

**Robert Pollack,  
Professor of Biological Sciences  
Director of the University Seminars  
Columbia University**

***Knowing vs. Seeing: Philosophy and Experience***

Let me begin with a quotation from Galileo's *Letter to the Grand Duchess Christina*. It poses the problem I wish to discuss: how may one keep imagination, will and intellect aligned?

This is from a reading in a Colloquium Amy and I are taking this semester at the Heyman Center.

“... to command that the very professors of astronomy themselves see to the refutation of their own observations and proofs ... is to enjoin something that lies beyond any possibility of accomplishment. ... Before this could be done they would have to be taught how to make one mental faculty command another, and the inferior powers the superior, *so that the imagination and the will might be forced to believe the opposite of what the intellect understands.*”

What do we do when the will and imagination are being forced to believe the opposite of what the intellect understands? Rabbi Abraham Joshua Heschel of the Jewish Theological Seminary tells us, in his 1962 book on the Prophets:

“Our sight is suffused with knowing, instead of feeling painfully the lack of knowing what we see. *The principle to be kept in mind is to know what we see rather than to see what we know.*”

I arrived at Columbia for the first time almost exactly 60 years ago, when I came in from Coney Island's Stillwell Avenue station by subway for my interview in Hamilton Hall. I entered the dorms as a first year student – no, freshman – in the fall of 1957, and graduated 55 years ago, a middling member of the class of 1961. That means my 55<sup>th</sup> reunion will be this June, and it also means that I have spent part or all of seven decades here.

Tonight I would like to take your time consider the matters of how one can avoid simply seeing what one knows; and of how, not always but now and then, I have been able to know what I saw, in those very different decades of my life. So here is one story for each my seven decades here, and then a story at the end that speaks to the future in an unexpected way. If you'll have the patience to see where that story takes us, I know you'll have a lot to tell me when I am done.

*The 1950s*

I am a sophomore, a physics major, working in the Physics Department. The laboratory I work in is directed by Charles Townes, and he in turn is part of the intellectual world created in Pupin by Isidore Rabi. So when I am not in class or in my room in Hartley, I am in a lab on the 8<sup>th</sup> floor of Pupin. My research advisor is a graduate student recently arrived from City College, Arno Penzias. Our work involves the newly invented technology of coherent microwave radiation, precursor to the laser. Shades of Galileo, we are building antennas capable of picking up very low levels of microwave and infrared radiation from the moons of Jupiter. Penzias has been allowed by Townes to hire me on a Defense Department grant to the lab.

The previous year the United States and the Soviet Union had initiated a thaw in relations. That led to, among other things, an exchange program between the Schools of Journalism at Columbia and Moscow University. A visiting Journalism student from Moscow, Oleg Kalugin, is given a tour through our laboratories by the University. I am very impressed to meet him; my parents are hard leftists and in my house, nothing since the fall of Nazi Germany had made any difference to them in their support of the Soviet Union. I even invite him to visit my parents. He does.

Later that semester Kalugin finds me and asks me to have a cup of coffee with him. He tells me that my father has told him that I would be glad to share the details of my lab's work with him, because he – my father – very much wants me to do that.

First I see what I know: I know my father has put me in a spot. I am embarrassed but still, I do not want him angry at me.

But then I know what I see: I see this man may be a spy. So I say to him, No. He is very angry with me. I choose to ignore that, to ignore my father's equally angry response, and also, to say nothing to anyone, because if he is a spy, then I cannot turn him in without also turning in my father, and that I cannot do.

How did this turn out?

My time in the Pupin lab taught me what first-class science looked like. Townes got a Nobel Prize for his work on Lasers and Masers, and Penzias got his for the use of a microwave detector to pick up the 3 degrees-above absolute zero radiation left over from the Big Bang 13.7 billion years ago.

Oleg Kalugin became the New York correspondent of Radio Moscow while he was at Columbia, went back to Russia in 1961, and later became the head of Khrushchev's KGB for North America.

I did not mention this episode to anyone but Amy, who married me nevertheless, until I was invited by the President in the Spring of 1982 to be the next Dean of Columbia

College. I told him everything, because I did not want my story to embarrass the College. He asked me, “so did you *do* anything?” I said no, absolutely not. He said, “So, anyone complains, ignore them; you’re the next Dean.” Only he did not use the word “ignore.”

