CHAPTER 6

THE IMPORTANCE OF HUMIDITY CONTROL IN THE WORKPLACE

WOOD is an organic material. On a cellular level it is no more than a bundle of straws or tubes that "breathes." That is, even when aged and stabilized in the ways discussed in Chapter 5, wood changes in size in direct relation to how wet or dry the surrounding air is: its tubular structure takes on or gives off water molecules. This movement has always spelled trouble for wood products and constructs. Historically, the main point of applying a finish to a wood has been not so much to enhance its appearance (of course it does, but this is a secondary benefit) as it has been to seal it, stabilize it, and protect it from the weather. The fact is that wood, unlike concrete, plastic and metal, will expand and contract with the weather forever, and "stable" is a relative word with wood of any age.

Wood swells and shrinks the greatest (absolute) amount tangentially to its growth rings (i.e., concentrically) and the least amount radially **(Fig. 6.1 A/B)**. Put more simply, each growth ring will become bigger or smaller, while the distance between each ring and its neighbor will stay more or less the same. This would suggest that guitar tops, which are normally quartersawn, will want to swell and shrink most greatly in the direction of their thickness, and least in the direction of their width. However, the average guitar top is about 150 times as wide as it is thick, and the possible change in the top's thickness is negligible compared to the amount of possible side-to-side movement. For the guitar, this is an important potential behavior of a main component: the more movement in wood, the more problematic the wood's structure and the guitar's sound can be.

When I had been making guitars for five or six years, I was regularly meeting professional musicians who toured a lot; living in a metropolitan area practically guaranteed that this would happen. These traveling musicians had a problem in common: in one city their guitars' or mandolins' actions were really low; the next night in the next city the actions would be high. It drove them batty. But the phenomenon seemed to come with the work and the life. What was happening, of course, was that as they traveled to different cities at different altitudes and in different climates, in different seasons, and played outdoor venues alternating with indoor ones, their instruments were exposed to great fluctuations of ambient humidity and temperature. And the woods in their instruments responded.[6.1] Had their instruments

