Science Magazine Podcast

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Music

Host – Stewart Wills
Greetings, and welcome to the *Science* Podcast for September 9th, 2011. I'm Stewart Wills. This week: *Australopithecus sediba* and the story of the genus *Homo*, the race for the next superheavy element, and a step toward higher-capacity batteries. Plus: a look at social media as a job-hunting tool for scientists, and a few stories from our online daily news site.

Promo
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Host – Stewart Wills
Almost a year and a half ago in *Science*, a team led by Lee Berger of the University of Witwatersrand in South Africa published a description of a new species of ancient hominin -- *Australopithecus sediba*. This new australopithecine, occupying what had previously been a significant and critical gap in the fossil record, appeared then to have the potential to cast new light on the story of our own genus, *Homo*. Indeed, in an appearance on the April 9, 2010, edition of this show, Berger put it this way:

Interviewee – Lee Berger [from 9 April 2010 *Science* Podcast]
[5:17] It's the opinion of my colleagues and I that *Sediba* may very well be the Rosetta Stone that unlocks our understanding of the genus *Homo*.

Host – Stewart Wills
Now, Berger and his colleagues publish five new papers describing the *sediba* fossils in considerably greater detail, and including much new material excavated and studied since the April 2010 report. The picture that emerges from the two remarkably complete and well-preserved partial skeletons is of an intriguing creature with a mosaic of primitive and modern traits. I followed up with Berger about this new work, and began by asking him how his earlier "Rosetta Stone" prediction seems to be playing out a year and a half later.

Interviewee - Lee Berger
I think that what we're seeing is in four critical areas of anatomy – that is the brain, hand, pelvis, and foot – that *Australopithecus sediba* shares some remarkable features that are unique effectively to humans and our very closest relatives, Neandertals, and possibly *Homo erectus*. At the same time, in those same areas of anatomy, it shares features with

the earlier australopithecines, making it truly a mosaic hominid and one that appears to be very, very transitional possibly between the australopithecines and the earliest members of the genus *Homo*.

Interviewer - Stewart Wills
You know, in drilling down on that, I guess one key issue is in thinking about the relationship of these fossils to *Homo* is their age. And if I'm understanding things correctly, we now know perhaps more precisely than we did a year ago just when these fossils must have been buried?

Interviewee - Lee Berger
That's right. We now have one of the most accurate ages ever produced. The new date is 1.977 to 1.98 million years – that's a 3,000-year window in 2 million, or about a 0.15% error. Now, what that means is it places *sediba* squarely well ahead of pretty much all the fossils that are definitively ascribed to early members of the genus *Homo*. Everything that's older – and really, you're talking about a tiny, tiny handful of very fragmentary fossils – has to be equivocal by the nature of the record. Thus, it now is uniquely positioned in time, and possibly morphology, to be a good candidate ancestor of the earliest members of the genus *Homo*, but if it is, the evolution of things like *Homo erectus* probably didn't happen in the way we thought it did when viewing fossils like *Homo habilis*.

Interviewer - Stewart Wills
And we have these five new papers in which you and the team are describing and interpreting the *sediba* fossils in a lot more detail than when the species was first described in the paper a year ago. There's obviously a lot here, and you sort of alluded to some of the main points, but could you just talk a little bit more about what you think are maybe the two or three most striking things that you're finding as you look at these fossils?

Interviewee - Lee Berger
Absolutely. We're also describing a lot of new material that we didn't have as recently as last April. The big areas are this: in the foot, particularly the heel and ankle, we have an incredibly primitive heel – that is, a heel like a chimpanzee – but the remainder of the foot looks pretty advanced. When you look at the pelvis, it's remarkably like that of the more derived things we'd normally look at – like a *Homo*-like pelvis or our pelvis – yet little aspects of it, particularly around the sacrum, seem to be extremely primitive. The hand is probably the most advanced hand we've ever discovered, outside of *Homo sapiens* and Neandertals. It lacks curvature, it's got a long thumb, it's got shortened fingers – hallmarks of our hand. And the brain, while small like an australopithecine, and shaped broadly like an australopithecine, has aspects in the anterior portion that appear to show that it's deriving towards our brain, and the unique derived features we see in the brain of later members of the genus *Homo*.

