Intellectual Property Owners (IPO)
1999 National Inventor of the Year

"Short version" (given at 6pm reception in the Canon House Office Bldg, June 30, 1999)

Thank you so much, Chairman Coble. I am honored to join this distinguished group of awardees.

Perhaps I should say no more, but you know when you give a professor such an audience, the professor will profess. I cannot resist the opportunity to give by a *very* brief sketch of what my invention is about:

In 1993, I saw Bryan. He became my first patient to receive a CD34+ stem cell transplant. He was 3 years old. Bryan had a lethal, soccer ball-sized cancer called neuroblastoma. The cancer had wrapped around the organs in Bryan's belly and spread to his bone marrow.

We needed to use massive, supra-lethal doses of chemotherapy to attack this aggressive, metastatic cancer. Since this would kill the bone marrow stem cells, we first harvested bone marrow cells from Bryan.

Then we used the invention: We specifically hooked Bryan's stem cells with my CD34 monoclonal antibody. Next we reeled in the stem cells with the prototype CD34 selection device (which looked nothing like the polished machine over there). We preserved the stem cells in the freezer. After his intensive chemotherapy, we gave Bryan back his purified stem cells, hopefully free of the cancer cells.

The purified CD34+ stem cells reconstituted Bryan's blood and immune system. Now 9 years old, Bryan is a straight-A 4th grade student and soccer star (You can see the poster of Bryan holding a soccer ball above his head). Incidentally, he likes science!

CD34+ stem cells are widely used in transplantation for a range of diseases, for research, and as the targets for gene therapy. Tools like CD34 make this an extraordinary time in science and medicine. With consistent public support, we stand to improve many aspects of our health. And along the way, we can develop new jobs, and opportunities for healthy people.

I want to recognize the wonderful people with whom I have the privilege to work:

- The scientific trainees in my lab who worked on this project (several are now distinguished scientists and physicians).
- The physicians and nurses who did the first human studies of our isolated stem cells.
- The patients and their families who dared to participate in the early clinical studies.
- The other scientists who worked in this area.
- The corporations who invested in our idea, making robust devices that could be used around the world.
- Mentors and many other vital supporters. Prominent among these is Dr. Martin Abeloff, Director of the Johns Hopkins Cancer Center, who is standing over there.
- *And finally, my family, especially my wife and sons who believed, and nurtured me.*

Intellectual Property Owners (IPO)
1999 National Inventor of the Year

"Long version" (given at 9am press conf, June 30, 1999)

I am tremendously pleased and *honored* to receive this Inventor of the Year award from the Intellectual Property Owners Association . It is indeed a great honor to join such an outstanding group of prior awardees. I want to extend my thanks to everyone who helped me.

What is this invention?

First, let me give you an illustration from my clinical experience:

In addition to being a scientist, I am an active pediatric oncologist caring for children with cancer. In 1993, I saw Bryan. He was 3 years old and had a lethal soccer-ball sized cancer called a neuroblastoma. The neuroblastoma had wrapped around the organs in Bryan's belly and spread to his bone marrow. Ordinary treatments could not cure Bryan's neuroblastoma. We needed to do something more for this child, and fortunately we had something to try — Bryan was my first patient to try the CD34 stem cell transplant. After the best surgery, radiation and ordinary chemotherapy to attack this aggressive, metastatic cancer, we added massive, supra-lethal doses of chemotherapy. Since this would kill the bone marrow stem cells, we harvested bone marrow cells from Bryan. We specifically hooked Bryan's stem cells with the CD34 antibody. Then we reeled in the stem cells with the prototype CD34 selection device, and preserved them in the freezer. After the intensive chemotherapy, we gave these purified stem cells, hopefully free of the tumor cells, back to Bryan intravenously. The CD34+ stem cells reconstituted Bryan's blood and immune system. Now 9 years old, Bryan is a straight A 4th grade student and soccer star (poster). Incidentally, he likes science.

Why are stem cells so important?:

Blood and immune "stem" cells are the primitive cells, like the queen bees which produce the infant progenitor cells which develop into all the mature blood and immune cells in our bodies.This poster shows how

the hierarchy of blood and immune cells develop from stem cells. In cancer patients like Bryan who require high dose radiation and chemotherapy treatments for resistant cancers, the stem cells are destroyed by these toxic treatments. If we can put healthy stem cells back into a patient's body after treatment, the stem cells will restore all of the patient's healthy blood and immune cell types.

In the early 1980s, the search for stem cells was an area of great interest. If these rare and elusive stem cells could be isolated, scientists would have the important component to revitalize the blood and immune system. And putting purified stem cells into scientists' hands would lead to a better understanding of their biology.

However, because these stem cells are so rare, it was difficult to isolate them. Only about 1% of human bone marrow cells are stem cells — so it is like finding the proverbial needle in a haystack. After years of research, we invented a way to find the needle.

Here's how it works:

The most important part of this invention is a monoclonal antibody. The antibody, called CD34, binds specifically to a certain substance we discovered on stem cells. In effect, CD34 weeds out 99% of cells in the bone marrow and flags the cells we need. It differentiates between the mature cells we don't want and the younger stem cells we need (poster).

Then, we developed a device and procedure to isolate the stem cells faster and in large quantities. By doing this, we converted the flag into a hook to reel in the big fish we wanted, the stem cells.

Here are some of the additional opportunities:

The ability to isolate CD34+ stem cells offers enormous opportunities for continuing research in stem cell biology. Other types of stem cells also exist in the body, those that form bone or brain cells, for example. Blood stem cells can teach us about different types of stem cells.

Back in the lab, we've recently discovered better ways to put genes into stem cells. We can put new genes into the DNA of stem cells to replace defective genes to help treat inherited diseases. We also hope to make the stem cells into better cancer fighting cells. In addition, we are learning how to make stem cells multiply in the test tube, so that we could grow vast amounts to supply like blood products. The prospects are exciting.

So from fighting cancer to treating diseases ranging from sickle cell anemia to rheumatoid arthritis, this Johns Hopkins-patented technology now can help thousands of people. In order to help children such as Bryan and others around the world, support for research from private organizations and government is critical. Industry can't do it all, and inventions cannot be discovered and translated to patients without public support.

These are extraordinary times in science and medicine. With the new tools now available, we have the potential to do much to help many people. With consistent public support, we stand to improve many aspects of our health. And along the way, we can develop new jobs and opportunities for healthy people. My goal is to make new inventions even better than this one, and the more of us doing this the merrier for our country and world.

I want to recognize the wonderful people with whom I have the privilege to work:

- scientific trainees in my lab who worked on this project (several are now distinguished scientists and physicians),
- physicians and nurses who led the way with the first human studies of our isolated stem cells,
- patients and their families who dared to participate in the early clinical studies,
- other scientists who worked in this area,
- corporations who invested in our idea, making robust devices that could be used around the world,
- many other vital supporters in my department, hospital, and university,
- and my family, especially my wife and sons who believed and

nurtured.