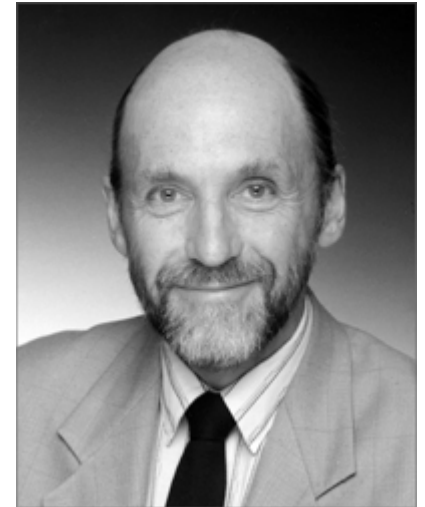


# Peter J. Feibelman: A PhD Is Not Enough

Helmut Hofbauer

# Peter J. Feibelman



- Sandia National Laboratories, Albuquerque (retired)
- \* Nov. 12, **1942**, New York (N.Y.).
- **1963** BA, Columbia University, New York (N.Y.).
- **1967** PhD in Physics, University of California, San Diego (Calif.).
- **1968 – 1969** National Science Foundation (NSF) Fellow/Attaché de recherches, Centre d'Études Nucléaires de Saclay, France.
- **1969 – 1971** Research Assistant Professor of Physics, University of Illinois, Urbana-Champaign.
- **1971 – 1974** Assistant Professor of Physics, State University of New York, Stony Brook.
- **1974 – present** Senior Scientist, Sandia National Laboratories, Albuquerque (N.M.).

**Source:** <https://history.aip.org/phn/11508026.html>

# Sandia National Laboratories

- Website: [www.sandia.gov](http://www.sandia.gov)
- Established: 1949
- Research type: **National security, nuclear science**
- Budget: US\$ 3.1 billion
- Staff: 10,652, students: 738
- Location: Albuquerque, New Mexico; Livermore, California.
- Campus: 8,699 acres (35.20 km<sup>2</sup>)
- Operating agency (since 2017): National Technology and Engineering Solutions of Sandia, under the direction of **Honeywell International**



**Source:** [https://en.wikipedia.org/wiki/Sandia\\_National\\_Laboratories](https://en.wikipedia.org/wiki/Sandia_National_Laboratories)

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Sandia National Labs (retired)  
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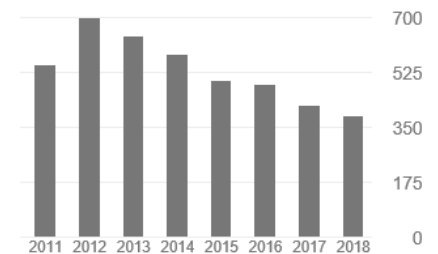
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TITLE	CITED BY	YEAR
<a href="#">Ion desorption by core-hole Auger decay</a> ML Knotek, PJ Feibelman Physical Review Letters 40 (14), 964	1246	1978
<a href="#">Surface electromagnetic fields</a> PJ Feibelman Progress in Surface Science 12 (4), 287-407	752	1982
<a href="#">The CO/Pt (111) puzzle</a> PJ Feibelman, B Hammer, JK Nørskov, F Wagner, M Scheffler, R Stumpf, ... The Journal of Physical Chemistry B 105 (18), 4018-4025	633	2001
<a href="#">Photoemission spectroscopy—correspondence between quantum theory and experimental phenomenology</a> PJ Feibelman, DE Eastman Physical Review B 10 (12), 4932	611	1974

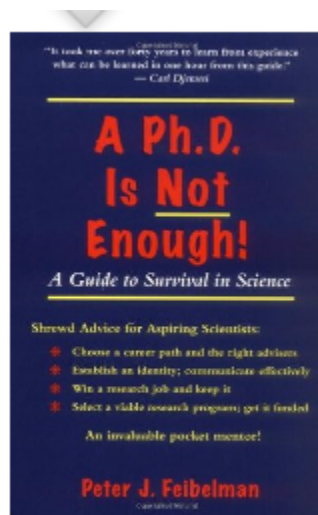
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# A PhD Is Not Enough

- First published: Basic Books, New York, Dec. 1993
- Current edition: Basic Books, New York, 2011



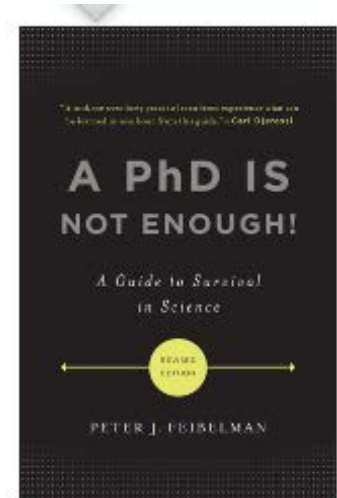
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by Peter J. Feibelman

