Chapter 21

How the Unconscious Shapes Modern Science[1]

Robert Pollack.

Let me begin with a brief quote from an unpublished talk I gave at the opening of the Learning Center at Cold Spring Harbor Laboratory in 1988:

> From the beginning I have known the Lab to be a place of education as well as research. In fact, that's how the unique moment in the 1970's came to pass, when molecular biologists all over the world voluntarily agreed to suspend certain experiments in gene splicing. When I first came to the Lab, it was at Joe Sambrook's invitation, to give a class in the 1969 Summer course on Culturing Mammalian Cells, and to chair a session of the very first Tumor Virus Meeting later that summer.

It may be a familiar story by now, but it bears repeating today: I learned from one of Stanford biochemist Paul Berg's students in my summer course that Paul was about to construct a recombinant DNA including the transforming gene of the tumor virus SV40. This experimental protocol seemed in principle to be capable of generating a molecule with a novel and unpredictable infectivity. That was

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1. This talk is adapted from portions of my book, *The Missing Moment*, Houghton Mifflin, Boston, 1999

worrisome. It was a worry that could be dealt with by experimentation, so I called Paul in California and asked him if he were worried too.

He was not, nor was he able to answer my worry, so he did the honorable thing and helped the National Institutes of Health to set up the experiments to test whether my worries were grounded. I am pleased to say the experiments absolved SV40 recombinant molecules of the novel danger I had imagined. As you might guess, my own research at Columbia is now totally dependent upon these very recombinant molecules.

I tell the story here for two reasons. First, because the work on recombinant DNA held up for years by these concerns included the work of colleagues here at the Lab, in particular Joe Sambrook's. I think I was right to make a fuss, but I think also that it must have been difficult for him and for others here at the Lab to see me unhindered in my work here, while I raised issues that temporarily stopped them from pursuing their ideas.

That makes a nice story for some people, but not for others. In his new biography of Jim Watson, Victor McElheny gives his narration of this incident the heading "Robert Pollack Has a Fit."[2]

To bring it up to date , my call led to the Asilomar conferences, which led to the formation of the Recombinant DNA Advisory Committee or RAC, a model of bioethics at work; and my friend and colleague, Dr. Ted Friedman, the newly retired Chairman of

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2. Viktor McElheny. *Watson and DNA: Making a Scientific Revolution*. (New York: Perseus, 2003).

the RAC, assures us that it is alive, well, and doing important work on behalf of both scientists and the public. But as the author Conan Doyle might have noted, there is something funny going on: there is a dog that has not barked. That is, I called Paul Berg in 1971, more than four decades ago, and from that time until now, there have been no reports that I have seen of any scientist, in any field, precipitating an internal moratorium on any line of active basic research, ever. Why not?

At this long remove from those days, two reasons come to mind, . First, I was close enough to the work to understand it and its implications more fully than most observers might have been, but not so close nor so involved with it that my own lab would be immediately impacted by my call. Not right away perhaps, but before I gave my grants back to the NIH in the mid-1990s, I had plenty of time to think about the additional work I had given everyone including myself. And second, even then I was aware that fears – my own fears and the fears of others around me – were expected to be kept from the daily discourse of the lab, and even then I knew that that was wrong.

What, then, has kept other scientists from being open about their own fears? Are they simply fearless? Here is a quote from Albert Einstein that may help us to see another explanation. Many religiously observant scientists like me have used the last line of this paragraph to support our own choice, but as you will see, most of us have probably misunderstood his own intentions.

> Now even though the realms of religion and science in themselves are clearly marked off from each other, nevertheless there exist between the two strong

> reciprocal relationships and tendencies. Though religion may be that which determines the goal, it has, nevertheless, learned from science, in the broadest sense, what means will contribute to the goals it has set up. But science can only be created by those who are thoroughly imbued with the aspiration towards truth and understanding. This source of feeling, however, springs from the sphere of religion. *To this there also belongs the faith in the possibility that the regulations valid for the world of existence are rational, that is, comprehensible to reason. I cannot conceive of a genuine scientist without that profound faith.* [my italics]. The situation may be expressed by an image: science without religion is lame, religion without science is blind.[3]

Einstein wrote of his belief that no scientist lacked his "profound religion" of science, for a conference on Science, Technology and Religion held at the Jewish Theological Seminary in September 1940, the month of my own birth. It was then quickly published across the street, in the November 1940 issue of the *Union Review*, by the students of the Union Theological Seminary, under Paul Tillich's guidance. As an aside, this welcome for a scientist at a Protestant seminary resonates with the happy fact that in a gesture of ecumenical liberality the Union Theological Seminary has given the Columbia Center for the study of Science and Religion a handsome suite of offices.

