

# **Berfikir Kreatif bagi Para Engineers**

***Sumber :***  
**Creativity in Science and Engineering:**

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## **TOPICS**

**1.Creativity in Science and Engineering**

**2.How to Get a Good Idea**

**3.Colleagues**

**4.The Art of Obsession**

**5.The Technology You Use**

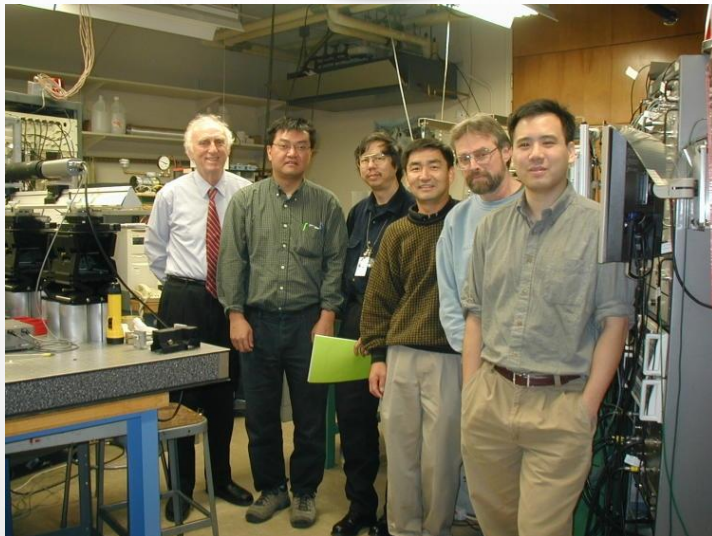
**6.Future Technology**

**SLAC: A Model for an R&D Laboratory**

# 3. COLLEAGUES



In the modern world the highly productive lone engineer or inventor or scientist is very rare.



