

letters

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to me by *physics today*. In my original version (which will appear in the *Journal of Applied Physics*) I was careful to say "it is a long and difficult process to determine their (biological molecules) structure by x-ray diffraction," which is not the same as "not amenable to structural analysis by x-ray diffraction." Also I did not write that knowledge of the state of the iron is all that is needed to understand how the molecule works—I was careful to use phrases like "one might hope to understand. . ." which are quite different in meaning. Later in the article there are several references to the fact that the structure of hemoglobin is known, which Lattman may have failed to see. It is unfortunate, however, if readers got the impression that we are unaware of Perutz's contributions. Perutz has in fact given us great encouragement in our Mössbauer work.

Incidentally Lattman is not right in supposing that there are no insuperable obstacles to determining the x-ray structures of other biological molecules, and is mistaken in believing that the difficulty is proportional to their molecular weight. For instance some of the iron-sulfur proteins mentioned have molecular weights of only 6000, and the x-ray patterns still defy interpretation. The success with determining the structure of hemoglobin (which is ten times bigger) resulted from Perutz's skill (a) in growing good single crystals of hemoglobin and (b) in devising a method to perform isomorphous replacement by heavy atoms to get the phase of the diffracted x-rays. What other molecules will yield to this treatment depends upon how easy it is to achieve these two things, and has nothing to do with their molecular weight.

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Solid-state biology

Freeman Cope presented an optimistic viewpoint of solid-state biology in his April letter (page 13) addressed to solid-state physicists. The letter reviews semiconductor behavior in biological systems and concludes that "the field of solid-state biology is wide open to solid-state physicists, but it is extremely difficult because of experimental problems."

I submit that in addition, a class of theoretical problems exist in the field of solid-state biology that are socially relevant and belong, as a proper subset, to the field of solid-state physics. One such problem is the proposed model of the Parkinson psychosis and extrapyramidal diseases. G. C. Cotzias ob-

served that animals without melanin in the *substantia nigra* are immune to natural and induced extrapyramidal disorders.¹ Cotzias also noted that drugs such as phenothiazine tranquilizers can both induce and relieve these disorders, as a function of concentration.¹ P. Proctor and I have noted that the common property of these drugs is their ability to transfer electrons.² It is proposed that brain melanin may exist with the energy levels filled close to the band edge.^{2,3} An increase in the concentration of electron donor compounds can fill the band producing an insulator. Higher concentrations may fill the next band restoring conductivity. This model would explain the paradoxical behavior of these drugs. The semiconductor behavior of melanin and attempts to determine the band structure are available in the biochemical literature.⁴ The final resolution to the problem will probably rest on photoconductivity and band-structure measurements.

Biological journals are beginning to contain sufficient data to choose among various models, and problems are being defined in terms that form a serious challenge to solid-state physicists of both experimental and theoretical inclinations. In particular, Proctor has been able to extend the electron-donor model to include an explanation of the loss of uricase in the primate line.⁵ Sufficient data were available to justify his model and no immediate experiments were necessary.

Solid-state biology is, in fact, "wide open." It is in great need of theoretical unification, which in the examples given above at least appear to stem directly from the established body of information in solid-state physics. The existence of problems in model building should interest physicists who have been reluctant to join the experimental efforts in solid-state biology.

References

1. G. C. Cotzias, P. S. Papavasiliou, M. H. Van Voert, A. Sakamoto, *Fed. Proc.* 23, 713.
2. P. Proctor, J. E. McGinness, *Lancet*, Dec. 26, 1970.
3. J. E. McGinness, P. Proctor, in submission.
4. B. Pullman, *Biochem. et Biophys. Acta* 66, 164 (1963).
5. P. Proctor, *Nature* 228, Nov. 28, 1970.

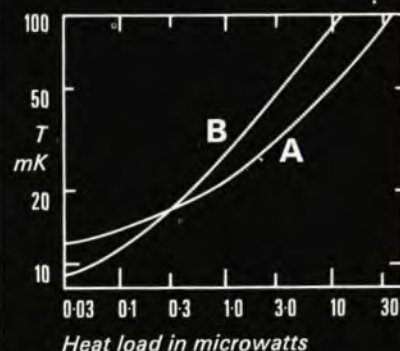
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Correction

June, pages 30-31—The caption for the center photograph should read: "Picnicking on Barton's farm are Barton, George B. Pegram, John Tate and Madeline Mitchell. . ." We interchanged the first two names. □

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