

# **Putting PhDs to WORK: Entrepreneurship and Graduate Education**



**Dr. Peter S. Fiske**  
**peterfiske@yahoo.com**



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**CGS**

# Why am I here?

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**Finished my Ph.D. 12 years ago –**

- **Worked in an applied R&D environment (LLNL)**
- **White House Fellow ('96-'97)**
- **Led a research group (LLNL)**
- **Co-founded a technology-based start-up (RAPT Industries, Inc.)**
- **Leading a second technology-based start-up (PAX Mixer Inc.)**

**Hired more than a dozen PhD scientists and engineers and have worked with them in the start-up environment.**

**First-hand view of graduate schools' “product” and how it meets the needs of the economy – particularly the start-up environment.**

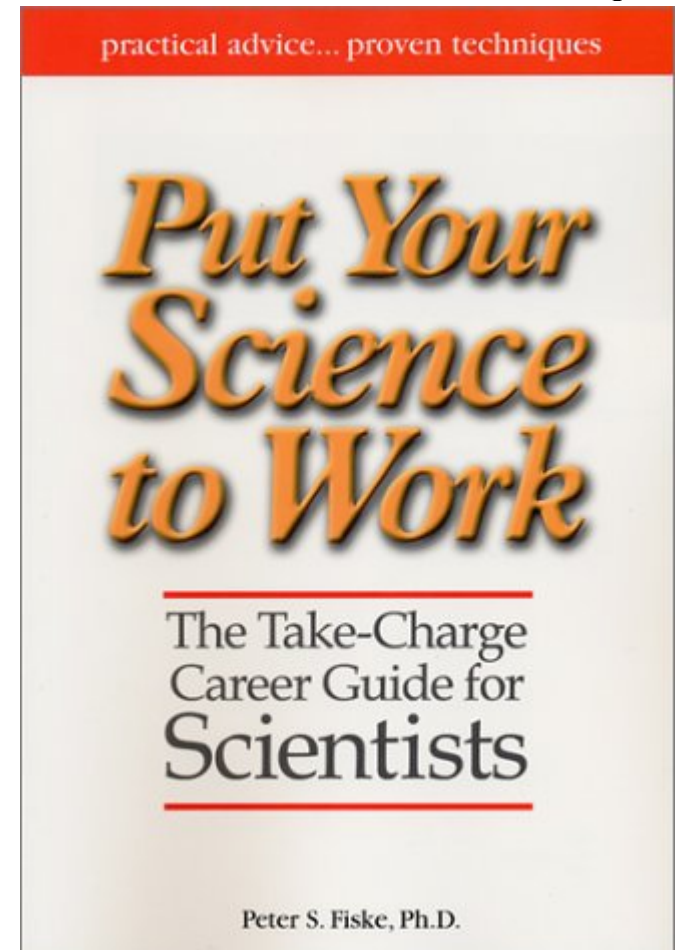


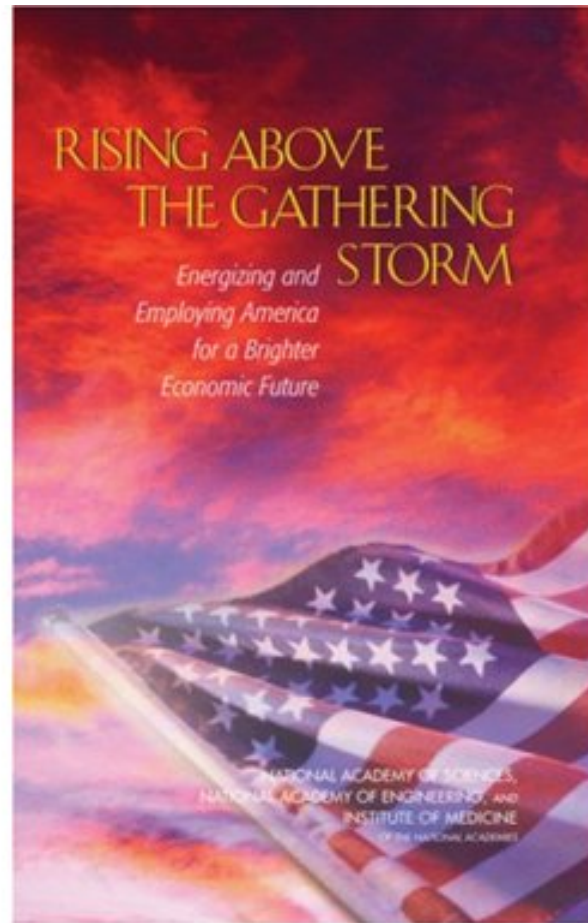
## But I am also here because...

