

I WAS HAPPY, WHEN I got the invitation to give the John Danz Lectures, to hear that there would be three lectures, as I had thought about these ideas at great length and wanted an opportunity not to express myself in only one lecture, but to develop the ideas slowly and carefully in three lectures. I found out that I developed them slowly and carefully, completely, in two.

I have completely run out of organized ideas, but I have a large number of uncomfortable feelings about the world which I haven't been able to put into some obvious, logical, and sensible form. So, since I already contracted to give three lectures, the only thing I can do is to give this potpourri of uncomfortable feelings without having them very well organized.

Perhaps someday, when I find a real deep reason behind them all, I will be able to give them in one sensible lecture instead of this thing. Also, in case you are beginning to believe that some of the things I said before are true because I am a scientist and according to the brochure that you get I won some awards and so forth, instead of your looking at the ideas themselves and judging them directly—in other words, you see, you have some feeling toward authority—I will get rid of that tonight. I dedicate this lecture to showing what ridiculous conclusions and rare statements such a man as myself can make. I wish, therefore, to destroy any image of authority that has previously been generated.

You see, a Saturday night is a night for entertainment, and that is... I think I have got the right spirit now and we can go on. It is always a good to entitle a lecture in a way that nobody can believe. It is either peculiar or it is just the opposite of what you would expect. And that is the reason, of course, for calling it "This Unscientific Age." Of course if you mean by scientific the applications of technology, there is no doubt that this is a scientific age. There is no doubt at all that today we have all kinds of scientific applications which are causing us all kinds of trouble as well as giving us all kinds of advantages. And so in that sense it certainly is a scientific age. If you mean by a scientific age an age in which science is developing rapidly and advancing fully as fast as it can, then this is definitely a scientific age.

The speed at which science has been developing for the last two hundred years has been ever increasing, and we reach a culmination of speed now. We are in particular in the biological sciences, on the threshold of the most remarkable discoveries. What they are going to be I am unable to tell you. Naturally, that is the excitement of it. And the excitement that comes from turning one stone over after another and finding underneath new discoveries has been going on now perpetually for several hundred years, and it is an ever-rising crescendo. This is, in that sense, definitely a scientific age. It has been called a heroic age, by a scientist, of course. Nobody else knows about it. Sometime when history looks back at this age they will see that it was a most dramatic and remarkable age, the transformation from not knowing much about the world to knowing a great deal more than was known before. But if you mean that this is an age of science in the sense that in art, in literature, and in people's attitudes and understandings, and so forth science plays a large part, I don't think it is a scientific age at all. You see, if you take the heroic age of the Greeks, say, there were poems about the military heroes. In the religious period of the Middle Ages, art was related directly to religion, and people's attitudes toward life were definitely closely knit to the religious viewpoints. It was a religious age. This is not a scientific age from that point of view.

Now, that there are unscientific things is not my grief. That's a nice word. I mean, that is not what I am worrying about, that there are unscientific things. That something is unscientific is not bad; there is nothing the matter with it. It is just unscientific. And scientific is limited, of course, to those things that we can tell about by trial and error. For example, there is the absurdity of the young these days chanting things about purple people eaters and hound dogs, something that we cannot criticize at all if we belong to the old flat foot floogie and a floy floy or the music goes down and around. Sons of mothers who sang about "come, Josephine, in my flying machine," which sounds

just about as modern as “I’d like to get you on a slow boat to China.” So in life, in gaiety, in emotion, in human pleasures and pursuits, and in literature and so on, there is no need to be scientific, there is no reason to be scientific. One must relax and enjoy life. That is not the criticism. That is not the point.

But if you do stop to think about it for a while, you will find that there are numerous, mostly trivial things which are unscientific, unnecessarily. For instance, there are extra seats in the front here, even though there are people [standing in the back]. While I was talking to some of the students in one of the classes, one man asked me a question, which was, “Are there any attitudes or experiences that you have when working in scientific information which you think might be useful in working with other information?”

(By the way, I will at the end say how much of the world today is sensible, rational, and scientific. It’s a great deal. So, I am only taking the bad parts first. It’s more fun. Then we soften it at the end. And I latched onto that as a nice organizing way to make my discussion of all the things that I think are unscientific in the world.)

I would like, therefore, to discuss some of the little tricks of the trade in trying to judge an idea. We have the advantage that we can ultimately refer the idea to experiment in the sciences, which may not be possible in other fields. But nevertheless, some of the ways of judging things, some of the experiences undoubtedly are useful in other ways. So, I start with a few examples. The first one has to do with whether a man knows what he is talking about, whether what he says has some basis or not. And my trick that I use is very easy. If you ask him intelligent questions—that is, penetrating, interested, honest, frank, direct questions on the subject, and no trick questions—then he quickly gets stuck. It is like a child asking naive questions. If you ask naive but relevant questions, then almost immediately the person doesn’t know the answer, if he is an honest man. It is important to appreciate that. And I think that I can illustrate one unscientific aspect of the world which would be probably very much better if it were more scientific. It has to do with politics. Suppose two politicians are running for president, and one goes through the farm section and is asked, “What are you going to do about the farm question?” And he knows right away—bang, bang, bang. Now he goes to the next campaigner who comes through. “What are you going to do about the farm problem?” “Well, I don’t know. I used to be a general, and I don’t know anything about farming. But it seems to me it must be a very difficult problem, because for twelve, fifteen, twenty years people have been struggling with it, and people say that they know how to solve the farm problem. And it must be a hard problem. So the way that I intend to solve the farm problem is to gather around me a lot of people who know something about it, to look at all the experience that we have had with this problem before, to take a certain amount of time at it, and then to come to some conclusion in a reasonable way about it. Now, I can’t tell you ahead of time what conclusion, but I can give you some of the principles I’ll try to use—not to make things difficult for individual farmers, if there are any special problems we will have to have some way to take care of them,” etc., etc., etc.

Now such a man would never get anywhere in this country, I think. Its never been tried, anyway. This is in the attitude of mind of the populace, that they have to have an answer and that a man who gives an answer is better than a man who gives no answer, when the real fact of the matter is, in most cases, it is the other way around. And the result of this of course is that the politician must give an answer. And the result of this is that political promises can never be kept. It is a mechanical fact; it is impossible. The result of that is that nobody believes campaign promises. And the result of that is a general disparaging of politics, a general lack of respect for the people who are trying to solve problems, and so forth. It’s all generated from the very beginning (maybe—this is a simple analysis). Its all generated, maybe, by the fact that the attitude of the populace is to try to find the answer instead of trying to find a man who has a way of getting at the answer.

Now we try another item that comes in the sciences—I give only one or two illustrations of each of the general ideas—and that is how to deal with uncertainty. There have been a lot of jokes made about ideas of uncertainty. I would like to remind you that you can be pretty sure of things even though you are uncertain, that you don't have to be so in-the-middle, in fact not at all in-the-middle. People say to me, "Well, how can you teach your children what is right and wrong if you don't know?" Because I'm pretty sure of what's right and wrong. I'm not absolutely sure; some experiences may change my mind. But I know what I would expect to teach them. But, of course, a child won't learn what you teach him. I would like to mention a somewhat technical idea, but it's the way, you see, we have to understand how to handle uncertainty. How does something move from being almost certainly false to being almost certainly true? How does experience change? How do you handle the changes of your certainty with experience? And it's rather complicated, technically, but I'll give a rather simple, idealized example.

You have, we suppose, two theories about the way something is going to happen, which I will call "Theory A" and "Theory B." Now it gets complicated. Theory A and Theory B. Before you make any observations, for some reason or other, that is, your past experiences and other observations and intuition and so on, suppose that you are very much more certain of Theory A than of Theory B—much more sure. But suppose that the thing that you are going to observe is a test. According to Theory A, nothing should happen. According to Theory B, it should turn blue. Well, you make the observation, and it turns sort of a greenish. Then you look at Theory A, and you say, "It's very unlikely," and you turn to Theory B, and you say, "Well, it should have turned sort of blue, but it wasn't impossible that it should turn sort of greenish color." So the result of this observation, then, is that Theory A is getting weaker, and Theory B is getting stronger. And if you continue to make more tests, then the odds on Theory B increase. Incidentally, it is not right to simply repeat the same test over and over and over and over, no matter how many times you look and it still looks greenish, you haven't made up your mind yet. But if you find a whole lot of other things that distinguish Theory A from Theory B that are different, then by accumulating a large number of these, the odds on Theory B increase.

