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Chapter 1

P. W. Anderson Seen Through the Eyes of a Student

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These remarks were given after dinner at PWA90. A former student of P. W. Anderson reminisces on what it was like to work for Phil by relating some anecdotes.

1. Some Anecdotes

I was both an undergraduate and graduate physics student at Princeton. I first heard about Phil when I was a junior. One morning in October 1977, I was sitting in a classroom, waiting for my statistical mechanics class to begin, when the professor, Tom Carver, came bounding into the room and exclaimed, “We’re all very excited! Phil Anderson has just won the Nobel Prize!” I thought, “Who? What did you say his name was? Why are we excited? Is he a professor here?” I was, of course, to destined to become much more acquainted with Phil.

Phil worked primarily in solid state physics. As a junior, this sounded to me like a very dull subject. I pictured a solid block of aluminum just sitting on a table, not doing anything. Boring! But my view soon changed in the summer following my junior year when I read a *Scientific American* article¹ about the discovery of superfluid ^3He . So in the fall of my senior year, I asked Phil to be my senior thesis advisor and told him that I thought superfluid ^3He was interesting. He said that was too hard for a beginning student and suggested I work on solid ^3He , which I did. He captured my interest when he pointed out that even though the helium atom is very simple, a collection of them produces unexpected phenomena such as superfluidity and magnetic phases. Basically he was giving me an example of “More is Different”² without my realizing it.

In the course of working on my senior thesis, Phil taught me the art of making estimates and plugging in numbers. He explained that you do not just plug numbers in to a calculator; you think about each number and physical constant. You keep the important physical constants in your head and you use units that are suitable for

the problem, e.g., do not use Joules/mole, use Kelvin/atom. That was an important lesson that I now try to pass onto those working for me.

I stayed on at Princeton as a graduate student. My dream was to do quantum gravity. Doug Osheroff, my Bell Laboratories Graduate Research Program for Women mentor, did not think that quantum gravity was a good career choice since it would be very difficult to get a job in that field. In fact, he thought it was a mistake and told me so. I figured, "He's an experimentalist. What does he know about theory?" The real problem was that Doug was not telling me what I wanted to hear, so I ignored him. (He did not have a Nobel Prize yet.) Realizing that his good advice was falling on deaf ears, Doug went and told Phil. Phil called me into his office, sat me down, and managed to knock some sense into me. So I decided to do condensed matter theory instead and work for Phil.

For my thesis, Phil suggested that I prove it was impossible to have high temperature superconductivity. (This was in 1981 before the discovery of high temperature superconductivity.) Fortunately, that did not last long and I moved onto other topics.

In the course of working with Phil, there were times when he would get frustrated with me as one does with students from time to time. Once, in complete exasperation, he said, "Theoretical physics isn't doing calculations." I said nothing, but thought, "Ok, so what is it?" Reading my mind, he went on to say, "It's setting up the problem so that any fool could do the calculation."

Communicating with Phil was a challenge. For example, I learned to summarize everything in 90 seconds or less, or else he would start to read his mail or fall asleep. Also his words had a different meaning when he used them than when other people used those same words. So I would read his papers to try to figure out what he meant by those words. When he talked about "it", I often wonder what "it" was. As he spoke, I would build a picture in my mind and then suddenly come to my senses and realize that the picture made no sense. So I would stand in his office stammering "What?" When I left his office, I would try to remember all the words he used, and put them together in all possible combinations to try to find one that made sense. That is how Phil taught me to think.

As a graduate student, I had the privilege of editing Phil's book, *Basic Notions of Condensed Matter Physics*.³ I would try to reword things to make them clearer. However, sometimes there were sections that I could not understand. So I would ask others like Mike Cross or Sue Coppersmith for help. But I remember there was one particular passage which no one could comprehend. So I showed it to Phil. He looked at it and said, "I guess I wasn't very clear." He stared at it for a while longer, then finally understood what he meant, and explained to me. Then he looked back at the passage and said, "I think I said it ok." But added, "But you can rewrite it if you want," which I did.

I would like to end with one final anecdote that occurred after I graduated. At the 1987 American Physical Society March meeting in New York City, Phil was

giving at talk at the symposium on the History of Superconductivity. The title of Phil's talk was "It's Not Over 'Till the Fat Lady Sings." A lady at the convention center told us that the saying was a reference to the singer, Kate Smith, who used to sing "God Bless America" at the end of the Philadelphia Flyers' hockey games.^a Another former student of Phil's, Yaotian Fu, and I thought it would bring down the house if we could get a fat lady to sing "God Bless America" at the end of Phil's talk. Since we were in New York City, we figured we could hire a singer who would fit the bill. So we called a local talent agent who told us that it would cost \$200 if he could even find such a singer on such short notice. In 1987, \$200 was a lot of money for two postdocs, so we decided to solicit contributions. If ten people each gave \$20, we would have it made. So we told the agent to line up a singer and we started to hit up our friends for money. I asked my friend Sue Coppersmith who agreed to not only contribute, but to help us work the floor. She said when she asked Ted Geballe, a long time friend of Phil's, he whipped out his wallet and asked, "How much do you need?" Sue responded that we were not accepting any money until we actually knew someone had agreed to sing. Unfortunately, the talent agent was not able to find a singer, and Phil gave his talk with no surprise endings. But word of our scheme spread and Sue said that people she did not even know came up to her the next day and offered to contribute. I never told Phil until years later at an event like this one.

In closing, I would like to thank Phil for being my advisor and wish him a very happy birthday.

References

1. N. D. Mermin and D. M. Lee, Superfluid helium 3, *Scientific American*. **235**, 56–60, 62, 64, 67–68, 70–71, (1976).
2. P. W. Anderson, More is different, *Science*. **177**(4047), 393–396, (1972).
3. P. W. Anderson, *Basic Notions in Condensed Matter Physics*. (Benjamin/Cummings, Menlo Park, CA, 1984).

^aThis is probably not the origin of the saying since Kate Smith sang at the beginning of the Flyers' games.