Forest Biometry
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Lecture – 15
Measurement of bark and growth rings

[FL] today we have a look at the measurement of bark and feedings.

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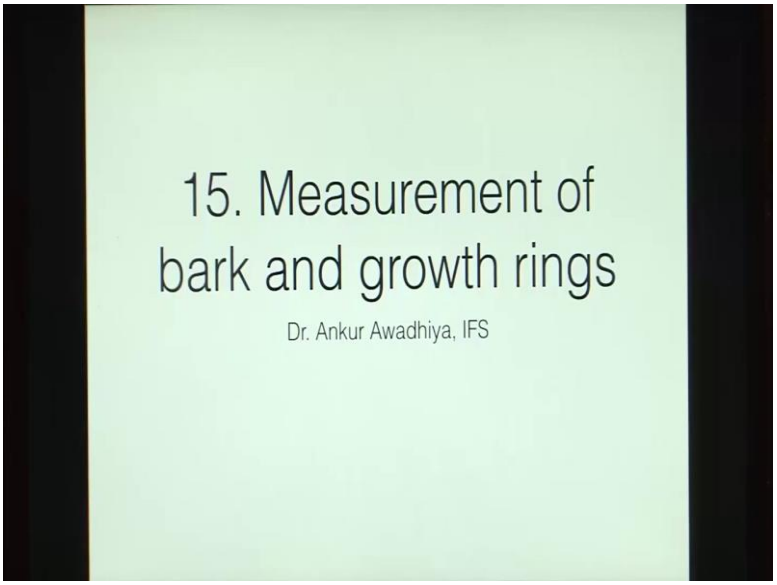

So, we have covered bark in an earlier lecture. So, in this slide Summarizes what we learned about it.

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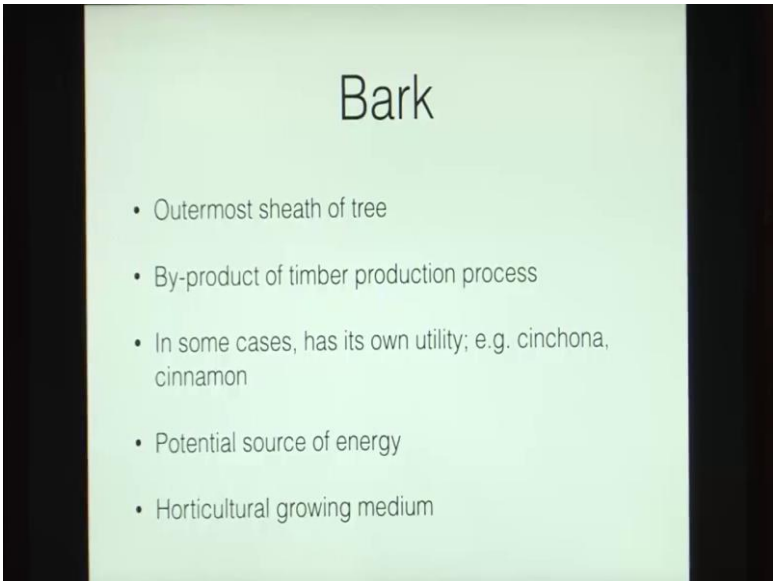

So, bark is the outermost sheath of a tree. So, it is the most outer cover of the tree we normally consider it as a byproduct of the timber production process, because as we saw in the previous lectures we are more interested in the diameter under bark.

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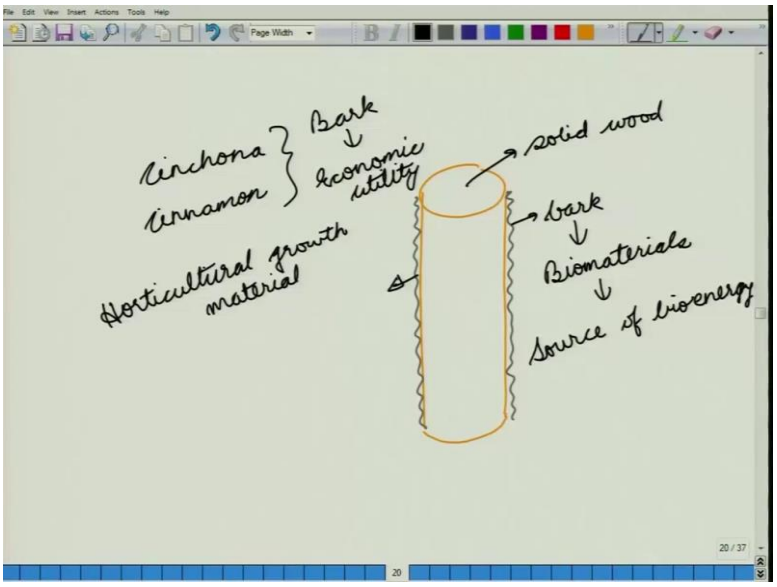

So, because these bark it forms a loose sheath all around. And so, this is our bark and this is our solid wood. So, in most cases we are interested in the solid wood for it is mechanical properties and for it is use in industries.

