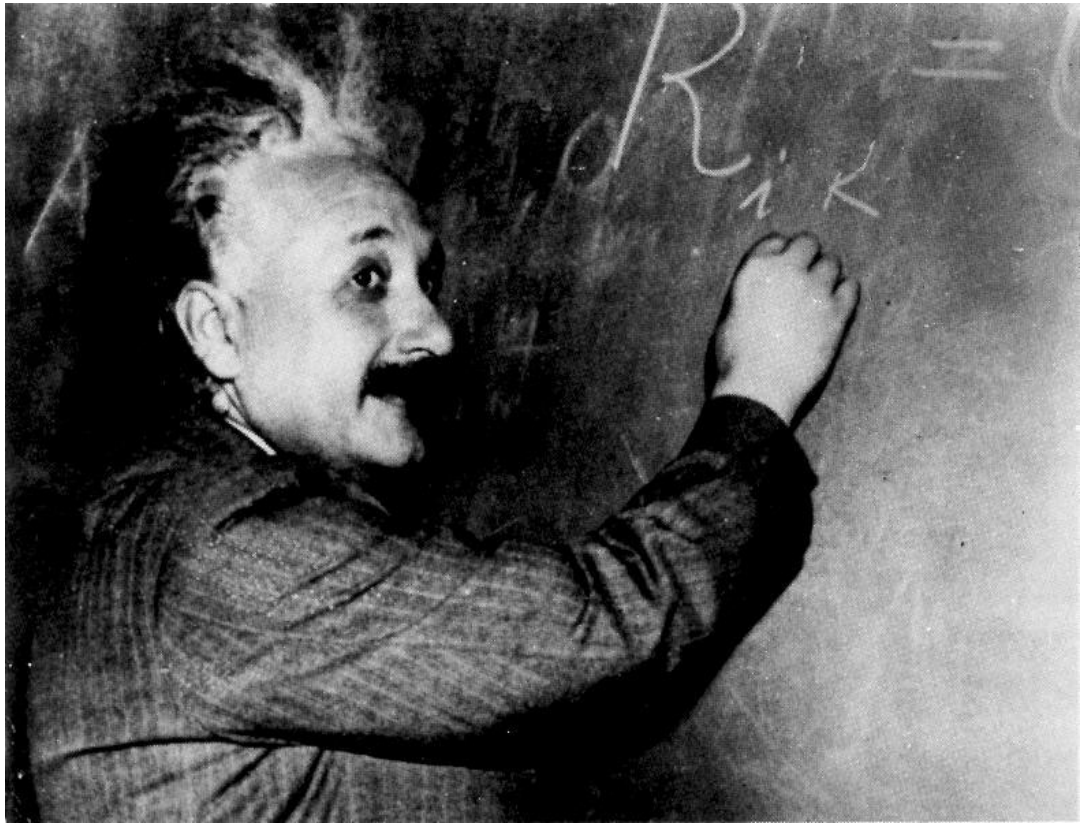
Scientific integrity and scientific culture:

Telling the truth to the public



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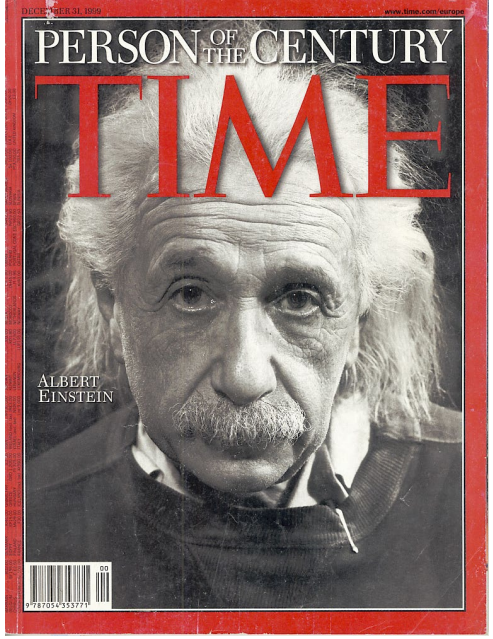
Lisbon, 18/9/2007



