Lifetime Achievement Award Lecture

I thank Wally Mckeehan for the very kind words of introduction. They remind me of the story of the town bum who had died. At his funeral in the eulogy, the preacher was lavish in his praise of the deceased for the exemplary life he had led. His wife leaned over and whispered to her son, "Son, go look in the coffin and see if that's really your daddy in there."

I thank the members of this society and its president, and past president, Dr. Mary Ann Lila Smith, and Dr. Cynthia Goodman for this award. The title of this award, Lifetime!!! Achievement Award, sounds terminal. I may be in denial, but I feel I still have many years of useful work ahead of me. Finally, I wonder if I can say anything that anyone will consider worth remembering. My approach will be to raise questions that trouble me, and for which I have no answers. I have arrived at these questions in the course of pursuing scientific objectives. I believe these questions concern the well-being and survival of the human race.

First let me tell you a little bit about my career in basic science, which to say the least, is a bit unusual. I was a mediocre student, so in 1950 I found myself working as a gardener mowing lawns in the vicinity of Cal Tech. I would drive by Cal Tech, wistfully wishing I could be a student there. One day I fell off my truck, sprained my ankle so I couldn't work, and limped into Cal Tech to see if I could become a student. The first man I met was a famous physicist who asked me what I wanted. "I want to be a student". "What kind of student were you before?". "Terrible". " Well, we only take the best here, but tell me what you are interested in". "Transport across biological membranes". "Oh, that's biology, go see this man Beadle". I got the same response from Beadle. To get rid of me he asked what my interests were, and when I told him, he said that's biophysics, go see this man Delbruck. I found Max sitting in a dark office, deep in thought. He was annoyed when I knocked. What do you want, he asked. "I want to be a student". "Tell me the story of your life". I must have been pretty eloquent for an hour or so because Max arranged for me to come back the next week to be examined by a committee to see if they would accept me as a special student. When I arrived at the appointed hour, I was met by a committee of distinguished scientists. Max was reading a newspaper. He said, I've just read that one organism is the most numerous in the world, could you tell me what it is? "Phylum Arthropoda?" "Yes, yes". " Class Insecta?". "Yes, Yes"."Order Coleoptera?" "Yes, yes, there are more beattles than anything else in the world". He then said, "I have a radioactive element, A, which decays into B that decays into C. If I give you A at zero time, can you tell me C at a later time?". "Oh, that's just simultaneous differential equations". Today, I confess, I don't remember what simultaneous differential equations are. I passed the exam, and was thrown in with graduate students in physics and math, and for the first time in my life, I studied hard, because the physics, and math curriculum at Cal Tech could only be described as brutal. In retrospect, I marvel

how lucky I was to encounter a young man, (Max was about forty years old at the time), so confident in himself that he could with ease flaunt convention, and accept such an unpromising student as myself. I am also impressed by the American system which allows late bloomers to get through. In the lab at that time, were Max Delbruck, Renato Dulbecco, Jim Watson, Niels Jerne, and Dick Feynman learning phage genetics from Charley Steinberg. I was too dumb to be overwhelmed, and demoralized. On mature reflection, I think my youthful reaction was correct. I could never match these brilliant people, but that did not mean that I couldn't lead a useful life as a scientist.

After leaving Cal Tech, I worked with Gunther Stent on determining whether DNA replicated by a conservative or semi conservative mode. The experimental approach was conceived by Gunther and Niels Jerne. While we were doing these experiments, Matt Meselson came by and asked, "hey, what are you guys doing?" We told him, and a short time later he devised with Frank Stahl, the cesium chloride gradient technique, which answered the question definitively. It was exciting working with Gunther because his mind was roaming every where, looking for and identifying the most important problems in biology. At the time, he was wondering how information was transferred from DNA to protein and had conceived of DNA complementary RNA long before messenger RNA was discovered. At this juncture, Ted Puck came by and offered me a post-doctoral job. He had just developed the single cell plating technique. He had wanted to develop a plaque assay for animal viruses, but Dulbecco achieved this first, so Puck turned to tissue culture. He thought that tissue culture needed the kind of quantitative thinking found in the phage field, so he asked Max to recommend someone. I was the only one Max could spare.

