Annual Reviews Conversations Presents

An Interview with John M. Prausnitz

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Host: Anna Rascouët-Paz

Anna: Hello and welcome to Annual Reviews Audio, part of the Conversation Series from Annual Reviews, where insightful research begins. I am your host Anna Rascouët-Paz. On each episode of our show, we will speak with top scientists in fields ranging from astrophysics to sociology. Today we talk to John Prausnitz, Professor of the College of Chemistry at the University of California, Berkeley and the Editor of the Annual Review of Chemical and Biomolecular Engineering.

Professor John Prausnitz joined Berkeley's faculty in 1955 and went on to develop molecular thermodynamics [that changed our] understanding of the way that molecules interact in fluids and solids in order to predict their behavior on a larger scale. His research helped render the chemical industry safer, more efficient, and more environmentally sound, especially the refining of crude oil and the production of polymers. Later, he turned his attention to biotechnology.

Professor John Prausnitz is a member of the National Academy of Sciences, the National Academy of Engineering, as well as a member of the American Academy of Arts and Sciences. In 2003, he won the

United States's highest scientific honor, the National Medal of Science.

Hello, and welcome to our show Professor John Prausnitz.

Professor Prausnitz: Hello.

Anna: So let us start at the beginning. You received your PhD from Princeton in 1955 and immediately thereafter, you joined the school where you teach today. What was it about Berkeley?

Professor Prausnitz: Well, Berkeley was then known, as it is today, as one of the leading Universities of the world, and at that time, chemical engineering at Berkeley was very young. It was only a few years old. I saw a tremendous opportunity to be in on the ground floor, so to speak, in making a new department. That was one reason.

Another reason is that there was a Professor of Chemistry here called Joel Hildebrand; and I had read his writings and his books and I was very much impressed by him. He was already quite elderly at the time. He was already retired when I came but still remarkably active. He looked into phenomena that were of particular interest to me. He wrote a book called Solubility, which I studied carefully…talks about how different substances mix or do not mix; like water and oil don't mix but water and vinegar do. Now why is that? What is it about the intermolecular forces that bring that about? We know water boils at 100°C, makes a vapor, and other fluids boil at different temperatures to make a vapor; now why is that? So, I was interested in learning something about the macroscopic large-scale properties of materials in terms of the intermolecular interactions that are responsible for them. I should point out that this is a very important field in chemical engineering.

In chemical engineering, we are always separating mixtures; nature does not give us pure substances. Nature gives us mixtures. The best example is air. Air is mostly oxygen and nitrogen, with a few other things. So, if you want the oxygen from air you have to make a separation process. You have to know something about the properties of oxygen and nitrogen when mixed. Another well-known example is oil. For the oil to get out of the ground it is quite useless as such, you have to make separations. You have to take the light ends and you get natural gas, which we use to heat our homes. Then the middle parts, intermediate part we use for gasoline, and the very heavy materials we use as tar on our roads. So the separation is the bread and butter, you might say, of chemical engineering. So, the kind of work that Professor Hildebrand was doing was of much interest to me.

Anna: So you went on to develop molecular thermodynamics. Is it exactly what you just described?

Professor Prausnitz: Yes, it is exactly what I described. The idea is that if you know something about how two molecules interact, then with suitable assumptions and various mathematical techniques, you can then explain how a very, very large molecules behave.

Anna: How did you decide to go into that while you were still studying at Princeton and Cornell? What was it about chemical engineering that attracted you?

Professor Prausnitz: Well what attracted me then is what attracts me now. It is opportunity to use science and do something useful with it. That is exactly what I have been doing and it is what my colleagues here in chemical engineering do also. We do not try to advance science as such;

we try to understand it. We have here at Berkeley all sorts of outstanding scientists, and what I try to do is to listen to what they have to say. I cannot compete with them, they are people with different training that I do not have. But, I can understand what they do and then I can ask myself, All right I have this understanding now how can I put that to use? That is exactly what molecular thermodynamics does.

Anna: It became extremely useful, as we said earlier, it was widely used in the chemical industry refining polymers, etc. You had an extremely prolific career developing this field, and you went on to receive the National Medal of Science. What is your proudest achievement?