So, bark is generally considered a byproduct of the timber production process, but in some cases the bark may have it is own utility, say in the case of cinchona or in the case of cinnamon. So, cinnamon also known as dalchini is the bark of a tree, similarly the bark of the cinchona tree gives the quinine. So, in these cases bark has it is own economic utility. And it is not just a byproduct of the timber production. Now when a bark is a byproduct of the timber production there is well bark is made out of biomaterials. And in the case of a tree it is mostly carbohydrates. So, this might also be having say cellulose and other a byproducts of a cellular reactions. So, this might be used as a source of bioenergy. What we mean in that case is that we can take this bark out which is a byproduct of the timber production, we can chop it up then convert it into blocks and that blocks can be used for heating purposes.

So, they can be used as sources of bioenergy. Now this bark can also be used as a horticultural growth material, why because this bark is made out of a biomaterials and the properties of this bark when it is crushed and when it is mixed with soil it very much acts like humors. So, it increases the water retention capacity of the soil and it also helps plants to thrive. Now let us now have a look at the bark thickness relationship of a tree.

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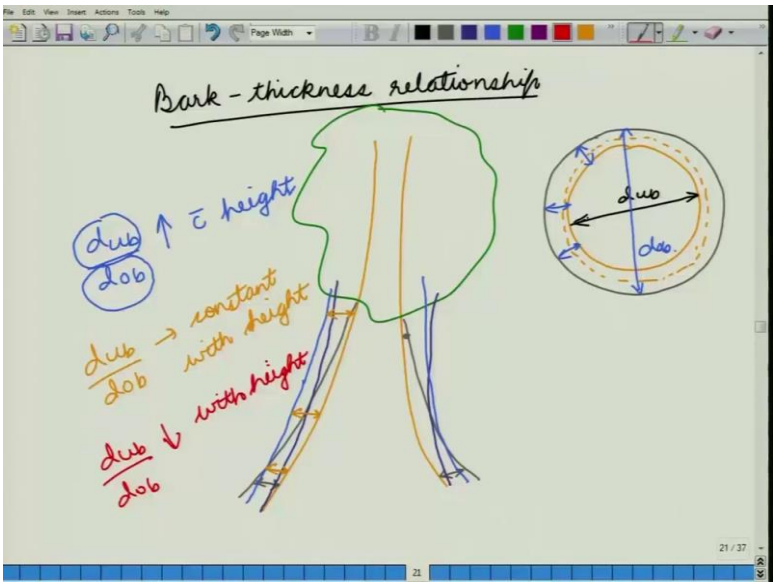

Bark thickness relationship, what we mean by a bark thickness relationship is consider a tree. Now and this tree is having bark.

So, does the amount of bark decrease as we go up. So, in this case at lower heights we would be having a greater thickness of bark as compared to the upper heights. Or we might be having a situation that is just the reverse of it. That is the lower portion has very less amount of bark and the amount of bark goes on increasing as we go up, or in a third situation the amount might be constant in which your bark would be having it would make a parallel sheath as compared to the tree stem. So, what happens? In most species especially coniferous species the ratio diameter under bark upon diameter over bark it increases with height. So, if the diameter under bark is increasing as compared to diameter over bark what it means is that in the cross section of the tree.

So, here we have the diameter under bark and this is the diameter over bark. Now if diameter under bark is increasing as compared to diameter over bark. It means that the thickness of the bark would reduce. So, that is your dub it is moving move towards the outside. And so, the proportion of bark is reducing. So, this happens in most of the species especially coniferous species. In some hardwood species this ratio dub by dob is constant with height. In which case the thickness of the bark is the same whether you look at lower reaches or whether you look at the higher reaches. In some species this ratio dub by dob it might decrease with height, which would mean that the bath volume percent increases with height.

