



LOW PAY AND LONG HOURS

Leon M. Lederman

Last summer I gave a lecture entitled "Low Pay and Long Hours" to an audience of aspiring college students. My sermon had to do with the joys of the life of science. About a week later, a thoughtful letter arrived from a young undergraduate who had attended the lecture. His remarks carried the following thrust:

Dear Dr. Lederman:

I have worked hard and performed reasonably well in my academic studies, but I have yet to show real promise in any area, and despite all my efforts, I seem to be stuck in the crowd of average students. I ask myself why should I bother to work hard in graduate school and then in an academic or a governmental research career, only to discover at best one or two things that anyone else who went through the same motions might discover? Instead, with only a bachelor's degree, I can get a high-paying job with 9-to-5 hours as an actuary.

I have to admit that the possibility of becoming an actuary seems somewhat dissatisfying, because I want to pursue a career that actively promotes the welfare of humanity, and I believe that for me, science will provide the best way to accomplish this goal. However, I am very discouraged by the fact that my best only seems equal to what is average, and at times I really wonder why I should bother to pursue a career in science. In your talk, you suggested that the rewards for participating in science are those moments when you make a discovery and realize that you know something that no one else knows. Yet if my past is any indication of the future, I can

expect such moments in my career to occur infrequently. Indeed, it seems to me that only the people who have done well and won awards in the past succeed and win awards in the future.

(Incidentally, it seems to me that the only people who say one should not care about winning awards are those who either know they will win awards or know they do not have a chance to win awards. It is people like me—who know what greatness is and can just taste it, but cannot seem to achieve it—who care about awards. Also, when our society gives awards, it seems to focus on actual accomplishments rather than on the hard work that led to those accomplishments. It is the general lack of appreciation for people who work hard but do not succeed that tends to discourage me.)

I would like to conclude by asking you two sets of questions. My first set of questions concerns you: What motivated you to pursue a career in science? When did you recognize that you were talented in science and that you excelled in relation to your classmates or colleagues? Also, did you know that you were "Nobel Prize stuff" when you did your research 40 years ago that earned you the 1988 Nobel Prize in Physics? Perhaps most important, what has kept you motivated throughout your long and productive career?

My second set of questions concerns the "rest of us"—those aspiring young students who, despite their efforts, have yet to distinguish themselves from the crowd of other average students: Why should we bother to pursue careers in science? What are our prospects for success, both in terms of making great scientific discoveries and in terms of pulling ourselves above the crowd? Is hard work an adequate substitute for natural talent, or must one work hard and possess natural brilliance to succeed? Finally, how can we keep ourselves

motivated throughout our careers, especially during the long pauses between our successes?

Sincerely,
A Young Undergrad

Dear Young Undergrad,

I'm not sure I can offer clarifying guidance on so complex and subtle a series of issues. But I can tell you my own experience. In high school I was a B-to-B+ student. I graduated from City College, a tough (free) college in New York, *cum laude*—that is, with a B+ average. I had a passion for science, but I knew that I was far below the class leaders in both high school and college. But they were my best friends and the ones I enjoyed being with over all others. Three years in the US Army during World War II gave me time to think, and so I started graduate school in physics with this idea: If I can do well enough to associate, inconspicuously, with my genius friends, that will result in a good enough life. My Depression-years upbringing also fashioned a fatalistic attitude toward money. In City College we used to say: "I'm going to be unemployed in chemistry. What are you planning to be unemployed in?"

Today any trained scientist or engineer who is average (B) is assured employment at reasonable wages. But what I think you must know is yourself: What do you want out of life? If you can imagine waking up in the morning and not being able to wait to get to work; if staying up for 30 hours is for you a sign of passion and not of desire for overtime pay; if you seek real joy in the workplace, whether you're there 40 or 70 hours a week (it will still be a major occupier of your time)—if all of these are true of you, then you still have to ask: Are these "joys" worth the extra \$20 000 a year you'll give up when you give up actuary work? What will the better-paying job do for your life?

Leon Lederman is director emeritus of Fermilab, in Batavia, Illinois, and a professor of physics at the University of Chicago. He is an experimentalist in elementary particles.

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I don't think you *need* the great rewards of the superscientist. Teamwork is more often than not essential. Much of the pleasure of science is a kind of voyeurism; you have to learn to take joy in other's achievements. If you struggle hard through the drudgery of the academic process and win through, then you are a scientist! Instantly, you are part of an awesome set of traditions and masters: Newton, Faraday, Einstein, Fermi... Think of how you will describe your daily work to your children when you come home at night.

To summarize:

▷ Being average *now* isn't decisive. Find out about yourself. Do you dream? Do you ever have ideas, even wrong ones? Do you enjoy the scientific process, even as an observer?

▷ Aiming higher than you believe plausible *is* worthwhile. You can retreat later. As far as I know, we are only given one shot at the whole living process.

▷ Ask yourself lots of hard questions. Try to be as hard-nosed and skeptical of your own motivations as you can. What really gives you pleasure? What is really worthwhile on this planet? Why did you decide to do such and such last week? What has driven you in the past? And so on.

To answer your specific questions: It was probably five years after my PhD when I began to realize that I was fairly competent. By year 10, I realized to my surprise that I was as productive as those best friends who brought me into physics, even though they understood much more than I did.

A good experiment like our neutrino research led to the pleasure of giving talks but much more obsessively it led to the next experiment.

The continuing drive? The science itself! The extra added ego boost of success. At low points (many!) it was a job, but there were my associates, students, teachers, pals worldwide, who gave me support.

I've already more or less addressed the second set of questions. Hard work—yes, it really accounts for a lot of the success. Most scientists aren't brilliant. Some are even very slow. Being solid is important—that means really knowing what you have to know even if it takes a long time. Many "brilliant" guys are superficial. Determination, doggedness and hard work are the characteristics that are highly valued in a group. Imagination puts the icing on the cake.

I hope some of this is useful. Good luck!

Sincerely,
Leon M. Lederman ■

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