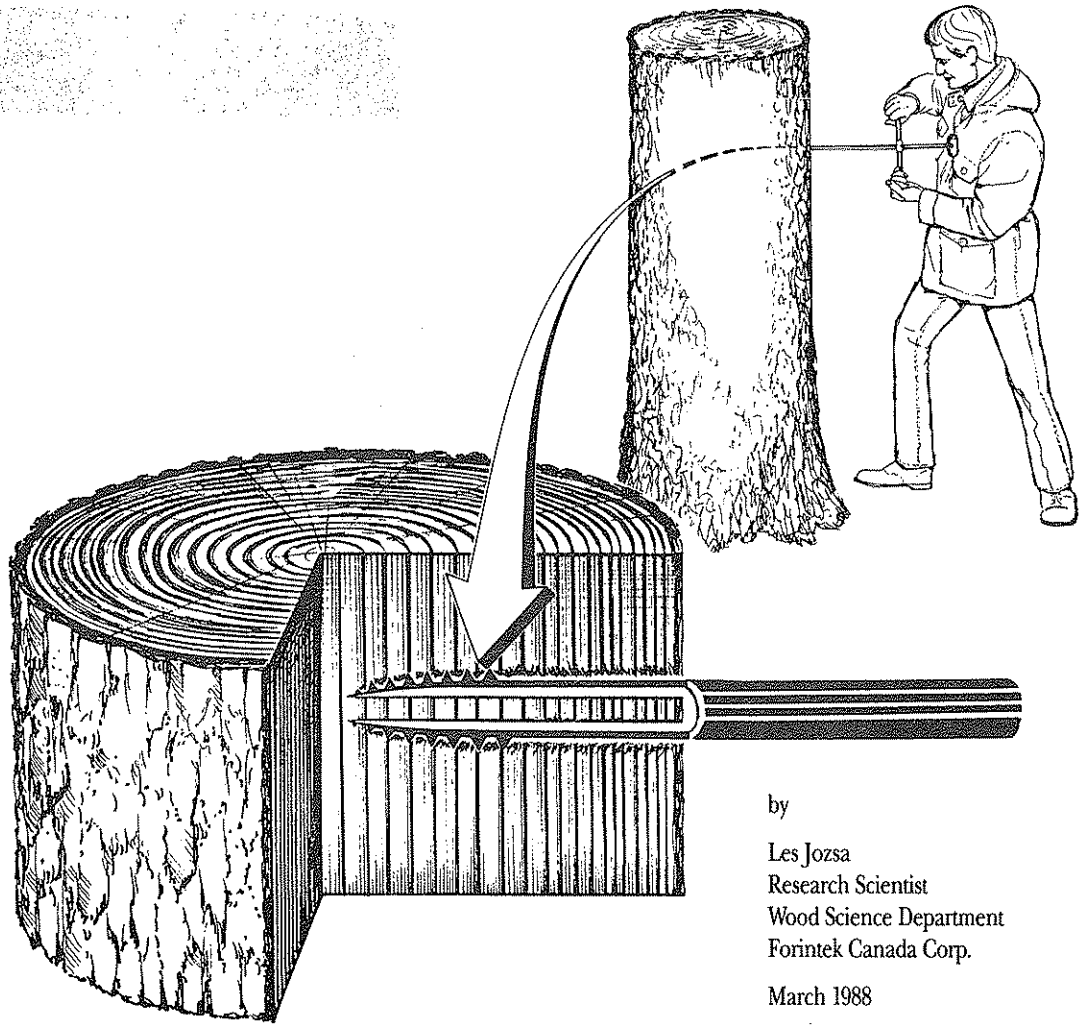
B.K. Adams

INCREMENT CORE SAMPLING TECHNIQUES FOR HIGH QUALITY CORES



by

Les Jozsa
Research Scientist
Wood Science Department
Forintek Canada Corp.

March 1988

Forintek Canada Corp., is Canada's wood products research institute providing the Canadian wood products industry and governments with services in research and development and technology transfer.

Forintek's mission is to be the leading force in the technological advancement of the Canadian wood products industry, through the creation and implementation of innovative concepts, processes, products and education programs.

Forintek Canada Corp., est l'institut de recherche sur les produits du bois du Canada. Forintek offre à l'industrie canadienne des produits du bois et aux gouvernements des services de recherche, de développement et de transfert technologique.

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Laboratoire Vancouver Laboratory
6620 N. W. Marine Drive
Vancouver, B.C. V6T 1X2
Telephone (604) 224-3221
Telex 04-508552

Laboratoire Ottawa Laboratory
800 Montreal Road
Ottawa, Ontario K1G 3Z5
Telephone (613) 744-0963
Telex 053-3606

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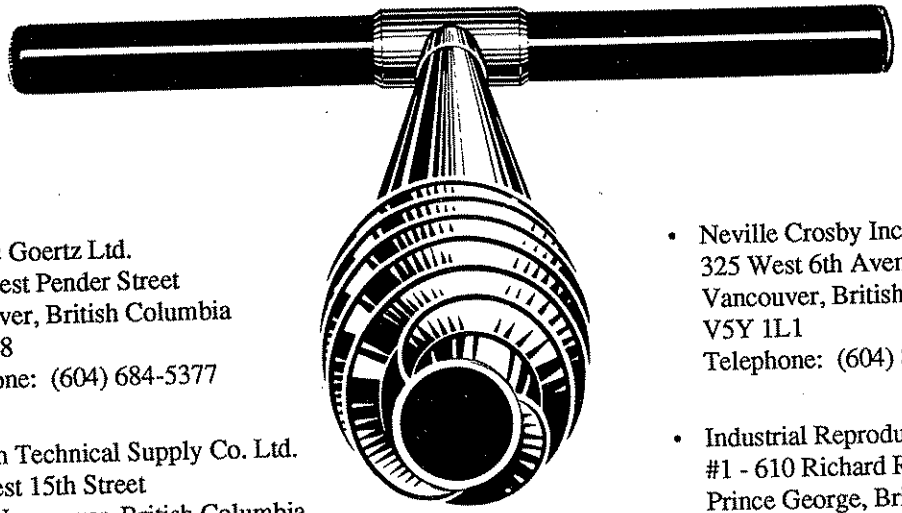

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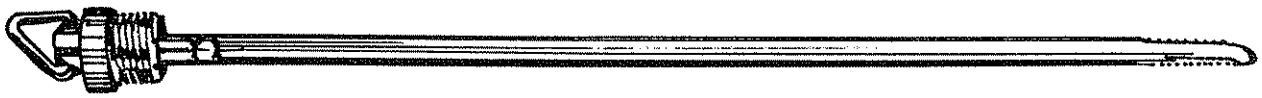
THE ANATOMY OF AN INCREMENT BORER IN RELATION TO AN INCREMENT CORE

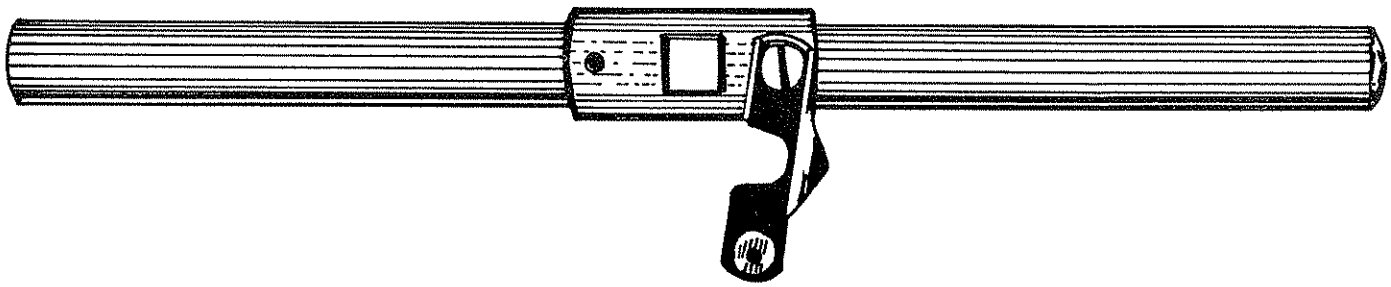
The increment borer has three parts:

1. Core extracting spoon



2. Core barrel with threaded bit

3. Turning handle



Increment borer in its carrying mode

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INTRODUCTION

Increment borers are the most widely used tool for extracting a core of wood for: studying growth rate, age, and decay in living trees; obtaining material for evaluating parent tree wood density for tree improvement programs; X-ray densitometric ring width and density determinations; measuring the depth of preservative impregnation in poles and timbers; testing the condition of wooden structures such as boats, bridges and buildings.

The use of increment borers is so widespread that at Forintek alone, thousands of cores are handled and analyzed for tree growth and wood quality each year. Unfortunately, these cores are often received in a very poor condition, resulting in excessive handling times and difficulties with precision and accuracy in various wood quality determinations.

Admittedly, in a forest products research establishment our quality requirements are more rigorous than if one were to take cores only for a quick age or growth-rate determination. Still, with good quality cores one can do even these in-the-field tasks much more efficiently.

In general improved core quality translates into considerable savings of time and expense. At the same time the accuracy and precision of ring width and density determinations increases.

Common quality defects in most increment cores are:

1. rough, broken core surfaces because of dull borers;

2. corkscrewing for the first 1 to 2 cm near the bark from a wobbly free-hand start and directional change, often resulting in broken cores and missing outermost rings;

3. discoloration and decay because of improper storage of perfectly good cores.

Dramatic improvements in core quality are possible by following simple instructions, provided the information is comprehensive and includes increment borer selection, the anatomy of increment borers, the basics of the coring procedure, maintenance, and sharpening.

