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RESEARCH REPORT A
COMMITTEE : COMMISSION ON SCIENCE AND TECHNOLOGY
ISSUE : SCIENTIFIC TOPIC – PREVENTING CLONING IN ALL ITS FORMS FROM BECOMING THE NEXT ILLEGAL BLACK MARKET
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INTRODUCTION

In 2016, British scientists released an alarming report warning governments that cloning was probably to become the next illegal black market. Cloning has been used for centuries in agriculture but the ethical and more complicated technical questions surrounding this method only started to arise a few decades ago when it was first used on living organisms such as bacterias or animals. Soon after these scientific revolutions, researchers raised the possibility of cloning a human being, Politicians started to worry about the consequences such an act would have. Most countries have therefore banned reproductive human cloning but some allow research on embryos. In the past few years, the possible uses of cloning have been multiplied but the regulations could incite potential customers to ask for the services of illegal trade organisations without considerin the more questionable aspects of cloning. With the increasing knowledge of cloning, the production of clones has become a possible high profit activity. Many books and films have represented the dangers of human cloning and most of the public opinion seem to consider this possibility as frightening. It has become a necessity for countries to control the cloning industry and set definite laws regarding this practice in order to avoid the growth of an important black market of cloning. *(We will have a little reminder of the basics definitions and information about cloning then we will overlook its different problems and the possible solutions.)*

KEY TERMS

Clone: a) the aggregate of genetically identical cells or organisms asexually produced by a single progenitor cell or organism

b) in biology, a clone is defined as an organism having identical or nearly identical genetic material. Therefore, clones are not only the organisms obtained in the laboratory as a result of complex procedures, but also organisms created in the process of vegetative reproduction, such as bacteria, unicellular organisms, offshoots and plantlets.

Cloning: the production of a population of genetically identical cells or of organisms asexually produced by a single cell or organism.

How is it done? You need to collect an egg cell from a donor . Then you need to carefully remove the nucleus from the cell and collect another cell from the skin, udder or other tissue from another male or female donor of the same species . This is the animal/organism that will be cloned. From this cell, you also need to remove the cell nucleus and place it in the empty egg. The egg obtained in such a way needs to be treated with a gentle electric shock. The egg should begin to divide and grow into a multicellular embryo. At this stage, the embryo needs to be implanted into the uterus of a surrogate mother. If the pregnancy develops normally and the animal is born – we have a clone!

Black market: illicit trade in goods or commodities in violation of official regulations; *also* : a place where such trade is carried on

MAIN ACTORS

World Health Organization: a specialized agency of the United Nations that is concerned with international public health, the WHO has shown its worries about cloning and published a list of recommendations concerning cloning *(see bibliography at the end)*

U.S Food and Drug administration: is a federal agency of the United States Department of Health and Human services, it is responsible for protecting and promoting public health in the country. However its reports are carefully red by global organisations and officials from all countries. The FDA started to be interested in cloning since 2001 when it became apparent that animal cloning may be the new commercial venture to improve herds. The agency has conducted an intensive evaluation of the safety of food produced from cloned livestock, and concluded that milk and meat from goats, cows , pigs clones are perfectly safe.

TIMELINE OF EVENTS

5000 B.C : Humans discover that they can improve corn crops by planting seeds from the best plants

1902: Hans Spemann divides a salamander embryo in two and shows early embryo cells retain all the genetic information necessary to create a new organism. This experiment is the first artificial inducement of the natural cloning that produces identical twins, triplets, and so on.

1903: Herbert Webber (U.S. Dept. of Agriculture) is the first to use the word clon—which eventually becomes clone—to refer to “any group of cells or organisms produced asexually from a single sexually produced ancestor.”

1958 : German scientist Hans Spemann proposes a "fantastical experiment" to transfer one cell's nucleus into an egg without a nucleus, the basic method that would eventually be used in cloning.