Example. I'm in Las Vegas, suppose. And I meet a mind reader, or, let's say, a man who claims not to be a mind reader, but more technically speaking to have the ability of telekinesis, which means that he can influence the way things behave by pure thought. This fellow comes to me, and he says, "I will demonstrate this to you. We will stand at the roulette wheel and I will tell you ahead of time whether it is going to be black or red on every shot."

I believe, say, before I begin, it doesn't make any difference what number you choose for this. I happen to be prejudiced against mind readers from experience in nature, in physics. I don't see, if I believe that man is made out of atoms and if I know all of the—most of the—ways atoms interact with each other, any direct way in which the machinations in the mind can affect the ball. So from other experience and general knowledge, I have a strong prejudice against mind readers. Million to one.

Now we begin. The mind reader says it's going to be black. It's black. The mind reader says it's going to be red. It's red. Do I believe in mind readers? No. It could happen. The mind reader says it's going to be black. It's black. The mind reader says it's going to be red. It's red. Sweat. I'm about to learn something. This continues, let us suppose, for ten times. Now it's possible by chance that that happened ten times, but the odds are a thousand to one against it. Therefore, I now have to conclude that the odds that a mind reader is really doing it are a thousand to one that he's not a mind reader still, but it was a million to one before. But if I get ten more, you see, he'll convince me. Not quite. One must always allow for alternative theories. There is another theory that I should have mentioned before. As we went up to the roulette table, I must have thought in my mind of the possibility that there is collusion between the so-called mind reader and the people at the table.

That's possible. Although this fellow doesn't look like he's got any contact with the Flamingo Club, so I suspect that the odds are a hundred to one against that. However, after he has run ten times favorable, since I was so prejudiced against mind reading, I conclude it's collusion. Ten to one. That it's collusion rather than accident, I mean, is ten to one, but rather more likely collusion than not is still 10,000 to one. How is he ever going to prove he's a mind reader to me if I still have this terrible prejudice and now I claim it's collusion? Well, we can make another test. We can go to another club.

We can make other tests. I can buy dice. And we can sit in a room and try it. We can keep on going and get rid of all the alternative theories. It will not do any good for that mind reader to stand in front of that particular roulette table ad infinitum. He can predict the result, but I only conclude it is collusion.

But he still has an opportunity to prove he's a mind reader by doing other things. Now suppose that we go to another club, and it works, and another one and it works. I buy dice and it works. I take him home and I build a roulette wheel; it works. What do I conclude? I conclude he is a mind reader. And that's the way, but not certainty, of course. I have certain odds. After all these experiences I conclude he really was a mind reader, with some odds. And now, as new experiences grow, I may discover that there's a way of blowing through the corner of your mouth unseen, and so on. And when I discover that, the odds shift again, and the uncertainties always remain. But for a long time it is possible to conclude, by a number of tests, that mind reading really exists. If it does, I get extremely excited, because I didn't expect it before. I learned something that I did not know, and as a physicist would love to investigate it as a phenomenon of nature. Does it depend upon how far he is from the ball? What about if you put sheets of glass or paper or other materials in between? That's the way all of these things have been worked out, what magnetism is, what electricity is. And what mind reading is would also be analyzable by doing enough experiments.

Anyway, there is an example of how to deal with uncertainty and how to look at something scientifically. To be prejudiced against mind reading a million to one does not mean that you can never be convinced that a man is a mind reader. The only way that you can never be convinced that a man is a mind reader is one of two things: If you are limited to a finite number of experiments, and he won't let you do any more, or if you are infinitely prejudiced at the beginning that it's absolutely impossible.

Now, another example of a test of truth, so to speak, that works in the sciences that would probably work in other fields to some extent is that if something is true, really so, if you continue observations and improve the effectiveness of the observations, the effects stand out more obviously. Not less obviously. That is, if there is something really there, and you can't see good because the glass is foggy, and you polish the glass and look clearer, then it's more obvious that it's there, not less. I give an example. A professor, I think somewhere in Virginia, has done a lot of experiments for a number of years on the subject of mental telepathy, the same kind of stuff as mind reading. In his early experiments the game was to have a set of cards with various designs on them (you probably know all this, because they sold the cards and people used to play this game), and you would guess whether it's a circle or a triangle and so on while someone else was thinking about it. You would sit and not see the card, and he would see the card and think about the card and you'd guess what it was. And in the beginning of these researches, he found very remarkable effects. He found people who would guess ten to fifteen of the cards correctly, when it should be on the average only five. More even than that. There were some who would come very close to a hundred percent in going through all the cards. Excellent mind readers.

A number of people pointed out a set of criticisms. One thing, for example, is that he didn't count all the cases that didn't work. And he just took the few that did, and then you can't do statistics

anymore. And then there were a large number of apparent clues by which signals inadvertently, or advertently, were being transmitted from one to the other.

Various criticisms of the techniques and the statistical methods were made by people. The technique was therefore improved. The result was that, although five cards should be the average, it averaged about six and a half cards over a large number of tests. Never did he get anything like ten or fifteen or twenty – five cards. Therefore, the phenomenon is that the first experiments are wrong. The second experiments proved that the phenomenon observed in the first experiment was nonexistent. The fact that we have six and a half instead of five on the average now brings up a new possibility, that there is such a thing as mental telepathy, but at a much lower level. It's a different idea, because, if the thing was really there before, having improved the methods of experiment, the phenomenon would still be there. It would still be fifteen cards. Why is it down to six and a half? Because the technique improved. Now it still is that the six and a half is a little bit higher than the average of statistics, and various people criticized it more subtly and noticed a Couple of other slight effects which might account for the results. It turned out that people would get tired during the tests, according to the professor. The evidence showed that they were getting a little bit lower on the average number of agreements. Well, if you take out the cases that are low, the laws of statistics don't work, and the average is a little higher than the five, and so on. So if the man was tired, the last two or three were thrown away. Things of this nature were improved still further. The results were that mental telepathy still exists, but this time at 5.1 on the average, and therefore all the experiments which indicated 6.5 were false. Now what about the five? . . . Well, we can go on forever, but the point is that there are always errors in experiments that are subtle and unknown. But the reason that I do not believe that the researchers in mental telepathy have led to a demonstration of its existence is that as the techniques were improved, the phenomenon got weaker. In short, the later experiments in every case disproved all the results of the former experiments. If remembered that way, then you can appreciate the situation.

There has been, of course, some considerable prejudice against mental telepathy and things of this kind, because of its arising in the mystic business of spiritualism and all kinds of hocus-pocus in the nineteenth century. Prejudices have a tendency to make it harder to prove something, but when something exists, it can nevertheless often lift itself out.

One of the interesting examples is the phenomenon of hypnotism. It took an awful lot to convince people that hypnotism really existed. It started with Mr. Mesmer who was curing people of hysteria by letting them sit around bathtubs with pipes that they would hold onto and all kinds of things. But part of the phenomenon was a hypnotic phenomenon, which had not been recognized as existing before. And you can imagine from this beginning how hard it was to get anybody to pay enough attention to do enough experiments. Fortunately for us, the phenomenon of hypnotism has been extracted and demonstrated beyond a doubt even though it had weird beginnings. So it's not the weird beginnings which make the thing that people are prejudiced against. They start prejudiced against it, but after the investigation, then you could change your mind.

Another principle of the same general idea is that the effect we are describing has to have a certain permanence or constancy of some kind, that if a phenomenon is difficult to experiment with, if seen from many sides, it has to have some aspects which are more or less the same.

If we come to the case of flying saucers, for example, we have the difficulty that almost everybody who observes flying saucers sees something different, unless they were previously informed of what they were supposed to see. So the history of flying saucers consists of orange balls of light, blue spheres which bounce on the floor, gray fogs which disappear, gossamer-like streams which evaporate into the air, tin, round flat things out of which objects come with funny shapes that are something like a human being.

If you have any appreciation for the complexities of nature and for the evolution of life on earth, you can understand the tremendous variety of possible forms that life would have. People say life can't exist without air, but it does under water; in fact it started in the sea. You have to be able to move around and have nerves. Plants have no nerves. Just think a few minutes of the variety of life that there is. And then you see that the thing that comes out of the saucer isn't going to be anything like what anybody describes. Very unlikely. It's very unlikely that flying saucers would arrive here, in this particular era, without having caused something of a stir earlier. Why didn't they come earlier? Just when we're getting scientific enough to appreciate the possibility of traveling from one place to another, here come the flying saucers.

There are various arguments of a not complete nature that indicate some doubt that the flying saucers are coming from Venus—in fact, considerable doubt. So much doubt that it is going to take a lot of very accurate experiments, and the lack of consistency and permanency of the characteristics of the observed phenomenon means that it isn't there. Most likely. It's not worth paying much more attention to, unless it begins to sharpen up.

