*). Summer.

85. *UREDO OXALIDIS*, Lev. On Wood Sorrel (*Oxalis violacea*.) Very abundant on the lower side of the leaves, the bright orange-red spores often completely covering them, stopping the growth of the plant. Hardly a specimen of this plant to be found without the fungus. Spring.

86. *UROMYCES APPENDICULATUS*, Pers. Bean Rust. Stages II and III. On Cultivated Bean, at Hempstead, Texas. Stage III. On *Phaseolus*, sp. Forming dark brown or black powdery spots; abundant on both sides of the leaves.

87. *UROMYCES DACTYLIDIS*, Otth. Stages II and III. On Wild Barley (*Hordeum pratense*). North Texas; summer, 1889. Stage III. On Small Fescue Grass (*Festuca tenella*). College Station; spring, 1890. Sori small, black.

88. *UROMYCES POLYGONI* (Pers.) Fckl. Stage II. Small inconspicuous brown spots on both sides of the leaves of Knot Grass (*Polygonum* sp.).

89. *UROMYCES RUDBECKIÆ*, Arthur and Holway. Stage III. On Cone Flower (*Rudbeckia fulgida*). Forming definite light brown spots on the lower sides of the leaves. Spring; not common.

90. *UROMYCES TEREBINTHI*, DC. Stage III. On Poison Ivy (*Rhus Toxicodendron*). Brown rust on both sides of the leaves. Not common.

91. *UROMYCES TRIFOLII*, DC. Clover Rust. Stages I, II, and III. On Carolina Clover (*Trifolium Carolinianum*). All three stages exceedingly common; the *Æcidium* from January till April; stages II and III all the rest of the summer and fall. Injurious.

92. *USTILAGO APICULATA*, Ell. & Galw., n. sp. On Beard Grass (*Andropogon saccharoides*). Black smut on the inner side of the sheaths, near the joint; extending scarcely more than an inch or two above it. Not conspicuous; probably not injurious.

93. *USTILAGO MAYDIS*, Corda. Corn Smut. Not noticed as being very common; more common on the black waxy lands of North Texas.

94. *USTILAGO SEGETUM*, L. Black Smut of Grain. On Oats and Barley; common, often causing a considerable per cent of loss in these crops.

95. *USTILAGO SYNTHESMÆ*, Schw. On Crab Grass (*Panicum sanguinale*), converting the spikes into a black mass of spores, entirely destroying the seeds of the plant. Not common; observed at Paris and College Station, Texas.

The fungi in this list were collected, except where otherwise stated, at College Station, between the months of November, 1889, and April, 1890. While not a long list, it contains some of much economic importance and eight new species, besides extending the hosts of several. For the determination of many of these species and various courtesies, I wish to acknowledge my obligations to Profs. B. T. Galloway and D. G. Fairchild, of the Section of Vegetable Pathology, Washington, D. C., and to Mr. J. B. Ellis, of Newfield, N. J. Also to Prof. T. L. Brunk, to whom should be credited many of the notes as to their economic importance; also the observation and collection of several species, especially those collected in different parts of the State.