

## RODNEY BROOKS INTERVIEW PART ONE - INTRO

Hello Ars Technica readers. My name is Rob Reid, and this is the second week of an experiment we're doing here on Ars, serializing episodes of my podcast - which is called After On - into two to three 30-ish minute chunks that we post on two to three consecutive days, roughly at lunchtime. East Coast time zone anyway. That's a bit early for lunch in some places, a bit late in others. But once it's content's up there, you can of course listen whenever you like. Which may well be your own timezone's next lunch shift.

This week's episode will run in three parts, starting today. And our guest is the world-renowned roboticist and AI pioneer Rodney Brooks. For those who missed last week's episode with Harvard genomicist and bioengineer George Church, I'll now briefly review my own background. And if you don't need this context, it'll run about a minute, so feel free to skip ahead.

I'm a recovering serial entrepreneur turned podcaster. The best-known company that I started built the Rhapsody music service back in the day, which created the unlimited on-demand streaming model that most people now associate with Spotify. These days, my main job is writing sprawling science fiction novels for the Del Rey imprint at Random House. And my podcast began an offshoot of my most recent novel - which is also called After On

My show dives deep into complex issues in science, tech and society which we should all probably understand a bit better. Each episode's built around an in-depth interview with a world-class expert in the relevant field. I do 20-30 hours of up-front research and preparation before sitting down with my guests. And I structure my interviews carefully, so that their information density hopefully feels a bit more like TED talk than a meandering long-form interview. Ideally, I try to bring my listeners from a glancing familiarity with the day's subject to a top-percentile understanding of it in the course of the 60 to 90 minutes that most of my episodes run.

So - on to the detailed background of this week's guest, Rodney Brooks.

Rob Reid: It's a rare and exalted distinction to be considered a true founding parent of any major field of tech. It's virtually unheard of for someone to achieve that in two separate domains, but Rodney is one of the very few people who have done just that. When he left Australia for the region that would later become known as Silicon Valley, there were quite literally three mobile robots of consequence on the entire planet. Years later, Rodney would found a company which has brought tens of millions of these critters into the world. His products have saved countless lives, and have also liberated thousands of acres of carpeting from dust, crumbs, dog hair, and other detritus.

Rob Reid: The realm of AI was almost as nascent as that of robotics when Rodney first entered it. A separate company he founded became the leading provider of AI development tools throughout the 80s and early 90s. By the way, he squeezed all of his entrepreneurship in while pursuing a very storied academic career largely at MIT where he ran one of the two largest and most prominent AI centers in the world for many, many years. Because Rodney witnessed and

shaped so much of the history of both robotics and AI, we'll spend a bit more time than usual talking about past decades. That's probably a bit more than 20 minutes of our conversation.

Rob Reid: I've included it in part because it's great storytelling, but mainly because it's important to understand the many false starts and great leaps forward that these fields have both endured, as this will bring a much more nuanced perspective on their present and future. That future is the subject of the bulk of our conversation. For one thing, we'll discuss self driving cars as they comprise the very intersection of robotics and artificial intelligence. Rodney considers the forecasts made by many leaders in this field to be irrationally optimistic. Those who want their self-driving cars immediately won't necessarily like this, but you have to respect that Rodney's own predictions are very concrete and verifiable.

Rob Reid: Also, he makes them in writing and affixes them with hard dates. Something that many futurists lack the courage to do. Rodney also diverges from fashionable narratives about the interplay between employment and automation. To paraphrase one of his blog posts, he's not at all worried that there won't be enough jobs to go around. Instead he's concerned that there won't be enough labor available to do the jobs that will need to be done even after many more revolutionary strides are made in robotics and other automation. Yes, really.

Rob Reid: Thirdly, Rodney is far less concerned about Super AI risks than many of tech's most prominent commentators. If your job description includes freaking out about AI risks, and I guess mine kind of does, you may find his perspective to be frustratingly sanguine. On the other hand, if you prefer that humanity not perish at the hands of amoral and genocidal AI overlords, you might find his arguments reassuring, particularly given the authority and experience that they're based on.

Rob Reid: With that, it's time for our interview with Rodney Brooks.

## THE INTERVIEW BEGINS

Rob Reid: Rodney, I'm delighted that we're able to catch up doing one of our brief overlaps here in San Francisco. Thanks so much for making time.

Rodney Brooks: Happy to be here.

