

be any domain outside of science, and therefore have concluded that there is no domain outside the natural world. But this is a philosophical conclusion and not a scientific one. According to its own definitions, science can say nothing about such subjects as God, beauty, love and faith.

The fundamental problem is not "a lack of new values to replace obsolete ones." It is the indifference to and the caricaturization of basic values in the presence of changing stimuli. R. Hobart Ellis Jr, who wrote the editorial, provides an example inadvertently. The advance of science has not done away with faith in "protective providence," as Ellis seems to take for granted. The bestowal of scientific authority to such nonproofs is one of the elemental ways in which the interpretation of science has contributed to the modern dilemma about which Ellis is sincerely concerned. Can we not establish the basic truth that the understanding of a physical mechanism in physical terms does not in any sense constitute a complete and exclusive understanding? Is it not clear that the belief that the laws of nature are self-existing and self-sustaining is just as much an article of faith as the belief that God has created them and continues to sustain them? This kind of misinterpretation and misapplication of science constitutes the major non-proof active in weakening the ethical and religious foundations of human behavior. Nothing that science can uncover can in any way alter the basic relationship between man and that God to whom providence, justice, good, order and love have the same kind of deep personal meaning that they had long before Batman and the astronauts.

As to the "fundamental, basic, causal" wrongness of our world—let this be traced directly to the innermost quality of man, whether we call it pictorially his heart or his soul, which is characterized by unconcerned self-centeredness. Against the popular picture that man is suffering from some kind of spiritual sickness from which he can cure himself by good intentions and education, let us face the fact that the sickness in man is of the

kind that will prove fatal unless he receives help from outside himself. It is a sickness that science can not touch, that is unassailable by the power of logical thought. It requires not a new outlook but a new beginning; not a new effort, but a new heart or soul that is freed from the limitations of self-centeredness.

My personal conviction is that such help has been made available to man by God in and through Jesus Christ.

Richard H. Bube
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More about longevity

Thank you for the opportunity to comment on some of the letters received by PHYSICS TODAY about my article on life prolongation (PHYSICS TODAY, November, page 45). I am glad to see that there has been some reaction among other scientists to my rather speculative remarks.

I was particularly happy to hear that such a distinguished medical researcher as Peter Gouras (February, page 13) agrees with the reasoning I have described, and thinks that the problem of storage at low temperature may be solved within our lifetime. I hope that he is right.

Ephraim Fischbach (January, page 10) mentions the interesting work of N. H. Grant, who finds that certain enzymatic reactions go faster at around -20°C than at higher temperatures. It would of course be of great interest to know whether such a phenomenon persists down to the low temperatures (around -190°C) envisaged for long-term storage, at which the Arrhenius equation predicts a tremendous decrease in the reaction rate. The experiments already carried out on freezing and storage of individual cells seem to agree with such a decrease.

Finally, there is the letter of Arthur E. Sowers (February, page 14) who takes me to task for "irresponsibly suggesting" that freezing, storing and reviving humans would have widespread applications. I am not sure that I understand the point of Sowers's remarks. If he is suggesting that I am advocating an idea without considering the consequences, I must demur. I am well aware that the technical fea-

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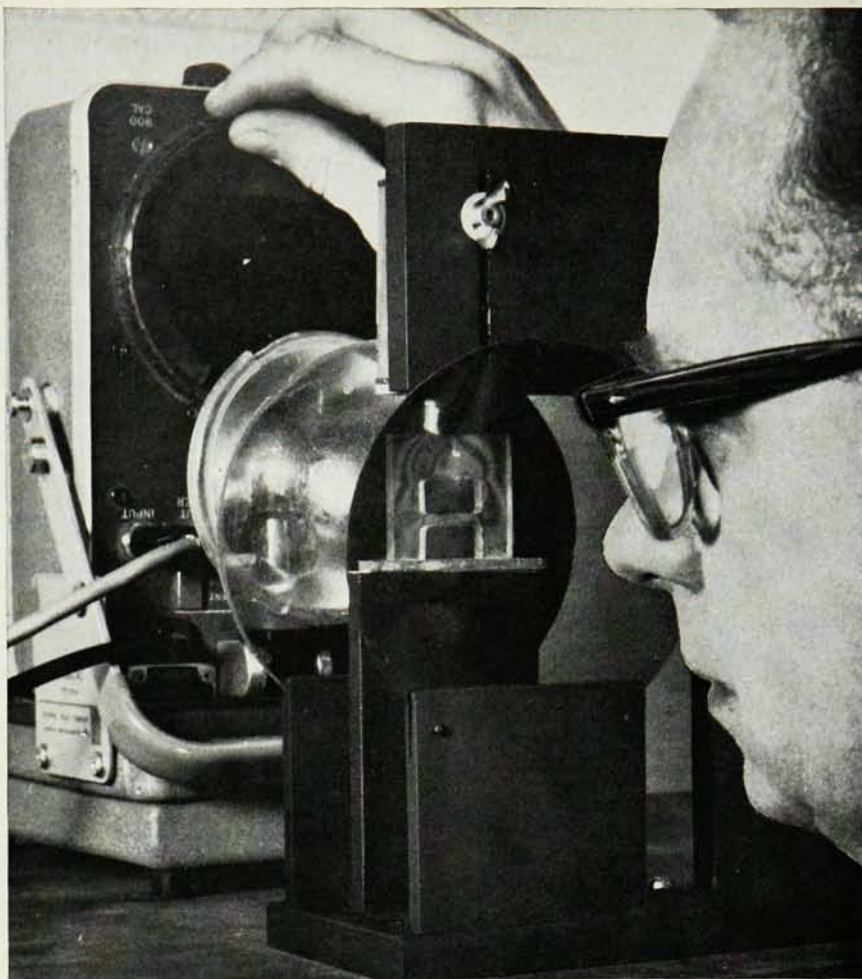


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An inside look at stress

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sibility of an idea does not imply its social desirability. But I do not think that scientists should conceal technical possibilities from the public on those grounds. To decide what should be done, it is necessary to know what can be done, and this was the point of writing my article. I do not agree with Sowers's statement that the originator of an idea faces the moral responsibility for its application. This seems to me the worst form of technocracy. The moral responsibility for the decision about a proposal that could affect the lives of much of mankind belongs to all of mankind, which must as a group decide what is to be done with it.

There is at least a *prima facie* case that freezing and reanimating humans in the distant future could be desirable, in that it would be another weapon in the fight against death, a fight that I believe most men consider worthwhile. There may indeed be possible arguments to the contrary, but I do not think that they are the "practical" considerations of Sowers. If we consider his "worst case" in which everybody who is going to die is frozen and stored for 100 years, then assuming it costs \$5000 to prepare each body for storage, and \$50 per year to keep it stored (a reasonable figure based on group storage in insulated vaults at liquid-nitrogen temperature), the cost per year comes to \$100 per living person per year, or perhaps 2% of the gross product for developed countries like the United States. There is no significant storage-space problem or, so far as I can tell, any real problem with the medical labor involved. However, a detailed systems analysis of the consequences of adopting a freezing program would certainly be valuable.

The one thing in Sowers's letter I can agree with is his final comment on ends and means. This problem becomes increasingly important as the possibilities opened by science and technology increase, and I do not think they can be solved conclusively until the human race decides upon what goals it wishes to accomplish.

Gerald Feinberg
The Rockefeller University □