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- Wrote two books on the subject of career development for S&Es
- Presented career development workshops to over 8,000 S&Es in the US and UK
- Wrote a monthly career development column from 1997-2000 (Tooling Up: AAAS's website NextWave)
- Presently write a new column (Opportunities – AAAS's website ScienceCareers.org)
- Also co-write a blog on training and employment of S&Es (blog.phds.org)

**I have been counseling graduate students and post-docs in their careers for the past 16 years**





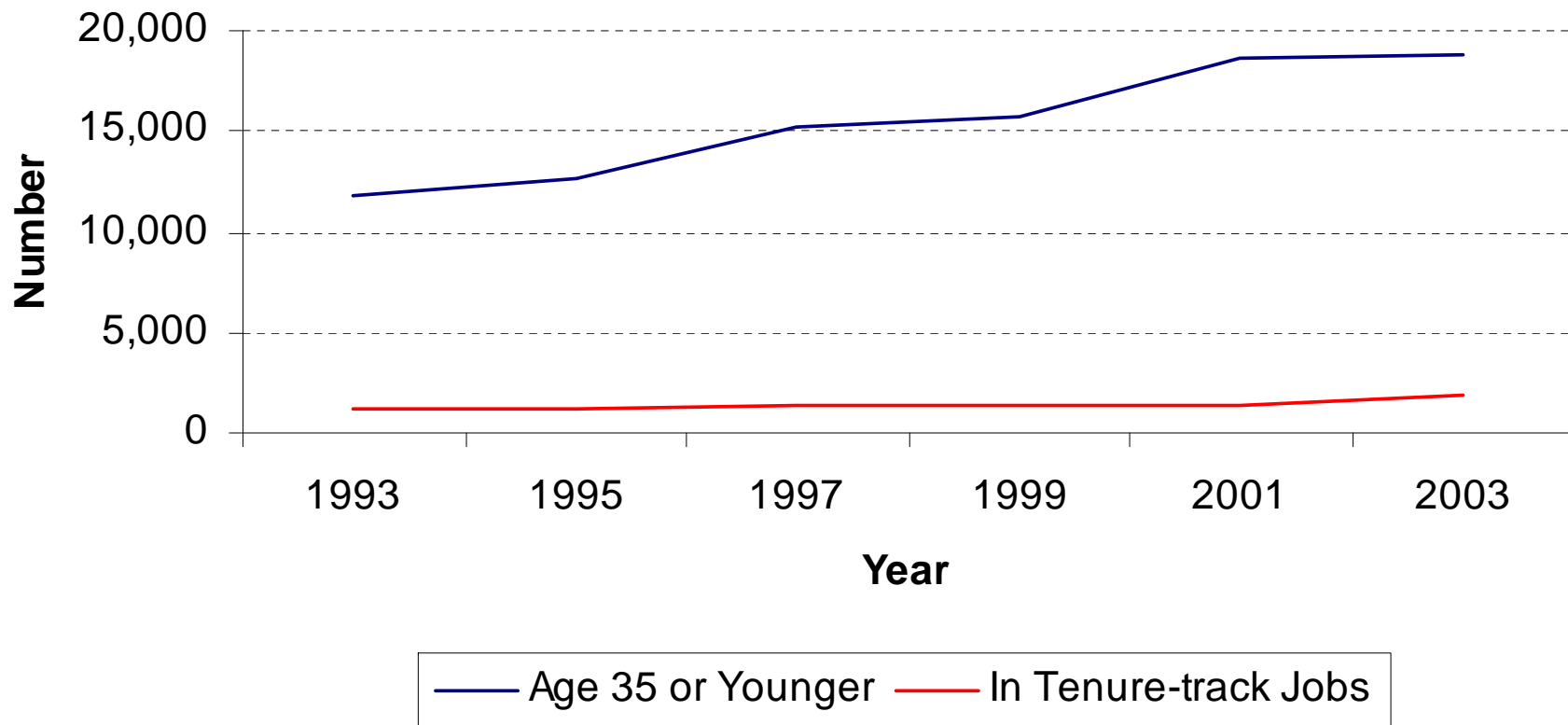
# The Paradox

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- **PhD graduates in many fields of science (less so in engineering) face years of temporary employment, stagnant wages.**
  - Graduate students know this and are frightened
  - Prospective graduate students hear this and weigh their options accordingly
- **High-tech employers face a REAL dearth of qualified U.S. citizen candidates to fill technical positions in their organizations**
  - Gobble up a year's supply of H1-B visas in a single day