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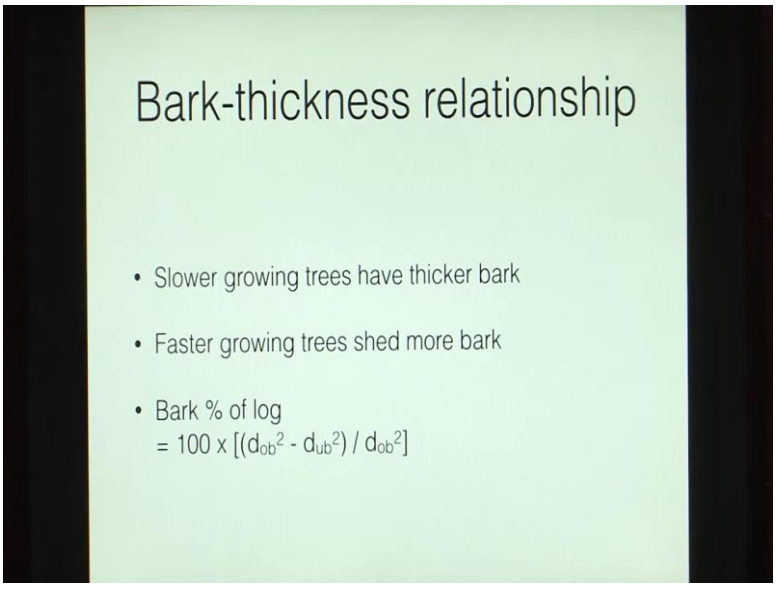

Now, it is known That slower growing trees have thicker barks, because the faster growing trees they shed their bark as they go up. Now we have this equation bark percentage of log. So, we have bark percentage of log is equal to 100 times dob square minus dub square divided by dob square.

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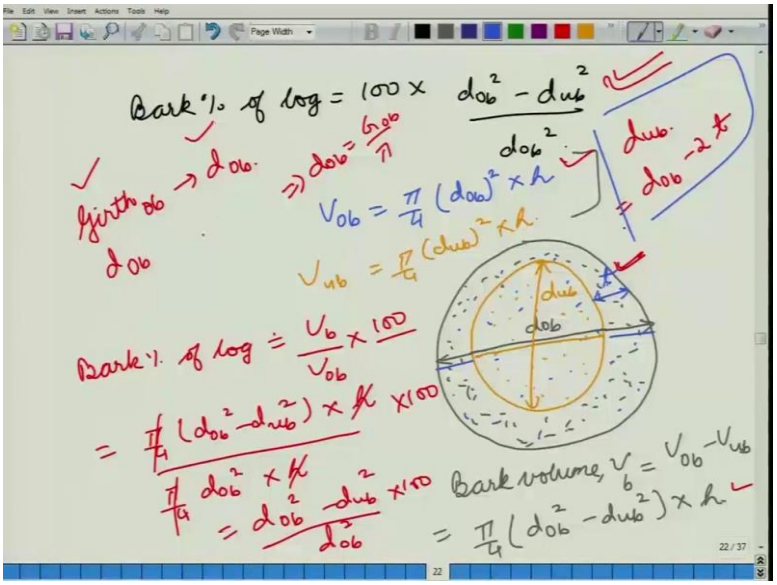

Now can we derive this relationship still it is very easy. So, suppose you have a tree that has bark all around it. So, if we looked at a cross section, it would look something like this. So, you have the inside the diameter under bark and then you have. So, this is the dob, this thing is the dub and this is the bark thickness t.

Now, because this cross section is there all around. So, we might considered this as concentric cylinders. If it were some other form we would just have to multiply it by the form factor. So now, if we consider in this situation what is the volume over bark? The volume over bark is given by pi by 4 d over bark square multiplied by the height. So, it is this volume, what is the volume under bark? Now when we talk about volume under bark we are talking about this volume. So, this is equal to pi by 4 dub it is square multiplied by the height.

Now, what is the bark volume? By bark volume we mean in this volume. So, in the bark volume or let us call it V b is equal to volume over bark minus volume under bark. So, if it took the over bark volume and then subtracted under bark volume format we would be getting the bark volume. So, what is it using these 2 equations it becomes pi by 4 dob

square minus dub square multiplied by height. So, that is the bark volume. So, what is the bark percentage of log this thing is volume under bark thing.