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Despite your graduate education, brainpower, and technical prowess, your career in scientific research is far from assured. Permanent positions are scarce, science survival is rarely part of formal graduate training, and a good mentor is hard to find. This exceptional volume explains what stands between you and fulfilling long-term research career. Bringing the key survival ...[more](#)



**Source:** <https://www.goodreads.com/book/show/10303781-a-phd-is-not-enough>

# What is Science? (1)

Science =  
scientific knowledge

Science =  
The Scientific Community

Theory of Science

Theory of Sociology of  
Science

## Example for Science = scientific knowledge:

Ludwig Wittgenstein: *Tractatus logico-philosophicus*: „4.11 Die Gesamtheit der wahren Sätze ist die gesamte Naturwissenschaft...“

# Theory of Science

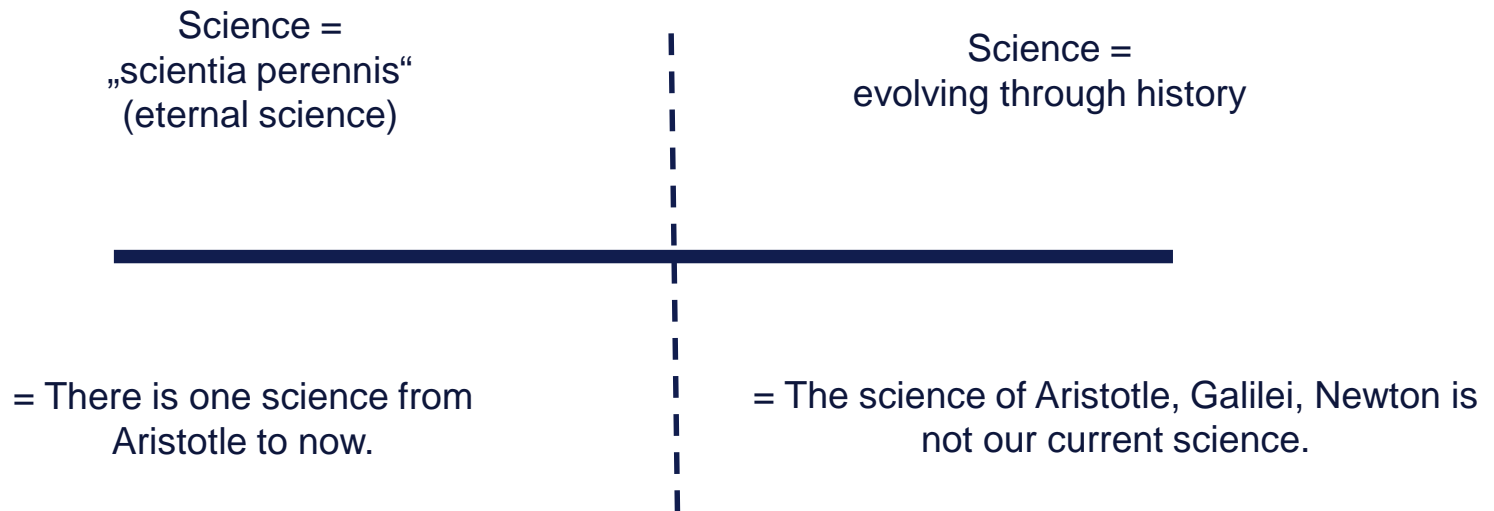
- (i) wie ist eine wissenschaftliche Sprache aufgebaut?
- (ii) was sind die Regeln für die Gültigkeit eines Argumentes?
- (iii) was zeichnet eine wissenschaftliche Beobachtung aus?
- (iv) worin besteht eine Gesetzhypothese, und worin eine Theorie?
- (v) wie werden Gesetzhypothesen und Theorien empirisch überprüft?
- (vi) was leistet eine wissenschaftliche Voraussage, was eine Kausalerklärung?

Hauptfragen der  
allgemeinen Wissen-  
schaftstheorie

→ The question „How should the (individual) scientist behave within the scientific community?“ does not belong to Theory of Science.



# What is Science? (2)



- Scientia perennis takes from Aristotle, Galilei etc. **what fits to current science** and ignores the rest.
- History of science is **retrospective opportunistic story-telling**.



# Case: The PhD Technician (p. 11)

- L. spent **2 years as PhD** in a prestigious lab
- He had been hired because of his **technical know-how**
- His task was to **build a piece of equipment**
- At the end of the 2 years the **desired instrument was in place**
- L. **did not receive a permanent job position** because he had not learned the basics of his new field

= L. has done everything his employer asked for – the result is fatal for his career.  
= L. has done everything Theory of Science asks for – it's not enough to survive in science.

