

The Science Studio With Paul and Patricia Churchland

ROGER BINGHAM, MODERATOR: So Patricia, or Pat, Churchland and Paul Churchland are philosophers at the University of California, San Diego. Pat is in fact Chairman of the Department of Philosophy, I suppose I should say chairperson. They work at the intersection of philosophy of mind and cognitive neuroscience and they have a number of books that you may have heard of. Pat's most recent is Brainwise, but in 1986 she did a book called Neurophilosophy which basically established a subfield of the discipline. Paul has a number of books but one of his most recent is The Engine of Reason: The Seat of the Soul. And I like to think of them as the first couple of philosophy, although there are, obviously other married couples in philosophy, so perhaps I should say, one of the first couples in philosophy. Let me just start with something you wrote, Paul, at the beginning of The Engine of Reason: Seat of the Soul. You said, "After 25 years of affection and collaboration, with your wife, I often feel we've become the left and right hemispheres of a single brain." Who's left and who is right?

PAUL CHURCHLAND: Well I'm not sure I've even addressed that question before, nor, I think, does it matter. I'm afraid we're both very verbal, so you're not going to be able to make one of us the left. I think maybe Pat's the left and I'm the right, but...

PATRICIA CHURCHLAND: Well I do think Paul has greater spatial capacities than I do. When he is constructing a project, building something for example, I would have to do it all by drawing it out and having everything measured and so forth. He does it all in his head and I find that something really almost incomprehensible to me. But, by the way, notice that that's actually a common pattern of gender differences between women and men. That lots of women like me don't have this rather richer spatial capacity for doing in your head these visual/spatial constructions.

BINGHAM: Now I noticed actually that Paul's book has a toy in the back, a stereopticon, a gadget. You're very much of a gadgeteer as well, aren't you?

PAUL: Guilty.

BINGHAM: So, on the other hand I was surprised to hear you say that because my memory is that you grew up on the farm in Canada? Therefore being very practical and you would have to know left from right and your way around.

PATRICIA: This is very true. And I did grow up on a farm and did mean that life was very practical and that all of us farm children had to really rely on ourselves

from a very young age because there was nobody around to help you, if you were off doing something and you had a problem you had to solve it yourself. So in many ways it was a life that was very practically and pragmatically oriented. The contrast with Paul really had to do with these visuo-spatial constructive kind of things. Yes, but in other spatial things like finding my way around, I'm ok.

PAUL: You sell yourself short dear, you're actually very good at these things.

PATRICIA: Oh.

BINGHAM: So where did you grow up? I mean, you both grew up in Canada, so lets get the genesis of all this.

PAUL: I grew up with a wonderful example of a father who was an aircraftsman during the Second World War, who started a boat works building business in Vancouver when I was in grade school. My basement or my backyard was always full of drills and planers and saws and metal-working stuff and he ended up being, first of all, an industrial arts teacher in high school and went back to school at a university, got himself a degree and became a high school science teacher, so those were the sorts of influences he had on me.

BINGHAM: A high school science teacher sounds like a good lead there. So, is that what made you go into science? I mean, were you good at science when you were a kid at school?

PAUL: Yes, my initial ambition was to be an engineer, in particular an aeronautical engineer because I had become besotted with all kinds of model airplanes- helicopters, you name it, as a child. And when I got to university of course broadened and I wanted to go into physics, and as I started to learn physics, I wanted to know about the history of science, and when I got into the history of science I was interested in the epistemology of science and by stages I slowly tumbled off the physics bandwagon and into the philosophy cart and have been there ever since.

BINGHAM: Now, your parents were what, I mean, originally from Scotland or something?

PATRICIA: No not quite, they were both born in Canada, but they both grew up in the prairies, what you would call the Midwest. And they actually both grew up in sod huts, if you can imagine.

BINGHAM: Sod huts?

PATRICIA: Sod huts, that is to say, there weren't trees, so people constructed houses by cutting large pieces of sod and stacking them up. And both of them were on farms and my father was avid in school but his school only went to grade 6. So my father actually only had a grade 6 education. By the time he was 12 he was sent, quite willingly actually, to be a printer's devil in a newspaper office in a small town on the prairies and it was really as working as a printer's devil in a newspaper office that his education really expanded and he learned to write, he read extensively and of course he ended up being very good in the newspaper business.

BINGHAM: So what does a printer's devil do?

PATRICIA: Well a printer's devil does the odd jobs. They sweep up the crud from the floor, they collect the old lead, this of course is not what happens now, but they collect the old lead from the type, and melt it down, put it back in the linotype for reprocessing... They basically are sort of at everyone's beck and call.

BINGHAM: So this was Mr. Smith's job.

PATRICIA: That was his job.

BINGHAM: Right, ok. So was there any science in your household? Was your mother intrigued or...?

PATRICIA: Well there was science in the sense that, if you're living on a farm and you're living in an out-of-the-way place, that you have to learn to do everything yourself. And my father was very good at that and so for example, we lived in a dry place where in order for the trees to grow, you had to irrigate the trees and the trees were of course fruit trees and that's how we were supposed to be making a living.

But in any case, so there was a creek that encircled the farm and the problem was to get the water up out of the creek, up the hill, and to the trees. And so he built a water wheel and built a dam, so that the water would come down, be caught in these little cans on the water wheel, come up to the top, dump out into a flume, and then he had this vast system of flumes. And he was also a bit of an inventor. So by the time that technology had progressed to a certain point, he invented a machine, a very simple machine in a way, for replacing a common hand ladder so that it would be machine-driven and it had a boom so that you could get up into the tree. And of course we see these all over the place now and we call them cherry pickers. He wasn't, I think, the first, I think probably around the same time all kinds of people were inventing them. So he was sort of a scientist by nature.

And the funny thing, you would appreciate this actually, the funny thing was that he had read The Origin of Species and had understood it and so I grew up very much in the context of a biology that was not theologically underpinned, but was underpinned by natural selection.

BINGHAM: I think it's often forgotten that on the 24th of November, 1859 when that book was published, 14 shillings, 12,050 copies- they sold out that day. It was a very popular book, so you probably would have known that.

PAUL: Yea, it moved her father. He was a very, very clever man, made all sorts of things, and I think he was very glad to see me when I came along, he wasn't sure what was going to happen to his daughter.

BINGHAM: He probably thought you'd be an extra pair of hands to do all the projects. So how did you get the inclination to even go to university, because I assume this was the first generation of your family...?

PATRICIA: Oh very much so. My mother was not unlike my father in her education, that is she only had grade 8, but at that time, it was possible to train for a nurse even though you hadn't graduated from school and so she trained to be a nurse in a far flung little hospital in northern BC that was very, very isolated. And she was very practical too, because she had to know how to, you know, deliver babies and help people die and set broken legs and all of those kinds of things. And I think both of them realized the value of education and even though I was a female, they thought that my sisters and I should go to college. Many of the farmers thought this was hilarious and a grotesque waste of money; but they prevailed and it worked out.

BINGHAM: Paul?

PAUL: I was the oldest son of three sons and both my father and my mother, I think, felt that they had missed out on something, that they hadn't gone to college and they very much wanted us to go. And we all did pretty well in school, so naturally we did and got caught up in things. We were all so fortunate in having lots of good friends in our local high school. It wasn't very big, I think our graduating class was 80 people, but I think 90 percent of those went on to university. So it was just the thing that you did, I didn't think it was terribly special.

BINGHAM: When did you meet?

PAUL: We met in a Plato class.

BINGHAM: It's appropriate in one sense but knowing what you think, the wrong philosopher really, for you.

PATRICIA: Yeah, it should have been Aristotle.

BINGHAM: Right, that's what I was thinking.

PAUL: I think I was in my second year and you were in your freshman year, or was it...?

PATRICIA: I think you were in your third and I was in my second.

PAUL: I remember seeing this very, very comely lady on the other side of the class but I don't think I got to know you until well into that year. She had a boyfriend and I had a girlfriend, and so we were friends for years before we became sweethearts.

BINGHAM: So what was your trajectory for the first few, graduate school and so on. You went to...?