Interviewer - Stewart Wills

I understand that there's some very interesting evidence related to the brain, and sort of the record of convolutions. Could you talk a little bit more about that?

Interviewee - Lee Berger
Well, in very simple terms, we're seeing a symmetry in the brain which is much more common in humans than it is in apes and australopithecines. It does appear to have what looks like an enlarged Broca's area, which has sometimes been associated with the origins of language. So in very superficial terms, it appears that reorganization is taking place more towards the human condition. And it may very well mean that our idea that encephalization took place first – that is, enlargement of the brain – took place before reorganization is wrong, and that reorganization took place before brain enlargement. And when you put that in the perspective of this very advanced hand, that maybe makes a little more sense.

Interviewer - Stewart Wills
It's surprising to me that so much can be inferred about the brain from hard fossils like this. Can you talk a little bit more about that evidence?

Interviewee - Lee Berger
Well, yes, I mean what you're seeing in our paper is, arguably, or maybe not even arguably, the most accurate scan of the interior of a skull ever produced. And of course, the brain effectively pounds the shape, its external shape, out on the inside of your skull. We scanned that skull with a synchrotron scan, producing a 90-micron pass through it that allows us to produce this incredibly accurate image of the sulci and gyri, and venous patterns of this brain, and thus make interpretations of almost a faux brain.

Interviewer - Stewart Wills
Well, taking all of this together – the lines of evidence you've discussed – what do you think the *sediba* fossils say broadly about the end of the australopithecines and the emergence of the genus *Homo*?

Interviewee - Lee Berger
Well, I think we have to now look at alternatives to the traditional way we view the origins of the genus *Homo*, and that is that it simply went from something like Lucy, or *Australopithecus afarensis*, into something like *Homo habilis* – the brain gets bigger, but you maintain a primitive body – then on to *Homo erectus*. *Sediba* offers an alternative to that. It's saying that critical areas of our anatomy – like the pelvis, the hand, and the brain, and the dentition, and parts of the face – they shifted first, and then we made only relatively minor transitions to get to something like *Homo erectus*. So, it opens up the possibility for alternative models to the origin of our immediate ancestor.

Interviewer - Stewart Wills
Well obviously in paleoanthropology, nothing is ever – or it seems to me, at least – nothing is ever uncontroversial, and the meaning of these fossils, given the potential significance you've just outlined, seems likely to be particularly debated. What do you

think are the most significant areas of uncertainty in your interpretation of these fossils, the things that are most likely to stoke that debate?

Interviewee - Lee Berger
Well, I think one of the interesting things is the debate hasn't centered around whether this is a legitimate species or not, that seems to be largely accepted. It's really, does this sit in the genus *Homo* or not? Is it close enough to us to be in that genus? And secondly, it's the interpretation of where this sits, because, you know, we've got 40 or 50 years of hypotheses built on a relatively fragment-free record, and suddenly you're dropping these very complete fossils into this. It doesn't mean these new hypotheses are right, but they do have to be acknowledged. I think you'll see a very healthy debate around the models of the way human evolution works, but also some really serious debate about our understanding of biomechanics, form, and function. That's where it's really going to be interesting.

Interviewer - Stewart Wills
Well where is the work of your team going next on this?

Interviewee - Lee Berger
In every direction. There's something like 80 scientists involved in this project, and every aspect of this anatomy is almost universally the most complete that we've ever seen. We have multiple individuals now coming out at multiple ages. We're analyzing the specific at every joint area, the generalist ideas of these, from questions of detailed morphology all the way through to big questions of phylogeny and evolutionary biology.

Interviewer - Stewart Wills
Well Lee Berger, good luck and thanks very much.

Interviewee - Lee Berger
Thank you.

Host – Stewart Wills
Lee Berger is senior author on a set of five papers describing the ancient hominin *Australopithecus sediba*. You can find the papers, along with three related News Focus articles, at www.sciencemag.org/extra/sediba -- that's S-E-D-I-B-A.