1978: The release of David Rorvik's book, In His Image: The Cloning of a Man, sparks a worldwide debate on cloning ethics.

1980: U.S. Supreme Court rules that live, human-made organisms are patentable material.

1984: Steen Willadsen, a Danish scientist, reports he has made a genetic copy of a lamb from early sheep embryo cells, a process now called twinning. This is the first verified cloning of a mammal via nuclear transfer. Other scientists will eventually use his method to twin cattle, pigs, goats, rabbits, and rhesus monkeys.

1996: Dolly, a sheep, the first animal cloned from adult cells, is born (not announced until 1997).

1997: - Only a week after the Dolly announcement, scientists bring cloning technology closer to humans by twinning rhesus monkeys from embryos. The first cloned cow is produced from a fetal cell.

- Researchers at the University of Hawaii produce first mouse cloned from an adult cell.
- President Bill Clinton proposes a five-year moratorium on human cloning. Scientists and ethicists testifying at a Senate hearing on cloning urge Congress not to rush to ban research on the cloning of human beings. President Clinton signs a five-year moratorium on the use of federal funds for human cloning research. His National Bioethics Advisory Commission had concluded that human cloning would be unsafe and unethical.
1997 Richard Seed, a successful fertility researcher, announces his plans to clone a human.

2000: - Britain becomes the first country to grant a patent for cloned early-stage human embryos. Geron Corporation, which received the patent, says it has no intention of creating cloned humans.
- The group that created Dolly the sheep announces the first cloned pigs. Scientists hope that pigs could be genetically engineered for use in human organ transplants. 3)Genetics Savings & Clone is founded to produce clones of domestic pets.

2001: The first human clone embryo is produced; it is planned for embryonic stem cell harvesting, not reproductive cloning. However, it stops dividing before stem cells can be harvested.

2004: The first commercially-produced pet clone, a domestic cat named Little Nicky, is delivered to his owner.

2008: The Human Fertilisation and Embryology Act 2008 is voted by the Parliament of the United Kindgom allows scientists to study the effects of therapeutic cloning but also ensures that all human embryos outside the body—whatever the process used in their creation—are subject to regulation

2009: - the first animal from an extinct species cloned: Pyrenean ibex. The animal lived seven minutes. It died of lung malformation and a camel female cloned (Injaz); Injaz was created from ovarian cells of a female killed for meat in 2005. The camel cloning programme in Saudi Arabia enjoys special care of the government.

2016: Dr Charles Foster a research associate at Oxford predicts a black market of therapeutic cloning will emerge.

Scientists in China have recently announced that they will open a mass-cloning factory by the end of the year, where they will be producing livestock, and hope to be mass-producing one million cows every 12 months by 2020 for human use.

MAJOR COUNTRIES INVOLVED

USA : no federal laws regarding human cloning, authorizes cloning of livestock for breeding and researches purposes.

France, Germany , Switzerland : banned the creation of cloned human embryos for therapeutic and reproductive purposes.

England, Sweden, Singapore, China, Israël : allow cloning for researches but prohibit it for reproduction.

South Korea: authorizes animal cloning (Sooam Company clones your dogs)
DPRK: an imprevisible government which could have a controversial attitude towards cloning.

BACKGROUND INFORMATIONS

- Therapeutic and reproductive cloning: the differences

In most people's minds, cloning is about multiplying the same animal in an infinity of perfect replicas, however cloning is a more complex process that does not only apply to sheep. As we shall see there are many ways in which it has been used and many more potential applications. What cloning has come to mean to most people is to produce a baby animal that will become an exact duplicate of a single adult animal. That process is called "reproductive cloning."

But another major meaning of cloning, though more unknown is the creation of an embryo -- from the genetic material of a single organism -- that will never be allowed to develop beyond a clump of cells, and will never be implanted into a woman. This is considered "non-reproductive" or "therapeutic" cloning.