### *The 1960s*

I have finished up my four years in the College as a physics major. I have decided to switch my graduate plans from a getting a PhD in Physics, to getting a PhD in Biology. Lots of reasons, some obvious. I have the summer of 1961 to make the transition. Brandeis University has accepted me as a graduate student in their Biology/Biophysics graduate program. I will have only \$1200 to live on, but the stipend will go up when Amy and I get married, all the way to \$1600. First though, I have to get a B or better in Organic Chemistry in the Summer of 1961. No B, no Fellowship.

I am spending the summer in a room in the Single Residence Only flophouse now called Hogan Hall. The lectures and quizzes in Orgo are not too bad; after all, I did just finish four years of physics and math, albeit without one course in chemistry or biology. But the lab! Orgo Lab in the summer: I am the only non-pre-med there, and it is really hot in Schermerhorn.

The culminating work is to synthesize acetylsalicylic acid from salicylic acid. Salicylic acid is taken from the bark of the willow tree (Latin: *Salix*). As Wikipedia puts it: “Salicylic acid ... also known as 2-hydroxybenzoic acid. It is poorly soluble in water (2 g/L at 20 °C). Aspirin (acetylsalicylic acid or ASA) can be prepared by the esterification of the phenolic hydroxyl group of salicylic acid with the acetyl group from acetic anhydride or acetyl chloride.”

Get it? We are synthesizing aspirin. The product of synthesis is drawn up into a thin glass tube and assayed for its melting point as a measure of its solubility and purity. My yield is a light brown crud whose melting point is not quite what it should be, but, I turn in my data and before I go home, I look around.

First I see what I know: I know my yield should have been the white powder that we know as aspirin. I am really worried that I have screwed up.

Second, I know what I see: I see my classmates’ yields range from my brown, to lighter brown than mine, to bright white shiny stuff with precisely the right melting point. I’m in the mix, so I’m ok.

How did this turn out?

First, I got a B in Orgo, went on to Brandeis, married Amy that winter, we had a daughter and got my PhD. A good start, all around.

Second, I found out soon after the course was over, that the lab was itself an experiment, but one carried out on the students by the TAs. The starting material was C<sup>14</sup>-

labeled salicylic acid. The yields were all assayed for radioactivity in a Geiger counter. Brown ones like mine had lots of radioactivity, because whatever contaminating crud we had, we also had made acetylsalicylic acid from the C<sup>14</sup>-labeled material. The lighter-brown yields had some radioactivity, but not much, because they were produced by doping the yield with a little crushed Bayer aspirin. And the really clever ones with the beautiful yields that were all Bayer? Those guys got an F for the lab.

### *The 1970s*

I get my PhD from Brandeis in 1966, and Amy gets her second degree in Art as well. We come back to New York City with our little girl and I am a postdoctoral Fellow in Pathology at NYU Medical center, following up on an idea I had gotten from my earlier work with bacterial viruses. I was impressed by the émigré scientists from Italy and Germany, Salvador Luria and Max Delbruck, and their demonstration that antibiotic resistance in bacteria arises by random, stable mutation, rather than being induced by an antibiotic.

This confirmed Darwin's great predictive insight in the simplest forms of life, and it gave me the idea to see whether in the same way, Revertant normal cells might arise from the descendants of a tumor cell, in advance and at random. I show that revertants did indeed exist, and suggest that to understand the random, non-induced cellular mutation that could overcome a viral oncogene, might open a pathway to treatment of cancer by normalization of tumor cells, rather than by killing them.

In the summers we go out on Long Island to the Laboratory at Cold Spring Harbor, where I teach a course on how viruses can transform normal cells into cancer cells. We spend the Academic Year 1969-70 in Israel at the Weizmann Institute, and then we come back to a life at Cold Spring Harbor, where I run a lab, and find myself reporting to James D. Watson, the Laboratory's new Director.

Yes, that James D. Watson.