Professor Prausnitz: Well let me just make a very minor correction. You said it was used in the industry. I am happy to say it is used. It is not a matter of the past. It is used a lot all over the world when people design a chemical plant to make some sort of a product, or they design a refinery, some of the things that we have done here at Berkeley turned out to be very useful.

My proudest achievement I think I can give the usual answer that Professor's tend to give. My proudest achievement is students. I have enjoyed, very much, working with students, influencing them. I hope that the influence that I have had on them has been beneficial. I think it has in most cases. The greatest reward that someone like me gets is the success of the students. There is not any one thing in my scientific career that I can point to that is more satisfying than any other; I mean, they all are satisfying. But, the contact with young people and the opportunity to influence them beneficially, that has been a major reward for me.

There is one other little answer that I might give which is perhaps a little strange but I think it is also true. We had a classroom in Gilman Hall where my office is, and many of our classes were conducted in that room. It is not very large, and so whenever it was a rainy day, the students would come in with their raincoats and umbrellas and their galoshes and it was a terrible mess because the room was not very large and I did not know what to do with all this rain gear. So I decided, well, we obviously need some hooks on the wall where they could hang things up.

I tried for quite a while to get the administration interested in doing this and I found out, as I now know, that I got the usual run around; no one wanted to do this. It was somebody else's job and there was no money and so the usual excuses of the bureaucracy here, which is, I think, my biggest enemy on this campus, is the bureaucracy. So one weekend I got a few of my graduate students together. We went to the hardware store, we bought hooks, we got some nails and hammers, and we put them up on the wall and after that when it rained the students had an opportunity to get rid of their rain gear. So, in a way, that is my proudest achievement.

Anna: Well, you said this hall does not exist anymore. This classroom does not exist anymore. How has the department evolved since you arrived here at Berkeley? How has everything evolved because there were schools at the time where chemical engineers and chemists were very, very different? They sometimes did not communicate, so how was it when you got here?

Professor Prausnitz: Well I was one of the great attractions. The chemical engineering department actually was not a department at that time, so the division was part of chemistry, and that is relatively rare. In most universities, chemical engineering is part of the culture of engineering. As always in life, there are advantages and disadvantages. But in this case, the advantages, being associated with chemistry are very large indeed. We had then and still have an outstanding chemistry department, like Professor Hildebrand, whom I just mentioned, and so there was real opportunity for, not just for me, but also for all my colleagues in the department to

get expert advice on chemical matters.

And that has played a huge role in the development of the department. We stress molecules. What is the molecule doing, that is always the question. What are the molecules doing and how can we get them to do something else that we prefer? That is the central theme, which all my colleagues have that as their central theme and that is not necessarily typical of a chemical engineering department. In many other chemical engineering departments they are much more concerned with every day practical things. We here do not stress the everyday practical; we stress the future practical.

Anna: And that is what you continue to do.

Professor Prausnitz: That is what we have been doing all along and we tend to select faculty who have that sort of viewpoint and philosophy. So, in the department we have many research projects that are conducted together with chemistry professors.

Anna: How did you decide to turn your attention to the biomolecular world?

Professor Prausnitz: Well that is a national trend. Bio is king now, you see the letters B-I-O all over the place, and so what I did there is certainly nothing unusual. There are two major factors, I think, that pushed it. First of all, I found it very challenging to ask if molecular thermodynamics could tell us something that would be of use in the biological area. So far, that has been very limited. But, I found that a great challenge. Then beyond that, there are practical things. If you want to get good graduate students to work with you, you have to have something that is exciting, that they at least think is exciting.

So, my usual topics about oil refinery and polyethylene and stuff like that, that was not exciting, that was considered old stuff. But, if, instead of saying, "Would you like to do thermodynamics?" The answer would usually be no. If I can say, "Would you like to work in biothermodynamics?" Oh that was fine, you see? So, it was student pressure and then the usual one that dictates so much of what we do in research, is financial pressure.

If you want to get funds from the various sponsor agencies in Washington, you have to have a topic that is popular and that is considered relevant to today. So, that was another force that pushed me in that direction.