Music

Host – Stewart Wills
In a News Focus article this week, *Science* European deputy news editor Dan Clery talks about the race among physicists in several countries to create the next stable "superheavy" element in the laboratory. Here's Dan Clery.

Interviewee - Daniel Clery
It's about ongoing efforts to make new elements which are right at the boundary of the periodic table. You know, they've got more neutrons, and more protons in the nuclei

than any existing atoms, so they are, you know, artificial atoms that are made in particle accelerators.

Interviewer - Stewart Wills
Well, I guess this is one of those areas that might be kind of a tough sell to the general public. It might seem like spending a lot of money to create a new element that might only be around for a few seconds, or even microseconds – might seem a bit exotic and impractical. Why are physicists so captivated and motivated to do this?

Interviewee - Daniel Clery
Part of it is scientific curiosity. You know, they want to see what these things are like and whether they are different from how people might expect these atoms to be – you know, whether they fit into their position on their periodic table and behave in the predictable way. But there's another driver, in that nuclear theory predicts that there are nuclei – which at the moment we don't know how to make – that might have extra stability, so they might actually last a long time, you know, maybe even hours, days, years, or millions of years. And they could have very exotic chemical properties and be useful for things. You know, we don't know what they would be like, but they might be completely unlike the atoms that exist at the moment. If we can only get to them, then we would find out.

Interviewer - Stewart Wills
And I gather that this drive to get to these islands of stability, as you refer to them in the article, is shaping up into sort of an international horse race. Could you tell me something about the main players there?

Interviewee - Daniel Clery
Certainly, yes. The whole history of creating elements beyond uranium, which is the heaviest natural element, has been dominated by three groups: Berkeley, in the U.S., what is now the Lawrence Berkeley National Laboratory, set the pace for a long time, from the 1940s until the '60s, making elements 93 up to 103. And then, for a while, another lab in Russia got an advantage – that's in Dubna in Russia – and they made another three superheavy elements. Then it was the turn of GSI Laboratory in Germany, and they made a string of six more superheavy elements, up to number 112. And since then, it's been the Russians again who've been dominating this work, and they've made another six, I think, up to today's record, which is 118.

Interviewer - Stewart Wills
So the Russian group is the Joint Institute for Nuclear Research in Russia that's on this?

Interviewee - Daniel Clery
That's right.

Interviewer - Stewart Wills

So, we have three labs that are dominating this field. How do they actually go about trying to create these superheavy elements? What are some of the techniques for doing that?

Interviewee - Daniel Clery
Well, the first thing you need is a particle accelerator. These don't have to be huge ones like at CERN – they're quite modest in size – but they need to produce quite a high-intensity beam of ions, so that's lots and lots of particles. And they fire them at a thin film made of a very, very heavy element – usually these days, they are the superheavy elements that have been made by some other method. So they have this foil, and they fire particles at it, and most of the projectile particles just fly straight through, or, you know, scatter, or something. But just occasionally, they will hit a target nucleus head-on, and the projectile and the target nucleus will fuse together and make a larger nucleus.

Interviewer - Stewart Wills
So it's really just sort of the blunt instrument of trying to pack extra neutrons and protons into an already heavy nucleus.

Interviewee - Daniel Clery
That's it, yes. In fact, they find that the heavier the target nucleus and the smaller the projectile, the better it works. So they're, you know, trying to use as big a target nucleus as they can and hit it with small little projectiles, in the hope they'll fuse to make something that's slightly bigger. They've come up against a problem now, because, as the target nucleus, they're using californium, which is one of the heaviest elements that you can actually make quantities that you can see with the naked eye. Beyond californium, einsteinium is only made in milligrams per year in reactors. And so, beyond that, we only have teeny, teeny quantities of the next elements after that. So, they have a problem in how to move on to the next elements.

Interviewer - Stewart Wills
And so how are they trying to get around that problem?

Interviewee - Daniel Clery
They've had to use slightly heavier projectile atoms. Calcium-48 was the one they used for many years at the Dubna Institute in Russia, and it was really successful, and they managed to get six new super-heavy elements, all using calcium-48. But now that their target nucleus – now they've got californium and can't go any larger – they have to come up with a larger projectile, so they're having to try some other nuclei as projectiles, which may or may not be as successful as calcium-48.