Rob Reid: I'd like to start by going briefly through some of your early background. You grew up on one of the southern fringes of the inhabited world, didn't you?

Rodney Brooks: Yeah, from where I grew up, the next thing south was actually Antarctica. I grew up on the South Coast of Australia. At the time, it was actually the third biggest city in the country, Adelaide.

Rob Reid: Back then, you literally would get your tech news by steamship.

Rodney Brooks: Yes, we'd get mostly British magazines and they would show up three months after the date on the cover, because they came by ship.

Rob Reid: Then, you were obsessed with robotic and computing from a very, very early age, correct? You had a garden shed where you built all these things?

Rodney Brooks: Yeah. My mother actually bought me two magazine-like books that were a series called The How and Why Wonder Books, which were American books. She bought me two in 1961. One on electricity and one on computers and giant brains. I still have those to this day. From that, I've learnt how to build little, simple electrical circuits with materials I had. Nails, the metal from a vegetable can, wires, light bulbs from flashlights, and batteries. I started building ors, and ands, and nots was a little harder.

Rob Reid: Not's tricky.

Rodney Brooks: Started building little circuits from a pretty early age around nine or ten.

Rob Reid: We've all heard about the budding, young entrepreneur in the back shed, but you're building computers, and also nascent robots, if I'm not mistaking, in the 1960s. Maybe a decade before we normally associate with this activity.

Rodney Brooks: I wasn't so good mechanically. The first time I got a robot to actually move was more like 1970-

Rob Reid: Oh, much later.

Rodney Brooks: ... To be fair. Actually, by 1971, I was actually building printed circuit boards where I would etch them. I found a source of surplus transistors by that time, and was building circuits with hundreds of transistors.

Rob Reid: Then, university in 1972.

Rodney Brooks: Yes. I started at a university called Flinders University in Adelaide. It was six years old when I went there and all the math faculty were refugees from Czechoslovakia from the Prague Spring-

Rob Reid: Oh, 1968.

Rodney Brooks: ... When they had fled.

Rob Reid: Yeah.

Rodney Brooks: I ended up getting a classical, eastern European mathematics education. In my four years there, I took 41 classes. One was in chemistry, one was in physics, and 39 were in mathematics.

Rob Reid: It's a huge amount of math.

Rodney Brooks: Yeah.

Rob Reid: Now, this would have been well before there was a computer science department there, of course.

Rodney Brooks: Right. There was no computer science department. The mainframe for the university was a 16 kilobyte IBM 1130. It had a megabyte disk. It had four full-time operators running it, and you punched your cards, put them in, and 24 hours later, you'd get a printout. Wonderfully for me. Wonderfully. [inaudible 00:14:18] who taught numerical analysis, recognized in me something, and arranged for me to have that computer to myself for 12 hours every Sunday from 9AM to 9PM. You talk about the 10000 hours? That was my 10000 hours.

Rob Reid: You probably had more compute resources than almost anybody on the continent at that point, having 12 hours of a dedicated mainframe like that, right?

Rodney Brooks: Yeah, and I had access to everything.

Rob Reid: Naturally, when you were done with all that, there was nowhere to go but Silicon Valley. Not that anybody knew what Silicon Valley was, yet.

Rodney Brooks: It wasn't called Silicon Valley. I knew that I had to come to the United States. The three important places in the US for computer science at the time, still largely today were MIT, Carnegie-Mellon, and Stanford.

Rob Reid: It hasn't changed.

Rodney Brooks: I applied to those three, did not get into MIT, did get into Carnegie-Mellon, and to Stanford. I went to the library, found an atlas, and looked up where Pittsburgh and Palo Alto were. Palo Alto was closer to Australia, so, that's what I chose.

Rob Reid: That cannot be denied. Then, in 1977, when you came over, describe the state of robotics at that time. Specifically, how many mobile robots were in the world in 1977?

Rodney Brooks: As far as I know, unless there were some in the Soviet Union, which we didn't know about, but that anyone knew of, there were three. There was a robot

called [inaudible 00:15:36] at LAAS in Toulouse, France. There was a robot at Jet Propulsion Lab in Pasadena. There was something called The Cart, C-A-R-T-

Rob Reid: The Cart.

Rodney Brooks: The Cart.

Rob Reid: Definite article. It was not an acronym, it was just "The Cart"?

Rodney Brooks: At Stanford AI lab.

Rob Reid: Given that one of the three robots was there, it was obviously a very good choice that you did make versus Carnegie-Mellon.

