MAN, ENVIRONMENT, TECHNOLOGY AND UNIVERSITIES

Professor Meral Kence
Department of Biology
Middle East Technical University
Ankara
Turkey

Professor Aykut Kence
Department of Biology
Middle East Technical University
Ankara
Turkey

In humankind's recent past, especially after the industrial revolution and the advance of technology, humanity spread rapidly over the earth's surface and adapted to land, sea, and air environments. The rapid increase in human population, without any sign of cessation, gave the impression that human populations are not subject to the ecological laws that limit the growth of populations of other living species.

Evolutionary biology had demonstrated that humans share a common biological past with other living species on earth. All living organisms, together with human beings, have reached their present situation over millions, even billions of years of evolution. During their evolution living species accomplished a tremendous adaptation with each other while they were adapting themselves to their physical environments.

Human species dispersed over the earth at an enormous rate during the last centuries with the development of technology and gained tremendous success in competition with other species for resources of life. However, this success may be very misleading. Because, the success, from an evolutionary point of view, is measured as the duration of the species' existence rather than the number of the individuals in the population. Species living today make up less than 1% of those that became extinct during evolutionary time. This means that a species living today is in danger of future extinction with the probability of more than 99%.

The existence of the human species on earth spans no more than a few million years. If we consider that cockroaches have existed for 300 million years it would not be wise to conclude that the human species is a successful one.

Human beings affect the evolution of all living species on earth with their developed technology. According to one estimate, should the careless use of resources continue at its present rate, one million out of five million species will become extinct in the next 20-30 years. Why should we bother with this? Why should the existence or extinction of a bird, an insect or a plant species that we never see or are aware of, concern us? We cannot predict the consequences of this enormous destruction of ecosystems, but the effect may be fatal for the human species.

No living population can grow forever. Population size is limited by the availability of food and living space. Populations have to stay in balance with their resources to be able to maintain their existence. This fundamental principle of ecology is valid for all biological organisms including human beings. This means that the population of a species can never grow to infinity, but will fluctuate between certain limits imposed on it by its resources. However, the human population has been growing at a great rate especially within the last century. After finding cures for malaria, cholera, small pox, and other infectious diseases, the death rate was reduced considerably, leading to a population explosion. The human population was around a few million during its early history, it reached 500 million by the 17th century, 1 billion in the 19th century, and increased five fold, reaching five billion in the 20th century.

Man is a biological organism just as all the other living things. Man's difference from the other organisms is his ability to widen his living space continuously due to technological advances and to increase the `carrying capacity' of his environment. In ecology, the term `carrying capacity' refers to the maximum load that the environment can carry without putting the population's continuity in danger. In other words, resources needed by future generations should not be consumed to the extent that they cannot renew themselves. Here by `load' we mean the demand made by all populations on resources necessary for life. Pressure made by human beings on the resources increases in two dimensions. On the one hand, the number of individuals increases, on the other, energy consumption per individual increases, leading in turn to an increase in the demand on resources.

Universities have to emphasize these subjects. Biology courses must be given to all students from all disciplines as compulsory courses to teach them that human beings are part of nature just as any other species are and that they have to obey ecological laws as do all living beings. The main problem for humankind is the population explosion. This came as a result of the increased food production, and the decreased death rate due to advances in medicine. Both improvements are the results of advanced technology.

In the history of technological development there are many examples where technology created environmental problems that could not have been predicted. The costs of technology are usually hidden and cannot be predicted a priori whereas the benefits of technology are obvious and immediate.