PAUL: I was very lucky. My enthusiasm for physics was genuine and I kept taking physics and math courses and I ended up with the equivalent of a Bachelor of Science degree in physics, but I had decided I wanted to go on in philosophy. And there was a wonderful graduate program at the University of Pittsburgh, which was famed for having a lot of philosophers in science, and they were delighted to see an application from somebody who had a background in both physics and philosophy; it was an unusual combination then. So they took me in and that put me into contact not just with a bunch of perfectly wonderful teachers and philosophers, I'll spare you the names, more importantly still, it put me in contact with a bunch of perfectly wonderful other graduate students, a large handful of which are 40 years after the fact, very accomplished philosophers. Pat came to Pitt the year following...

PATRICIA: This was '66...

PAUL: I think so...

PATRICIA: No, that would have, yes I beg your pardon. That was '66.

PAUL: So we all thrived. It was a community of very gifted young men and women and we profited mightily. Although, she ran off to Oxford to get her last degree, for Pittsburgh then was a dirty steel town and a lady who had grown up in a sylvan orchard did not find it an agreeable city. So two years later I had to go chasing across the Atlantic in order to bring her back.

BINGHAM: Alright, well let's cut to the chase before the chase, which is, you went to Oxford for what reason? What was the feeling when you got there, what was the sense of the philosophy that you were learning there?

PATRICIA: Well it wasn't really a very good reason, that is, from a professional perspective I should have stayed at Pittsburgh because it was a perfectly wonderful place. And I had learned a huge amount in the single year that I was there, but I had never traveled and I had this conception of England that was very romantic and I really just wanted to travel there and see what it was like. I won a scholarship from the Canadian government to go, and so I was off. And the philosophy there at that time had actually become quite fashionable. It had really grown out of work by the later Wittgenstein and it focused on language and meaning and conceptual analysis and so forth.

And although I didn't really think that there was likely to be very much gold in those hills, I did want to be in England and I did want to go to the theater in London and see all these wonderful castles. So it was great being there, and the other thing that was quite wonderful about Oxford was this: that once you were there and you were accepted into the program, they assumed you weren't impossibly stupid and so they pretty much let you do what you want. And so I was allowed to sort of, you know, drift around and find what I thought was interesting, which of course turned out to be very much on the fringes of what was mainstream philosophy. And I think that they thought it was pretty odd, but I was at Oxford after all so, you know, it must be more or less ok. And so, the great thing about Oxford was that I had all of this freedom to do what I wanted to do.

BINGHAM: So, if what was being taught there at that time was not good for you, where did you get the sort of intellectual oxygen that kept you breathing?

PATRICIA: I think that it had in fact come from that year I spent at Pittsburgh. And the particular thing that happened there was that we had a seminar with these lively wonderful graduate students that Paul referred to. We had a seminar on a book by a philosopher called Quine, Willard Van Orman Quine, and Quine was very, very different from the mainstream and he... Basically Quine said, look, conceptual analysis, which is what these later Wittgensteinian philosophers do, is really only looking at what people mean, currently mean, by certain expressions. But it doesn't tell you anything about whether or not those concepts truly apply to the nature of things. And it also doesn't tell you whether those concepts might be better revised as a result of empirical data, and whether in fact you might want to ditch those concepts as the empirical data come in. And he said, this is true about ideas of knowledge, of what it is to know, and ideas about logic, ideas about decision-making, about the whole kit and caboodle.

Now, when I describe it that way it doesn't sound terribly revolutionary but in actual fact, it was. And what it did for me was say, ha, this means then that I'm not just interested in the anthropological question of what somebody means by free will. I'm interested in whether or not we have it! Is it real? Is it in our brains? And that meant that all of a sudden I found myself shifting into the empirical domain, to try to understand what we knew, what science knew about the things I was interested in. So Quine for me was the watershed. And of course I tried to argue with people at Oxford and say, but look, but look! And they weren't ready for it at that point, but that didn't matter to me too much because I had great fun doing what I was doing.

BINGHAM: Did Quine have an influence on you as well?

PAUL: Yes he did, an enormous influence. It happened to me a little bit later than Pat, but Quine is one of the three or four biggest influences on my life, and for the same reasons that Pat outlines. For him, the philosophical undertaking wasn't something distinct from science.

The Oxford philosophy said we do conceptual analysis and that's at a higher level, it's an a priori undertaking. The scientists engage in factual questions, that's at a different level and the two solitudes can avoid one another. And Quine's perspective said no, it's all of the piece. If philosophy is anything it's just the sloppy, frothy, disorganized cutting edge of research about the human race in general. A really successful philosopher gets dubbed a scientist by history. And if you look back at people like Aristotle and Descartes and Galileo and Newton, these people were all regarded as philosophers or natural philosophers at the time. But they managed to piece together a conceptual framework that was sufficiently organized and sufficiently detailed to make contact with empirical reality that you could then begin to test it, and thus begins the familiar scientific dialectic of putting up the theory, testing it against the world, seeing that it doesn't fit, going back and changing the theory, and it goes back and forth and then we start to make progress.

That was a picture that captured me, especially because I had grown up as an undergraduate hoping to be a scientist. It turned out I didn't have to give up that ambition after all. I could do it in the philosophy department.

BINGHAM: Or as you said to me the other day, slowly learning how not to be fooled by appearances, one thing at a time.

PAUL: That is how science proceeds, yes.

BINGHAM: So now, you were at Oxford, you apparently went on a retrieval mission. Is this right?

PAUL: Yes, it is true. By this time, Pat was two years behind me. We were writing letters back and forth across the Atlantic.

PATRICIA: I don't think we should go into too much detail.

PAUL: Not too much detail here.

BINGHAM: We do have copies of the letters if you are... [laughter]

PAUL: I went and visited Oxford two summers in a row. This is when I was writing my dissertation for Pittsburgh and she was writing hers for Oxford and it was a case of two heads being four times better than one. And, so I had two beautiful summers in Oxford, chasing around after Pat and ...

BINGHAM: And the English countryside...

PAUL: And, uh, well Oxford itself was perfectly wonderful but we did of course trot out to the countryside. We were both very young, it was idyllic, it was, we remember those years with great fondness. And we made friends there in Oxford that have lasted the 40 or 45 years since, just as we made long-lasting friends in Pittsburgh. They've been intellectual friends, interlocutors for a long time. So all together, very fortunate, we were lucky as hell.

BINGHAM: And then back to Canada? To begin teaching?

PATRICIA: Yeah well, you know, I think had the Vietnam war not been in full sway in 1969, I think we might have come to America. But as it was, it were, the times were very uncertain, very troubled and we really felt that we had better stay in Canada. And Paul at that time actually had a nice job, a tenure track job in Toronto and because there were several universities in Toronto, I sort of assumed that I'd probably get a job there too. But that didn't work out, and partly because one department at York University said don't even bother applying, because we do not hire women. We do not think they should be in the profession and so, you know, you're a very nice person, but we would never hire you.

BINGHAM: You mean because you can't think?

PATRICIA: Well this was 1969, it was not that long ago, and I often tell my female students that story because it's not that long ago and these were very, you know, basically decent people. I mean, they weren't thugs who were running about, you know, assaulting people and this was simply their view. In any case, so as it happened, there were positions at the University of Manitoba, and Paul and I went there. And this was to Winnipeg.

BINGHAM: Right. To where you taught for a number of years...

PATRICIA: 14 years.

BINGHAM: Started a family, 2 children...

PATRICIA: And went to medical school.

BINGHAM: Right. And those two children who are now both neuroscientists, right, which we'll get back to in a moment. And you're grandparents now.

PAUL: Yes, happily so.

BINGHAM: Small neuroscientists, or neurophilosophers perhaps.

PATRICIA & PAUL: We'll see.

BINGHAM: So, you're back in Canada but at some point, there's this interest develops in neuroscience. And, I know from my own experience of doing television programs about the brain, that even if you show people a brain they sort of, don't even like the look of it. The thought that it is actually in their heads seems to be somehow repugnant. People seem to think that a lot of the things we do like free will, consciousness must come from some other agency and not this three pounds of meat. So, how did the brain enter your life?

