was published anyway, the excuse being that it contained a very important result that was already being referred to in other publications. Since then I have not had a great deal of sympathy for editors who complain that they receive too many papers. If the first criterion applied to every submission were clarity of presentation, and if any manuscript failing to meet this test were returned to the author with instructions not to send it in again until it had been rewritten, the number of submissions would soon drop, as writers got the message, and the quality would go up. But until editors apply such a standard, the situation will not change.

Second, journal editors who use referees should consider instructing them that an unclear presentation is quite sufficient grounds for rejecting a paper; there is no need to try and figure out what the author is trying to say—that is, to evaluate the scientific contents. That way, referees would only have to pay serious attention to the contents of clearly written manuscripts, which could reduce their load by 80–90% (judging from my own experience), and free up their time for serious consideration of better manuscripts. Scientists who have something useful to say but do not know how to write clearly should be encouraged to seek help from colleagues (not limited to their own institutions); their trying to rewrite something on the basis of detailed suggestions from an anonymous referee is not a good solution to the problem.

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Peer Tutoring Proved Successful in Past, Could Be Useful Today

John M. Clement's letter supporting the efficacy of peer tutoring (February, page 97) prompts me to point out that peer tutoring has an old and very successful history that seems to have been forgotten or ignored by today's radical education ideologists. An English educator named Joseph Lancaster (1778–1838) developed a form of elementary education known as the monitorial, or mutual, system that was based on the use of a kind of peer tutoring. The crowds of poor children who came to him spurred Lancaster's innovations. The students would gather in a single room filled with benches, each of which had a monitor—an older and more advanced student. An adult master taught the monitors, and then each monitor taught his row of perhaps ten students the lesson in reading, writing, arithmetic, spelling or higher subjects. The monitors also took attendance, examined and promoted pupils, checked books and slates and so forth.

Lancaster's school was quite successful. It was later reorganized as the Royal Lancasterian Institution, but severe financial problems led Lancaster to leave the project and emigrate to America, where he lectured extensively but failed in his efforts to start another school. Nevertheless, during the early 19th century, according to the *Encyclopaedia Britannica* (1960 edition), the monitorial system, "as developed by Lancaster, Andrew Bell and Jean Baptiste Girard, became perhaps the most widespread means of providing the rudiments of education for children of the common people on the [European] continent and in England and America, and helped pave the way for universal education supported and controlled by the state."

A modern example of success with peer tutoring was my own experience years ago as a student at Stuyvesant High School in New York City. As a new member of the school's math team, I learned almost all of my high school math before ever encountering it in class. Our team captain, Andy Farkas, would rapidly review solutions to contest problems, and would taunt us harshly if we were slow. We learned very quickly. No one cared about being insulted by just another student. The standard for math team members was getting a perfect score on the New York State Mathematics Regents examinations.

In my opinion, peer tutoring, properly supervised, could significantly improve academic performance in many subjects in today's urban schools!

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DOD Monitors Nuclear Tests Worldwide, Runs CTBT-Related Web Sites

PHYSICS TODAY readers interested in additional technical detail beyond that presented in Jeremiah Sullivan's excellent article on the Comprehensive Test Ban Treaty (CTBT) in the March issue (page 24) would be well advised to visit the World Wide Web site (www.pidc.org) of the prototype CTBT International Data Center (IDC). The Web site presents the prototype products of the CTBT IDC. Updated hourly, it provides access to the nearly 70 000 elastic wave and radionuclide events recorded since 1995, when the initial monitoring system was put into 24-hours-a-day, 7-days-a-week operation. Although most of the events recorded are earthquakes, all of the French, Chinese, Indian and Pakistani nuclear tests conducted since January 1995 are also well recorded and the data are available for inspection. The Web site also contains a wealth of other information, including downloadable copies of the CTBT itself, a nuclear explosion database and monthly performance reports on the state and status of the prototype IDC. It also provides information on the current status of the seismic, hydroacoustic, infrasound and radionuclide international monitoring system. (Approximately 50% of the predominantly seismic IMS stations or their stand-ins are connected on-line to the prototype IDC, which is located in Arlington, Virginia.)

The US Department of Defense (DOD) is responsible for the implementation and operation of the US monitoring infrastructure in compliance with the CTBT. Within DOD, the Nuclear Treaty Programs Office (of which I am the principal program director) is managing the development of the prototype IDC, as well as its transition to the permanent CTBT IDC to be located in Vienna, Austria. Additionally, this office, with the Defense Special Weapons Agency as executive agent, is sponsoring a multimillion-dollar, peer-reviewed R&D program for the advancement of basic and applied research in the area of nuclear monitoring.