The purpose of this increment borer owner's manual is to provide the reader with a number of increment core collection "tricks-of-the-trade" which will help one in collecting consistently high quality cores. It is aimed at a wide audience, from novice to experienced workers.

Forintek Canada Corp.

WHAT KIND OF INCREMENT BORER TO BUY, AND WHERE

Most increment borers on the market today have been manufactured in Finland or Sweden. They come in a wide range of lengths and diameters, either in two or three thread style. For commercially important softwoods in Canada, the number of threads are of no importance in obtaining good quality cores; it takes about the same physical effort. Almost all borers are now Teflon-coated to minimize friction. Unfortunately the Teflon coating tends to wear off first where there is the most friction and where it is most needed - on the tapered threaded bit.

For most routine forest growth evaluation and dendrochronological work, **the 5-mm diameter cores are much more convenient to handle than the nominal 4-mm ones.** Other core diameters can be obtained as

5 mm

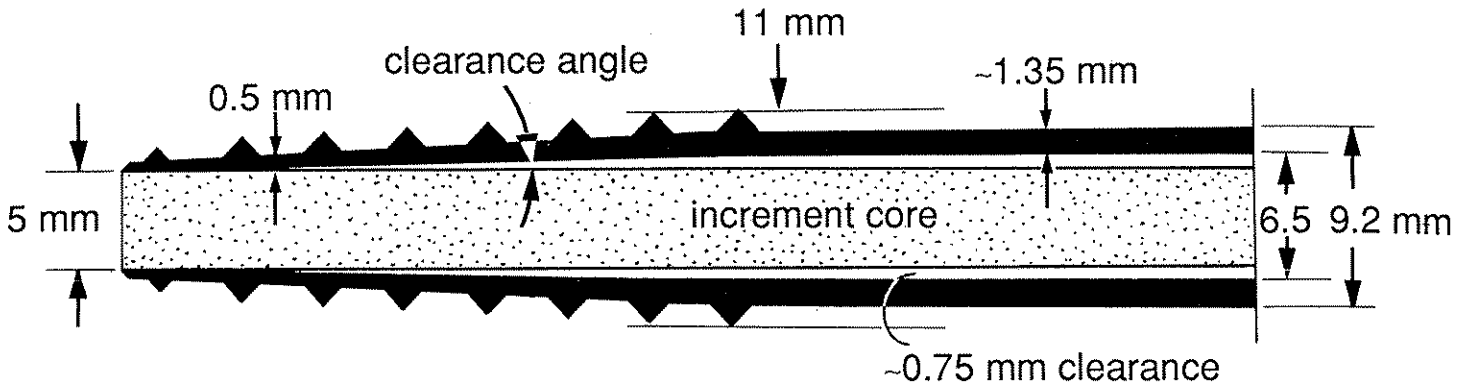
4 mm

well; 8, 10 and 12 mm. As a rule, the larger diameter cores are taken to obtain sufficient sample size for fiber length measurements. Increment borers are manufactured in various lengths from 150 mm to 1000 mm (6 to 40 inches). Usually the cost is directly proportional to the length (of course, the longer ones being the most expensive). The most popular lengths are 300, 350 and 400 mm (12, 14 and 16 inches), although in the Pacific Northwest, longer lengths are often needed to reach the centre of larger trees.

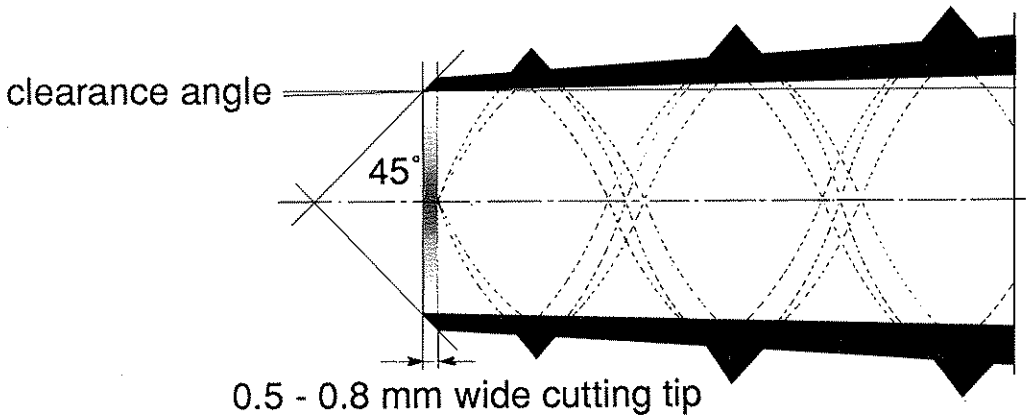
An important thing to remember when purchasing increment borers is that **a brand new increment borer is not necessarily sharp.** At Forintek we prefer borers where the spacing between the cutting edge and the threaded bit is substantial. Unfortunately, all too often, the start of the spiral is less than 0.5 mm from the cutting edge, reducing the "life expectancy" of the borer and making hand sharpening awkward.

We have used many brands of increment borers, including Djos, Haglof, Mora, Suunto, and Sandvik (no longer on the market) and we have found all of them to be excellent hand tools when properly maintained. In other words, a well sharpened borer will cut good quality increment cores regardless of brand name. One annoyance we have experienced over the years is that certain manufacturers have changed the core extractor thread design (so a new one will not fit into the older borer) and the size of the square hole in the handle (again, resulting in a misfit).

Increment borers can be purchased at forestry equipment and supply distributors. A comprehensive list of supply sources is not included here because of the difficulty in preparing an all-inclusive agency list. However, if you have difficulty in locating a distributor in your community, the Canadian and United States representatives of Hagloff and Suunto borers are as follows:



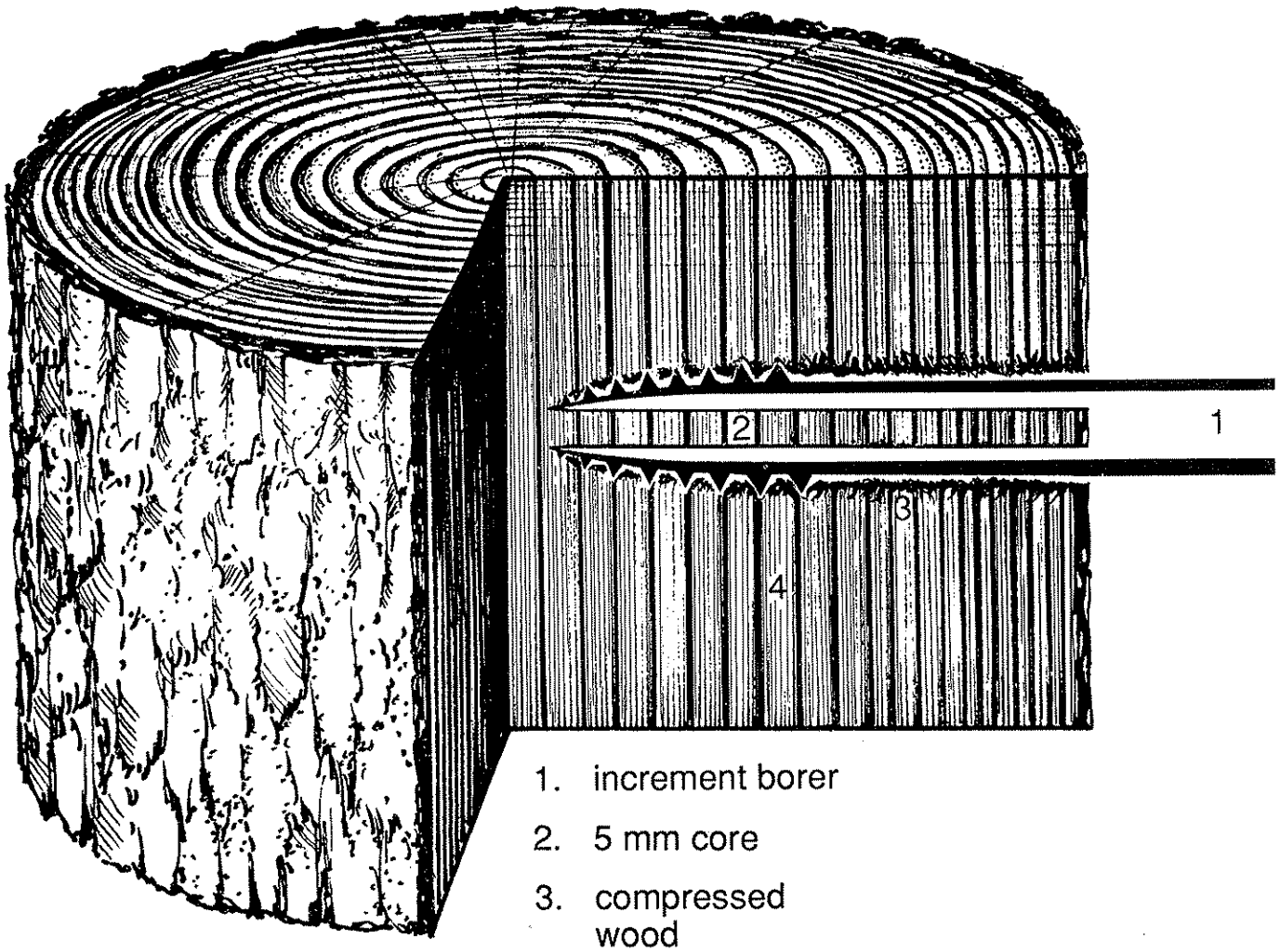
Longitudinal section showing the pinched down tip; note the seemingly fragile average dimensions in the drawing which was drafted to scale.



The all-important cutting edge in front of the threaded bit - often overlooked by both manufacturers and purchasers. Avoid borers that have the start of the spirals (threads) right on the cutting edge.