PATRICIA: Well, I've remarked already on the influence of Quine and the movement towards looking at the empirical data. And it just seemed to me very obvious that how we think and feel and reason is not something done by the non-physical soul. I don't think there is such a thing. So it must be done by the brain. So, we need to know how the brain does these things.

And, you know, having grown up on a farm, one of the jobs of course is to kill the chickens and to then clean the chickens and I learned a lot about physiology or at least a lot about anatomy by cleaning chickens. And, you know, after a while, I mean it has a bad smell, so you can just kind of get beyond that, but it's really quite wonderful. And so when you see, for example, a series of eggs, from almost completely foreign to slightly less foreign with very soft shells to softer shells to tinier and tinier, and you realize you're looking at an egg, a series of eggs being formed and about to be laid, it's a very beautiful thing.

So it was with great excitement that I went to the medical school at the University of Manitoba, and the anatomy department was very happy to have me come. And actually I did have a human brain that was mine to dissect. And probably like you,

the first encounter with this brain, I just felt tremendous awe that this sort of grey uninspiring-looking thing was what made somebody the person they were. It was very exciting.

BINGHAM: It has the consistency of tofu as well.

PATRICIA: Yeah.

PAUL: The consistency isn't what matters, what matters is what it does. We were lucky in a further respect about this time after we had been at Manitoba for about six or seven years and started the family, we had a fortunate sabbatical, which we spent in Vancouver and there was a visiting neurosurgeon, this is... Joe Bogen?

PATRICIA: Oh yeah, Joe. Yeah, yeah

PAUL: Who was...

BINGHAM: Who performed the split brain....?

PAUL: Yes that's exactly right, this was when the split-brain research was hitting the newspapers and the magazines full board. He was giving a talk across town at Simon Fraser University and Pat said, Paul we've got to go to this. So we did go, and it was indeed, very, very gripping. And at that point I was working on my very first book, which was defending materialism, but at that time neither of us knew very much about the brain, but we came back after that year in Vancouver with a real enthusiasm. And that's when Pat said, I'm going down to the medical school to see what I can get hooked up with. And it was sort of a new life for her. I remember it really rekindled her enthusiasm for things philosophical because the data from the neurosciences was starting to flow. The new instruments were now available to everybody, and microprobes, putting electrodes into single cells and doing recordings. There were CAT scans were now coming online. We were starting to learn about the brain, that is to say the neuroscientific profession was, and pouring information out that addressed questions that we had long had.

So we got lucky. We're out there on surfboards and a big wave came by just at the right time. We caught it and we've been riding it ever since. It did... in a way we were fortunate to be at the University of Manitoba. And once again it was the freedom that it afforded us, we weren't at Harvard with some bank of greybeards looking down at us telling us what we had to do, and we weren't a philosophy department, we could sort of switch over to neuroscience. Pat went to work in Larry Jordan's lab; he was concerned with the motor system rather than the perceptual system, which we would have chosen. But beggars can't be choosers and we were delighted that he let first Pat into the lab for a year. After awhile I began to feel left out so he let me in and we both participated in his wonderful

Wednesday night experiments, where we would try and figure out how it is that the cat spinal cord allows the cat to walk. What's the actual mechanism? Larry also had bigger budgets than philosophers usually had, so he was able to get a computer into the lab.

This would have been in what, '77? The very early stages, so that introduced us to computers and I got caught up in modeling then. About that time, we had an opportunity to start to move to other universities. And bless this institution and the Salk across the street, and all the other institutions that are around here; they made us welcome. And we didn't quite appreciate what a hotbed this place was for neuroscience. Once again, we were lucky.

BINGHAM: Had you known Francis Crick at this point? Had you met Francis?

PATRICIA: Yes, there was a meeting at John Hopkins and I had known of Vernon Mountcastle and it was sort of in honor of Vernon Mountcastle and Francis was there to give a talk, I happened to be there also, Dan Dennett, and somebody else. And so that was where I met Francis and that was our last year at the University of Manitoba. And so it was a tremendous delight to meet Francis and he was very surprised at the take that I had on problems such as the nature of consciousness, which was essentially, let's figure out how it works in the brain.

The other really great thing that happened at that time was that Terry was at John Hopkins, Terry Sejnowski. And he had just published an article with Geoff Hinton and Dana Ballard in Nature on computation with neurons and so I was very interested to meet him. So I met both Terry and Francis at this particular meeting at Hopkins. And then of course, suddenly things began to change and we were flown out to give job talks here and then we moved. That was 1984, so it was in the fall of 1983 that all of this excitement happened at Hopkins.

BINGHAM: Ok and so Neurophilosophy was published in 1986?

PATRICIA: That was 19... So it was underway but not yet completed. I had a lot of it, sort of in place the year that we spent at the Institute for Advanced Study in Princeton. And then we came back for a year and then we came here. But it required an awful lot of work.

BINGHAM: And had written, you were writing Matter and Consciousness at that point?

PAUL: I finished Matter and Consciousness the fall quarter of our year at the "Princetitude" as they called it. That was fortunate too, we got to know the east coast neuroscientists and psychologist George Miller and Rodolfo Llinas up at NYU.

PATRICIA: And Mike Gazzaniga of course. Because we were close enough to New York that I could go and see Mike and see Rodolfo and it was good.

BINGHAM: Well the reason that I'm going through this trajectory is to make the point to people that science is an enormous network of networks and that the interdisciplinary way in which it's going now is quite a wonderful development in my view, from these isolated silos that you were originally talking about, certainly with the philosophy...

PAUL: Thank you for highlighting that, because Francis we know, Francis Crick was a structural chemist, well originally he was a physicist. Terry Sejnowski was a physicist.

PATRICIA: An astrophysicist.

PAUL: Who came into neuroscience. I think he did his... that's right. He was studying under Wheeler.

BINGHAM: John Wheeler.

PATRICIA: And then he shifted to do work with Hoffield on neural nets.

PAUL: That's right, and Pat and I came out of philosophy and other people came out of computer science. It was very much an interdisciplinary gathering and the cross-fertilization of disciplines was absolutely vital. None of this would have happened if those seven or eight disciplines hadn't started talking to one another.

BINGHAM: But to bring this into philosophy as well. I mean, I mentioned to you the other day the Dobzhansky quote that, "Nothing in biology makes sense except in the light of natural selection of evolution." It almost seems bizarre at this point that anybody could conceivably think that anything in philosophy could make sense unless you knew some neuroscience and some evolutionary biology. And yet...

PATRICIA: And yet that is not the mainstream. The mainstream still really is quite isolated from the empirical sciences, of any kind. The mainstream questions in epistemology about the nature of knowledge and how its possible for us to know about the external world or to know about each other, that is really quite isolated from anything in psychology and anything in neuroscience. And our work is, I mean, I think its really quite fair to say, is really regarded within the field of philosophy as very fringe-y, probably cranky, and certainly not of very much genuine philosophical interest.

PAUL: There are reasons for this, let me interject, Pat. We get arguments; it isn't just crankiness on their part. They have, or think they have, principled arguments, and one of the arguments is with regard to say, epistemology- the theory of knowledge. What is it to be rational? Or in moral theory, what is it to be just or fair. And they say these are normative questions...

PATRICIA: By normative, meaning...

PAUL: Meaning they are questions of what should be the case, of what ought to be the case, not questions of what is the case. Now they're quite willing to concede that the sciences deal with what is the case. But there's this dubious principle in philosophy over the last hundred years that you can't derive an "ought" from an "is" without an additional premise about an "ought". So the suggestion is that normative knowledge somehow has a different foundation, a different source, and philosophers can pursue that. Now there's a rational explanation, a principled reason, at least that's how they see it, for saying, look that's all very well, you guys want to go off and learn about the brain, that's perfectly good, but don't think its going to have anything essential to do with philosophy.