Finally, we started adding bio-type people in our department. We now have, I think, four professors out of twenty who are bio orientated. They are professors of bioengineering you might say. So associating with them was also an influence.

Anna: So, what have you been working on since you moved on to biomolecular engineering?

Professor Prausnitz: Well there are two areas. One of them is really not bio; it is more medical. But, let me mention the bio one first. We have been working on biofuels. We take a grass, a rather rough grass called Miscanthus, which grows to about six, seven feet high and does not require very much fertilizer. It grows in the wild areas in poor soil so it is not worth anything. And, we take this Miscanthus and we try to make a liquid fuel out of it that you could use in your automobile or in an airplane. We are not the only ones, of course, that are doing that. There is a huge effort here on campus in biofuels. But, the trick is not to do it…that is easy. The trick is to do in cheaply. Any product you make, a biofuel product has to be competitive with gasoline, and that is hard.

The various steps for taking a grass or some other material like that, an agricultural product, and making a fuel out of it, that has been known for years. That is nothing really new there. But, it is much too expensive. So, the problem is how to do it in such a way that you can do it in very large quantities and with low cost. So, that is one thing I have been doing and I do not do this alone. I have colleagues who are also in this area and we have some students and post docs who are working along with us.

The other area is more in the medical line. I have a former student, Dr. Clay Radke, who is now a professor here, so he is one of my colleagues. He and I are old friends by now, we get along extremely well, and we rather think alike. Clay has been active for years with contact lenses. He is also a professor here in the optometry school. We are trying, I am helping him on this, we are trying to develop a new kind of contact lens. Of course, there are all sorts of problems that come up. How do you do this? What do you want this lens to accomplish that the other ones did not? There is a lot of physical chemistry involved. So, that is the other project that I am working on.

Anna: And how are those going?

Professor Prausnitz: Well, they are coming along. Research necessarily is slow, and academia is particularly slow because of all the other things that students have to do and professors have to do. And because of this incredible bureaucracy that I have already mentioned, which has gotten worse and worse every year. It is not going nearly as fast as I think it could, but yes, we are making progress.

One of the things we are trying to do with the contact lens that you might find interesting… have you ever worn contact lenses?

Anna: I have, yes, absolutely.

Professor Prausnitz: Well, one of the things that we try to do is…we are worried about salt. You know the salt in your tears and if you have those contact lenses on, especially if you have them on too long, water evaporates but the salt does not. So, the salt concentrates in the middle of the eye and that could cause all sorts of great damage to the cornea. So we want to work on a contact lens that allows the salt to go through the contact lens and then is absorbed at the outer edge by some sort of a sponge. Then you would wash that sponge every so often to get the salt out.

We think that might be a way of preventing people from getting dry eye and other illnesses that comes from contact lenses. Also, we would like to develop a contact lens that you can keep on indefinitely. The way you do it now is you have to take it off at night and wash it and so on. Which is not bad, but it is a bit of a nuisance and so that is one of the things we hope to do. This will not happen tomorrow.

Anna: Right. Well that would be great. I mean it is the last step before surgery so that is something that would be pretty great if it happened.

I just wanted to go back to your students and to education, to a topic you have talked about many times, and you seem to feel very strongly about: the intellectual isolation of the College of Chemistry at Berkeley. What exactly do you mean by this?

Professor Prausnitz: Well, by that I mean that we have superb chemists. They are very, very good, we have had Nobel Prize winners, and in the national ratings, chemistry at Berkeley always

rates number one or number two…it is top notch. We have very, very good people, but they tend to spend their time just talking to each other. Occasionally they may talk to a physicist. I think that our chemistry in all our sciences would be much advanced if we learned to speak to people who are not in science. If you learned to talk to political scientists and literature people, artists, and so on because that gives us a much broader perspective.

So, when I say isolation that is what I mean. Our chemistry people and our chemical engineers are well known throughout the world. We traveled for meetings and we visit other universities and so on. However, we always talk to each other. I think we would do much better if we talked to people who are not like us or provide us with a certain stimulus, and furthermore, we would be much happier. We all have good brains and we ought to use them, and enjoy our intellectual abilities and not restrict them solely to one narrow area. So, that is what I mean by isolation. I have gotten almost nowhere with this. Whenever I mention this to my colleagues they just nod and say, "Oh yes, yes, yes," but nothing really ever happens.