I have argued flying saucers with lots of people. (Incidentally, I must explain that because I am a scientist does not mean that I have not had contact with human beings. Ordinary human beings. I know what they are like. I like to go to Las Vegas and talk to the show girls and the gamblers and so on. I have banged around a lot in my life, so I know about ordinary people.) Anyway, I have to argue about flying saucers on the beach with people, you know. And I was interested in this: they keep arguing that it is possible. And that's true. It is possible. They do not appreciate that the problem is not to demonstrate whether it's possible or not but whether it's going on or not. Whether it's probably occurring or not, not whether it could occur.

That brings me to the fourth kind of attitude toward ideas, and that is that the problem is not what is possible. That's not the problem. The problem is what is probable, what is happening. It does no good to demonstrate again and again that you can't disprove that this could be a flying saucer. We have to guess ahead of time whether we have to worry about the Martian invasion. We have to make a judgment about whether it is a flying saucer, whether it's reasonable, whether it's likely. And we do that on the basis of a lot more experience than whether it's just possible, because the number of things that are possible is not fully appreciated by the average individual. And it is also not clear, then, to them how many things that are possible must not be happening. That it's impossible that everything that is possible is happening. And there is too much variety, so most likely anything that you think of that is possible isn't true. In fact that's a general principle in physics theories: no matter what a guy thinks of, it's almost always false. So there have been five or ten theories that have been right in the history of physics, and those are the ones we want. But that doesn't mean that everything's false. We'll find out.

To give an example of a case in which trying to find out what is possible is mistaken for what is probable, I could consider the beatification of Mother Seaton. There was a saintly woman who did very many good works for many people. There is no doubt about that—excuse me, there's very little doubt about that. And it has already been announced that she has demonstrated heroism of virtues. At that stage in the Catholic system for determining saints, the next question is to consider miracles. So the next problem we have is to decide whether she performed miracles.

There was a girl who had acute leukemia, and the doctors don't know how to cure her. In the duress and troubles of the family in the last minutes, many things are tried—different medicines, all kinds of things. Among other things is the possibility of pinning a ribbon which has touched a bone of Mother Seaton to the sheet of the girl and also arranging that several hundred people pray for her health. And the result is that she—no, not the result—then she gets better from leukemia.

A special tribunal is arranged to investigate this. Very formal, very careful, very scientific. Everything has to be just so. Every question has to be asked very carefully. Everything that is asked is written down in a book very carefully. There are a thousand pages of writing, translated into Italian when it got to the Vatican. Wrapped in special strings, and so on. And the tribunal asks the doctors in the case what this was like. And they all agreed that there was no other case, that this was completely unusual, that at no time before had somebody with this kind of leukemia had the disease stopped for such a long period of time. Done. True, we don't know what happened. Nobody knows what happened. It was possible it was a miracle. The question is not whether it was possible it was a miracle. It is only a question of whether it is probable it was a miracle. And the problem for the tribunal is to determine whether it is probable that it is a miracle. It's a question to determine whether Mother Seaton had anything to do with it. Oh, that they did. In Rome. I didn't find out how they did it, but that's the crux of the matter.

The question is whether the cure had anything to do with the process associated with the praying of Mother Seaton. In order to answer a question like that, one would have to gather all cases in which prayers had been given in the favor of Mother Seaton for the cures of various people, in various states of disease. They would then have to compare the success of the cure of these people with the average cure of people for whom such prayers were not made, and so forth. It's an honest, straightforward way to do it, and there is nothing dishonest and nothing sacrilegious about it, because if it's a miracle, it will hold up. And if it's not a miracle, the scientific method will destroy it.

The people who study medicine and try to cure people are interested in every method that they can find. And they have developed clinical techniques in which (all these problems are very difficult) they are trying all kinds of medicines too, and the woman got better. She also had chicken pox just before she got better. Has that got anything to do with it? So there is a definite clinical way to test what it is that might have something to do with it—by making comparisons and so forth. The problem is not to determine that something surprising happens. The problem is to make really good use of that to determine what to do next, because if it does turn out that it has something to do with the prayers of Mother Seaton, then it is worthwhile exhuming the body, which has been done, collecting the bones, touching many ribbons to the bones, so as to get secondary things to tie on other beds.

I now turn to another kind of principle or idea, and that is that there is no sense in calculating the probability or the chance that something happens after it happens. A lot of scientists don't even appreciate this. In fact, the first time I got into an argument over this was when I was a graduate student at Princeton, and there was a guy in the psychology department who was running rat races. I mean, he has a T-shaped thing, and the rats go, and they go to the right, and the left, and so on. And it's a general principle of psychologists that in these tests they arrange so that the odds that the things that happen happen by chance is small, in fact, less than one in twenty. That means that one in twenty of their laws is probably wrong. But the statistical ways of calculating the odds, like coin flipping if the rats were to go randomly right and left, are easy to work out. This man had designed an experiment which would show something which I do not remember, if the rats always went to the right, let's say. I can't remember exactly. He had to do a great number of tests, because, of course, they could go to the right accidentally, so to get it down to one in twenty by odds, he had to do a number of them. And it's hard to do, and he did his number. Then he found that it didn't work. They went to the right, and they went to the left, and so on. And then he noticed, most remarkably, that they alternated, first right, then left, then right, then left. And then he ran to me, and he said, "Calculate the probability for me that they should alternate, so that I can see if it is less than one in twenty." I said, "It probably is less than one in twenty, but it doesn't count." He said, "Why?" I said, "Because it doesn't make any sense to calculate after the event. You see, you found the peculiarity, and so you selected the peculiar case."

For example, I had the most remarkable experience this evening. While coming in here, I saw license plate ANZ 912. Calculate for me, please, the odds that of all the license plates in the state of Washington I should happen to see ANZ 912. Well, it's a ridiculous thing. And, in the same way, what he must do is this: The fact that the rat directions alternate suggests the possibility that rats alternate. If he wants to test this hypothesis, one in twenty, he cannot do it from the same data that gave him the clue. He must do another experiment all over again and then see if they alternate. He did, and it didn't work.

Many people believe things from anecdotes in which there is only one case instead of a large number of cases. There are stories of different kinds of influences. Things that happened to people, and they all remember, and how do you explain that, they say. I can remember things in my life, too. And I give two examples of most remarkable experiences.

The first was when I was in a fraternity at M.I.T. I was upstairs typewriting a theme on something about philosophy. And I was completely engrossed, not thinking of anything but the theme, when all of a sudden in a most mysterious fashion, there swept through my mind the idea: my grandmother has died. Now, of course, I exaggerate slightly, as you should in all such stories. I just sort of half got the idea for a minute. It wasn't something strong, but I exaggerate slightly. That's important. Immediately after that the telephone rang downstairs. I remember this distinctly for the reason you will now hear. The man answered the telephone, and he called, "Hey, Pete!" My name isn't Peter. It was for somebody else. My grandmother was perfectly healthy, and there's nothing to it. Now what we have to do is to accumulate a large number of these in order to fight the few cases when it could happen. It could happen. It might have occurred. Its not impossible, and from then on am I supposed to believe in the miracle that I can tell when my grandmother is dying from something in my head? Another thing about these anecdotes is that all the conditions are not described. And for that reason I describe another, less happy, circumstance.

I met a girl at about thirteen or fourteen whom I loved very much, and we took about thirteen years to get married. It's not my present wife, as you will see. And she got tuberculosis and had it, actually, for several years. And when she got tuberculosis I gave her a clock which had nice big numbers that turned over rather than ones with a dial, and she liked it. The day she got sick I gave it to her, and she kept it by the side of her bed for four, five, six years while she got sicker and sicker. And ultimately she died. She died at 9:22 in the evening. And the clock stopped at 9:22 in the evening and never went again. Fortunately, I noticed some part of the anecdote I have to tell you. After five years the clock gets kind of weak in the knees. Every once in a while I had to fix it, so the wheels were loose. And secondly, the nurse who had to write on the death certificate the time of death, because the light was low in the room, took the clock and turned it up a little bit to see the numbers a little bit better and put it down. If I hadn't noticed that, again I would be in some trouble. So one must be very careful in such anecdotes to remember all the conditions, and even the ones that you don't notice may be the explanation of the mystery.

So, in short, you can't prove anything by one occurrence, or two occurrences, and so on. Everything has to be checked out very carefully. Otherwise you become one of these people who believe all kinds of crazy stuff and doesn't understand the world they're in. Nobody understands the world they're in, but some people are better off at it than others.