Now I think the counter to this view is easily seen once you consider an analogous case that the human race has already been through. Go back four or five hundred years and ask what it is to be a living thing. Here we're dealing with very, very early biology. Well, what were the standard theories at the time? Well there were three or four, but they were all of them versions of the "a living thing is alive because it is ensouled by a vital spirit," and biology and chemistry were still in their utter infancies, so this sort of view held sway. Now it could become further questions. What is it for a living thing to live a good life? Well, it's for it to be healthy. And people could say whether or not something is healthy, and what health consists in is a normative question. It's a question of how a living thing should be or how it ought to conduct its internal affairs and here all of a sudden you've got a principled argument for not doing physiology, for doing chemistry, for doing physics of the body.

Now we know, 500 years later that coming to understand that the heart pumped the blood, coming to understand the thermodynamics of metabolism, the physiology and chemistry of cells, coming to understand all of this factual knowledge has given us a fantastically deeper insight into the normative question, what is it for a living thing to be healthy? And with that knowledge comes the technology to make people healthy when they get sick; to prevent smallpox beforehand, to get a grip on the moral domain so we can be far more successful at bringing about what ought to be the case. Now I take that lesson from history as a lesson that is applicable here. We need to know what the brain is, we need to know how it functions, what it does when it learns, what it does when it theorizes, what it does when it engages in social behavior, to evaluate theories. And this

factual enterprise is going to end up giving us much deeper insight into all of these normative issues.

BINGHAM: Hence what I call neuroproliferation. We have neuroethics now; we have neuroeconomics; we have neurojurisprudence... So the injection of interesting information from neuroscience, from fMRI, from single-cell studies, and so on, into why people make decisions, into prediction-reward systems, into the way in which people assign value to things, into the way in which they make moral judgments. There's a book here called Neuroethics, which you of course have a chapter in. It seems to me that this can only be a profitable enterprise at the point, right?

PATRICIA: I think so. I mean after all, the things that we really do want to understand have both a theoretical and a very practical dimension. It's worth remembering that one percent of the population is schizophrenic. And of course, we know that once you're 65 the probability of Alzheimer's goes way up. And everybody either has in their family, or knows somebody very well, who has a neurological issue of some kind. Whether it's addiction or autism or alcoholism or they're frontal or they're dyslexic... and my feeling is that, in general people really want, that is just, people really want to understand how that can be. What is it that goes on in the brain when someone can't learn or if they can't remember anything anymore? And why is it that if the two hemispheres are separated as in a split-brain surgery that one hemisphere can know things that the other one can't?

And so I think it does have an impact on how we think we really, ourselves make decisions. Is it really all present to me, and I'm fully conscious of all the things that go into a decision? And then I perform it? That's sort of the model that philosophers have peddled for a long time, but we know it isn't so. So we kind of have to rethink what it is to make decisions and to form judgments.

BINGHAM: So what's your version of the whole panoply here the construction of the self, what is the self, what is consciousness? These are subjects that you used to talk to Francis Crick about, you've written about consciousness. What's your take on this?

PATRICIA: The problem of consciousness, I think, is a little bit like the problem of life. And that is that it isn't going to be answered with a single experiment or a set of experiments and it isn't going to be answered by looking for correlations between this and that. I think it's going to require that we understand the nature of declarative memory and how it's different from skilled learning. It's going to require we understand the various attentional systems. The top-down one that we can, as it were, consciously control, and the bottom-up one that makes us turn our heads to a flash or a sound.

We're going to need to understand more about the emotions and the role that they have and all of these funny things that play a role in consciousness, like feeling dizzy, feeling well, feeling fatigue. These are extremely important signals for the wellbeing of the body and they're part of what has to be integrated in order for people or for animals with brains to make good judgments about what to do. So I don't think we know.

BINGHAM: Yeah, but you don't make any sort of little cutoffs here and say well, humans are conscious, other creatures aren't, or...

PAUL: Oh no.

BINGHAM: Or you need language to be conscious, as Dan Dennett would suggest?

PATRICIA: No, I don't think so, I mean, bear in mind that we differ from mice in only 300 genes, that Paul is more similar genetically to a male chimpanzee than he is to me. There's not a lot of room, genetically, for something that's wholly and completely new. And besides, what we see in many animals is the kind of flexibility in action and behavior that's very similar to the kind of flexibility in human planning and organization, that seems to need awareness.

PAUL: May I? There's a point that wants making at this juncture. Upon hearing how we might come to understand how brain pathology can produce social pathology, upon hearing that we may come to understand how consciousness is produced by god-knows-what mechanisms in the brain. A common reaction is to say, this is frightening, this is reductionistic, this is making us small, it's cold and it's frightening and it's dehumanizing. And I appreciate those feelings and I want to suggest that exactly the opposite is true. And here are the reasons why.

As we come to understand more deeply and slowly gain control over the various kinds of pathology of character or intellect or memory, we will be able to take better care of our children and our brothers and our sisters and our loved ones as a result of coming to understand how a person's consciousness and the person's personality, the profile of cognitive and social virtues they display, as a result of coming to understand how those things develop in the course of a lifetime, we'll be in a much better position to ward off predations, we can save people from disasters that might otherwise befall them. We will see more deeply into the reality that is another person and therefore we will be able to take better care of it. I can sum this up by saying, what you understand better, you can have better control over. That which you control allows you to intervene and to modulate. It takes you from a situation where which you have no freedom at all, because you're simply hostage to a fate and you don't understand, to a case where, to a situation where you

actually have some freedom, you have some foresight, you can see what's going on.

I think this will lead to greater humanization of the individual humans. I think it will allow us to be more kind, more insightful, more caring about other people and much more effective in bringing about... I don't fear it at all on the whole. Knowledge is power and power can always be abused, for sure. But power that can reduce misery and make us see more deeply into each other's souls is knowledge we should seek.

BINGHAM: Well that's a good enlightenment perspective, and but there's still as you well know, playing devil's advocate for a moment, lots of people out there who think that the work of science basically is dehumanizing, in a curious sense, and that they find more... its taking away the meaning of life, and that somehow there's more solace in religion, other belief systems, other ways of knowing.

PAUL: That's a fair point and it deserves addressing. What can I say on short notice? Something like the following. Let's go back a hundred thousand years to when humans were hunter-gatherers or scabbling their way through the forest, lifting up rocks, hoping to find some grubs for dinner. And think of the level of meaning that their lives had. It certainly wasn't zero- they loved one another, they defended one another, they did all sorts of wonderful things. But, I don't think that their life is more meaningful than is the life of anybody in this room because they were ignorant of science.

I think science has broadened our horizons in a hundred different dimensions, and life now has more meaning, more potential for humans than it has ever had before. I think the reaction you describe is a very shortsighted reaction, and it's just the normal reaction of being told that you're going to have to learn something new. Nobody wants to learn something new, at least if they're past 50 and they're suspicious of the would-be teacher.

BINGHAM: We've talked about this before, you know, different ways of knowing. If you're going to whisk away the carpet, don't you have to put something else in its place first? Some sort of...

PATRICIA: Well I don't know about what the carpet is that's being whisked away. I mean I think there is, of course, a tendency for people to imagine that religion provides something like meaningfulness in life, but often, you know, when you talk to people who have a religious belief, it isn't really very much different from the kind of belief that I have. It's just a sort of general sense of kind of hopefulness, a sense that, you know, things might be better for the offspring than they are for the parents. A general sense that somehow the problems that we as a group confront, that they can be solved. And those are things that I share as well.

But of course it's another very different issue to try to have a sort of institution of ignorance, which really tries to prevent science from moving forward and has to prevent science from making discoveries that can help. And there I think, you know, the fact of it is that there are people, and Leon Cass on the President's Bioethics Council is one of them, who opposes the very idea of the enlightenment, thinks that the period of the enlightenment was one of the great tragedies of human history and that we really would have been better off living in what you and I would call the dark ages, but in what he would think of as an age where people had the comfort of knowing that they would go to hell if they didn't do what the priest's said and so on and so forth. And I don't know how you talk somebody out of that.

BINGHAM: Well you probably must have tried, because you actually went and gave evidence to the President's Council on Bioethics. It wasn't Mr. Smith goes to Washington, it was Mr. Smith's daughter goes to Washington, right? So what did you tell him?