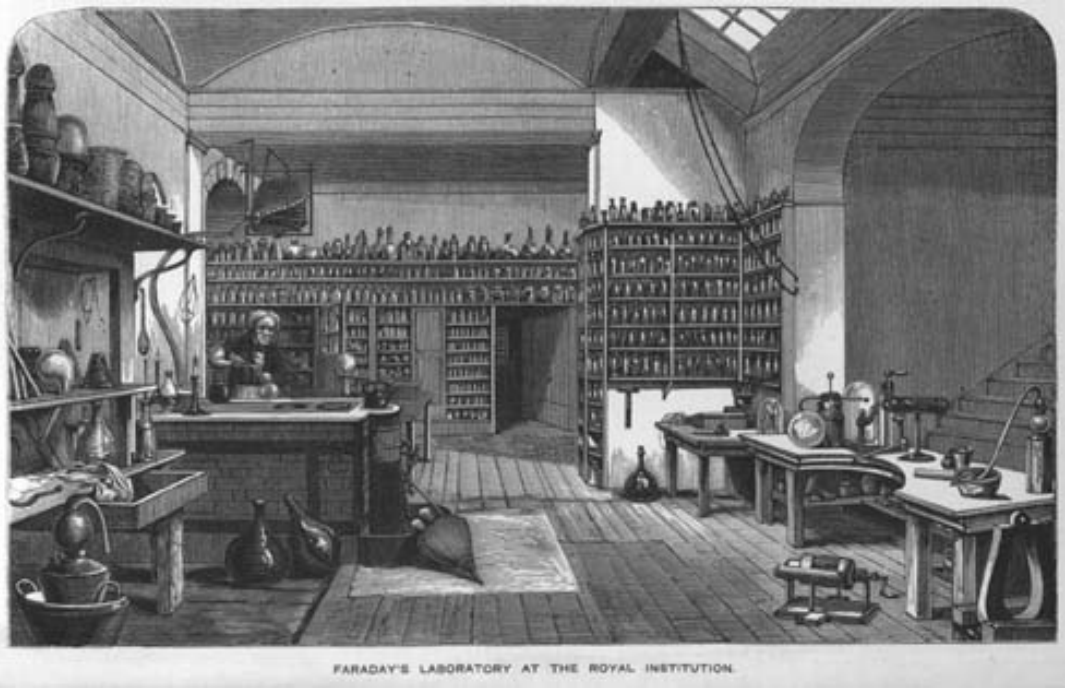
Science: seeking errors

- **Science** – the discovery of the world and the human being - is one of the most demanding human endeavours.

- Along the history scientists have always tried to **find and discard errors** in their statements about the world and men. They are therefore very sensitive to errors, and they know that truth may only be achieved in a continuous and progressive way. Although truth is and has always been an ideal, in many practical cases it is easy to recognize the lack of truth.

- The **scientific method**, where peer review plays a determinant role, has been created and improved to accomplish the mission of science in the best possible way. Is has accomplished a lot.

The power of science



FARADAY'S LABORATORY AT THE ROYAL INSTITUTION.

- It is never too much to emphasize the power of the scientific method: in fact, society has completely changed after the Scientific Revolution.This is justified by the simple fact that we may live better in a world we know better!

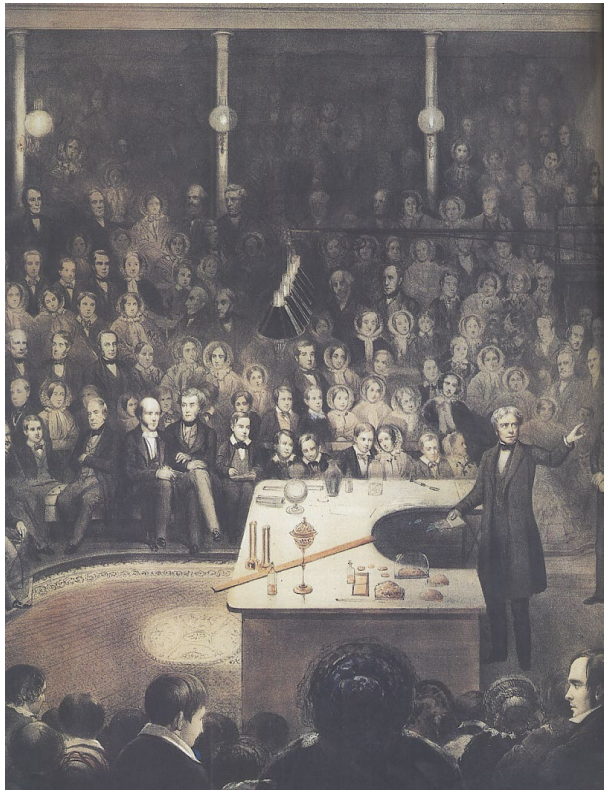
What is the role of ethics?

