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Of politicians and theologians: The post-Dolly scenario

As usual, the conclusion seems to be that, where evil is concerned, humans seem to have a monopoly.

—Colin Wilson

History is witness that all great scientific achievements have usually been followed by frenzied and irrational doubts, usually expressed by political and/or religious leaders – the self-appointed guardians of our society. The alchemists of old, who laid down the foundations of modern chemistry were hounded (and also cultivated according to the need of the hour) in the medieval period. Copernicus was persecuted for propounding the theory of a heliocentric universe. When Edison invented the carbon filament lamp in 1879, William Preece informed the House of Commons that the concept of electric light in homes was fanciful and absurd. For fear of the Inquisition, Leonardo da Vinci spent several years secretly designing prototypes of flying machines which uncannily resemble the helicopters of today. More recently, computers and robots were viewed with suspicion and fear that these would eventually take over the world as rulers of mankind. However, anyone, who has been even remotely associated with computers and robots will be well aware as to how fragile and dependent these machines are on humans for their operation and maintenance.

When the world woke up to the birth of Dolly, a cloned 'true-to-type' sheep at the Roslin Institute, Edinburgh, several scientists and leaders of different hues issued statements for and against such scientific researches. As the Roman Catholic Church has long expressed its opposition to any form of reproduction divorced from the sexual act, the Vatican, in a knee-jerk reaction, issued a statement that every person has the right to be born in a human way and not in a laboratory. Several persons in the world today, technically known as test-tube babies therefore, have no right to exist because they were conceived in test-tubes instead of a human womb. Although, taking the medico-legal aspects into consideration, they were born in a human fashion, only conceived artificially .... The arguments are endless.

As any primary student of biology knows, the birth of a new organism is not confined to the sexual union of gametes alone; vegetative propagation, asexual reproduction and even parthenogenesis are common phenomena in the world of biology. From simple cross-breeding and grafting to somaclonal hybridization and oligonucleotide-directed *in vitro* mutagenesis – the twin sciences of genetics and molecular biology have evolved with such gigantic steps that creating either a biotype or an identical clone has become a routine affair rather than a source of wonder. 'True-to-type' plants have been produced by tissue culture for the past several years. Oncologists have been using cloning techniques to study the origin and growth of cancer cells. Then why the hullabaloo if a true-to-type sheep or a couple of simians have been produced through cloning techniques?

If the phenomenon of giving birth to a new being is a Divine Act, it should not be confined to mammals alone but should also be applicable to the plant kingdom and lowly invertebrates. While the author is no authority on theology or metaphysics, it is apparent even to a layman that God should not be defined according to the limited vision of our religious and political leaders. Scientific inventions and discoveries should not be looked upon as a threat to God's existence but as another manifestation of His Divine Presence. Satellite TV and space travel by humans do not imply that God is dead. One need not revert to the Stone Age, simply to acknowledge the existence of God.

The US administration has issued a directive, banning the federal funding of research on cloning of human beings. Is it really justified? Can we arrest the progress of science with a political ban? Can important and significant scientific discoveries simply be wished away? It is unfortunate that the world did not act with equal alacrity to ban nuclear weapons of mass destruction. It appears that we are heading towards the Middle Ages where scientific ideas not in consonance with the limited vision of politicians and religious leaders were banned and the scientists put to death.

Coming back to Dolly, Steven Spielberg, in his sci-fi magnum opus, *Jurassic Park* had envisioned the re-birth of dinosaurs through cloning. The public lapped it up with delight as it had lapped other sci-fi fantasies in *2001 – A Space Odyssey*, *Demon Seed* and *Star Wars*. However, while the public is relatively calm and scientists delighted with the immense possibilities of cloning techniques, it was left to our political and religious leaders to stir up a controversy and contribute to mass hysteria. Perhaps for publicity, if not for votes.

It has been truly said that more powerful than a thousand armies is an idea whose time has finally come. Just as by banning

a book, one cannot ban the idea behind it; by banning researches on cloning in humans, one cannot ban the immense possibilities behind such technology. Moreover, it should be remembered that cloning is the biological equivalent of photocopying. To use a crude analogy, any layman can photocopy a Shakespearean sonnet from a book but it takes God in His munificence to produce a Shakespeare in a millennium. However, we are digressing. Perhaps the actual fear is not of cloning technology *per se* but the apprehension that the technology may be misused to produce a race of 'superior' Anglo-Saxons, lending an almost prophetic touch to Colin Wilson's observation.