PATRICIA: Yes, so I did, I was invited to address the President's Bioethics Council in Washington, and it's a rather impressive and august group of people. Most of them are physicians of one kind or another. There were a number of issues that they had wanted to talk about, but human dignity was the preeminent issue, and my understanding was that the issue of human dignity was up for discussion mainly because of its role in stem cell research and that was because of the use of human embryos. And there was also I think some expectation that it was an issue for assisted suicide.

So I pondered long and hard about how best to address them. I mean, I was first of all quite shocked to be invited, because they are very much, of course, of the color and stripe of the current administration. But my thought was, look, human dignity really does have something to do with acquiring power over the tragedies of life through knowledge. So I have long been interested in the history of religious resistance to biomedical technologies and so I'd wanted to talk to them about a number of incidents in the history of the resistance. And the first one had to do with the church's opposition to the dissection of bodies, and this occurred in the very early part of the Renaissance. It's not clear why there was this resistance but it had something to do with the expectation that there would be a physical resurrection and if you had dissected the body that it might be difficult for the all-powerful God to put it together again.

And of course that was a great mistake because being able to dissect bodies was extremely important in understanding how they work. You have to know the structure and the anatomy if you're going to understand. So that was one thing. And of course, that was quietly dropped, the opposition. Nobody really stood up

from the pulpit and said sorry guys, we were wrong; it's ok to dissect. It's that it quietly was dropped.

The second really major issue had to do with smallpox vaccination. When Jenner discovered that you could proof someone against the disease of smallpox, it was extremely important. Thousands of children, every year, died a most horrible and miserable death. Many others contracted smallpox and didn't die but were left terribly disfigured. The church, both the Catholic and the Protestant church, opposed smallpox vaccination and preached against it on grounds that it was God's will that someone would acquire or be immune to smallpox. Now, the interesting thing was that the church again ultimately changed its position. But not because they sort of stood up and said, my god, this was a terrible mistake, we were wrong, but because people essentially voted with their feet. They said we want this. The benefits were so clear, so overwhelming, so obvious, that the opposition by the church eventually withered away.

PAUL: Children's deaths from smallpox fell, I think I got this statistic from you, Pat, and one of the, was it Brittany? Fell from twenty five thousand deaths in a year to one thousand. Now that's a lot of innocent little children saved from a miserable death and its no surprise that in the face of this incidence, the resistance quietly backed away but little was said. But this pattern has more repetitions. Back to you, dear.

PATRICIA: Yes, so the next one had to do with anesthesia; the discovery of anesthesia was extremely important. Hitherto people had relied, if they had to do an amputation, for example, or if a woman was having terrible difficulty during childbirth, either you just put up with it or, you know, you drank Scotch. So the discovery of chloroform and ether was extremely important. Again the church opposed it and this time the biblical reference was that, after all, Eve had tempted Adam and God had said, as he threw them out of the garden of Eden, henceforth shall you bring forth children in pain. So there were bitter disputes in Scotland, in England particularly, over whether women in childbirth, including women undergoing Caesarean sections, whether they should be allowed to have anesthesia. Now, that was changed really by Queen Victoria, who was not about to put up with a lot of nonsense and who had many children and who did not want to have a lot of pain and said, right-o we're going to do this my way. And henceforth, again, the opposition of the church withered away quietly.

Finally, my last case: 1956, Pope Pius the twelfth has an injunction against anyone doing organ donation. No organs shall be donated, especially from a living person to another living person. Now I think its very interesting, and I think it's actually sort of morally scandalous that having now ceased to oppose it, the church has not bothered to come out and say we have changed our minds on smallpox, on anesthesia, on dissection, on organ transplant. And my own view is that a similar

thing is likely to happen with regard to especially very early abortions. The benefits are overwhelming and the opposition will eventually wither away. The Catholic Church, after all, has only had a prohibition on abortion since 1870. Before that it was considered as moderately unacceptable, but, you know, it was certainly not considered to be murder.

So I think understanding the history is extremely important. I have to tell you, however, that although some people on the President's Bioethics Council found the history interesting, by and large, they were offended and they found my presentation of the data – and you know, this is just the history, I didn't make it up – they found it to be something that made them extremely uncomfortable, and I was very disappointed. But others on the council, I think at least three or four out of 17, took it very seriously.

BINGHAM: So you said at one point, and I've heard you say that on the issue of belief, for example, you're happy to entertain other people having other beliefs as long as they don't impose them on you, but you can understand these other belief systems do exist.

PATRICIA: Yes of course. and I think where there are religious belief systems, where there's a sort of metaphysical part and a moral part, the metaphysical part usually consists in the belief in a particular sort of being of one kind or another, and that all in a way is independent of the effect on me. Where the problem arises in a large social group is where you go from the metaphysical part to the moral part, where someone thinks that because they have the metaphysical part, it gives them special insight into the deep moral truths. Where then they want to impose those moral truths on everybody so that, you know, I have to dress in a certain way, or I have to have my feet bound or I have to wear a bag over my head or I have to have such and so many babies or I can't have any babies or blah and blah and blah, where all of a sudden, my life is being affected by someone's metaphysical beliefs.

And I think one of the great things about the American constitution is that although many of the founding fathers had a religious belief of one kind or another, they fully realized that in a social context, religion must be non-denominational. Yet you can have your own private metaphysical beliefs, and you and you, but if we're going to get along, then you can't claim moral superiority by virtue of your metaphysical beliefs. And I think it's absolutely central.

PAUL: There's another side to this. The diversity of religious views, metaphysical views, moral views, scientific views, is as much solution as it is problem. It's a sign of the health of a nation that it's conversation reaches out to consider not just one or two or three voices, but ten or fifty or one hundred. What I fear is some sort of monopolistic intellectual, moral, political view taking over what everybody thinks.

And once you've got the absolute truth, of course you don't have to learn anything more. You've got the absolute truth. And that's the trouble with absolute truth; it brings learning to an end. If God told you that this is the final truth, well that's kind of it, isn't it, but it prevents you or your community from learning and what communities do best when they are diverse is learn from our ongoing experiences. We modify our laws, we change our economic practices, we change what we believe, we invent new technologies and we keep getting better and better and wiser and wiser and, knock on wood, happier and happier. I prize religious diversity and I think America is one of the best examples of it in human history. It's one of the reasons why we're a great nation.

BINGHAM: The injection of science into the moral sciences, I mean, where do you see that going?

PATRICIA: Well I, this re-raises the issue of neuroethics and here's kind of how I see the developments in the last ten years that I think are really very interesting. One is that, as we understand the nature of social groups from an evolutionary perspective, we see that there are great advantages for organisms to live in groups, whether its wolves or chimps or birds or humans. And the biologists like Hamilton and Axelrod and so forth also realize that it isn't just, of course, physical traits that have a genetic basis; it's also certain behavioral patterns. And, so, together with other people like Robert Frank, who do the modeling, it was pretty quickly realized that if you're going to have social groups, you also have to have, or nature has also likely selected for certain kinds of social dispositions- the disposition to cooperate, to share, to teach, and the disposition to punish the miscreants; that is, those who would otherwise threaten the well-being of the group or who are violent or anti-social in a certain way, get punished.

And so I think that the great benefit that we've seen come out of sociobiology, and here I'm particularly thinking of Ed Wilson, is to see that the foundations of morals, cooperation, altruism, sharing, punishment, and so forth, really does reside in the genetic story. And that, of course, for most animals that are social there is also this enormous capacity to learn, and that what they learn are the prevailing institutions and norms of the group, but that also that those norms can change over time, especially if you have a highly flexible brain, such as the human brain.

And so I think we're kind of learning both to look at ethics as fundamentally rooted in our neurobiology, but also to see as Dewey did, actually, to see various institutions, justice institutions of the courts, of schools and other things, as kind of social experiments. That legislation to have a certain kind of a tax rather than another is a kind of social experiment and that that part of the story, so there's the biological part of the story, and then there's this part of the story that is politics in its broadest sense, where we try to figure out how we can negotiate with each other

so that we can keep going and what might work well and what might have consequences long down the road that would be most unfortunate.