So now to stick another color bark percentage of log, it is the volume of the bark divided by the over bark volume multiplied by 100. So, it is V b we take it from here pi by 4 d ob square minus dub square multiplied by height divided by the over bark volume from here. So, it is pi by 4 multiplied by dob square multiplied by h, and then we need to multiply it by 100. So, pi by 4 and pi by 4 get cancelled h and h get cancelled. So, we get d ob square minus dub square divided by dob square multiplied by 100 which is this formula. So, this is the bark percentage of log.

Now, in some situations we might need to measure the thickness of the bark. Or why should we be we measuring this thickness t? Where is that important? Now this thickness might be important because in the case of a tree it is very easy to get the girth over bark. So, if we are using a tape we can very easily get the girth over bark. We can also get the diameter over bark now if you want to measure the under bark diameter or it is girth or it is volume that we are more interested in we can get it. So, from girth over bark also you can get the diameter over bark.

So, as dob is equal to g by pi. So, we can get the girth and we can get the diameter over bark, but we are interested in the diameter under bark. So, this we can get by subtracting twice the thickness from the diameter over bark because in this diameter over bark we have the diameter under bark and we have a thickness t here and the thickness t here. So, the diameter under bark plus thickness plus thickness becomes the diameter over bark. So, if we wanted diameter under bark we would get from this equation. So now, it is easy to measure this and if we were able to measure this t we would be able to get the diameter under bark.

So, how do we measure of this thickness t?

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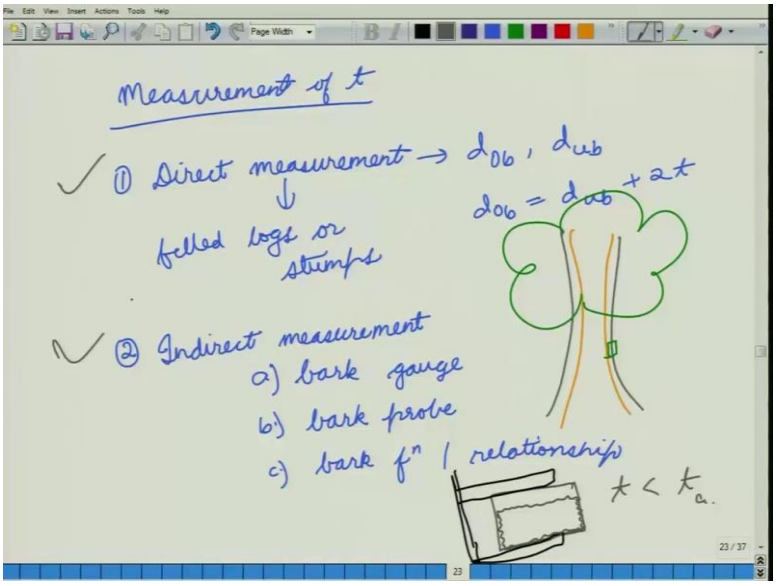

So, here we have 2 ways of measurement one is called direct measurement, direct measurement is what we get from felled logs or from stumps. So, in the case of stumps or in the case of felled locks we can measure the over bark diameter we can measure the under bark diameter, and then we can get the thickness using the relation diameter over bark is equal to diameter under bark plus twice t, but this can be used for felled logs or stumps. Another cases we might go for an indirect measurement. So, indirect measurement can be had using an instrument such as a bark gauge or a bark probe or we might measure it using bark function or relationship.

So now you could also ask that suppose we have a tree, and it has a bark outside could we not just take a sample of this bark and then measure it is thickness say using the calipers. Vernier calipers for instance or by using a as screw gauge well that is possible, but the problem with that approach is that bark happens to be an extremely fragile material. So, if this is your bark and suppose while measuring it is thickness you put one end of your vernier calipers here. You put the other end of the vernier calipers here and you try to tighten it. So, when you tighten it this quotient would very easily become compressed to a smaller volume.

So, the thickness that you would be measuring would be less than the actual thickness. So, which is why we need to go with these direct or the indirect measurements. So, if we have a look at The slide now.

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This is the swedish bark gauge. So, this is a measure of indirect measurement. So, as we can see in this image this instrument has a tip now that tip is a sharp tip and it is spent to go inside the bark. It also has a flange it has a scale and a handle. So, how do we use this instrument? So, again considering a tree with a bark.

