

The Cloning Glory

Cloning as a method of reproduction is nothing new. Most of the lower organisms like the amoeba and the yeast reproduce by cloning. Genetic engineers in Britain, for the first time have engineered an animal clone which has lead to a worldwide debate on the possible ramifications of such a development. Further, scientists are also contemplating the effects of a possible human clone.

■ G.P. Vinayababu



with internet access software.

IBM's Aptiva, is being distributed by TISL. Gateway has tied-up with DCM Data Systems after a brief stint with other large players in India. Packard Bell has tied-up with Cere..., a Bangalore based PC manufacturer after a brief stint with Crompton Greaves. Busybee series is also being distributed for SOHO segment.

Dell with PCL and Olivetti with Modi are also trying their hands at this segment. Wipro is targeting SOHO with its Super Genius Impact. All the above mentioned global players are mainly focussing on the value conscious customers.

To serve the cost conscious customers, there are companies like Zenith, offering PCs from most unconventional outlets such as home appliances showrooms and photo studios in major metros, which obviously brings down the overheads and thus the price of a PC. Similarly CMS computers also has set up the retail chain called Chain Reaction Stores scheme throughout India. These stores are multiproduct supermarkets displaying leading computer hardware, software brands Zenith and CMS have got tremendous response from this methods

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of distribution. In fact, these two companies shall capture most of the cost conscious customers.

The Netherlands based Tulip Computers plans to tap the growing SOHO market in India. Tulip India has now rolled up its sleeves with a Rs.40 crore finance plan to sell the PCs. It has tied-up with Bombay based Weizmann Finance Ltd. with a two part finance plan to target the corporate clients as well as the SOHO segment.

The players are trying to create a situation wherein the home PC becomes indispensable. TISL has already started conducting awareness programmes in school. Apple has its M Power evenings whereby some families are invited for demos. Wipro's Apple Division has also employed market researchers mostly college going youth, to do door-to-door campaigns.

Strategies to capture the SOHO market

◆ To exploit this highly potential SOHO market the vendors need to go in for aggressive advertising campaigns, price reduction and special financial schemes.

◆ The SOHO customer cannot wait long for delivery. "Customer-Sales" methods have to be introduced immediately.

◆ Retail chains have to be formed with more number of retailers and Zenith's concept of selling a PC in supermarkets, photo studios and consumer electronic shops has to be popularised, which in turn shall bring down the overheads and thus the price of computer.

◆ More than 50% of the customers are going to be price conscious, rather than value conscious. Attractive purchase schemes should be announced

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and reliable financing methodologies have to be evaluated, making a PC affordable to all who want to own one.

◆ A SOHO buyer is conscious of the serviceability. He/She shall try to treat a Home PC just like a washing machine, TV or a refrigerator. So, the warranty and good support services have to be provided with lot of care.

◆ The Home PC should be packed with all the required software and hardware. Today's requirement in the Indian scenario are a CD-ROM drive, multimedia capabilities, sound blaster cards, fax and modem cards, speaker etc. and the necessary software package.