## Number PhDs 35-or-younger increased far more than those in tenure-track jobs



Source: Survey of Doctorate Recipients, NSF. M. Teitelbaum, 2007

# “Young” biomedical scientists



## EDITORIAL

### Supply Without Demand

If there is one domain of science policy in which bad estimates have become routine, it is the one we used to call “scientific manpower.” Time after time we have been warned of impending shortages which, with evergreen consistency, are subsequently transformed into gluts, to the dismay of those most affected: the future practitioners of our disciplines. Somehow, the predictors seem to forget that calls to increase future supply should bear some relationship to the present balance between supply and demand.

This is an old problem in the United States, where the ill-advised prognostications of the National Science Foundation in the early 1990s were followed by intense congressional criticism and widespread outrage among graduate students and postdocs. The National Science Board has apparently not profited from that harsh lesson. Now, expressing concern that few native-born citizens are entering scientific careers, it calls for an intensified national effort to expand domestic production. Meanwhile, unemployment rates for scientists are going up; according to the American Chemical Society, they have doubled among chemists over the past 2 years.

The habit is apparently contagious. On the other side of the Atlantic, the European Union has set targets for increases in R&D spending that, it predicts, will require 700,000 new scientists in the coming years. To meet this anticipated demand, the European Commission (EC) is implementing a series of new programs, as Philippe Busquin reported on this page last month (*Science* 9 January 2004, p. 145). But repatriation and mobility won't solve the problem. At an EC meeting at Rockefeller University in December 2003, angry expatriate Italian scientists pointed out that even if they want to go home, as many do, there are no jobs for them.

What is going on here? Why do we keep wishing to expand the supply of scientists even though there is no evidence of imminent shortages, and most jobs are in the private sector, where they are immune to management by policy fiat? First, there is a widespread belief that economic progress depends on science and technology; why shouldn't we have more of such a good thing? Second, policies are set mainly by elders, who, like the institutions that employ them, have little incentive to downsize their operations. Instead, academic reward structures and government funding priorities lead to perpetuate the “train more scientists” status quo.

There's one more, uncomfortable, explanation for calls to increase the supply of scientists. The present situation provides real advantages for the science and technology sector and the academic and corporate institutions that depend on it. We've arranged to produce more knowledge workers than we can employ, creating a labor-excess economy that keeps labor costs down and productivity high. Maybe we keep doing this because in our heart of hearts, we really prefer it this way.

The consequences of this are troubling. To be sure, the best graduates of the most prestigious programs may eventually find good jobs, but only after they are well past the age at which their predecessors were productively established. The rest—scientists of considerable potential who didn't quite make it in a tough market—form an international legion of the discontented.

Are there some things we might do to help us kick this habit? For one thing, university departments should be obliged to give applicants a detailed account of the placement histories of recent graduates, as few now do. Academic scientists should think realistically about how many intellectual offspring they ought to produce over a career and talk candidly with current students about the job market. Official needs estimates should study the present relationship between applicants and jobs—we don't need more calls for “more scientists” from policy-makers who haven't first looked hard at the balance between supply and demand. Finally, governments and funding agencies should carefully consider the job market implications of their burgeoning science budgets.

