Chronometric Dating Methods

METHOD	MATERIAL REQUIRED	AGE RANGE	EXAMPLE
Dendrochronology	Large pieces of wood with visible ring structure	0 to 12,000 years	Use of wooden beams from Viking ship to date its construction
Radiocarbon	Organic material: wood, bone, shell, leather, hair, plant remains	300 to 50,000 years	Charcoal from an ancient fire hearth
Potassium-argon	Volcanic rock or ash	100,000 to several billion years	Lava flows covering fossil-bearing beds
Uranium series	Bone, shell, calcite	10,000 to 500,000 years	Fossil bone from a limestone cave
Thermoluminescence	Fired clay, pottery	0 to 100,000 years	A fired-clay vessel
Electron spin resonance	Tooth enamel, calcite, bone	1,000 to 1 million years	A tooth from a fossil hominid
Archaeomagnetism	Pottery, clay, soil, rocks	0 to 30,000 years	Burned clay house floors
Obsidian hydration analysis	Obsidian	0 to 500,000 years	A thin section from a projectile point

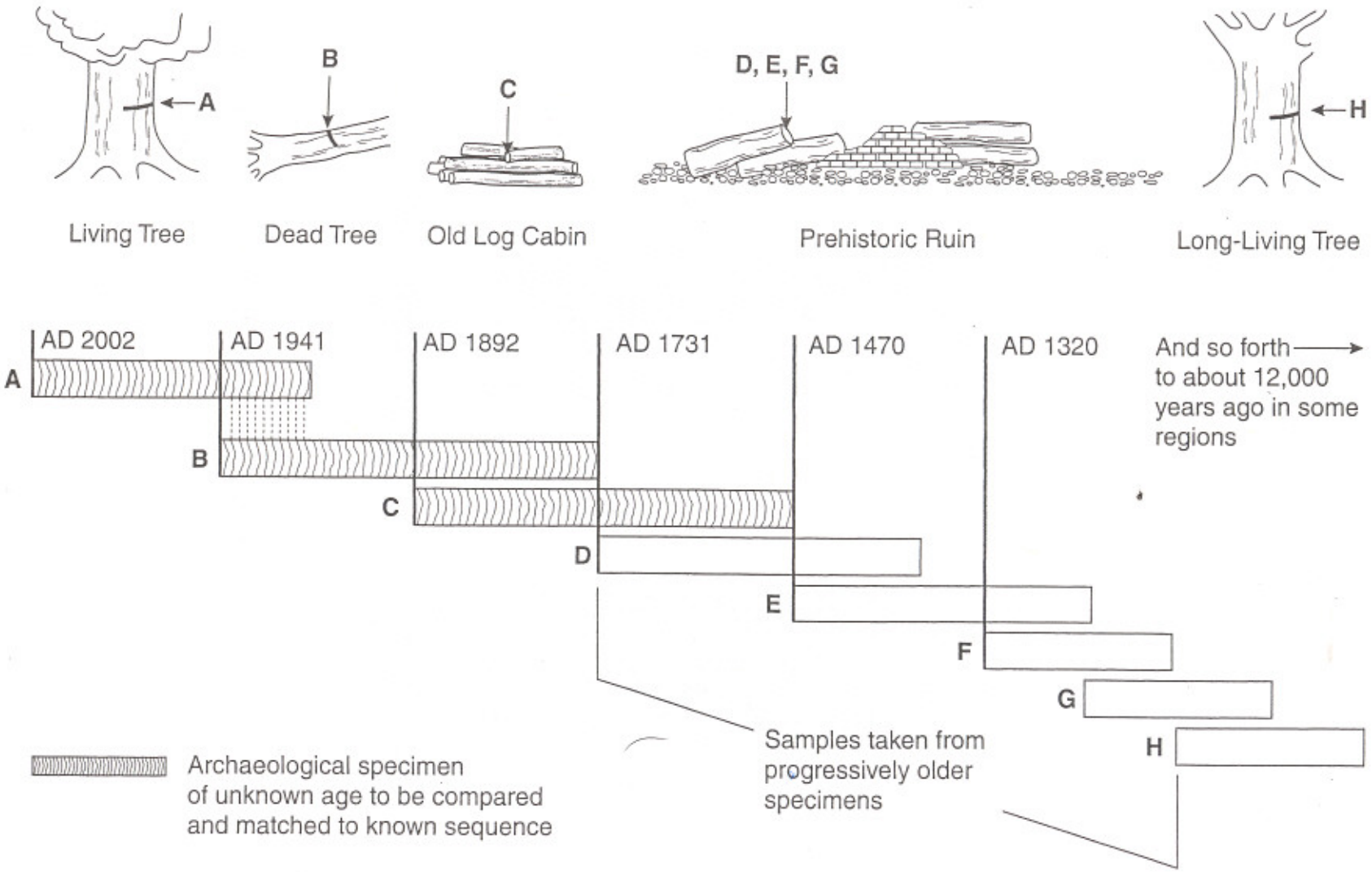


figure 7.2

How Dendrochronology Works. Cores are taken from woods of different ages, beginning with a living specimen, and the unique ring distributions are matched up to form a continuous sequence, called a *skeleton plot*. The rings of an archaeological specimen of unknown age can be matched to the skeleton plot, and its age can be determined.

HOW TO READ A RADIOCARBON DATE

1	2	3	4	5	6
Beta-203181	2840 ± 50 bp *(uncal. ^{14}C date)*	890 ± 50 bc *(uncal. ^{14}C date)*	1000 BC *(cal. intercept)*	1040-920 BC *(cal. 1 sigma)*	1130-880 BC *(cal. 2 sigma)*

1. Laboratory and number of specimen. In this case the lab is the Beta Analytic Company (in Florida) and the sample number is 203191. This information is included so the researcher, or future researchers, can contact the lab to ask questions about the sample.

