

tried very hard to place this debate in the proper context. The history and anecdotes that Dresden relates in his letter are interesting but not relevant for the issues raised in my article.

I am grateful to Helmut Rechenberg for his tacit willingness to "agree to disagree." As far as I can see, our difference of opinion can be summed up in the following question: Did the German scientists *try* to make nuclear weapons during the Second World War? But this question has no one answer. It depends on what one means by "try." If trying to make nuclear weapons means making the massive industrial efforts, spending the billions of marks, employing the thousands of scientists and engineers, and building the factories that were all obviously needed to manufacture nuclear weapons, then the Germans did not try. However, if trying to make nuclear weapons means making efforts to produce known nuclear explosives—plutonium and uranium-235—in steadily increasing amounts as quickly as possible without interfering with the war effort, then the Germans did try. In my book, I tried to leave this question open, so that each reader could decide for him- or herself which interpretation is justified. In my condensed article in *PHYSICS TODAY*, this discussion unavoidably was simplified.

Finally, I would like to say that I agree completely with A. van der Ziel. I have considerable sympathy for individuals who have to work and live under any totalitarian regime, and I have tried very hard to express this sympathy in my work.

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3/91

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## Unemployment Rates and Reactions

After reading Leon Lederman's reply (October 1990, page 122) to the critics of his Reference Frame column "Low

Pay and Long Hours" (January 1990, page 9), I feel compelled to comment about his optimism regarding future and current employment opportunities for physicists.

I have strong reservations about the statistics Lederman uses to support his claims. I have worked in industry for nearly 20 years, and the salary surveys and manpower projections of AIP and NSF seem more optimistic than experience warrants. The positive projections may be self-serving, since negative results can cause funding problems for the NSF and for members of AIP member societies. Further, using unemployment rates supplied by the government to argue increased employment of any group is extremely questionable. The rates are based on the number of persons currently collecting unemployment insurance. A person who exhausts his insurance is dropped from the ranks of the unemployed. A person who doesn't register or who doesn't qualify for unemployment insurance isn't even counted.

Lederman claims that "to first order, there was 100% unemployment" during the Great Depression. The *World Book Encyclopedia* says that at the height of the Depression unemployment was at 13 million, or 25% of the work force. Using this method of "first order" estimation the current unemployment rate is also 100%.

Lederman's belief that there will always be work for physicists because the world needs technology to solve its ever growing problems is unduly hopeful. The problems of pollution and diminishing resources are not new, yet the plight of the unemployed physicist is growing. The only thing clear is that there are fewer jobs for physicists because there is less economic need for physicists.

The trend of American business is increasingly toward short-term goals. I have witnessed many companies once involved with R&D drop it, continue to reduce staffing or go out of business. My own career is a testament to the pursuit of new employment due to reduced staffing or the elimination of R&D.

The solution to this crisis is political. Economic incentives must be created to make it profitable for American business to increase the priority of long-term goals. The APS should be trying to convince legislators to provide these incentives. The current commitment by the APS to promote science education is almost folly given the declining demand for physicists.

It is unlikely that there will be in the foreseeable future a demand for

physicists comparable to that of the 1960s. There are, however, things you can do to get through the difficult times:

▷ Contact your local unemployment office; you may be eligible for benefits.  
▷ Do not expect job advertisements to be what they appear. Many companies advertise because of corporate policy, but most positions are filled through professional recruiters (also called headhunters). So find yourself a good headhunter. His fee is paid by the hiring company. He will advise you on how to write a resume and conduct an interview.

▷ Use as many contacts as possible to learn of openings or gain access to those hiring. The more influential the contacts, the better. Many job openings are filled before they get listed; the listings are often pro forma.

▷ Be open to changing your direction. The ability to carry on thesis work for a lifetime is seldom an option when you need to survive. Most physicists have many marketable skills, such as the ability to do advanced engineering and project management, and many jobs held by physicists have corporate engineering and management titles. So be sure to list engineering skills in your resume, particularly if you include smaller corporations in your job search. Smaller companies often need their technical staff to perform a variety of functions.  
▷ Consider being a consultant. If you have many contacts then try to consult on your own; otherwise sign up with consulting firms. The problem with consulting is that you are self-employed and work is irregular.

▷ Write a book. A well-prepared prospectus demonstrating that your book is marketable is indispensable in getting your book published.

▷ Should you find suitable employment, assume it will not be permanent. That is, plan for the unexpected. Try to set aside money in safe income-producing investments as if you were planning your own retirement fund. You may need that income when you are between jobs.

Finally, do not expect too much useful help from the APS or AIP. As long as officers are elected on the basis of awards, publications, committee memberships and name recognition, I don't think you will hear them make realistic proposals for improving your employment or economic condition.

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10/90

THE EXECUTIVE DIRECTOR OF AIP REPLIES: The American Institute of Physics is widely known and respect-

ed for its professional surveys covering the education and employment of physicists. The surveys are meant to serve the physics community by being reliable and informative. I do not know what it would mean for them to be "self-serving."