One of my administrative tasks is to help manage the Lab's program of summer courses and meetings. So it should have not been the surprise it is, when I learn from Israeli scientists we had invited to attend a meeting, that they cannot attend as the event is to fall on the Jewish New Year. Now this does not carry much weight at all in terms of our life then, but it seems pretty clear that the Lab has a problem if it has invited people who could not attend because of our choice of schedule. So I go to Jim and lay out the problem. His response is simple, so simple I can remember it to this day:

"You people own the banks, and you own the newspapers, but you don't own me."

First, I see what I know: I know that Jim Watson is my mentor, and he is the most important living scientist I am likely ever to know.

Then, I know what I see: I see there is no point in trying to please such a bigot. I am in a toxic situation, and I must get out, fast.

How did this turn out?

I looked about for an alternative job. I had only one requirement: it must have academic tenure, because I had learned how vulnerable I am without that shield. Stony Brook Medical School had recently opened, and I was offered and accepted a tenured associate professorship in Microbiology. On the one hand this allowed me to avoid the hazing associated with life as an untenured assistant professor, but on the other hand, Eastern Suffolk county was not really a place that made us feel wholly at home.

So, when the Fairchild Life Sciences Building was opened in 1976 I wrote to the chairman of Biological Sciences at Columbia and asked if I could move my lab there and – yes! – it worked. I came as a full professor in 1978 and have been here ever since, thanks to knowing what I saw in the words of my mentor James D. Watson.

### *The 1980s*

We arrive on campus and after a while we move our family into a Riverside Drive apartment. I run a lab in Fairchild from 1978 until 1982 when, as I have already mentioned, I am asked to be the Dean of Columbia College. Three years later, with two coeducational classes admitted and doing well, the world comes to my door. Students and community groups protesting Columbia's investment in American companies doing business in South Africa have occupied the steps in front of Hamilton Hall, blockading the doors, and putting up a cardboard plaque to rename the building Mandela Hall. Jessie Jackson comes to make a speech, and a banner flies from John Jay windows: "Hello Jesse, welcome to Hymietown."

I can access my office in 208 Hamilton though the tunnels, but there's really no way to make believe it is ok: classes in Hamilton cannot meet, and there is no way for me to point out that the Dean of the college does not have authority over the endowment policies of the University. Student marchers follow me around chanting "Apartheid kills and Pollack pays the bills."

Of course those in authority who do have the capacity to make changes in the investment of the University – the Trustees – have also taken notice, and I am spending more time in the President's office than my own. At first the president considers a public relations coup: we have awarded Bishop Tutu and honorary degree *in absentia*, so let's ask him to intervene. The President makes the call and we all listen over the speaker-phone. The President explains the problem, and the Bishop replies, "Oh, how wonderful. Please let me talk to the students, so I can congratulate them."

The president then turns to the legal option – a court order to stand down from the blockade and police intervention if it is not followed. I say, "No, we know since 1968 what

it looks like when police break up student demonstrations on this campus.” To my amazement my case is heard, and I am invited to arrange a meeting of the President and me, with leaders of the blockade, in my office in Hamilton.

The day arrives, I am in my office with the student leaders. The President arrives, and I see in the lobby of Hamilton the number of serious looking guys who have walked him over, hovering about. There’s a knock on my door, and I open it to see an earnest face. “I’m Reverend Calvin Butts, Minister of the Abyssinian Baptist Church. The students have asked me to join them.”

First, I see what I know: I know the students have set me up. The President’s guys are hovering very close outside the door, and if I give the word, Reverend Butts will be escorted out.

Then, I know what I see: I see these are nevertheless my students, and they need Reverend Butts with them.

So, I say, “Come on in, Reverend Butts.” We all sit down in my office, and Reverend Butts proceeds to negotiate directly with the President: “I would like to help these students understand that they should step down in the face of an injunction, in order not to be arrested or worse. Mr. President, are you aware of the terrible condition of the Nurses’ residence next to the Abyssinian Baptist Church? This is the Residence for nurses in Harlem Hospital, and your University provides that hospital with its physicians.”

The President does not skip a beat: “Reverend Butts, we will see to it that Columbia fixes up the Residence Hall where these nurses live.” Reverend Butts says nothing to the President but instead turns to the students: “I think you should see that you have made your point, and that you should step down peacefully.”

