"that" introduces an essential clause. Examine these two sentences: “CtB mutants, which are tolerant to colicin E2, also have an altered...” “CtB mutants that are tolerant to colicin E2 also have an altered...” Note the substantial difference in meaning. The first sentence indicates that all CtB mutants are tolerant to colicin; the second sentence indicates that only some of the CtB mutants are tolerant to it.

while. When a time relationship exists, “while” is correct; otherwise, “whereas” would be a better choice. “Nero fiddled while Rome burned” is fine. “Nero fiddled while we wrote a book on scientific writing” is not.

Those of us who have struggled to make ourselves understood in a foreign language might especially appreciate this story: A graduate student had recently arrived in the United States from one of the more remote countries of the world. He had a massive English vocabulary, developed by many years of assiduous study. Unfortunately, he had had few opportunities to speak the language. Soon after his arrival, the dean of the school invited a number of the students and faculty to an afternoon tea. Some of the faculty members soon engaged the new foreign student in conversation. One of the first questions asked was “Are you married?” The student said, “Oh, yes, I am most entrancingly married to one of the most exquisite belles of my country, who will soon be arriving here in the United States, ending our temporary bifurcation.” The faculty members exchanged questioning glances—then came the next question: “Do you have children?” The student answered “No.” After some thought, the student decided this answer needed some amplification, so he said, “You see, my wife is inconceivable.” At this, his questioners could not hide their smiles, so the student, realizing he had committed a faux pas, decided to try again. He said, “Perhaps I should have said that my wife is impregnable.” When this comment was greeted with open laughter, the student decided to try one more time: “I guess I should have said my wife is unbearable.”

All seriousness aside, is there something about the use (rather than abuse) of English in scientific writing that merits special comment? The following is a tense answer.

TENSE IN SCIENTIFIC WRITING

One special convention of writing scientific papers is very tricky. It has to do with tense, and it is important because proper usage derives from scientific ethics.
When a scientific paper has been validly published in a primary journal, it thereby becomes knowledge. Whenever you state previously published findings, ethics requires you to treat the work with respect. You do this by using the present tense. It is correct to say “Streptomycin inhibits the growth of *M. tuberculosis* (13).” Whenever you state previously published findings, you should use the present tense; you are referring to established knowledge. You would do this just as you would say “The Earth is round.” (If previously published results have been proven false by later experiments, the use of past rather than present tense would be appropriate.)

Your own present work must be referred to in the past tense. Your work is not presumed to be established knowledge until after it has been published. If you determined that the optimal growth temperature for *Streptomyces evercolor* was 37°C, you should say “*S. evercolor* grew best at 37°C.” If you are citing previous work, possibly your own, it is then correct to say “*S. evercolor* grows best at 37°C.”

In the typical paper, you will normally go back and forth between the past and present tenses. Most of the Abstract should be in the past tense, because you are referring to your own present results. Likewise, the Materials and Methods and the Results sections should be in the past tense, as you describe what you did and what you found. On the other hand, much of the Introduction and much of the Discussion should be in the present tense, because these sections often emphasize previously established knowledge.

Suppose that your research concerned the effect of streptomycin on *Streptomyces evercolor*. The tense would vary somewhat as follows.

In the Abstract, you would write “The effect of streptomycin on *S. evercolor* grown in various media was tested. Growth of *S. evercolor*, measured in terms of optical density, was inhibited in all media tested. Inhibition was most pronounced at high pH levels.”

In the introduction, typical sentences might be “Streptomycin is an antibiotic produced by *Streptomyces griseus* (13). This antibiotic inhibits the growth of certain other strains of *Streptomyces* (7, 14, 17). The effect of streptomycin on *S. evercolor* is reported in this paper.”

In the Materials and Methods section, you would write “The effect of streptomycin was tested against *S. evercolor* grown on Trypticase soy agar (BBL) and several other media (Table 1). Various growth temperatures and pH levels were employed. Growth was measured in terms of optical density (Klett units).”

In the Results, you would write “Growth of *S. evercolor* was inhibited by streptomycin at all concentrations tested (Table 2) and at all
pH levels (Table 3). Maximum inhibition occurred at pH 8.2; inhibition was slight below pH 7."

In the Discussion, you might write "S. everycolor was most susceptible to streptomycin at pH 8.2, whereas S. nocolor is most susceptible at pH 7.6 (13). Various other Streptomyces species are most susceptible to streptomycin at even lower pH levels (6, 9, 17)."

In short, you should normally use the present tense when you refer to previously published work, and you should use the past tense when referring to your present results.

The main exceptions to this rule are in the areas of attribution and presentation. It is correct to say "Smith (9) showed that streptomycin inhibits S. nocolor." It is also correct to say "Table 4 shows that streptomycin inhibited S. everycolor at all pH levels." Another exception is that the results of calculations and statistical analysis should be in the present tense, even though statements about the objects to which they refer are in the past tense; for example, "These values are significantly greater than those of the females of the same age, indicating that the males grew more rapidly." Still another exception is a general statement or known truth. Simply put, you could say "Water was added and the towels became damp, which proves again that water is wet." More commonly, you will need to use this kind of tense variation: "Significant amounts of type IV procollagen were isolated. These results indicate that type IV procollagen is a major constituent of the Schwann cell ECM."

**ACTIVE VERSUS PASSIVE VOICE**

Let us now talk about voice. In any type of writing, the active voice is usually more precise and less wordy than is the passive voice. (This is not always true; if it were, we would have an Eleventh Commandment: "The passive voice should never be used.")

As noted in Chapter 11, passive voice sometimes functions well in the Methods section. Elsewhere in a scientific paper, however, it rarely should be used.

Why, then, do scientists use so much passive voice? Perhaps this bad habit results from the erroneous idea that it is somehow impolite to use first-person pronouns. Because of this idea, the scientist commonly uses verbose (and imprecise) statements such as "It was found that" in preference to the short, unambiguous "I found."

Young scientists should renounce the false modesty of their predecessors. Do not be afraid to name the agent of the action in a sentence,