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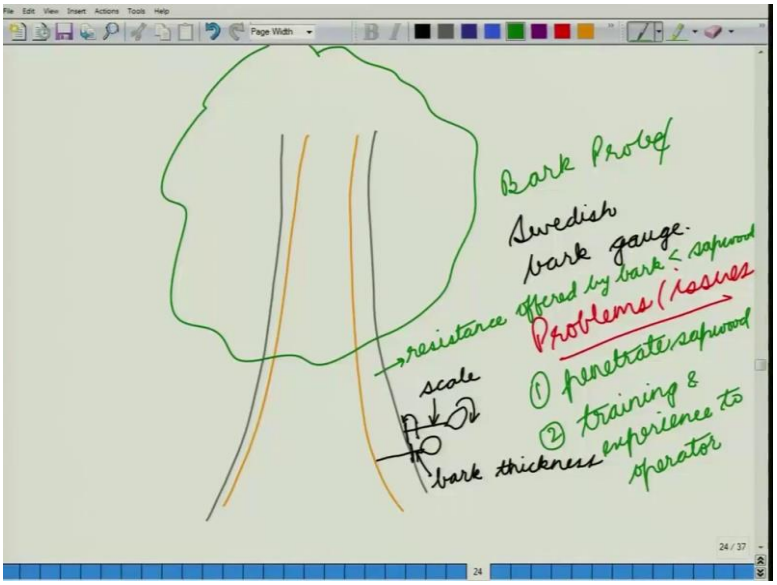

So, to use this instrument you will take the tip. So, it also have a gauge here, and it has a handle here.

So, you take the tip you will put the gauge right in the front. And then you try to rotate it and push it inside. So, once it is inside it would go something like this. Now this flange when it was kept close to at this point it would move. And this portion the stem has the scale. So, once you have put it inside the reading that you get here is the bark thickness. So, this instrument is the swedish bark gauge. So, this is how you measure the thickness of the bark, this instrument also has another variant called as the bark probe. So, if we look at the slides now.

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This is a bark probe.

Now, a bark probe is also a very similar instrument, but in this case it is design is a bit different it also has a scale it also has a flange it also has a handle and the auger is inside at present. Now 2 main problems or issues when we are trying to use this bark gauge or a bark probe in both the cases, the issue lies here the measurement is based on the idea that the resistance offered by bark to these instruments is less than that offered by sapwood, because that is the inside portion it is the more solid portion of the wood. So, it would give us much more resistance as compared to the bark.

So, essentially both these instruments bark probe and bark gauge, they rely on the skills of the operator to be able to feel while he is penetrating the instrument inside the bark he should be able to feel at what point does this bark this instrument has reached inside of the bark and as reach the sapwood. Now that might be easy for some species, but in some

other species the sapwood might also give very less resistance to the instrument. So, in those cases it would become difficult for the operator to discern whether the instrument has already penetrated the bark or whether it has penetrated at the sapwood. So, he might just go on pushing it inside and inside and what you we would be measuring is not the bark thickness, but the bark plus sapwood thickness which would be a wrong measure.

So, that is the first limitation that it is it the it might penetrate sapwood. So, what is the way out? The way out is to give much more training and experience to operator, but once you try to do that the process becomes much more expensive. Let us now have a look at the other indirect method that was the bark function or relationship.

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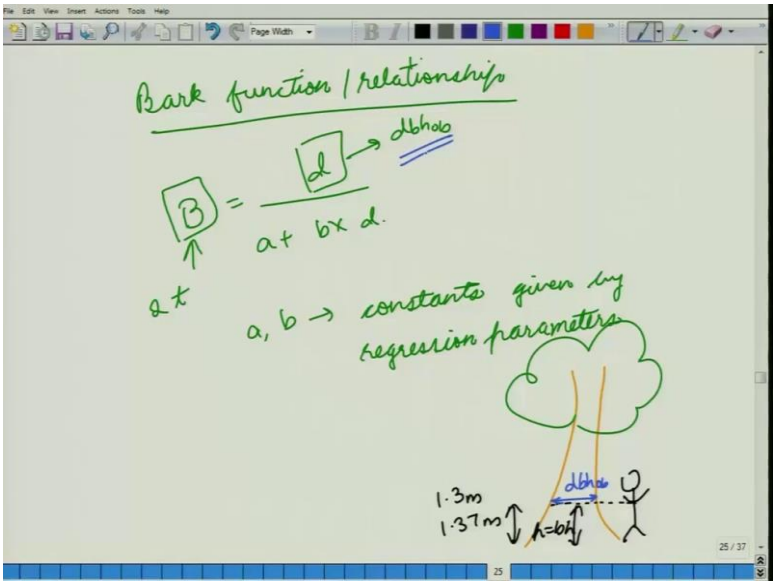

Now in the case of a bark function or relationship it is given by a generalized equation, where b which is twice the bark thickness is equal to d which is your dbh over bark divided by a plus b times d. Where a and b are constants given by the regression parameters.

