An Open Letter to the Next Generation

James D. Patterson

Starting as an undergraduate student and ending as a department head, I had a career in physics that spanned approximately a half century. While, on the whole, I enjoyed my various roles as student, professor, and department head, I suppose a reviewer of a proposal I wrote got it right when he said I had had a relatively undistinguished career. Then why you may wonder, should you listen to me? For one thing, I think my career was fun. Physics is so interesting that I believe it is rewarding at whatever level you can perform. My teaching often energized me; I wrote papers that interested me, if few others; and I met many interesting people. However, I wish I had maximized my opportunities. Obviously, because I had a long, uninterrupted physics career, I must have done a few things right. But that is another story.

Retirement has given me time for introspection, and I think I have figured out a few reasons why I was not more successful. Such insights are of little use to me now, but perhaps they may be helpful to some of the younger generation.

Doing too much too soon

When I arrived at the University of Chicago in the fall of 1956, I had just graduated from the University of Missouri–Columbia, where I had been more interested in getting good grades than gaining understanding. I was advised that perhaps I should take some senior courses before venturing into the graduate ones. I refused, and consequently never really caught up with the graduate level at Chicago. When I began teaching, I still had trouble with the basics and related details. It wasn't until I was doing research on my own that I realized I needed to understand the basics before delving into the unknown.

We have to learn basics first, because we need them for all that follows. If we do not learn the basics, we are disadvantaged. A related sin is skipping essential details. Then we do not get to the bottom of things and are not well grounded.

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Disrespecting superiors

When I headed the physics and space sciences department at the Florida Institute of Technology, the dean was younger than I, and I thought his philosophy was wrong headed. So I tended to oppose him head on. Whether he was right or not really misses the issue. My job was to move the department ahead as best I could, given the boundary conditions I was working under. Obviously, my technique was not optimal. Later, I observed a more effective department head who approached the same dean about an issue by saying, "How do you see this?" Then the department head skillfully guided the conversation until he ended up with at least part of what he wanted.

Regarding superiors with ill-conceived contempt often comes from a false arrogance that may arise from insecurity. It can lead us to rebel and become isolated from the very ones who can help us. Courtesy is not insincere nor is networking with those who are helpful or whom we can help.

Not controlling temper

While I was serving as the department head at Florida Tech a few faculty members thought I was doing a poor job. I lost my temper with them more than once in departmental meetings and privately. As a consequence, I probably had less support from the department than I could have had, and also lost influence with the dean, who I am sure heard about my lack of support.

Losing one's temper often comes from frustration, which in turn may come from poor performance. If we lose our temper we let the situation control us rather than the converse.

Being inefficient

As a second-year graduate student at Chicago, I resolved to spend most of my time studying for the dreaded "basic" exam. So I took few courses, and it was up to me to organize my time. I did not have a focus to my work, but instead read a lot and worked few problems. Chicago itself also provided distractions. One student I knew resolved to work every problem in Charles Kittel's *Introduction to Solid State Physics*. He passed the basic. I did not, although many students did take the exam again. Instead, I transferred to the University of Kansas, where I eventually earned my PhD.

In graduate school, time may be your most valuable asset. Even impractical goals, which some people would say included my goal of becoming a theoretical physicist, need a practical, organized approach for accomplishment.

Being a desk potato

After several years as professor at the South Dakota School of Mines and Technology, my friend Gerald L. Jones invited me to spend a sabbatical year at the University of Notre Dame. I arrived tired and fat. However, I resolved to change. I got a dog, took him for walks, dieted, and worked hard in between. Compared to my previous achievements, the year was productive and fulfilling. I actually solved more problems—some while walking—than I ever would have done otherwise.

Sometimes our problems are so vexing we feel we cannot leave our desk or we will never find the solutions. However, we often need a rested body and a fresh approach to generate new ideas. Staying in condition, taking walks, and doing other sorts of exercise are important. Fatigue arising from lack of conditioning can cause errors and inhibit inspiration.

Using math without experiment

My PhD research at Kansas was on the theoretical interpretation of color centers, crystalline defects that absorb visible light. Although this area was clearly linked to experiment, I found it very frustrating because the calculations that could be done at that time were rudimentary. When I started my career, I looked for an area that had few directly relevant experimental results. For a while I settled on applying statistical mechanics to finite Heisenberg magnetic systems. During a job interview, I was asked why I did not work on problems that

connected easily with experiment. I had no answer. I did not get the job. Incidentally, for a role model in the opposite direction, I recommend Marvin L. Cohen and his calculations; he has used pseudopotential and other techniques on real materials with strong connections to experiment.

When we begin learning about something, it is comforting to be able to "surround" it—to achieve a concrete understanding of what we are dealing with and thereby have a precise understanding of what we need to know. Mathematical problems that are easy to surround are said to be well posed, but just because they are well defined does not mean they relate to reality. An intuitive feel for reality is necessary for doing physics. Mathematics is essential, but so are the measurements and their meaning.

Having unrealistic goals

Early on, I somehow got the idea that being a theorist was the only truly prestigious objective in physics. In my heart, I felt that nuclear or high-energy physics was the most noble. Despite my eventually settling on solid-state, I thought for a long time that the subject was not important enough. Maybe I bought into some precursor of the idea, often attributed to Murray Gell-Mann, that solid-state physics was really squalid-state physics. I finally came to see that every physics subfield has many fascinating, rewarding, and useful problems. The trick is to find an area you can handle. And today, even though I have written a text on solid-state physics, I would not say I have mastered the topic to the extent that it deserves.

In my early teaching, I often tried to do too much, either to learn something new or to impress the students. It wasn't until I figured out that my job was to teach the students in my class, rather than to make a splash, that I began to succeed as an instructor.

Our goals should fit our interests and aptitude. It is all very well to attempt solving the most fundamental problems, but not all of us can make headway on them. Sometimes other problems, perhaps less fundamental, offer us rich opportunities for making contributions. We need to think carefully before doing our work. Of course, if we are excited and interested in it, we will have fun. Otherwise, work may seem like total drudgery.

Not referring to original literature

Scientific papers are almost always more complete and understandable than their digested versions in books. A recent example for me involved the half-integer quantum Hall effect. I never seemed to get the point of it from texts. Then I ran into Horst Stormer's Nobel Prize address.[1] Somehow that paper, involving both theoretical ideas and experiment, clicked with me. After digesting it, I was able to read the original papers.

When we want to know something, there is a tendency to seek a quick answer in a textbook. This often works, but we need to get in the habit of looking at original papers. Textbooks are often abbreviated second- or third-hand distortions of the facts, and they usually do not convey the flavor of scientific research.

Never memorizing basic facts

Graduate students at Kansas needed to take some courses outside their major. I chose to take a couple of courses involving group theory with William R. Scott. I could not follow him, even though he was a renowned expert in the field. He expected that after he defined something, we would remember the definition and he could then use the term without elaboration. I was lost because of my faulty memory. I had a similar problem while attending American Physical Society meetings.

Although memorization is not the goal of physics, when we listen to presentations, we need to know what the speaker is referring to without looking everything up. Some physicists may automatically remember what they need, but for the rest of us, memorizing is an often overlooked tool.

I do not claim this list exhausts all of the missteps I have made. But these are the ones that occur to me as perhaps being common to many other physicists. And although I cannot claim expertise in many areas, I do think I know something about my own shortcomings. At this stage of the game, I have nothing to gain by hiding from the truth.

Reference

1. H. Stormer, *Rev. Mod. Phys.* **71**, 875 (1998). ■

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