One of the problems I worked on in the Puck laboratory with Harold Fisher was to identify the factors in serum required for cell growth. As we were purifying one factor, the more we purified the bluer it got. This work was not carried to successful conclusion, but I never forgot ceruloplasmin, and metallo-proteins. One night, about midnight, I was having coffee in the hospital cafeteria with other members of the lab, when Dmitri Markovin, a radiologist, post-doc, said, "you know, there's no differentiated cells in tissue culture". Wow, I thought, he's right, this is what I must work on in my upcoming job at Brandeis, under the chairmanship of Nathan O. Kaplan.

At Brandeis, we attempted to establish rat liver parenchyma in culture. We used as a marker, with the help of Mary Ellen Jones, the enzyme, ornithine transcarbamylase, which is liver specific, and on the pathway to arginine biosynthesis. We failed many times to establish liver parenchyma in culture with ornithine transcarbamylase. Puzzled, and frustrated, we asked the question, is the result due to selective overgrowth of fibroblasts or to dedifferentiation of parenchyma? Dedifferentiation was the conventional belief at the time. Our results clearly implicated selective overgrowth by the small minority of fibroblasts in the liver inoculum (1). I was severely criticized for propounding nonsense, especially by members of this society, who offered to chip in to

buy me a microscope so I could watch liver cells turn into fibroblasts. The American Cancer Society wrote me a letter saying I should never apply to them for a grant again. The controversy, selection versus dedifferentiation, has long been settled in favor of selection. It is especially understandable in light of the discovery of platelet derived growth factor by Sam Balk (2). At this point, conscious of the selective advantage of fibroblasts, we turned our attention to devising enrichment culture techniques for growing differentiated cells in culture. I had been Dulbecco's teaching assistant for three years in microbiology. He constantly emphasized selection and enrichment culture. At the time, I didn't realize that this would greatly influence my future work in tissue culture. We turned to Jacob Furth, the great experimental oncologist, and obtained many differentiated tumors from him. We placed them in culture for various times, and injected them into animals to get culture derived tumors. We alternately passed tumors from culture to animal to culture. The rationale was that passage in culture would select for culture hardy cells, and these would generate new tumors that could grow better in culture. The fibroblasts in culture would contribute little to tumor growth because they were normal. The methods worked, and we first established adrenal cortex cells in culture which responded to ACTH by producing steroids, and pituitary cells that produced ACTH (3). We went on to produce many differentiated cultures, growth hormone producing pituitary cells, C6 bearing glioma cells, norepinephrine producing neuroblastoma cells, differentiating teratocarcinoma cells, pigmented melanoma, etc. I believe we were also instrumental in introducing the general use of biochemical and immunological markers in cell culture, because we were surrounded by competent biochemists and immunologists. This was brought home to me one day when my graduate student, Bob Pierson, gave a talk at the TCA meeting on the identification of the steroid, 20 alpha hydroxy progesterone, produced by adrenal cultures. The chairman of the session complained to me that this was biochemistry not tissue culture.

One day at a lab meeting, we were discussing the mechanism whereby ACTH causes adrenal cortex cells to produce steroids. I was pushing the idea that it must be causing the translocation of cholesterol from one site in the cell to the mitochondria where the side chain cleavage enzyme resided. At this meeting, Kiyoshi Ueda, a post doc in the lab, commented that there were no cells in culture which give a growth response to hormones. This immediately impressed me as very important. If cell cultures were to give insights into the cell biology, and cell endocrinology operating in the whole animal, cells in culture would have to give this response. I decided to work on this problem in my next job at the University of California at San Diego. I would summarize my experience at Brandeis as wonderful. It was only after the death of Nathan O. Kaplan that I realized how much I had learned from him. He had an almost childlike love of science. He created a communal spirit, and an atmosphere of intense ferment, where all the young assistant professors were encouraged to succeed in science. All of the young people he selected have gone on to distinguished careers. Nate had an uncanny knack for selecting people who would be productive. He also had a marvelous intuitive approach to nurturing young scientists. My other memorable experience at Brandeis was a

conversation I had with Bill Jencks, an extraordinary enzymologists, and thinker. He asked me why I did science. I said because I enjoyed it. It was great fun. He said he did it because of a sense of duty. I did not understand him then, but I understand him now. I have the greatest respect and admiration for Bill Jencks.