The next kind of technique that's involved is statistical sampling. I referred to that idea when I said they tried to arrange things so that they had one in twenty odds. The whole subject of statistical sampling is somewhat mathematical, and I won't go into the details. The general idea is kind of obvious. If you want to know how many people are taller than six feet tall, then you just pick people out at random, and you see that maybe forty of them are more than six feet so you guess that maybe everybody is. Sounds stupid. Well, it is and it isn't. If you pick the hundred out by seeing which

ones come through a low door, you're going to get it wrong. If you pick the hundred out by looking at your friends you'll get it wrong because they're all in one place in the country. But if you pick out a way that as far as anybody can figure out has no connection with their height at all, then if you find forty out of a hundred, then, in a hundred million there will be more or less forty million. How much more or how much less can be worked out quite accurately. In fact, it turns out that to be more or less correct to 1 percent, you have to have 10,000 samples. People don't realize how difficult it is to get the accuracy high. For only 1 or 2 percent you need 10,000 tries.

The people who judge the value of advertising in television use this method. No, they think they use this method. It's a very difficult thing to do, and the most difficult part of it is the choice of the samples. How they can arrange to have an average guy put into his house this gadget by which they remember which TV programs he's looking at, or what kind of a guy an average guy is who will agree to be paid to write in a log, and how accurately he writes in the log what he's listening to every fifteen minutes when a bell goes off, we don't know. We have no right, therefore, to judge from the thousand, or 10,000, and that's all it is, people who do this, who study what the average person is looking at, because there's no question at all that the sample is off. This business of statistics is well known, and the problem of getting a good sample is a very serious one, and everybody knows about it, and it's a scientifically OK business. Except if you don't do it. The conclusion from all the researchers is that all people in the world are as dopey as can be, and the only way to tell them anything is to perpetually insult their intelligence. This conclusion may be correct. On the other hand, it may be false. And we are making a terrible mistake if it is false. It is, therefore, a matter of considerable responsibility to get straightened out on how to test whether or not people pay attention to different kinds of advertising.

As I say, I know a lot of people. Ordinary people. And I think their intelligence is being insulted. I mean there's all kinds of things. You turn on the radio; if you have any soul, you go crazy. People have a way—I haven't learned it yet—of not listening to it. I don't know how to do it. So in order to prepare this talk I turned on the radio for three minutes when I was at home, and I heard two things.

First, I turned it on and I heard Indian music—Indians from New Mexico, Navajos. I recognized it. I had heard them in Gallup, and I was delighted. I won't give an imitation of the war chant, although I would like to. I'm tempted. It's very interesting, and it's deep in their religion, and it's something that they respect. So I would report honestly that I was pleased to see that on the radio there was something interesting. That was cultural. So we have to be honest. If we're going to report, you listen for three minutes, that's what you hear. So I kept listening. I have to report that I cheated a little bit. I kept listening because I liked it; it was good. It stopped. And a man said, "We are on the warpath against automobile accidents." And then he went on and said how you have to be careful in automobile accidents. That's not an insult to intelligence; it's an insult to the Navajo Indians, and to their religion and their ideas. And so I listened until I heard that there is a drink of some kind, I think it's called Pepsi-Cola, for people who think young. So I said, all right, that's enough. I'll think about that a while. First of all, the whole idea is crazy. What is a person who thinks young? I suppose it is a person who likes to do things that young people like to do. Alright, let them think that. Then this is a drink for such people. I suppose that the people in the research department of the drink company decided how much lime to put in as follows: "Well, we used to have a drink that was just an ordinary drink, but we have to rearrange it, not for ordinary people but for special people who think young. More sugar." The whole idea that a drink is especially for people who think young is an absolute absurdity.

So as a result of this, we get perpetually insulted, our intelligence always insulted. I have an idea of how to beat it. People have all kinds of plans, you know, and the F.T.C. is trying to straighten it out. I've got an easy plan. Suppose that you purchased the use for thirty days of twenty-six billboards in Greater Seattle, eighteen of them lighted. And you put onto the billboards a sign which says, "Has

your intelligence been insulted? Don't buy the product." And then you buy a few spots on the television or the radio. In the middle of some program a man comes up and says, "Pardon me, I'm sorry to interrupt you, but if you find that any of the advertising that you hear insults your intelligence or in any way disturbs you, we would advise you not to buy the product," and things will be straightened out as quickly as it can be. Thank you.

Now if anybody has any money that they want to throw around, I'd advise that as an experiment to find out about the intelligence of the average television viewer. It's an interesting question. It's a quick shortcut to find out about their intelligence. But maybe it's a little bit expensive.

You say, "It's not very important. The advertisers have to sell their wares," and so on and so on. On the other hand, the whole idea that the average person is unintelligent is a very dangerous idea. Even if it's true, it shouldn't be dealt with the way it's dealt with.

Newspaper reporters and commentators—there is a large number of them who assume that the public is stupider than they are, that the public cannot understand things that they [the reporters and the commentators] cannot understand. Now that is ridiculous. I'm not trying to say they're dumber than the average man, but they're dumber in some way than somebody else. If I ever have to explain something scientific to a reporter, and he says what is the idea? Well, I explain it in words of one syllable, as I would explain it to my neighbor. He doesn't understand it, which is possible, because he's brought up differently — he doesn't fix washing machines, he doesn't know what a motor is, or something. In other words, he has no technical experience. There are lots of engineers in the world. There are lots of mechanically minded people. There are lots of people who are smarter than the reporter, say, in science, for example. It is, therefore, his duty to report the thing, whether he understands it or not, accurately and in the way it's been given. The same goes in economics and other situations. The reporters appreciate the fact that they don't understand the complicated business about international trade, but they report, more or less, what somebody says, pretty closely. But when it comes to science, for some reason or another, they will pat me on the head and explain to me that the dopey people aren't going to understand it because he, dope, can't understand it. But I know that some people can understand it. Not everybody who reads the newspaper has to understand every article in the newspaper. Some people aren't interested in science. Some are. At least they could find out what it's all about instead of discovering that an atomic bomb was used that came out of a machine that weighed seven tons. I can't read the articles in the paper. I don't know what they mean. I don't know what kind of a machine it was just because it weighed seven tons. And there are now sixty-two kinds of particles, and I would like to know what atomic bomb he is referring to.

This whole business of statistical sampling and the determining of the properties of people by this manner is a very serious business altogether. It's coming into its own, but it's used very often, and we have to be very, very careful with it. It's used for choice of personnel—by giving examinations to people—marriage counseling, and things of this kind. It's used to determine whether people get into college, in a way that I am not in favor of, but I will leave my arguments on this. I will address them to the people who decide who gets into Caltech. And after I have had my arguments, I will come back and tell you something about it. But this has one serious feature, among others, aside from the difficulties of sampling. There is a tendency, then, to use only what can be measured as a criterion. That is, the spirit of the man, the way he feels toward things, may be difficult to measure. There is some tendency to have interviews and to try to correct this. So much the better. But it's easier to have more examinations and not have to waste the time with the interviews, and the result is that only those things which can be measured, actually which they think they can measure, are what count, and a lot of good things are left out, a lot of good guys are missed. So it's a dangerous business and has to be very carefully checked. The things like marriage questions, "How are you getting along with your husband," and so on, that appear in magazines are all nonsense. They go

something like this: “This has been tested on a thousand couples.” And then you can tell how they answered and how you answered and tell if you are happily married. What you do is the following. You make up a bunch of questions, like “Do you give him breakfast in bed?” and so on and so on. And then you give this questionnaire to a thousand people. And you have an independent way of telling whether they are happily married, like asking them, or something. But never mind. It doesn’t make any difference what it is, even if the test is perfect. That’s not the part where the trouble is. Then you do the following. You see about all the ones who are happy—how did they answer about the breakfast in bed, how did they answer about this, how did they answer about that? You see it’s exactly the same as my rat race, with right and left. They have decided on the odds of the thing in terms of the one sample. What they ought to do to be honest is to take the same test that has now been designed, in which they know how to make the score. They’ve decided this gets five points, that gets ten points, in such a way that the thousand that they tried it on get marvelous scores if they are happy and lousy scores if they’re not. But now is the test of the test. They cannot use the sample which determined the scoring for them. That’s going backwards. They must take the test to another thousand people, independently, and run it out to see whether the happy ones are the ones that score high, or not. They do not do that, because it’s too much trouble, A, and the few times that they tried it, B, it showed that the test was no good.

