**Exciting technologies**

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During the last few decades, we have witnessed amazing developments in various fields of science and technology. Some of the most remarkable developments are in the field of biological sciences.

Let us first turn to the functioning of our own brain. With about 100 billion neurons, and with each neuron communicating with some 8,000 other neurons, it represents the most complex object of our universe, according to current knowledge. Thoughts are not ‘abstract’ as many would imagine but have a material existence. They are composed of various molecules that are stored in the brain. While much has been discovered about where the thoughts are stored in the brain (hypothalamus) but the precise mechanisms of thought storage and recall are little understood.

Our researches during the last two decades have revealed that the storage of thoughts may be in the form of patterns that are formed by the folding of glycoproteins, and logical processes may be considered as the inter-relationships of these patterns. These exciting discoveries are embodied in over 20 US patents and have led to the discovery of exciting potential drugs against epilepsy, Parkinson’s disease and Alzheimer’s disease that are undergoing clinical trials.

With ageing populations, the prevalence of neurodegenerative diseases is increasing exponentially and there is urgent need to address this issue so that the elderly populations can live longer healthier lives. The understanding of how the human brain actually works and the genes responsible for the development of various parts of the brain will also allow the manipulation of human intelligence, improvement of personality traits and the control of criminal tendencies that are linked to certain genetic factors present in some individuals.

A fascinating area under development is that of electronic chips that can be interfaced with neurons. This can allow the transfer of information between chips and nerve cells through Brain-Chip-Interfaces (BCHIs) in one or both directions. Indeed, devices that can interface with the neural system have already been developed for therapeutic purposes. For instance, patients with Parkinson’s disease can have a device implanted in their brain that can send electrical impulses to control tremors and improve motor control. Brain implants are also under development to help persons suffering from paralysis to restore hand movements.

Thoughts of patients with severe spinal injury can be translated into text using a brain implant with a high degree of accuracy. Elon Musk has formed a company, Neuralink, to develop Brain-Computer Interfaces (BCIs). Such devices, once implanted in the human brain, will allow thoughts of completely paralysed persons to be converted into actions, such as typing, manipulating a joystick etc, just by thinking about the action.

Another area of biology that is undergoing rapid development is that of gene editing. This technique allows specific changes to be made in the DNA sequence of a living organism. Gene editing technologies can be used to modify the genetic structure of plants to increase yields, disease resistance and drought resistance. They are also being explored to address genetic diseases with limited success.

While new plant or animal species could take thousands of years to develop through the process of evolution, it is now possible to develop new species in the laboratory through targeted genetic interventions in a matter of months, if not weeks. This has opened up new horizons in agriculture and animal husbandry. The ethical and social implications of this rapidly evolving technology have been the subject of much discussion, as it has the potential to alter human intelligence as well as personalities.

Another rapidly developing area is that of 3D printing. Originally used for producing small plastic objects, it has now been developed to produce all sorts of materials including 3D printing of entire houses, metal objects including guns, food (chocolates, pizza etc), cars, drones, customized clothing exactly fitting body specifications, or a 3D printer itself. Even parts of living kidneys and livers can be printed by multiplying living cells in a tank and spraying them into the exact shape, layer by layer, through a 3D printer.

A major problem facing our planet is that of water for agriculture and for drinking. With global warming, there is now a severe stress in countries such as Pakistan that are predicted to be among the worst affected. The advent of nano technology, and the development of nanomembranes and various nanomaterials promise to provide cost effective solutions to global water shortages. Nanotechnology involves the preparation and study of materials that have a size of a billionth of a millimeter. At this size, the materials exhibit strange new properties, which are finding large scale applications in electronics, drugs and drug delivery, energy, environment, sensors, diagnostics, textiles and a whole range of other fields.

Pakistan’s first dedicated research center on nanotechnology, the Latif Ebrahim Jamal Nanotechnology Center, was established within the International Center for Chemical and Biological Sciences (ICCBS) at the University of Karachi by Aziz Latif Jamal through a generous donation of the Husein Ebrahim Jamal Foundation. It is working on the development of various nano-pharmaceuticals in close collaboration with the Dr Panjwani Center for Molecular Medicine and Drug Research, established by Ms Nadira Panjwani within (ICCBS) through the generous grant of the Dr Panjwani Foundation.

The ICCBS is a leading research center in the Afro-Asian region and has been designated as the UNESCO Center of Excellence, the WHO Center of Excellence, The World Academy of Sciences (TWAS) (Italy) Center of Excellence and the OIC Center of Excellence. Over 100 German scientists have been trained in this institution over the last few years and it is the only research center in the developing world where advanced countries send their faculty and students for research. It is focusing on new and emerging technologies such as nano-pharmaceuticals, advanced genomics, gene editing, neurodegenerative diseases, antibiotics resistance, and regenerative medicine including stem cell technologies.

It is important for universities in Pakistan to focus on the new and emerging technologies so that they can prepare our youth for tomorrow’s world. An excellent beginning in this direction has been made with the establishment of the Pakistan Austrian University of Applied Science and Engineering in Haripur which will have five postgraduate research centers of excellence in fields such as Artificial Intelligence, Mineral Resource Engineering, High Speed Railways Technologies, and Advanced Agricultural Technologies. Eight foreign universities, three from Austria and five from China, will offer their courses in this unique university.

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