At UCSD we began by following the work of Biskind, and Biskind (4). We injected fragments of ovary into the spleens of ovariectomized mice. The rationale is that the spleen is drained by the hepatic portal vessel so that any ovarian steroids produced by the implant would be destroyed by the liver, and the pituitary sensing a deficiency of ovarian steroids would hypersecrete gonadotrophins causing the implant to grow. Jeff Clark in our lab cloned these cells in culture. They would only grow if the cells were provided a solution of crude luteinizing hormone from the NIH. We got a preparation of pure luteinizing hormone from Dennis Gospodarowicz, and it didn't work. When we applied for an NIH grant to continue the work, it was turned down because pure hormone did not work. This was a case of pure professional rivalry and jealousy. Also unbeknownst to me, a young member of my lab was secretly meeting with Gospdarowicz to plan isolating the factor from NIH-LH, which turned out to be FGF. It was time to move on.

Because of our involvement with hormones and growth of cells in culture, I got the idea that the function of serum in cell culture medium was to provide complexes of hormones. I assigned this problem to Izumi Hayashi. She had selected me as her thesis advisor, and I was reluctant to accept her. I had known her family for a long time, and if we failed, Japanese tradition would require that I travel to Japan, apologize to her family, lay out a ceremonial mat, and disembowel myself. Fortunately, she was very successful (5). She worked out the hormones necessary to replace serum for GH3 cells, which was a growth hormone secreting line established in my lab at Brandeis. It turned out that this was one of the hardest cells for which to work out their hormonal requirements. I marvel at how she managed. She was just marvelously skillful, and a delightful person. One day she was assisting me to teach a course at Cold Spring Harbor. I asked Barbara McClintock if she could talk to Izumi for a half hour or so. It was my practice to expose young people to the inspiring influence of Barbara. After five hours they were still talking. They must have discussed every important issue under the sun. Afterwards, Barbara came to me and said, emphasizing every word, "she's very intelligent". I and the members of my lab during the Izumi time miss her and lament the great potential that was not realized due to her untimely death. During this work I also had good intuition as to what would be useful. I knew about Ham's F12 media, and the competence of the Ham laboratory. F12 media was absolutely necessary for this work. Also because of my experience with metallo proteins in the Puck lab, I gave Izumi transferrin to try. This turned out to be generally essential for cells. When I applied for an NIH grant to support this work it was turned down on the grounds that just because it worked for GH3 cells did not mean it was a general principle. It was the same individual that turned down the LH grant. I marvel at how new and important ideas do not sit well with granting agencies--- selection instead

of dedifferentiation as the reason for lack of differentiated cultures, important new factor in crude luteinizing hormone, and replacement of serum by hormones in cell culture.

Hormonally defined media have come to be considered a mere technical advance that is convenient for growing cells in culture. There is also the lingering doubt that the findings are culture artifacts. This is nonsense. The molecules found are made in the body, and their effects on cultured cells must have a counterpart in whole animal physiology. I had always considered hormonally defined media as a great expansion of endocrinology. These methods can find hormones that the classical extirpation of glands and injection of extracts cannot find. I have also been of the opinion that working out the hormonal requirements, and responses of each individual cell type will lead to a deeper understanding of integrated physiology. This notion has yet to catch on, but ultimately it will become the conventional wisdom. To publish these views I got the journal Cell to invite me to write a review (6). I asked David Barnes to help me. Soon he was doing all the work, and I was feeling very guilty. Then David got 2000 reprint requests, and I stopped feeling guilty, but I then had the problem of how to buy 2000 reprints, get clerical help and postage to mail them out. I went to Collaborative Research, gave them the reprint requests, and said you buy the reprints and mail them out, and you have an addition to your potential customer list.

