

Ethics of Science and Technology: A Scientist's View

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A practicing scientist does not normally start daily business with the question "is what I am going to do today moral or ethical?" We normally assume that the quest for new knowledge and the building of new gadgets are virtues in themselves. We realized long ago that with more knowledge and ways to apply our knowledge, we are empowering ourselves more, while we hardly thought about the implications of such empowerment. With knowledge of how to split the atom, we can release immense energy from materials; with capability to manipulate the genes, we can practically create new life forms. To be sure, we realized also that the power that we gained from science and technology could be put to good or bad use. Then one day – no, indeed on many, many days - we discovered, with shock, that our power was used in immoral, unethical ways. True, the abuse of the products of science and technology – as weapons, as tools for terrorism, or for crime – is by and large not the work of the scientists and inventors themselves. We are only the tool makers, and the people who use them in bad ways surely should be blamed. This is all very well, but are the scientists and inventors all absolved from the blame?

Worse still, in many cases, we do not know whether our inventions are good or bad, simply because they are so new that we have not had enough time to ponder over them. For example, while it is surely bad to create and use weapons of mass destruction, is it good or bad to create new life forms, or to clone parts of or even whole human beings?

Our dilemma is made more urgent since we now have the technical capability to do many things which we do not yet know for sure are good or bad, right or wrong. Our sense of right or wrong can guide us in many cases. However, in other cases, we simply do not yet know the consequences and implications. It is surely right to use our knowledge of cloning to make spare organs from our own stem cells. But how about using the cells from human embryos? Are we in effect killing others for our own survival? Are embryos human beings? The debate has become more urgent now that the technology to grow nerve, liver, kidney and other

tissues is at our doorstep, and it will be technically easier to use embryonic cells, rather than stem cells from adults who will need the tissues for repair. The Bush Administration, relying on a law amendment which prohibits the use of US federal funds to support any research that destroys human embryos or puts them at serious risk of destruction, barred the support of research on new lines of stem cells by arguing that that federal taxpayer dollars should not be used to encourage the exploitation or destruction of nascent human life, even if scientific and medical benefits might come from such acts. Many see this as seriously retarding the emergence of new therapeutic avenues to rehabilitate such patients as the late Christopher Reeve. They argue that since the embryos created from *in vitro* fertilization clinics will have to be destroyed anyway, what is wrong in using them for research for medical benefits? At the global level, the debate on cloning has taken on importance in various countries and in the international arena, with no simple consensus yet despite declarations at the UN and other levels.

The struggle may not be futile, and some issues may be settled in the future. Our ethical sense has indeed evolved over the last few decades. When *in vitro* fertilization first became possible, giving rise to Louise Brown and other test tube babies, there was a lot of doubt about the ethics of such an undertaking. Although some controversies still remain, the issue has been mostly settled now as the world became familiar with the technology and, more importantly, greater understanding about the ethical problems involved. As far as cloning is concerned, we need to understand more about the technologies involved and consider the ethical implications on a continuing basis. While it is generally agreed that whole human cloning should be off limits for the present, the area of therapeutic cloning, cloning of cells and organs for therapeutic purposes, is now at the crucial testing ground. Understanding and conclusions from this area should help in tackling the more difficult area of whole human cloning.

Cloning is but one issue among many for which ethical considerations need to be given. Many other issues which have arisen through advances in science and technology require rigorous debates on the ethical aspects. From genetic sciences alone, we need to

consider issues, such as who has the right to the genetic information of individuals, whether genetic improvement or correction should be made to offspring, and how the rights of parents versus those of the unborn children should be weighed. In the future, not only can the genetic characters of the unborn child be known and defects corrected, but they can also be designed in advance, so as to improve the looks or possibly even the intelligence. In the book "Our Posthuman Future", Francis Fukuyama raised serious questions on how far society should let biotechnology go. Are "designer babies" becoming true dreams or nightmares in the making, once this is practiced on a large scale? Should we allow manipulation of genes which modify behaviour? Apart from genetic interference, how far do we allow the use of drugs which alter moral character? Even in extending life, which is surely a worthy goal for everyone, what long-term overall impacts will this make on economies, international relations, and new idea generation? The concerns of Fukuyama indeed echo those of Aldous Huxley raised long ago in the famous science fiction "Brave New World", or closer to home and more recently, of the Thai author Wimol Sainimnuan in "Amata". These books and other media reflect the concerns of society on the new advances in biotechnology, which promise so much for our quality of life, yet evoke some suspicion on whether they may also bring some bad news along with the good.

Obviously, there are many other aspects, many other areas than biotechnology, in which technical advances have raised new ethical issues, or indeed in which old ethical issues still have to be settled. The fact that we can now store and process vast amounts of information about individuals, of which genetic information is only a part, raises many issues on human rights, privacy and freedom. Some governments are employing the "smart card" as a means of keeping tabs on their population and a means to increase government efficiency. But how far should governments or employers have legitimacy to store and use such information? Who should have access to such information? Most importantly, when is it right, and when is it wrong, to access and use such information?

