

**THE WORLD FOOD PRIZE
SUMMER INTERNSHIP
2000**

**INTERNATIONAL POTATO CENTER (CIP)
LIMA, PERU**

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My name is Anthony Todd, from Iowa City, IA. I graduated from City High School, and am currently attending Macalester College in St. Paul, MN. I attended the WFP Youth Institute in 1998, as a junior in high school.

1998 was one of the first times that the internship program had been available, and I listened in awe to the amazing stories that the returning students told us. The experience had changed their lives, and I wanted to have a similar revelation. So, after filling out all of the application material, and being interviewed by the WFP, I was informed that I would be spending the summer in Lima, Peru, working at the Centro Internacional de la Papa (International Potato Center, or CIP).

I was apprehensive about this trip for many reasons. I would have to survive, on my own, in a foreign country for 2 months. I didn't speak much of the language, and I knew next to nothing about the culture. On a more scientific note, I had almost no experience in botany, and certainly none in potatoes. To make matters worse, instead of being assigned to the bacteriology department (a field in which I have some experience), I was assigned to the virology department. So, I would have to learn a whole new science, in a different language.

The CIP was founded as a non-profit research institution devoted to promoting the potato as a viable agricultural product. Its location in Peru is very appropriate, because the great majority of the world root and tuber crops are native to the Andean region of South America. The CIP has projects spanning every discipline, including education, agriculture, genetic engineering, medicine and communications. It is member of the Cooperative Group for International Agricultural Research (CGIAR), which gives the people at CIP access to resources from all over the world.

When I arrived, the head of the Crop Protection/Virology dept, Dr. Luis Salazar, gave me a brief introduction to the center, and described the course my internship would take. I would be involved in all parts of the department, from the greenhouses to the labs. I would rotate from lab to lab, with a different mentor each time. The mentor would show me the basic duties of the lab or greenhouse, then turn me loose on a task.

My first day of work was in the greenhouse. Hugo Espinoza, the head of the main greenhouse, was assigned as my mentor. He spoke no English, and, at that point, I spoke very little Spanish, so our communication was somewhat limited. In spite of these difficulties, I probably learned more in that first week than during any other period.

Plant viruses are more difficult to culture than the bacteria I was used to working with. With a bacteria culture, you can use a wide variety of media, in any container, and the bacteria will grow. With a plant virus, however, you must inoculate living plants, and use the whole organism as a biological petri dish. But just like in bacteriology, in order to inoculate a growth medium with a specimen, the growth medium must be free of contaminants. CIP has several strains of “pure” or “indicator” plants growing in isolated greenhouses. These greenhouses are exceptionally clean, and absolutely free of virus. In addition to being free of virus, because of the limited number of species available, symptoms of common viruses are well known. This is an enormous help in research, allowing anomalous symptoms to be easily picked out from a large group of plants.

For my first week, I worked in the “pure” greenhouses filling orders that CIP personnel had placed for indicator plants. This was an incredibly useful experience, teaching my basic gardening and plant management, skills I would find very useful in the coming weeks. It also taught me the importance of cleanliness and aseptic technique.

The plants have to be constantly tended and monitored. Many of them are still not very “greenhouse friendly” and are very hard to propagate.

During my second week, I moved to the inoculation side of the greenhouse. Except in cases of insect or aphid transmission, plant viruses are not contagious in a traditional sense. The two most common ways to transmit viruses from plant to plant are manual inoculation and grafting, both of which are very labor-intensive. Manual inoculation involves grinding up leaves from the infected plant and painting the solution onto healthy leaves. This method is almost always effective, and is the most common at CIP. It is also very efficient, because 1 or 2 leaves from an infected plant can inoculate hundreds of healthy plants. The only major drawback is the local nature of the symptoms. In many cases, because the virus is administered externally, only the directly infected leaves show symptoms, and the rest of the plant remains healthy.

Grafting is the more direct method, but it is also much more difficult. It involves transplanting sprigs of infected leaves into healthy plants, by cutting slivers of each, and binding them together. Because of the size of many of the “receiver” plants, cutting them can be extremely difficult. But, because of the direct vein-to-vein contact, the virus is spread throughout the entire plant, providing a much more even distribution of symptoms.

In this environment, I met many members of the scientific staff. Unlike the pure greenhouse, the inoculation greenhouses did not provide services (except me), so all the project leaders had to come and work. This gave me an early exposure to many of the people I would be working with.

The inoculation greenhouse also maintained stocks of infected plants. These plants were kept in locked, isolated rooms and access was very restricted. Keeping these stocks was very labor intensive, because after the plant dies, it is no longer a viable sample for the virus. So every 2 weeks, all the plants have to be replaced with freshly inoculated specimens.

After I had tired of working in the greenhouse, I moved to the basement of the virology section, to the Serology lab. This lab, directed by Violeta Flores, is one of the busiest at CIP. It is mainly a service lab, but Ms. Flores has many projects of her own.

The Serology department is concerned with the detection of virus in infected tissue. They use many tests, but the most common is the DAS-ELIZA, the same test used to detect AIDS and many other viruses in humans. In an ELIZA, antibodies of various viruses are bonded to a test plate, and plant tissue to be tested is added. Then, after the addition of a coloring agent, the plate is read under a scanner and the strength and the purity of the color in the plate relates directly to the amount of virus in the sample.