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Biosafety of transgenics

I have read with interest the article 'Transgenic plants and biosafety concerns in India' by P. K. Ghosh (*Curr. Sci.*, 1997, **72**, 172–179). It brings out all the issues that have been raised regarding the biosafety of the transgenic plants, and the procedures adopted in India for the clearances required at various levels for developing, evaluation, upscaling and commercial cultivation of transgenic plants. The latter information should be extremely useful for the researchers working, or intending to work, in this area, especially the young research scholars, who develop such plants while working abroad and wish to bring transformed cell cultures or plants to their own laboratories back home. However, while reading the article it was felt that it only echoes the concerns that have been raised[1–3] but fails to bring out the widely accepted viewpoint of the plant geneticists and breeders especially in North America, Organization for Economic Co-operation and Development (OECD), China and Australia where, as stated by Ghosh, transgenic crops will be grown over an area of over four million hectares this year. Most of these countries, in the past, have shown greater concern for the environmental issues than in India.

Rissler and Mellon[1] argued that (i) The r-DNA methods are more powerful tools for genetic manipulation than the conventional methods used by the breeders, so far. (ii) Prior to the r-DNA methods, genetic manipulations were confined to the use of genetic variability in the primary, or at best, the secondary gene pool of the crop species. (iii) With the new techniques, genes of a large variety from any living organism or a synthesized gene can be expressed in plants, while the conventional methods were limited to replacing alleles or their deletions.

They therefore inferred that r-DNA methods may be linked with 'greater unpredictability' in comparison to the conventional methods, which are limited to genetic manipulation at cellular level alone. In this context, some of the decisions of the National Experts on Safety in Biotechnology of the OECD[2] are very pertinent. They have recognized that 'the safety of an organism is independent of the process of genetic modification *per se*. It is the characteristic of the organism, including new traits, (however introduced), the environment and the application that determine the (likelihood of) risk of the introduction.' Thus, the environmental risks from the transgenic crop plants also apply to the cultivars with similar properties developed using the conventional methods of plant breeding. An insect-resistant crop cultivar developed using inter-cultivaral hybridization or distant hybridization poses the same risk as the one developed by using the genetic engineering methods. Further, it has been accepted that 'the same physical and biological laws control the behaviour of the organism, whether modified by conventional or r-DNA techniques'. Thus the risk is based on the characteristic of the organism, the modified trait, the environment in which the crop is grown, the interaction between these and the intended application.

While examining the environmental risks from the transgenic plants, it should be recognized that all human activities cause some environmental perturbations. Cultivation of large areas with single species by itself has adverse effect on the environment, even without the use of any fertilizers or pesticides, but can the present human civilization survive without agriculture? There is always a certain amount of risk in all activities which have been accepted in our daily life on the basis of the risks verses the benefits. In the early phase of the r-DNA technologies the 'fear of the unknown' not only in the public but even among the geneticists and molecular biologists led to an extremely cautious approach. However, as the experience with transgenic plants has shown, they do not pose greater risks than the crop cultivars developed using the conventional breeding methods. Yet, as has been pointed out by Deshayes[4] regulations have been implemented to avoid environmental risks. Hence, each crop–transgene combination calls for risk–benefit analysis before initiating the experiments and at all further stages of upscaling.

The major environmental risks from transgenic crops raised and as mentioned by Ghosh are: Weediness of the transgenics (not covered by Ghosh); Gene flow into other cultivars, weedy and wild relatives; Development of new strains of viruses on transgenic virus-resistant plants; Effect of transgenic pesticidal products on non-target organisms; Overcoming the resistance mechanism of the transgenes; Safety of the workers and of food items obtained from transgenic crops.

These have been extensively examined[2,3,5–7] and it would not be appropriate to elaborate them here. Most of the above risks apply to crop varieties developed using conventional methods of breeding and are accepted as a part of the breeding strategy. Though these risks cannot be ignored, it is important to consider the number of independent events that would be required, and the probabilities of their occurrence. For instance, the gene flow into other crop cultivars, wild and weedy relatives, presence of sexually compatible wild and weedy relatives of the crop, flowering