# Feibelman's Advice

- „...you will greatly improve your chances for long-term productivity and survival in science if you can teach yourself to be **problem-rather than technique oriented**. [...]“ (p. 122)
- What it means to be a scientist: making my work meaningful to others (p. 6)
- Asking questions about the direction of one's scientific field, **reading as widely as possible** in its literature, and **formulating a research program of one's own**. (p. 12)

# Publication Strategy

## The concept of the „publon“

„Even though you are working toward a long-term goal, you report each project as an **independent piece of work** that has produced an **new kernel of knowledge** (only half jokingly a „publon,“ a **quantum of publication**\*). (p. 55)

\*The concept of the „publon“ emerged from the graduate student minds of M. J. Weber, now at the University of Virginia, and W. Eckhart, now at the Salk Institute.“ (footnote, p. 55)

# Publication Strategy

## Advantages of publishing a series of short articles

- Address the problem of writer's block (p. 57)
- Reviewers are busy, prefer to review short papers (p. 57)
- Numerous articles keep your name in the spotlight (p. 56)
- Managers & funding agencies need evidence that they have spent money wisely (p. 55)
- Kernels of knowledge will give confidence that you are a person who completes projects (p. 128)
- The length of your publication list reduces the risk of employing you in your potential employers eyes (p. 128)
- You win no brownie points for writing long, multifaceted papers (p. 129)

# Publication Strategy

## Requirements for publishing a series of short articles

- You need to develop an appreciation for when a piece of work is complete enough to be written up. (p. 57)

# Getting Funded

„In the „good old days“, prior to World War II, scientists did not apply for, nor did they receive, research grants from funding agencies.“ (p. 107)

- In the latter part of the 20th century societies realized that the products of hard sciences can improve life (p. 108)
- Government and industry learned that investing in scientific leadership is necessary for prosperity (p. 108)
- Universities discovered the blessings of receiving government and other outside funds (p. 108)
- Student's fees do not cover universities' costs (p. 108)
- „If you examine the science world around you, you will see that *he who spends most money has the most influence.*“ (p 102)

# Timing

- „Once you leave graduate school, the clock is ticking.” (p. 1)
- PhD T. was not able to finish his PhD work (programming a computer program) within time: “At least he would have reserved time each day or week to establish contact with other researchers at the lab and involved himself in one or two short-term projects with a clear chance for success.” (p. 9)
- „A problem that will take two years to finish must not be the main focus of your activities“ (p. 123)

# The Employer's viewpoint (1)

## The PhD

- „For a typical employer, a postdoc is cheap labor.“ (p. 32)
- „A postdoc will also be gone in two to four years.“ (p. 32)
- „...a postdoc is a trained researcher who can be expected to be reasonably competent and not terribly demanding of supervision“ (p. 32)
- „Acquiring a postdoc [...] is much like buying a piece of laboratory equipment.“



# The Employer's viewpoint (2)

## A Permanent Position

- „...to hire you is a big risk.“ (p. 95)
- „If you turn out to be directionless, if you are noninteractive, if you are unproductive, you will represent a huge waste of time and resources...“ (p. 95)
- „If you are one of ten staffers [...] and you fail, then the department is only 90 percent productive at best.“ (p. 95)
- „If you are simply going to be another pair of hands, a technician is a lot cheaper...“ (p. 96)

# Managed vs Unmanaged Environment

## Universities – unmanaged environments („academic freedom“)

- „A professorship is effectively **several jobs rolled into one.**“ (=teaching, writing grant proposals, reviewing, being an active academic citizen) (p. 74)
- **Assistant professors** – „suffer most of the disadvantages and have few of the benefits of a tenured academic position.“ (p. 77)
- Professors tend to **work independently** (there is no particular reward for collaboration) (p. 76)

## Industrial and governmental labs – managed environments

- „Your **job description is relatively simple**“ (=being a scientific leader) (p. 80)
- The „management monitors the functioning of the lab.“ (p. 82)
- „...your lab will *want* to provide you with the necessary hardware.“ (p. 80)
- **Cooperation of employees is rewarded.** (p. 82-83)

# Risk

- A young scientist who has **not yet completed a project** is „a pig in a poke“ for his potential employer (p. 8)
- „Employers generally feel that a **postdoctoral employee is not a big risk.**“ (p. 32)
- The **length of your publication list reduces the risk** of employing you in your potential employers eyes (p. 128)
- „...**to hire you [for a permanent position] is a big risk.**“ for the research lab. (p. 95)
- „Are you a **self-starter** or a **drone who always needs to be told what to do** next? Are you a leader or a follower? Will you take an **interest in your colleagues‘ work**, or will you **shut the door to your lab office...?**“

# Credit (or: Confidence)

- **Credit for the lab:** „If the word gets round that postdocs [...] end up with permanent positions [...], then the best PhD's will want to apply to the lab...“ (p. 96)
- Kernels of knowledge will give confidence that you are **a person who completes projects** (p. 128) (→publications)
- **Managers & funding agencies** need evidence that they have spent money wisely (p. 55) (→publications)
- The ability to formulate a research program – will give confidence that you do not need supervision.