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3. Albert Einstein, "Science and Religion," *The Union Review*, Union Theological Seminary, 1940 2: 5-7, 28.

Einstein's essay and Tillich's response both were published in the season of the Blitzkrieg's greatest successes. Surely Einstein knew by then that if he was right in his judgment that no serious scientist failed to share his faith in science, then that faith in science was extremely dangerous in and of itself. By then a scientifically-designed, medically-authorized, technologically-superb program to extinguish the lives of anyone who could claim at least one Jewish grandparent had already assured the deaths of his family at the hands of, among many other criminals, a considerable number of genuine scientists, many of whom now happily burned his books.

Here is a much larger context for my question than my own narrative: how could Einstein have kept these facts from himself when he wrote this paper? And if he, the greatest mind of the century, was capable of such strong faith in the goodness and purity of science even in the face of such astonishing evidence, what self-awareness can the rest of us hope to have?

Meaning, Denial and Repression

Everyone alive needs to make some sense of life, to give it some meaning. In the past century scientists and doctors have made four interlocking discoveries that have made the task of finding meaning much more difficult. The oldest discovery has had the deepest impact: it is that DNA-based natural selection generates life in all its diversity and orderliness — including a scientist with a brain of great capacity to understand life's structures and functions — while, by itself, natural selection contains no element of design nor purpose.

The second discovery concerns the mind. Scientists have shown that the conscious mind is the product of cells in the brain, an expression of the capacity of genes in these brain cells to respond to the outside world as well as to selectively recalled memories of earlier interactions with it. Third, they have found that the brain that does this is a tissue made of cells like any other tissue, albeit one that can imagine it has — or is — an ineffable, nonmaterial soul. And most painful of all, they have found that the entropic tendency of large and complicated structures to degrade into smaller ones assures that death — including the death of the inner voice we each hear when there is no one else in the room — is irreversible.

Together these discoveries paint a coherent and clear picture of the living world and of our place in it that is notable for its complete lack of meaning. Everyone who learns of these discoveries has the double task of finding a way to accept them, despite their cumulative power to exclude design and purpose from the living world, and of helping to assure that the science of the future will be made by men and women who have found meaning in their lives despite these facts of nature.

It has not been easy. Scientists cannot simply avoid thinking about these discoveries, as so many of the rest of us do. Many aspects of today's medicine are based on precisely these discoveries, which is why medicine has come to reject any larger meaning or purpose to life beyond the workings of genes and the capricious choices of natural selection. Yet one must — or at least I think one must — see life as more meaningful than that if one is to lead a life worth living. The alternative is denial. This is

the unconscious rejection of one or all of these facts of life. Denial allows one to avoid confronting one's fears, but it can lead to fateful errors of judgment.

In Einstein's case perhaps there would have been no way to save his family even if he were to lose his faith in the goodness of science; we cannot ever know. In any case, it seems clear to me that in our own world – the world of the medical sciences – a similar denial of unbearable facts can lead to the fantasy of conquering death itself, an impossible dream that is the root of many of the ethical issues we are now facing in light of the new developments in genetics.

Denial as a Brain Function

The Freudian unconscious of ego, id, and superego do not map completely to current diagrams of the functional anatomy of the brain, but unconscious matters of hunger, sexual desire, aggression, and fear occupy portions of the inner brain, while outer, cortical regions of the brain — especially the cortical regions behind the forehead — deal with conscious ego-like matters of subjective thought, abstraction, language, and planning. The unconscious superego's world of values, rules, standards, goals, rewards, and punishments is least centered.

The first data systematically demonstrating that the unconscious repression of difficult memories was an aspect of normal brain function came from studies of survivors of head wounds. Working to understand and help brain-damaged soldiers and civilians, the Russian psychiatrist Alexandr Luria was able to partially align the analytic model of the mind with the anatomy of the brain. His most dramatic conclusion was that the

normal brain was indeed functionally as well as anatomically divided into inner and outer parts. The centers of the inner brain were concerned with unconscious processes, affects, and memories; the centers of the outer brain carried out abstract conscious thought, perception of the outer world, directed action, and judgment; and at their boundary, a set of centers called the limbic systems carried out the balancing acts of bringing together the past and the present.