Now, looking at the troubles that we have with all the unscientific and peculiar things in the world, there are a number of them which cannot be associated with difficulties in how to think, I think, but are just due to some lack of information. In particular, there are believers in astrology, of which, no doubt, there are a number here. Astrologists say that there are days when it’s better to go to the dentist than other days. There are days when it’s better to fly in an airplane, for you, if you are born on such a day and such and such an hour. And it’s all calculated by very careful rules in terms of the position of the stars. If it were true it would be very interesting. Insurance people would be very interested to change the insurance rates on people if they follow the astrological rules, because they have a better chance when they are in the airplane. Tests to determine whether people who go on the day that they are not supposed to go are worse off or not have never been made by the astrologers. The question of whether it’s a good day for business or a bad day for business has never been established. Now what of it?

Maybe it’s still true, yes. On the other hand, there’s an awful lot of information that indicates that it isn’t true. Because we have a lot of knowledge about how things work, what people are, what the world is, what those stars are, what the planets are that you are looking at, what makes them go around more or less, where they’re going to be in the next 2000 years is completely known. They don’t have to look up to find out where it is. And furthermore, if you look very carefully at the different astrologers they don’t agree with each other, so what are you going to do? Disbelieve it. There’s no evidence at all for it. It’s pure nonsense. The only way you can believe it is to have a general lack of information about the stars and the world and what the rest of the things look like. If such a phenomenon existed it would be most remarkable, in the face of all the other phenomena that exist, and unless someone can demonstrate it to you with a real experiment, with a real test, took people who believe and people who didn’t believe and made a test, and so on, then there’s no point in listening to them. Tests of this kind, incidentally, have been made in the early days of science. It’s rather interesting. I found out that in the early days, like in the time when they were discovering oxygen and so on, people made such experimental attempts to find out, for example, whether missionaries— it sounds silly; it only sounds silly because you’re afraid to test it—whether good people like missionaries who pray and so on were less likely to be in a shipwreck than others. And so when missionaries were going to far countries, they checked in the shipwrecks whether the missionaries were less likely to drown than other people. And it turned out that there was no difference. So lots of people don’t believe that it makes any difference.

There are, if you turn on the radio—I don’t know how it is up here; it must be the same— in

California you hear all kinds of faith healers. I've seen them on television. It's another one of those things that it exhausts me to try to explain why it's rather a ridiculous proposition. There is, in fact, an entire religion that's respectable, so called, that's called Christian Science, that's based on the idea of faith healing. If it were true, it could be established, not by the anecdotes of a few people but by the careful checks, by the technically good clinical methods which are used on any other way of curing diseases. If you believe in faith healing, you have a tendency to avoid other ways of getting healed. It takes you a little longer to get to the doctor, possibly. Some people believe it strongly enough that it takes them longer to get to the doctor. It's possible that the faith healing isn't so good. It's possible—we are not sure—that it isn't. And it's therefore possible that there is some danger in believing in faith healing, that it's not a triviality, not like astrology wherein it doesn't make a lot of difference. It's just inconvenient for the people who believe in it that they have to do things on certain days. It may be, and I would like to know—it should be investigated—everybody has a right to know—whether more people have been hurt or helped by believing in Christ's ability to heal; whether there is more healing or harming by such a thing. It's possible either way. It should be investigated. It shouldn't be left lying for people to believe in without an investigation.

Not only are there faith healers on the radio, there are also radio religion people who use the Bible to predict all kinds of phenomena that are going to happen. I listened intrigued to a man who in a dream visited God and received all kinds of special information for his congregation, etc. Well, this unscientific age . . . But I don't know what to do with that one. I don't know what rule of reasoning to use to show right away that it's nutty. I think it just belongs to a general lack of understanding of how complicated the world is and how elaborate and how unlikely it would be that such a thing would work.

But I can't disprove, of course, without investigating more carefully. Maybe one way would be always to ask them how do they know it's true and to remember maybe that they are wrong. Just remember that much anyway, because you may keep yourself from sending in too much money.

There are also, of course, in the world a number of phenomena that you cannot beat that are just the result of a general stupidity. And we all do stupid things, and we know some people do more than others, but there is no use in trying to check who does the most. There is some attempt to protect this by government regulation, to protect this stupidity, but it doesn't work a hundred percent.

For example, I went on a visit to one of the desert sites to buy land. You know they sell land, these promoters—there's a new city going to be built. It's exciting. It's marvelous. You must go. Just imagine yourself in a desert with nothing but some flags poked here in the ground with numbers on them and street signs with names. And so you drive in the car across the desert to find the fourth street and so on to get to the lot 369, which is the one for you, you're thinking. And you stand there kicking sand in this thing discussing with the salesman why it's advantageous to have a corner lot and how the driveway will be good because it will be easier to get into from that side. Worse, believe it or not, you find yourself discussing the beach club, which is going to be on that sea, what the rules of membership are and how many friends you're allowed to bring. I swear, I got into that condition.

So when the time comes to buy the land, it turns out that the state has made an attempt to help you. So they have a description of this particular thing that you have read, and the man who sells you the land says it's the law, we have to give you this to read. They give it to you to read, and it says that this is very much like many other real estate deals in the state of California and so on and so on and so on. And among other things, I read that although they say that they want to have fifty thousand people at this site, there is not water enough for a number which I better not say or I'll get accused of libel, but it was very much less—I can't remember it exactly—it was in the neighborhood of five thousand people, somewhere like that. So, of course they had noticed that this was in there before,

and they told us that they had just found water at another site, far away, that they were going to pump down. And when I asked about it, they explained to me very carefully that they had just discovered this and that they hadn't had time to get it into the brochure from the state. Hmmm.

I'll give another example of the same thing. I was in Atlantic City, and I went into one of these—well, it was sort of a store. There were a lot of seats, and people were sitting there listening to a man speaking. And he was very interesting. He knew all about food, and he was talking about nutrition, different things. I remember several of the important statements which he made, such as “even worms won't eat white flour.” That kind of stuff. It was good. It was interesting. It was true—maybe it wasn't true about the worms, but it was good stuff about proteins and so on. And then he went on and described the Federal Pure Food and Drug Act, and he explained how it protects you. He explained that on every product that claims to be a good health food that's supposed to help you with minerals and this and that, there must be a label on the bottle which tells exactly what's in it, what it does, and all claims must be explicit, so that if it's wrong, so on and so on. He gives them everything. I said, “How is he going to make any money? Out come the bottles. It comes out, finally, that he sells this special health food, of course, in a brownish bottle. And it just so happens that he has just come in, and he's been in a hurry, and he hasn't had time to put the labels on. And here are the labels that belong on the bottles, and here are the bottles, and he's in a hurry to sell them, and he gives you the bottle, and you stick it on yourself. That man had courage. He first explained what to do, what to worry about, and then he went ahead and did it.

I found another lecture which was somewhat analogous to that one. And that was the second Danz lecture given by myself. I started out by pointing out that things were completely unscientific, that things were uncertain, particularly in political matters, and that there were the two nations, Russia and the United States, at odds with each other. And then by some mystic hocus-pocus it came out that we were the good guys and they were the bad guys. Yet, at the beginning, there was no way to decide which was the better of the two. In fact, that was the main point of the lecture. So by some sort of magic I produced some kind of relative certainty out of uncertainty. I told you about the bottle with the labels, and then I came out on the other end with a label on my bottle. How did I do it? You have to think about it a little bit. One thing, of course, that we can be certain of, once we're uncertain, and that is that we are uncertain. Somebody says “No, maybe I'm sure.” Actually, though, the gimmick in that particular lecture, the weak point in the whole thing, the thing that requires further development and study is this one: I made an impassioned plea for the idea that it's good to have an open channel, that there's value in uncertainty, that it's more important to permit us to discover new things, rather than to choose a solution that we now make up—that to choose a solution, no matter how we choose it now is to choose a much worse thing than what we would get if we waited and worked things out. And that's where I made the choice, and I am not sure of that choice. Okay. I have now destroyed authority.

Associated with these problems of lack of information and so forth, but particularly lack of information, there are a number of phenomena that are more serious, I believe, than astrology.

I, in preparation for this lecture, investigated something that was in my town, in the shopping center. There was a store with a flag in front. And it's the Americanism Center, Altadena Americanism Center. And so I went into the Americanism Center to find out what it is, and it's a volunteer organization. And on the front outside, there is a Constitution and the Bill of Rights and so on, and a letter which explains their purpose, which is to maintain rights and so on, all in accordance with the Constitution and the Bill of Rights and so on. That's the general idea. What they do in there is simply educative. They have books that people could buy on the various subjects that help to teach the ideas of citizenship and so on, and they have, among other books, also Congressional records, pamphlets on Congressional investigations and so on, so that people who are studying these problems can read them. They have study groups which meet at night, and so on. So,

being interested in rights for people, I asked, since I said I didn't know very much about it, I would like a book on the problem of the freedom of the Negroes to vote in the South. There was nothing. Yes, there was. There was one thing which turned up later, two things which I saw out of the corner of my eye. One was what went on in Mississippi according to the Oxford city fathers, and the other was a little pamphlet called "The National Association for the Advancement of Colored People and Communism."

