terials, the localization of states is expected to be enhanced because of the random fluctuations in the potential.

In the case of membranes there is a hydrophobic region surrounded by a hydrophilic surface. There is a further complication by the large number of proteins and enzymes associated with the membrane. This includes specialized proteins, which are associated only with the surface, as well as proteins that pass through the membrane. All of this makes for a complex situation. The conductivity of these materials can be changed in many cases over at least five orders of magnitude by the extent of hydration. It may be possible to fit some aspects of behavior of membranes with the superlattice-crystalline approach. However, it appears that efforts based on crystallinity or order will be of limited efficacy. On the other hand, the application of concepts from quantum mechanics of disordered systems may have some application in charge-transfer interactions with the membrane or in other specialized cases. It is to be hoped that there will be enough growth in the understanding of amorphous substances to tackle the more complex problems in biological systems

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More on math

I was pleased to see Robert Hermann's letter (December 1973, page 9), which regards as inadequate the current mathematical training of physicists. In rebuttal, Joel Spira feels (June, page 15) that the practical problems he runs into, as an executive of Lutron Electronics, require less mathematics than training given to him and his subordinates. This may well be a case of one man's poison being another's fancy, but as Head of the Mathematics Research Center of the Naval Research Laboratory under the scrutiny of a very practical and conservative authority, we have been given the problem of surveying areas of fundamental physics to examine if the mathematics being used is not responsible for stagnation, and if new techniques would not lead to new insights. There were eight positions open for people with clear analytic and creative minds, and in this review of candidates I am forced to agree with Hermann. Electrical engineers receive a better and more fundamental training in the mathematics of modern physics.

In my opinion physics owed much to the classical Göttingen school, but now may well be encumbered by its rigid influence. The powerful techniques of the French *Bourbakiests* have been restrained by physicists who many times as an example try to study discontinuous behavior with techniques suited to the continuum. Distributions, exterior algebra and meromorphic functions are mathematical areas that are suited for study of surface physics, condensation, phase changes, to name the phenomena basic to the field Spira represents—the electronics industry. Too often the technique dictates the problem, as people try and connect continua across an interface, when the interface itself should be studied. Nonlinear equations are the only ones that implicitly carry discontinuities and can describe particles as well as unite the ensemble of different physical regimes. Yet each nonlinear equation has been solved as a single entity in itself, and it is the theory of differential forms that is indicating a basis for establishing a systematic method of approaching these problems, as an alternative to perturbation theory.

In my opinion, no matter how bad the market is, intelligence is rare and precious, and the mind that can distill the essence of a system with simplicity and clarity will always be welcomed in this laboratory. I for one will endeavor to share whatever limited resources we have to give temporary shelter to talented people who want to pursue new mathematics in physics away from the indifference and morass of social economic pressure, which seeks only quick answers to be marketed in a hurry. I ask that we not make the problem any worse for these dedicated minorities—there is much work to be done in physics.

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Though I speak only for myself, seventeen years in Government, Industry and University persuade me that, while some physicists may need to apply better the fancy mathematics they already know, many more physicists need to know much more and more relevant mathematics. What then is the problem and where does it lie?

The problem is one of attitude. It lies partly in the attitude of many professors who appear to inculate in their students the fallacy that areas of physics that have redeeming social value are by definition not scholarly and are to be avoided. It lies partly in the attitude of

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many industrial emloyers who hire a man to do a job and could not care less how it is done ("those who can, do; those who cannot, teach").

How can the problem be solved? First of all, university professors should be more realistic and, by example, encourage their students to apply their skills to applied-physics problems—which usually do not have nice, "clean" solutions and very frequently require a far better grasp of more areas of mathematics than do many pure-physics problems. Studying more mathematics will make physicists more, rather than less, versatile. Second, industrial employers should realize that the physicists they hire to do a job need (not merely want, but need) to extend their immediate results to other ends, the value of which is not always immediately obvious. The "if he's so smart why ain't he rich?" syndrome must be corrected.

It is this attitude of many of the less enlightened industrial employers that has restrained physicists in the past from seeking industrial employment. This was a loss to physics as well as to industry. But today, when physicists perforce seek industrial jobs, is a good time to bridge the attitudinal gap. Physicists must be willing to apply their talents to seemingly commonplace problems. No less must industrial employers recognize, encourage and foster their physicists' creative needs to extend, generalize and, wherever appropriate, publish the work for which they were hired.

In the final analysis, there must be far more respect on both sides. The employer must respect (and not just be paying more money) his scientists and the scientist must respect the need of industry (which pays him his salary) for solutions in viable form to problems that may seem, but frequently turn out not to be, pedestrian.

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Challenging experiments

I recently pre-enrolled students in a sophomore course at Berkeley, Physics 4E. It is a day-long process wherein students come in to fill out cards and pick up "handouts." Among the things I handed out was a list of the laboratory experiments together with some comments about them. When I came to those that don't work very well as a rule, I fell back on the usual professorial gambit of describing them as "more challenging." I then grandly departed, leaving the rest of the chore to the graduate teaching assistants. Returning at 4:30 pm to close the pre-enrollment I found that my assistants had compiled their own list of "more challenging labs" on the blackboard. It is a list that might be shared with your readers:

1. Photograph vortex lines of He^4.
2. Measure neutrino flux from the sun; compare with theory.
3. Produce element 106; measure its halflife.
4. Measure gravitational wave flux from Crab Pulsar.
5. Build atomic bomb; test for ecological damage to environment.
6. Construct a 1 gram black hole; compare radiation flux to Siberian meteor of 1908.
7. Build a working fusion reactor.
8. Measure Young's Modulus of metallic hydrogen.
9. Establish radio contact with extraterrestrial life.

The authors of this list were Stephen Pollaine and Jerry Turney, perhaps with a little help from their friends.

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Laser separation

I want to make some comments regarding the paper "Many groups report laser-induced isotope separation" published in September (page 17).

Our first successful experiments on laser separation of isotopes of nitrogen by two-step photodissociation method were made in 1972 and published in January 1973.[1] The mean value of enrichment in our experiments was about 4.

The methods of two-step photoionization of atoms and photodissociation of molecules were experimentally tested by us in early 1971 (with atoms Rb^{85} and Rb^{87} and for molecules HCl^{35} and Hcl^{37}).[2]

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Correction

January, page 17—"An MIT group" (line 24) should read "A group from MIT and Brookhaven National Laboratory." The BNL member of this combined group is Y. Y. Lee, who is correctly identified in the photograph caption on page 17; Lee's name should be added to the list of authors for reference 1, on page 20. □