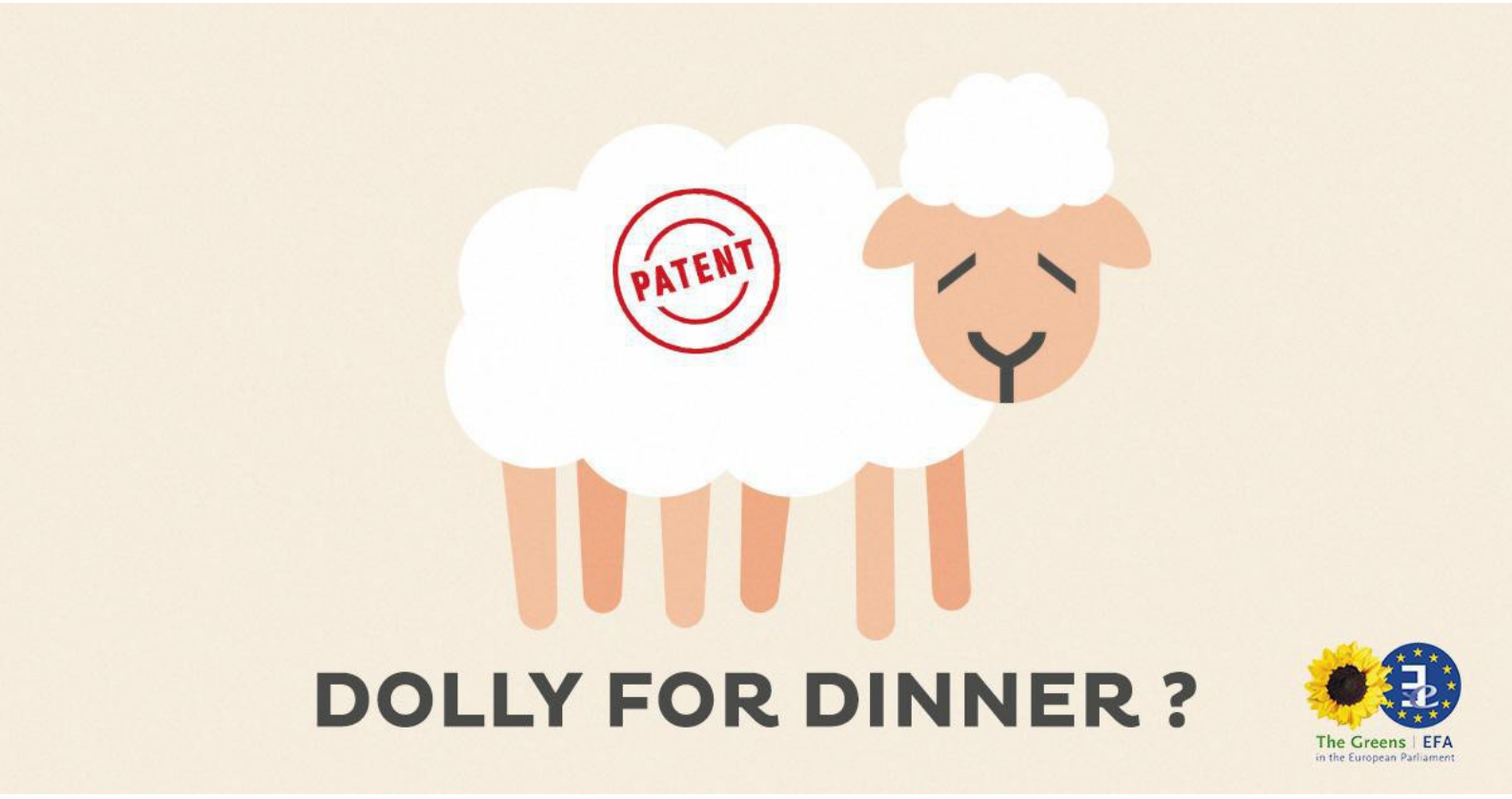
Some scientists chose to concentrate on cloning specific genes which is different to cloning an organism. When scientists clone a gene, they isolate and make exact copies of just one of an organism's genes. Cloning a gene usually involves copying the DNA sequence of that gene into a smaller, more easily manipulated piece of DNA, such as a plasmid. This process makes it easier to study the function of the individual gene in the laboratory. Nowadays,more and more researchers are cloning, or identifying, genes that are responsible for various medical conditions or traits. Cloning could be a plausible way to find cures to genetic diseases. Therapeutic cloning holds the most promise of valuable medical advancement. Scientists use the process by which a person's DNA is used to grow an embryonic clone. However, instead of inserting this embryo into a surrogate mother, its cells are used to grow stem cells. These stem cells could become the basis for customized human repair kits. They can grow replacement organs, such as hearts, livers and skin. They can also be used to grow neurons to cure those who suffer from Alzheimer's, Parkinson's or Rett syndrome. And since the stem cells would come from embryo clones using your own cell's DNA, your body would readily accept them.