So I discussed it at some greater length to discover what was going on and talked to the lady for a while, and she explained among other things (we talked about many things— we did this on a friendly basis, you will be surprised to hear) that she was not a member of the Birch Society but there was something that you could say for the Birch Society, she saw some movie about it and so on, and there was something that she could say for it. You're not a fence sitter when you're in the Birch Society. At least you know what you're for, because you don't have to join it if you don't want to, and this is what Mr. Welch said, and this is the way the Birch Society is, and if you believe in this then you join, and if you don't believe in this then you shouldn't join. It sounds just like the Communist Party. It's all very well if they have no power. But if they have power, it's a completely different situation. I tried to explain to her that this is not the kind of freedom that was being talked about, that in any organization there ought to be the possibility of discussion. That fence sitting is an art, and it's difficult, and it's important to do, rather than to go headlong in one direction or the other. Its just better to have action, isn't it, than to sit on the fence? Not if you're not sure which way to go, it isn't.

So I bought a couple of things there, just at random that they had. One of the things was called "The Dan Smoot Report"—it's a good name—and it talked about the Constitution, and a general idea I'll outline: that the Constitution was right the way it was written in the first place. And all the modifications that have come in are just the mistakes. Fundamentalists, only not in the Bible but in the Constitution. And then it goes on to give the ratings of Congressmen in votes, how they voted. And it said, very specifically and after explaining about their ideas, "The following give the ratings of the congressmen and senators with regard to whether they vote for or against the Constitution." Mind you that these ratings are not just an opinion, but they are based on fact. They are a matter of voting record. Fact. There's no opinion at all. It's just the voting record, and, of course, each item is either for or against the Constitution. Naturally. Medicare is against the Constitution, and so on. I tried to explain that they violate their own principles. According to the Constitution there are supposed to be votes. It isn't supposed to be automatically determinable ahead of time on each one of the items what's right and what's wrong. Otherwise there wouldn't be the bother to invent the Senate to have the votes. As long as you have the votes at all, then the purpose of the votes is to try to make up your mind which is the way to go. And it isn't possible for somebody to determine by fact ahead of time what is the situation. It violates its own principle.

It starts out all right, with the good, and love, and Christ, and so on, and it builds itself up until it's afraid of an enemy. And then it forgets its original idea. It turns itself inside out and becomes absolutely contrary to the beginning. I believe that the people who start some of these things, especially the volunteer ladies of Altadena, have a good heart and understand a little bit that it's good, the Constitution, and so on, but they are led astray in the system of the thing. How, I can't exactly get at, and what to do to keep from doing this, I don't exactly know.

I went still further into the thing and found out what the study group was about, and if you don't mind I'll tell you what that was about. They gave me some papers. There were a lot of chairs, you see, in the room, and they explained to me, yes, that evening they had a study group, and they gave me a thing which described what they were going to study. And I made some notes from it. It had to do with the S.P.X.R.A. In 1943 the S.P.X. research associates—which turns out to be the ... well, I'll tell you what it turns out to be—came into being through the professional interest of intelligence

officers then on active duty in the armed forces of the United States concerning the Soviet revival of a long dormant tenth principle of warfare. Paralysis. See the evil. Dormant. Mysterious. Frightening. The mystic people of the military orders have had principles of warfare since the Roman legions. Number one. Number two. Number three. This is number ten. We don't have to know what number seven is. The whole idea that there are long dormant principles of warfare, much less that there is a tenth principle of warfare, is an absurdity. And then what is this principle of paralysis? How are they going to use the idea? The boogie man is now generated. How do you use the boogie man? You use the boogie man as follows: This educational program concerns itself with all the areas where Soviet pressure can be used to paralyze the American will to resist. Agriculture, arts, and cultural exchange. Science, education, information media, finance, economics, government, labor, law, medicine, and our armed forces, and religion, that most sensitive of areas. In other words, we now have an open machine for pointing out that everybody who says something that you don't agree with has been paralyzed by the mystic force of the tenth principle of warfare.

This is a phenomenon analogous to paranoia. It is impossible to disprove the tenth principle. It's only possible if you have a certain balance, a certain understanding of the world to appreciate that it's out of balance, to think that the Supreme Court—which turns out to be an “instrument of global conquest”—has been paralyzed. Everything is paralyzed. You see how fearful it becomes, the terrible power which is demonstrated again and again by one example after the other of this fearful force which is made up. This describes what a paranoia is like. A woman gets nervous. She begins to suspect that her husband is trying to make trouble for her. She doesn't like to let him into the house. He tries to get into the house, proves that he's trying to make trouble for her. He gets a friend to try to talk to her. She knows that it's a friend, and she knows in her mind, which is going to one side, that this is only further evidence of the terrible fright and the fear that she's building up in her mind. Her neighbors come over to console her for a while. It works fairly well, for a while. They go back to their houses. The friend of the husband goes to visit them. They are spoiled now, and they are going to tell her husband all the terrible things she said. Oh dear, what did she say? And he's going to be able to use them against her. She calls up the police department. She says, “I'm afraid.” She's locked in her house now. She says, “I'm afraid.” Somebody's trying to get into the house. They come, they try to talk to her, they realize that there is nobody trying to get into the house. They have to go away. She remembers that her husband was important in the city. She remembers that he had a friend in the police department. The police department is only part of the scheme. It only proves it once again. She looks through the window of the house, and she sees across the way someone stopping at a neighbor's house. What are they talking about? In the backyard, she sees something coming up over a bush. They're watching her with a telescope! It turns out later to be some children playing in the back with a stick. A continuous and perpetual buildup, until the entire population is involved. The lawyer that she called, she remembers, was the lawyer once for a friend of her husband's. The doctor who has been trying to get her to the hospital is now obviously on the side of the husband.

The only way out is to have some balance, to think that it's impossible that the whole city is against her, that everybody is going to pay attention to this husband of mine who's such a dope, that everybody's going to do all these things, that there's a complete accumulation. All the neighbors, everybody's against her. It's out of proportion. It's only out of proportion. How can you explain to somebody who hasn't got a sense of proportion?

And so it is with these people. They don't have a sense of proportion. And so they will believe in such a possibility as the Soviet tenth principle of warfare. The only way that I can think to beat the game is to point the following out. They're right. And like my friend with the bottle with the label, the Soviets are very, very ingenious and clever indeed. They even tell us what they're doing to us. You see, these people, these research associates are really in the hire of the Soviets who are using

this method of paralysis. And what they want us to do is to lose faith in the Supreme Court, to lose faith in the Agriculture Department, to lose faith in the scientists and all the people who help us in all kinds of ways and so on and so on, and lose faith in all sorts of ways, and it's a way that they have entered into this movement of freedom that everybody wanted, this thing with all the flags and the Constitution, and they've gotten in on it, and they're getting in there, and they're going to paralyze it. Proof. In their own words. S.P.X.R.A. has qualified, under oath, in the United States court as the leading, American authority on the tenth principle. Where did they get the information? There's only one place. From the Soviet Union.

This paranoia, this phenomenon—I shouldn't call it a paranoia, I'm not a doctor, I don't know—but this phenomenon is a terrible one, and it has caused mankind and individuals a terrible unhappiness.

And another example of the same thing is the famous Protocol of the Elders of Zion, which was a fake document. It was supposed to be a meeting of the old Jews and the leaders of Zion in which they had gotten together and cooked up a scheme for the domination of the world. International bankers, international, you know... a great big marvelous machine! Just out of proportion. But it wasn't so far out of proportion that people didn't believe it; and it was one of the strongest forces in the development of anti-Semitism.

What I am asking for in many directions is an abject honesty. I think that we should have a more abject honesty in political matters. And I think we'll be freer that way.

I would like to point out that people are not honest. Scientists are not honest at all, either. It's useless. Nobody's honest. Scientists are not honest. And people usually believe that they are. That makes it worse. By honest I don't mean that you only tell what's true. But you make clear the entire situation. You make clear all the information that is required for somebody else who is intelligent to make up their mind.