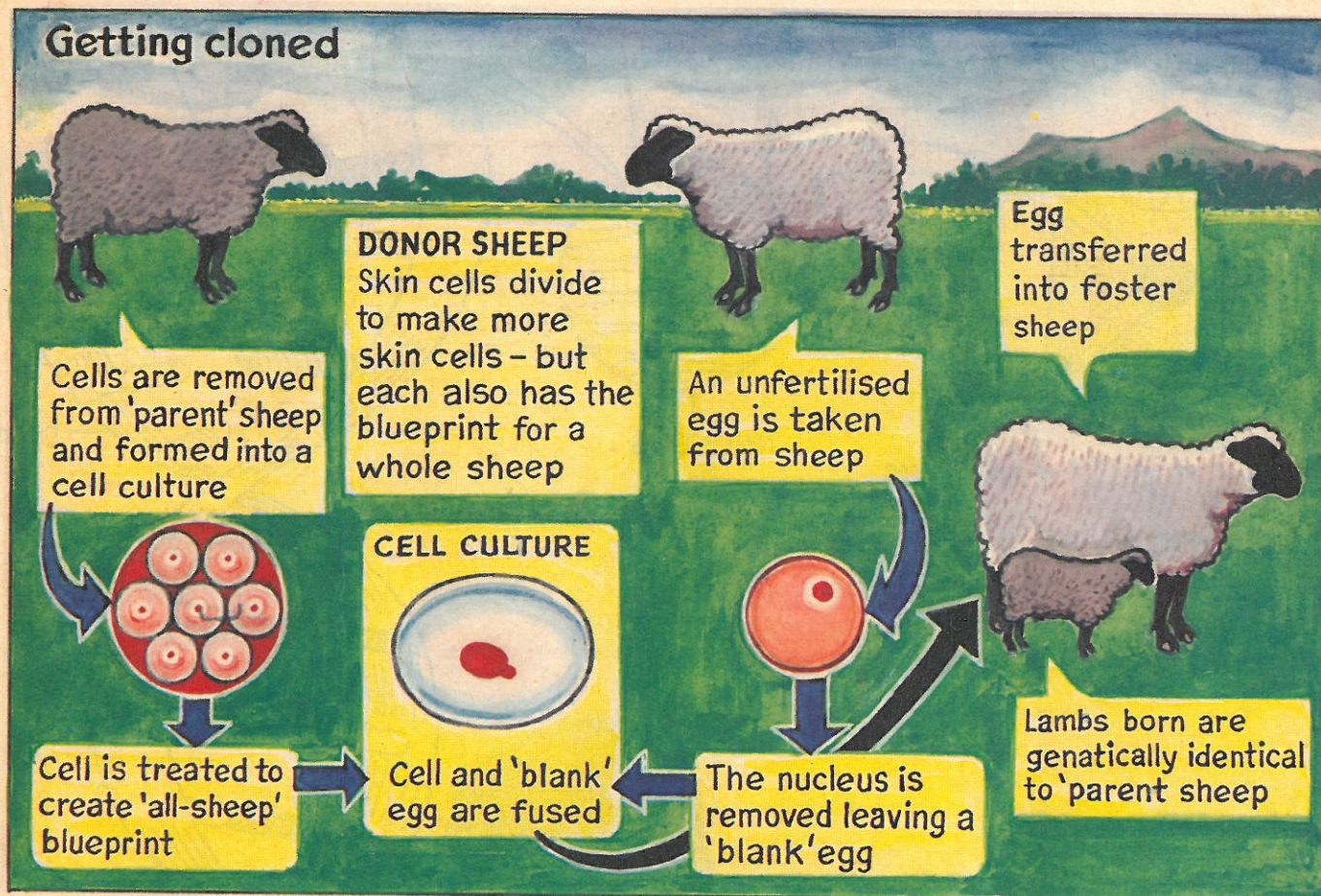
◆ As the market is in its evolutionary stage, the strategies should be flexible. The channels of distribution and brand positioning are crucial.

◆ Opening exclusive shops for multi-branded systems would be an ideal choice.

◆ Methods to create awareness among the children and the housewives should be sharpened. Massive ad campaigns in the women's magazines are likely to play a major role in popularising the Home PC.

◆ All the computer education points can be planned as retailer shops, where in students could get benefited.

Getting cloned



.... And God created Man.

This could well remain only a statement in future if the latest research in genetic engineering is anything to go by. After playing around with nature by polluting water and air, depleting the ozone layer with hazardous chemicals, disturbing the ecological balance by resorting to widespread deforestation- man has now ventured into manipulating the very roots of his existence. First it was the test tube baby, then the invitro fertilization and now man is all set to play the God himself by mastering the art of cloning.