When you are travelling by air the best way to transport your increment borers is in your hand luggage. If they don't fit, carry then separately. In either case declare them when you check in. Rightfully, airport security gets curious and sometimes upset during check-in and security clearance if they don't know what they are looking at. For example, at the height of high-jackings in the 1970's one laboratory Director in the U.S.A. got into "trouble" because of an increment borer, although it was packed in his suitcase. After much delay he was summoned on the public address system to a security room. Here, to his horror, he was confronted by an agent standing by his drenched suitcase, holding his increment borer, and asking in a perplexed voice, "What the hell is this?"

The Anatomy of the Borer in Relation to the Increment Core

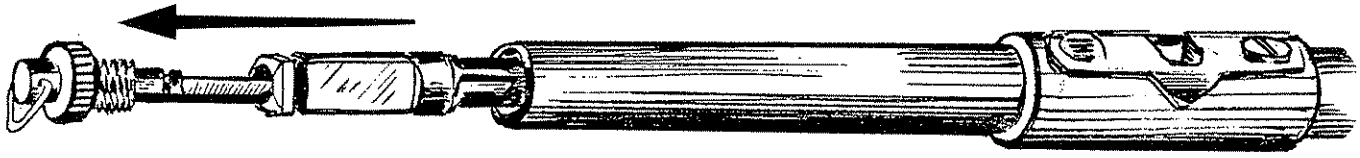


1. increment borer
2. 5 mm core
3. compressed wood
4. vertical grain orientation

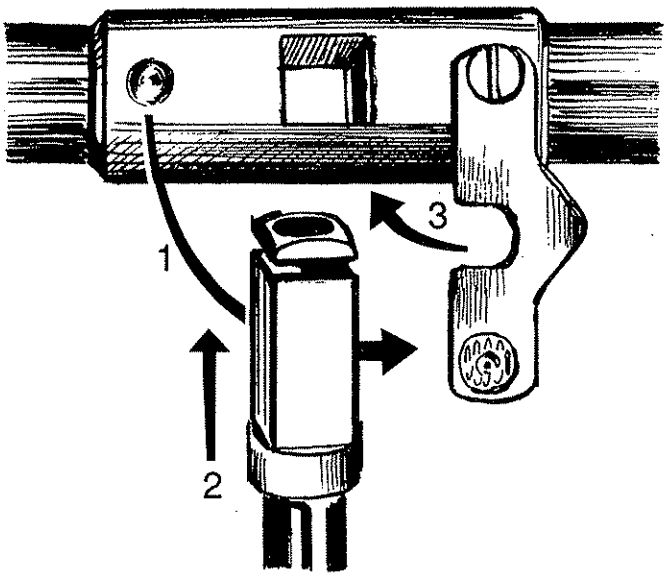
Note that as the borer advances into the tree trunk (right to left) the wood tissue is compressed by the tapered threaded bit and cams. The compression gives clearance for the 9 mm diameter shaft and permits the shaft to turn freely, while the cutting tip punches out the core like a cookie cutter. Please note that the increment borer was drawn with an exaggerated vertical scale for illustrative purposes only.

STARTING THE INCREMENT BORER AND TAKING THE CORE

A. Unscrew the locking knob on the handle.



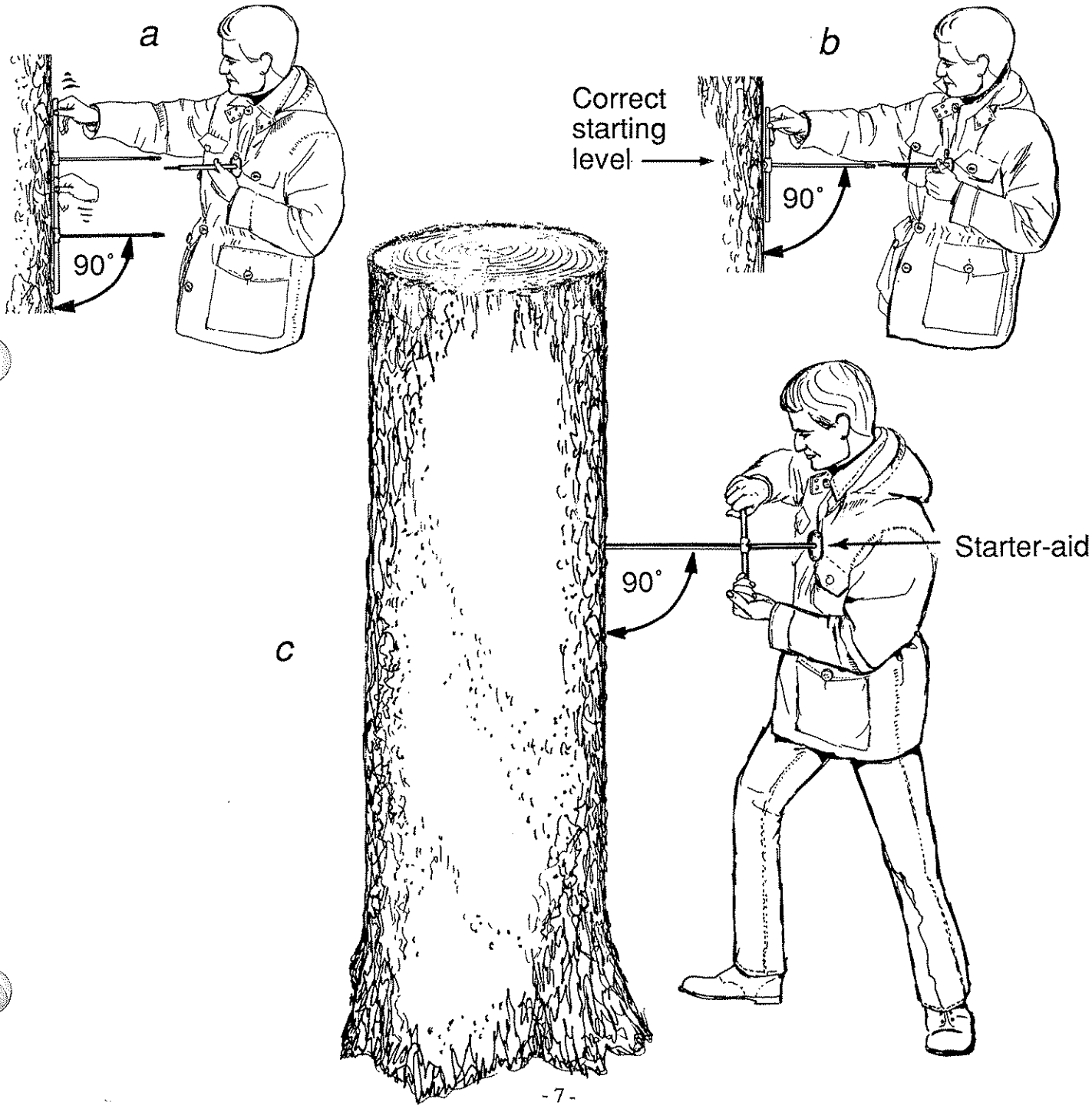
B. Pull out the core barrel from inside the handle. Set core extractor spoon aside.



C. 1. Swing out the catch. 2. Insert the core barrel in the handle.
3. Swing the catch back into the notches in the upper end of the core barrel.

- **How to establish coring position for optimum grain angle.**

Place the borer handle on the tree trunk with the spiraled bit pointing towards your chest. Raise or lower the borer, by sliding the borer handle on the tree trunk (a), until the desired height level is reached. By holding the borer starter (described below) on one's chest (at breast-height) and noting the correct starting level on the tree trunk (b), one has established the coring position for perfect grain angle. All one needs to do now is to turn the borer around and start drilling towards the pith (c).

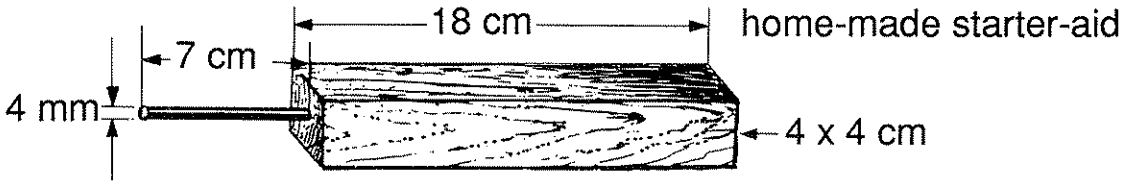


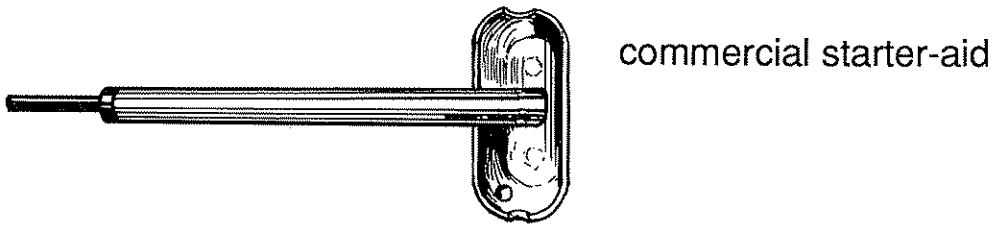
- **When to push and how hard.**

  At the start until borer engages and penetrates into the tree about 3 cm; push moderately hard.