Rodney Brooks: My thesis was not on that mobile-

Rob Reid: It was not on The Cart, but it was there.

Rodney Brooks: I helped Hans Moravec with his experiments as he was finishing up his PhD thesis.

Rob Reid: I read somewhere you experimented with a 28 hour day?

Rodney Brooks: Yeah, one summer, 'cause I was always getting up later and later. I decided okay, I'm just going to go for it. I would do six 28 hour cycles a week, that way I would be able to get to certain social events on Saturday nights-

Rob Reid: 'Cause, Hans was working with The Cart late at night, and you were on your bizarre 28 hour cycle, so you had a lot of time helping him out with The Cart stuff.

Rodney Brooks: He would try to do his rounds from 10 or 11PM to about 5AM when no one else was using the machine, largely so he'd get enough computer oomph to run his Cart in real time so that it could move a meter every 15 minutes.

Rob Reid: It would scan the floor and make sure it wasn't bumping into things. It would take 15 minutes to say, "Okay, I'm ready for my next meter."

Rodney Brooks: Ready for my next one meter.

Rob Reid: My next one meter [inaudible 00:16:47]. It is intriguing that you did come to robotic when it was virtually non-existent. What was the state of AI at that point? I know the term had been around for over 20 years, 'cause there had been that Dartmouth seminar in the 50s. What was the state of the field?

Rodney Brooks: The Dartmouth conference of 1956 was initiated by John McCarthy. John McCarthy was the director of the Stanford AI lab when I got there. Very remote figure.

Rob Reid: He had founded the AI lab at MIT as well, correct?

Rodney Brooks: Along with Marvin Minsky and then he left very soon after that, and he came to Stanford, and founded the Stanford AI lab. But, there were little pockets of AI apart from those big three. Berkeley had a little bit, some Canadian universities. But, they were labs. They weren't departments.

Rob Reid: Then, John McCarthy, he had co-founded the AI lab at MIT, he founded your lab, he named the field. He's the one who coined the term Artificial Intelligence. You were learning from the founder of the field, or one of the two or three founders of the field?

Rodney Brooks: Oh yeah, absolutely. Absolutely. Yes. Everyone knew everyone. There were maybe 250 AI researchers in the world and everyone knew everyone.

Rob Reid: What was the state and significance of the language LISP at that point?

Rodney Brooks: LISP had been developed by John McCarthy when he was at MIT, and then different versions had been built everywhere. LISP was the standard language that everyone was using.

Rob Reid: LISP was the language of AI at that time and for quite sometime after that.

Rodney Brooks: For a long time after that, yeah. I haven't hacked on my own version of LISP since yesterday afternoon.

Rob Reid: It's been that long, so, it is still a vibrant-

Rodney Brooks: I still use a version that I built in the early 1990's. I'm still tweaking it.

Rob Reid: That's fantastic. This was the language of AI and you ended up founding, or co-founding a company called Lucid that was really core to its proliferation, wasn't it?

Rodney Brooks: Yeah, at MIT, I had started building special purpose workstations to run LISP.

Rob Reid: Specifically for LISP?

Rodney Brooks: They were cordless machines all built by hand. There were about 19 or 20 of them at that point, at the AI lab when I got there.

Rob Reid: All built by hand?

Rodney Brooks: Yeah, built there. Then, two companies spun off. One called LISP Machine, Inc, and one called Symbolix.

Rob Reid: I remember Symbolix boxes. They were dedicated machines.

Rodney Brooks: Back at Stanford, just before I had left I had advised a good buddy of mine that his idea was a stupid, dumb idea, and workstations were not the future, mainframes were the future. Andy Bechtolsheim went ahead and founded some micro-systems anyway.

Rob Reid: Boy, did he.

Rodney Brooks: I knew about those workstations. They were not custom built processors. They used standard chips and it seemed to me that Symbolix was every machine was custom designed, the CPU was custom designed. They couldn't put as much engineering oomph into it as the chips which were used for other workstations, for other things. There was much more engineering going in. I decided that even though at that point, LISP in hardware have an advantage over LISP in software. LISP in software would ultimately win out.

Rob Reid: Just to clarify for those who aren't familiar with this era. Sun and several other companies created this new category of computers called workstations, which were way more powerful than PCs, but like PCs, could be used for lots of different things. You believed, correctly as it turns out, that computers that could only write LISP would be overwhelmed in the marketplace by workstations which could do that and countless other things. So, you created a software LISP package that could be used on a diversity of computers, including those of Sun. Anyway, back to what happened.