Anna: So, is this something that you feel is specific to Berkeley or do you think it is a symptom of our times?

Professor Prausnitz: It is a symptom of our times, but I think it is particularly bad at Berkeley. It is bad in many places. I have been to numerous universities in Europe and there it is even worse. The European professors are very isolated and do not talk to each other. And rather interesting, why that is, I mean obviously many reasons, but one reason that was explained to me by one of the professors, this was in Germany, he said, "I do not want to talk to other professors because that way I would show my ignorance you see. I do not know enough about the other fellow's area and so if I talk to him it would be embarrassing for me."

I certainly found that to be true here also. Especially when I try to talk to people, these are non-professors, just talk to people who are not in the sciences and say, "Why are you so antagonistic to science. Why don't you ever ask questions about it or want to know something about it." The same answer is given. "Well, I am embarrassed, you see I really do not know anything and I do not want to show my ignorance," and so on. So, it is a universal problem. People are insecure. I do not have that problem. I mean I talk to people in all sorts of areas and of course, I do not know much about it. But so what, I ask questions. I say, "What about this, and what about that, what do you mean by this," and so forth. I learn a lot and I do not feel embarrassed. Anyway, I seem to be unusual in that regard.

Anna: You certainly compare this to the richness of the education you received when you were at Cornell as an undergraduate. So, I am interested in finding out about the courses that you took and influences that you received when you were there.

Professor Prausnitz: Well, there are several answers. Let me just give two obvious ones. One is the courses. I took some very good courses with very good teachers. The teacher is really the important part. When I was at Princeton, the rule there was, for students, do not pick courses (when you are making up your curriculum), do not pick courses, pick instructors. Find out who the good professors are. Never mind what the subject is, you want to get a good teacher. Well, I had not heard that particular advice when I was at Cornell, but I was fortunate in getting some very, very good teachers. So I had a few courses in literature and philosophy that I liked very much. And then most important I had a two-semester sequence in the history of science. It was taught by a historian, a distinguished historian of science, and interestingly enough at that time, it

is no longer true, at that time, if you were in the engineering college you had to take this. This was a requirement: two semesters of history of science. And that was a blessing for me. It just opened up avenues and vistas that I have never seen before. So, that is one answer to your question.

The other answer to your question is that I chose my friends intentionally from areas outside of my own. My roommates were never chemists or chemical engineers. My roommates were always in some other area. My friends with whom I eat dinner and so on, they were also from other areas, and that has been a great boon to me. I keep trying to convince our students here to do the same. That they should, when they choose their living arrangements or their social events, they should meet other people. My success there is also pretty limited.

Anna: That is one of the questions I had for you. What exactly do you tell your students if you had to build a case for this and how broadening their horizons might inform their work and their mission in the world as scientists? What exactly do you tell them?

Professor Prausnitz: Well, what I tell them is that if they are well rounded, if they know something other than their own area, then they can make a good case to what they are doing. In other words, they can explain to the public, "Look I am doing such and such and the reason is because it will do such and such for society." I think that is a big help. It sort of relates what you do to what other people do. And it helps you to get support and helps you convince, perhaps the directors of your company, to allow you to do what you want to do. Furthermore, it gives you a perspective that you do not have otherwise. It allows you to look at your scientific problem quite differently. You look at it not just from a narrow viewpoint of what your predecessor had done, but what other people are doing in other areas. There is much, much evidence in the history of science to show that a given area, a given discipline, always grows at the periphery. It is what goes one at the boundaries of that area that is important, not what is inside.

Let me just give a few examples that you are familiar with. Why has medicine today become so much more successful then it was 50 years ago? It is not because much is happening in medicine; it is because what happened outside of medicine. We now have chemical analytical techniques, chromatographs and so on, nuclear magnetic residence, that can do blood tests that were unheard of fifty years ago. So diagnostics has been tremendously improved by what happened in physics.