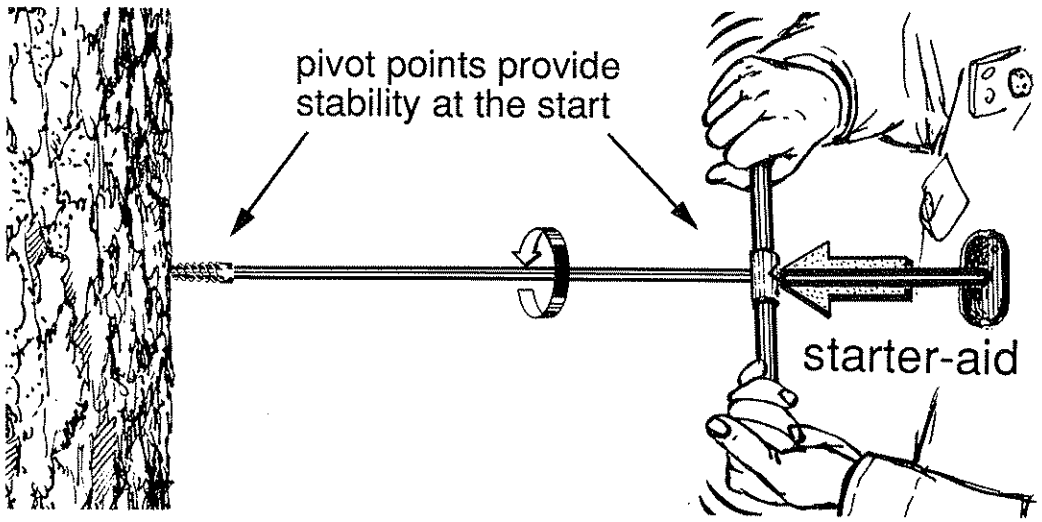
- **How to prevent cork-screwing.**

  Use home-made or purchased starter-aid for the first 3 cm of penetration into the bole. A short piece of two-by-two lumber with a nail sticking out one end works quite well. It is important that the nail be of substantial diameter (4-5 mm) to prevent buckling of the starter-aid with the increment borer.





The increment borer starter-aid frees both hands and maintains proper borer alignment. Most importantly, it provides a stable pivot point for the core barrel which prevents corkscrewing. Slight body lean towards the tree helps the threaded bit enter the wood.

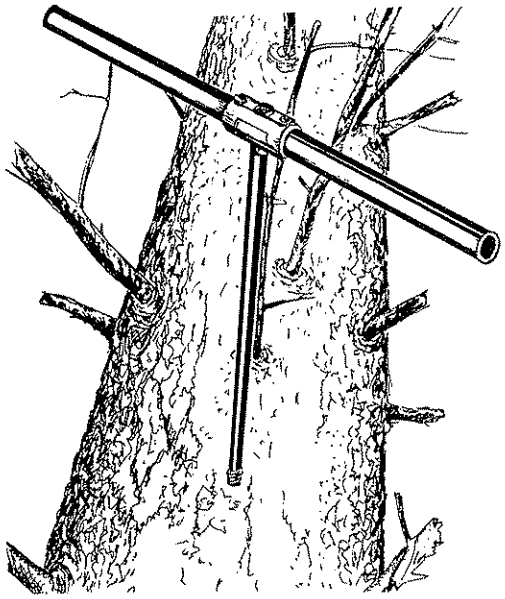


- **Avoid branch whorls on trees.**

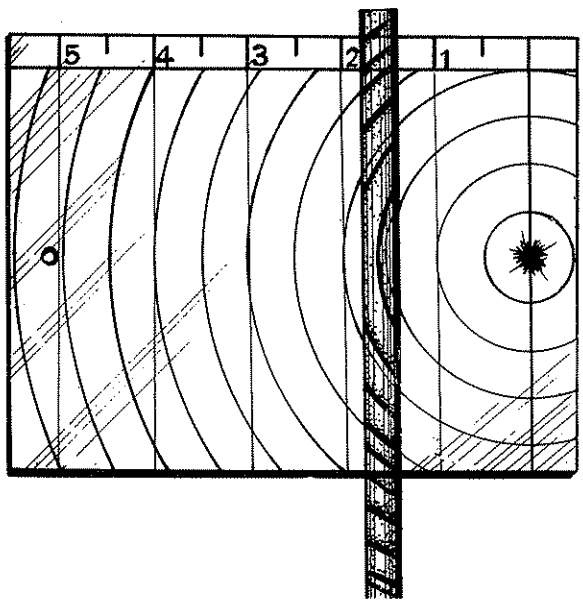
  Boring directly into knots should be avoided. Usually there are some signs of swelling and evidence of branch stubs even on older and bigger trees.

- **How to find the pith.**

  The increment borer should penetrate directly toward the pith which may not necessarily be at the geometric centre of the tree. Use branches above (or branch stubs) to guide you towards the centre; they all point to the pith. Remember, even experienced workers sometimes have difficulty hitting the pith (especially if they are being watched by inexperienced colleagues). If it is important to hit the pith, the chance of doing so on the second attempt is much greater if one uses the "offset" method (coring parallel, but offset from the first attempt) rather than the "intercept" method. The reason for this is simple. Using a home-made template, the offset can be measured from the ring curvature with a ruler. With the intercept method measuring the proper angle and keeping the borer in that alignment is more difficult.



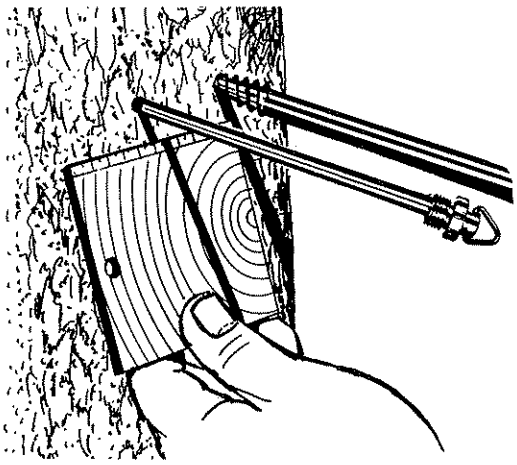
Using branches as a guide towards the pith



Home-made pith locator fitted to the curvature of the annual rings

Note the right/left orientation on the off-center core. Measuring the distance by which the initial core had missed the center of the tree the second attempt is made offset but parallel to the original bore hole. Placing the extractor spoon in the first bore hole, protruding about 10 to 20 cm, one has a good guide for the second attempt. Remove the extractor spoon (so that it does not interfere with the handle) when the new parallel direction is established. This maneuver takes a little practice to perfect (especially if the tree moves its botanical center between the two attempts).

Look at cut stumps or cross-sections sometime to see the differences occurring in location of the pith. Rarely are trees truly circular in cross-section.

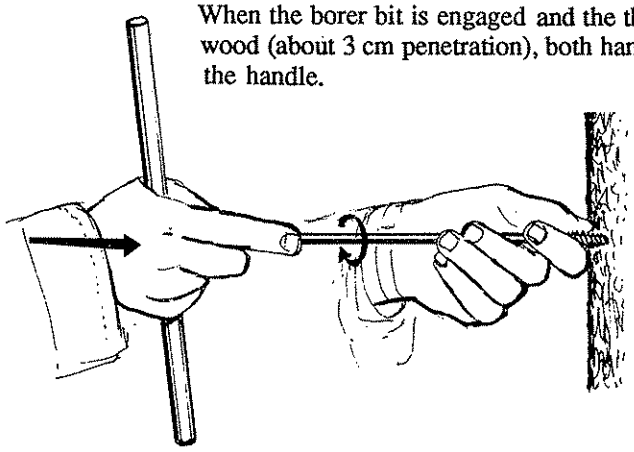


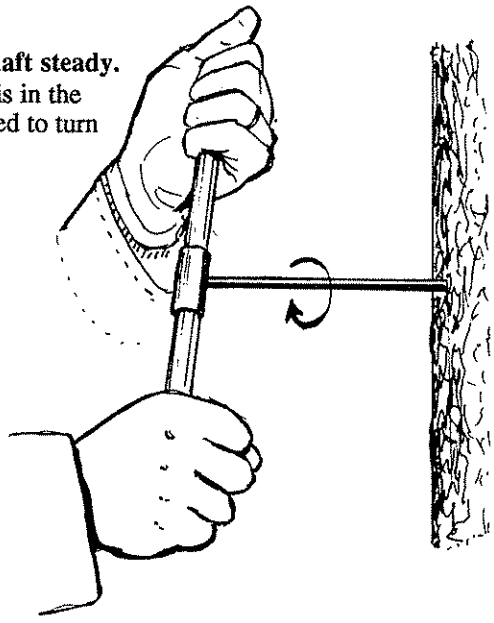
Measuring the distance of offset and the direction of the second offset attempt to the pith

- **Hand starting (when core starter is not available or cannot be used).**

Before inserting the borer into the tree, place your left hand close to the threaded bit to guide the penetration. The right hand is placed at the center of the borer handle. Push moderately hard and turn clockwise at the same time.

Pay extra special attention to holding the borer shaft steady. When the borer bit is engaged and the threaded part is in the wood (about 3 cm penetration), both hands can be used to turn the handle.





After the desired depth is reached, insert the core extractor spoon into the core barrel so that it faces upwards. Turn handle one full revolution anti-clockwise. This will break the core. Pull out the core extractor spoon together with the core. This alignment will then allow you to determine to which side the pith is if it has been missed. Label the core near the bark, in the sapwood zone, using an indelible pencil.

- ## How to test trees for decay.

When coring old trees, many with rotten centers, use the back of the axe to "sound" each tree. Strike a blow to the tree with the back of the axe, and listen. A hollow tree sounds like a drum. After some practice, one can also detect rot pockets by the sudden change in boring resistance as well; in decayed wood, the increment borer turns freely with very little effort. Conversely, a sudden increase in resistance means that the borer has hit a branch stub; do not force it, back off.

- ## How to test for decay and core compression.