For example, in connection with nuclear testing, I don't know myself whether I am for nuclear testing or against nuclear testing. There are reasons on both sides. It makes radioactivity, and it's dangerous, and it's also very bad to have a war. But whether it's going to be more likely to have a war or less likely to have a war because you test, I don't know. Whether preparation will stop the war, or lack of preparation, I don't know. So I'm not trying to say I'm on either side. That's why I can be abjectly honest on this one. The big question comes, of course, whether there's a danger from radioactivity. In my opinion the greatest danger and the greatest question on nuclear testing is the question of its future effects. The deaths and the radioactivity which would be caused by the war would be so many times more than the nuclear testing that the effects that it would have in the future are far more important than the infinitesimal amount of radioactivity produced now. How infinitesimal is the amount, however? Radioactivity is bad. Nobody knows a good effect of general radioactivity. So if you increase the general amount of radioactivity in the air, you are producing something not good. Therefore nuclear testing in this respect produces something not good. If you are a scientist, then, you have the right and should point out this fact.

On the other hand, the thing is quantitative. The question is how much is not good? You can play games and show that you will kill 10 million people in the next 2000 years with it. If I were to walk in front of a car, hoping that I will have some more children in the future, I also will kill 10,000 people in the next 10,000 years, if you figure it out, from a certain way of calculating. The question is how big is the effect? And the last time ... (I wish I had—I should, of course, have checked these figures, but let me put it differently.) The next time you hear a talk, ask the questions which I point out to you, because I asked some questions the last time I heard a talk, and I can remember the answers, but I haven't checked them very recently, so I don't have any figures, but I at least asked the question. How much is the increase in radioactivity compared to the general variations in the

amount of radioactivity from place to place? The amounts of background radioactivity in a wooden building and a brick building are quite different, because the wood is less radioactive than the bricks.

It turns out that at the time that I asked this question, the difference in the effects was less than the difference between being in a brick and a wooden building. And the difference between being at sea level and being at 5000 feet altitude was a hundred times, at least, bigger than the extra radioactivity produced by the atomic bomb testing.

Now, I say that if a man is absolutely honest and wants to protect the populace from the effects of radioactivity, which is what our scientific friends often say they are trying to do, then he should work on the biggest number, not on the smallest number, and he should try to point out that the radioactivity which is absorbed by living in the city of Denver is so much more serious, is a hundred times bigger than the background from the bomb, that all the people of Denver ought to move to lower altitudes. The situation really is—don't get frightened if you live in Denver—it's small. It doesn't make much difference. It's only a tiny effect. But the effect from the bombs is less than the difference between being at low level and high level, I believe. I'm not absolutely sure. I ask you to ask that question to get some idea whether you should be very careful about not walking into a brick building, as careful as you are to try to stop nuclear testing for the sole reason of radioactivity. There are many good reasons that you may feel politically strong about, one way or the other. But that's another question. We are, in the scientific things, getting into situations in which we are related to the government, and we have all kinds of lack of honesty. Particularly, lack of honesty is in the reporting and description of the adventures of going to different planets and in the various space adventures. To take an example, we can take the Mariner II voyage to Venus. A tremendously exciting thing, a marvelous thing, that man has been able to send a thing 40 million miles, a piece of the earth at last to another place. And to get so close to it as to get a view that corresponds to being 20,000 miles away. It's hard for me to explain how exciting that is, and how interesting. And I've used up more time than I ought.

The story of what happened during the trip was equally interesting and exciting. The apparent breakdown. The fact that they had to turn all the instruments off for a while because they were losing power in the batteries and the whole thing would stop. And then they were able to turn it on again. The fact of how it was heating up. How one thing after the other didn't work and then began to work. All the accidents and the excitement of a new adventure. Just like sending Columbus, or Magellan, around the world. There were mutinies, and there were troubles and there were shipwrecks, and there was the whole works. And it's an exciting story. When it, for example, heated up, it was said in the paper, "It's heating up, and we're learning from that." What could we be learning? If you know something, you realize you can't learn anything. You put satellites up near the earth, and you know how much radiation you get from the sun . . . we know that. And how much do they get when they get near Venus? Its a definitely accurate law, well known, inverse square. The closer you get, the brighter the light. Easy. So it's easy to figure out how much white and black to paint the thing so that the temperature adjusts itself.

The only thing we learned was that the fact that it got hot was not due to anything else than the fact that the thing was made in a very great hurry at the last minute and some changes were made in the inside apparatus, so that there was more power developed in the inside and it got hotter than it was designed for. What we learned, therefore, was not scientific. But we learned to be a little bit careful about going in such a hurry on these things and keep changing our minds at the last minute. By some miracle the thing almost worked when it was there. It was meant to look at Venus by making a series of passes across the planet, looking like a television screen, twenty-one passes across the planet. It made three. Good. It was a miracle. It was a great achievement. Columbus said he was going for gold and spices. He got no gold and very little spices. But it was a very important and

very exciting moment. Mariner was supposed to go for big and important scientific information. It got none. I tell you it got none. Well, I'll correct it in a minute. It got practically none. But it was a terrific and exciting experience. And in the future more will come from it. What it did find out, from looking at Venus, they say in the paper, was that the temperature was 800 degrees or something, under the surface of the clouds. That was already known. And it's being confirmed today, even now, by using the telescope at Palomar and making measurements on Venus from the earth. How clever. The same information could be gotten from looking from the Earth: I have a friend who has information on this, and he has a beautiful map of Venus in his room, with contour lines and hot and cold and different temperatures in different parts. In detail. From the earth. Not just three swatches with some pots of up and down. There was one piece of information that was obtained—that Venus has no magnetic field around it like the earth has—and that was a piece of information that could not have been obtained from here.

There was also very interesting information on what was going on in the space in between, on the way from here to Venus. It should be pointed out that if you don't try to make the thing hit a planet, you don't have to put extra correcting devices inside, you know, with extra rockets to re-steer it. You just shoot it off. You can put more instruments in, better instruments, more carefully designed, and if you really want to find out what there is in the space in between, you don't have to make such a to-do about going to Venus. The most important information was on the space in between, and if we want that information, then please let us send another one that isn't necessary to go to a planet and have all the complications of steering it.

Another thing is the Ranger program. I get sick when I read in the paper about, one after the other, five of them that don't work. And each time we learn something, and then we don't continue the program. We're learning an awful lot. We're learning that somebody forgot to close a valve, that somebody let sand into another part of the instrument. Sometimes we learn something, but most of the time we learn only that there's something the matter with our industry, our engineers and our scientists, that the failure of our program, to fail so many times, has no reasonable and simple explanation. It's not necessary that we have so many failures, as far as I can tell. There's something the matter in the organization, in the administration, in the engineering, or in the making of these instruments. It's important to know that. It's not worthwhile knowing that we're always learning something.

Incidentally, people ask me, why go to the moon? Because it's a great adventure in science. Incidentally, it also develops technology. You have to make all these instruments to go to the moon—rockets, and so on—and it's very important to develop technology. Also it makes scientists happy, and if scientists are happy maybe they'll work on something else good for warfare. Another possibility is a direct military use of space. I don't know how, nobody knows how, but there may turn out to be a use. Anyway, it's possible that if we keep on developing the military aspects of long-range flying to the moon that we'll prevent the Russians from making some military use that we can't figure out yet. Also there are indirect military advantages. That is, if you build bigger rockets, then you can use them more directly by going directly from here to some other part of the earth instead of having to go to the moon. Another good reason is a propaganda reason. We've lost some face in front of the world by letting the other guys get ahead in technology. It's good to be able to try to get that face back. None of these reasons alone is worthwhile and can explain our going to the moon. I believe, however, that if you put them all together, plus all the other reasons which I can't think of, it's worth it.

Well, I gotcha.

I would like to talk about one other thing, and that is, how do you get new ideas? This is for amusement for the students here, mostly. How do you get new ideas? That you do by analogy,

mostly, and in working with analogy you often make very great errors. It's a great game to try to look at the past, at an unscientific era, look at something there, and say have we got the same thing now, and where is it? So I would like to amuse myself with this game. First, we take witch doctors. The witch doctor says he knows how to cure. There are spirits inside which are trying to get out. You have to blow them out with an egg, and so on. Put a snakeskin on and take quinine from the bark of a tree. The quinine works. He doesn't know he's got the wrong theory of what happens. If I'm in the tribe and I'm sick, I go to the witch doctor. He knows more about it than anyone else. But I keep trying to tell him he doesn't know what he's doing and that someday when people investigate the thing freely and get free of all his complicated ideas they'll learn much better ways of doing it. Who are the witch doctors? Psychoanalysts and psychiatrists, of course. If you look at all of the complicated ideas that they have developed in an infinitesimal amount of time, if you compare to any other of the sciences how long it takes to get one idea after the other, if you consider all the structures and inventions and complicated things, the ids and the egos, the tensions and the forces, and the pushes and the pulls, I tell you they can't all be there. It's too much for one brain or a few brains to have cooked up in such a short time. However, I remind you that if you're in the tribe, there's nobody else to go to.

