would then have early notice of the work. This would not only discourage the difficulties discussed above, but would save people from wasting money and effort on work which, under the current system, they learn was completed six months ago. If someone urgently wants the paper he may write to the author. Further, it would lessen the anxieties of an author whose paper has run into difficulties with the referee. He could afford to carry on lengthy correspondence to clear up disputed points in the paper with the assurance that the rest of the world was at least aware of his work. Journals like *The Physical Review* can then remain what they should be, a permanent repository of properly refereed work free of defects caused by too rapid publication.

G. A. PRINZ
Naval Research Laboratory
Washington, D.C.

Program for physicists

Today the physics community is facing very serious economic problems. A significant number of mature physicists are out of work with their future careers threatened. A large number of recent PhD graduates can not find positions as physicists, nor as engineers. (If anyone knows *any* specific job opening where the employer is willing to hire a physicist with a PhD let me know about it and I will have *at least* 10 of them after the job! . . . and probably many more.) Many graduate students have delayed submitting their theses for more than six months because they can not find jobs. Our talks with officials of the government lead us to believe that we face more cuts in federal research funds in the future. This, coupled with the present declining economic activities, has produced a very difficult situation.

Physicists as a group need to work to improve their own professional and economic standing. While such an effort clearly includes improving working conditions and salaries of physicists we, as a profession, are intrinsically married to the welfare of science and our society as a whole. Therefore, besides acting in part in our own self-interest, we must also accept the larger responsibility of acting in the interest of our society. I believe physicists are capable of such actions. With this broader view in mind let us proceed to some of the actions that we as physicists should follow. These are programs The American Physicists Association (APA) plans to pursue. The degree and speed we work on these will depend upon the support we receive from individual physicists.

One of the first actions we need to take is to reduce the annual growth of the number of physicists from the current rate of approximately 9% per annum to a more reasonable 3 or 4% rate. This cut calls for more than a 50% cut in our current rate. This reduction can be brought about by *decreasing the subsidization of students* to study physics. These funds could be better spent by supporting already trained physicists in productive jobs.

We need to separate research in the academic world from the training of physicists. A physicist in a college or university should be funded to carry out research on its own merit, not just because he is training graduate students. We should train the physicists needed by our society, and we should also do the research that is needed. But this research does not need to be tied to the training of graduate students. Research is carried out in federal and industrial research laboratories without graduate students. It can be done in the academic world also.

Because of the increasing technological basis of our society we need to develop physics courses for non-physics and non-science majors. We must identify new "consumers" and "package" our product to serve their needs and then sell it. The March issue of PHYSICS TODAY has a series of valuable articles on this general subject. The Commission on College Physics should be continued because it has done excellent work in this area.

With the reorientation of public priorities we must justify our cost to our society. If we can not do this we should not be supported. However, APA has great confidence in the value of science to society, and physics is fundamental to most of the sciences. Thus, one of APA's main goals, as a spokesman for physicists, is to lobby for the support of physics research at a healthy level.

APA intends to complement the services offered to the physics community by the American Institute of Physics, the American Physical Society and the other professional societies with this lobbying activity. For this we should all work together. We hope to work as closely with the other societies as we can without jeopardizing their tax standing.

For use in our lobbying activities APA needs to develop a portfolio of arguments justifying the study of physics and physics research. We need concrete specific examples of how particular research efforts have benefitted or can benefit society. I am requesting anyone who can give such an argument, or anyone who would like to contribute to this activity, to write to me at:

