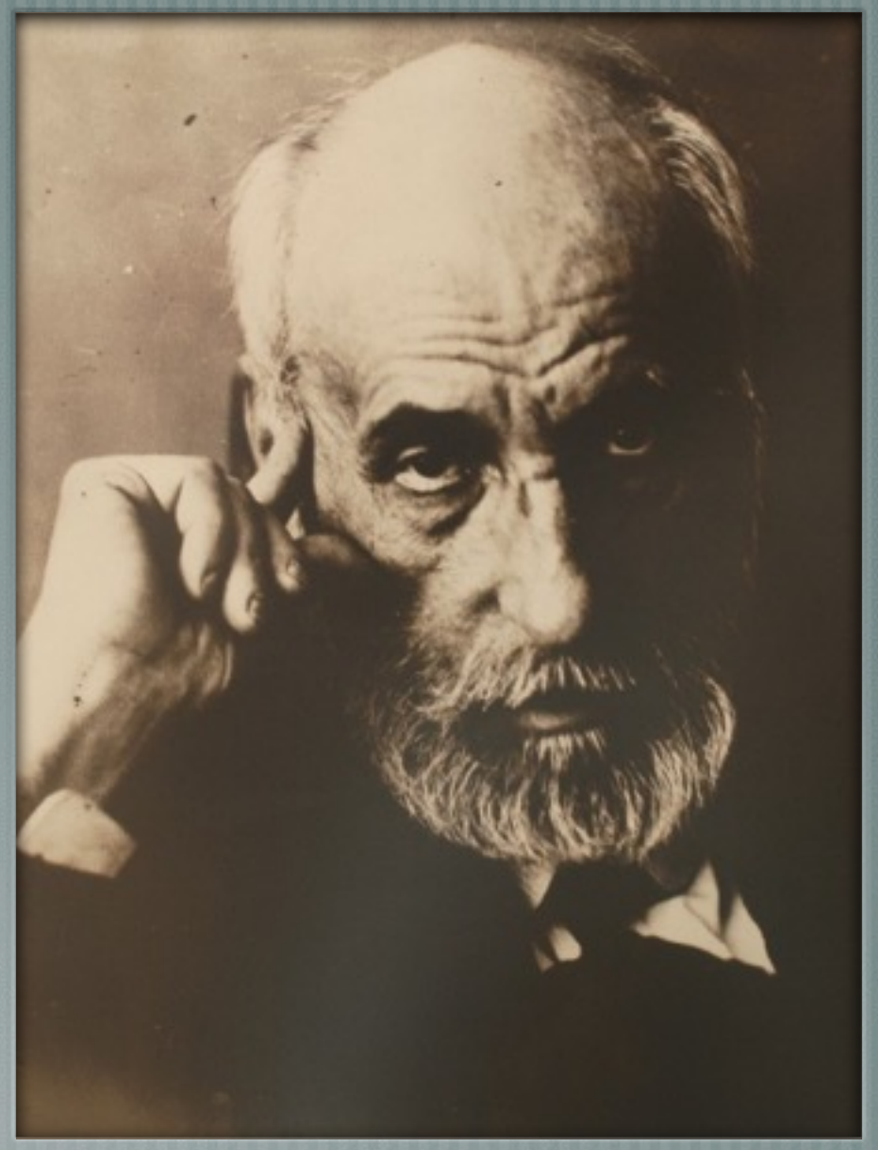
How to do a PhD and survive it!

Plan

- Advice for a young investigator. Ramón y Cajal, 1897.
- Summary (Student's side).
- Summary (Advisor's side)

Advice for a young investigator

Ramon y Cajal, 1897



Ramón y Cajal |rəˈmōn ē kəˈhäl|

Ramón y Cajal, Santiago (1852–1934), Spanish physician and histologist. He was a founder of the science of neurology, identifying the neuron as the fundamental unit of the nervous system. Nobel Prize for Physiology or Medicine (1906, shared with Camillo Golgi).

General considerations

- Sources of knowledge: Observation, Experimentation and inductive and deductive reasoning.
- Forget: the a priori, intuition, inspiration and dogmatism.
- Eliminate platonism.
- Read the classics.

General considerations

- Beware with formalisms per se. [Against logic] “the best logic for a particular science abandons the rules of logic when it begins serious discourse.” Schopenhauer
- No recipes.
- Abandone vague philosophical principles: go to the particular.
- Work next to a scholar.

Beginner's traps

- Undue admiration of authority. The most important problems are already solved. Arrogance is better than diffidence.
- Phases of a wise person: creative/destructive, defensive.
  - "There has never been a wise man who hasn't failed to prefer the lie invented by himself to the truth discovered by someone else." Rousseau

Beginner's traps

- The most important problems are already solved. This is often indolence masquerading as modesty.

- Many seeds of big discoveries were mentioned as minor issues in writings: Servet and pulmonary circulation, Seneca's mention of the magnifying power of a cristal sphere filled with water, precursor of the microscope and telescope.

Beginner's traps

- Excessive praise for practical science. Cultivate science for its own sake without considering its applications, they will come.
- Lack of ability. Excuse for abandon. Perhaps it is slowness in learning or laziness, or lack of patience, thoroughness, or determination. Many of these qualities can be acquired.

Am I apt?

Attempt to repeat some analytical method that is considered unreliable and difficult until patience and hard work yield results similar to those published by the author.

Find a scientific topic that is difficult and surrounded by controversy. Examine it superficially by reading general reference books. Then, consult the latest literature on the subject. If you arrive at similar conclusions of noted authorities, then abandon timidity.