At this time I became fascinated by the disease, LATS. It is an autoimmune disease in which antibodies are made to the TSH receptor, and cause hyperthyroidism. I was of the opinion that antibodies to hormone receptors would be a great tool in cell biology, but also an important element in cancer therapy. I came to this view because of the work of Francoise Kelly (7). She treated 3T3 cells and SV3T3 cells with cytochalasin B, which blocks cell division. The transformed cells in the absence of cell division would continue to produce nuclei, and the multinucleated cells would disintegrate upon removal of cytochalasin. The normal 3T3 cells in the absence of cell division would produce two nuclei and stop. When the cytochalasin was removed the cell would divide into two mononucleates, and continue dividing normally. I believe that Francoise's work has yet to be appreciated for its implications to cancer cell biology and to possible approaches to therapy. It would be very useful to discover the mechanism whereby a normal cell stops nuclear division at the binucleate stage when cell division is blocked, and how a transformed cell escapes this control, and whether or not it is intrinsic to the transformation process. It seems to me that when a cell escapes from normal growth control it loses coordination between the various processes involved in normal growth. If one process is blocked, the others continue, leading to an unbalanced situation that is lethal. This it seems to me is a vulnerability of the cancer cell. If the normal cell is blocked in one process involved in growth, all are stopped. Any way this was the rationale for our developing monoclonal antibodies to hormone receptors. Tomoyuki Kawamoto, Denry Sato, and Anh Le developed monoclonal antibodies to the EGF receptor in my lab . John Mendelsohn was a frequent visitor, took a strong interest in the

project, and was a frequent discussant. I am dismayed to read in Business Week that we are described as members of his team.

At this juncture, I was somehow recruited to be the director of the W. Alton Jones Cell Science Center in Lake Placid, New York. My research days were over. My task was now to take care of the careers of young scientist. To do this we instituted a system whereby young scientists were hired to head laboratories, and were guaranteed five years of salary and grant fund support. We set up a protein and molecular biology core laboratory so that all investigators would have ready access to these techniques. To get good graduate students, we established a graduate program with Clarkson University, and I got myself appointed honorary professor at Tsinghua University in China—the top science university in China. We brought over students from China as China was just opening up who didn't know the difference between Lake Placid and Manhattan. I would say our graduate students were comparable to those in the finest institutions in the land. Wally Mckeehan, and I established Upstate Biotechnology inc., and Josette Gaudreau managed it as its CEO. We established the company to provide long term support for the basic scientists at the center. I would judge the whole endeavor to be a partial success. The senior scientists, and graduate students have gone on to successful careers. I am justly proud of this. The Cell Science Center is closed down. Upstate Biotechnology is flourishing and earning money for those who either never helped in its creation or actually opposed it.

Since leaving the Center I have concentrated on my work in Eritrea to create food and wealth for impoverished, hungry people. This work started in 1986, during the Ethiopian famine, and the Eritrean struggle for independence. I discovered that Ethiopian famine was mostly Eritrean famine---the Ethiopian government was starving out the rebels. About this time I learned of a Japanese businesman, Shingo Nomura, who had experienced hunger as a child, at the end of world war II. He was grateful for food aid provided by America, and wanted to help famine plagued peoples. I had my people in Japan arrange an interview with him. They told him I was very busy, and could only talk to him for one hour. They said he had to arrive at my hotel lobby promptly at 8:00 AM, and the interview would be finished at 9:00 AM. He came and took notes as I talked. At the end of the talk, looking puzzled, he asked, " what do you want?". I said a half a million dollars. He said okay. What, I said, don't you want to check up on me. "Not necessary".
I thought he had already done a background check on me, but years later, I discovered he had not. With the help of Mr. Nomura's foundation, Global Action, I began helping Eritrean troops at their naval base in Agik on the Eritrean-Sudan border. When I first saw them they were ragged. I collected used clothing from a catholic charity, and sent a double shipping container of clothing. This was much appreciated. The clothing was a mixture of all types, and included some fancy ball gowns. The women fighters loved to put on these gowns and pose for photographs in the hot desert. Their drinking water was trucked in over a long distance, and was warm and muddy. I provided reverse osmosis

machines to make fresh water from sea water, and ice machines that could make ice from sea water. When ice water was served in the mess for the first time, the troops all stood up and cheered me. We dug ponds near the sea, filled them with sea water, fertilized the ponds to grow algae, and inoculated the ponds with fingerlings of algae eating mullet. Although this project never got very big, by the end of the war we were producing critically needed high protein food for the wounded.

