

letters

There are an infinite number of stars in a spatially infinite universe, but around each observer only the finite number N is needed to cover the entire sky. In Allen's mathematical model we have $\sigma = 0$ and $N = \infty$, and quite rightly in this particular case it is then questionable whether a bright sky is in principle possible. (For instance, if S is the radius of the universe and we keep the product SR constant as $S \rightarrow \infty$, it then follows that $\lambda/S \rightarrow \infty$, and a bright sky is impossible.) The value of N is estimated as follows: Let $\rho \approx 10^{-30} \text{ g cm}^{-3}$ be the average density of stellar material in the universe and let also $\rho^* \approx 1 \text{ g cm}^{-3}$ be the average density of matter within stars; we then obtain

$$N = \left(\frac{4}{3}\right) \left(\frac{\rho^*}{\rho}\right)^2 = 10^{60}$$

and this is the number of stars required to create a bright sky. A spatially closed homogeneous and isotropic static universe contains a finite number N' , say, of stars that may be less than N . In this case light circumnavigates the universe $(N/N')^{1/3}$ times to create a bright sky.

One can criticize many of the original physical assumptions of the bright-sky theory, but I do not think the paradox it poses can be dismissed or resolved by mathematical arguments of the kind raised by Allen. Many have criticized the paradox on the grounds that it is basically meaningless, and it is therefore important to realize that it is quite easy to construct models in which the night sky is not dark. An Einstein static model of density $\rho > 10^{-17} \text{ g cm}^{-3}$, for example, has a thermodynamic time scale (in which light circumnavigates more than 10^6 times) that is less than the luminous lifetime of stars, and in such a model the night sky is bright. At the risk of cluttering up the argument with details, I should perhaps also mention that the Einstein model is dynamically unstable. The time scale of this instability is approximately the time it takes for light to circumnavigate only once. We therefore require an Einstein static model of density $\rho > 10^{-5} \text{ g cm}^{-3}$ in order that the thermodynamic time scale be less than the instability time scale. It is then quite easy to show that this particular bright-sky model contains only 10^4 stars of solar mass.

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Models of the sun

At the end of Barbara Levi's account of the solar-oblateness measurements by Henry Hill and his collaborators at the University of Arizona (September, page

17), there is mention of the possible relation of these measurements with the problem of solar neutrinos. It is remarked that the low neutrino flux is consistent with models of the Sun with a rotating core such as Robert Dicke's model.

In the context of solar neutrinos, it is misleading to lump all solar models with a rotating interior under a single heading. In fact, Dicke's model of the Sun, in which most of the mass rotates rigidly with a period of about one day, yields practically the same high neutrino flux as a nonrotating model.¹ Among models with a rotating interior, of which a variety have been discussed during the last few decades, it appears that only those including a *small* rotating core (of the order of one tenth of a solar mass) in a state of *rapid* rotation (in the sense that rotation affects appreciably the pressure gradient in the model, corresponding to a period of the order of one hour) can produce the desired reduction in neutrino flux.²

Whatever the merits and drawbacks of this class of models, which have been discussed in recent literature,³ they imply an internal structure and rotational history for the Sun sufficiently different from that proposed by Dicke to make them definitely distinct.

References

1. R. K. Ulrich, *Astrophys. J.* 158, 427 (1969).
2. P. Demarque, J. G. Mengel, A. V. Sweigart, *Astrophys. J.* 183, 997 (1973); *Nature Physical Science* 246, 33 (1973).
3. I. W. Roxburgh, *Nature* 248, 209 (1974); R. K. Ulrich, *Astrophys. J.* 188, 369 (1974).

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Reactor safety study

"State and Society" in the November issue (page 87) reports on a \$3-million 14-volume reactor-safety study just released by the AEC. The overall conclusion is "the risks to the public from potential accidents in nuclear-power plants are very small." This is, if I remember correctly, the n -plus-one-th study by the AEC with the same conclusion in the past several years.

I call to your attention an article starting on page one of *The New York Times* of 10 November 1974. The title of the article is "AEC Files Show Effort to Conceal Safety Perils," and the article, written by David Burnham from an examination of letters and memos written by industry and commission officials in the past ten years, bears out the title.