Cloning

Man has always been curious about the fundamental life aspects like birth, ageing and death. His curiosity has made him

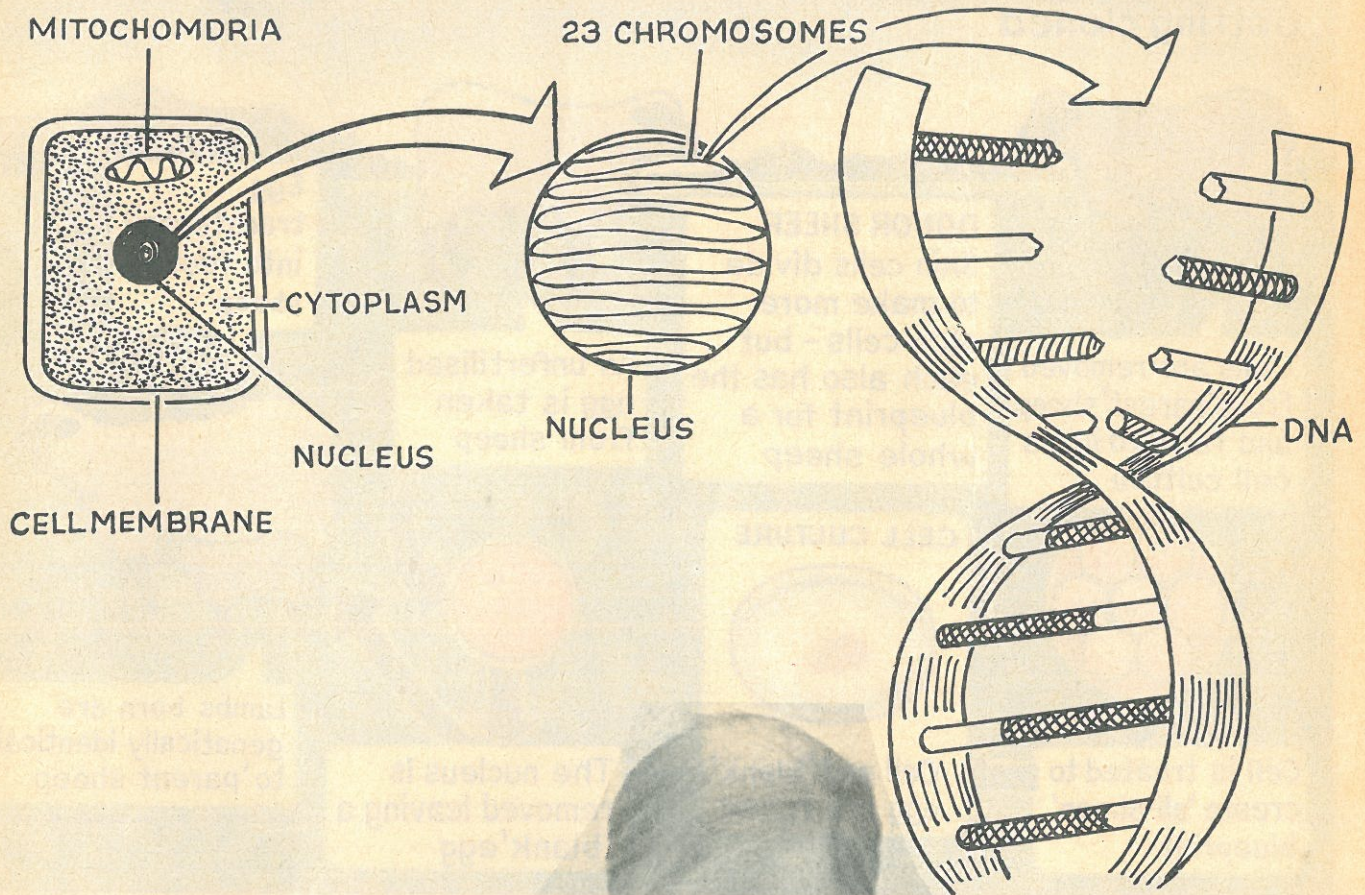
study the creator's work even to the smallest details. With an increased knowledge of the principles of life, man is now all set to make any number of carbon copies of his own species through cloning.

Clone is a group of organisms with the same genetic constitution as another, derived by asexual reproduction. Cloning in simple terms is the replication of an organism with similar genetic characteristics.