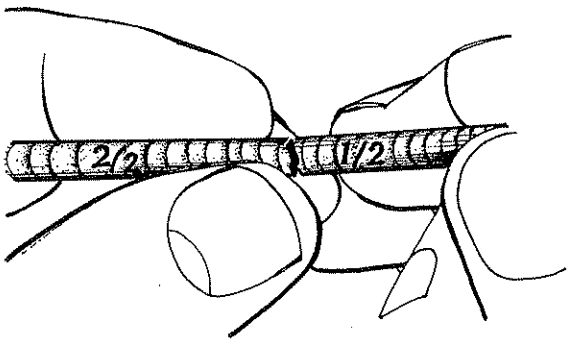
Insert core extractor spoon into the core barrel and push it in until the spoon tip reaches the bark. Hold the spoon firmly at the point where it enters the core barrel. Then remove the spoon and align it along the core barrel, pointing towards the tree. If the measured length of the spoon is the same length as that portion of the borer protruding from the tree, then the wood is solid. In the case of rot, this distance is greater because the core is compressed in the core barrel. Do not proceed, remove the core and the borer.

- ## Sampling small trees.

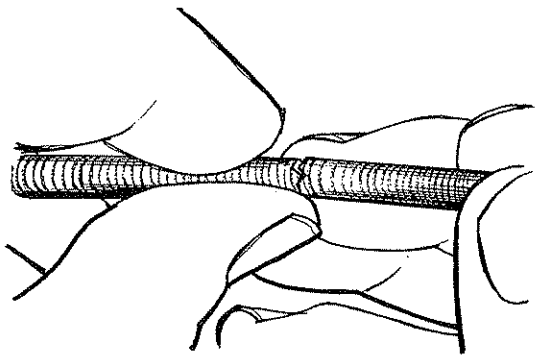
If a bark-to-bark core is taken from smaller trees, special precautions must be taken to ensure that the tip of the extractor spoon does not break off the far end of the core. Before the extractor is inserted, push the core back into the borer and away from the cutting tip (bit), about 3 cm (1.5 inches), with a piece of wood such as a twig. Then, holding the twig in place, insert the extractor spoon and remove the core.

- **Sampling very large trees.**

  Take the first core with a short borer (e.g., 400 mm or 16 in.). Next, using a longer one (e.g., 700 mm or 28 in.), enter the same bore hole from which the first core was taken. Take the second core. Then, if you have not reached the pith (and the tree still has sound wood), take a third core from the same entry hole with the 1000 mm (39 in.) borer. Interestingly the cores match perfectly where they were sheared off from the tree. The advantage of this "incremental" approach is that if you hit a rot pocket half way in, you will have used only the more inexpensive short borers.



These two cores were taken with a 700- and a 1000-mm long increment borer, from a living Douglas-fir tree, 3 m DBH. There were a total of 942 annual rings on the two cores. About 100-150 rings adjacent to the pith were missed because of tree size.



This is one of two "joints" from three core subsamples from a living 1200-year old yellow cypress tree, 2.96 m DBH. Note the excellent fit of the two broken core ends. (Interestingly, both of these big and old trees are growing within 20-25 km of downtown Vancouver, B.C., Canada.)

- **How to avoid taking cores of compression wood.**

  Avoid sampling leaning stems. If leaning stems must be sampled, take cores at right angle to the plane of lean. A more subtle problem occurs with sampling sites that are exposed to prevailing winds from one direction. Although stems will be nearly perfectly upright, stem cross-sections will not be circular but elliptical. To avoid compression wood take your cores at right angle to the long axis of the elliptic stem.

- **Sampling log cabin logs, totem poles and other dry dead wood.**

  With dry dead wood, an extremely sharp cutting edge is a must, otherwise the borer will crush and fragment the core. As a rule, there is no need for a "starter block". For example, the author has taken good quality cores from 150 year old western red cedar totem poles.

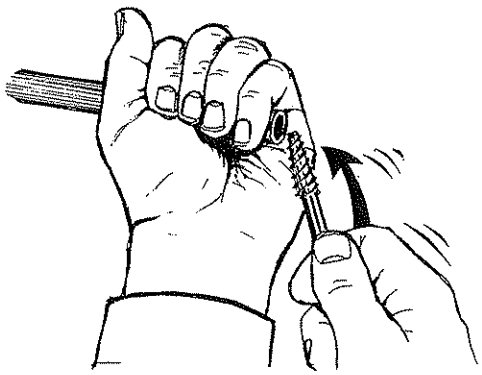
• Problems with core extractor spoon?

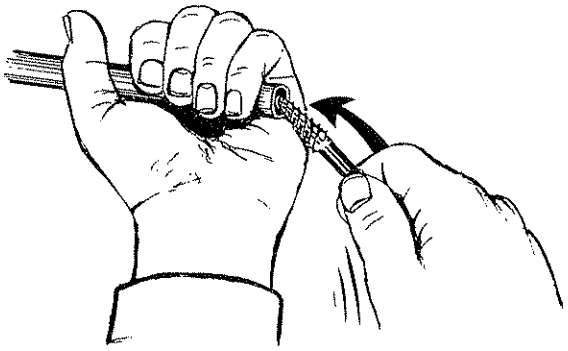
If the core extractor spoon is too tight it will score cores, if it is too loose, it will not grab the core.

If too tight, tap with a hammer to open tip of spoon, or you may want to file the serrations inside the spoon. If too loose, pinch together slightly with a pair of pliers.

Insert extractor spoon upside-down in the top of the core barrel for long cores. Long cores tend to slump to the bottom and there is more clearance on top. Be careful about determining pith position (a half turn anti-clockwise "flips" the pith).

After taking the core, immediately remove the borer from the tree. Resist the temptation to do age count, labelling, and visual examination until after the borer is taken out of the tree. The reason for this quick action is springback. Compressed wood, surrounding the borer shaft, does springback with time. Of course, when that happens, the borer is stuck for good.





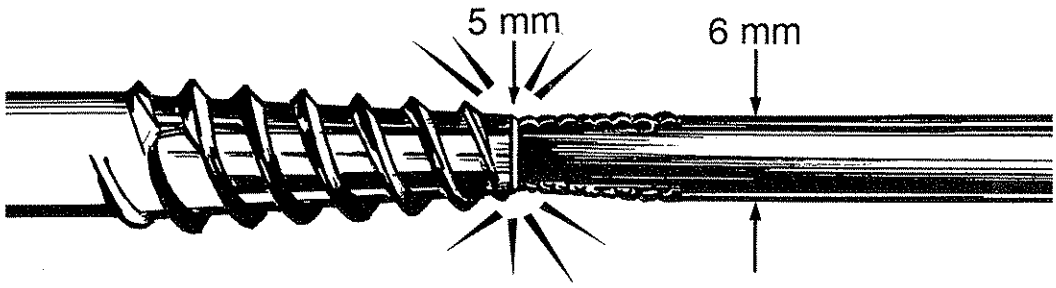
• Putting core barrel back into turning handle.

Even putting the core barrel away into the hollow handle can cause serious damage to the cutting edge if done haphazardly. Use controlled and deliberate movements. Hold both the hollow handle and the core barrel near the end. Rest the spiralled bit on the ball of your hand and slowly swing and push it into the handle opening. Gently insert the borer shaft into the handle; - do not drop it in. Add extractor spoon, and engage threaded part.

Pay special attention to avoiding any high impact contact between the cutting tip and the metal handle. High impact contact will definitely dull, chip, or even break the all-important cutting edge in front of the threaded bit. By the same token, the increment borer should not be used for bush-whacking or as a walking stick.

- **How to dislodge jammed tips.**

  Never, that is **NEVER** use the extractor spoon! It is much bigger than the cutting tip diameter.



  Often a wooden pencil or a small twig can dislodge jammed tips. If this does not work the first choice is a small hardwood peg about 4 to 4.5 mm diameter, 5 to 10 cm long (hobby stores sell small diameter hardwood dowels). A short length of 4 mm thick welding rod, or a similar diameter nail filed to a blunt end also works, provided one is extremely careful not to damage the cutting edge of the borer. Center the peg, clearing the cutting edge, and drive the obstruction into the larger diameter core barrel. If this fails "bake it out" in a warm oven. The heat dries the wood, it shrinks and will come out more easily.

- **How many cores per tree?**

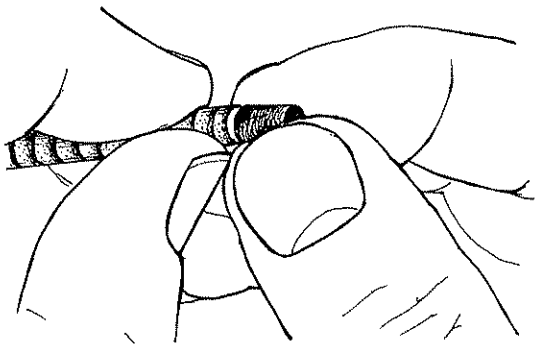
  Depending on your needs and experimental design, from one to many. For example, at Forintek, the circumferential variability of relative density was examined in lodgepole pine at breast height. Results showed that two cores taken 180 degrees apart give better estimates of relative density than three to four samples randomly taken.

- **Efficiency - how many cores can a person take in one day?**

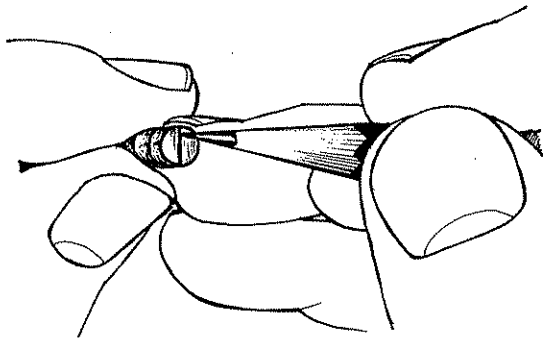
  This depends on tree species, tree size, borer sharpness, and the physical condition of the operator. However, a good average performance would yield about 50 cores from 40 cm diameter Douglas-fir, each core about 20 cm long (if the trees were marked and someone else is keeping notes on site descriptions). However, with larger and older unmarked trees, (e.g., climate reconstruction studies) it would be more like 20-25 cores per day.