Public opinion supports unanimously the ban on reproductive cloning. On the other hand, opposition to cloning that would produce an embryo but not a baby is not as vehement, maybe because not everyone knows about and understands therapeutic cloning. Scientists want to make and study cloned embryos because they hold great promise for understanding and ultimately treating disease. "Therapeutic cloning" is also sometimes called « research cloning » and a lot of scientists are cautious about this name because it tends to be linked with the caricatural « mad geneticist » image which was spread through popular culture.

- Various uses of cloning

Cloning can be used in many other ways apart from healing genetic diseases or research purposes. It has been used in agriculture for centuries to improve the productivity of exploitations, but cloned cattles are far more recent and still in a relatively small number (barely a few thousands in 2009 in the US and on a worldwide scale about 6000). According to genomics company owners, it costs at least 15 000 $ to clone a cow and 4 000 $ for a sow. Companies in the USA and in China are cloning livestock for breeding and research purposes . US Food and Drug administration considers meat from clones as safe as the

one from traditional animals. However, consumer acceptance of cloning as a viable mean to produce human food is still the top hurdle for companies. The Food Standard Agency of UK revealed in 2010 that some meat produced from a cloned beef entered illegally the food chain also an American farmer was suspected of illegally selling milk from the offspring of a cloned cow. People and anti-cloning associations were shocked to learn these products were able to circulate in countries in which they were prohibited . In 2015, the European Parliament voted to ban the cloning of all farm animals as well as the sale of cloned livestock, their offspring and products derived from them even though there is no evidence that eating milk or meat from a cloned animal is dangerous for health. Farmers can still import semen and embryos from cloned animals. In China, companies are planning to build the biggest cloning factory with a planned investment of 200 million yuans where dogs, cows and horses are to be replicated from 2020. Depending on the decisions of countries, cloning might be a the future of farming, maybe our future standard farming will be based on cloned livestock?



One of the most recent controversies around cloning is dog cloning. Since 2006 a biotech lab from South Korea, Sooam, offers to clone your deceased dog for the meagre sum of 100

000 dollars. Clients are mostly wealthy people from developed countries for whom their four-legged companion was priceless. The founder of Sooam is a very controversial scientist , Woo Su Hwang who was previously charged for having attempted to do research on human embryos. Despite the shady history of Hwang, Sooam is pretty successful, according to sales representatives the firm usually has around 15 clients a month and since the creation of the lab more than 400 dogs have been cloned. Sooam uses the same old technique employed to create Dolly in 1996 -nuclear transfer. The firm is planning to offer a wider range of possibilities and recently signed up with a Russian scientists for an attempt to clone a mammoth.