**Find colleagues who are smarter than you and know more.**

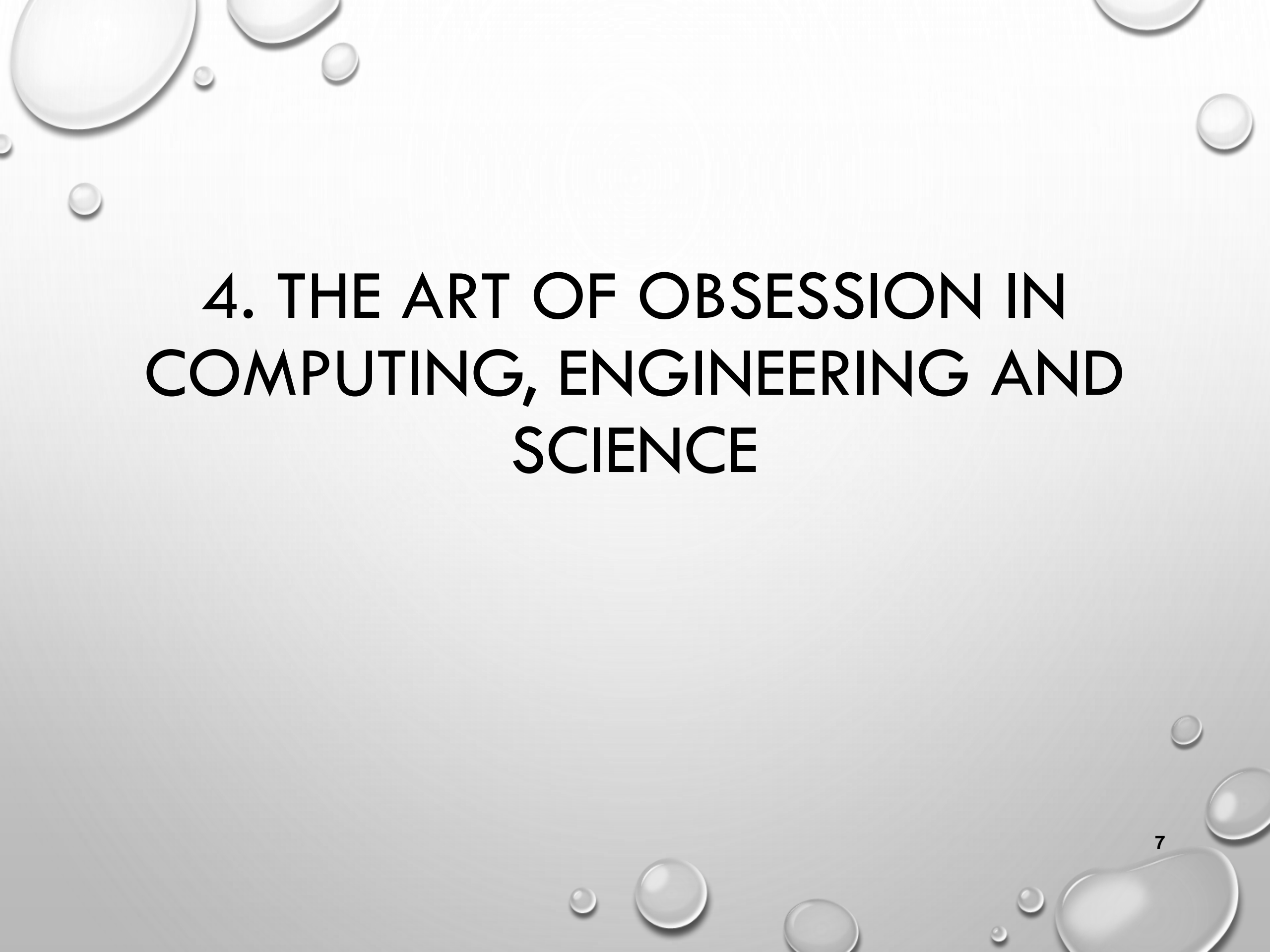


**I always look for colleagues who are smarter than I am and who know more than I do. The obvious advantages are she or he may be able to solve the problem that has produced a dead end in your work. Most important, smart and knowledgeable colleagues can save you lots of time.**

**You don't have to be a fast thinker or a fast talker.**

**In fact, it is best to avoid such people as colleagues**





# 4. THE ART OF OBSESSION IN COMPUTING, ENGINEERING AND SCIENCE



## **Obsession is important when you have a good computing, engineering or science idea**

