

Testimony of  
**Dr. Paul Berg**

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Mr. Chairman, Members of the Committee, thank you for inviting me to testify on this most important issue. I have followed the debate on the cloning questions we will address today and I welcome the opportunity to submit my own views on the matter.

For the record, I am Paul Berg, Robert and Vivian Cahill Professor of Cancer Research and Biochemistry, Emeritus, and Director, Emeritus, of the Beckman Center for Molecular and Genetic Medicine at Stanford University. I am also Chairman of the American Society of Cell Biology Public Policy Committee. For my work in developing recombinant DNA technology, I received the Nobel Prize in Chemistry in 1980.

The term 'cloning', before it was tainted by attributing nefarious purposes to it, is a legitimate scientific term to describe the preparation of an 'infinite' number of copies of, for example, a single molecule, a cell, a virus or a bacterium. Indeed, cloning is at the core of some of the most important recent advances in biomedical research. For example, cloning DNA molecules was essential for revealing the human genome sequence. Similarly, cloned DNA is critical to the fight against bioterrorism because it has already been used in the determination of the entire genome sequences of several organisms identified as bioweapons. Furthermore, cloning is integral to modern forensic procedures, medical diagnostics, vaccine development, and the discovery and production of many of the most promising drugs. In short, cloning is not a dirty word! We must not allow the term to be high jacked to frighten the public and to cloud the issues that confront us.

The congressional and public debate about cloning people is, I believe, a non-issue. Very few, if any, reputable biomedical scientists condone attempts to produce a cloned human being. The distinguished National Academy of Sciences panel that considered this issue concluded that it is dangerous and likely to fail; in short, the risks to the mother and any fetus that would result from the procedure are unacceptable. If for no other reason than this, your bill (S.303) and Senator Brownback's bill (S.245) are in agreement in mandating a legally enforceable ban on reproductive cloning.

But in contrast to Senator Brownback's proposed legislation, your bill takes a more enlightened position in permitting the somatic cell nuclear transplant procedure for research and therapeutic purposes. This research is supported by overwhelming scientific opinion because the technology may enable us to develop new forms of therapies for some of the most debilitating diseases and crippling disabilities. Presently, there are only proofs of principle behind this optimism, but these strongly suggest that if scientists are permitted to explore these opportunities, their benefits can be achieved. Research and demonstrations of clinical efficacy are the only means for validating whether stem cell-mediated therapies will materialize. We are ethically and morally obliged to pursue them for the benefit of those who suffer.

What is it that is being so vehemently opposed? Transplanting a body's cells nucleus into an unfertilized egg ultimately yields a hardly visible ball of cells from which embryonic stem cells can be recovered. These cells can be propagated in Petri dishes indefinitely, all the while retaining their capacity to be coaxed into forming all of the body's many cell types. The unique

value of nuclear transplantation technology is that the embryonic stem cells and the differentiated cells and tissues they yield have the same genetic makeup as the individual that donated the nucleus. Consequently, they can be used to repair or replace damaged or diseased tissues without invoking the immune rejection that would occur with unmatched cells. Thus, a person's own DNA is used to create compatible cells for the treatment of, for example, that individual's cancer, diabetes, spinal cord injury or Parkinson's disease.

A particularly promising opportunity that is also foreclosed by the Brownback bill is the preparation of stem cells using cell nuclei from individuals with inherited mutations; particularly, ones that predispose them to an increased probability for developing a variety of life-threatening and debilitating illnesses late in life. Examples include breast, colon, prostate and other cancers, as well as heart, neurological and autoimmune diseases. Such currently unavailable stem cell lines would provide a new way to explore how these life-threatening, late-onset diseases develop, and they could possibly generate clues to their prevention or cure. Such studies might help reveal the interrelations between inherited and environmental contributions that govern much of the balance between health and disease.

Both Congressman Weldon and Senator Brownback have accepted the assurances of their advisors that adult-derived tissue-specific stem cells, that is specialized stem cells that already exist in many of our tissues, are sufficient for meeting the clinical needs of repairing damaged or diseased tissue. Those assurances contradict the evidence. The claims on which those assurances rest are largely anecdotal, relying on experiments that most often have not been replicated by others and, in some cases, are now known to be flawed. Indeed, recent experiments have documented that claims that bone marrow can reconstitute tissues of other organs have been shown to be artifacts. Moreover, multi-potent adult-derived stem cells have with few exceptions not been maintained in culture for any significant period.

It is certainly true that bone marrow harbors rare stem cells, the so-called hematopoietic stem cells that can reconstitute the entire blood-forming system. Similar evidence exists that neural stem cells obtained from embryos can give rise to different neural cell types. But neural cells obtained by differentiation of cultured embryonic stem cells can populate the brain and deliver sufficient dopamine to alleviate the symptoms of Parkinson's Disease in the mouse.

Every scientific review of the therapeutic opportunities afforded by adult-derived and embryonic stem cells has concluded that embryonic stem cells are far more versatile for medical therapies. In a letter to Senator Specter last year, Dr. Catherine Verfaillie, whose research on adult stem cells has been cited by opponents to nuclear transplantation as reason to limit human embryonic stem cell research, said that, "It is far too early to say whether they [adult stem cells] will stack up when compared to embryonic stem cells in longevity and function... There are still too many unknowns for researchers or policymakers to begin closing doors to opportunities of learning." Most scientists working in these fields recommend strongly, as do I, that research with both adult and embryonic cells should proceed vigorously so as not to delay or forgo the benefits for patients as soon as possible. Choosing a single option could prove to be a great historical embarrassment, like when the Soviets bet on Lysenko's prejudices against genetics, losing out on improving their agricultural productivity and forsaking an entire generation of genetic science and scientists.

One justification for the criminalization of the nuclear transplantation procedure is to guard against rogue attempts to implant the product into a woman's uterus for the purpose of creating a cloned child. But like any socially deviant behavior, we can discourage it with appropriate punishments. We punish murder under criminal statutes but we fail to criminalize possession of

the weapons used for the crime! We should prohibit what we all agree is presently an objectionable practice but should not preclude the means for producing life-saving therapies. Nor should we be threatening to put people in prison for seeking cures for themselves or their children even if those therapies were developed elsewhere.

We take considerable pride in being a pluralistic society. So, there must be ample room for differences concerning the moral and ethical interpretations of early and intermediate stages of human development, especially where acknowledging these alternative legitimate views can mean the difference between life and death for many of our citizens.

Thank you for the opportunity to express my views.