PO Box 19343,
Washington, D.C. 20036

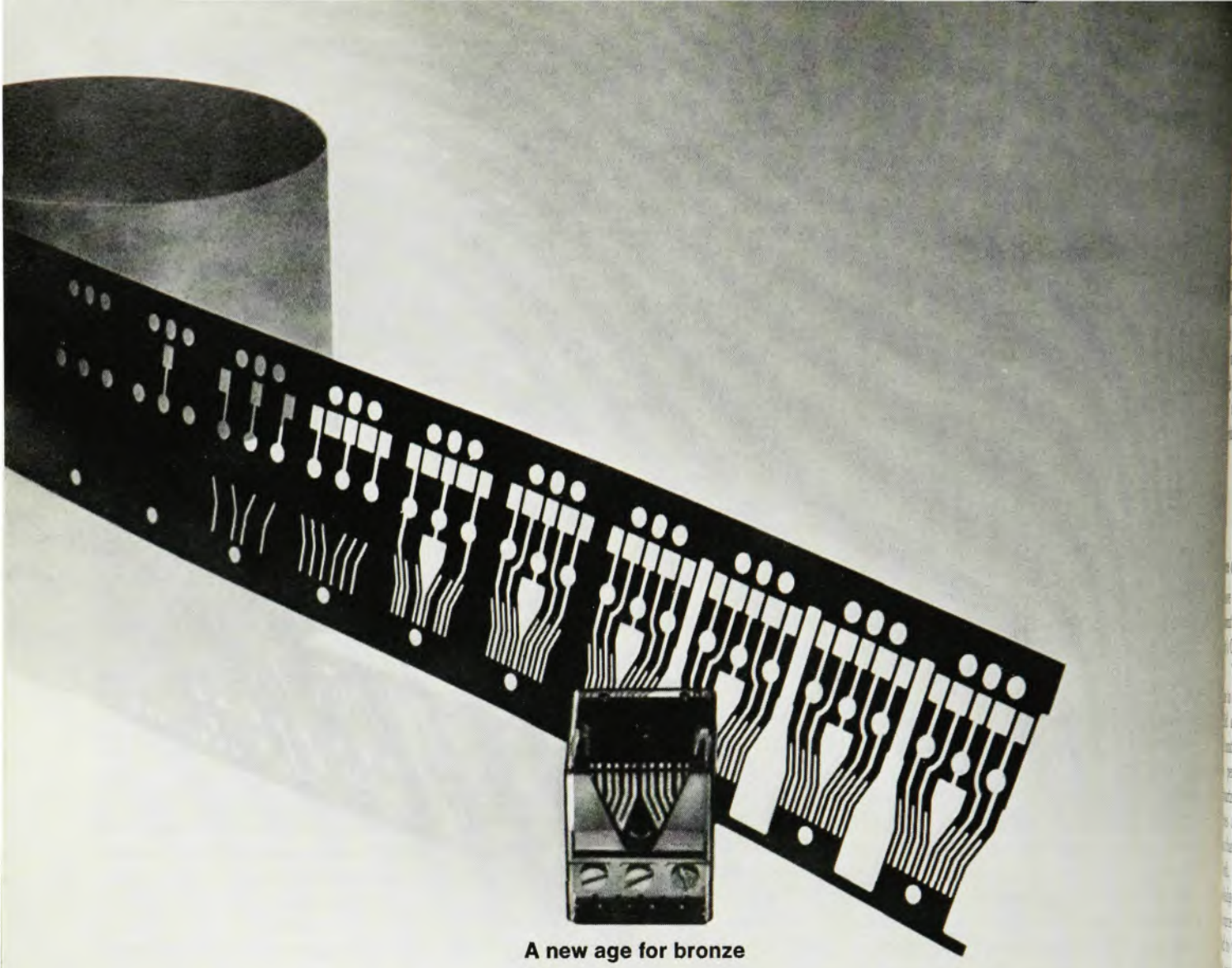
We will use this type of material and the counselling of experts, including those outside the field of physics, to formulate this material for consumption by Congress, the Administration and the general public. Our success will depend upon your support.

RICHARD L. SMITH
Chairman
American Physicists Association

Complaint about employers

Despite the heavy coverage already given to the problem of employers' stated needs and the capabilities of young professional physicists entering the job market I feel compelled to offer my little squawk. In 1967, when I was actively looking for a job, of the 10 or 12 industrial firms I interviewed at least half had in mind a specific position for a person with a very specific background. Never once in all my interviews and correspondence was it mentioned to me that there might be a place for a person with typical PhD training in physics who was interested in various sorts of work not necessarily related to his dissertation topic. This all leads me to believe that a lot of these industrial representatives are guilty of talking out of both sides of their faces when they complain about overspecialization in our training.

In nearly every graduate physics department across the country a PhD student takes strong courses in optics, electricity and magnetism, thermodynamics, quantum mechanics, and applied mathematics. Surely these subjects are basic to *every* other area of physics. In addition, an experimentalist usually has to learn how to get along with electronic gear or vacuum systems or computers or machine shops, or perhaps all of these and more besides. Now how in the world can this sort of training be called narrow?



A new age for bronze

Commercial metals consist of crystals whose properties, such as yield strength, may be greater in one direction than another. Because normal casting and forming tend to orient the crystals in a preferred alignment, metals often acquire directional properties or "texture."

Bell Laboratories scientists have been studying the laws that govern crystal alignment. By applying a computer technique called linear programming to a model of crystal deformation they can predict the result of metal-forming operations and, hence, the properties of the end material. This indicates that texture can be controlled to produce stronger materials.

A practical result of these studies is the development, by Gilbert Chin, Robert Hart, and Bud Wonsiewicz, of an improved high-strength phosphor bronze. (This copper/tin mixture, known since about 3500 BC, was probably man's first alloy.) Formed into springs for relays, connectors, and other devices, the improved alloy should give greatly increased life, savings in material, and new opportunities for miniaturization. (Photo shows a miniature relay and the steps in stamping relay springs from a sheet of the new bronze.)

Relay springs are continually flexed, so the bronze must have high yield strength (force needed to permanently deform a sample of given area). Up to a certain force, the crystal —and hence the bulk metal—is elastic. Beyond that, there is slip or shear along crystallographic planes: the metal bends permanently.

