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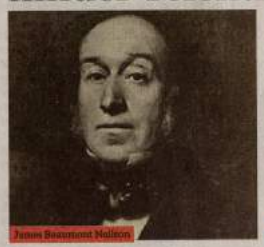
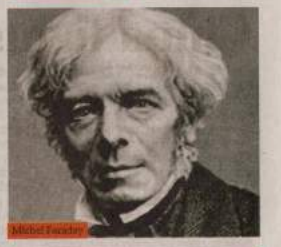
Exam-oriented education and traditional attitudes hinder scientific innovation


James Beaumont Neilson


Thomas Newcomen


James Watt


Michel Faraday

By
Prof. G. R. A. Kumara

World Science Day falls on 10 November, and many countries including Sri Lanka celebrate the week that follows as 'Science Week' to mark the introduction of science to society. As a country, this offers us an opportunity to examine scientific issues nationally, and moreover to ask the all-important question as to why we have not been strong in innovations.

The comforts we enjoy today are largely a result of utilizing science for the advancement of technology. Humans have surpassed all the other living beings and conquered the world as they differ from animals in two major areas. The first is their ability to innovate, and the second is their grasp of the scientific method.

The inculcation of both these qualities is essential to gather the fruits of technology and pave way for a peaceful society. Innovation and science are two different adventures, but are intimately related.

What is innovation?

An innovation is doing something new and useful. It can be an invention or an improvement to existing technology, or even an idea. Among the oldest innovations are tools made by primitive man and methods of igniting fire. Tools and firing pottery to form vessels, together with metallic implements greatly changed human lifestyles. Successful innovation by one individual would gain acceptance and further successive improvements followed as a result of continued innovations. The result was the origin of empirical technology—discovering better ways of doing things by trial and error.

Irrigation schemes, buildings and the manufacture of steel implements in ancient Sri Lanka were empirical technologies that evolved as a result of the innovative abilities of our forefathers. In many cases important innovations would have originated from an individual idea. But in ancient times names were not recorded, and due credit was not given to inventors.

Around 1700 years ago in Sri Lanka iron was smelted in windblown intricately designed furnaces. We don't know who invented or made improvements to this process. But today we encourage innovations giving credit to the inventor. The modern blast-furnace for making steel was invented by James Beaumont Neilson working in Scotland in 1828. Similarly Thomas Newcomen invented the first practical steam engine in 1712, and a major innovation by James Watt improved the steam engine in 1776.

The knowledge of electricity exponentially increased new innovations. The work of English Scientist Michael Faraday was a key in developments leading to the invention of the electric motor and subsequent improvements to it. Thereafter, countless more innovations shaped the world to bring us to our present status. One of the most revolutionary of these was the use of chemistry to produce new materials and medicines; the transistor on which the whole of modern electronics is based and innovations that originated after the discovery of DNA.

But the fact we cannot ignore is that almost all major modern innovations originated in the West. The reason seems to be our attitude towards science.

Science and Scientific Attitude

Science is the attempt to understand things and happenings around us through observation, experimentation and logical reasoning. This contrasts to explanations based on traditional beliefs or what is written in sacred texts. The motivation for scientific study is curiosity.

Our science education and science policy needs to change to accommodate the scientific attitude

The scientific attitude is adopting the above scientific method to clarify and resolve problems. Science cannot be geared towards innovations and technology without the scientific attitude and an education emphasizing the same. This is why the West succeeded in innovations leading to advanced technology, and in contrast we stand far behind. Our science education and science policy needs to change to accommodate the scientific attitude.

Science Education

A recent trend in science education in Sri Lanka is shifting the emphasis to the technological aspects of science, thinking this would be a faster and shorter road to industrialization. We talk about the virtues of Sri Lankan vein graphite for the fabrication of batteries and nanotechnology products without explaining to students why graphite is slippery and conduct electricity–properties of graphite that spark curiosity. Without that curiosity, it is hard to achieve graphite-based innovations. Similarly, we divert much attention to nanotechnology, omitting areas essential to gain a proper understanding of the subject.

One of our school science text books introduces the gadget known as the electron microscope. It is introduced to students as being important to nanotechnology. But what is more important is the science that enabled the development of the electron microscope. Unfortunately students at that level of preparation are unable to understand the principle of the electron microscope. A better approach would have been to introduce ideas necessary to learning the workings of the electron microscope.

As a result of exam-oriented teaching; the experimental component of teaching is greatly reduced. Another excuse is the shortage of materials and equipment. In a seminar I attended it was noted that many A/Level students had not even seen the preparation of oxygen in the laboratory. The reason teachers provided was the chemical substance known as potassium chlorate used in the preparation of oxygen by the standard prescription was unavailable (banned because of the possibility of using this compound in making explosives). But there are other methods of making oxygen in the school lab. A student will not learn chemistry curiously, without seeing how a strip of wood burns in oxygen. Trying to teach nanotechnology and introducing the electron microscope and electronics to schools without exposure to laboratory experimentation and theory is therefore counterproductive.

The country needs technicians and specialists with a scientific outlook and not specialists trained to work as technicians. The cause of the latter trend is a fault of our higher education. Our universities have revised science curricula to introduce technological themes at the expense of hard and more intellectually stimulating basic science, expecting innovations. But we continue to be poor in innovation and are backward in technological advancement compared to other countries in the region.

Compared to previous decades we have many institutions devoted to research. Most of the projects undertaken are on issues of applied nature. Yet innovations have not emerged as expected. The people of our country stand high in intellectual and innovative capabilities, but education and traditional attitudes hinder scientific progress leading to innovation. In this light, the 2021 Science Week is an opportunity to promote more programmes to inculcate the scientific attitude in society.

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