How did this turn out?

First, the students did step down; the police were not called in, and I regret only that I did not manage to save the Mandela Hall plaque.

Second, The President convened a faculty panel chaired by Law Professor Louis Henkin and me, to consider investment policies for companies doing business in South Africa. We proposed that the Trustees act to divest if and when the situation became even worse than it was. With the first subsequent acts of repression by the regime, the university divested.

Third, the following weekend Reverend Butts invited Amy and me and the President and his wife to services at Abyssinian Baptist Church. And there I knew what I saw, a second time. We were made completely welcome in a room with thousands of African-American neighbors whom we had just met under the most difficult circumstances. And I was left to ponder whether I could be sure of assembling a room with a few thousand

European-American neighbors and colleagues, who would be sure to make an African-American family feel so welcome so quickly and so completely.

### *The 1990s*

I have been back as a professor of biological sciences since stepping down from the Deanship in 1989. In the decade I have become the co-chair of the Jewish campus Life Fund, the organization that funded the office of the Jewish chaplain in Earl Hall since its formation in 1929 by Arthur Hays Sulzberger, the great-grand-nephew of Kings College trustee Gershom Mendes Seixas, and the grandfather of the current publisher of the New York Times. As co-chair I am working very hard to find a way to get Columbia to allow us to build a building of our own.

We seem to be making good progress and we get a big boost when Columbia Trustee Robert K. Kraft offers to designate a prior \$3 million gift to the University, to our planned building. We are able to propose a six-story building on 115 St. for a total of \$6 million, and we are able to assure Mr. Kraft that his gift would name the building as he wished. To close the deal, the President convenes a meeting in his office with Mr. Kraft, the provost, my co-chair and myself, and our friend and mentor, Herman Wouk. Author of *Marjorie Morningstar* and *The Caine Mutiny*, Herman is one of Columbia's most famous alumni. He has flown in from California to grace and bless the moment.

Thinking this is a piece of cake, I make the pitch and the president replies, "The Provost has shown me that the footprint of this site permits construction of 12 stories. You need only six. Would you be willing to raise the funds to build the full twelve, and donate six floors for the University to use? We are very tight for space, as you know." Mr. Kraft is frowning, and I can easily imagine him putting away his wallet as the naming goes out the window. The room is silent.

First, I see what I know: I know we will have to raise another six million and build the full twelve stories, or give up the project.

Then I know what I see: I see that I've been here before, with Jim Watson. But this is not Jim Watson, and I do have tenure. This time I speak up: I say that this building is to repair an historical injustice, but it is not a reparation. "We want to heal the past, and you, Mr. President, cannot heal the past by charging a 100% Jew Tax." A long silence, and then Herman Wouk gives me a big kick under the table. More silence, and then the President says "OK, build it for six."

How did this turn out?

It took another year, but we held out for the Trustees to accept our gifts for the building, as gifts to Columbia. This meant we were picking this secular institution in America as a place that could reasonably be trusted to maintain a home for its Jewish

constituency, in perpetuity. The Kraft Center opened in 2000. And today, alumni of any Columbia School can get credit for their gifts to the Hillel, as a gift to Columbia.

### *The 2000s*

Throughout the 1990s and into first decade of the 21<sup>st</sup> century I am a Professor of Biological Sciences, and a member of the faculty of the Earth Institute. In 2005 I am elected to the Advisory Board of University Seminars, invited by my freshman humanities instructor and mentor of sixty years, Robert Belknap, professor of Slavics.

I write books – most recently a book with Amy, on Natural Selection and its moral consequences - and I establish an organization for students who wish to do their own projects that involve elements of science, service, and subjective self-awareness. Today this organization is called The Research Cluster on Science and Subjectivity.

In the last year of Professor Belknap's life we become even closer friends, and at one point before Thanksgiving I capriciously decide to rib him about his ancestors. "Belknap" is a Mayflower name. So I ask him, "Bob, how many years has your family celebrated Thanksgiving?" I knew he'd say 350 years, or some such. He looks at me quizzically and says "I am not sure, 5000 years, 10,000 years, maybe." I am dumfounded. How can this be? "Well," he says, "you don't want me to remember my Mayflower ancestors and forget my Native American ancestors, do you?"