Interviewer - Stewart Wills
So, those are some of the techniques. Now we talked about how the sort of motivation of all of this is getting to those islands of stability, and people talk about, you know, magic numbers of protons and neutrons that lead to this stability. What are the next stability targets for protons and neutrons, and how close are we to actually getting there?

Interviewee - Daniel Clery
Well, the magic numbers are predicted by nuclear theory to be certain values where the nucleus becomes a little bit stabler than it would be otherwise. They're a bit like the shells of electrons around an atom, where once you get a complete shell, you get a very stable chemical atom, such as a noble gas. In the nucleus, you get the same sort of phenomenon. When you get a full shell of neutrons or protons, that gives the nucleus extra stability so it won't decay. So the theory isn't conclusive about where these magic numbers are once you get up to very heavy nuclei. The magic numbers for protons – they think there is one at 114, they think there is one at 120 and maybe 126 – so 114 is the nucleus that they have made already, and they did see an increase in stability. The atoms of 114 last for a few seconds, whereas other ones nearby disintegrated in microseconds. So the magic number is having an effect. But if they can get a nucleus with a magic number of protons and neutrons, then they will see a real difference, they think, and they might get to these very heavy nuclei that last for a very long time. But getting to the magic number of neutrons is proving more difficult, because the next one is 184, and the closest they've got so far is 177.

Interviewer - Stewart Wills
So, how do we get around that neutron problem?

Interviewee - Daniel Clery
They've got to try something different, because with current means, they just can't make nuclei that are more neutron-rich. So, they have to try something else, such as trying to get two heavy atoms to sort of come close together and swap a few neutrons. That's a possibility they are looking into. The other one is to get a very, very powerful neutron source and put your sample close to it, and hope that those neutrons will get co-opted into the nucleus. So they're thinking about new types of nuclear reactor that might produce enough neutrons, or even a nuclear explosion – though at the moment, those aren't permitted, even for scientific purposes.

Interviewer - Stewart Wills
So we've got three main groups that have been involved with this over the years. Care to offer any odds on who's going to win this current race?

Interviewee - Daniel Clery
Well, it's very hard to say. Certainly, the JINR Lab in Dubna in Russia, and GSI, which is the Heavy Ion Research Center in Germany, I would say are the two frontrunners. Berkeley is a little bit on the sidelines now, but there's also a dark horse in a group in Japan – that's the RIKEN Laboratory. So, you know, they could surprise us.

Interviewer - Stewart Wills
Well, Dan Clery, thanks very much.

Interviewee - Daniel Clery
Thank you.

Host – Stewart Wills
Dan Clery writes about the race to find the next superheavy element in a News Focus in this week's *Science*.

Music

Host – Stewart Wills
Lithium-ion batteries, which power everything from cellphones and laptops to an emerging suite of electric vehicles, have become an essential part of modern technological life. In the pursuit of higher-capacity, longer-lasting batteries, one route is a different chemistry for the anode, which is commonly composed of graphite. Silicon anodes have the potential for much greater charge storage -- but tend to degrade quickly as the battery is discharged and recharged. Moreover, the conventional methods of making lithium-ion battery anodes involve polymers and solvents with some potential environmental problems. Now, a paper published online this week by *Science* proposes a solution to both issues: a new anode binder created from alginate, a natural polysaccharide extracted from common brown algae. The team argues that mixing silicon nanopowder with the alginate extract can yield a stable, low-cost anode with charge capacity up to eight times higher than state-of-the-art graphite anodes. One of the paper's senior authors, Gleb Yushin of Georgia Tech, spoke with me about the work.

Interviewee - Gleb Yushin
So what we do we replace these traditional polymers with environmentally friendly alginate, which is dissolved in water. And in addition to being environmentally friendly and of low cost, binding can provide additional properties, additional functionalities. It can make electrodes last longer in batteries, and furthermore it can allow us to use materials which traditionally could not be used in lithium-ion batteries. So, for example, silicon, which stores 10 times more lithium as compared to graphite, could not be used in traditional binders. But with alginate it becomes possible.