To give an example, the discovery of pesticides starting with DDT in the 1940s, seemed to solve the pest problem by controlling populations of harmful insects of medical, veterinary, and agricultural importance. The success of synthetic poisons in controlling pest populations was considered as the victory of technology over the insect pests. Indeed, Paul H. Müller received the Nobel Prize in 1948 for his discovery of the properties of DDT as a pesticide. But this victory was soon overshadowed by the evolution of resistance problems. The belief that synthetic pesticides were the final solution to the pest problem had overlooked a fundamental law of biology, namely natural selection. The evolution of insecticide resistance is the result of natural selection favoring the resistance genes in environments where insecticides are applied. Persistent applications of an insecticide, initially killing the major portion of a population, results in continuously increasing percentages of surviving insects in the successive generations as the frequency of resistance genes spreads in the population, which in turn, necessitates the application of larger and larger doses of the chemical to achieve an effective control. The number of insect species becoming resistant to pesticides increased rapidly following the introduction of synthetic chemical pesticides immediately after the Second World War. Within the last 40 years, more than 400 species of insects developed resistance to synthetic insecticides. Between 1970 and 1980, the number of Arthropod species with resistance to pesticides almost doubled.

Development of insecticide resistance also brings with it serious environmental problems, because as the resistance to a given insecticide increases, the amount necessary to effectively control an insect population increases. As larger and larger amounts of insecticides are applied to pest control, the environment is poisoned, and ecosystems are damaged to a great extent. Furthermore, most of the time, only about 0.1% of pesticides applied to crops reaches target pests. Therefore, over 99% of these poisons move into ecosystems to contaminate the land, water, and air. The cost of the insecticide, and harm done to non-target organisms, and ecosystems will limit the amount of insecticide that can be applied to a given area. Therefore, after a certain point, increasing the amount of insecticide used becomes no longer practical, and new insecticides are required for effective control of the pest populations.

A common approach to the problem of resistance development has been to change the insecticide used for controlling the insect population. This approach is still being used extensively all over the world, although it becomes more and more expensive and difficult to develop new synthetic insecticides. Developing a new product is estimated to cost more than 20-45 million US dollars and to require a time of approximately 8 to 10 years. The evolution of resistance to new insecticides seems to be faster than the rate of development of new insecticides. In addition, the concentration of DDT increases rapidly as one goes up in the food chain. It turns to human beings who are at the top of the food chain.

Another example would be the use of synthetic detergents. Synthetic detergents were introduced into the environment during the period of 1945-1965. After a while, it was discovered that bacteria cannot degrade them. Thus they persist in the environment for a long time. They were then replaced by straight-chain substances which were biodegradable. But this did not solve the problem of detergents in the environment because they contain phosphate. The phosphates were the nutrition of algae in lakes and rivers and caused algal bloom and the death of lakes.

Today, fortunately, the danger of a nuclear war is much less than it was two years ago, but sources of radioactive pollution still exist. We were all terrified when a power plant in Chernobyl blew up, dispersing its radioactive pollution to many countries. In Turkey radioactive clouds settled on the tea plants leading to a massive pollution of the tea crop. Authorities then denied any bad effects of consuming radioactive, contaminated tea. It was left to the universities to take the problem seriously and warn people against low dose radiation exposure. Similarly, careless use of X-rays and radioisotopes in medical diagnosis and treatment in small doses pollutes the environment and presents a continuous threat to humankind.

As one can see from these examples, although technology has a beneficial effect on human populations–such as increasing living standards and decreasing death rates–it nevertheless pollutes the human environment. Thus, universities should carry out research in the field to minimize pollution resulting from technological development and predict adverse effects of new technologies ahead of time rather than learning by mistake. Universities should also educate students and the public in the problems related to the environment. New generations should be raised, who can look at nature as a friend rather than as an enemy to be ruled.

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Professor **Meral Kence** graduated from the Zoology-Botany Department of Istanbul University (B.Sc.). She worked at the University of New York at Stony Brook and the University of Houston. She studied at Middle East Technical University (M.S. and Ph.D.). Dr. Kence has been teaching Biology, Genetics and Conservation Biology at the Middle East Technical University. Her research work has been on the ecological genetics of pesticide resistance and pest control in pest populations and on environmental problems in lake ecosystems.

Professor **Aykut Kence** chairs the Department of Biology at Middle East Technical University in Ankara and has been awarded the International Insect Physiology and Ecology Associateship for 1988-1994 by the Third World Academy of Sciences. He teaches and has repeatedly received grants by the Research Council of Turkey for his work on the housefly Musca Domestica and has written on evolution, species differentiation, biological diversity, and the genetic effects of radiation.