After independence was won in 1991, our attention has turned from famine to economic development. Conventional agriculture in Eritrea does not produce enough food to feed its people. The agricultural highlands have been plagued with sporadic, unpredictable periods of drought. Our approach is to use the desert coast on the Red Sea, to grow plants that can be irrigated with sea water, and used to feed animals. The main plants we use are mangrove trees (mostly Avicennia marina, and to a lesser extent, Rhizophera mucronata), and the grass, Distichlis spicata.

As I was beginning this work, a young man came to me, and asked why I was doing this work. He said that I might succeed, and the population would grow very large, and they could be worse off then before. He said, "I never do anything before I ask why". Without thinking, I answered, "I never think why, I only think how". Ginette Serrero explained our difference of world view. This young man is an Existentionalist, who hold that no question is worth asking until we answer the question, why do we exist. Obviously, I am no Existentionalist. This was brought home to me in several conversations with Barbara McClintock over the years while I was teaching a summer course at Cold Spring Harbor. Barbara was a remarkable, rigorous thinker with little trace of sentimentality. She was also a mystic. As a child she did not go to school, but on her own studied Tibetan education. My conversations with her were immensely enjoyable, and memorable. Her insights were breathtaking. In my last conversation with her, as I was leaving, I said, Barbara, what's it all about. She said, I'm baffled. My immediate reaction was momentary disappointment, that gave way to relief. If Barbara could not figure it out, I need not bother trying. I can follow my instincts. If people are hungry, I can try to make them food. I need no philosophical justification.

Mangroves grow in the inter tidal zone of only about 15% of the coast, and where they grow they form a narrow fringe usually no more than 100 meters wide. We observed that the mangroves grow in "mersas" where the seasonal rains are channeled to enter the sea for a few days a year. We theorized that the fresh water must be bringing needed minerals from land, and the mangrove fringes are narrow because the fresh water cannot carry the minerals in sufficient quantity more than 100 meters from the high tide line. We examined the mineral content of sea water, and found that sea water contains in sufficient quantity all the minerals needed by plants except for nitrogen, phosphorus, and iron. We predicted that the barren inter tidal areas could be planted with mangroves, and that the fringes could be much wider if trees were provided with a slow release form of nitrogen,

phosphorus, and iron. Both of these predictions have proven true. Our method of providing slow release fertilizer in an area that is continuously awash in sea water is to place 500 grams of a 3/1 mixture of urea and diammonium phosphate in a plastic bag, tie the bag so it is sealed, and on one surface puncture 3 holes with a 0.2 cm diameter nail. The bag is buried next to the tree with its upper surface with puncture holes ten cms. below the soil surface. A piece of iron is buried next to each tree. This arrangement delivers nitrogen and phosphorus to the trees at just the desired rate. Five thousand trees with their fertilizer bags are planted in each hectare, and the bags deliver all their fertilizer in about three years, or about one ton per hectare per year. In figure 1. are shown five pots that were placed in an inter tidal zone where trees had not grown before. The pots were filled with soil from the area, and each pot was planted with two bare root seedlings at the four leaf stage. In each pot was placed a piece of iron and a fertilizer bag. The bags from right to left were punctured with 0, 1, 2. 4, and 8 nail holes. The photographs were taken about five months after planting. With 0 holes and therefore no nitrogen or phosphorus, the trees died. This shows that the soil cannot support trees without fertilizer. Increasing the holes from 1 to 4 increases growth, while 8 holes probably results in over fertilization. Our standard procedure is to use three holes. In figure 2. is shown a planting of mangroves in the middle of the port city of Massawa. Trees have never grown here before, but grow very well when provided with nitrogen, phosphorus, and iron. The trees attract fishes, and the area is filled with birds attracted to the fishes. Approximately, 10,000 trees have been planted in this area. To date we have planted about 250,000 trees, mostly near the village of Hargigo to provide fodder for sheep, goats, and camels. We cut the young, tender branches with a lopper, wash off the salt crystals with sea water, shake off excess water, and sprinkle the leaves with urea before feeding the animals. The urea provides ammonia, which in combination with the sugar produced from cellulose in the rumen, increases the amount of protein available to the animal. Preliminary experiments indicate that urea sprinkled mangroves can provide at least the bulk of the food for animals. In the future we plan to supplement the diet with mangrove seeds (presently reserved for generating new trees), and grasses such as Distichlis. We believe that planting mangroves can make Eritrea self sufficient in food, and produce the bulk of the food and income for people living in coastal villages.