So, what we are trying to do in this case, is that we are trying to find out a relation between the bark thickness and the over bark dbh. Now dbh over bark can very easily be measured for a tree. So, it is the diameter over bark at the breast height. So, if you remember what the breast height is. So, if you have a tree and you have an operator that is standing right next to the tree breast height is roughly equal to the chest height it does 1.37 meters in the case of indian conditions or it is 1.3 meters for some other countries

and at this height h is equal to breast height you measure this diameter. And you are measuring the diameter over bark. So, this is dbh over bark the over bark diameter might be measured either using tapes or by using calipers.

So, once you have these readings of dbh over bark can you get the bark thickness for that particular tree. So, this is a table of bark relationship.

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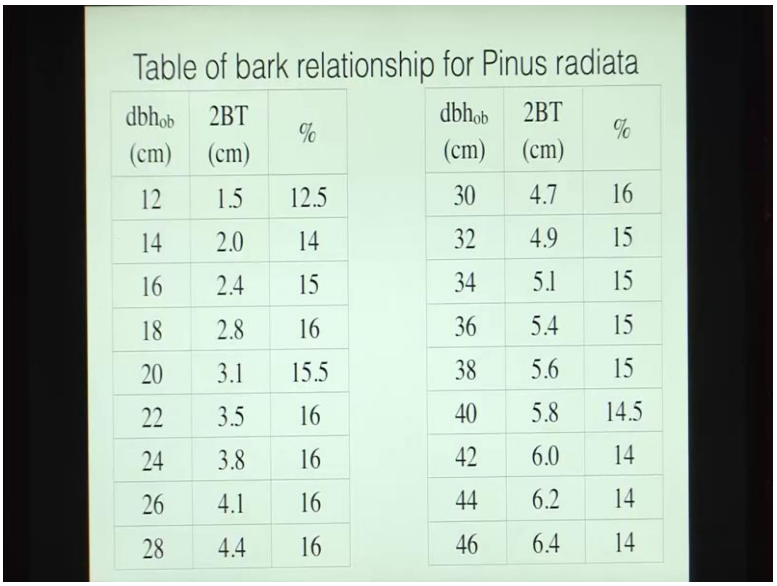

For pinus radiata. So, here you can see in the first column we have diameter at breast height over bark in the second column we have twice of bark signals that we have a represented as capital b. And the third column gives us the percentage. So, as we can see from this figure as the dbh over bark increases. So, you have the bark percentage going from 12.5 through 14 15 and 16 in that it reduces again from 15 to 14.

So, if we had this table and this is a generalized table taking a number of readings. So, if we went to any pinus radiata tree and we if we measure it is dbh over bark we would be able to get the bark percentage and the bark thickness. Now another instrument that works very similar to that of this bark gauge is called an increment borer.

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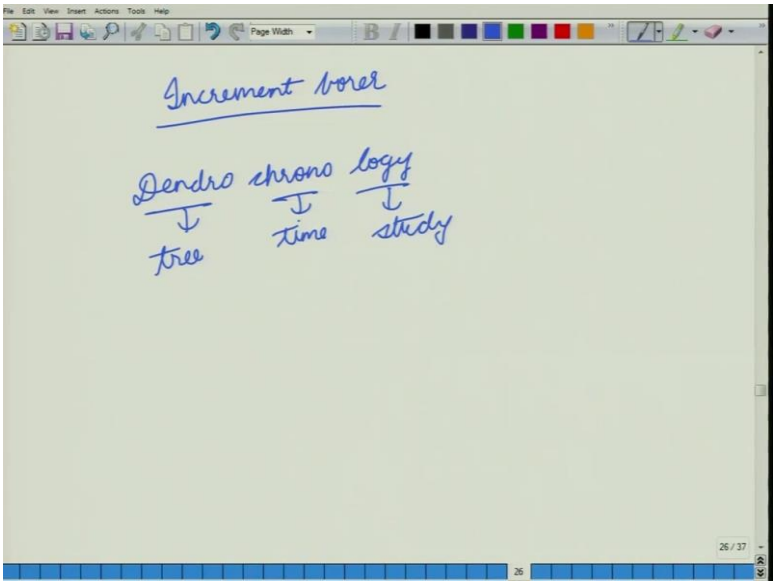

Now increment borer is used for the collection of samples for dendro chronology. Dendro is tree chrono is time and logy is study. So, this is the science that deals with time as measured from tree growth rings.