Also, the CT scan is not a product of medicine; it is a product of electrical engineering. Again, that has been a tremendous boon in medicine. And so on and many, many other examples. So, you have to be aware of what is happening outside. That is why your science, I think, will improve.

Now the other reason is a more personal one. I think you would just be a happier person. You can talk to people from all walks of life and relate to them and they can relate to you. You can have a more interesting dinner conversation with your wife. You can use your God-given good brains in a much broader way and I think it is very satisfying to do that.

Anna: So you said you have had a lot of resistance from both the department and your students when you come up to them with those arguments. What do they tell you?

Professor Prausnitz: Resistance is perhaps the wrong word. Whenever I mention these things, people do not disagree with me. They say, "yes it would be good if we did that. If we revise our curriculum accordingly," and so on. They all say that. The problem is they never give it enough priority. Everybody is busy and it has gotten much worse in recent years, especially with these budget crises. So, everybody says, "Oh yes, yes, yes, we should do that. What you say there, John Prausnitz, it is very sensible. It's fine, but excuse me I have to go to a meeting now." It is not that

anybody opposes it. It is not resistance. It is just that there is always something else that has to be done.

Anna: So what do you suggest to kind of go around this problem?

Professor Prausnitz: Oh, I wish I knew. I have a very modest suggestion. I have something called the Bernofsky Project. I do not know if the name Bernofsky means anything to you. He was an author about thirty years ago. Did a lot to talk about science and the arts. I am a great admirer of Bernofsky. He had a television series called the "Assent of Man" where this was discussed. Anyway, this Bernofsky Project is an attempt to bring, what you might call, humanistic factors into our existing courses.

So, the idea is that if a professor of chemistry or engineering talks about some subject, and he should take a few minutes, maybe five minutes is enough, to indicate how what he is talking about really matters. How has it changed our lives? Who really cares about this? And, whenever I mention this to my colleagues, I say, "Oh yes, that would be a good idea. But, I do not have the material you know, and I cannot take time to work this out." So, the Bernofsky Project is something that I have pursued now for a few years.

Where we take applications of chemical technology and show how they really are important to us in our daily lives and I write, I don't write it up, I have students do this, and they write up a report of about five pages, which elaborates on this subject. The idea is that these reports, we now have about fifty of them, these reports will be made available on the internet so anybody could get them. And, I hope professors will do that. All they have to do is look at the report and talk about it for a little while.

I have certainly done this in my classes whenever I, usually in the middle of the hour when students are beginning to get a little sleepy. When I talk about a real life consequence, oh they wake up. They really enjoy that. They want to know more about that.

Anna: Just to help them realize the kind of input…

Professor Prausnitz: Well our students partition their minds. They take a course in chemistry or physics or something, and then they are required to take a few, not many, take a few courses in humanities. So, when they are taking a course in chemistry they open the chemistry valve, and the chemistry flows in. Then when they go to the history class, they close the chemistry valve and open the history valve and history flows in. It does not occur to them that the two are connected. They do not see the connection. And, the Bernofsky Project is a very modest attempt to try and do something about that. So, that is the only really practical thing I have come up with. It is just hard to get people to change.

Anna: Bernofsky as an author was talking about building the bridge between sciences and the arts and one of your students, or your former students rather, is now the Dean of the School of Art and Design at the University of Michigan. Would you tell me more about him?

Professor Prausnitz: Yes, I am not up to date. I am not sure that he is still the Dean, but as far as I know, he is still at the University of Michigan. Before that, he had a similar position at the Mellon University in Pittsburgh, Carnegie Mellon. So, he has done a lot of this. Yes, I can tell you a little about him.

This was many years ago, he was here around 1970. He was an extremely good student in

chemical engineering. Obviously, very bright. He had come here from a bachelors training at Yale, and he had some industrial experience in Los Angeles. And he came here and realized that Berkeley was a whole new world. Berkeley was quite different from Yale in those days. He also saw, this was 1970 the time of the student rebellions and so on. He had a real change of personality, you might say. He became involved with some friends in the College of Design, where they have art and architecture, and he was particularly interested in sculpture.