It sounds simple, but in fact it is a very complicated, 2-3 day process with a very high chance of contamination. I only managed to do a perfect ELIZA on my last day at CIP. But, the Serology lab was a very good place to work. Many people spoke English, because 2 other international scientists were there, one from Iran and the other from China. It was a very social environment, and had the best facilities at CIP.

One of the major concerns of the Serology lab is the constant mutation of the viruses. The antibodies needed for DAS-ELIZA are very specific, very expensive, and very complicated to make. If a virus mutates at all, the antibodies will no longer be effective, so they have to spend most of their time trying to stay one step ahead of the

virus's mutation. They also possess one of the greatest genetic databases at CIP, with thousands of antibodies stored in the freezers.

I spent about 3 weeks in the serology lab, because I was learning so much and because of my good relationship with the director. But, eventually I had to move on. I went to work for Ida Bartolini in the Molecular Virology lab. The duties of the M.V. lab are very similar to that of the serology lab, but the techniques used are much more exact.

The department was undergoing a major change as I arrived. They used a method called Spot hybridization to detect viruses. During this procedure a radioactive plasmid is combined with the plant cells to be tested. The plasmid is designed to hybridize only with cells that contain viral DNA. After the hybridization is complete, the hybridization and the virus can be detected by using photographic film to capture the radiation from the plasmid.

But, there were problems. This method was very expensive, and required lots of government permits to acquire the nuclear material. It was also quite dangerous, and CIP personnel were beginning to get significant doses of radiation. So, a new method was being introduced, substituting a fluorescent plasmid for a radioactive one. The new method (Non-Radioactive Spot Hybridization) was not as accurate, but good results could still be achieved.

Ms. Bartolini was also working on techniques of PCR; both to perfect her own skill and propagate the viral DNA being studied. PCR, or Polymerase Chain Reaction, is one of the most basic techniques in genetics. It is used to force DNA to reproduce in large numbers. Since DNA is made up of only 4 bases, and these bases only come in specific pairs, it is possible to force the strand of DNA to split in half using a cutting

enzyme. Once that has been accomplished, stocks of the 4 bases are added to the machine, and the temperature is cycled very fast. The new bases bond to the correct spots on each half of the original strand, creating 2 strands. The 2 are broken apart, and the procedure is continued until the desired amount of DNA is reached.

While I was with Ida, I also learned about many of the programs CIP uses to support food security. Besides the virus detection and prevention activities, the virology department sends scientists all over the world, to teach farmers how to use the detection techniques, and how to farm safely. CIP works with other institutions all over the world, and works with samples from all over South America. They have contributed enormously to the security of root and tuber crops throughout the world.

I also had many interesting experiences outside of the lab, some of which influenced my outlook on culture and politics. I lived in Miraflores, one of the wealthier suburbs of Lima, so I didn't see very much poverty on a daily basis. However, several times during my stay, I took side trips to the center of Lima, which is completely different. I saw poverty like I had never seen before, and I felt incredible outrage. There are very few middle class people in Peru; almost everyone is incredibly poor, except for the lucky few in charge.

I also spent a weekend at Machu Picchu, a gigantic Incan city, situated in the mountains outside Cusco, Peru's second largest city. I flew into Cusco very early on a Thursday morning. It was an amazing site, to rise out of the mists covering Lima and land in Cusco, clear and sunny. But, as I had failed to anticipate, it was also freezing. Cusco is around 11000 ft above sea level, so the temperature changes from below freezing at night to high 90's in the afternoon.

I went to my hotel and had the obligatory cup of Coca tea, an old Inca remedy for altitude sickness. They make you rest for several hours after you arrive, which is a much more effective remedy, and I went up to my room and tried to sleep. In the afternoon, I was taken on a tour of some of the Inca ruins in and around the city. Almost every building near the central plaza is built on Incan foundations, which are seemingly indestructible. They are made of hand-cut stone blocks, all identically cut, and they have survived several hundred years of earthquakes, wars and wear and tear completely unmarked.

There are several Inca temples in Cusco that have been restored. One of the biggest is set inside a Spanish Cathedral. When the conquistadors arrived in Peru, one of the first things they did was try to eliminate the Incan religion. One of the most common ways they did this was to build cathedrals on top of main temples, to force people to enter the church. Another way is evident in much of the architecture. All Incan walls and doors are slanted, always at exact angles of 7, 11, or 13 degrees. This was done to prevent earthquake damage, and gives the doors an interesting trapezoidal figure. When the Spanish arrived, they destroyed all the doors, often using artillery, and re-formed them into standard rectangular doors.

The next day I got up early and caught the train for Machu Picchu. The train takes you from Cusco to Aguas Calientes, the city servicing the tourists of Machu Picchu. The city is very poor, and vendors and beggars line all the streets. The only way to get to Machu Picchu itself is by bus, and it is the most frightening ride I've ever taken. The road switchback up at least 1000 ft, and finally ends up at the Machu Picchu hotel. The city itself is very large, equivalent to 4-5 football fields in total area. The entire city is

made of stone, and it almost perfectly preserved. But, all the artifacts and gold are missing, presumably from looters, so it is very difficult for archeologists to study and explain the purposes of each building.

Once I flew back to Lima, I didn't have very long before I left, and the doctor's at CIP took me out for a surprise lunch. Everyone told me how much they had appreciated my coming, and what a pleasure it had been. I told them how much I had enjoyed my trip, and how much I had learned, not only about science, but also about the status of another country in the world, something many Americans overlook. But, I will never be able to look at the world in the same way again, and along with my mind, my horizons have been permanently expanded.