So, if you look at the slide now. So, the slide gives us a required reading that you are required to go through. So, this is a paper by grissino mayor 2003.

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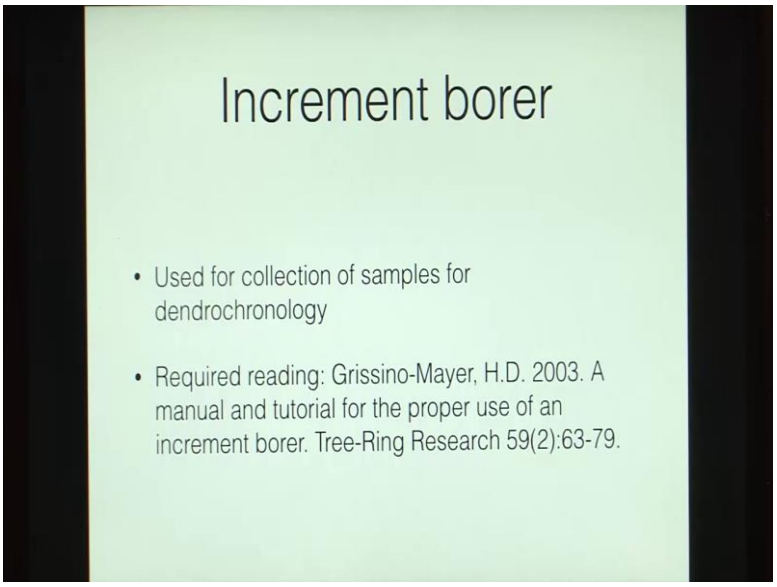

A manual end tutorial for the proper use of an increment borer. Now an instrument borer is used in a very similar fashion to that of the bark gauge.

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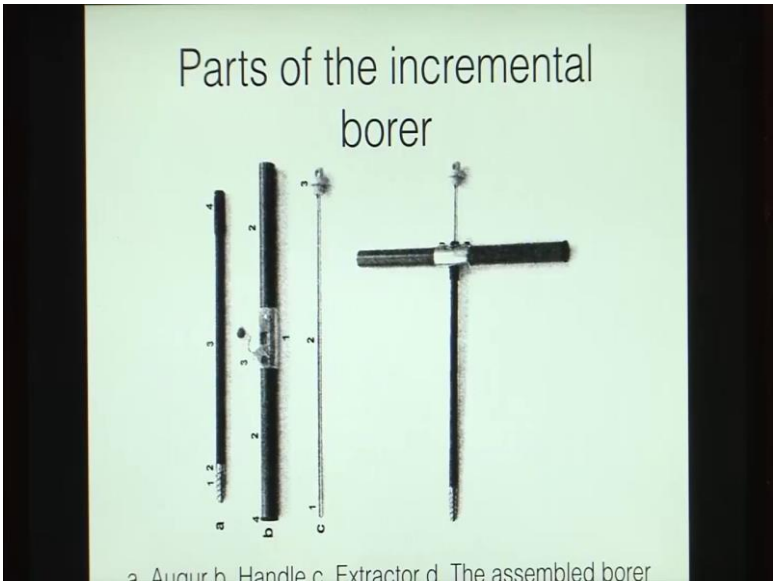

So This slide now tells us the parts of the increment borer. So, it has got 3 parts. Or if you go from left to right it has an auger, a handle and an extractor. And then on the very end we see an assembled borer. So, how does this instrument look like.

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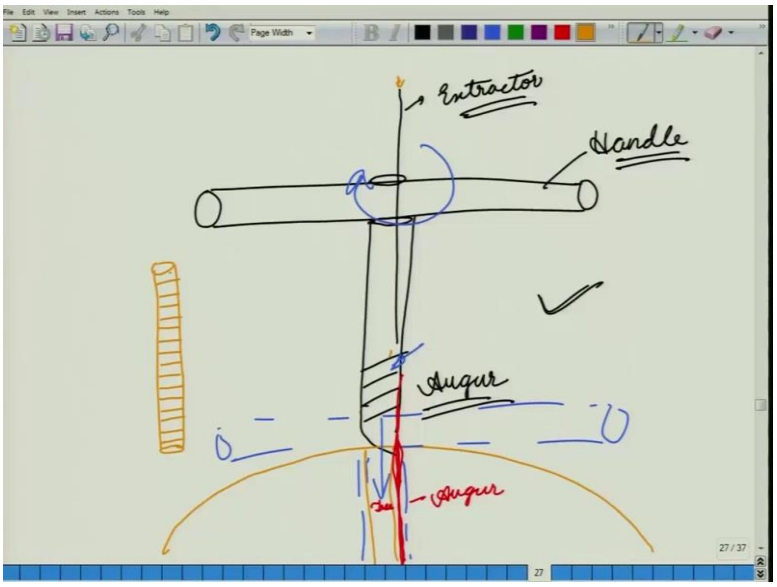

