

Rackham Commencement

Congratulations!!

Congratulations!

After what must seem like an eternity of education,
you now stand on the pinnacle of receiving your
graduate degree.

A long, long time ago,
...in a galaxy far, far away,
I sat where you are today,
a newly minted PhD.

Our commencement speaker that day was one of our faculty,
Richard Feynmann.

Introduction

Today, your commencement speaker will also
be a faculty member...but unfortunately
not a Nobel Laureate...but rather that lowest
form of academic life, a university president!

There has long been a tradition that the president
of a University is invited to give the Commencement address
at the beginning of his/her tenure...

And, similarly, it is customary for an outgoing
president to deliver the address.

Since I am soon to be set free from a decade of
bondage in academic administration,
I have drawn the duty.

Now, actually, I would have preferred someone else,
probably even more than you do--perhaps a Nobel Laureate,
or the President of the United States, or even
a famous personality such as Robert Redford or Kermit the Frog.

But, alas, tradition wins out.

Fortunately, it is easier to prepare a commencement address
than it is to listen to one!

Because, you see, there is really only one commencement address,
although it has been given thousands of times,
in thousands of different ways

The basic message is always the same.

First you tell the graduates that their education
has prepared them to go forth into a world in which they,
and they alone, will have the power to shape their future,
to control their destiny.

Then you throw in some advice on how to go about doing this.

And, of course, it is tradition for graduates to totally ignore this advice.

The only real challenge is to figure out how to say this once again,
in yet a different way, and to keep it all under fifteen minutes!

So here goes.

The Excitement of Graduate Study

Let me begin with a bit of nostalgia...

I remember well my own graduate days...

The very rapid sense of responsibility and
control. Graduate students are expected to
possess the intellectual maturity to determine
their own course of study -- to set their own

pace...

The intellectual excitement--of being able to
dig into a subject as deeply as you choose!

The quality of student colleagues...

The sense of collegiality with the faculty.

In a short time, many of you will have acquired
knowledge in a narrow area that exceeds your
faculty advisor. At this stage, the learning
relationship passes from a parent/child to
a peer-to-peer nature...and you become a
collaborator and a colleague.

Indeed, my most valuable colleagues and
closest friends were always my PhD students...
which is natural, I suppose, because the
bonds between faculty and graduate students
are particularly strong in almost every
discipline.

We worked together...played together...and learned together...

The age-old tensions which surround university faculty...

Since graduate students play many roles in a research
university:

students
teaching assistants
research assistants
faculty colleagues

Graduate study is one of the most
exciting periods in your intellectual development
since one rapidly becomes
a master in your chosen area of study...
and indeed can draw on the reputation of the
institution and your faculty colleagues...yet
you are not subject to the other pressures of a
faculty position -- e.g., pressure to achieve tenure.

Challenges

But I also remember other types of challenges...
that are quite similar to those of today...

The end of the Apollo program and the Vietnam War
brought with them a significant downturn in the job
prospects for PhDs.

While the rumors of PhDs driving taxicabs was a bit
exaggerated, it nevertheless was a time of some concern.

Similar, in many ways, I suspect, to the concerns
that many of you here today have...

And, indeed, this is just the subject I wish to focus
my remarks on today...

...the needs of our society for PhDs...
...and whether we should modify
our PhD programs to make them more
responsive to these societal needs...

In focusing on this subject,

I am going to set aside my hat as a university president,
and instead don another hat,

as a member and past chair of the National Science Board,
the nation's principal body for policy concerning
research and graduate education.

The future of the American PhD has been very much
on our mind of late...
for reasons painfully obvious to many of you

The Problem: Mismatches

The problem is that we have several serious mismatches today...

The Problem: Mismatches between

...the production of PhDs and job opportunities

...PhD training (too narrow) and career needs (breadth)

...PhD expectations (become a professor) and reality

Is there an oversupply of PhDs?

Overall unemployment rates for recent PhDs have remained
very low.

But there do seem to be far more seekers of jobs as professors in
academe and as basic researchers than there are available
positions. This situation is the basis of the frustrated
expectations of new PhDs.

There are some worrisome indicators of weakness in the
market, such as the substantially longer delays in the
initial placement of new graduates.

The current oversupply of PhDs will continue and may well
worsen in the near term as federal budget cuts hit even harder.

The Causes

1. The Post Cold-War blues

The US system of graduate education is arguably the most
effective system yet devised for advanced training.

By carrying our graduate education in institutions where
a large portion of the nation's best research is done,
the universities have created a research and training system
that is one of the nation's great strengths.

This system evolved when the demand for research was either
stable or rising. The national security demands of the Cold War
and domestic priorities such as health stimulated a strong
research infrastructure, including graduate education.

The situation is now changing. The end of the Cold War, the
rapid growth of international competition in technology-based
industries, and a variety of constraints on research spending
have altered our market for PhDs. In recent years, the
number of foreign graduate students has also increased rapidly.