By doing this work, I am manning one tiny outpost on one frontier of human advancement. Looking around, I am discouraged but remain optimistic. I live and work on a continent rife with corruption and mismanagement, that results in human misery---hunger, poverty, sickness, and the ever present danger of sudden, violent death. Let me cite a few examples. The Sudan has about forty million acres of arable land, and all of the waters of the blue, and white Nile, which converge at Khartoum. If planted, the Sudan could feed all of Africa. They suffer famine, and require international food aid. In addition thousands have died as a result of the central government attempts to impose Sharia, or Muslim law on southern Christians, and Animists. Nigeria has large oil reserves which are sufficient to build a prosperous nation. The people are so poor that they cannot afford fuel to cook their food. They drill into pipelines and are blown up.

When their dictator, Abacha, died of a heart attack in a viagra supported sex orgy, his wife showed up a few days later at the airport with eighteen suitcases of money. This is a crime against humanity. Zimbabwe used to export food. It is on the brink of famine. The people of Kenya are poor, but its president, Arap Moi, is reputedly the sixth richest man in the world. Somalia has recently suffered famine. Its seas are teeming with fish. If it had a government with authority and competence, it could plant its 2000 mile coastline with mangroves, and it would never be in danger of famine. Horrific massacres have been occurring in Rwanda, and Sierra Leone. My conclusion from these doleful ruminations is that in efforts to use science to improve the lives of people, technology is the easy part. The difficult problems are politics, culture, and religion. These are areas in which I have no claim to any expertise whatsoever. However we have a legitimate claim to be able to formulate valid opinions in these areas. We are scientists. We are heirs to the age of reason. We are practitioners of so called western rationality. That is to say, our thinking proceeds from observable facts, not from religious belief or historical myths.

What are the problems facing the human race, for which rational thinking could be employed to find practical, viable solutions? The problems are easy to find. They have been propounded centuries ago by the so-called prophets of doom. Malthus predicted that the human race would increase in number to exceed the carrying capacity of the planet. In 1999, the population reached 6 billion. The increase in population comes mostly from the poor countries of the world. I believe we have a hundred years or so to solve this problem before we are overwhelmed to the point where we can never recover. Marx said that capitalism contains the seeds of its own destruction. He argued that because workers were not paid enough to buy the products they made, that this would lead to interminable wars over markets, and depression. Today, his arguments seem fallacious. We have come to regard free market capitalism as this great system that can generate prosperity for all. However, it is a vulnerable system. It depends on the confidence of consumers to buy, and investors to invest. Corporate accounting fraud, and 9/11 have revealed this weakness. I remember the depression of the 1930s, and worldwide depression is dreadful to contemplate. The Luddites rioted when power looms were introduced in England. They argued that this would lead to widespread unemployment. Today we are seeing an increasing gap in incomes between those who have the education, and technical skills and those who don't. The manual laborer, and even skilled artisans are being marginalized.

The problem that concerns me most is Armageden, and Apocalypse. This problem has yet to appear on the radar screen of most people, yet it is dangerously urgent, and deserves our every attention, and widespread public discussion.