BINGHAM: So you see a direct application of science to social policy then?

PATRICIA: In the following sense that I think there is much we can learn as we develop social policy from understanding the nature of the brain itself. Now let me just qualify that. It doesn't mean that we're going to learn some neurobiological fact from which we're going to say, aha, here's the policy we ought to have.

BINGHAM: Let me interrupt you there; let's take a case that we know about, which is being called the MAOA mutants. In fact, Pat, perhaps you'd like to explain that?

PATRICIA: Yes, the MAOA mutant story is really very interesting, but the heart of the story goes like this. That there is a mutation carried on the X chromosome for a protein called monoamine oxidase A, MAOA. And what that protein normally does in the brain is regulate the reuptake of the neurotransmitter serotonin, which is largely in prefrontal structures. The MAOA mutants do not produce very much of that protein and consequently there is an abnormality in the serotonin reuptake which means that there is an abnormality in the serotonin levels that regulate prefrontal organization.

Behaviorally, what's that all mean? Behaviorally, it means that these people really tend to lack the capacity for self-control and are often very aggressive and violent, and violent in a way that's harmful to themselves, they are self-destructively violent.

BINGHAM: Isn't it the case that this is particularly if they were abused as children?

PATRICIA: Yeah, and the other half of it is that the probability that an MAOA mutant will show the behavioral pattern goes way up if in addition they were abused as children. So it has raised questions in people's minds about exactly to what degree we should hold them responsible for their behavior. They do not, of course, qualify for the insanity defense; they do not really qualify as incompetent to stand trial; so as the law now stands, they are treated the way anybody else should be. And of course the issue is complicated because these are not nice people. They are very dangerous and they do very horrible things, impulsively. So it can't be the case that we just say, well, you know, bad luck you're an MAOA mutant, so you know, run along now and try to be nice. You can't do that.

BINGHAM: Well can you screen for them, isn't that...

PATRICIA: So one thing you might do is at least raise the question of screening all male infants to see which are MAOA mutants and perhaps do something to intervene, to ensure that they do not receive an abusive upbringing.

BINGHAM: That's kind of a scary intervention, isn't it?

PATRICIA: It's a very scary intervention.

BINGHAM: Plainly the best solution is that nobody should receive an abused childhood. That would be a great intervention.

PATRICIA: I mean the important thing, actually, was also that this study found that even if you were not an MAOA mutant and you had an abusive childhood, the probability of showing violent behavior goes way up. So I mean, it's something we know. And it's like knowing that you must not drink alcohol when you're pregnant. And so this is something that is very clear, very well understood at this point, but so far I don't think there has been any activity on the part of various family groups, like Focus on the Family. I think they are not interested in this issue at all.

BINGHAM: There is obviously regulating that would be a very tricky issue, very tricky. But on the other hand, what is responsible and what is not responsible? How far does your argument go? Is most of the present population responsible or not responsible? Do they have free will? Do they not have? You see where the ball rolls...

PAUL: Too simple.

PATRICIA: It's very complicated because it asks us, I mean these are exactly the right questions, what it asks us to do is to go back and think about why we hold people responsible at all and what role punishment plays. And I think that the best way to get a fix on that really is to look at it from the perspective of evolutionary biology, and that is that we have to have something like a system of punishment for the same reason that chimpanzees do, because you want to deter those who would cause problems and because you need to correct those who, I mean, part of what you do when you punish someone is, in the crudest possible way, intervene in the reward system. You bring it about that they feel pain so that they won't do that thing again.

So that's the general reason why we have punishment, and then of course now we're going to ask the political question about, so if the default is that we punish the abusers, that is those who violate the social norms, how then do we fine-tune it? You know, suppose the person was having an epileptic seizure or suppose the person is extremely young. And then, various groups try to refine their rules for

punishment to do what seems most efficacious. That is to say, if you put this law into place, you have consequences for the group as a whole, which work well.

BINGHAM: I was just actually thinking about an experiment that you probably are familiar with, it was done in Frans de Waal's lab, I think it was done by Sarah Boysen, I'm not sure if she's still there, where they had some capuchin monkeys and the monkey performs a task, and once it does the task, it gets rewarded to a piece of cucumber. So the monkey does the task, gets the cucumber, the monkey does the task, gets the cucumber. You then have another monkey in a cage next to, so it can see what's going on. So there's a reward for a task, a reward for a task... If you then have the second monkey who's observing, doing the same task, and it's given a grape- which is a big reward. It's really big time. This monkey gets very irritated, the one that's getting the cucumber for doing the same job. So and then the third thing is that if you actually give this monkey the grape, even if it doesn't do the job, just have a grape, this one starts throwing feces at the keeper, and so it gets really irritated. And it does seem to be that it's the sort of the basics of an economics and value system, in capuchin monkeys.

PATRICIA: Oh I think so. There's a sense of what's a fair distribution. Sarah Boysen, working with Frans de Waal, did that, and they did it with capuchins but they also did it with chimps and there is a sense of, you know, what's acceptable and I rather imagine that little children, you know, have pretty much the same sense, especially with regard to distribution of food.

BINGHAM: I'm going to make a leap here to justice, to social justice and to go from a capuchin cage to John Rawls and talk about, use a couple of magical phrases here, but perhaps you could explain and see whether you agree with the original position and the veil of ignorance. Does one of you sort of want to do an instant, one paragraph John Rawls?

PATRICIA: You should do the one paragraph John Rawls and then I'll tell you why it's wrong.

PAUL: Very well. John Rawls presumed to give us a criterion for what was and what was not a just system of rules in given society, a system for distributing the goods of the society, concerned the issue of distributed justice. And the test is really quite an appealing one at first glance. He says, in order to know which of a range of possible organizations- social organizations, economic organizations, privileges given and withheld and so forth- you put someone behind a veil of ignorance. They look at any of these candidate systems and the question is, look at the system, see how it runs, tell me if you would like to live in it, but we're not going to let you know where you're going to be in this system. You might be the chairman of Enron; you might be a garbage man in the back alley; you might be a drug addict on skid row; you're not going to know where you're going to be.

And the point of Rawl's story was that each rational person would choose the society where the minimum level of welfare was the highest. Because, even if they ended up being the worst person off in that society, life would still be tolerable. And it was argued that such a society can allow for broad differences in income, especially if that raised the bottom level higher- rising tide raises all boats, and so it was widely seen as an effective rationale for liberal democracy and that was John's view. I have some comments on it too, but the agreement was to let Pat go first.

PATRICIA: No you should say what you think.

PAUL: I can say it quickly but then I'd like to see what your objection is.

BINGHAM: The reason I raised that one is, here's a classic case; it's almost like a philosopher not knowing science. You can then look at that situation and say, now let me pour some science into this. Let me put some gender in there, let me put some genetic inequities in there, let me put all sorts of things into there and see if it still works.

PAUL: True, true, and I think that John Rawls was making a mistake. More than one, I'll point to only one of them. I think he was trying to come up with a criterion that could settle the issue of what's the just society, as it were, once and for all. And someone might have been suspecting Pat, looking at how capuchin monkeys go, thinking that maybe if we look at our biology, we'll be able to settle once and for all, what's the right moral order. I think that hope is a vain one. All we can hope to do is to improve the moral organization that's already in place and then improve it again and then improve it again. It's like science unfolding. Nobody stands up and says, I have the insight and the criterion for telling, right now, here and now, the final ultimate true theory. Everybody has gotten used to the idea that as the centuries roll by that our theories get better and better and deeper and deeper.

I think that moral and political insight, which I think is just as real as scientific insight, has the same long-term profile. We're learning from our ongoing experience and we will get better and better and better. And there's no hope of identifying something here and now as the ultimate truth, here and now, make everybody bow down and pray to it. No, that's not a good thing to do. The best thing to do is to keep learning and never stop learning and never lose sight of the fact that there is always something new to learn.

BINGHAM: Now for you on Rawls.