So, it has a handle Which is very much like a cylindrical pipe.

So, this is your handle. In this pipe we have a hole here and a hole here on which we fix the augur. And then from this hole we can push inside the extractor. Now the beauty of the instrument is that you can put the auger and the extractor both inside the handle and

then carry it in your west. So, how do we use this instrument? This portion has got some screw like a linings. So, this is how you use the incremental borer. If we look at the slide on the left side it shows us an incremental borer being used. So, if we now move back to the diagram you take the auger portion and then you rest it against your tree.

So, if this were your tree you would rest it against it, then you would turn your instrument So that your auger is able to go inside. So, this is the direction of the auger. So, after a while your auger would be inside, your handle would be somewhere like here, or depending on till what tips do you want to go inside the tree this augur would have now a chunk of the tree inside it. So, this would be a chunk of the tree that has gone inside the augur. Then you put the extractor inside this hole. So, this extractor would then go somewhere here between your auger and the tree. So, this is your augur this is your tree and your extractor goes in between both of these. And then you are able to take this core outside. So, when you take this core outside it would be like a cylinder with all your tree rings as seen on the surface.

So, these are the annual rings of the tree. So, essentially what you have done is that you have taken this tree with it is annual rings.

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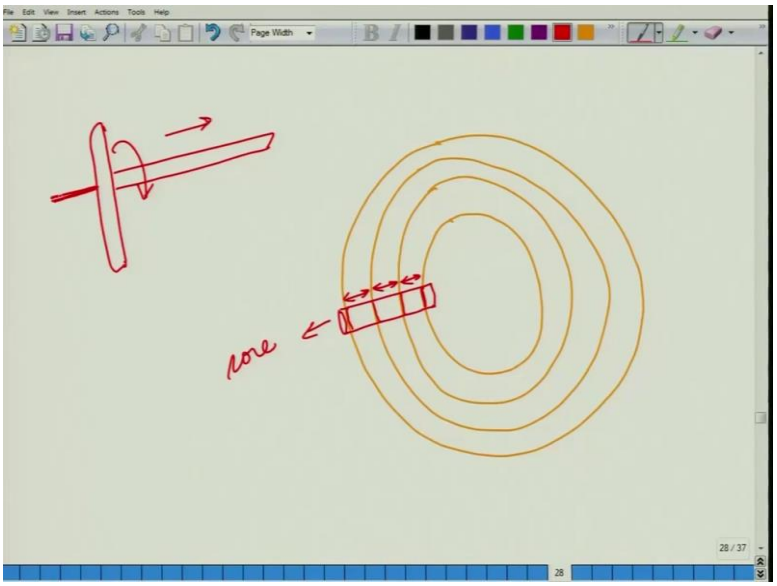

Then you have taken a portion of it outside in the form of a cylinder. So now, the cylinder will show you markings that are roughly parallel to each other. So, you can use this core this portion is called a core to measure the distances between the various rings

with time now because every ring shows you one year in the life of the tree you can go as much bark in time as you wanted to. Now coming back to the slide the right hand side figure shows you a helping device. So, what it does is that in the case of your normal operation, you have the augur and you have this handle and you are moving it you are turning it to move inside.

Now, while turning you are also required to put a force towards the tree. So, you can also use a starter, a starter is another device that has a flat tip that you can rest against your chest. So now, if you move back to the slide. So, in the slide in a the right hand side picture you can see that this person is having this aid towards his chest he is resting it with it is chest and he is ah leading towards are a tree in question to apply that the pressure towards the tree, So that the augur is not only able to rotate on it is axis, but is also able to penetrate inside the tree. So, incremental borer is an instrument that we used to take the core out for a study in the science known as dendrochronology.

Thank you for your attention. [FL]