# Synopsis (1)

## The perfect scientist

- Is a „self-starter“ (=does not need supervision)
- Is a person who completes projects
- Knows his field
- Is able to formulate a research program
- Knows what motivates a particular scientific question
- Is able to communicate to others what makes his research important
- Sees the big picture
- Is problem- not technique-oriented
  
- **=is somebody who fits into an unmanaged environment!**

# Synopsis (2)

## The Scientific Community (SC)

- **„To win a permanent research position is to seal a contract with the scientific community“** (p. 137) = participation in science starts with permanent research position
- **Products of the SC:** (1.) publons, (2.) good scientists, (3.) good labs
- **Risk reduction strategies in the SC:** (1.) requirement of finishing projects, (2.) job positions and grants for 2-4 years, (3.) continuous publication of publons, (4.) (long) publication list, (5.) others (e.g. personal networks)

# Mining of Knowledge



# Discussion

- **What we are told:** Everybody who is rational and willing to conform to scientific methodology may participate in science.
- Problems that may arise from the organisation of knowledge in the form of publons? (Are publons the adequate form for knowledge?)
- Scientific career as scientific entrepreneurship (=surviving in an unmanaged environment): „...remember that *you* are responsible for your success or failure as a scientist“ (p. 124) – acceptable?
- Science as an economy driven by venture capital rewarded with publons as cryptocurrency, and scientists/labs accumulating credit – a possible bubble?
- Why are the skills for survival in science not officially taught to young scientists? **Which rules can you believe, anyway?**



# Two Sets of Interacting Rules

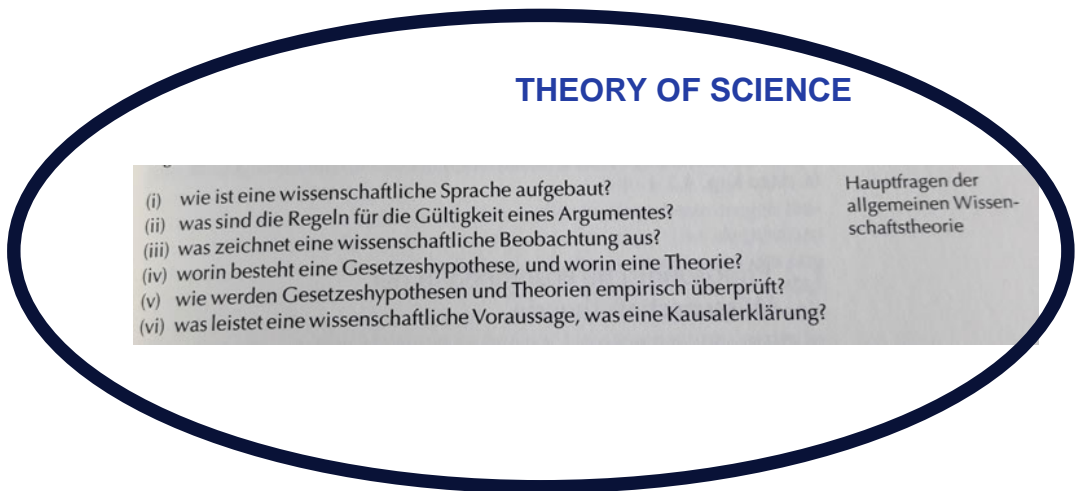
## THEORY OF SOCIOLOGY OF SCIENCE

**Time Constraint (1):** 2 years for a project

Knowledge takes on the form of **publons**.

Show that you can finish projects!

## THEORY OF SCIENCE

- 
- Hauptfragen der allgemeinen Wissenschaftstheorie
- (i) wie ist eine wissenschaftliche Sprache aufgebaut?
  - (ii) was sind die Regeln für die Gültigkeit eines Argumentes?
  - (iii) was zeichnet eine wissenschaftliche Beobachtung aus?
  - (iv) worin besteht eine Gesetzhypothese, und worin eine Theorie?
  - (v) wie werden Gesetzhypothesen und Theorien empirisch überprüft?
  - (vi) was leistet eine wissenschaftliche Voraussage, was eine Kausalerklärung?

Show that you can formulate a research program!

The industry of science strives to reduce **risk** and rewards **credit**.

**Understand that you are alone:** that you are responsible for your scientific career!

**Time Constraint (2):** Try to get a permanent position as quickly as possible!

Interact with your colleagues in your lab!