Rodney Brooks: When I joined the faculty and staff in 1983, one of the first things I did while I was writing a book on LISP for my undergraduate course, while I had my first baby, I also wrote a software LISP system for the Sun workstations. In the middle of '84, I was leaving Stanford and going back to MIT. A bunch of other people saw my LISP running on those workstations and said, "We can start a company building a software version of LISP." I teamed up with them and just to get the first funding, and get bootstrapped; they decided Brooks' compiler is sort of hack-y, but we'll use it to start with. A week after we incorporated the company, got funding, I left, went to MIT to join the faculty for the next few years while being a junior professor. Pretty much every morning I would have a 40 megabyte cartridge tape ready for the Federal Express person who would come and take the cartridge tape, sometimes bring the newspaper in as they came, and ship that across the country.

Rodney Brooks: When I finally called Federal Express meant and then there was a guy at Lucid. One of his jobs was to take my code and integrate it into the build system. He was not exactly complimentary about everything. He called my compiler Bertha. Brooks extremely ran the twisted hack assortment. Ultimately, when the

company failed, he went off and got another job. He became employee number one at a little place up in Seattle called Amazon. [inaudible 00:21:57]

Rob Reid: Oh, nicely done.

Rodney Brooks: He did very, very well.

Rob Reid: Now, with Lucid, you ended up creating LISP that would run on 19 different platforms, 'cause there were many, many different dialects of Unix back in those days.

Rodney Brooks: Well, there were many different dialects of process. It was great that I was at MIT, because there were so many spin outs from Digital Equipment Corporation that all had their own architecture. There was Prime, there was Apollo, there were a bunch of others, and then there was DEC itself, which had multiple architects.

Rob Reid: Did you run on MIPS?

Rodney Brooks: Yeah, we ran on MIPS.

Rob Reid: So, you ran on Silicon Graphics then?

Rodney Brooks: Yeah, yeah, yeah.

Rob Reid: That was my first job in tech was at Silicon Graphics. You ended up betting on the workstation platform at exactly the right time, during the great thriving of LISP, I imagine the vast majority of people who were using it were using it on Lucid. Is that correct?

Rodney Brooks: Yeah, it was the bigger seller. There were some free versions around, but we were much better.

Rob Reid: Then, in the midst of all this, you're having an academic career obviously at MIT. Then, eventually you were running the AI lab, correct?

Rodney Brooks: Yeah, I had started out building custom mobile robots during the 80s, teaching LISP, and in '97, I became director of the lab.

Rob Reid: So, very foundational moments clearly for both robotics and for AI. In the midst of this, in 1990, you founded iRobot, correct?

Rodney Brooks: In 1990, I founded iRobot. Lucid was still around for a couple more years, but along with Colin Angle and Helen Greiner, Colin was my student, Helen, I was her registration officer, which meant I had to approve her course selection. We thought robots must be important, so, let's start a company. We didn't have a business model. We started the company and I was sort of annoyed at VCs after



the Lucid experience, so we decided not to take any external funding, we decided to bootstrap.

Rob Reid: Really? I didn't know that.

Rodney Brooks: We bootstrapped from 1990 to 1998 before we took any external funding. We would sell robots before we had built them with 50% upfront, and that was how we financed the building of them.

Rob Reid: Got it. I know you've written elsewhere you had 14 failed business models, correct?

Rodney Brooks: Yes, Colin Angle who is still the CEO-

Rob Reid: Oh, is he?

Rodney Brooks: He says it's the only job he's had besides camp counselor as a teenager. He's got a slide where he shows the 14 business models that failed.

Rob Reid: Including, what was it Baby Jade?

Rodney Brooks: No, My Real Baby.

Rob Reid: My Real Baby, which was a robotic doll, right?

Rodney Brooks: A robotic doll.

Rob Reid: Humanoid.

Rodney Brooks: Humanoid. We partnered with Hasbro and we sold them. Right around '98, we had 30 employees with six divisions, working in six different areas. Down-hole oil well robots, military robots, toys, et cetera.

Rob Reid: Got it.

Rodney Brooks: I personally learned how to do low-cost manufacturing. I was the one who went to Taipei, spent time with various people, but we soon discovered that we had been shown in Toy Fair, and other people would see our toy and copy it.

Rob Reid: I've got to commend you. I caught some video online and you did manage to create a truly creepy doll.