WHAT TO DO WITH THE CORE IN THE FIELD

- **Remove bark (unless needed) and mark grain direction on cambium.**



removing bark

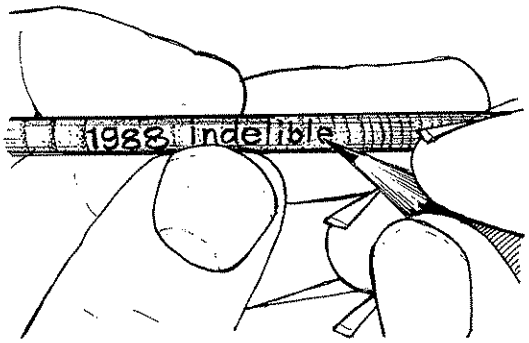


marking grain direction

Back in the laboratory or office, the reference line will be an indicator that the core is complete. Thus, tree rings can be calendar dated with the additional knowledge of the core collection date.

- **Label cores directly with indelible pencil.**

Be systematic (because trees grow from left-to-right!), therefore write sample numbers near the bark end, in the wet sapwood zone. If the wood is dry, wet it, not the pencil. This marking will leave a permanent I.D. if allowed to dry. Even after extensive extraction (about two weeks) in alcohol/cyclohexane and water, labelling holds up very well. (At present, indelible pencils may be difficult to locate in Canada. Dixon still makes these pencils, although at least two manufacturers have discontinued making them.)



- **Keep cores in a core tube.**

  No need for milkshake straws. Use milkshake straws only for those "bad" cores which are fragmented. Core tubes can be made from 5 to 10 cm diameter (paper or plastic) map mailing tubes.

  Rubber bands can be used from time to time to keep handful of core bundles together. For example, different plot, treatment or species groups can be segregated in this manner.

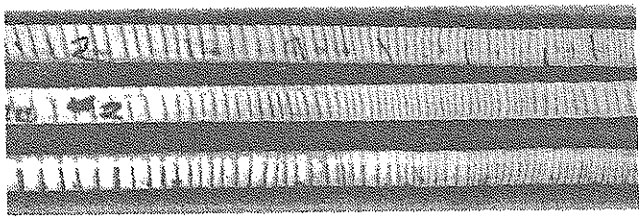
- **Labelling broken cores.**

  Use fractional numbering sequence for broken cores: e.g., 1/3, 2/3, 3/3, in the proper order (these can be put in a milkshake straw or wrapped in newspaper).

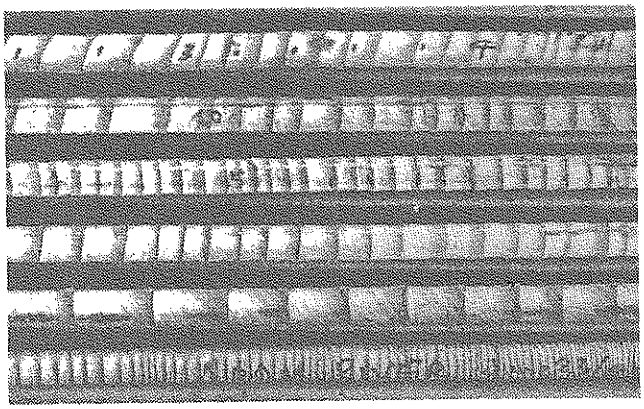
- **Air-drying cores.**

  Use corrugated cardboard and masking tape to restrain cores during air drying.

  The corrugated cardboard (with the cores held in place with masking tape) can be rolled up for storage and transport. For record keeping, surprisingly good quality photocopies can be made of your core collection if cores are taped in place with transparent tape.



lodgepole pine



Douglas-fir

- **Long-term storage of cores.**

  Air dry cores for a day or two (or keep in freezer if biological freshness is required) to prevent molding and decay.

- **The three most common quality defects with most increment cores:**

1. Rough, broken core surface because of a dull borer.
   Remedy: use a sharp borer.

2. Corkscrewing from a wobbly, free-hand start and directional change; often results in broken cores. This problem always occurs in the outer 2 to 3 cm of the core, just beneath the bark.
   Remedy: use borer starter aid and hold borer shaft steady at the start.

3. Discoloration and decay because of improper storage of perfectly good cores. Most often cores are sealed in air-tight plastic straws (or tubes) and kept at room temperature. Discoloration and mold can rear their ugly heads within days.
   Remedy: air dry cores soon after collected, or keep frozen.

CHAPTER 5

INCREMENT BORER DAMAGE TO THE TREE

Increment boring is not a completely harmless sampling technique and should not be used indiscriminately. In the literature the general consensus is that healing progressed most satisfactorily when the holes were left unplugged. Occasionally, public relations may require that the core holes be plugged. Use about 8 mm diameter corks, available at chemical laboratory supply houses. Push the cork in far enough in the core hole to facilitate quick healing. This is accomplished by making the outermost cork surface flush with the cambium, or pushing the cork a few millimeters further in. If the cork seems too small for the core hole, soon after the borer extraction, do not fret; the compressed wood will spring back from about 10 mm to as little as 5.5 mm diameter. In fact, small pieces of increment cores can be used to plug the holes when corks are not available. Resin will fill the gaps.

The first stage of the healing process is almost immediate through resin exudation. Next, callus tissue will be formed over the wound with new growth. The dimpled surface of the stem will become more straight grained with each succeeding growth increment. The affected area will be so small that the lumber values will hardly suffer from one boring. However, repeat borings, even years apart, may have a cumulative effect. Avoid them if possible.

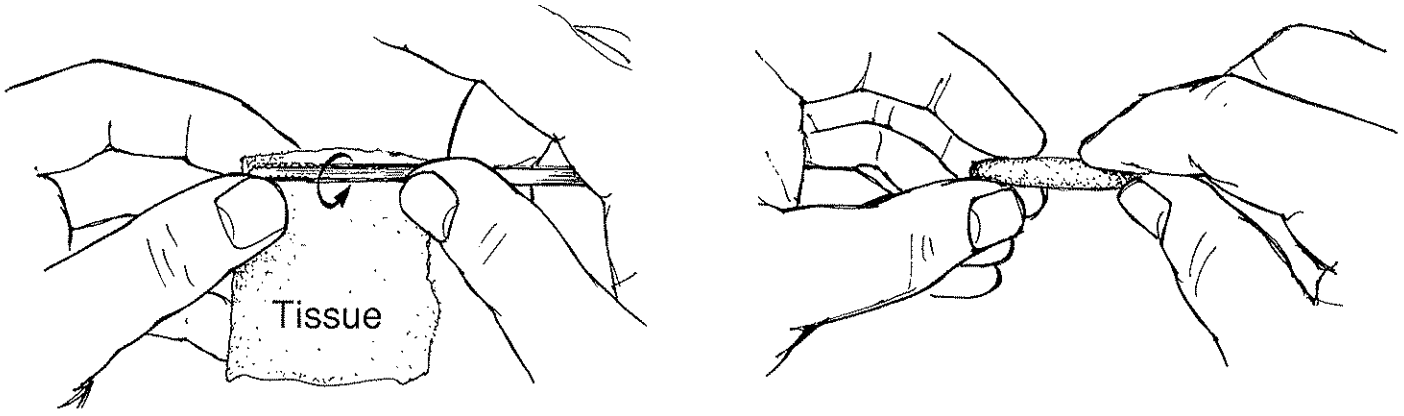
CHAPTER 6

INCREMENT BORER MAINTENANCE IN THE FIELD

Always leave the office with a minimum of two, but preferably three, sharp and clean borers when visiting remote sampling sites. Expense of an aborted field trip (just started, half-finished, or almost complete) versus borer cost will support carrying a spare or two, always. Often tree sampling sites are in remote places which are reached only through considerable effort and expense. Also, with a spare or two, when one notices a need for a quick sharpening touch-up, one can simply switch to one of the spares.

• Increment borer cleaning.

Cleaning of borers is often forgotten altogether, or can take an almost ritualistic mood. Some workers have modified and used 22 caliber rifle cleaning kits for increment borer cleaning. At Forintek our considerable experience has suggested that such drastic measures are necessary only for long-neglected borers (or increment borers that had been modified for hunting small game).



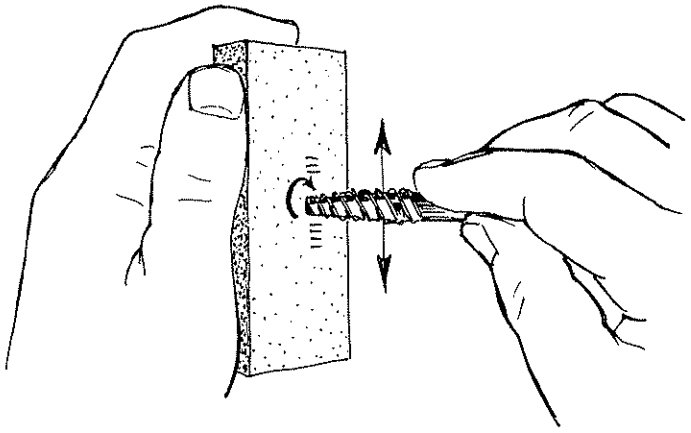
Our preference is for small pieces of tissue paper (one-half square of toilet paper is about the right size) wrapped tightly on the extractor spoon tip. The serrated tip of the extractor is ideally designed for keeping the tissue paper on; but if it falls off in the core barrel, it can pushed out by "pumping" the extractor. Cleaning frequency in the field is determined by the type of sample material; tree species, bark thickness, pitch or resin, decay, water condensate, etc. Repeat until clean. Visual inspection can reveal the necessity for cleaning. Use any light oil or WD-40 in a spray can. Spray directly into the core barrel and wipe clean with the tissue wrap on the extractor. Some workers have used liquid floor wax with excellent results. In case of emergency even insect repellent can be used. Fine steel wool can be used instead of paper for cleaning rusty borers.