**When you are imagining and visualizing an idea that you expect to be fruitful it is important to be obsessed with the idea. Think about the idea as much as possible, neglecting boyfriends, girlfriends, children spouses. Obsession will bring immersion of your mind into all the aspects of the idea: what has been done on related ideas, compatibility with physical laws and mathematics and logic, feasibility, practicality, extensions, variations.**



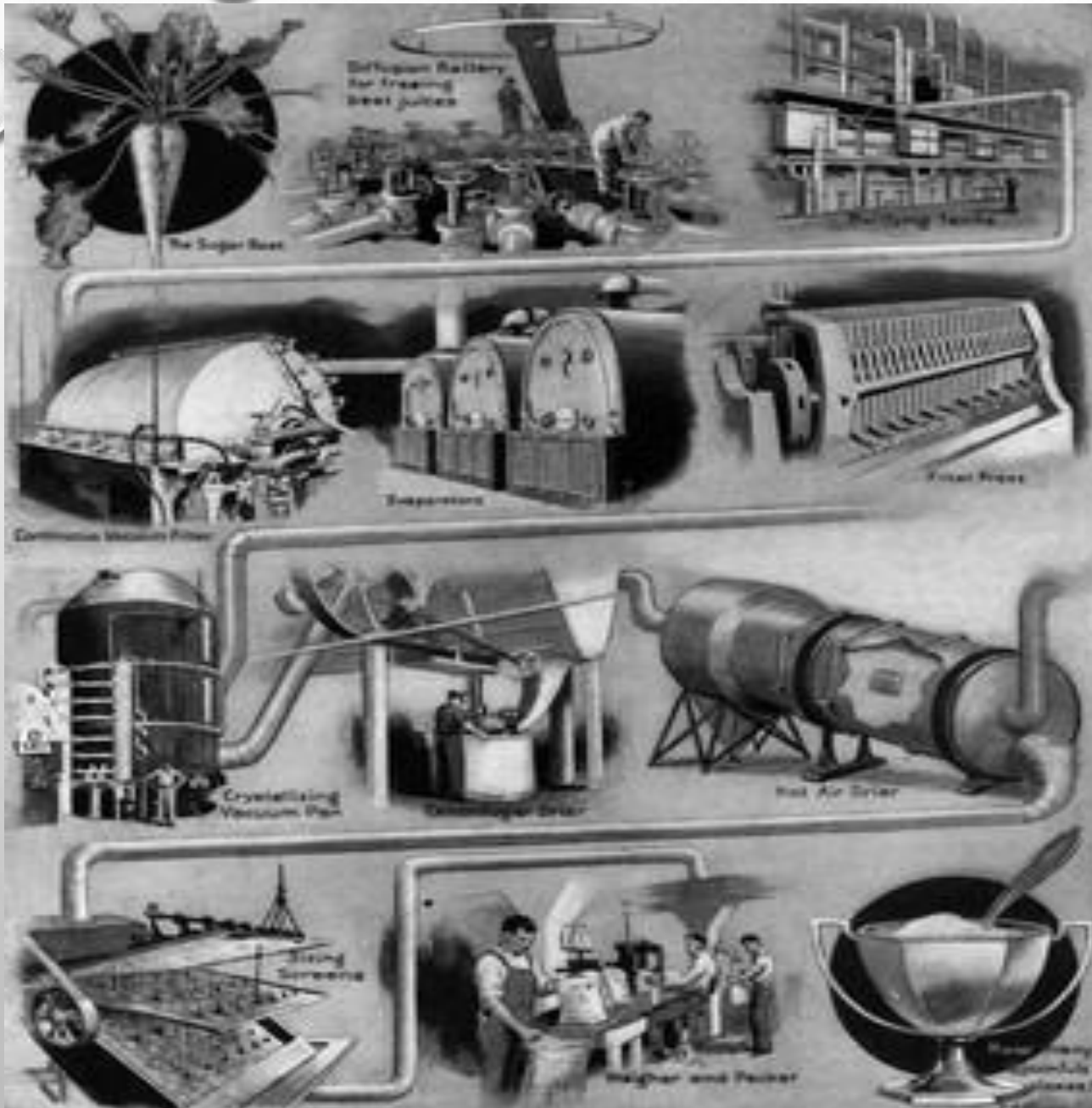
**But if the course of the work you find that someone has a better idea or that you have run out of money or that the idea has a serious flaw. Give up the obsession**