Another area of potential concern for ethics in science and technology is that of nanotechnology. This is a new area, and therefore it is fitting to raise the issues early, so that we do not follow the history of GMO controversy which arose from advances in biotechnology. We should think about potential liabilities of products from nanotechnology, both to human health and the environment. The issues of "nanosafety" should be addressed as early as possible, so that preventive and other measures can be made to make this new technology, and its products, both

beneficial and safe for all.

Ethical issues can be raised in other areas of science and technology, or areas on which science and technology have great impact. These diverse issues make me feel a need to find guiding principles to deal with them. After considerable struggle, I found that my own root in Buddhism has helped me in finding the guiding principles. Let me share some of my thoughts with you.

Three core principles of Buddhism were given by the Buddha in his sermon, "Owata Patimok". These are refraining from committing evil, being good and doing good, and purifying the mind. Refraining from committing evil covers both physical and mental acts. The same goes with being good and doing good. Purifying the mind is achieved when the mind is at peace, free from greed, hatred and delusion – "the roots of evil".

Can these core principles of Buddhism be applied as a guide towards the ethics of science and technology? I find no difficulty in agreeing that the first two can provide good guidelines, although real cases will be complex and need to be considered from various angles, on a case-by-case basis. For example, on gene-based diagnosis, considerations will have to be made concerning: for whom it is good and for whom it is bad, both for individuals and for society. For some people it is good to know whether they will have breast cancer, while others may not want to know. How much does this prior knowledge of our fate benefit or cost the society? If a product from science and technology such as gene-based diagnosis is of reasonable cost, and people have a choice whether to use it or not, together with the choice of follow-up action, then on the whole I think everyone would agree that this is good. On the other hand, if a product such as a smart card is used by an authoritarian government to exert controlling influence over its population, then the product and the way that it is used should be judged as bad. Smart cards should be used in ethically smart ways.

Application of the third principle, purifying the mind, causes me more difficulty in pondering and interpreting in relation to the ethics of science and technology. I would propose that this principle, as applied to the ethics of science and technology, tells us whether a science-and-technology based action or product gives peace of mind on reflection. We need to reflect on the basic reason and the ultimate consequence and implications of our action, including the benefit-risk considerations of the effect in the future. Let us think of an example. We know that global warming is due to the increasing level of carbon dioxide emitted from industrial and other sources. Suppose someone comes up with an ingenious scheme of capturing carbon dioxide in liquid form and containing it in the deep

ocean or deep geological formations. We may think that this is a wonderful solution, but on second thoughts, how can we be sure that the captured carbon dioxide will stay inertly where we put it? What is the risk of it escaping or reacting adversely with its surrounding environment? And even if everything goes according to plan, is this just an ingenious way of dumping industrial pollution? It is the difficulty in analyzing this kind of complex scenario that make scientists and technologists, so clear about the underlying principles of their trade, become so unclear and tentative about many possible consequences of their products. The main point here is that scientists and technologists should not only go about their work in a business-as-usual manner, and should not be too attached to the technical wonders of their products, but should also reflect on the consequences of their actions and their products in relation to their effects on society and the environment. They should furthermore seek the opinions of a wide range of people before making up their minds, and be ready to change them when new information points in a new direction. Purification of the mind, therefore, is not just for individuals but for the mind of the public as a whole. This, I would like to propose, is the essential task in purifying the mind.

In addition to Buddhism, other religions and other healthy systems of belief can surely also be invoked to examine the ethics of science and technology. Broadly speaking, the new actions and consequences stemming from science and technology, should be examined in the light of possible overall risks and benefits to human society and the environment, with broad participation from the public as well as the scientists and technologists. The scientists and technologists, being close to the actions, can point out possible effects and scenarios, but the public, including people from various backgrounds and professions, need to be involved, because complex interlinked chains of events are possible, and cannot be all foreseen by only a few individuals.

In a lighter vein, the story of Godzilla gives a good range of issues for ethics of science and technology. How? The monster first came out from its peaceful territory as a consequence of repeated nuclear bomb experiments, already a lesson in ethics for us all here. A young scientist found a way to destroy Godzilla, but unfortunately his invention could also be used as a weapon of mass destruction. In the attempt to solve the dilemma, he eventually decided to burn all his documents and end his own life by facing Godzilla under water. Are there similar stories to Godzilla in real life? Yes, if we equate it to unintended consequences of our action. Yes, if our solutions are double-edge swords which can cut both ways, solving one problem as well as creating others. Are there real scientists as brave as

our hero? We wish so, although hopefully they would not meet the same fate!

In his elegant critique, *On Ethics and Economics*, Amartya Sen argues that economics can be enriched by paying more explicit attention to ethics, and that modern ethical studies can also benefit from a closer contact with economics. I would like to reflect his views here by saying that science and technology can also be enriched by paying more attention to ethics, and vice versa, modern ethical studies should take account of new developments in science and technology. In a world in which science and technology play an increasing role in all aspects of society and the environment, their ethical implications should receive greater emphasis, and their impact on ethical principles themselves should not be ignored.