Special Note: always clean and lubricate your borer at the end of the day. Never store borers wet and dirty because rust will destroy the thin cutting edge through pitting. WD-40 is particularly effective in driving out moisture.

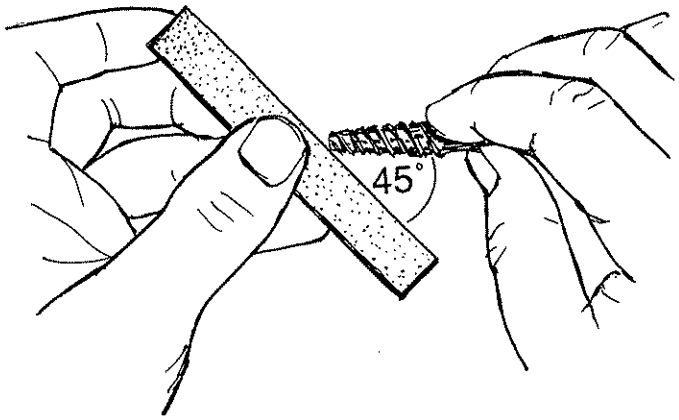
• Sharpening the bevelled cutting tip.

One will need a flat and a round sharpening stone of fine grit and a thin oil to float away the metal particles from the stone. The round sharpening stone should be about 6.5 mm diameter, tapering to a conical tip.

Apply a few drops of light oil to the flat stone and place the bevelled cutting tip on the stone at about 45° orientation (see illustrations). Move the tip back and forth along the stone with small elliptical motion, while rotating the bit continuously between your fingertips. Do not apply any pressure, just let the weight of the core barrel rest on the stone. Support the other end of the core barrel (the extractor spoon in it), on something stationary and hold the flat stone steady as well (by locking your elbow against your body). Leave the extractor spoon in the core barrel. It makes a good pivot point, even partially withdrawn. Inspect the tip with a 10X hand lens, and continue until sharp. This procedure is similar to sharpening a pencil to a fine point on paper.



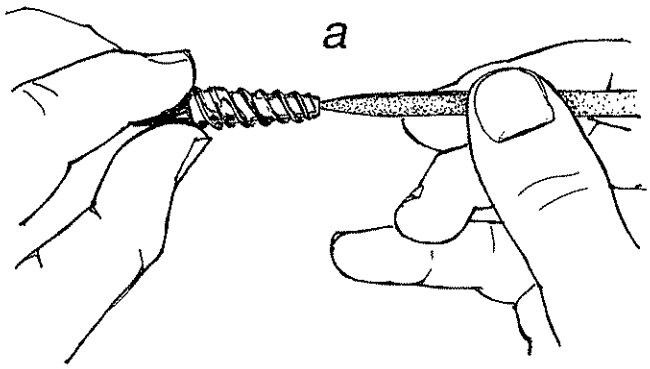
Top view

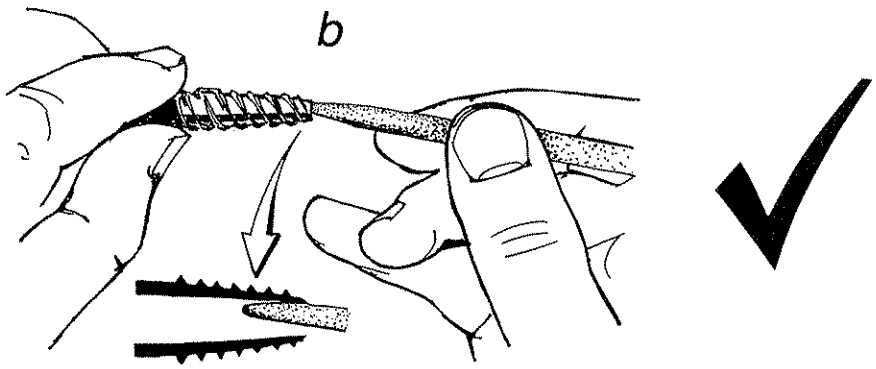


Side view

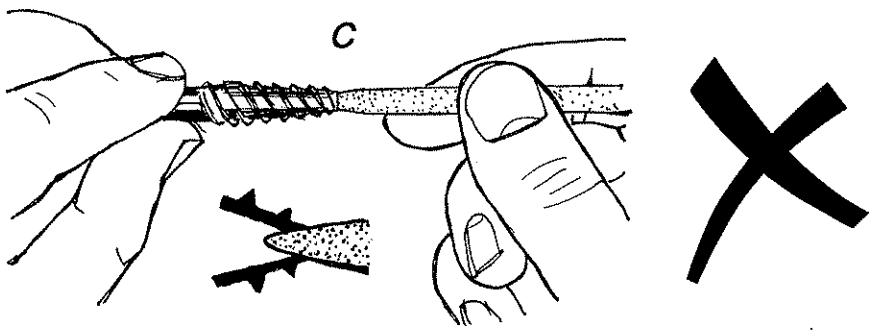
If you are uncomfortable with the idea of "free-handing" this operation, particularly the 45° orientation, attach the flat stone to a bevelled 45° surface (a piece of corner moulding will do or purchase a fine oil stone with a 45° bevelled face). Place oil stone on table top with core barrel. Pick up threaded bit and bring it in contact with the stone. Proceed as above.

The next step is to remove the burr from the inside edge of the cutting tip. This is accomplished by using the pointed end of the round stone (with a drop of oil) in a controlled fashion; insert the tip until it occupies only about three-fourths of the cutting tip opening (a), and let the borer rest on the stone. Adjust the alignment until the stone is in direct contact with the cutting edge and the inside wall of the tapered threaded bit (b). Now rotate the borer shaft a few times until the inside burr is removed. Inspect with magnifying glass and your finger tip. It should feel very "keen".

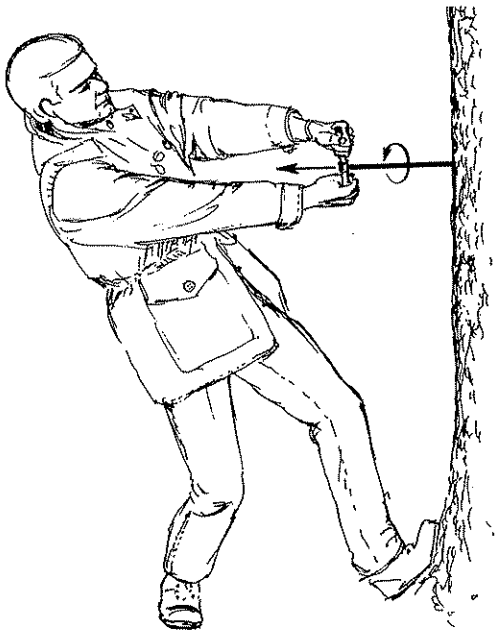




Do not force the pointed end of the round stone all the way in!
This mode of sharpening creates a reverse bevel.



The bevelled cutting tip can be brought to an even finer finish by stropping on a piece of leather. A mixture of flour emery powder, pumice powder, or crocus powder and vaseline is rubbed into the leather, and acts as a polishing agent. The bevelled cutting tip rubbed several times along the strop, with similar motions as with the flatstone, will produce a mirror-like surface. As a result of this treatment, the cutting tip will give a finer core surface.



- **Stuck borers.**

  Pull and twist repeatedly.
  Happens mostly when borer is left in the tree after removing the core.

If necessary, to assist in removing the borer from the tree, increased pull may be exerted by looping a rope around the borer's handle and an adjacent tree. Then, twisting the looped rope causes it to shorten and pull on the borer to engage the threads. This is a potentially dangerous trick because the only thing that holds the turning handle on the core barrel is the small clip on the handle.

- **Sampling normal trees.**

  Under normal circumstances, one can sample normal trees all day or for several days with no touch-up. If core surfaces lose their smoothness, it is time for a sharpening job. This should take less than 10 minutes. In other words, it is not a very time-consuming job.

- **Dulling.**

  Depends on the density of the wood being bored (high density versus lows density), extractives, pin knots, resin pockets, etc.

- **How to deal with emergencies (chipped and broken tips).**

  Switch to a spare borer.

- **Sampling near dusty roads with grit on bark.**

  Chip away some of the outer dead bark to remove abrasive substances.

- **Life expectancy of an increment borer with proper maintenance.**

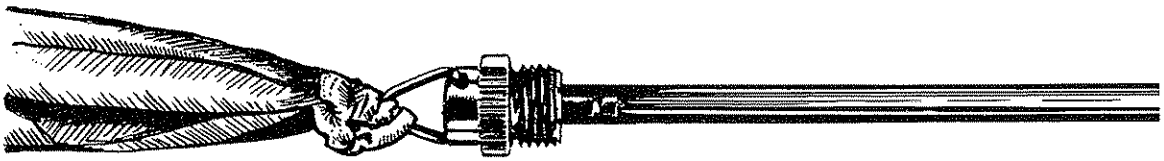
  With proper attitude, (e.g., if bought with own money), minimum of 1000 trees, 25 to 60 cm diameter (two cores per tree), with a relative density of 0.30 to 0.60.

  Unfortunately, if inexperienced workers have a poor attitude (or an inexhaustible supply of "inkies" just for the asking), only as few as 50 trees.

- **Identify your borers.**

  Borers should be numbered or otherwise identified. For ready reference, as to core size and quality, a current test core can be tied to the flagging on the core extractor spoon.

