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pled with a contempt for the democratic ideal. Lawyers regard the electorate as a salivating mob that requires a judicial oligarchy to defend it from itself. Similarly, Dr. Woodruff sees his duty as one that runs to unnamed "policymakers in government," not to his fellow citizens.

At the risk of seeming unkind or naive, I suggest that scientists, like lawyers, need to frequently remind themselves that the events of 1776 require us to put our trust in our fellow citizens, not King Ronnie, the Barons of The Bench or the Dukes of DOE.

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Burning question

"Forest Fires, Barnacles and Trickling Oil" (SN: 10/3/87, p.220) was a good exposition of the usefulness of even very simple computer models of natural processes. It might have pointed out that most of the models discussed could easily be explored by anyone with access to a home computer. However, apparently unnoticed by the author, the article also illustrates the potential pitfalls of carelessly applied models.

The sequence of diagrams appears to indicate that a forest fire will tend, as the probability p of igniting neighboring cells grows from 0.51 to 0.75, to burn first as a fractal blob, then a rough circular area, then . . . a *square?* This is an artifact of the rectangular grid, as is easily shown with graph paper and a pencil. Suppose for simplicity that p is 1.0: A cell with a burning neighbor always catches fire itself. (Perhaps a very dry windy day?) Then for t = 1, 2, 3, the "fire" will grow:

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      3
    3 2 3
. . . 3 2 1 2 3 . . .
    3 2 3
      3
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Obviously this tells us a lot more about graph paper than about forest fires. The lesson is important: For many values of p the results of the model may be meaningful; for values of 0.75 and larger, they are not. Everyone is aware that a model may be misleading if relevant factors (like wind) are omitted; this kind of error, while less familiar, is no less serious.

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Redshift paradox

There appears to be a paradox in the application of the redshift to very distant objects such as quasars ("Breaking the redshift-4 barrier," SN: 10/17/87, p.254). If we were 18 billion light-years away from the quasar when the light we are now seeing started, wouldn't it have taken more than 18 billion years for the quasar to reach the state it had at the time the light started its journey to us? This would make the universe more than 36 billion years old and the quasar at least middle-aged at the time the light started on its way to us.

I realize that relativity theory will alter this simple argument. Unfortunately, I have never seen mention of, much less a satisfactory explanation of, this apparent paradox. The fundamental importance of these concepts would seem to warrant a detailed analysis.

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The redshift in the quasar's light gives a velocity by way of the Doppler shift forumla. That velocity translates to a distance by way of Hubble's relation. In units of light travel time, that distance is 18 billion light-years, provided one uses a Hubble constant of 50 kilometers per second per megaparsec. The other popular value for the Hubble constant, 100, would yield 9 billion light-years. Until we get a measurement of the Hubble constant on which everybody agrees, we will continue to have these discrepancies.

Taking the value of 18 billion light-years means that we are seeing light that left the quasar 18 billion years ago; thus we are seeing it as it was and where it was 18 billion years ago. There is no reason to assume any existence for the quasar previous to that moment. It could have formed just then. We assume, however, that it could not exist before the beginning of the universe, and other evidence indicates that, given a Hubble constant of 50, the universe began about 20 billion years ago. That means that if we could see the actual Big Bang, it would appear with a redshift translatable to 20 billion light-years away.

What we see of distant objects depends on our distance from them in both space and time. In cosmology, as in Einsteinian relativity, the two are not separable, and we cannot say anything about the existence or condition of a given object at any epoch before (or after) we can see it. — D.E. Thomsen