To strengthen the bronze, the Bell Labs scientists prescribed severe rolling to develop texture. A 97% reduction in thickness increased the metal's yield strength to 1½ times the value attained in usual commercial practice, where 70% is the maximum reduction. As the computerized model predicted, greatest yield strength was transverse to the direction of rolling.

Moreover, the additional rolling enhanced particle precipitation in the crystal matrix. Hence, heat treatment after the extensive rolling increased the yield strength of the bronze an additional 40%. The material became more resistant to slip or strain. This cannot be achieved with less heavily worked material.

Tests at Bell Laboratories indicate dramatic increases in the life of these important components of telephone systems. And Western Electric, manufacturing and supply unit of the Bell System, has used the new alloy in pilot runs of miniature relays.

For the Bell System, such improvements in basic materials mean better service in communications.

From the Research and Development Unit of the Bell System:

Bell Labs

In all the discussion of the employment problem the only *real* fault of the physics departments appears to be in the attitude they impart to their graduate students. I would agree that applied research has come off second best because of this attitude, but why not correct this problem and leave the rest of the training essentially as it is? All that would then be needed would be for some of these industrial outfits to back away from their "cake-and-eat-it-too" stance and recognize that most physicists are still pretty versatile.

R. C. NICKLIN
Appalachian State University
Boone, N. C.

More on Schwartz's abstract

I have read with great interest your account of the American Physical Society's Chicago meeting (March, page 67). Two questions immediately come to mind.

Did a representative of the APS first contact the Air Force office to obtain permission to print Charles Schwartz's acknowledgment?

Does a subsequent council action mean that now the APS, or the author, or both, must furnish proof that acknowledged support is actually from the source stated in each abstract submitted to the APS *Bulletin*? How else could one ascertain equitably that "no laws are violated?"

MILTON W. VALENTA
University of Vienna

REPLY FOR APS: In the case of the Schwartz paper given at the Chicago APS Meeting, the Society was first called by Schwartz's university, the University of California. Their US Air Force Contract Administrator had become aware of the USAF credit line contained in the Schwartz abstract and denied that this was a correct representation as far as the USAF contract with the University of California was concerned. Subsequently, the Society also was approached by the Office of the Secretary of the Air Force by phone and by correspondence denying viability with the claim of crediting Schwartz's work to the Air Force.

Under normal circumstances, the Society prints abstracts by direct photocopy reprint as received. Due to the time required in processing hundreds of abstracts submitted, it is only when a gross error is brought to our attention that a correction can be entertained.

The use of the expression "no laws are violated" pertains more appropriately to the nonprofit, second-class postage rates that the Society enjoys in forwarding journals to its members, without which there would need to be gross increases in subscription costs. Within very stringent financial limits, this is the fastest means of moving bulk technical information into the hands of members. Postal regulations are very severe in sanctioning the type of material that is permitted to use this privilege. The Society feels that if its journals were to become less of a technical and educational text, while increasing focus on political positions and debate, the continuation of its second-class mail privilege would be jeopardized. The administration of the Society dislikes to base its rationale on a dollar-and-cents consideration, but from a practical standpoint, we feel that low-cost diffusion of knowledge in physics must remain the priority control.

W. W. HAVENS, JR
Executive Secretary
American Physical Society

Lord Rayleigh and the bicycle

The editor of an electrical-engineering journal recently suggested that his authors should make sure that their researches had not been published by Lord Rayleigh. David Jones's very interesting article on the stability of the bicycle (April, page 34) has been to some extent similarly anticipated. He does not refer to the classical article by F.J. Whipple, titled "The Stability of the Motion of a Bicycle," which appeared in the *Quarterly Journal of Pure and Applied Mathematics*, no. 120 (1899).

WILLIAM B. THOMPSON
University of California
San Diego, California

THE AUTHOR COMMENTS: This paper has already been brought to my attention by F. J. W. Whipple's son, R. T. P. Whipple, who states that his father did not have the facilities for experiments as elaborate as those I was able to perform. He also tells me that his father's thesis examiners insisted that the action of pedalling played an essential part in the action of balancing (those were the days before the free wheel!).

Quartic equations of motion have also been obtained for the bicycle by A. Sommerfeld and by R. H. Pearsall, whose work, referred to in my paper, I took as typifying this approach. My investigation was concerned with checking such theoretical work, and the diverse explanations frequently advanced for bicycle stability, by experiment. I concluded that center-of-gravity and castoring effects have not always been given due weight.

I am grateful to Thompson for calling my attention to Whipple's paper, and if any reader has knowledge of other references in this field that I may have missed I shall be glad to hear of them. I intend at some future time to derive an equation of motion including all the empirically important factors; it will be interesting to compare it with those obtained by the classical investigators.

DAVID E. H. JONES
Runcorn, UK □