Interviewer - Stewart Wills
Okay, why has silicon – which you say is potentially so much more effective than graphite as an anode material in these batteries – been so difficult to use with traditional binders?

Interviewee - Gleb Yushin
So most of the chemically active particles do not change significant volume when you insert and extract lithium out of them. Silicon consumes so much lithium when it's getting charged, it expands quite dramatically – it expands up to four times in volume. So you have this expansion, you have this contraction. And it brings a variety of different problems.

Interviewer - Stewart Wills
Okay, if I'm understanding this correctly, because of these volume changes – this expanding and contracting behavior – silicon would basically wear out too quickly in these traditional lithium-ion batteries, even though using a silicon anode would allow

much greater charge storage than graphite. To resolve that problem, you created this new binder for the anode using this alginate natural material. What led you to this alginate?

Interviewee - Gleb Yushin
In spite of all of this technological developments, natural materials often surprise you with their, let's say, nature-optimized, evolution-optimized properties. So for example, spider silk – the strength of the spider silk is still difficult to overcome using traditional and technological roads to produce fibers. So it's difficult to produce fibers with comparable properties. So we wondered if we could find a polymer – a natural polymer – with functions similar to what we need in lithium-ion battery operations. And we hypothesized initially that what we need is high concentration of carboxylic groups on the surface of the binder – uniform distribution of these groups – and we wanted this polymer not to interact with the solvent – electrolyte solvent – because if we had this interactions the electrolyte solvent propagates through the polymer; it essentially comes to the interface and between the polymer and the active particles. And when it comes to this interface, it always decomposes. When the decomposition happens, you separate particles from the binder. And we hypothesized that these carboxylic groups can assist to minimize the harmful or undesirable interactions between electrolyte and the particles.

Interviewer - Stewart Wills
So you knew you were looking for something with these carboxyl group properties, and you found that in this alginate. How difficult was it actually to use this alginate as a component in these electrodes?

Interviewee - Gleb Yushin
You can actually prepare alginate by yourself. You just take in brown algae, and you boil it – you can do it in the kitchen – and you can boil it in a salt solution. And you extract alginate in the sodium salt form. So you take the alginate and mix it out of particles and then cast it on a copper foil and then dry and you have your electrodes. So you can make an electrode in common environment because you don't use any harmful components.

Interviewer - Stewart Wills
So you were able to make the electrodes – it sounds like – in a fairly straightforward process. How did you measure its performance?

Interviewee - Gleb Yushin
You have to make a battery. But for that, unfortunately, you do have to have a ground box, you do have to have an environment which is water-free, moisture-free, and this has to be done in the university lab or company lab. So you essentially make a battery and test it. You charge it and discharge to see how much energy can store, you see how many cycles you can, the battery can survive. We tested, for example, our anodes in half-cells and survived over 1,000 cycles. In reality, the batteries in consumer electronic devices, the inexpensive ones, for example, local cell phones, normally they are qualified to last 400 cycles. In fancy and high-quality cell phones, they're qualified to last 500 cycles. In automobiles and electric automobiles, people are looking for 500 to 1,000 cycles. And in

the future, the government wants to increase the cycle life for electrical vehicles to five to maybe ten thousands.

Interviewer - Stewart Wills
So this gets us on the way to that government target, if you will. But, in the here and now, puts us potentially at much better capacity than current batteries in consumer electronics, for example?

Interviewee - Gleb Yushin
That is correct. You can use alginate binder for with traditional electrodes. And in this case, the capacity will not change much, so the energy of the battery will not change, but you will be able to cycle the battery for longer time. But if you replace traditional materials, for example, if you replace traditional graphite with silicon, then you can boost the energy density. In this case, the battery will last much longer – so you can use a cell phone for a longer time, you can use your batteries in your laptop for much longer time.

Interviewer - Stewart Wills
So what's the next step in putting this sort of approach into production?