And now I can have some more fun, and this is especially for the students of this university. I thought, among other people, of the Arabian scholars of science during the Middle Ages. They did a little bit of science themselves, yes, but they wrote commentaries on the great men that came before them. They wrote commentaries on commentaries. They described what each other wrote about each other. They just kept writing these commentaries. Writing commentaries is some kind of a disease of the intellect. Tradition is very important. And freedom of new ideas, new possibilities, are disregarded on the grounds that the way it was is better than anything I can do. I have no right to change this or to invent anything or to think of anything. Well, those are your English professors. They are steeped in tradition, and they write commentaries. Of course, they also teach us, some of us, English. That's where the analogy breaks down.

Now if we continue in the analogy here, we see that if they had a more enlightened view of the world there would be a lot of interesting problems. Maybe, how many parts of speech are there? Shall we invent another part of speech? Ooohhhh!

Well, then how about the vocabulary? Have we got too many words? No, no. We need them to express ideas. Have we got too few words? No. By some accident, of course, through the history of time, we happened to have developed the perfect combination of words.

Now let me get to a lower level still in this question. And that is, all the time you hear the question, "why can't Johnny read?" And the answer is, because of the spelling. The Phoenicians, 2000, more, 3000, 4000 years ago, somewhere around there, were able to figure out from their language a scheme of describing the sounds with symbols. It was very simple. Each sound had a corresponding symbol, and each symbol, a corresponding sound. So that when you could see what the symbols' sounds were, you could see what the words were supposed to sound like. It's a marvelous invention. And in the period of time things have happened, and things have gotten out of whack in the English language. Why can't we change the spelling? Who should do it if not the professors of English? If the professors of English will complain to me that the students who come to the universities, after all those years of study, still cannot spell "friend," I say to them that something's the matter with the way you spell friend.

And also, it can be argued, perhaps, if they wish, that it's a question of style and beauty in the language, and that to make new words and new parts of speech might destroy that. But they cannot argue that respelling the words would have anything to do with the style. There's no form of art form or literary form, with the sole exception of crossword puzzles, in which the spelling makes a

bit of difference to the style. And even crossword puzzles can be made with a different spelling. And if it's not the English professors that do it, and if we give them two years and nothing happens—and please don't invent three ways of doing it, just one way, that everybody is used to—if we wait two or three years and nothing happens, then we'll ask the philologists and the linguists and so on because they know how to do it. Did you know that they can write any language with an alphabet so that you can read how it sounds in another language when you hear it? That's really something. So they ought to be able to do it in English alone. One thing else I would leave to them. This does show, of course, that there are great dangers in arguing from analogy. And these dangers should be pointed out. I don't have time to do that, and so I leave to your English professors the problem of pointing out the errors of reasoning by analogy. Now there are a number of things, positive things, in which a scientific type of reasoning works, and in which considerable progress has been made, and I've been picking out a number of the negative things. I want you to know I appreciate positive things. (I also appreciate that I'm talking too long, so I will mention them only. But it's out of proportion. I wanted to spend more time.) There are a number of things in which rational people work very hard using methods which are quite sensible. And nobody's bothered with them, yet.

For instance, people have arranged traffic systems and arranged the way the traffic will work in other cities. Criminal detection is at a pretty high level of knowing how to get evidence, how to judge evidence, how to control your emotions on the evidence, and so on.

We shouldn't only think of the technological inventions when we consider the progress of man. There are an enormous number of most important non-technological inventions which mustn't be disregarded. Economic inventions in checks, for example, and banks, things of this nature. International financial arrangements, and so on, are marvelous inventions. And they are absolutely essential and represent a great advance. Systems of accounting, for example. Business accounting is a scientific process—I mean, is not a scientific, maybe, but a rational process. A system of law has been gradually developed. There is a system of laws and juries and judges. And although there are, of course, many faults and flaws, and we must continue to work on them, I have great admiration for that. And also the development of government organizations which have been going on through the years. There are a large number of problems which have been solved in certain countries in ways that we sometimes can understand and sometimes we cannot. I remind you of one, because it bothers me. And that has to do with the fact that the government really has the problem of the control of the forces. And most of the time there has been trouble because the strongest forces try to get control of the government. It is marvelous, is it not, that someone with no force can control someone with force. And so the difficulties in the Roman empire, with the Praetorian guards, seemed insoluble, because they had more force than the Senate. Yet in our country we have a sort of discipline of the military, so that they never try to control the Senate directly. People laugh at the brass. They tease them all the time. No matter how many things we've stuffed down their throats, we civilians have still been able to control the military! I think that the military's discipline in knowing what its place is in the government of the United States is one of our great heritages and one of the very valuable things, and I don't think that we should keep pushing on them so hard until they get impatient and break out from their self-imposed discipline. Don't misunderstand me. The military has a large number of faults, like anything else. And the way they handled Mr. Anderson, I believe his name was, the fellow who was supposed to have murdered somebody and so on, is an example of what would happen if they did take over.

Now, if I look to the future, I should talk about the future development of mechanics, the possibilities that will arise because we have almost free energy when we get to controlled fusion. And in the near future the developments in biology will make problems like no one has ever seen before. The very rapid developments of biology are going to cause all kinds of very exciting problems. I haven't time to describe them, so I just refer you to Aldous Huxley's book *Brave New*

World, which gives some indication of the type of problem that future biology will involve itself in.

One thing about the future I look to with favor. I think there are a lot of things working in the right direction. In the first place, the fact that there are so many nations and they hear each other, on account of the communications, even if they try to close their ears. And so there are all kinds of opinions running around, and the net result is that it's hard to keep ideas out. And some of the troubles that the Russians are having in holding down people like Mr. Nakhrosov are a kind of trouble that I hope will continue to develop.

One other point that I would like to take a moment or two to make a little bit more in detail is this one: The problem of moral values and ethical judgments is one into which science cannot enter, as I have already indicated, and which I don't know of any particular way to word. However, I see one possibility. There may be others, but I see one possibility. You see we need some kind of a mechanism, something like the trick we have to make an observation and believe it, a scheme for choosing moral values. Now in the days of Galileo there were great arguments about what makes a body fall, all kinds of arguments about the medium and the pushes and the pulls and so on. And what Galileo did was disregard all the arguments and decide if it fell and how fast it fell, and just describe that. On that everybody could agree. And keep on studying in that direction, on what everyone can agree, and never mind the machinery and the theory underneath, as long as possible. And then gradually, with the accumulation of experience, you find other theories underneath that are more satisfactory, perhaps. There were in the early days of science terrible arguments about, for instance, light. Newton did some experiments which showed that a light beam separated and spread with a prism would never get separated again. Why did he have to argue with Hooke? He had to argue with Hooke because of the theories of the day about what light was like and so on. He wasn't arguing whether the phenomenon was right. Hooke took a prism and saw that it was true.

So the question is whether it is possible to do something analogous (and work by analogy) with moral problems. I believe that it is not at all impossible that there be agreements on consequences, that we agree on the net result, but maybe not on the reason we do what we ought to do. That the argument that existed in the early days of the Christians as to, for instance, whether Jesus was of a substance like the Father or of the same substance as the Father, which when translated into the Greek became the argument between the Homoiousians and the Homoousians. Laugh, but people were hurt by that. Reputations were destroyed, people were killed, arguing whether it's the same or similar. And today we should learn that lesson and not have an argument as to the reason why we agree if we agree.

I therefore consider the Encyclical of Pope John XXIII, which I have read, to be one of the most remarkable occurrences of our time and a great step to the future. I can find no better expression of my beliefs of morality, of the duties and responsibilities of mankind, people to other people, than is in that encyclical. I do not agree with some of the machinery which supports some of the ideas, that they spring from God, perhaps, I don't personally believe, or that some of these ideas are the natural consequence of ideas of earlier popes, in a natural and perfectly sensible way. I don't agree, and I will not ridicule it, and I won't argue it. I agree with the responsibilities and with the duties that the Pope represents as the responsibilities and the duties of people. And I recognize this encyclical as the beginning, possibly, of a new future where we forget, perhaps, about the theories of why we believe things as long as we ultimately in the end, as far as action is concerned, believe the same thing.