letters

Tone-deaf Feynman took on stiff strings, piano tuning

Richard Feynman's exercise on stiff strings (PHYSICS TODAY, December 2009, page 46) illustrates well his many interests. He and author John Bryner might have saved themselves a lot of trouble (and maybe missed out on some fun) by examining the substantial literature on the subject. The fact that the stiffness of a string stretches the frequencies of the harmonics has long been known. Lord Rayleigh in 1894 treated the case in which the string is free to tilt at the bridge.[1] He also calculated the effect of movement of the end pins, of which Feynman says, "It is too hard for me to figure how big these effects would be." In 1939 Robert Shankland and I gave formulas for that and for the case in which the string is clamped at the end,[2] and he presented experimental evidence that the piano string acted with a combination of these. Altogether, piano tuning by ear has always had the effect of taking into account the stiffness of the strings.

References

1. J. W. S. Rayleigh, *The Theory of Sound*, 2nd ed., vol. 1, Dover, Mineola, NY (1976), pp. 200, 207.
2. R. S. Shankland, J. W. Coltman, *J. Acoust. Soc. Am.* **10**, 161 (1939).

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[Editors' note: With sadness, we have learned that John Coltman passed away on 10 February 2010.]

I was fascinated by Richard Feynman's letter on piano tuning. While the author's assertion that "had he wanted to, Feynman would have been a fine piano tuner" is understandable, readers might be amused to know that Feynman was seriously tone deaf: Not only could he not carry a tune, he could not reliably tell whether one note on the piano was the same as, higher than, or lower than another played a few seconds earlier. For example, in experiments we did together, he would often misinterpret the same note played louder as being higher in pitch. Nevertheless, we enjoyed playing on the piano together—1.2 hands, one might say, with me providing chords in the lower register and Feynman playing a very passable improvised melody, using one finger from each hand, a transfer of his marimba skills. Feynman's piano playing was analogous to his drumming, in which he never counted out rhythms or phrases; rather, he captured the feel of the patterns—those unquantifiable aspects of a rhythm that make it human.

That a tone-deaf Feynman could expound on piano tuning so deeply—like a colorblind amateur pointing out intricacies of hue to a professional artist—makes his letter all the more remarkable, and it reminds me once again how much we miss him.

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Element 117 fits a pattern

The announcement on 7 April of the discovery of element 117 (see the news story on page 11 of this issue) completes row 7 of the periodic table. The discovery of elements 93 and 94 started a 65-year quest to extend the table to higher and higher atomic numbers. Omitting the "trigger" elements 93 and 94, the 24 elements 95–118 have a rather amazing distribution of discovery.

The first six (95–100) were discovered in the US by Albert Ghiorso, Glenn Seaborg, and collaborators. The next six (101–106) were discovered in the US by Ghiorso and collaborators. The next six (107–112) were discovered in Germany by Peter Armbruster and collaborators. The last six (113–118) were discovered in Russia by Yuri Oganessian and collaborators. Although the description is slightly simplified, it is nevertheless significant: US (6), US (6), Germany (6), and Russia (6). The cause of that pattern is easily traceable to the experimental facilities available and the irresistible urge to try just a bit harder to add one more proton. Another amazing fact is that Ghiorso is codiscoverer of 10% of the periodic table. Of course, not every element is as useful as carbon or copper, but who knows? Forever isn't over yet.

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Many facets of light pollution

The article "Lighting and Astronomy" by Chris Luginbuhl, Connie Walker, and Richard Wainscoat (PHYSICS TODAY, December 2009, page 32) is a welcome and important discussion of the impact of outdoor lighting on astronomical observation. It seems to fall short, however, with regard to actual practice and the effects outdoor lighting has on communities other than astronomers. Light pollution is wasted light and should be minimized for both environmental and financial reasons. Despite good intentions, many outdoor lighting applications waste light. The following important questions are not addressed in the article: How much light are we wasting now? How do we measure wasted light? And what can be done to reduce that waste?

People complain about three aspects of outdoor lighting: sky glow, light trespass, and glare. In terms of sky glow, the topic addressed by the authors, reflected light, rather than light directly leaving the fixture, typically contributes more than 80% of the light leaving the property.[1] As the authors correctly point out, however, the direction of that escaping light matters for astronomical observations; low-angle light is relatively more important than high-angle light, but proximity to and absolute levels of the light sources are even more important. That point is also made indirectly by the data the authors