Surfacing the Core

After the glue is set and the string is removed, the core is surfaced for study—the quickest way being to slice the core with a razor blade as illustrated in Figure 29. The blade is held at an acute angle to the direction of slicing, and a flat surface is cut on the top of the core. If orientation of the core in the mount was properly done, this cut will be at an angle to the tracheid cross section.

Occasionally a core will contain a large amount of resin which makes it too tough to be properly surfaced with a blade. Often, soaking the mounted core in water will sufficiently soften the wood to allow a good cut to be made.

Excellent results can also be obtained by sanding the core in the manner described for cross sections. The first sanding, however, should be done with a finer grade of paper (No. 280 or No. 320). The flat surface is put on the core at this stage, and then it is sanded by hand with a very fine and clean grade of sandpaper mounted on a small sanding block. Figure 30 (top) shows a sanded specimen compared with an unsanded specimen. Note that both cores are in mounts.

The Process of Dating Specimens

The Skeleton Plot

One of the major difficulties besetting any study is the reduction of all data to a form which can easily be used for analysis. Samples occupy a large amount of space, and are a nuisance to check each time information is needed. Specimens, even after proper surfacing, are difficult to compare directly one with another. Ideally, we reduce the information derived from study of these samples to paper in such a way that one specimen can easily be compared with another and so that data from several specimens can be combined to produce a suitable composite piece of information.

The skeleton-plot technique is one way in which data are reduced to paper. These plots are used as an aid for chronologically relating a group of specimens to each other by pattern matching and for determining dates for individual specimens of the group. The skeleton plot method has the advantage of being much faster than methods requiring actual ring measurement, but practice is required before the technique can be used effectively.

The process of dating is started by constructing a skeleton plot of each individual specimen. A strip of graph paper is labeled with the specimen number; and, to facilitate counting, a zero is placed at the extreme left of the paper, and every tenth square to the right is numbered. Each vertical line on the graph paper corresponds to one ring. The specimen is examined with a hand lens or other suitable low-power optical instrument so that all of the rings can be seen easily. The innermost ring on the specimen is plotted at zero, and the plotting progresses from this point outward on the specimen.

In skeleton plotting the narrow rings are the ones primarily being compared; so a line is marked at each interval where a narrow ring occurs. The decision of narrowness is based on the comparison of each ring with its immediate neighbors. The narrower the ring, the longer the line is drawn. The narrowest rings are arbitrarily represented with a line 2 cm in height, wide rings
are marked with a "B," and average rings are not marked. If a ring shows some slight reduction in width, but is not so narrow as to be indicated by a line on the skeleton plot, a dot is sometimes used to point out this fact.

Figure 31 shows a portion of archaeological specimen BE-343 with the corresponding portion of its skeleton plot. To facilitate comparison, a few rings on the specimen have been connected to their plots.

Skeleton plots of modern cores are prepared in the same manner as for archaeological specimens, except that the outside date of the core is known; and this date is marked at the right of the skeleton plot as soon as the plot is complete. It is necessary, however, to note whether the core was removed before, during, or after the growing season before assigning the outside date. For example, if a core was taken in March, 1961, before the growing season started, the outside ring would be dated 1960, not 1961. It is theoretically possible, of course, to core from a spot where the last-formed ring is double or absent, but an experienced dendrochronologist can soon detect this by checking the ring pattern.

The Composite Skeleton Plot

After each specimen in a group has been skeleton-plotted, several of these plots can be compared at one time. When this is done, similarities in their ring patterns can be noted and matched by placing the plots so these similar patterns are lined-up one under the other as illustrated in Figure 32. When this matching has been correctly done, all of the rings for any given year (although not yet assigned a date) will fall on the same vertical line. After all of the specimens have been lined-up, a piece of graph paper is placed at the bottom of the series, and a composite is made by plotting the average line length for each year. Since these lines are not measured, these averages, like the individual plots, are a matter of judgment.

The purpose of aligning the individual plots and constructing a composite plot is to find a time period common to all of the specimens. When this has been done, we say the specimens have been dated relative to each other but not yet placed in time. This process aids in the detection of abnormalities like missing or double rings, since the chance of an abnormality occurring in all of the specimens at the same year is small. The composite plot is usually longer than any of the single plots, which thus increases the chance of obtaining actual dates. When attempts to match skeleton plots prove to be unsuccessful, the original specimens are checked to detect any plotting errors. If none are found, it is assumed that the specimens have no patterns in common; and hence, they have no time period in common.