Luria's work, at the work of many others since then, has shown the repressive capacity of the mind — its ability to prevent certain memories and fantasies from reaching consciousness — and its ability to let these memories emerge in the form of fantasies and daydreams have an anatomical correlate in the limbic systems where the two brains and their worlds meet. Damage to one particular place on the boundary between the inner and outer brains, where the most frontal of the limbic centers meets the most internal portion of the frontal zones of the cortex, has a spectacular effect on the place of dreams in a person's life: victims become unable to distinguish their dreams from reality. These lesions leave people in a permanent dream world, unable to tell whether what they see and hear is happening in the outside world or in their imagination. They suffer from “a constellation of vivacious dreams, hallucinations, confabulation, and a breakdown of the distinction between thought and reality.” In unaffected people, this portion of the brain must be constantly choosing among fantasy, unconscious memory, and current reality.

Each part of the brain thus contributes to the one inner voice of consciousness. Even the conscious act of learning from an event — the minimal unit of scientific

observation — is the sum of at least four different kinds of neural activity taking place simultaneously in the two brains and in their shared limbic boundary. At the conscious level, the right cortical hemisphere of the outer brain internalizes the sensory experience of the event in terms of self-definition — what does this mean to me? — while the left cortical hemisphere retains the event cognitively, in language, as a set of facts and observations.

Simultaneously, the limbic system attaches an emotional affect associated with the event; the hippocampal memory retains a trace of both the event and the affect; while the hypothalamic regions of the inner brain generate their unconscious responses to the event. Of these various expressions of the brain's functional anatomy, someone doing mental work — a scientist analyzing her data, for instance — is consciously aware of only the first two.

Denial in Science

The emotional affects and memories of the past will not be part of a scientist's conscious experience, but because they are registered as changes in brain circuitry, they necessarily will be part of each act of observing and understanding the natural world. Scientists may insist that no aspect of nature is hidden from them, but inevitably their own nature — the conscious manifestations of their unconscious fears and needs — shapes the questions they ask of nature and thus what they can discover about the body and the mind.

What happens if we apply this empirical, clinical model of the relation between conscious thought and unconscious memory to the question of how the agenda of a science may keep unwanted unconscious memories from emerging to trouble the consciousness of its scientists? The conscious part of science begins with an act of faith, the ancient Greek belief that the natural world works by mechanisms that we can understand, even though they may initially be hidden from view.

Today, as in Democritus's time and in Einstein's, science works within the Greek belief that despite the smallness of atoms, the largeness of the cosmos, the rapidity of atomic transmutation or chemical catalysis, and the imperceptible slowness of evolutionary change, the underlying reality of any aspect of nature will be consistent, understandable, and therefore knowable. Everyone who plays the game of science must come to it infused with the belief that the way the natural world works can be understood to any degree of detail by sufficiently clever experimental manipulation.

Since nature is clearly silent and uninterested in a scientist's curious faith, the first step toward understanding is for the scientist to come up with a hypothesis to explain how some natural phenomenon works. The hypothesis is then tested through experiments that compare its predictions to the actual behavior of nature. Good experiments must often use elaborate machinery, so science can be expensive. But a good experiment need not be complicated because it is never simply a set of measurements; it is a test of the usefulness of a figment of the imagination and a moment of risk and drama.

If experiments confirm a hypothesis — for why a ball bounces, a cell dies, the moon turns, or a muscle contracts — then the scientist must expand the range of tests to

determine whether the hypothesis explains a little or a lot. As in backgammon, the stakes in science always go up; the game is never more risky than when a hypothesis proven right in a small corner of the natural world is tested in a bigger one. Each successive confirmation carries with it the obligation to push a hypothesis into ever-larger realms of nature by more extensive and subtler experiments. When — usually sooner than later — careful experimentation confounds a hypothesis, it has reached the limits of its usefulness, and it must be redrawn or withdrawn.

One may think that a hypothesis that explained even a little would be treasured and preserved. But once a hypothesis has been bounded by contradiction, the faith of science demands that it be altered or entirely replaced so that the task of understanding nature more fully may go on. Solely on the conscious level, science is thus reduced to a mixture of ritual and game, complete with a game's obedience to its own rules, austere unworldliness, and willful naïveté.