- **Ethical norms** belong to the scientific method. They are not an external imposition to science but an essential element of the scientific method.

- Scientists may be imaginative with respect to theories but they have to respect facts. Theory has to be adjusted to facts and not the other way around. Any manipulation of data leads immediately to **discredit:** it is a **professional death.**

- Moreover, the creation and the announcement of science discoveries obey to **strict rules**: e.g., scientists should be aware of other people's work and cite it properly.

Scientific culture



Scientists have a strong duty to society: **scientific knowledge should be as open as possible** so that everyone should have access to the basic teachings of science. Furthermore, some acquaintance with the **scientific method is part of modern citizenship**. Scientific culture is the imbedding of science in society.

As ethics belong to the method of science, the disseminators of scientific culture should also convey **ethical norms**. Ethical issues in scientific culture are basically the same as in scientific research. For instance **respect to the truth and to the others should** be shared by the creators and by the disseminators of science. However, many problems remain in assuring scientific integrity in practice…

Science in Portugal

- The situation in Portugal is not, with respect to scientific integrity, much different from that in other European countries. The differences have to do with the size of the country and the late arrival of research here. Unfortunately, and despite the light shed by some illuminated people in the past, only recently a big investment has been made is science and technology, allocating to it considerable material and human resources.

Scientific culture in Portugal

- At the same time, an important investment has been made to promote science in schools and in society. The “Ciência Viva” program has been internationally recognized as a model in science outreach. But Portuguese scientists have been feeling the same type of difficulties as their foreign peers in the interaction with the public.

Genetics

- In the much mediatized “Maddie case”, how to tell to the public the meaning of an 80% match of DNA material and, therefore, convey the message that science cannot, in general, offer certainty? In fact, people have some trouble with the notion of probability. They want yes-no answers, when in almost all cases science can only offer a probability.

Transgenics

- Recently a radical ecological group invaded and destroyed a transgenic plantation in Alentejo. Besides all political and legal issues, the discussion centred, as in other countries, in the danger of genetically modified organisms. How to tell to the public what is transgenic corn? Is it dangerous? The public has, in general, a poor notion of risk, it is simply afraid of the unknown. Again they demand from science certainties that cannot be given.

Energy

- Also recently, controversies have been taking on the construction of a new dam in North Portugal and of the first nuclear power station. How to present people the advantages and disadvantages of new energy centrals? Of course scientific aspects are not the only ones to be considered when taking decisions and one of the questions is to disentangle the scientific aspects from the others. But is that really possible?

Global warming

- Portugal has signed the Kyoto treaty and is trying to reduce CO2 emissions. In a world where global warming is a hot issue and where a consensual position seem to emerge on the human origin of global warming, what can and should be said to the public? Here the public is confused by the fact that the scientific community is not unanimous and that the predictions are based on computational models with considerable errors.

Bird flu

- One of the variants of bird flu, that which is mediated by the H5ON2 virus, was detected some days ago in Central Portugal. In a world which is afraid of pandemic diseases, how to inform people about the different danger of different diseases? How to explain e.g. that, contrary to H5ON1, H50N2 is not dangerous to humans, but about 100 000 ducks have to be killed?

Telling the truth to the public

- One of the difficulties of the diffusion of science is to talk or write clear on sometimes very complex issues. People want to know and **simple** and **honest** answers should always be given. Uncertainty and discussion belong to science and this should not be hidden. Discussion helps to reduce uncertainty!

- Scientists are obliged to tell the truth, although it is impossible to tell the non-existent ultimate truth. **It is possible to be rigorous** avoiding cumbersome details, which can only be understood by experts.

- Science is also transmitted by **journalists**: they also have their own code of rules, which in some cases is identical to that of the scientists. Clearly, respect to the truth is a common value. They have to interact more.

To conclude

- Of course scientists are humans and their opinions or acts may be influenced by non-scientific pressures. Some people want to use science due to its prestige and it is not easy to disentangle science from the rest. Scientists should remember that they have a **strong commitment to science and the scientific method** in all cases, but mainly when others factors – political, economical, journalistic, etc. – are at stake.

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- In science research as well as in science outreach, the **scientific community has been the best keeper of integrity**. Everyone in that community is looking for errors. Also the public, knowing the scientific method, is looking for errors and may get some.

- Although we can and should do better - in particular, **schools can do better!** -, I do not see the need to make big modifications in a self-regulated system, which, after all, has been working well.