The theory of pattern matching has been discussed above (chap. 1, "Cross Dating"). Unfortunately, the actual practice is mastered by trial-and-error experience and cannot be adequately described. Careful examination of the three skeleton plots compared in
Figure 32 shows that, while several of the patterns match, there are many individual rings which do not match from plot-to-plot. This variation is typical. It is logical to ask how many such unmatched rings can be accepted in what we call matched plots. Our answer would have to be that, when most of the rings match, the fit is considered correct. While this may sound like a very unscientific answer, experienced dendrochronologists using these methods are able to duplicate each other. One helpful key to cross dating is to look for the time periods with very distinctive ring patterns; for example, 1890–1904. Experienced dendrochronologists carry many of these sequences in mind and can frequently date specimens from memory without resorting to skeleton plots.

**Dating the Specimens**

When the composite skeleton plot for a group of archaeological specimens has been completed, the next step is to attempt to place the composite plot in time. This is accomplished by comparing the skeleton composite or a single skeleton plot with a plot of a master chronology (a dated composite chronology). The method of compiling a master chronology is discussed in detail later. The skeleton plot is moved along the master plot ring-by-ring until an alignment is found where the patterns match (see Fig 33). This technique is identical to that described in Figure 32 for matching skeleton plots of single specimens, except that the master plot is already dated. After it has been established that this is the only placement of the composite which produces a “match,” the plots are compared on a ring-by-ring basis along the entire length of
their overlapping portion. When this has been done, the composite has been tentatively placed in time. Each individual specimen must then be compared ring-by-ring with the master chronology before dates are considered to be verified.

In practice, very few of our cores are skeleton plotted before dating. If a series of cores is too difficult to date from memory, however, a few of the more promising ones are plotted and compared individually with the master plot; in this case the outside ring of the core has already been located in time.

Methods Used for Marking a Series of Dated Specimens

After the composite skeleton plot has been placed in time, each individual specimen in the group must be dated ring-by-ring. Usually, dating is started at a ring whose calendar equivalent is easily recognized and continues until every ring is dated. Dating every ring on the specimen, instead of just the outside one, not only serves to verify the outside date, but the information is used for other purposes, such as compiling master chronologies or for year-by-year studies of climatic data. As the dating progresses, the rings on the specimen are marked as illustrated in Figure 34. Figure 35 gives the complete scheme of dating marks.

Compiling a Master Chronology

Basic Steps in Chronology Building

One of the ultimate aims of specimen analysis is to reduce the information obtained to some absolute form, which can be understood and used by others. While the skeleton-plot technique is an excellent tool for tentative dating, it is an unsatisfactory form for permanent storage or transmission of data. The construction of skeleton plots involves judgment, and the application of these plots is limited to the actual specimens plotted.

These limitations can be eliminated, if exact measurements are made of each ring width and if these measurements are plotted and ultimately converted to mathematical indices. Composite, or master, chronologies can be compiled by computing yearly averages of these indices. It is a simple matter to plot these yearly averages. By using this mathematical method, there is no limit to the number of specimens which can be “averaged” into a master
Compiling a Master Chronology

chronology, and the result is inherently more accurate than a composite skeleton plot. This process is described in detail in the sections which follow. Since the specimens used in constructing a master chronology have already been dated ring-by-ring, there is no further need to distinguish between archaeological and modern specimens.

Measuring Ring Widths of the Specimen

The specimen selected for measuring is mounted so that the ring structure is clearly visible in the microscope of the instrument being used. The magnification of the microscope in Figure 36 is ×40, which is adequate for a clear view of the individual cells in each ring. Cross hairs in the ocular serve as a reference point for measurement of ring widths. The microscope in Figure 36 is mounted on a stage, which can be moved along the stationary specimen by turning a crank so that the cross hairs in the ocular pass visually first over the earlywood of the ring and on to the outermost margin of the latewood of the same ring. The amount the microscope has moved (that is the ring width) registers on a dial. This value is read to the nearest .01 mm and is recorded on adding-machine tape.

There are other machines such as the Addo-X (Fig. 37), which automatically "reads" the distance the specimen has been moved relative to the microscope and records this value (to the nearest .01 mm) when a button is pushed. The process is faster, but the accuracy still depends on the operator.

All measurements are made along one continuous radius so that the relative ring widths are consistent. If it is necessary to shift the line of measurement when working on a specimen with an interrupted surface, each new radius is treated as an individual specimen.

Plotting Ring Widths and Growth Curve

After the specimen has been measured ring-by-ring, the next step is the plotting of these measurements. Standard sheets of metric-scale graph paper are glued together to form a sheet large enough