And with that lesson, Bob Belknap made me see what we must all see: we must not pick from among our ancestors the ones we think matter. I may not discard any of my Polish and Ukrainian ancestors, any more than he may discard his Native American ancestors. All such denial and embarrassment is no more than avoidable, self-inflicted suffering.

### *The 2010s*

This story of seeing and knowing today, started forty-four years ago, in 1971, when I was at Cold Spring harbor. In addition to my work on Reversion I am also the teacher of a summer course on the techniques of cell culture and transformation. In the class a graduate student tells us of new work from California: Taking the tumor-virus of my lab, SV40; excising the T-antigen gene that encodes the virus's tumorigenic activity, recombining its DNA with the DNA of *E. coli* bacteria, and thereby generating a *Recombinant E. coli* for research on T-antigen.

I call the chief of that lab, Paul Berg, that evening from home with great trepidation to ask whether he has thought he might be opening a new pathway for the emergence of colon cancer in those of his colleagues handling the recombinant bacterial strain, since *E. coli* is a part of normal gut flora, what we would today call our microbiome. He is unambiguously unhappy with my call, but he takes me seriously and from that call emerges the Asilomar Conference a few years later, at which scientists in this and other fields



involving recombinant DNA voluntarily agree to suspend research while the matters of safety are resolved in highly protected laboratories at the NIH.

The resulting Recombinant DNA guidelines remain in effect today and so far as I know, no one has suffered a serious disease from the technology, although a good case could be made that recombinant food plants carrying DNA encoding pesticide resistance, are a really good way to assure the emergence of pesticide-resistant weeds.

Now for the current decade. A few months ago a group of nine scientists, led by one of the organizers of the Asilomar Conference, Nobel Laureate David Baltimore, published a paper in *Science* to argue that it was time to hold a "Second Asilomar," this time to consider whether there ought to be any boundaries set on possible work with the new *Crispr-cas9* system for editing DNA.

I know that this technology holds great promise for specific and precise gene modification with all the benefits that may imply for future generations. But once again, what I see is not what I know.

What I see in this case is about the future. The best will in the world will not be able to remove the pain from those born into a world of germ-line modification, who will not have had a CRISPR-cas9 edit done on their fertilized egg cell, as an investment. Such babies will emerge as we all did, with the complexity of a genome less orderly than what this technology will be able to define as "normal."

I see that rational eugenics is still eugenics. Today I am among the minority of colleagues in this field who say that only a complete and total ban on human germ-line modification will prevent this powerful force for rational medicine from becoming the beginning of the end of the simplest notion of being "endowed by our Creator with certain inalienable rights." Time will tell.

### *The future*

Back to the future. Recall that in the late 1960s I got my start as a scientist working on cellular reversion of oncogenic transformation by viruses. My lab's papers on reversion of tumor cells were published from 1968 through the 1980s.

Beginning about a decade ago I started to see signs that they were being referenced after a hiatus of thirty or more years. The reason is simple: with big-data analysis of whole genomes, a comparison of normal, tumor and revertant lines has at last opened the possibility of finding mechanisms of reversion, and from there, the possibility of designing drugs to revert tumor cells rather than killing them.

A few months ago Scott Powers, my former Columbia grad student, now Stony Brook Professor of Pathology, asked me to co-author a review on reversion for *Nature Reviews/Cancer*. That review was published this month. I cannot know the future here, but if indeed that idea from 1968 was right all along, but only fruitful after half a century, then I will be very happy indeed.

In fact it will serve as the best example of something I heard once from the Director of human Resources at Goldman Sachs. For the first co-ed class entering in 1983, I wanted to put together summer internships that would present both men and women in the classes of 1987 and thereafter with new opportunities. Toward that end a very serious alum at Goldman Sachs had me brought to the palatial office of the HR director. I made my request for internships.

He looked quizzical and asked "Where did you say you were from?" "Columbia College," I said. "Ah." He replied, "I know Columbia students. You tell them no. They tell you, you don't understand."

And it's true.