Will is powerful

- Discovery is the result of common sense strengthened by technical education.
- Youthful brain is pliable.
- Deficiencies are compensated by persistent hard work.
- Talent is usually more expeditious than qualitative.
- If memory is weak, manage it well.
- Forget the futile trifles of everyday life.

Intellectual qualities

- Independent judgment. Saints may emerge from the docile and humble, but rarely scholars. If a paper impresses, read it two or three times, then gaps appear. Inferior intellect adapts better to error, which almost always involves a simple answer, than to truth, which is often rigorous and difficult.

- Sustained concentration. Orientation to a single object of study. Get preoccupied.

Intellectual qualities

- If the solution does not appear but seems close: rest, travel.
- Competition leads to coincidences, conflicts of priority. No dismay if someone gets ahead.
- Spend as much time as you can. “Genius is nothing else than extreme patience.”

Passion for reputation

- Two essential motivations: a devotion for truth and a passion for reputation.
- Individuals are capable of ingratitude, collectives rarely are when they are conscious of the truth of an idea.
- Be scholars not heroes. (Read the paragraph!)

Patriotism

- "Science has no country but scientific scholars do". Pasteur.
- Chauvinism is repulsible. Patriotism can encourage healthy competition.

What do you need to know?

- General scientific education.
- Not too much! you have to specialise. Sword or bludgeon!
- Specialists' readings (not too much!).
- Languages! Scientific work in more than 6 languages.
- Read to learn: research methods and open problems.
- Flee from abstracts and syllabus.

What do you need to know?

- Learn the methods.
- Chose recent and difficult procedures. They will be less explored and you will walk alone with less competition.
- Look for new facts. The difficult question. There are no recipes, sometimes is the diligence, sometimes chance (but be at work when it arrives!).
- When you need to chose among topics: the one with best understood methodology and that you like the most.

Diseases of the will

- Contemplators. They only appreciate aesthetic qualities.
- Bibliophiles and polyglots. Not just experience but construct.
- Megalomaniacs. They want to start their careers with an extraordinary achievement. Subclass: project planners.
- Instrument addicts.
- Misfits. Science is a step for something else. Or a way to get a salary. The may become abulics.
- Theorists. Restless imagination and aversion to the lab.

Research process

- Observe.
- Experiment. In this way you understand the causes of variation. Get data. Theories come and go but data remain
- Working hypotheses. Necessary (without it there is no possibility to explain the phenomenon). Verifiable. Imaginable (as a mechanism). That suggests other researches.

Working hypotheses

- No recipes
- Same means for equivalent ends
- View the problem in its simplest forms
- Hypotheses have to be verified
- If it is falsified, reject without mercy

Publish

Mr. Billings is a scholarly Washington librarian who is burdened with the task of classifying thousands of publications where essentially the same facts are presented in different ways, or truths known since antiquity are expounded upon. He counsels scientific writers to govern themselves by the following rules: (1) Have something to say, (2) say it, (3) stop once it is said, and (4) give the article a suitable title and order of presentation.

- Bibliography. Respect, respect, ...
- Justice and courtesy in decisions.
- Be critical: on theoretical or observational errors. Save what can be saved.

Publish

- Conclusions
- Add illustrations
- Style
- Where to publish

Other interesting stuff

- How to choose a wife
- Why is Spain behind in research
- The investigator as a teacher

Summary (student side)

A PhD must be:

- Original. A new method, a new solution, a new technique, ...
- Practical if possible.
- Relevant.

Attitudes

- Passion. If you don't feel it, no one will.
- Curiosity. Read, read, read. Be (a bit) multidisciplinary.
- Boldness. A reasonable dose!
- Aim at perfection. But don't get sterilized by the aim
- Open-minded. Discuss, discuss, discuss...
- Strength against failures.

Code of conduct

- Give Credit. All researchers want is credit.
- Be original. No plagiarism.
- Honesty. Tell the true story.
- Publish or perish?

Is this a normal job? No!

- Not a 9 to 5 job. Nights and Week-ends may be inspiring.
- Sometimes depressing, sometimes exciting.
- Negative results are also valuable.
- You are responsible: It is YOUR work, not your supervisor's!

The process

- Plan your tasks ahead of time.
- Reserve six months for writing.
- Travel, explain your ideas, listen, accept critiques.
- Keep an eye on your funding!
- Plan the postdoc ahead of time.

The memory

- Use Latex!
- Use versioning systems. Technology helps.
- Plan the chapters soon, and plan papers to cover them.

And don’t forget to

- Start your network of colleagues
- Socialise with your fellow students, and overall
- Enjoy the adventure!

Summary (advisor side)

A social contract

- That is free. It should be accepted by both parts.
- That can be broken. e.g. if student underperfoms.

Attitudes

- Flexibility. Do not steer too much.
- Autonomy. Don’t write your student’s papers.
- Constructiveness. Critique but do not destroy.
- Generosity. Become a peer in the process.

Code of conduct

- Commit time to the student.
- Honesty. You don’t know everything.
- Don’t ask for impossibles. Adapt the thesis to the student.
- Publish or perish?

The process

- Keep an updated schedule.
- Select the adequate conferences and journals.
- Help the student in becoming autonomous.
- Keep an eye on her/his funding!
- Plan the postdoc ahead of time.

The memory

- You will need time to correct the memory. Plan for it.
- Be aware of deadlines.
- Plan the chapters soon, and plan papers to cover them.

Enjoy it!