PATRICIA: Well I think that Rawls really did think of these things as quite independent of biology, which is sort of strange in a way, because there he was at Harvard and here, sort of down the hall so to speak, was Ed Wilson. And Ed Wilson's a biologist, but a biologist who realized that much of the moral motivation has to come from the basic biology. So it was very odd in that respect. I think that then, one way to see what Ed might have wanted to say to John Rawls was, look, where do you think these intuitions come from? That you're asked to draw upon when you're behind the veil of ignorance as to what would work and what would be good.

Well, principally they come from your biology and then your biology is tuned by the culture you happen to live in. They don't come from Plato's heaven. They don't come from pure reason. They don't come from religion. Where the hell do you think they come from? And I think that the great weakness, and here I think Paul and I are really in basic agreement, was that this was an abiological approach to something that really can only be understood if you look first at it as a biological phenomenon- moral behavior. And then as a biological phenomenon that's shaped and changed by changing conditions and changing cultures.

You know, there's another animal story I just have to mention to you, and you may know this story, but you know, Bernd Heinrich is one of the great ethologists and he has worked on birds, mainly on ravens and crows and owls. And the raven story goes like this, that ravens have a very clear sense, they will work together to drive off a wolf, for example, from a moose carcass. But then the possession that each has of a piece of food is a very powerful thing. So they seem to have a sort of strict code of behavior, such that this is my food, you don't steal it. So he set up to test this, he set it up so that the ravens in the group all knew that this belonged to raven number one, this food. And then he arranged that this raven didn't realize that the food belonged to him and the raven went and got it, he was mobbed by the other ravens, so that there was a kind of enforcement of social practice, at the level of birds! I mean, not that I mean to demean birds, ravens are probably every bit as smart as chimps, but it is clearly a pattern that we see amongst social animals, that to function and to get the benefits of living in a social group, certain social dispositions have to be in play.

BINGHAM: Okay then when you said, obviously it's difficult to talk about these things without the use of ordinary language, but when you say you realized, are we talking about a cognitive act now? Are we talking about a raven with a theory of mind? There are some papers that suggest that. Starlings as well.

PATRICIA: Well that's hard to know. Indeed and there's recent work showing that jay's, I guess they're stellar jays, know that another jay has seen them cache a nut here and they will deceive and so forth in order to prevent that jay from stealing the nut. So I think that almost certainly, lots of social animals have a concept of what

the other has as intentions and goals and so forth. Whether they have the richest conception of belief systems and so forth that we have, I suppose that's rather doubtful. But it's very clear from the chimp work, for example, that one chimp knows what the other one can see. And one chimp knows the intentions and goals of the other chimp and you can set it up so that it's as clear as can be. There's just no doubt about it.

BINGHAM: Just to follow that argument slightly, there seems to be, and perhaps you can explain what we mean about representation as well, but there seems to be, as you know from Bud Craig's work, sort of a level at which the capacity to take an experience and then re-represent it higher up the cognitive system, so that you have a sense of yourself as having been an experiencer. His argument would be that the area where that initial waystation, which he calls the MPO, as you know, the space is privileged to primates and above. It seems to suggest that there is a distinct cutoff there. Do you have any comments on that?

PATRICIA: I really am not sure what to think. I guess, the thing about birds, and now I mean, really smart birds like ravens and owls and jays, is that their anatomy is quite different. And it turns out that they do have cortex, but that it's just organized in a rather different way. And it's just taken a lot of anatomy to show that. I mean, as Harvey Carton is fond of saying, there are dinosaurs, they are amongst us, they live in the trees; they are birds! And so what I would want to do before thinking that it's only primates that have this capacity to sort of reflect upon their own representations and make this division between a representation of what's internal and a representation of what's out there, what's external. I'd also want to look more closely at the relation between bird behavior and bird brains and what they really can do. Because I figure there's separate evolution here, but I bet it's not too different in terms of functionality.

BINGHAM: So in terms of consciousness now, just thinking, there's a philosopher you probably know called Colin McGinn who basically thinks there's a kind of cognitive closure, that we are simply incapable with the machinery that we have, of ever understanding consciousness. Your thoughts on that, Paul?

PAUL: I'd like to know how Colin McGinn can know that. I'm sure that there are many things beyond the comprehension of a human brain, in just the way that, as Colin himself says, there are many things that are beyond the comprehension of a mouse. A mouse, as their brains are currently constituted, will never understand differential calculus. That sounds plausible. Colin then goes on to suggest, it may be that our brains are forever inadequate to understand the phenomenon of consciousness. Well, that is of course a priori possible. Why he would think that it's probable is something that's always mystified me. I suspect it's something like, well I'm Colin McGinn, I'm a bright fellow, I can't imagine how I could understand

it, therefore, no human brain can understand- that's the unkind take on the situation.

I'm unmoved by it because for one thing, understanding comes in various levels and degrees. Understanding isn't something that's either on or off. We could, with our brains, come to have a feeble understanding of what the brain is and how it works. We already have some understanding; take that, Colin. Now why can't it go up? No reason why it can't go up. Are you in a position to tell me where it's going to top out? Of course you're not. You'd have to know something about the brain beyond what you think is possible in order to give a proof of this kind.

Finally, we're coming to an age where cognitive prosthetics, whether they're, you know, just sticking some extra RAM into your head somewhere, or more realistically, interacting with a machine. We can enhance human cognition and maybe enhanced human cognition can understand cognition, consciousness, even if in the unlikely even that Colin McGinn might be right. I find it an unhelpful position. It is of course and intriguing question, might it be forever beyond our understanding? Yeah, that's an intriguing question, but I don't think it's anything more and I don't take his position very seriously and I'm going to spend my life trying to advance our understanding of what consciousness is. We've made lots of progress, no reason to think it has to stop here.

BINGHAM: At the recent Society for Neuroscience meeting, there was a presentation there by somebody who had taken some experimental procedures into Tibet, and she had been asking Tibetan monks to perform, to see if they could hold... I'm just trying to recall this as we go along, here... trying to hold two different percepts, two different stimuli, constant. In other words so, she... she gave them goggles and had a horizontal grating in one and...

PAUL: Oh, a binocular rivalry.

BINGHAM: A binocular rivalry situation. Or as in the situation of the Necker cube where you have the faces flipping. The experiment was equivalent to saying, see if you can hold that one of those percepts stable and not let it flip. As you know, if you're watching that cube, it will flip every 5 or 7 seconds. And there was apparently, although this was self-reported, one of the monks, they just stopped timing at 723 seconds. And he was sort of baffled at the end, he wondered what the experiment was all about and what was the big deal, but here was somebody who obviously had, apparently had, a very different level of control, to put it that way, than we have. So, perhaps there is something in these other traditions? One wonders that we still have a great deal to learn from. The Dalai Lama, of course, was at the conference at the same time; you've had some exchange with him. Any thoughts on that?

PATRICIA: I think it is very interesting and I think that meditation is a real brain phenomenon and I fully expect that there are real differences between a meditating brain and one that isn't meditating, and that it might be helpful to understand that. But I think the practical point is, in a way, the other thing that you're getting at here, which is that- might there be ways of improving our lives by using some of these other traditions. And I think, then, the answer is absolutely. I think meditation is a wonderful thing. I think yoga is a wonderful thing. I don't understand how exactly it works, but there's no doubt that it makes you feel different than you did before. And so I'm entirely open to those sorts of things.

Now what I don't think is that the metaphysical part of some of these traditions, that say, and this isn't necessarily the Dalai Lama, that say that it's really the non-physical soul that is doing all this and the non-physical soul will depart the body upon my death. That part of the story I don't think is right for all of the standard reasons. But as for it making a change in lifestyle and so forth, I think that's quite reasonable. I should also just mention that on the occasion when I met the Dalai Lama, he was also giving a lecture at Irvine on morality. And he made a point which Paul actually just made with regard to Rawls, and that is that you can't really expect that the foundations of morality consists in a set of rules with well-defined exceptions, that isn't really how it works. And that rather it's a sort of skill that you acquire by living in groups, by reflecting on the consequences of this and that kind of outcome, and that it's possible to make moral progress. In other words, he sounded very much like Aristotle and I thought that was really an extraordinary thing. But I think on moral issues, he's very deep.