  Surveyor's bright flagging tied onto the core extractor spoon handle will help keep track of it in the woods (and prevent people from stepping on it inadvertently).



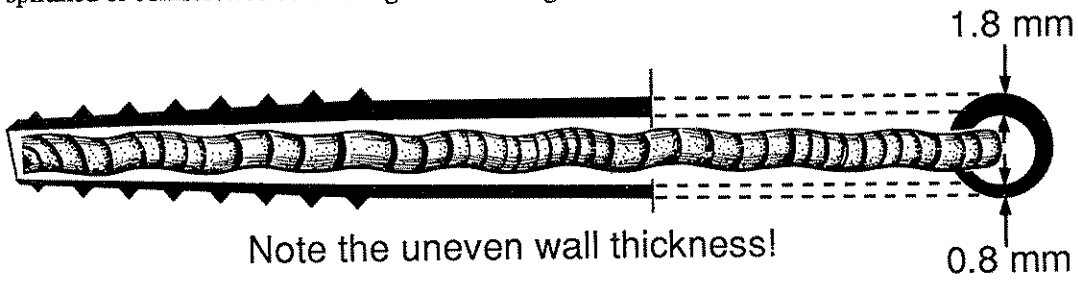
- **Where to keep the core extractor spoon during coring.**

  It is best to stick the extractor spoon into the outer dead bark on the tree trunk above eye level. This prevents misplacing and accidentally stepping on it. One need not "stab" the tree, just slip the extractor spoon tip, with serrations toward the trunk, into a crack of the outer dead bark.

BORER SHARPENING AND RECONDITIONING IN THE MACHINE SHOP

Increment borer sharpening and reconditioning in the machine shop should be attempted only by the most experienced shop workers. Our experience has shown that once the cutting edge (in front of the spiral) is ground away, and the sharpening process has "attacked" the threaded part, it is time to buy a new borer. Therefore, be gentle to the cutting edge and preserve it for borer longevity.

The literature covers procedures but it is well worth remembering that the inside and the outside of the borer shaft are not concentric. Therefore, if the borer is not centered to the inside hole of the shaft on the lathe, the cutting edge will be ground off from the perpendicular, and a bevelled or slanted cutting edge will cut spiralled or corkscrewed cores along the entire length.



Professional sharpening services are often offered by increment borer dealers and distributors for a nominal fee. Use them, because they know what they are doing. Factory reconditioning may be another option in extending the useful life of borers but shipping charges and turn-around time make this an impossible dream.

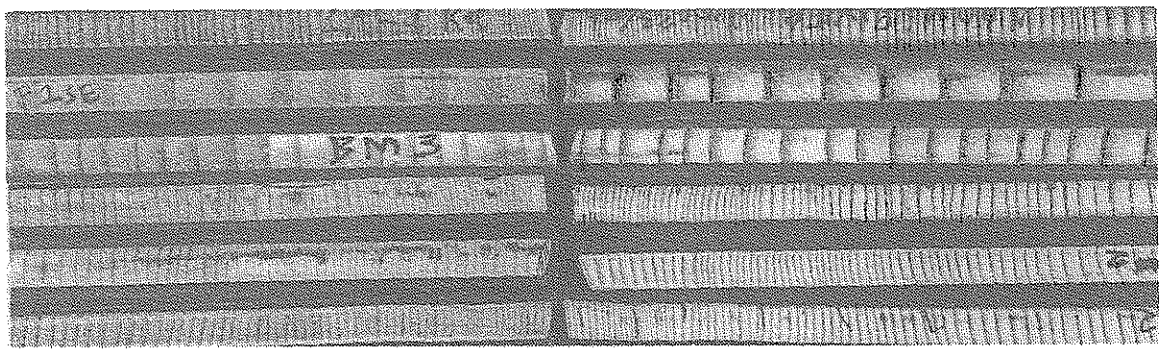
In summary, most of us have gone to near-ridiculous extremes to "squeeze-one-more-core" from that mythical favourite borer. Stop wasting your time! Buy a new borer and use it respectfully. In the end, your unit cost per increment core will favour the new one over "Betsy".

CHAPTER 8

BASIC SAMPLE PREPARATION STEPS FOR MICROSCOPIC AND OTHER EXAMINATION

This topic alone could be the subject of an entire manual. Fortunately there is one published by Richard L. Phipps of the U.S. Geological Survey, Water Resources Division, 461 National Center, Reston, Virginia, 22092. In this excellent publication, "Collecting, preparing cross-dating, and measuring tree increment cores", Dr. Phipps describes everything one would want to know about this topic. His seven chapters are titled: 1. Identification of tree rings; 2. Preparing the increment borer for use; 3. Collecting the sample; 4. Handling the core; 5. Surfacing the core; 6. Cross-dating and measuring tree rings; and 7. Glossary.

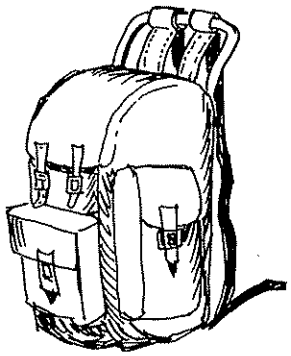
For field examination a 10X handlens is very useful, especially for slow grown tree-ring material. Some trendy field workers wear a handlens necklace, made of string, to show that they are serious. For accentuating ring detail and contrast, use soft white chalk (the type used on blackboards). Simply rub the core cross-sectional area with chalk (you will be glad that you have used a sharp borer!) and wipe clean with your fingers. This will force white chalk particles into the pores (fiber lumina) making the rings "jump out at you".



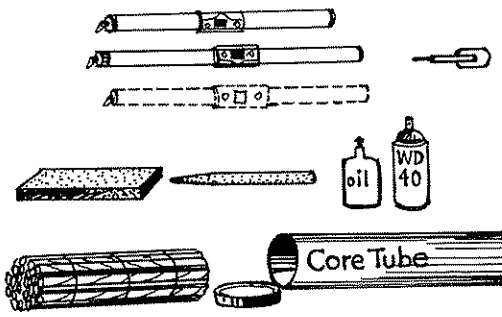
Without chalk Rubbed with white chalk

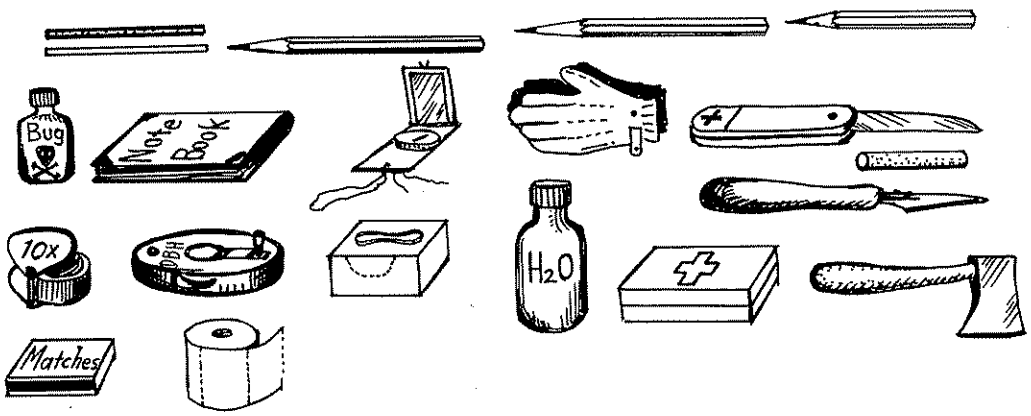
CHECK-LIST OF FIELD EQUIPMENT

Have your coring and associated equipment stored in a small backpack, ready to be taken into the field. The following is a check-list of essential items:



- Two or three increment borers;
- Increment borer starter-aid;
- Sharpening stones and light oil;
- Core tubes;
- Milkshake straws;
- 4 mm diameter hardwood peg and a short length of welding rod;
- Indelible pencils;
- Insect repellent;
- Notebook;
- Compass (Silva-type), but remember about magnetic declanation;
- Leather work gloves - minimize cuts and scrapes;
- Knife (Swiss Army or Boy-Scout type);
- White chalk;
- Scalpel;
- Masking tape;
- Handlens with 10X magnification;
- Diameter tape;
- Rubber bands;
- Drinking water container;
- First-aid kit;
- Small axe;
- Waterproof matches;
- Surveyor's vest;
- Roll of toilet paper.





When you are ready to leave for field work include the following items to complete the pack:

- Film and camera;
- Topographical map of area you are going into;
- Food and other personal items.

Last but not least, always inform someone staying behind about your destination and route to be taken.

ACKNOWLEDGEMENTS

I would like to thank my friends and colleagues for their suggestions in making this assemblage of "tricks-of-the-trade" into a comprehensive manual about increment core collection: John Barker, Joe Braz, Malcolm Hughes, Kim Iles, Gordon Jacoby, Clayton Keith, Bob Kellogg, Robert Kozak, John Kurucz, Brian Luckman, Don McMullan, Carlos Martin, Les Meyers, Serge Payette, Richard Phipps, Arlene Sawadsky, Harry Smith, and John Viszlai.

SUGGESTED REFERENCES FOR ADDITIONAL INFORMATION

1. Phipps, Richard L. 1985. Collecting, preparing, cross-dating, and measuring tree increment cores. U.S. Geological Survey, Water-Resources Investigations Report 85-4148. Reston, VA. 48pp.

2. Maeglin, R.R. 1979. Increment cores: how to collect, handle, and use them. Gen. Tech. Rep. FPL 25, Forest Service, U.S., Dept. Agr., Madison, WI. 18pp.

3. Reineke, L.H. 1941. A new increment core instrument and coring wrinkles. J. Forestry 39:304-309.

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