The conscious part of science is what most scientists would insist is all there is to science: an agenda for understanding nature. However, based on what we know of some minds, we can expect that the minds of scientists and therefore perhaps even the mind of science — the communality of experience and motivation shared by most scientists — have both conscious and unconscious parts. Just as the conscious part of science is shaped by the set of simple and universal rules that govern the conscious activity of all scientists, engaging and pooling the efforts of many different people's conscious minds, the unconscious parts of the mind of science — in particular, the sciences that serve

medicine — would be expected to emerge as fantasies and obsessions shared by scientists in these fields.

Although the notion that scientists may share their unconscious fears and conscious fantasies, dreams, and myths may seem disingenuous, meaningless, or just plain silly, recall that until not too long ago, many serious observers thought it was disingenuous, meaningless, or silly to imagine that an individual brain might contain — within its biological functions — any individual mind at all. The early behaviorist assumption that the mind is an illusory, ineffable byproduct of the brain's mindless application of instinctive rules had to be set aside in light of what we now know about the brain's functional anatomy.

It is time to follow up on that conclusion, to set aside the notion that science can operate in the present moment without an unconscious component to its deliberations. Science is the product of the unconscious sources of imagination and introspection as much as it is the product of a set of rules. The emotions and memories shared by scientists in the same field are its inner voice, and there is no reason that these inner voices should not be dealing with the same unconscious, repressed memories as do any of a field's practitioners. The question is not whether, but how, the unconscious aspects of science, refracted in maturity through its methods, resurface in ways that deflect the course of science itself.

Though science may seem at first remote from unconscious memory or conscious fantasy and obsessive behavior, it remains a human enterprise, and the fantasies of infancy are likely to be the same, whatever a person's later career. When universal,

negative experiences are dealt with in the same way by a group of people linked by language and culture, their shared fantasies can crystallize into a core of collective myth. Every time biomedical scientists look at a piece of the human body through the lens of science, the lens becomes a mirror. What they see in it is at once familiar and completely strange. The human mind and body, but especially the mind and body of the scientist, become uncanny; the German word *unheimlich* best conveys the way each becomes more strange as it becomes better understood. This uncanny element of the life sciences derives from the fact that we can neither fully accept nor consciously and rationally even understand our own death.

Inescapable Mortality

Nature makes us mortal; surely that affects the behavior of every thinking person. For the scientist, what better way to reduce the feared figure of our own mortality than to make it our experimental material? This is a modern version of the original Greek notion of science, born in a world that did not distinguish between science and religion. The underlying myth of science concerns one of their immortal but otherwise altogether human gods. Asklepios, the demigod of medicine, was the son of the immortal god Apollo and a human princess named Coronis. The centaur Chiron — a physician of consummate medical skill who also happened to be an early human-horse recombinant hybrid — taught Asklepios the arts of medicine, and Asklepios became so skilled at healing that he was able to resurrect the dead.

Hades, the immortal god who ruled the underworld, complained to Zeus, the father of the gods, that he feared the loss of future subjects if humans were no longer to die. Zeus's response — he killed Asklepios with a thunderbolt — explains our present mortality and leaves us with the fantasy that by rediscovering the skills of Chiron and Asklepios, we may yet one day escape death.

The rest of the myth as it has come down from the Greeks tells us that Apollo, the immortal god of song and light, took such offense at this act of Zeus that he slew the Cyclopes, the makers of Zeus's thunderbolts, in revenge. Revenge, however, came too late to help poor mortals then or now. This myth and the hope it expresses have survived for thousands of years longer than any of the gods it describes. Despite all the rewards of scientific understanding, Apollo — science itself — has not yet overcome mortality. But we all vest the same hope in Asklepios — consciously or unconsciously — just as the Greeks did, each time we visit the doctor.

The original Greek myth is alive not only in the minds of patients; it also lives in the minds of many doctors and scientists. Sometimes a great scientist will let the dream of Asklepios surface, allowing it to peek out from behind that other ancient Greek mask, the rationality of science. For instance, in his autobiography, the French Nobel laureate François Jacob is ostensibly discussing what it feels like to carry out a series of experiments, and the American Nobel laureate Arthur Kornberg is writing an editorial explaining why the scientific endeavor is unique among human activities, when both emerge with unexpected confessions of faith:

Jacob: "And with this idea that the essence of things, both permanent and hidden, was suddenly unveiled, I felt emancipated from the laws of time. More than ever, research seemed to be identified with human nature. To express its appetite, its desire to live. It was by far the best means found by man to face the chaos of the universe. To triumph over death!"