**and move on**

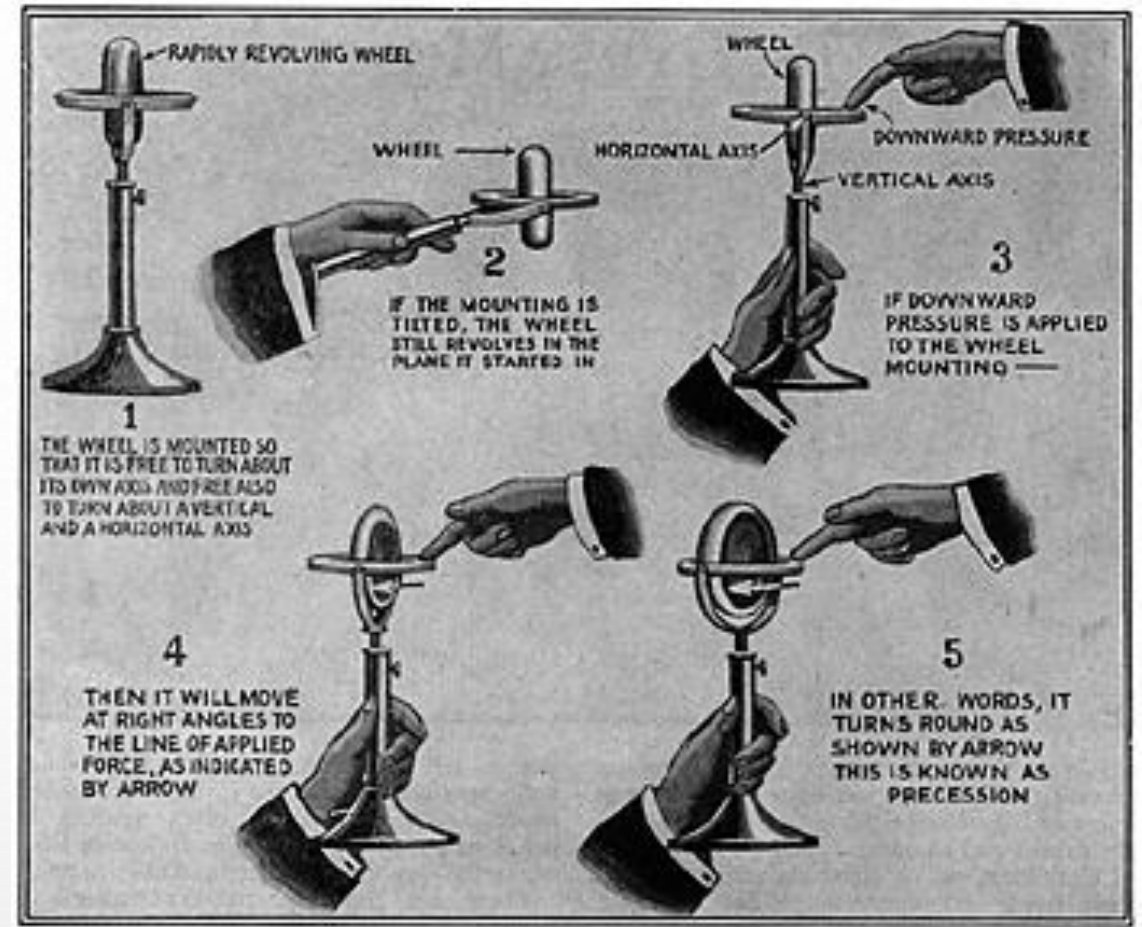


# 5. THE TECHNOLOGY YOU USE



**You must be interested in, even enchanted by some of the technology or software or mathematics you use. Then the bad days are not so bad**

Another advantage of being enchanted by the technology or the programming or the mathematics is that you will be more likely to think of improvements and variations.



Sperry

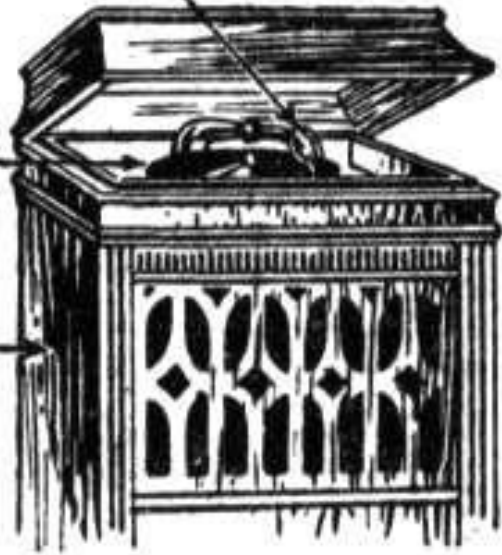


REPRODUCING,  
MECHANISM

RECORD

STONE  
CHAMBER

Phonograph



**You should be fond of the technology or mathematics or programs that you use, but not too much in love with the technology or mathematics or programs. There may be a better way.**



# 6. THE TECHNOLOGY OF THE FUTURE

**It is often impossible to predict the future of a technology. Some technologies are replaced again and again by new technologies serving the same function**



**It is often impossible to predict the future of a technology.**

**Some technologies persist through incremental improvements**



**The reciprocating gasoline engine is 140 years old**



# Some promising technologies go nowhere

My experience in 1950 with the miniature vacuum tube and the transistor



Transistor inventors **William Shockley** (seated), **John Bardeen**, and **Walter Brattain**, 1948.



**I have been unsuccessful in  
predicting the long term  
future of technologies**

# **SLAC: A Model for an R&D Laboratory**

## **Facilities for:**

**Elementary particle physics**

**Photon and x-ray physics**

**Astrophysics**

**Accelerator physics**



## **SLAC is an Egalitarian Laboratory**

**We have no ‘Herr Professors’. We respect equally the knowledge and skill of everyone at SLAC be they a mathematical physicist thinking about dark energy or a welder skilled in making vacuum systems or a business person who understands the intricacies of federal contracts**

## Flexibility

At SLAC we tremendously value individual and institutional flexibility. Our institutional flexibility is the ability of the Laboratory to move into new areas and to fill new national and international science needs.



## **The SLAC Process:**

- 1. Broad openness to new Ideas.**
- 2. Thorough evaluation, experimentation and calculation on the new idea.**
- 3. Careful, open conclusion.**

**One example: in experimental physics research we are broadly open to new ideas, the research is carried out with thorough analysis, but we take great care to make sure we are right before we publish.**

## Practicality

SLAC is an ivory tower in a real world but we know that we are supported by the real world.



US Taxpayer



Congress



White House



Dept. of Energy



Office of Science



SLAC

**Thank You**

**I thank Professor Milutinovic and Professor Fujii for the opportunity to give this talk.**

**I will be grateful for comments and ideas from the audience**