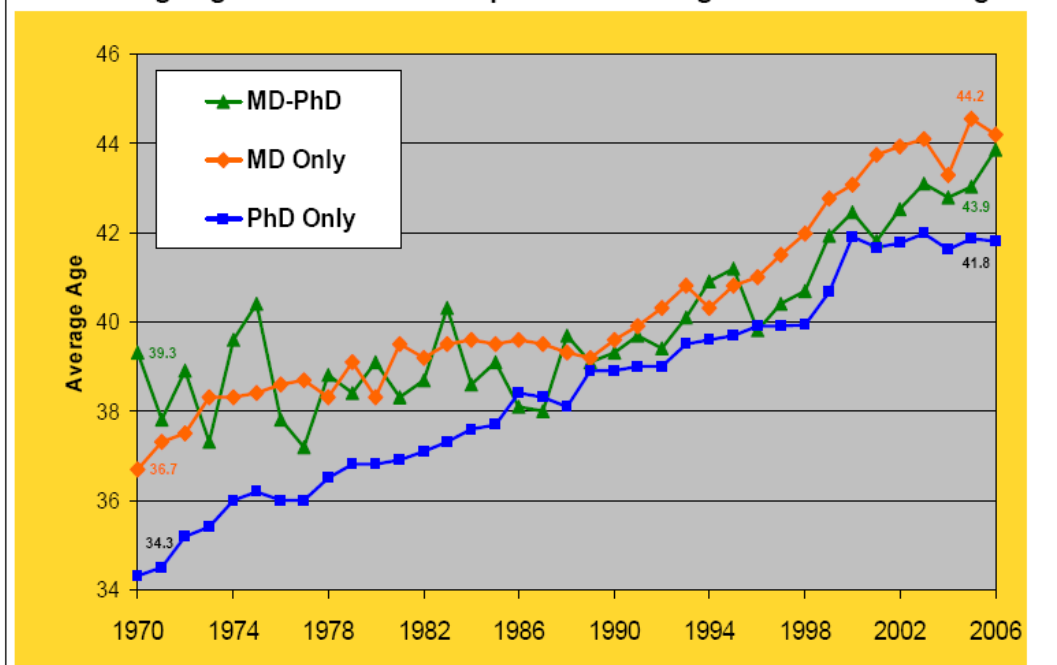
Of course, the problem may solve itself. Undergraduates seem to be getting the message that science jobs are scarce and that the graduate students and postdocs in their departments are deeply concerned about their future prospects. As they turn their attention elsewhere and a real shortage develops, we may finally get the best science minds into stable, rewarding positions at a young age. That's a good outcome, but do we have to get there the hard way?

Donald Kennedy, Jim Austin, Kirstie Urquhart, Crispin Taylor

Donald Kennedy is Editor-in-Chief of *Science*; Jim Austin, Kirstie Urquhart, and Crispin Taylor are, respectively, U.S. Editor, European Editor, and Editorial Director of *Science's Next Wave* ([www.nextwave.org](http://www.nextwave.org)).



The average age of first time R01 equivalent investigators has been rising



THE NATIONAL ACADEMIES  
Advisers to the Nation on Science, Engineering, and Medicine

Source:  
<http://grants1.nih.gov/grants/award/award.htm>

C. Kuh, 2007

## The big irony in all this...

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- **Science and engineering-trained graduate students possess many of the broader skills that are of highest value in today's economy**
- **Early-career scientists and engineers can make GREAT entrepreneurs**
  - Resourceful, persistent and determined
  - Can function in a wide varieties of environments and roles
  - Can survive on \$2K/month!
  - Young enough not to know what they can't do

**Consider the story of Avi Spier...**

## What makes the U.S. special?

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- **We are not the only country with an extensive and well-funded higher education infrastructure**
- **We are not the only country that funds basic and applied research at universities**

**What makes us special is our ability to INNOVATE and translate the fruits of scientific research into goods and services that promote our economic growth**

**Entrepreneurship is seldom discussed outside of Business School**

# How to broaden graduate students' perspectives (without sacrificing program quality)

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- **Professional development resources for graduate students and post-docs**
  - Graduate-specific career counseling
  - Career symposia
  - Workshops
  - Graduate student and post-doc associations
- **Promote consulting for graduate students as well as faculty**
- **Connect your Engineering/Science programs w/ B-schools**
- **A “Golden Chapter” of the PhD thesis**