Hence the three areas of primary employment for PhDs,
universities, industry, and government--are experiencing
simultaneous change.

2. Too Many Foreign Students

The numbers of foreign PhDs is rising rapidly,
while number of US citizens is stable.

3. PhD production drivers are wrong...decoupling from the marketplace

The crux of the problem is that there is little relationship between
the supply of PhDs and the demand for them. Doctoral supply
is governed by the need for university teaching assistants and
the level of research funding--not the needs of the marketplace.

We have not, as a nation, paid adequate attention to the function of the graduate schools in meeting the country's varied needs. There is no clear human resources policy, so that PhD production is largely a byproduct of research. The simplifying assumption has apparently been that the primary mission of graduate programs is to produce the next generation of academicians.

4. PhD goals are wrong

The majority of Ph.D. programs have traditionally seen their role as training the next generation of academicians, that is, self-replication. This narrow definition of the role of the Ph.D.-trained scientist or engineer does not serve well either the nation or the student. In the future, the majority of Ph.D. graduates will work outside the academy; and the training of Ph.D. scientists and engineers needs to reflect these broader roles in industry, business, and education. The process of graduate education is highly effective in preparing students whose careers will focus on academic research. It must continue this. But graduate education must also serve better the needs of those whose careers will not center on research. More than half of new PhDs will find work in nonacademic, nonresearch settings.

5. Need to change PhD training paradigm

The success of the U.S. basic science endeavor to date has relied to the large extent on individual effort, as reflected in the investigator-initiated grant process. This emphasis on individuals is strongly reflected in the tenure system at the research universities. Yet today's research problems are becoming increasingly complex, and their solution requires inter-disciplinary teamwork. The training of new PhDs is often too narrow intellectually, to campus-centered, and too long.

6. PhD student expectations are wrong

Further, too many new PhDs have much too narrow a set of personal and career expectations. They think that what they know is how to solve certain highly technical and specialized problems. Of course what they actually know that is of lasting value is how to formulate questions and partially answer them starting from powerful and fundamental points of view. Most do not understand that that is what gives them any edge they may have over young people of their own age who are already out in the workplace without PhDs but with a six year head start in experience.

What to do?

Department level

...rightsizing programs...birth control?

1 PhD per faculty?

No. Most PhDs do not train other PhDs...

...less than one-fifth of them currently do.

At 1991 rates, the subset of senior faculty in doctorate-granting institutions would produce about 10.7 new PhDs over a 30-year career.

When spread over all PhDs, this amounts to only 1.7 new PhDs per existing PhD. If we were to discount foreign students, then this reproduction rate drops to less than 1.0...

No...7 PhDs per faculty --> 1.7 for academy

...correct drivers

education, not TA, RA needs

...foreign PhDs?

Most make major contributions to nation.

Some indication that many are now beginning to return.

...faculty acceptance of responsibility for placement

Graduate students should receive more up-to-date and accurate information about careers.

Academic departments should provide this.

Indeed, each department should have an ombudsman for graduate placement

In fact, perhaps each faculty member that accepts

the responsibility as chair of a dissertation committee should also accept a personal responsibility for helping to place the PhD graduate!

University level

...broadening requirements

We must retain the research training that is the acknowledged strength of the current system, but we must also undertake these changes if our academic institutions and their graduates are to make their optimal contribution to society in the future.

We need to design training programs

that emphasize disciplines at the borders between fields, as well as programs that include interaction among scientists within different disciplines.

Careful attention will need to be given to striking the right balance between training individuals capable of spanning fields and those with deep understanding of a highly specialized field.

Both kinds of scientists and engineers will be needed.

Perhaps the Cornell model would be the best...

at least for a certain fraction of our doctoral students!

...Integrative, practice-oriented degree programs

But we believe that a greater number of job opportunities will be available to PhDs who have better real-world connections and experience.

To produce more versatile graduates, programs should provide options that allow students to gain a wider variety of skills. They should be discouraged from overspecializing.

It is also recommended that universities be encouraged to develop integrative, practice-oriented degree programs that better respond to the needs of industry, perhaps through a redefinition of the masters degree or an alternative form of the doctorate.

...intern experiences

Have graduate students spend time in appropriate

settings outside the university--an internship program (John Armstrong, COSEPUP, NSB)...

3 to 6 month stays at nonacademic host institutions.

Internship programs which provide students with experience in industry or government could prove useful in this objective of broadening graduate education.

...time to degrees

The time required for the PhD has steadily increased for two decades, doubling in some cases to 10 years...

We should control the time to degree. The primary objective of graduate education is the education of students. The value of such activities as working as RAs or TAs should be judged according to the extent to which they contribute to a student's education. A student's progress should be the responsibility of an entire department rather than of a single faculty member.

National

...shifting from RAs to traineeships

The re-direction of Ph.D. training can only occur with a sustained commitment of the federal government to support new and innovative education initiatives.

To foster versatility, we should shift from research assistantships to fellowships and traineeships (particularly the latter).