Jews have been persecuted for hundreds of years, in the many pogroms, the inquisition, and culminating in the holocaust. Shortly, after the end of World War II, Palestinian Jews were desperately trying to bring the survivors of the holocaust to Palestine. The English refused them entry. Out of desperation and righteous indignation, Palestinian Jews committed acts of terrorism against the English. The English found these people too

troublesome, vacated the Palestinian mandate, and turned the matter over to the United Nations to implement the Balfour Declaration, and establish the State of Israel. When the State of Israel was established in 1948, world wide euphoria resulted, not only among world Jewry, but among rational peoples throughout the world. Jews who had just gone through the holocaust now had a homeland, and a haven from further persecution. Euphoria quickly changed to fear and anger as six Muslim countries attacked Israel with the intent of exterminating the new country. Fortunately, the six Muslim countries were defeated. In the process, seven hundred thousand Israeli Muslims were expelled. In light of the emotional heat at the time, this was understandable----Jews had just gone through the holocaust, the English refused entry of holocaust survivors, they needed a homeland as a haven that was predominantly Jewish, and now six Muslim countries were trying to exterminate them. The expulsion of Israeli Muslims has come to haunt us to this day. Seven hundred thousand people have been dispossessed of their homes, their land, and their personal property. They have been living as impoverished refugees in Gaza, and the West Bank, and for thirty-five years of this time under military occupation by the very people who had dispossessed them. About ten thousand of them have been killed by occupying soldiers of the Israeli Defense Force. One can only expect hatred, anger, and a bloody thirst for vengeance. This is a grave danger to the human race. Sooner or later, Palestinian extremists, and their Muslim extremist brethren throughout the world will gain access to weapons of massive destructive power. Because of religious belief, they will use these weapons without heed to the consequences to the human race. Our only hope is to remove the causes of the anger and hatred. Israel must acknowledge the injustices done to the Palestinians, redress these grievances, (with international assistance, but cannot include the return of refugees which is impractical), and withdraw the settlements from the West Bank and Gaza. With these steps hatred and anger may subside sufficiently so that moderate elements on both sides of the conflict prevail. Without these steps, hatred and anger will persist until Armaggeden. In the United States there is a conspiracy of silence. No politician or journalist dares to mention the reasons for the hatred and anger of the Palestinians. This must stop. We cannot solve any problem if we deceptively pretend that the root causes do not exist. I am disheartened by newspaper, and television reports on homeland security. The overwhelming emphasis is on surveillance, screening, intelligence, soldiers, and police. We must spend a small part of the effort on examining and understanding the grievances of those who practice terrorism, and trying to find ways to ameliorate these grievances. What are the grievances of the Palestinians, the Belfast Catholics, the Kashmiri Muslims, the Tamil Christians, the Sri Lanka Buddhists, etc.?

I would like to end my talk on an upbeat note. Over the years, I have organized several scientific conferences, always held in honor of a person---Gordon Tomkins, Jacob Furth, Johannes Holtfreter, Ralph Brinster, Leroy Stevens, Jack Gorski, Ted Rall, Nancy Bucher, Yasutomi Nishizuka, Michael Berridge, Stanley Cohen, Rita Levi Montalcini, and Martin Rodbell. Until today, I have not tried to explain to myself the reason for instinctively following this path. This is best explained by recounting the Cell

Biology Symposium at Cold Spring Harbor that Russel Ross, and I organized in memory of Gordon Tompkins. Gordon was a brilliant, multitalented human being. He was a classical musician, and a jazz musician. He had been lead sax in Stan Kenton's band. To him science was a joy, music was a joy, and life was a joy. He loved people. His passing was grieved by all who knew him. Ten days before the meeting I arrived at Cold Spring Harbor, went to the meeting secretary, and said I want a string quartet, and a jazz band. Incredulous, she said you want a WHAT! A week later I had hired a string quartet of Julliard students, and a jazz combo headed by a former member of Count Basie's band. At the beginning of the meeting I asked the participants to contribute to the cost. Jim Watson stood up and said, "don't make us look cheap, I'll pay for the musicians". The final night of the meeting was the jazz concert. The air was electric with emotion. We were listening to music that Gordon loved. Each was thinking personal memories of Gordon, and we were united in our love of this man, and the shared values that he embodied. One of the greatest satisfactions of a scientific career is the people.

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