What is Cloning? Dictionary describes Clone as a group of organisms of same genetic constitution as another, derived by asexual reproduction. Cloning in simple terms is the replication of an organism with similar genetic characteristics. That means the information contained in the DNA of an organism is replicated in another. The first successful experiment of cloning in an animal was carried out in England recently. Dolly, the sheep was cloned recently at the Roslin Institute, Edinburgh, Scotland, bearing the same genetic characteristics as her sister.

What is so great about Animal Cloning?

All life forms which reproduce by asexual methods produce clones (young ones



with the same genetic characteristics). Unicellular organisms like amoeba, paramoecium and yeasts all reproduce by the same method. Some of the plants like mango and rose also display this kind of reproduction. A twig or a small part of these plants can be made to grow into full plants.

When many organic forms produce clones, why is it that animal cloning is seen as a marvellous achievement? Cloning so far had only been restricted to life forms which reproduced asexually. But Dolly is the first clone of a living being which reproduces by sexual means and in that a mammal too. It was thought that cloning an animal was totally impossible all these days. But the improbable and the unimaginable has happened.



Before we understand the Cloning technique, it is important for us to understand the basic building blocks of any organism.

Building Blocks

All organisms are made up of cells. The number of cells varies from a lower organism to a higher organism. While an Amoeba is made of only a single cell (hence the name unicellular organism), man's body is made up of millions of cells. Whatever be the number of cells in an organism, they all carry the same basic information for the growth of that entity. A better understanding of a cell structure (human cell) will make things clear.

A cell is made up of essentially a cell membrane, cytoplasm, mitochondria and a nucleus. Here nucleus is of prime importance to us. The nucleus of a cell contains chromosomes which are thread like elements in the nucleus which contain the genetic code of the individual. The number of chromosomes vary in different species. If it is 46 chromosomes in human cell, it is 54 in the sheep. A species preserves its characteristics by maintaining the right number of chromosomes and passing on this number to its next generation.

The human cell has 46 chromosomes in 23 pairs. It is the chromosome which determines the characteristics of a living being. The discovery of DNA (Deoxyribose Nucleic Acid) - a protein in the nucleus by Crick and Watson in 1953 provided the ultimate truth about the characteristics of living organisms. These scientists showed that DNA contains four basic proteins namely Adenine, Guanine, Cytosine and Thiamine which are programmed in different combinations in different individuals. Now we know that all cells

in a particular individual have the same DNA structure and this is unique for that creature.

All the cells in human beings are divided into 3 types - somatic cells or body cells which make our whole body, including the skeleton, bones and cartilages, sex cells or gametes which help in reproduction and are of two types - sperms in males and ova in females, and dead cells - which form a thin layer on our skin.

All the cells carry 46 chromosomes in the nucleus and this state is called

Dolly The Cloned Sheep

Dolly, a sheep cloned with the DNA taken from the udder of a six year old adult animal, is the latest in a number of genetic experiments carried out by Edinburgh's Roslin Institute and PPL Therapeutics.

Last year the two organisations embryonically cloned Megan and Morag, two lambs which are now pregnant while a transgenic cow called Rosie produces human milk protein which could be used to feed premature infants whose mothers cannot breastfeed.

The ten year project is being undertaken to get medical products to patients much more quickly. By using cloned animals the research period will be cut by two years. PPL are developing treatments for haemophiliacs and studying the ageing process. In 1987, the Institute reprogrammed a sheep to deliver alpha-1-antitrypsin in her milk. This hitherto unobtainable protein is now undergoing trials to help cystic fibrosis sufferers.

The Roslin scientists research work has attracted a great deal of publicity amid fears that the genetic manipulation of animal cells and tissue could lead to scientific experiments with human cells which is forbidden by British law.

Dolly was named after country and Western singer Dolly Parton because the cells used in the experiment had been taken from mammary tissue and transferred to an egg which had its nucleus removed. Out of 277 embryos produced only 29 developed successfully which ultimately resulted in one lamb, Dolly, being born. One question scientists are waiting to find out is whether Dolly is six years old (reflecting the age of the original cell) or newly-born. Until this experiment, the Roslin scientists had only used embryonic cells in their cloning work. Future experiments will shortly be carried out on pigs and cows.