The shift to RAs in the early 1970s (the Mansfield policy) has created a situation in which training is geared toward "the needs of funded projects".

This can best be accomplished by a shift in training dollars away from individual research grants and portable fellowships to well-designed training grants to institutions, similar to those currently provided by the National Institutes of Health.

Furthermore, the government should also look to increase the number of federal agencies that provide substantial training dollars, which will have the benefit of diversifying the nature of Ph.D. training.

...demanding fixed time to degrees

Students should consider three alternative pathways:

i) M.S. for those heading to other careers

ii) PhD for those heading to research

iii) PhD with a special dissertation for requiring less time for those heading to non-research careers

...development of national human resource policy

A National Human Resources Policy

White House Panel

There seems little doubt that the prosperity, security, and social well-being of our nation during an era of rapid technological change will require both an adequate supply of people with advanced degrees.

It is alarming to note that the United States has not had a definitive, coherent policy for human resource development for decades--since the massive efforts represented by the G.I. Bill in the 1940s and the National Defense Education Act in the 1960s.

Instead, the nation has drifted on autopilot,
with its human resource development largely determined as
a byproduct of federal research and development programs
rather than through a strategic consideration of national needs.

While there is a general consensus that the quality of
the graduate education and training in the United States
has been second to none, there are signs of strain that
will only increase with time.

The current system tends to replicate itself by producing graduates
trained for increasingly narrow--and increasingly
limited--research and academic roles, largely ignoring
the broader interests of our best students, the increasing diversity
of today's generation of students, and the complex and rapidly
broadening roles in our society played by those
with advanced training.

Our panel believes it imperative that the Administration develop both
a vision and a closely aligned federal policy concerning
the development of human resources at the graduate level
capable of responding to the contemporary and future needs of the
nation.

This policy should be closely coordinated with parallel policies
concerning research and technology development
and deployment.

It should be executed through federal programs sustained for
a sufficiently long period to yield the necessary changes
in the academic culture
and in broadening the roles that those with advanced
education will play in our knowledge-driven society.

This policy should also respond to both the changing nature
of national needs and the increasing diversity of the American people.

The wisdom of Vannevar Bush's 1945 recommendation
that basic research be focused in the nation's research universities
is evident today.

The coupling of research with education and training has served
this country remarkably well.

It is important that a similar relationship be established between
federal policies for research and education and policies
for human resource development in our society

A Word of Advice

And now, finally, let me convey the customary words
of advice...

All too often people...and institutions... tend to regard
their role more as the keepers and transmitters
of existing knowledge than as the
creators of new knowledge...and chose to work
only on the safe problems.

But you, as new graduates, not only have the talent...
but also the education to work down in
the high-risk, exponential part of the knowledge curve...

I don't know how many of you have ever read Thomas Kuhn's
book on the nature of scientific revolution, but Kuhn
points out that most scholarship is really quite traditional...

it is really not designed to produce major novelties.

Progress is not gradual, but rather occurs through revolution...

through dramatic changes from one way of thinking...

from the old "paradigm" as Kuhn puts it, to the new "paradigm"

As Kuhn puts it, those scholars who achieve the fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they change. These are the individuals who, being little committed by prior practice to the traditional rules of normal scholarship, are particularly likely to see that those rules no longer define a playable game and to conceive another set that can replace them.

Try to be creative and imaginative...

In a sense, try something new before you fall into the same ruts that have trapped the rest of us.

Another Word of Advice

PhD training is best described as apprenticeship.

Graduate students attach themselves early and tightly to individual professors.

The PhD Paradox.

In order to get to the frontier of knowledge it is expected that one will ask a narrowly defined set of questions, and in that narrow region, think and/or experiment deeply.

In the course of this deep but narrow exploration the graduate student acquires a powerful methodology for formulating and solving problems, starting with an understanding of the fundamentals of a subject.

The student has learned how to learn at a very sophisticated level.

The "paradox" is that in the course of deep, specialized inquiry one acquires an intellectual armamentarium and outlook that may be of great general utility.

The training of the specialist, in fact, provides much of what might be termed training for the advanced generalist.

It is also the case, however, that many new graduates do not seem to value this powerful generalist capability--perhaps because their professors seldom value it either.

Overspecialization

The acceptance of overspecialization can result in a lack of both perspective and self-confidence; new Phds often believe themselves ill-prepared to venture outside their speciality.

This is due in part to the lack of serious requirements for breadth in the typical graduate curriculum, as well as to the fact that there is little or no encouragement and a lot of implicit discouragement for one who wants to depart from the straight and narrow.

Conclusions

I remember my wife and two very young daughters,
in the crowd out on the lawn
on an unusually cold June day in Pasadena.

I also remember the sacrifices they made so
that I could finish my degree.

Hence, congratulations as well to all of the
family members and friends in the audience
who have supported these graduates before us.
This is your day as well.

Congratulations

...God Speed

...and Go Blue