How Broadly to Take Temperature?

Charles Kittel's Opinion piece (May 1988, page 93) disputing the concept of fluctuating temperature also questions any use of the concept of temperature in describing the behavior of small systems. His general point of view seems to me quite reasonable, but a conclusion about what to call "small" requires some knowledge of the actual systems in question.

Let us agree to limit the use of temperature to systems possessing an energy reservoir that can be shared statistically, and also possessing a smooth density of states whose logarithm varies linearly with excitation energy over a substantial range. These conditions appear to be satisfied for heavy nuclei excited to several tens of MeV of energy, even though they contain a small number of particles. For example, at an excitation of 50 MeV there should be about 10^{28} levels per MeV in a nucleus of mass number 200, and the density should increase by a factor of e for an increase of 1 MeV, roughly, in excitation energy. How do we make a heat reservoir? When the nucleus emits a neutron, its energy distribution is determined by the density of daughter states. In effect, the nucleus exchanges energy statistically with the freed neutron. The neutron energy spectrum then falls off with the factor e for each MeV increase in energy. Empirically, behavior like this is observed over several decades of the probability distribution. Dare we call this a Boltzmann factor with a temperature $T = 1$ MeV? The reader must judge for himself.

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Life Styles of the Rich (and Physicists)

One of the most important issues relating to the strength of our scientific establishment is that of quality of life. I feel that this issue, more than the quality of high school science instruction, is responsible for the current state of technology in our country.

While success in law, business and medicine is often measured in six figures, pay levels in skilled labor jobs often equal the salaries paid scientists and engineers. Today, it is not uncommon to find carpenters, plumbers or electricians whose average yearly pay is in the \$40 000–\$50 000 range. *R&D* magazine in its yearly poll of over 1900 readers found that the average scientist or engineer with 17 years of experience and a master's degree earns between \$45 000 and \$50 000.

Salary is but one facet in the quality-of-life debate. The educational establishment often forces a prospective physicist into a monastic life of poverty, chastity and obedience. This begins in the undergraduate program, where the science and math requirements leave little time for the student to educate him- or herself about the rest of the world. Lack of education in other areas limits career growth as well as contributes to the image of the physicist as a one-dimensional intellectual.

For most physicists, graduate school represents a financial as well as an intellectual challenge. It is not uncommon for students to postpone marriage and starting a family while in graduate school, especially if the prospective spouse does not work. Often, little guidance is offered to a student about permanent job propects in his or her thesis concentration area. We all know of areas in physics that offer only postdoc-type positions. The time it takes to complete a doctorate in physics is longer than in related fields like mathematics and engineering. Is this due to academic rigor or to the lack of graduate students?

A number of graduate departments, through misguided policies, actually increase the difficulty of graduate life. The qualifying examination process often can be dragged out over two years or longer. If a student receives an additional research scholarship or grant from an outside organization, the student is often limited in what additional funds he or she may receive from the department. Joint programs, where a