The possibility of reviving a mammoth might be closer than ever and this brings us to another way cloning is to be used. Cloning is now considered as a viable tool to revive extinct species, however in the mammoth case some obstacles remain, as no good samples of DNA have been found. Some other experiments were more successful, because the animal disappeared more recently; in 2013, a team of French and Spanish scientists created the first extinct animal clone ever. The team cloned a bucardo, (subspecies of

Spanish Ibex) that went extinct in 2000, using frozen skin, but the newborn cloned only survived a few minutes. Still the experiment is considered a great success and the first step towards the resurrection of extinct species. For a lot of scientists the method should be extended to endangered species in order to insure the perpetuation of the most threatened animals. Who knows, Jurassic Park may exist in a few centuries thanks to cloning if countries do not pass laws to control animal cloning. One of the most recent controversies around cloning is dog cloning. Since 2006 a biotech lab from South Korea, Sooam, offers to clone your deceased dog for the meagre sum of 100 000 dollars. Clients are mostly wealthy people from developed countries for whom their four-legged companion was priceless. The founder of Sooam is a very controversial scientist , Woo Su Hwang who was previously charged for having attempted to do research on human embryos. Despite the shady history of Hwang, Sooam is pretty successful, according to sales representatives the firm usually has around 15 clients a month and since the

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PROBLEMS RAISED

Since human cloning seemed to fall more into the realm of science fiction than science fact, ethicists largely ignored the topic prior to the late 1990s. Then, in 1997 -- faced with Dolly the cloned sheep - President Clinton asked his National Bioethics Advisory Commission (NBAC) to write a report on cloning. The report concluded that no one knew whether cloning to make a human baby was safe, and therefore human cloning should not be done. The panel feared that a baby might be born with severe birth defects (*cf: next paragraph*). There was also concern that the process was so inefficient it would take literally hundreds of eggs to get a single successful pregnancy.

Ethics and cloning

In 2002, President Bush's Council on Bioethics wrote a report arguing that reproductive cloning should be banned, but left the door open to allowing research/therapeutic cloning. The council seemed headed toward a recommendation to approve research cloning before last-minute politicking by cloning opponents blocked that move. Most governments across the world have also taken the position that cloning to create a human being should be banned. President Bush has expressed his opposition to any kind of human embryo cloning on numerous occasions.

Opponents of research/therapeutic cloning object on both a practical and an ethical basis. Practical objections include the theoretical impossibility of ensuring that a clone created for research purposes will not subsequently "get away" and be implanted into a woman to grow into a human baby. Those who cite ethical objections recoil at the idea that a potential life is being created solely for the purpose of supplying material for medicine or research. Cloning also goes against the beliefs of most religions, and to most people, human cloning is madness because it would mean that humans can create humans thus taking in a way God’s place.

And what about the clone as an individual? Is it reasonable to expect he or she will be treated as simply another child? There's also the concern that clones would spend their lives burdened by the knowledge that they're not an original, that they're just a copy of someone else's genetic makeup. Others would argue that a clone is more than the sum of its genes; that experiences, starting in the womb and building throughout life, would shape what kind of person a clone grows into. For instance, identical twins have identical genes, and while they may be similar, they are distinct human beings. A clone created for scientific research still remains a human being which means that ethical rules apply also to him. As for arguments that cloning will create difficult family relationships, over the few past decades the structure of the « classic family » has been deeply modified (gay marriage, AI, surrogacy..etc)

On a broader level, there are concerns that cloning would become the symbol of social inequalities, with only the wealthy able to afford the procedure. There's also the shadow of eugenics which recalls the most horrible totalitarian regimes: Cloning might be used to select -- or reject -- certain traits, depending on a society's preferences. In India and China, abortions have been used for decades to select against daughters, to the point

where census reports have found women are in short supply in some communities and cloning could be used to multiply the chances of having a male descendent.