In times of recession or of oversupply of physicists (such as the early 1970s), some physicists have been employed in jobs that do not fully use their talents or fully meet their expectations. However, very few are unemployed.

It is most regrettable that Murray Arnow calls it "almost folly" to promote science education. The purpose of science education is not primarily to train scientists, any more than the purpose of education in English is primarily to train novelists and literary critics. A time when job prospects for scientists are not the brightest is the very time when we need more science education.

Arnold's recommendations to job-seeking physicists seem generally sound. Physicists do indeed have many marketable skills, and many have found fulfilling careers by going in directions that they did not initially envision.

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3/91

I would like to make a few comments on the letters that appeared in the October issue under the headline "Physics Career Advice—and Dissent."

Concerning the letters by "Name Withheld" and Caroline L. Herzenberg I say "Ditto!!!" and "Ditto!" respectively.

As for Leon Lederman's reply, I would say, in his own words, "So what's new" from the establishment? I have been writing letters to *PHYSICS TODAY* for the last ten years or so on the issues of un- and underemployment of PhD physicists and the way in which AIP reports its employment statistics. (See, for example, May 1987, page 124, and January 1988, page 122.) But just as with Lederman, the replies inevitably came back from the establishment in the form of an academic joust based on limited experience and a myopic point of view.

I have eventually come to the conclusion that there are two distinct classes in the physics profession: the Haves (the establishment) and the Have-Nots. The Haves are those who go into an indignant frenzy when their research budgets get cut by 15%, yet their basic salaries come from hard funds. The Have-Nots are those who work on a zero-based bud-

get every six months to a year, or are employed temporarily (by the Haves), underemployed or, worst of all, unemployed. The Have-Nots once in a while write letters of frustration to *PHYSICS TODAY*, which for the most part are discounted by the Haves. There are many more Have-Nots than Haves. And it is in the economic interest of the Haves to keep pumping large numbers of Have-Nots-to-be out of the universities.

It would be a delight if some of the established physicists who lead the community would apply the ethics of what they teach in grad school about the science of doing physics to the business of doing physics and to the students they produce. In addition, it would be a great advancement for these lead figures to endeavor to alter the APS into an organization that actively works for the health of the profession and the welfare of its members.

FRANK MADARASZ  
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The exchange of letters between Leon Lederman and "Name Withheld" gave me a sense of *déjà vu*. Some of us have been trying to call attention to the dismal employment prospects for graduating PhD physicists since the late 1960s. If the situation has improved at all in the interim it is because the number of graduating PhDs has decreased, not because the number of new tenure-track academic positions has increased.

I remain extremely skeptical about the impending PhD shortage that is supposed to occur when large numbers of present faculty members retire, for the following reasons: Many faculty members may decide *not* to retire at age 65; universities facing financial pressures may decide *not* to replace retiring tenured faculty; and there is a large pool of underemployed physics PhDs left over from the 1970s who would be only too glad to take one of the opening academic posts.

Lederman has indeed had an illustriously successful career in physics. However, the chances of a recent PhD's being equally successful are little better than the chances of a young writer's being as successful as Hemingway or a young painter's being as successful as Picasso.

ROBERT J. YAES  
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11/90

"Name Withheld" stated that "really significant discoveries are very rare and it's not wise or realistic to bet your career on one, regardless of your level of talent."

Perhaps that is true of physics, though I doubt it; but in astronomy, particularly high-dispersion stellar spectroscopy, discoveries come in thick and fast. In 35 years as an observer I can hardly recall an observing run of three or four clear nights on which I did not find something extremely interesting on my spectra. In the old days I could recognize new and exciting discoveries while the photographic plate was still dripping with hypo—such things as doubled spectral lines indicating a layered atmosphere with two Doppler shifts in a pulsating star, or a lithium line in a star that should show no lithium. Nowadays we see these things on the computer screen as our digital data are read out from the electronic detector. All it takes to recognize the anomalies in a stellar spectrum is sufficient knowledge of the literature, access to a telescope with a spectrograph, and a sharp eye.

The interesting stars are all there waiting for you to observe them, and sometimes they "grin" for you at the right time—that is, they explode or eclipse while you are assigned the telescope. Whether or not the discoveries of a stellar spectroscopist are "really significant" is an individual judgment, but to me it is a really significant thrill to know something about the universe before anybody else.

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Leon Lederman's point, "to thine own self be true," is well taken. However, it is unfair to encourage young students to choose a scientific career based on the scanty statistical evidence Lederman presents.

For example, he states that science employment nearly doubled from 1980 to 1988. But in that period there was 26% growth in the membership of The American Physical Society.

He also asserts that employment of engineers increased by 75% in that time. Such engineers undoubtedly include sales engineers, customer support engineers and civil engineers. These positions are often at the baccalaureate level and have little involvement with science. Furthermore, I recently read an article that stated that the average engineer does engineering for no more than eight years after receipt of his or her degree. This fact seems to be discordant with either satisfaction or stable employment.