Rodney Brooks: It was creepy?

Rob Reid: Really creepy.

Rodney Brooks: It was with Hasbro.

Rob Reid: Yes, of course.

Rodney Brooks: What I'm proudest of there is the low-cost manufacturing. When we started, the prototype had six motors in the face. When we shipped, it had one motor, and you couldn't tell the difference.

Rob Reid: After 14 failed business models, you suddenly had not one, but two hits in the same year, 2002.

Rodney Brooks: We had two commercial hits and a wild publicity hit. 2002, we were seen by millions of people live with a robot in the Great Pyramid looking into a cavern that hadn't been seen before. Drilling a hole and the big reveal, what was in the cavern?

Rob Reid: Nothing.

Rodney Brooks: Nothing, yes.

Rob Reid: I could guess. I lived in Cairo for a while, so, I know what's in those caverns.

Rodney Brooks: Anyway, that was early September 2002. September 18th, we released the Roomba. Earlier in the year, we had sent two of our military robots, Packbots to Bagram Air Force Base in Afghanistan.

Rob Reid: Just two of them?

Rodney Brooks: Just two to start with.

Rob Reid: What was the intended purpose of them at that point?

Rodney Brooks: The intended purpose and the use was to go look in caves. The big thing was what are in the caves? Where is everyone hiding? What's going on? The 82nd, one of the first air borns, said we don't need the stinking robots until they got there, and there was this black hole they had to bend down to go in, and suddenly, the idea of sending a robot in ahead of them with a camera feeding back what was in there seemed like a good idea before walking in there.

Rob Reid: Then, ultimately, fast forward, there ended up being 6500 Packbots bots deployed throughout Iraq and Afghanistan, is that right?

Rodney Brooks: Yeah, roughly that number

Rob Reid: They ended being used for IEDS, not just for caves, but for lots of other things.

Rodney Brooks: Oh, lots of other things. Their big use really was IEDS, Improvised Explosive Devices. All those roadside bombs that people remember in the news reports, things blowing up on the side of the road. When we first went there, the US

Military Doctrine was to put someone with a bomb suit, send them out with a stick to poke the bomb.

Rob Reid: That would be a lousy job. Then, obviously the Roomba is a household name. There are 25 million of them in the world?

Rodney Brooks: Yeah, It's not clear how many, but \$800 million revenue.

Rob Reid: Wow.

Rodney Brooks: That's a lot of Roombas [Crosstalk 00:26:46].

Rob Reid: That's a lot of Roombas. That's \$800 million a year that iRobot is doing right now. So, tens of millions of Roombas out there. Millions shipping every year. Comparing that to a world in which there were three mobile robots not all that long before.

Rodney Brooks: It feels good, but I tell you what the best feeling I have is 2011, a week after the Fukushima disaster, we sent some robots, and those robots were used in the shutdown of the reactor.

Rob Reid: They were used?

Rodney Brooks: Yes. They're still there, they're still there. It was quite a good feeling to see that we had helped.

Rob Reid: Oh yeah, I'm sure you saved the lives of countless soldiers, as well. We'll never know how many lives you've saved.

Rodney Brooks: Yeah, we often get postcards saying "iRobot saved my life," which the company has kept and has on display.

Rob Reid: iRobot robots have cleaned pools, they've mowed lawns, they've cleaned floors. Then, you ended up deciding to move on, was it 2008 that you started Rethink Robotics?

Rodney Brooks: Yes, I did.

Rob Reid: You also left academia at that point, correct?

Rodney Brooks: Yeah, I stepped down as lab director in 2007, and I was on sabbatical for a year. I was still CTO of iRobot. September 1st, 2008, I took leave from MIT and I stepped down as CTO of iRobot. I stayed on the board for another three years and started another company.

Rob Reid: That is Rethink Robotics. What did you feel that the world of robotics needed at that point that iRobot wasn't in a position to provide? That this new company, this new platform?

Rodney Brooks: It came from two sets of experiences. I had been involved in manufacturing in China since the late '90's. We use contract manufacturers. We had noticed that after Golden Week, which is Chinese New Year, the biggest migration of humans in the world, we would have trouble staffing as many lines, because not so many people would come back.

Rob Reid: Oh, so there was huge churn, then?

Rodney Brooks: It was churn. That was getting weird, then simultaneously as director of CSale, we were working with a bunch of Taiwan-based companies, so, we started a lot of joint research projects with them, and they would tell me about their labor problems in Mainland China.