Kornberg: "The ultimate scientific languages used to report results are international, tolerate no dialects, and remain valid for all of time. . . . Science not only enables the scientist to contribute to the progress of grand enterprises, but also offers an endless frontier for the exploration of nature."

Only faith or obsession — if they are not the same — can expect a method for observing nature to give a vision of endlessness or of triumph over death. Hyperbole like Jacob's may be intended or read as metaphysical metaphor, but the underlying fantasy remains clearly expressed: omnipotence of thought will bring immortality. This notion does not stand up to rational analysis; that is why the conscious, operational agenda of science masks the fantasy in Kornberg's “endless frontier,” the cloak of institutional immortality. But institutional immortality itself, born from the unconscious will that one's name not be scattered, is just a different version of the same fantasy, an ancient impulse not limited to the sciences.

Myths of immortality — personal or institutional — distort scientists' conscious behavior. They steer the game of science in directions that have less utility than the scientists themselves may believe but that point away from an explicit confirmation of

the underlying fears that create these myths. The uncanny familiarity of death, always on the threshold of being rediscovered by the rules of science, obliges scientists unconsciously to subvert the rules of their game, turning away from some of their most important discoveries.

The denial of the fear of nature's terrible power of mortality, the projection of the suppressed wish not to die into a vision of nature as capable of bestowing immortality; these are the marks of a masked unconscious creating a biomedical science at war with its own stated purposes. When scientists say “give us your bodies, and we will cure you,” they have found a way to deal with an otherwise unbearable ambivalence toward their own experimentally vulnerable existence. They protect themselves, not necessarily by curing anyone, but by gaining control of someone else's body if not their own. Freud, incidentally, recognized this role of medical science as the one “higher superstition” he himself believed in.

Institutional Immortality

In its disciplined way of looking at the natural world, science requires its practitioners to act as if they were observers, not participants. The first and last scientific instrument, the one that must be used in every experiment, is the scientist's brain; scientists who choose the human body and mind as their playing field cannot fully meet this requirement without dislodging themselves from their own bodies and minds. The strain of trying to meet a standard of dispassionate curiosity without flying into pieces imposes an irrational gap between the student of the brain and the brain of the student,

between the scientist and his or her body and mind. To deal with the emergence of this intolerable thought, medical scientists have created the myth that their instruments and procedures somehow free them from the boundaries of their minds and bodies. This is the myth of absolute rational control of the physician and scientist over their material, the notion that the metaphor of scientist as sculptor will not break down even when the sculptor and the sculpture are one and the same. This myth may work to keep thoughts repressed, but at the cost of requiring the belief in an invented, institutional immortality based on the dry fact of precedence.

Every discovery must have at least one discoverer, and many have more than one. As competing sculptors may race to clear the excess stone from blocks of marble to reveal their different visions of what lay hidden inside, competing scientists clear away layers of plausible models, racing to uncover a demonstrably accurate schematic explanation of a part of the natural world's inner workings. Consciously and conscientiously followed, these rules work; they permit at least some scientists to uncover the mechanisms and structures of the natural world, and they do permit a few to win the game.

The dream of winning takes on an obsessive quality in the medical sciences, where the subject of scientific study is the mind and body and the reality of mortality becomes unavoidable. The result is an obsessive hope: that a big enough win in the game of science will confer a form of immortality on the winner. Discoveries that set the agenda for the future work of a large group of other scientists do this after a fashion, permanently associating a scientist's name with an aspect of nature. Think of the Freudian

slip and the Watson-Crick model of DNA. Players in a game that can confer even this sort of immortality — however rarely — cannot be playing only for conscious stakes. In the medical sciences, the belief in winning immortality of this sort can become problematic when it supports the denial of an unpleasant biological reality, especially when that reality emerges from precedent-setting discoveries themselves.

It is not that science and medicine wish to avoid finding cures. It is that they are too strongly motivated by an irrational, unconscious need to cure death to be fully motivated by the lesser task of preventing and curing disease simply to put off the inevitable end of their patients' lives and, by extension, their own. There is a way for the life sciences to end their denial of their own unconscious, freeing it from the obfuscations and inefficiencies it creates today out of its own fantasies. Choices are necessary, and it is at the moment when choices are made that the scientific method departs from the wholly conscious tool of scientific experimentation and enters the human world in which all choices are made in a personal and social historical context, replete with emotional affects and barely remembered feelings.