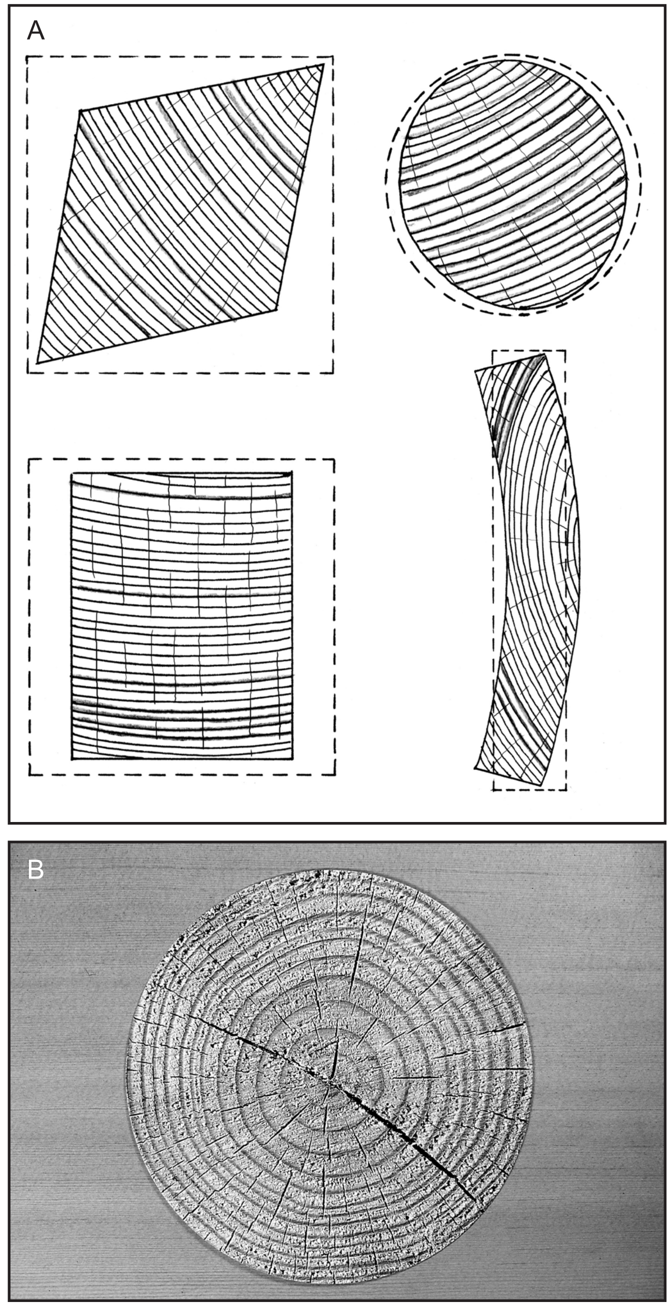

Fig. 6.1 (A) *Wood shrinkage patterns as a function of grain orientation;* ***(B)*** *Normal wood shrinkage patterns within any portion of a cut tree. These shrinkage patterns are fully consistent with how medullary ray stabilizes wood.*

been made of planks of wood these changes would have occurred over days or weeks; being made of very thin and vulnerable woods, however, the changes occurred in hours.

A flat unbraced plate of spruce will expand and contract like an accordion, per the movements described above, so long as air movement is equal on both sides of it. If air movement is unequal the plate will cup or bulge rather than simply swell or shrink. A braced top or back will act like a plate with such unequal air movement because the fibers on one side of the plate are locked into place and prevented from moving, while the other side is free to move: the braces act, in effect, as a straitjacket for one surface. Consequently, the plate's movement in swelling and shrinking is displaced from sideways movement to a vertical one; and, rather than getting wider and narrower, it will instead bulge out or cup in **(Fig. 6.2).** This is what was happening to these musicians' instruments while on the road. Their instruments' woods had a finish on the outside that would retard these changes but none whatsoever on the inside. We'll revisit these matters in Chapter 18.

[5] These wood behaviors suggest the wisdom of gluing a guitar up under controlled levels of humidity. One can't stop the woods from moving, but one can "lock them into place" in a consistent relationship to one another when gluing on braces and bridge, so as to prevent subsequent movement from being inconsistent or radical. A face that's glued up under 40% relative humidity will move different amounts to different levels of string action than one that's glued up under 60% rh when the instrument finally "stabilizes" in its purchaser's environment. This will affect action, bridge torque, and sinking or bulging of face – all factors that affect playability and tone. Another way to look at this is that guitars built otherwise identically but in the open air can easily sound different as a function of what season, climate or even time of day they're assembled in – and there go all your careful work and measurements down the drain.[6.2] Fully as important, a guitar that's glued up on the "dry" side won't be as likely to crack when both the weather and the woods dry out, compared with a guitar that is glued up "wetter" to begin with. Being exposed to humidity is not generally harmful to a musical instrument, but being exposed to dryness – especially if the change is sudden – is dangerous: cracking occurs when woods dry out too rapidly for the wood fibers to keep up with the shrinkage. Guitar backs are subject to the same fluctuations and stresses as tops, and they need to be glued together and braced with the same precautions in mind.

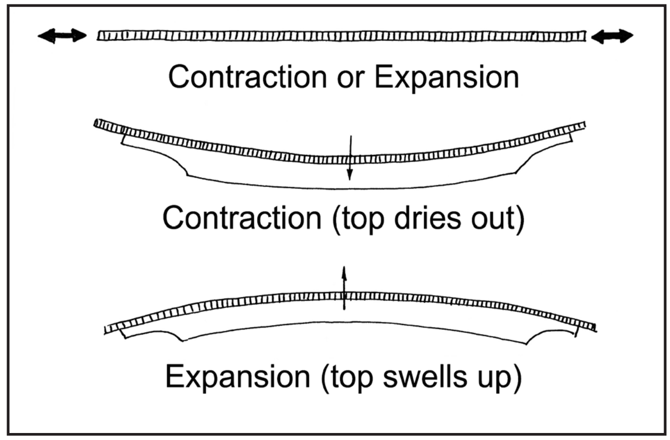

Fig. 6.2 *Ambient-related movement in braced and unbraced spruce faces.*

Guitar making shops that pay attention to this level of the work will have a controlled-humidity room in which tops and backs can be glued up. I recommend that you make or set aside a small room for this use.[6.3] Install a dehumidifier to draw the moisture out of the air (or a humidifier to moisten it, in dry climates). My own dry room is set to 50% relative humidity.[6.4] An accurate hygrometer is a must.[6.5] So is an air cleaner if you do any sanding in that room. It is also smart to not use chemicals or solvents, do prolonged epoxying operations, etc., in it; such fumes have nowhere to go in a closed room but into your lungs.