## What not to do

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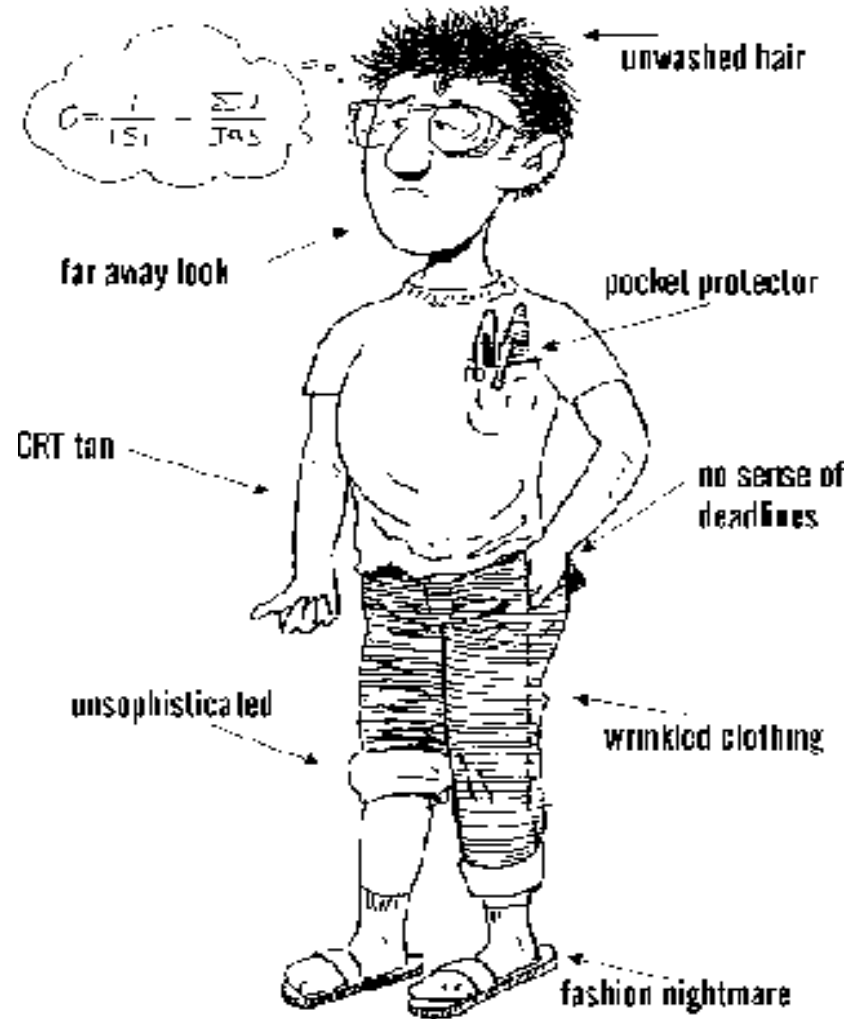
- **Remain complacent**
  - Transferable skills are unrealized if not promoted
  - Research training alone does not prepare graduates for the range of opportunities they will face
- **Rely solely on faculty/departments to bridge the gap**
  - They represent the “traditional” path
  - They don’t KNOW what opportunities are out there
  - They are very very busy
    - Do not expect that another unfunded mandate will be acted upon with much enthusiasm

**We have an oversupply of PhDs trained for academic research**

**We have an undersupply of technically-versatile problem-solvers  
with a desire to have an impact on the world**

# Do not allow your students to graduate looking like this!

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# A few exciting examples of innovation in graduate education



## Management of Technology Program – U.C. Berkeley

MANAGEMENT OF TECHNOLOGY PROGRAM  
University of California, Berkeley

## Program in Intellectual Entrepreneurship – U.T. Austin



Intellectual Entrepreneurship: *"Educating Citizen-Scholars"*  
A Cross-Disciplinary Consortium

## TI:GER – Georgia Tech

TECHNOLOGICAL INNOVATION:  
**TI:GER**<sup>®</sup>  
GENERATING ECONOMIC RESULTS

## Univ. Colorado Denver



## Stanford University VPGE – SPICE and SCORE



STANFORD UNIVERSITY »

VICE PROVOST FOR GRADUATE EDUCATION

# The Consequences of Inaction

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- **A growing underclass of research-trained scientists**
  - not a very attractive pathway except for those with few other options
- **An increasing proportion of non-citizen graduate students**
  - Increasing visa congestion
- **Inevitable public policy intervention**

**A big missed opportunity to align science and engineering graduate education to the needs and the strengths of the US economy**

# The World Beyond Academe...

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**Frightening  
Confusing  
Amazing  
Liberating  
Empowering**

## Further information and resources

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- **Peter Fiske's new column at [ScienceCareers.org](http://ScienceCareers.org): "Opportunities"**

[Walking on the Dark Side](#)

19 October 2007

[The Most Important Venture Capitalist](#)

14 September 2007

[The Power of Poverty](#)

10 August 2007

[The Accidental Consultant](#)

13 July 2007

[From PDF to IPO, One Scientist's Journey](#)

8 June 2007

[More School?](#)

11 May 2007

[A Day in the Life, Part 2](#)

13 April 2007

[Breadth Versus Depth](#)

9 March 2007

[A Day in the Life](#)

16 February 2007

[Insubordination](#)

12 January 2007

[Intellectual Property, Part 2](#)

8 December 2006

[Intellectual Property, Part 1](#)

10 November 2006

[Stealing Time](#)

13 October 2006

[Opportunities](#)

8 September 2006