Through the Air Force Technical Applications Center, DOD also operates the US Atomic Energy Detection System and the US National Data Center (which are both headquartered at Patrick Air Force Base in Florida). The data center's Web page (www.tt.aftac.gov) can provide readers with useful CTBT-related information.

The US places great store on the implementation of an accurate monitoring system for the CTBT. To that end, DOD has supported the development of automated monitoring software and the training of future operators of this system. The US will be transferring all of those software assets to the CTBT IDC in Vienna in a series of four software releases. The first such release was made in early June, and the final release is planned for early 2000. Together, the automated monitoring system and the

trained personnel will provide a critical jump start for the IDC, equipping it with an almost-instant monitoring capability when the CTBT enters into force—and without the delays and growing pains that have characterized past treaty-monitoring efforts.

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Physics, Bible Used to Reexamine if Heaven Is Hotter than Hell

We have detected a long-standing error in certain calculations used in an age-old argument about whether heaven is hotter than hell.

In 1972 a letter to the editor of *Applied Optics* discussed the temperatures of heaven and hell and cited the findings of "an unnamed environmental physicist of several decades back."[1] In estimating these temperatures, the unknown physicist had taken the Bible as a source of data. Isaiah 30:26 provided a description of the luminosity of the Moon and the Sun in heaven: "Moreover the light of the moon shall be as the light of the sun, and the light of sun shall be sevenfold, as the light of seven days. . . ." (Technically, of course, the passage is a description of a hypothetical future prosperity, not of heaven as such.) Using the Stefan–Boltzmann fourth-power law for radiation, $R_T = \sigma \times T^4$, where R_T is the radiant energy of a blackbody and σ is the Stefan–Boltzmann constant, the physicist calculated the temperature of heaven, T_{heaven}, to be 798 K.

As for the temperature of hell, the physicist could not calculate it exactly and therefore set a maximum limit value on the basis of the description of hell given in Revelation (or Apocalypse) 21:8: "But the fearful, and unbelieving . . . shall have their part in the lake which burneth with fire and brimstone. . . ." This passage implies that the temperature of hell must be equal to or somewhat below the boiling point of brimstone, now better known as sulfur, which is 717.6 K, at normal pressure.

So the unknown physicist "proved" the shocking fact that heaven is hotter than hell, a finding that jolted the media enough when it was later revealed in *Applied Optics* that the matter was even commented upon in the 21 August 1972 issue of *Time*. (That same year, K. Nassau[2] did further analysis to calculate the increase of pressure needed to raise the boiling point of sulfur up to the temperature of heaven; the temperature of hell had been given at a pressure of 1 atmosphere.)

The error we have found lies in the unknown physicist's use of Isaiah 30:26, which says that heaven receives as much radiation from the Moon as Earth does from the Sun, in addition to what it receives directly from the Sun. The error occurred when the physicist took heaven's radiation from the Sun to be 7×7 times more intense than on Earth, whereas the Isaiah passage clearly states that the light of the Sun falling on heaven is only 7 times greater, not 49 times. (We have verified the accuracy of this passage in Spanish Bibles translated directly from the original manuscripts, and also have confirmed the accuracy of our reading with an accredited biblical expert—Eugenio Romero Pose, the auxiliary Catholic bishop of Madrid, to whom we are very much indebted for his help.)

Accordingly, the total radiation—from both the Moon and the Sun—falling on heaven is 8 times greater than the total falling on Earth (as the unknown physicist mentioned, the light that Earth receives from the Moon is a ten-thousandth of the light received from the Sun and can be ignored). This total radiation heats up heaven to the point where thermodynamic equilibrium is reached—that is, the heat lost by radiation is just equal to that received by radiation. Then, the Stefan–Boltzmann law applies. Taking the temperature of Earth, T_{earth}, to be 300 K, we have

$$\left(\frac{T_{heaven}}{T_{earth}}\right)^4 = 8$$

That gives us T_{heaven} = 504.5 K, which is considerably lower than the 798 K originally calculated.

So the traditional belief is correct after all; at 717.6 K, hell is indeed much hotter than heaven.

References

1. Appl. Opt. **11** (8), A14 (1972).
2. K. Nassau, Applied Optics **11** (12), A14 (1972).

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Correction

March, pages 20 and 21—Bernard Durney's name was misspelled as Bernard Gurney. And his affiliation should have included the University of Arizona. ■