Rob Reid: Labor problems in Mainland China?

Rodney Brooks: There's not enough people.

Rob Reid: In the late 90s?

Rodney Brooks: No, this is the early 2000's.

Rob Reid: Early 2000's.

Rodney Brooks: 2003, 2004, 2005.

Rob Reid: But, still at a time when I think-

Rodney Brooks: When everyone else thought, [inaudible 00:28:51] labor China.

Rob Reid: Yeah, I remember very, very sophisticated people saying Western China is going to export deflation to the rest of the world for a decade, because there's so many folks, but there were already labor shortages.

Rodney Brooks: One person said to me at the time, you know, in the old days, we would put a little three inch by five inch card outside our factory saying we want labor tomorrow and there'd be a line around the block. Now we advertise on TV, we have scholarship programs, we do this, we do that, we still can't get more people. I started hearing that. At the same time, I was in an advisory group to John Deere, so I visited just about every John Deere factory in the United States. What they hear there, our manufacturing population is aging. There are no young people in Dubuque, Iowa anymore. We have to hang on to our workforce, we can't replace them.

Rob Reid: Those who are in Dubuque, don't want to go to work in the factory.

Rodney Brooks: No one aspires to be a factory worker and that's what happened in China, by the way. Not only did the standard of living grow up, but the education went up. That was an aspiration at one point, it's not an aspiration now. I'm seeing the US [inaudible 00:29:52] labor shortages in manufacturing despite people thinking all the jobs are being stolen away. I see them not being fillible in China, so I thought okay, we need robots in factories. There were robots in factories, in car factories. If you went into a car factor then or you go into a car factory today, there are two worlds. There's the world of the body shop where there's welding, robots, and no people. Dante's Inferno.

Rob Reid: Sort of the nobody shop.

Rodney Brooks: The nobody shop.

Rob Reid: There are no humans in there, 'cause it's too dangerous.

Rodney Brooks: It's too dangerous and it's being automated out the wazoo, it's an expensive process. Then, this final assembly where there's very few robots.

Rob Reid: It's all people.

Rodney Brooks: It's all people. Robots and people don't mix.

Rob Reid: 'Cause of danger?

Rodney Brooks: Two reasons. One is the danger, the other is if there are people around, they're messy, and things move. The way automation worked, we know exactly where every piece is, we keep track of it.

Rob Reid: No surprises?

Rodney Brooks: No surprises. In looking at Chinese factories and looking at shop floors of deer and others, I thought what were needed were robots that could intermingle with people with no cages, 'cause if you've got to replace all the people, it's an enormous capitol expense, then it locks you into high volumes. You can't do it in low volumes.

Rob Reid: Yeah, and all the robots were literally behind cages to protect humans from them.

Rodney Brooks: Or, one way of looking at it in some factors, there are a few cages that humans can't go in amongst the robots. There were two things. Make it so it was safe to be close to a robot and make it so the robot can adapt to things not being in precise locations, so a person could just push up a cart of parts next to the robot

without having to get it down to, and this is the normal number, 1/10th of a millimeter precision.

Rob Reid: That's what you needed for a traditional industrial robot?

Rodney Brooks: That's the number today.

### **END INTERVIEW ELEMENT OF PART ONE**

Hello again, Ars readers. That was the first excerpt of three from my interview with Rodney Brooks. Which, if you're curious, originally ran on my podcast on March 19<sup>th</sup> of this year. If you can't wait to hear the rest of it. Or, if you'd like to browse my other 30-ish episodes, you can just head on over to my site, at [after-dash-on-dot-com](http://after-dash-on-dot-com). Or, type the words After On into your favorite podcast player. You'll find lots of stuff about life sciences - above all, genomics and synthetic biology. Multiple episodes connected to neuroscience and consciousness. Conversations about robotics, privacy and government hacking, cryptocurrency, astrophysics, drones, and a whole lot more

If you like what I do, I hope you'll consider subscribing to my podcast and listening to some of the episodes in archive - all of which were designed to have long shelf lives, and none of which have gone stale yet.

And of course you can join me here tomorrow on Ars, when we'll continue with Part Two of this interview. We will pick right where we left off. In fact if you listen closely, you might even catch the final millisecond of the word Rodney just closed on, which was "today." It's pretty clear he was saying that word, but if there's any doubt in your mind we will put it to rest tomorrow. Please join me.