An enlightened medical science would acknowledge that there are limits to conscious thought and to life itself that cannot be transcended by any rational agenda. It would then be able to stop making promises that it cannot keep, whether to itself or to the rest of us who pay its way. Having next acknowledged the unconscious memories of its practitioners and the shared fantasies they have generated, it would then be ready to find ways to diminish the influence of these fantasies on its conscious agendas.

Interdependence Instead of Immortality

Although the narratives of successful science — discoveries, we call them — are bounded by culture no less than any other narrative, the models they stem from, confirm, and alter are not. These models, the most recently adapted, current working hypotheses of science, float above all their previous narrative versions, persisting through time, never final. We live by such models because they mold the patterns of our thought. In Hamlet's soliloquies, Shakespeare gave us our way of seeing ourselves as having inner voices and developing through inner dialogue. In a similar way, the sciences continue to give us new and sometimes precarious perspectives from which to see ourselves. These, in time, become as completely taken for granted as the Shakespearean notion of a private monologue. In just this way Freud's unconscious and Darwin's natural selection have not merely been added to our vocabulary. They have become aspects of the way we understand ourselves; it is left for scientists to learn that these insights of self-understanding apply to them as well.

For example, the denial of mortality is often accompanied by the denial of another aspect of the human genetic birthright, that we are intrinsically social beings. The mind is the product of social interactions; there would not be enough DNA in the world to encode a single mind. From birth on, minds develop in brains by the imitation of other minds, partly but not solely the minds of biological parents. Most of the few behaviors wired into our genes at birth maintain and thicken the bonds through which this imitation can proceed. The current biomedical model of a person as an autonomous object lacks a

proper respect for these social interactions. It severs the patient from family and social context, and it devalues preventive — social — medicine to an afterthought or a charity.

This denial of the reality of the social bond, like the denial of mortality, is an avoidable mistake of science. These and other strains that have opened between scientific medicine and society are not simply matters of resource allocation. They are signs that the knowledge of death and the need for others in one's life cannot be suppressed any longer, that the dreams of science are no longer satisfying even the dreamers.

In the United States the cost of medical care for eighty-four percent of the people is rapidly closing on a trillion — a million times a million — dollars each year, with no satisfactory national commitment to deliver it to the remaining sixteen percent. It is unlikely that the two intertwined mistakes of today's medical science can be corrected without a renewal of interest in preventive medicine. But what is to be prevented? Prevention has two meanings, depending on what is meant by a healthy person. If health is given a functional definition — you are healthy if you are free to work and think and play to the best of your born abilities — then preventive medicine — in the form of a vaccine, for instance — simply lowers the risk of developing a disease later in life.

If, on the other hand, one imagines there is an ideal of human form and function to which we all must aspire, then preventive medicine takes on a different, perhaps alluring, but in the end sinister purpose: the elimination of avoidable deviation from this ideal. Physicians have already begun to take on the role of gatekeepers, inadvertent agents of selection, eugenicists *manqué*, deciding on the relative value of different human

lives. Should that become even more common, definitions of disease will once again become less a matter of biology than of politics.

I believe that it is our ethical obligation to help scientists accept the validity of their own inner voices and see their research as an expression of their innermost feelings. This will be difficult, but it is not impossible. In a sense, it is just an extension inward of the fundamental methods of science. The great physicist Richard Feynman of Cal Tech saw the possibility as an obligation:

> It is our responsibility as scientists, knowing the great progress which comes from a satisfactory philosophy of ignorance, the great progress which is the fruit of freedom of thought, to proclaim the value of this freedom; to teach how doubt is not to be feared but welcomed and discussed; and to demand this freedom, as our duty to all coming generations.[4]**<Pls source this in a note>**

Today, few scientists accept this obligation, and the public knows it. If there s a particular and specific way in which we may contribute to the general good as Jews as well as scientists and ethicists, it is by embracing – as particularly Jewish – this notion of a "philosophy of ignorance." Every morning's prayers begin with "*Reshit hokhmay yirat HaShem*/The beginning of wisdom is awe of Heaven." That awe suits the philosophy of ignorance perfectly, and it is, for that reason, a strong antidote to the arrogance that denial

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[4] Feynman, Richard P. (1988). «*What Do You Care What Other People Think?*»*: Further Adventures of a Curious Character*, ed. Ralph Leighton, W.W. Norton and Company, New York, NY, pp. 240-248.

feeds. Absent awe, or modesty, the popular vision of scientists as white-coated practitioners of a pagan religion will remain all too accurate.