UK agriculture minister Tony Baldry said the work had been done to make selective breeding more rapid, efficient and cost effective. UK law prevents any similar work with humans.

diploid state.

Cell Life

A typical sex cell undergoes two types of cell division - meiosis followed by mitosis. In the meiosis type of cell division a cell divides into two daughter cells in a haploid manner - i.e., resulting in the half of the original. Here the 46 chromosomes of a gamete gets divided into 23 chromosomes each for the two daughter cells, resulting in haploid division. After meiosis is over, which takes place in both male and female sex cells, two haploid gametes from either

parents fuse together - each carrying only 23 chromosomes. This fused cell - the zygote will have the complete set of 46 chromosomes, since a set of 23 chromosomes are provided by both the parents, also attributing to the genes from both mother and father. This zygote then undergoes mitosis which results in diploid cell division. Mitosis is nothing but simple cell multiplication. Here the parent cell (in this case the zygote) undergoes mitosis (cell division) resulting in 4 diploid daughter cells, i.e., each having 46 chromosomes.

In the case of a somatic cell (a body cell), meiosis does not take place. They go through plain cell division (mitosis) each time resulting in diploid daughter cells. Hence a somatic cell only divides and further divides continuously.

In Dolly's case a somatic cell was extracted from the father and a gamete from the mother. No meiosis could take place. Hence the mitosis or the cell multiplication of the only gamete taken - from her mother, is the reason for her being the clone of her mother's. Whereas in the case of test tube babies, both the type of cell division is carried out but in artificial medium with fertilization taking place externally.

Test Tube Baby

Test Tube' technique has ensured that a fusion of sperm and the egg cells can take place even in external environment other than the female body.

The sperms from a male and ovum from a female are extracted and are allowed to fuse together in an artificial environment which closely simulates that of a human body. Once the two cells fuse and a zygote is formed, it is cultured in special test tubes under controlled conditions to grow into an embryo. When the embryo has grown to an extent that it can continue further by attaching

Cloning Numbers

At the Roslin Institute in Edinburgh, Scotland, scientists who cloned the sheep had 277 udder cells from a pregnant ewe and an equal number of fused eggs. Only 29 fused eggs of these had developed into embryos. When they transferred these embryos to a surrogate sheep only 13 became pregnant. Out of those 13, only one completed the gestation period and delivered a live lamb which was named Dolly.

itself to the uterus of a mother, the embryo is transferred onto the mother's womb from where the growth of the embryo takes place in the usual procedure. Even this is considered to be a sexual reproduction though not in the traditional sense.

Cloning

The marvel of cloning Dolly lies in the development of a complete young one with just a somatic cell (Somatic - A body cell). Cells from the body of a male sheep were extracted and cultured to produce healthy cells. At the same time an ovum from the udder of a female sheep was extracted and was denucleated i.e., the nucleus was removed. The nucleus from the cultured somatic cell was then transferred on to the ovum devoid of nucleus using an electrical impulse.

Upto 277 cells were fused with an equal number of ova. But in Roslin Institute, Edinburgh, only one of them went on to develop into a young one in the form of Dolly.

The fused ovum (zygote) was transferred in to a surrogate mother where the embryo developed into a sheep which was an exact replica of the parent

sheep.

The Difference

But what is the difference between a test tube baby and cloned baby since both these procedures involve fusion of two cells externally and growth in the womb of a mother?

In fact the two of them cannot be compared at all. Test tube technique is nothing out of the way. A test tube baby is born out of sexual reproduction method with the male and female gametes fusing together, only difference from the conventional method being that the fertilization takes place externally outside the mother's body.

The baby thus born will have the genetic characteristics of both parents and the DNA of the child will be a combination of the DNA characteristics of father and mother.

In case of cloning, the reproduction technique is totally different. Cloning produces a baby out of asexual reproduction. Instead of male and female gametes (reproductive cells) fusing together, here any somatic cell is extracted from the body of a fully grown animal and used for reproduction. The total number of chromosomes in pairs from one parent will be fused with an egg cell devoid of nucleus - in effect devoid of genetic information, to form a fertilised egg.