So, we devised a curriculum for him, whereby he would get his joint PhD in chemical engineering and in art. He made as part of his thesis, he built a sculpture of glass, and he had fluids flowing through this very intricate glass design with pumps that pumped the fluids. He had various little heating sensors, heating and cooling, because he had several fluids and they had different colors. Depending on the temperature, the fluids could either be visible or not. So, part of the time you would have bubbles, and then the bubbles would disappear and then later on they might reappear again. So, it was a very nice, clever design on his part. That was the last chapter of his thesis.

So, we had an exhibit of that sculpture and a few others he had done. We had an exhibit of that in Gilman Hall. This was about 1972 or three, something like that. Somehow, that information got out and this was the only time in my long, long history at Berkeley that the Chancellor came to Gilman Hall. I do not think the Chancellor had ever been there before, and certainly none has been there since. Anyway, the Chancellor came to see this sculpture and then the television cameras came, so I had my brief moment on television saying a few things about this. Then Brian went to Europe. He went to an art college in Munich, and eventually he became a faculty member at San Francisco State University and then he went, as I said, to Carnegie Mellon and finally University of Michigan.

Well, he had given up his chemical engineering totally, so he went much further than I had ever intended. I do not want people to leave chemical engineering, necessarily. But, certainly his technical knowledge has greatly influenced his work. He would not be able to do the kind of work he does without that technical background.

Anna: That was really interesting to me. That was Brian Rodgers for the record. Because it reminded me of a story, I heard about a couple of years ago. There was a stem cell researcher name Victor Nurcombe, who partnered with an artist, called Trish Adams, he helped her turn cells taken from her blood into a cluster of cardiac cells, and he was talking about this project saying that it reminded him of how much joy he could find in his work and experimentation. How do you feel about the idea that art can provide that kind of space for science?

Professor Prausnitz: Oh, there is no doubt about it. There is a lot of historical evidence to show that. One of the most famous examples is a man named Kekulé; this was in the nineteeth century, who first came up with the structure of benzene. It was very puzzling. Benzene has certain properties that did not seem to agree with what was thought to be the structure of the benzene molecule, and he saw, I guess in a dream, he saw a painting of a snake biting its own tail. And that suggested to him that maybe benzene was a circular molecule not a linier, but a circular molecule. Indeed that is what it is. Then the properties of benzene got right into line with the structure.

There are many, many, many examples of that, where by analogies you see something in art. You see a painting or a sculpture, or you hear some music and that suggests to you how you might go about solving a problem of science. There is lots of evidence to this. So, I am a great believer in that. Also, I think it just is much more fun that way. It is not only that science advances, but also the joy of living is served.

Anna: And you used it very much actively in your life. I watched the 2004 session of Lunch Poems, here at Berkeley during which you read a poem by Walt Whitman, another by Reina Maria Rilke, one by Sheenagh Pugh, Welsh poet, I believe. It was incredibly moving. So, you have an interest in literature and history and philosophy…so how has all this informed your work.

Professor Prausnitz: Well it is informing in the sense that I feel that much of what I do is of direct use. In other words, it has a connection with society. It's not just something that you write up, then it goes into a library, and gathers dust. It is something that is useful and makes for hopefully, a somewhat better world. That is one level.

The other level is that it enables me, in my personal life, to relate to people whom otherwise I would have difficulty relating too. I enjoy very much meeting people, who are in literature, or political science, or what have you; and I find I can talk to them and learn something. Of course, I am not an expert in these areas, but I know enough to ask the right questions and the big problem I have actually, is getting the conversation partner to shut up. I mean they want to talk indefinitely. But, they are always delighted when somebody comes and asks a question. They are more than happy to discuss what they are doing and the problem is to get them to stop.

But, it has enriched my life, I would say. Has it had a big influence on my work? It is hard for me to say, I do not know. I just cannot conceive of living in such a way that I would only do chemical engineering. I always tell my students there is more to life than chemical engineering. Now go out and do something else. And as you know, that is a problem because time is limited and the students work hard and they have lots things to do to satisfy their academic requirements.