2. Conventional radiocarbon date (*uncalibrated*) in years before present, bp (by international agreement, "the present" is always AD 1950 [the date the carbon-14 method was invented by Libby]). The date of 2840 is the mean or statistical average of the calculated radiocarbon age of the sample, ±50 is its standard deviation. Thus, this sample has a date of 2,840 years before present plus or minus 50 radiocarbon years, which means the sample falls between 2,890–2,790 years before present (1950) in radiocarbon years. Note that lower case letters always refer to uncalibrated dates.

3. Conventional radiocarbon date (#2) converted to our calendar using the present date of AD 1950.

   1,950–2,890 = 890. With "plus and minus" deviation added we get **890 bc ± 50**

   We now have an uncalibrated date in years bc. If we want real time, we need to convert this date using information from dendrochronology. This is known as calibration. See next step.

4. Intercept of radiocarbon date (2840 bp, from #2) and calibration curve (tree ring chronology). If you wish to see the plot, see other side of this page (*this is only to help you understand the process of calibration, you will not be asked to generate or interpret such a plot on an exam*). Note that the date of 1000 BC is about a century earlier than the radiocarbon date of 890 bc/2840 bp.

5. Estimation of calibrated date (span) based on the intercept of 2,890–2,790 radiocarbon years before present (see step #2) and the calibration curve. This is a 1 sigma statistical result, meaning that there is a 68% probability that the actual date falls between the intercepts of 1040 and 920 BC (in our calendar).

6. 2 sigma calibration result, meaning that there is a 95% probability that the actual date falls between the intercepts of 1130 and 880 BC (in our calendar). Although we have a better probability using 2 sigma, the time spread is now greater. In other words, for greater certainty we sacrifice accuracy.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.5:lab. mult=1)

Laboratory number: **Beta-203181**

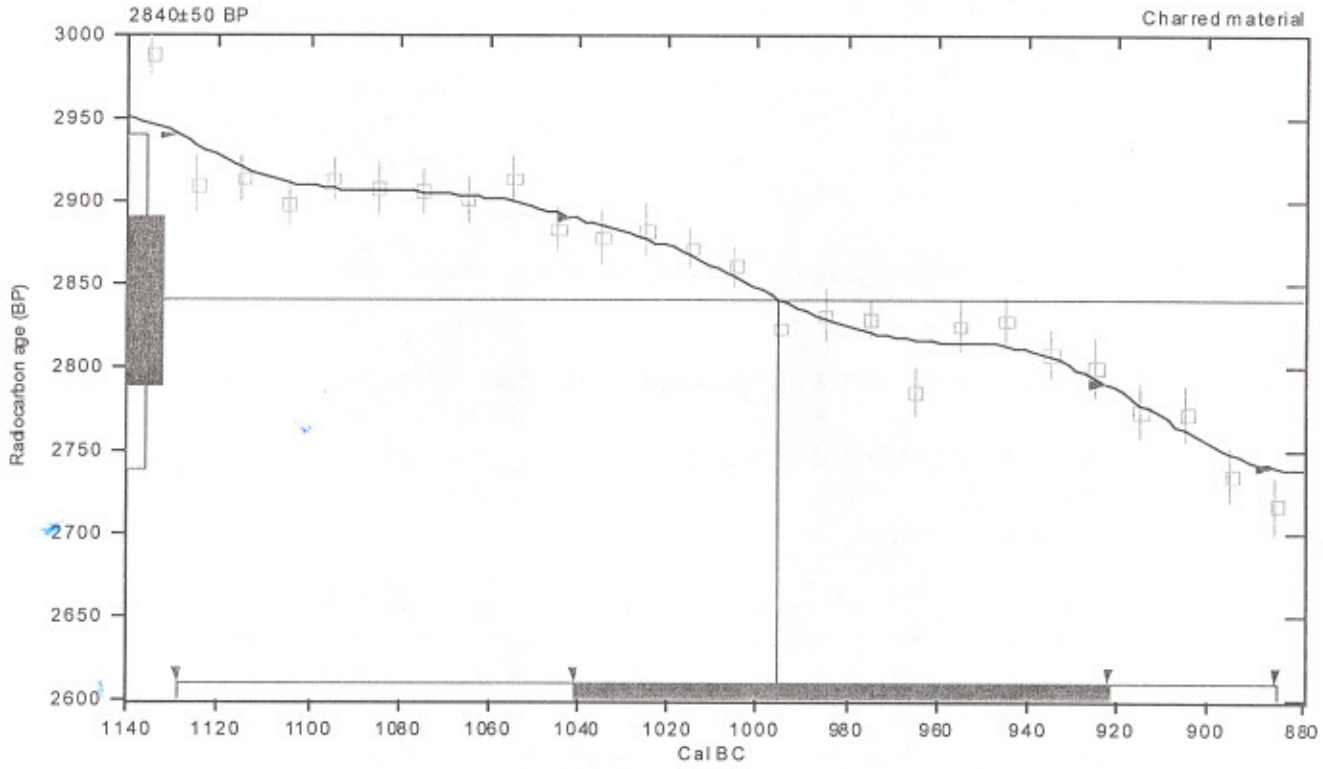
Conventional radiocarbon age: **2840±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 1130 to 880 (Cal BP 3080 to 2840)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 1000 (Cal BP 2940)

1 Sigma calibrated result: (68% probability) Cal BC 1040 to 920 (Cal BP 2990 to 2870)



References:

Database used

INTCAL98

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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RADIOCARBON DATES VS. CALIBRATED DATES