Technical difficulties and cloning

Animal cloning allowed scientists to discover many “technical “ problems of cloning. Even though cloning is one of the most promising scientific method for the preservation of rare species, many researchers say that creating healthy animals through cloning is difficult. They have pointed out the high embryo mortality during the gestation, extended gestation length and increased neonatal mortality, also it was observed that some cloned calves were abnormally huge at birth. This explain why cloning beings is so rare and complicated, for instance, there were 277 failed attempts before Dolly the sheep was born. The surviving clones often have problems severe enough: lungs malformation, heart defects and developmental delays, some cloned mice who first appeared healthy grew up as a young adult to be grotesquely fat. Anomalies in cloning are very random and uncontrollable because the process is too quick, but a slight alteration of the clone’s DNA may lead to heavy consequences on its health which could be fatal soon after birth or lead to major medical problems later on. According to researchers, the actual cloning techniques aren’t sure enough to even think about human cloning. While the debate over human cloning was always dominated by ethical arguments, many are now saying the real issue is the clones potential genetic abnormalities that could either be fatal or subtle. Until that the problem is solved, human cloning is out of question.

However the temptation of human cloning remains and scientists are deeply worried about it. Clonaid a company affiliated to the Raelian sect is highly interested in human cloning as they believe it is a mission given to humans by extraterrestrials. In 2002 they claimed to have cloned a baby girl Eve but never gave further proof. Talking about madmen, some rich megalomaniacs might be tempted to pay for their own clone as a way to defy death and remain eternal. Other cases could be more complicated, with for instance desperate patients who would turn to illegal therapeutic cloning market as a last resort, to obtain new organs or healthy genes. The cloning blackmarket could create their clones and grow the needed organs on the clones. Creating clones to harvest their organs means killing a human to save another one, for instance in the case of a heart transplant. The film “The Island (2005) by Michael Bay revolves around this question which is a

recurring sub-theme of cloning fiction.

Recent advances in technology lowered the price and made cloning more “affordable” therefore it could interest more possible customers. Still the majority of those who will be able to enjoy its benefits would be wealthy old American men. Cloning fever is likely to spread around the globe according to scientists who believe that the financial benefits will outweigh the ethics, some estimations says that the cost of a human clone would vary between $500,000 and $2 millions.

SOLUTIONS AND FORESEEN FUTURE

With the quick increase of cloning technology, countries have barely started to realise the potential of this practice and have not yet taken measures to control the uses of cloning. We have seen in this report the many ways cloning can be used and the problems it has started to raise. In a time of never ending scientific advancements, most countries are not paying enough attention to the dangers of cloning and do not seem to be alarmed by the lack of regulations around certain forms of cloning. Cloning has created new possibilities and some companies have chosen to specialize in it : cloning your deceased dog or eating meat from a cloned beef could become common in a few decades. However awareness has spread in a certain range of public opinion, because of the media, films and recent polemics around the commercialisation of cloned livestock . Ecologists in developed countries have started to militate for a better control of cloning. Some scientists warned global leaders that a too restrictive policy on cloning could lead to the creation of a black market where diverse cloning services could be offered: from the exchange of genes to heal from rare diseases, to the creation of your own clones. Scientists estimate the cost of a human clone from 500 000 dollars to 2 millions, we can understand why the opportunity of a black market might be so tempting, and many greedy people will not hesitate to overlook the ethical problems raised by cloning to try and make the most profit out of it.

Here are some ideas to create solutions in order to avoid the creation of a cloning blackmarket:

- Countries need to control and regulate the diffusion of cloning to avoid a risk of

unethical abuse of the technology

- Countries need to pass specific laws on therapeutic cloning and harmonize the guidelines on genetics research according to laws existing in MEDCs
- Creation of a specialized agency to monitor cloning issues
- Countries need to decide whether or not cloned products (livestock and derived products) should be commercialized
- Countries should question themselves on who should finance and control cloning (private firms, entreprises ..etc)
- Countries should question the already existing uses of cloning and debate on the ethical aspect of cloning, the question of human cloning needs to be controlled the most strictly

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