But, what I am talking about does not really take any extra time. I want students, when they have dinner to stop meeting with other chemical engineers and talk to people who are in law school, or literature school, or what do I know, something else. They have dinner anyway. They have lunch. They certainly, on weekends, have outings, I do not know what they do, they go to dances or whatever. They should do that with people who are not like themselves! So, it is true, it does take some time, but I do not think it takes nearly as much time as people say. When they say to me, "Oh I cannot do that, I do not have the time," I think it is a cop out. It is an excuse; they do not want to make the effort. It is so comfortable to be with people like yourself. There is no challenge. I see it at the faculty club. The purpose of the faculty club, one of the purposes of the faculty club, was to get professors from different areas together…cross-fertilization and so on. This rarely happens. You find there is a table where the chemists sit, there is a table where the literature people sit, and so on. There is some, but there is very little mixing because it is an effort. It is so much easier to sit down with somebody who you know for years and talk about the same thing all the time.

So, it is human nature not to want to do that. But, I think we should. I think it is worthwhile.

Anna: Also, because it does feel that hard sciences like this feel very isolated. There are things that the general public, people who come from the humanities, find extremely intimidating. Is this the kind of thing that would help?

Professor Prausnitz: Absolutely it would help. Certainly. If you talk to people who are not like you, then you learn how to communicate in such a way that other people can understand what you are doing. I constantly run into this with students. These are undergraduates mostly. I say to the undergraduates, "I know how you face certain situations, you come home on vacation, and there is grandma. and grandma says, 'Well here, you are at Berkeley; you are taking all these courses

what is this all about? Can you tell me?'" Then you as a student reply, "Oh grandma, you would not understand," and everybody chuckles. Because they all identify with that remark.

My response is, it is not true. Grandma understands a lot more than you think. It is you who does not understand because you have not learned how to say it in such a way that grandma could follow you. Grandma is not stupid. But, you have to do it in the right way.

Anna: So do you feel scientists have a duty to communicate?

Professor Prausnitz: Absolutely. They have a duty to communicate; otherwise it is going to… we are going to have increasing trouble. After all, it is society that supports us. If they do not support us, then we cannot function. The only way they are going to support us is if we tell them what we are doing and convince them this is really worthwhile.

Anna: I have one last question, which relates to your interest in philosophy and theology. This is a time and a place where God and science seem to be at war. How do you approach this question?

Professor Prausnitz: Well I think you are very much mistaken. I do not think that is true at all…at least not in the intellectual areas that I go in. It used to be true certainly; in the nineteenth century and even before there was this struggle…Galileo, it was even earlier. But, I do not think it is true today. I think today there is much more sympathy on both sides. There is much more communication going back and forth, and I think people realize that there are domains where one is dominant and other domains were the other is dominant. And there is no reason why they can't get along. There is no reason for the struggle between them.

The example that we use today with people with your point of view is intelligent design, and the opposition to intelligent design is really not opposition to the idea of intelligent design, the opposition is that somehow, people who believe in intelligent design think it is science. That is the problem. It is not science; it is belief. And if people want to believe that, there is really no harm and scientists really do not see any danger in it. It is when the people who believe this passionately claim it is science, then we get upset. It is not science. But, if you accept it for what it is, then I don't think there is any problem.

There is also a very growing belief…I shouldn't say growing belief…an acceptance of results that we get from neuroscientists about just how people function, how people work. There is a new book out by David Brooks that you may have seen…it came out recently…which pushes this (but, his book is not the only one). And that is that emotions and feelings play a much greater role than we think. We like to think that we are rational beings and that we decide everything in a rational way. But, research shows us that is absolutely not true. We decide things on an emotional way and then after that we rationalize. We think up rational reasons as to why we made this decision. But, in many essential everyday decisions, it is really our emotions that govern us. So where does that come from? Where do these emotions come from? Well, there is some power in the world that we don't really quite understand and I think it was William James who said that "Religion really is the acceptance that there are powers in the world that are beyond understanding and that it would be wise for us to be in harmony with these powers."

Well if you define religion that way then it is no problem. So, I do not see any problem.

Anna: Professor John Prausnitz, thank you very much for joining us today.

Professor Prausnitz: Thank you for giving me the opportunity to share my ideas. Thank you.

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I am Anna Rascouët -Paz. Thanks for listening.