EPSC Abstracts
Vol. 7 EPSC2012-453-1 2012
European Planetary Science Congress 2012


# The Principles of Progress

**Emil Khalisi**
*Max-Planck-Institute for Nuclear Physics, Saupfercheckweg 1, D– 69177 Heidelberg, Germany* and
*Institute for Space Research, University of Stuttgart, Pfaffenwaldring 29, D– 70569 Stuttgart, Germany*

## Abstract

The achievements of mankind are based on the interaction of discovery, invention, and innovation. Once man learnt how to utilize the laws of nature, he advanced to a being who attained greatest strength upon other creatures. An analogy can be drawn for civilisations: Those conducting fundamental research will gain strategical power. Among the sciences, astronomy and astrophysics provide the largest potential for discoveries that reach far beyond our intellectual limits. They trigger technology and have a decisive impact on the society.

## 1. Introduction

The driving force of our social development is simply called "progress". Without it, no being could ever evolve to its optimisation. Progress is based on new ideas, and these are always in conflict with traditions that try to save the status quo. Since the environment is changed by natural forces (as well as by its beings), any creature is damned to a permanent improvement. The same holds for a civilisation: If not keeping pace with the changes imposed from outwards, the civilisation will suffer a regress. The role of science is most important within this process of social advancement.

## 2. Components of the progress

We split the term "progress" into three aspects of different purpose: discoveries, inventions, and innovations.

### 2.1. Discovery

Discoveries comprehend a gain of general knowledge, usually dealing with the functionality of nature. They are not a creative act of intellect, but rather an awareness of a new phenomenon. Some discoveries come by chance, others result from sophisticated experiments that are aimed to find out the principles of nature, i.e. laws, composition, relations of interacting features. Examples are, among innumerable others: the gravitational force, a chemical element, the moons of Jupiter, or prime numbers. Discoveries are subject to what we call "basic research". The identified new phenomenon will still exist independently of someone being aware of it or not. And, vice versa, our awareness does not change the appearance of the phenomenon itself. Such achievements of our knowledge are not patentable, but publishable. They just increase our education.

### 2.2. Invention

On the other hand, the invention does change the environment which they are part of. It is an act of a creative brain, and it is supposed to alter the immediate history. Inventions are built on a previous knowledge, so, they need a precursor. They can be an improvement of a device or the solution to a problem. An invention is the utilisation of natural principles in a way that was not considered before.

One of the most intriguing ideas, for example, was the invention of the wheel. It is based on the discovery of the laws of periodicity. Periodicity provides a recurrent change of force, angular momentum, and energy. It was the humans that firstly utilized these physical laws to disburden their lives. The outcome of the idea to use the regular cyclic motion was, besides the wheel, the throwing mill or a pulley. Also, our clock and calendar are inventions attributed to periodicities supplied by nature.

Inventions can be patented. In most cases technology benefits from it. Other domains of likewise creativity are literature, music, and arts. In the juristical sense, the latter are treated by the copyright, but from the mental point of view there is no reason to distinguish that from a technical invention. The intellectual contribution shall be the same. Thus, juristical laws are man-made (they act like inventions themselves), but they do not stand representatively for some “universal verity” like the laws of nature do. In particular, juristical laws even differ between the cultures and are being modified in the course of man’s history.

### 2.3. Innovation

A third form of progress is the innovation. This is the process of implementation of non-material features into the social environment. Innovations need the ability to assert oneself against the enrooted traditions. They may apply to organisations, community, or technical treatments. Examples are: the establishment of a republic, a currency, new haircuts, equality of genders, the logarithmic calculus, religious believes etc. The border between innovation and invention can be smooth and flowing, indeed.

The motivation for accomplishing an innovation is, in most cases, a subjective advantage. The new aspect procures some exclusivity to the owner, since he is the only one deploying it. On the short run, at least. His differentness allows him a certain attention from the others. This might result, but not necessarily, in a financial gain or prestige. However, the acceptance of the innovative idea will be as different as the people's opinions. Sometimes the success will be a long time coming and rarely attributed to the creator but a small group of avant-gardists who pick up that new idea.

## 3. The circle of progress

How do discoveries, inventions, and innovations work together? — Loosely speaking, scientists are targeted towards discoveries. Their goal is not to explain a "sense" of some phenomena in nature, but rather to find correlations between them. Natural sciences explain *how* something is going to happen and under which circumstances, but not why. Moreover, there is usually no intention of turning the discovery into a commercial use.

In contrast, engineers are the inventors who produce an application, a device, out of the scientific results. In the eyes of the society, their artifacts are percepted more lucid than the work of scientists. This is due to the attitude of asking "What is the new acquirement good for?" The questioner unconsciously expects an indication to a usage, which cannot be given in the case of a discovery. But the discovery might actually have caused the invention. One prominent example is the General Theory of Relativity. Once it was a mind game of theorists, a model for astrophysical objects which even were not known at that time. Today, the Global Positioning System (GPS) would not do without that theory.

So, discoveries initiate inventions and technological improvements. Inventions lead to new discoveries or sometimes to new methods. Both, discoveries and inventions, do cause innovations which might be as large as a "paradigm shift". This, in turn, alters the society.

Scientific research offers the concepts for discoveries, while astronomy is one of the most active fields therein. The Universe turns out to be much more manifold than our human imagination on Earth could ever be. Therefore, astronomy will provide new insights to a surprisingly broad functionality of nature. Any space mission we send out to the planets is founded on the discovery that an interesting target exists out there. New technology is to be constructed that aims to study that particular object. Quite often, the technology of those spacecrafts finds its way into industry and households somewhat later. And whenever the spacecraft reaches its destination, a new and unforeseen discovery is made. This, again, calls for a new explanation, a new idea, and the loop continues.

## 4. Conclusion

The progress in science, technology, and society can be founded on certain criteria. Two characteristics are curiousity and a learning aptitude. Furthermore, it is the utilisation of natural resources. These properties can be attributed to a number of beings, but only man has learnt the act of a foresighted planning, while animals perform their acts rather instinctively. Man is able to replicate an operation which is acquired from the laws of physics. And finally, he must be willing to make mistakes which brings us back to the learning aptitude. As such, science governs the progress that is essential for the success of an entire society.

## Acknowledgements

The author thanks the Klaus Tschira Foundation, Heidelberg, for funding under the grant no. 00.161.2010.