Lederman cites the low unemployment rate of scientists and engineers in 1980. The relevance of 1980 data to 1990 is open to question.

Lederman contends that shortages are underestimated because of future needs related to environmental problems, natural resource limitations and gaps in the standard of living. These problems seem to be solvable at the engineering level or even at the cultural level. It's not clear that PhDs will be needed to address these issues.

Finally, if unemployment among young PhDs is anecdotal, I personally know a bookful of anecdotes.

Lederman's optimism might be justified, but I hope better statistics will be gathered to clarify why the stated figures are at such odds with the experiences of a number of individuals. One doesn't see articles proclaiming the need for more lawyers or MBAs, despite the projected high demand for these job categories. Perhaps a study of these professions might indicate why science fails to attract "sufficient" young talent.

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## Where Are the Jobs for Young Physicists?

Since my letter appeared in the October 1990 issue (page 13), I have received over 100 responses from young physicists. Without exception, they confirm the dismal picture of employment prospects for young physicists that I exposed in that letter. Here is an excerpt from a letter that is typical in most respects:

"I can tell you that I sent out 116 letters and CVs over a 1-year period. From that effort I reaped 6 (5.2%) interviews and 2 (1.7%) job offers. The offer which I turned down was for \$22K.

"In the process I contacted group leaders at Kodak, GE in Schenectady, IBM and Digital Equipment whom I had contact with through the university and personally. I was told by my contact at GE that research funding goes through highs and lows at these facilities and that GE was in an unusually deep trough. My contact at IBM is a physicist and said that he prefers to hire physicists for particular projects even if they do not have direct experience in the research area, because in the long run such physicists often come up with fresh approaches to problems. However, in the current economic situation IBM presently tends to hire people who have had experience doing X to work on a project centered upon X. My contacts at Kodak and DEC said their companies had hiring freezes on.

"Respondents to my job search often complimented me upon my quali-

fications and expressed optimism about my job prospects."

This respondent is unique in that he received a relatively large number of interviews and his job search was successful (the job he accepted is a postdoc). The rest of his story is repeated, *ad nauseam*, in the other letters. In addition, many of the people who wrote me accuse me of being too optimistic about the probability of finding a postdoc or permanent employment at a nonresearch university.

Press reports have led many people to believe that the job market for young scientists is brimming with opportunities. However, an oft-overlooked passage from Richard C. Atkinson's report "Supply and Demand for Scientists and Engineers: A National Crisis in the Making"<sup>1</sup> should have prepared us for the bleak job market that we now face: "In the short term, pressures created by an increasing demand for new PhDs in the nonacademic sectors are likely to be offset somewhat by a decline in the number of new faculty required to teach a decreasing number of college students. The analysis by Bowen and Sosa<sup>2</sup> indicates that all academic fields (sciences, humanities and the arts) are likely to experience an *excess supply of new PhDs* until the mid-1990s, after which time the situation will rapidly reverse itself with demand outstripping supply well into the next century" (italics mine).

A recent survey of academic institutions conducted by The American Physical Society and the American Institute of Physics (see PHYSICS TODAY, November, page 99) is in agreement with the quote above. The survey concludes that "there are comparatively few academic positions for young physicists." This same survey found that the total number of academic openings had remained almost constant from 1988 to 1990, but that the demand for condensed matter experimentalists had dropped almost 30%. Considered together with the reorganization plans of many industrial labs, including the reorganization of Bell Labs at Murray Hill, New Jersey, that will reportedly result in a staff reduction of around 200 physicists, this report is hardly encouraging.

I have heard comments like "Well, you young people must not be any good" and "Boy, you young people sure have unrealistic expectations" from less sympathetic older physicists. The first charge is certainly not supported by my evidence. If we are, as a whole, untalented and lazy, why were we allowed to obtain PhDs? The

second charge has some merit given the current realities of the job market.

However, young physicists are not the only people with unrealistic expectations. Employers complain that they can't find enough scientists with five or ten years' experience in project X who also have a better-than-average chance of obtaining outside funding. This complaint then gets translated as "There are not enough PhDs" by the press and government officials. How do these employers propose to produce a larger number of experienced PhDs when young scientists are not given the opportunity to mature?

The poor employment prospects for young physicists are symptoms of the larger difficulties facing the sciences. There are simply too many good ideas for the available funds, and given the state of the economy, a significant increase in those funds is unlikely. Many science policy experts now consider reducing the demand for funds the most likely solution to the funding problems.<sup>3</sup> I fail to see how this reduction in the demand for funds will increase the demand for young PhDs in physics.

I am investigating the career options for young physicists, including "escape routes" for those of us who choose to leave the profession. If you have any employment suggestions, please contact me. The results of my investigation will be reported in a few months.

## References

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Kevin Aylesworth's October letter on the difficulties young physicists have in finding permanent employment does not reflect the opportunities in solid-Earth geophysics. The job fair at Stanford University this month turned up 26 students in geophysics to be interviewed by 25 industry recruiters looking for people with MS and PhD degrees.

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