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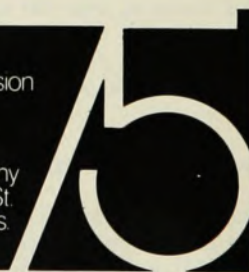
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letters

For example, a Brookhaven National Lab report of 1964, updating an earlier report by the same group, said at one point, "The results of the hypothetical Brookhaven National Laboratory accident are more severe than those equivalent to a good-sized weapon..." A committee reviewing this report received a memo from an AEC official that said in part, "Mr. Smith has prepared isotope curves for given releases and meteorological conditions that show the areas involved: For a big accident the area would be the size of the State of Pennsylvania."

It is not my intention to quote here the entire 3000-word *Times* article, nor to imply that it, and it alone, contains the only revealed truth. However, I wish to demonstrate that the optimistic picture painted by the AEC's report quoted in *PHYSICS TODAY* is not the only picture existing.

My own view was expressed by D. H. Imhoff, head of development engineering of General Electric's nuclear division, in a letter five years ago to an AEC official. "We believe future safety program plans... should... resolve important safety issues before rather than after-the-fact." In other words, that the commission should do safety research before, rather than after, building reactors.

And the results of this research should be made available to the people before, rather than after, a major accident.

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Undetected ether drift

Referring to the excellent, comprehensive article by Robert S. Shankland on "Michelson and His Interferometer" (April, page 36), I would like to point out that recent developments show why the "ether drift" experiments produced null results. The orientation of the apparatus foreordained such results!

The existence of a near-isotropic 3.5-cm electromagnetic radiation flux (3 K) has been demonstrated by several studies. This is postulated to result from the "big bang," a celestial primordial event. E. K. Conklin¹ estimates the Earth's absolute motion, with this flux as the generalized frame of reference, as approximately 160 km/sec. Direction of this motion in local coordinates; Right Ascension, 13 hours, Declination, 32 deg.

Orientation of interferometers in planes tangent to the Earth's surface at Cleveland and Pasadena would ensure that the angle of approach of an "ether drift" would be nearly normal to the plane of the interferometer, and/or that rotation of the instrument in this plane

would only slightly alter the effective velocity of the "ether" at the two arms of the interferometer.

Experimental testing of the above has been proposed, utilizing masers and lasers oriented parallel and at 90 degrees to the Earth's galactic motion.

References

1. E. K. Conklin, *Nature* 222, 971 (1969).
2. H. C. Dudley, *Nuovo Cimento* 4B 68 (1971).

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Wrong nationality

In the September issue (page 25) you reproduced an engraving drawn by anatomist Andreas Vesalius. In the caption Vesale is presented as being Italian. I would like to correct this error.

Indeed Andre Vesale was born in Brussels in 1514. He spent most of his career at the University of Louvain, Belgium, and he may be considered as the founder of modern anatomy. Like many Renaissance scientists, however, he travelled a lot, namely in France and Italy; he died in a wreck off the Greek coast. In Belgium we consider Vesale as a great man of our past and you can

even see his portrait on our 5000-franc notes.

This year two Belgian scientists won the Nobel Prize for Physiology. This is another opportunity to remember that we have a medical tradition going far in the past.

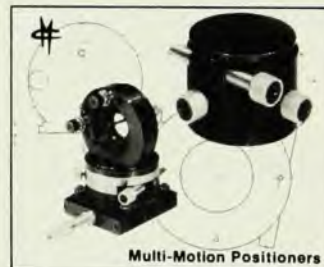
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Corrections

In addition to the information included about Alexander von Humboldt grants to US scientists (September, page 80), it should be noted that self-applications are not possible. Only German research scientists and German institutes are entitled to nominate American scientists for the Award which allows them to carry out research of their choice at various German institutes.

The third sentence of the fourth paragraph of Herman M. Schwartz's review of *The Special Theory of Relativity* (December, page 51) should read "more importantly, space-time covariance methods are usually handled with undue restraint, as, for example, on pages 108-109 where the derivations are tortuous, and the gratuitous equation following (6.1.8) is strange." □

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