BINGHAM: And he has that great sense of humor as well.

PATRICIA: And he has a great sense of humor.

BINGHAM: "If you find some way of proving that neuroscience shows that our laws are wrong, we change them!" He is very clear about it. Twenty years ago, we find that Bill Moyers, in the interview that you did with him, it was almost 20 years ago, asked you about this fascination with the brain and where it came from; obviously its still there. Where do you see things going now in terms of the brain and neurophilosophy with your particular studies?

PATRICIA: Well I guess my interests have moved in a direction that I never would have expected, and that is, into the area of ethics. And so the recent developments in social neuroscience seem to me to be tremendously exciting and tremendously important. Big, big major issues remain in neuroscience. There are huge unanswered questions about how we integrate across vast areas of the brain, how we retrieve memories, how neurons code information, how systems manage to work together, and so forth, but I also have the feeling that progress is being made on those, not really, I mean sort of yes, little experiment by little experiment, but

also because people are thinking in a big way. And I think that that's very different from how neuroscience was, say 30 years ago when really it was just kind of impossible to start thinking in a big way about how you might solve problems of the nature of integration across sensory and motor systems, for example.

BINGHAM: Plus, it's actually getting a lot of money thrown at it these days. I mean, there's these giant new centers on the east coast, and this area, as you know, is jokingly called "Neuron Valley" because of all the neurosciences here.

PATRICIA: I didn't know it was called "Neuron Valley."

BINGHAM: Well Ramachandran dubs it "Neuron Valley."

PATRICIA: Oh that's wonderful.

BINGHAM: And we would like to see more of it. So if you, by the way, just the binocular rivalry experiments and the monks holding those things constant- the person doing that research, who was Olivia Carter, just wanted to make sure that I got that. If you were, if you hadn't become philosophers and scientists, what would you have done? What other career would have appealed to you?

PATRICIA: Oh, I would have liked to have been a trail guide up in the Yukon, taking people on rafting trips.

PAUL: She still occasionally does that, actually. All that I have been, all I can do is to tell you what were the temptations along the way. I was briefly tempted to be a musician in my early years in college. As I mentioned, I thought I might be an aeronautical engineer and a physicist. There was a brief period when I thought, oh Paul, give up these dreams, go be a school teacher, go back to the Okanagan Valley. But I got lucky and things kept capturing my interest, as they still do.

You asked Pat a moment ago where this brain stuff might go from here, and it's social consequences, and she again focused quickly on the neuroethics, social behavior dimension, but there are other dimensions here too. One of my abiding interests is how do brains do theoretical science? How is it that human brains can do things like n-dimensional geometry or quantum physics or astrophysics or structural chemistry or thermodynamics? These are all extraordinary skills that at least some human brains have managed to master or create. I'd like to know how that's done.

There's also a distinct dimension having to do with artificial neurotechnology. We've all heard hype over the last 30 or 40 years about artificial intelligence, and what we've seen is non-trivial because computers, even standard computers, are very powerful machines. But to some people's, to many people's disappointment,

these attempts at artificial intelligence never actually produced anything that had anything very much like human consciousness or human perception. Now that we can build artificial neural networks, which mimic the way in which the brain of a human or a chimpanzee or a golden retriever, the elements, are wired up, then we can make artificial devices that function literally like brains from the word “go”.

And neural network technology is already at work in interesting little places, I'll spare you the long story, but that is something which is going to change the world in interesting ways. Artificial intelligence is a subject with a great future. It tripped out of the starting gate 30 years ago; people went for the standard serial digital von Neumann computer as the device to model cognition. No, the model we should be following is the terrestrial brain. Once more we go back to the empirical facts, we ignore them at our peril, and if we can imitate parts of the brain, if not whole brains. I'm not so eager to create a C3PO or a Data, I'm interested in neurotechnology because this is a very interesting technology that evolution lit upon and it's been exploited in all sorts of ways across the animal kingdom for the last 500 million years, but we've only just started.

BINGHAM: Is there any discoveries you would have liked to have made had you, if you had thought about it?

PATRICIA: Well that's an interesting question.

BINGHAM: Because you don't think that anybody's is going to discover the function of consciousness, right?

PATRICIA: Well, I think it will emerge in the way that we now really pretty much understand the story of what it is to be alive. And I do think we will understand the story of what it is to be conscious. And playing a role in that story, I think, is really fun and exciting. I guess neuroscience right now is terribly hamstrung by the fact that we have these macrotechnologies like functional magnetic resonance imaging, fMRI, and EEG, on the one hand, and then we have these very microtechnologies like single cell recording or recording from, you know, groups of cells.

But if we are to be able to explain macrobehavior, we somehow have to get into the middle. We have to have an experimental technique for accessing or telling the story of how a hundred thousand neurons within a single cortical column is functioning. Now one possibility is to model that, and I know Henry Markram, with IBM money, is trying to do something along those lines. But that seems to me to be absolutely critical. That's a big gap. We'll get there. I don't see how to get there right yet, but there has to be some way of pulling these things together so that we understand what we are seeing when we see an fMRI diagram and what it really means in terms of mechanism. I mean it's a very pretty picture and we say the brain lights up when... but we don't understand what it means in terms of

mechanism. And the mechanism story is down here but it's too fine-grained. So somehow we have to get in between.

BINGHAM: Finally, who would you have liked to have had a conversation with, historically?

PAUL: Oh that's hard because there's at least five or ten people that I would have loved to have had a conversation with. If you take into account their personalities, I think Isaac Newton wasn't supposed to have been a very engaging fellow, though I would have loved to have talked with him.

I think Immanuel Kant, not because I think his philosophy was correct, but because he was simultaneously a groundbreaking thinker with regard to astronomy. He figured out how the solar system formed. He figured out what spiral galaxies were. And wrote a book called On the Theory and Natural History of the Heavens before he became a very, very famous philosopher late in his life. And he knew his physics, he admired Isaac Newton enormously, and he also wanted to know how the mind worked and gave a very interesting theory, one that captured many imaginations. And I'd like to talk to him, not so much by going back there and talking to him but by bringing him forward and saying, Immanuel, have I got some surprises for you. Some of them you're going to love, some of them are going to dumbfound you, some of them might move you to say, curses, I got it wrong. But ok, Immanuel Kant comes to mind.

BINGHAM: Pat?

PATRICIA: Well of course we'd all love to talk to Darwin and just sort of sit in the garden in Down cottage and just spend the afternoon. And yeah, that of course would have been wonderful. I would have also liked to have known William Hamilton. I knew John Maynard-Smith very briefly and sort of towards the end of his life and I just found him wonderfully interesting to talk to. Helmholtz must have been fantastic.

BINGHAM: Anybody want to meet Freud?

PATRICIA: I don't think so. No, I mean, Freud wasn't, he wasn't a very good guy, actually. And I don't think he was very smart either.

BINGHAM: So your children, Ann and Mark, are now neuroscientists? What are they working on? Same?

PATRICIA: Well they're both post-docs. Ann works on decision-making in the awake behaving monkey and Mark works on planning in the awake behaving monkey. And so the work is somewhat close and they trade back and forth and

they go back and forth, and of course we're interested in both of those projects because of the relevance to the wider issue about judgment and planning and deciding, as we know it in a larger context.

BINGHAM: So they have a philosophical bent as well?

PAUL: They grew up in a philosophical household. They got a philosophical education without even appreciating that it was happening. My son, I remember him in the hot tub with my colleague Gerry Doppelt. My son was then about 13 and giving Gerry Doppelt hell about his foolish theories of moral philosophy, and this is a distinguished moral philosopher. Yeah, they learned lots of philosophy, but they took good care to stay a certain distance away from mom and dad. And I think that served them well. Neuroscience is close enough to what we do.

BINGHAM: I was going to ask you about free will but I'll probably save that for another time. I think there may be some questions from the audience anyway, so let me just thank you for the conversation.

PATRICIA: Thank you, Roger. Thank you so much.