One may wonder as to why an ovum is required and not any other cell could be used for fusion and subsequent growth of an embryo. The answer is simple. To form an embryo the environment of an ovum - like cytoplasm is required. Only then the single cell can get the nourishment to grow further.

The next question which will crop up is why should cloning be adopted to produce young ones when the sexual

method of reproduction itself is causing a near population explosion.

Cloning may not be used to produce young ones. It could be used in future to make selective breeding of superior race of living beings.

A cloned young one will have the same genetic characteristics of a single parent. What that means is - the young one will have the same features of the parent. In case of a cloned human (if it can be done!), the new born clone will have the same genetic characteristics as the parent - like finger prints, iris and hair colour.

With the first mammal cloned, there is wide spread discussion on whether a human could be cloned. Opposition to such an eventuality has already been expressed from all corners of the world. People fear that cloning a human would amount to playing God. "Dolly, the lamb is not just an answer, she is a big question. In fact, she raises, questions about more ambitious clones of humans. Scientists in Britain say this would be pointless and unethical and illegal, but that is not reassuring; pointless unethical and illegal things happen every day" says Tim Radford in the Guardian.

The natural phenomenon of sexual reproduction and life cycle could be altered by such a thing. This may lead to baby producing factories with specifications from parents. Parents need not weep at the death of a young child now. It could be brought back to life by saving the DNA of the baby for further use. Also the most intelligent, most handsome and most beautiful people could relive again. There will be no meaning to life and death in that case - scientists argue.

Human cloning may not have direct advantages. But it will certainly unravel some of the mysteries of human

existence. For instance the human ageing patterns and life after death could be determined. Also it will facilitate our medical experts to understand more about deadly diseases like cancer and AIDS. Cloning could also provide solutions to the growing problem of men losing virility, since babies are born without reproductive cells taking part in the process.

Though cloning can produce genetically identical living beings there is no evidence to prove that the way a

Now the gene of a person who wants an organ could be inserted into the cell of a pig. This way scientists would develop the organs and the same can be harvested for transplantation in that person.

parent thinks could be replicated in the clone. As Ms. Savita, a Ph.D student in the Physics department working in IISc on genetic engineering, puts it "The brain could be replicated but not the way the brain thinks". Further research will concentrate on such issues. So if a Bill Gates or a Stephen Hawkings is cloned by some means, there is no guarantee that the clone could be as intelligent as these two.

But on the other hand animal cloning could be advantageous in more than one way. Researchers in Scotland (in Roslin Institute) have grown gene altered sheep that produce human blood substances.

Tracy, a sheep engineered genetically is able to produce 30 gms. of alpha-1 antitrypsin (AAT), a protein approved as a replacement therapy with genetic deficiency, per litre. In her first lactation, she produced a kilogram of the protein worth \$10,000. Now, using Wilmut's cloning technique it would be possible to mass produce copies of Tracy rather than wait for off-springs. Similarly scientists in Australia are trying to create sheep that produce more and better wool. Also animals could be genetically engineered providing vital organs for transplant in humans.

Today, there is an acute shortage of organs. The solution could be to insert the gene of a person who wants an organ into the cell of a pig. This way scientists can develop the organs and the same can be harvested for transplantation. Since the organ 'grows up' with a human genetic blueprint, the human body can not reject it.

"Now if a farmer knows that an animal performs well, he can clone it or make copies. In the earlier method, all the progenies would not be necessary to perform as well as the original animal". Another area of interest is protecting endangered animals. Such animals can be cloned and the genetic diversity of nature maintained.

Cloning is definitely a major breakthrough in the history of medical science. This incident has once again raked up the debate on whether science is useful or harmful to humanity. Whatever be the case, man has proceeded far too ahead in his quest of understanding his surroundings. In fact, for man, science is not just an understanding but a tool to create unimaginable things. Time is not too far before man could outbeat science fiction and create anything he imagines.