Book Review
by
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Far too small for the naked eye to see, under the microscope lies a bizarre world inhabited by creatures of every shape and form. Most of the squirmy little things beneath it are harmless, in fact they are so helpful that life on earth would vanish if they disappeared. But other denizens of this world are lethal, the cause of disease and death. Because we have understood their dangerous designs, in the modern age we live longer, healthier lives than at any time in the past.

Professor Viqar Zaman's "Life Sciences for the Non-Scientist", is a delightfully lucid introduction to the micro-world that takes us from the formation of large molecules and the chemical origin of life into the astounding diversity of life forms, both small and large, that make our world such an interesting place. It is simple enough for the uninitiated yet precise, and at every point bears the quiet authority of an expert speaking in a language that all can understand. Occasional anecdotes lighten the text, making the journey more enjoyable.

The first chapter, entitled "In Search of Truth", is unremarkable but indispensable. It is a joy to read largely because it comes from a Pakistani author, and we Pakistanis are in the general habit of extolling the benefits of science while ignoring – or even attacking – scientific thought. This brief chapter contains a clear exposition of the nature of scientific method; a way of thinking about the physical universe that stubbornly insists that facts can only considered scientifically valid if they come through our sensory organs or equipment, have passed the test of experimental verification, and are logically consistent. Why this insistence? Clearly, in its absence, we would have nought but opinions, speculations, dreams, and hallucinations that would act as a brake on serious investigations of the physical world. Zaman briefly touches on the clash between dogma and science, but interested readers might wish to refer to a copiously documented book on this subject, "A History of the Warfare of Science with Theology", published in 1894 by the first president of Cornell University, Andrew Dickson White. They will see that those who cling to the past have objected to serious science in all disciplines but, most of all, to discoveries in the life sciences. Nevertheless, opponents of scientific thought have no problems in using cell phones and computers or treating themselves with modern medicines.

The scientific method leads inevitably to the chemical basis of life; the journey from molecules present in the primordial soup of the early earth towards the simplest forms of life, then up the evolutionary tree towards the kinds of complex living beings in existence today, including humans. Chemical forces can turn simple atoms into molecules, then to amino acids and proteins, and onwards to the DNA molecule wherein is encoded the ultimate secrets of life. Jalaludin Rumi, in a famous poem (which Zaman quotes in part), had no difficulty accepting the idea of inanimate matter leading to life. And that was the 13^{th} century! But Harun Yahya – a hugely popular purveyor of pseudoscience in the Islamic world today – stands as proof that the resistance to such ideas is far from over.

Inanimate matter is generally easy to distinguish from living creatures, but not always. At the interface lie complex molecular arrangements called viruses. Obsessed with seeking to increase their numbers, they live off more complex life forms. Sometimes during the process of viral replication, mutations (changes) occur. If the mutation is harmful, the new virus particle might no longer be functional (infectious). However, because a given virus can generate many, many copies of itself it may still be able to survive after a mutation. Further, some mutations don't lead to harm to the virus, but instead lead to a functional but now brand-new strain of virus (the influenza virus can do this; consequently, there are several different strains of this virus which have to be identified each year in order to make a vaccine against the particular strain which might cause the "flu").

There is another creature that lives under the microscope that is much larger than a virus, called bacterium. If a virus were the size of a mouse, a bacterium would be about as big as an elephant. These one-celled bodies either take food through chemical processes or feed on live hosts or dead matter. During their billions of years on earth, they have learned to live in virtually all sorts of habitats and conditions. Bacteria are amazingly resilient – some live even in springs of boiling water, others under the polar ice shelf. Scientists found colonies of bacteria thriving 1,600 feet below sea level without oxygen or sunlight. There may even be signs of microbial life on Mars!

Bacteria cause disease and there was a time when having an infected wound, or contracting any one of several hundreds of diseases like TB or cholera, usually meant death. Most people in pre-scientific Europe thought that diseases are nothing but either divine punishment for their sins or as a gauge to test the faithful. It was a hard bite to swallow that some "invisible" organism, too small to see, can debilitate strong men and women. This greatly slowed the search for cures. Doctors did not know what the cause of disease was until two hundred years ago, and so they often caused as much illness as they cured.

Penicillin, the first antibiotic, was a revolution in the war against disease. But it was not until 1941 that commercial methods to produce penicillin for human use were developed. The total amount of penicillin available for use in the clinical trial on humans at that time, was less than the amount one would receive in a single shot today! At that time, of course, World-War II was in progress, and there was a major effort to try to make penicillin available to all of the British, U.S., and other allies involved with fighting Germany, Japan, and Italy. Because England did not have the industrial capacity necessary for large-scale production, nor protection from bombing raids, the entire process was moved to the United States. It is for this reason primarily, that the pharmaceutical industry became so well-established in the U.S. Initially, only military personnel were allowed access to this life-saving material. Eventually, prior to the end of World-War II, penicillin was made available to the general public.

Most antibiotics in use today, like penicillin, are isolated from bacteria. There are a few antibiotics, however, which are completely synthetic that is, are made from scratch in the laboratory. These particular antibiotics are designed to inhibit some process previously identified to be completely unique to bacteria, and necessary for the bacterium to remain alive. How do microbes "learn" to defeat antibiotics? That's a feverishly important question in an era of mounting resistance to life-saving drugs. Unfortunately, the answers are disturbing. Just as the evolutionary learning of plants, animals, and humans made them capable of surviving in diverse climes, microbes too can learn the art of survival. This leads to antibiotics losing their efficacy over a rather short time.

Zaman worries that whereas the developed world is now paying close attention to the problem of antibiotic resistance, not much has been done in Pakistan or, for that matter, the entire third world. Even the extent of the problem is largely unknown due to non-existence of any kind of national surveillance and a crippling lack of data. Antibiotic resistance is a societal problem. Therefore, every component of the society – government, doctors, the pharmaceutical industry and general public – should strive to stop it before it's too late.

Other chapters of the book deal with issues of heredity and genetics. Genetics may be defined as the study of the way in which genes – the functional units of heritable material – operate and are transmitted from parents to offspring. Modern genetics is essentially the study of the mechanism of gene action; that is, the way in which the genetic material affects physiological reactions within the cell.

It is possible that humans may soon control their heredity; even now functional genes can be transferred from one organism to another, and certain treatments are able to cause specific kinds of mutations. Such manipulation of genes eventually may be useful in solving many human hereditary diseases; e.g., stopping the function of genes that are out of control and starting the function of nonfunctioning ones. Activation of nonfunctioning genes in some types of tissue may enable them to replace body parts that have been injured or destroyed. It is conceivable that we may someday learn how to change harmful genes into normal ones. Artificial insemination, in vitro fertilization (e.g., "test-tube" babies), sperm banks, cloning, and gene manipulation are not science fiction any more.

It is a commonplace that all organisms die. "Maut ka aik din mo'yen hai", said Ghalib. Some living forms die after only a brief existence, like that of the mayfly, whose adult life burns out in a day, while some pine trees have lived thousands of years. The limits of the life span of each species appear to be determined ultimately by heredity. Locked within the code of the genetic material are instructions that specify the age beyond which a species cannot live given even the most favourable conditions.

Will we humans ultimately be able to dial in desired lifetimes into our own genes, or that of our progeny? Create this or that physical or mental characteristic? This raises enormous moral and ethical issues – such as the one we see today in the debate over the use of stem cells. This slim little volume obviously can do no more than touch upon them. But the author makes us aware of the brave new world that lies ahead.