Interviewee - Gleb Yushin
I think the adoption of this technology doing this should be very straightforward. It doesn't require any change in the manufacturing of lithium-ion battery electrodes; it doesn't require any changes in the viewpoint, in the behavior of people. Even if you invent some new and really cool technology, the commercialization can become difficult if you're required to completely redesign the manufacturing process. It's very difficult to change behavior of people; it's very difficult to change dramatically the manufacturing facilities. And so many wonderful discoveries would not be commercialized for this reason. It was either too expensive to make the change, or it required too much of an effort. So that's why we wanted to utilize technologies which will allow us to do this transition as easy as possible.

Interviewer - Stewart Wills
Well, beyond the issue of ease of production, I guess I found this particularly interesting because it was based on a natural material. Do you see any additional advantages in that from the point of view of actually sustaining production?

Interviewee - Gleb Yushin
The ability to grow new materials in plants has been highly underutilized, particularly in aquatic plants. So alginate is derived from brown algae, one of the fastest growing plants on this planet. And you can use, for example, lands which are conventionally not used for growing plants, so not agricultural land. You can use seawater land; you can use wastewater land; and you can grow this wonderful plant very effectively. So, because it's one of the fastest growing plants on the planet, you require much less land to produce this material. And furthermore, when you grow brown algae, it captures carbon dioxide, which is also good for the environment. So overall this, let's say, "procedure" or this

“route" to grow new materials in plants can be quite attractive for the future, for sustainable future.

Interviewer - Stewart Wills
Gleb Yushin, thanks very much for being with us today.

Interviewee - Gleb Yushin
Well, you’re most welcome.

Host – Stewart Wills
Gleb Yushin is a senior author on a new paper, "A Major Constituent of Brown Algae for Use in High-Capacity Li-ion Batteries." You can find the paper online at www.sciencexpress.org .

Music

Host – Stewart Wills
Next, a report from *Science*'s online resource for job seekers and career builders, *Science* Careers. The topic is social media. Recently, the Pew Internet and American Life Project reported that 65% of adult American Internet users say they use one or more social-networking tools, like Facebook, Twitter, or LinkedIn. Clifford Mintz, a former med school professor and industrial scientist who now specializes in career development for scientists, writes this week about how the popularity of social media is playing out in the scientific job search. He spoke with Donisha Adams of *Science* Careers, who began by asking him just why these tools are becoming so important for job seekers in the sciences.

Interviewee - Clifford Mintz
They’re important job-seeking resources, because they give potential job candidates and jobseekers an opportunity to interact with prospective employers in ways in which they were not able to do in the past, in that it’s an online network that doesn’t require face-to-face interactions, and it provides accessibility to people that otherwise would not necessarily be available to persons looking for jobs.

Interviewer - Donisha Adams
Well, just as a potential employer has a stack of résumés on their desk, there’s probably a lot of people on social media, too. How can a jobseeker really stand out when everyone has a social media page these days?

Interviewee - Clifford Mintz
Well, one of the best things to do is to look for professional networks, particularly, in this case, there are a couple that everybody should know about. And one of those is, of course, LinkedIn, which is billed as the world’s largest professional social networking site. LinkedIn is, by far, the place to be for persons looking for jobs in the life sciences, mainly because there are many scientists on LinkedIn. There are a lot of prospective employers there, people who work at companies – vendor companies, universities, et cetera. Pretty much, LinkedIn has been approved by almost any business, organization,

or entity that is looking to hire new candidates. And, one of the ways to get noticed on LinkedIn is to have a very complete profile. So, there's an opportunity to fill out a profile – it's sort of an online résumé – and jobseekers should complete the profile, put a picture – one or two pictures, or photos – of themselves there, and, basically, then start to build a network by inviting other persons who are on LinkedIn to join their personal networks. And, when you do that, you begin to build out your personal network, and then you have access to other persons, or other people's networks that they've created, and you could then correspond with other folks on LinkedIn to broaden the online network. So, you could start off knowing five or 10 people, and if you work at it and create your network, you could have thousands of people within your network that are the types of people you want in your network. So for example, if you are a molecular biologist and you are looking for a job in molecular biology, I recommend that everyone in your network be a molecular biologist working at various and sundry organizations, companies, institutions, et cetera, that are looking, possibly, to hire new candidates. And once you create that network, you could begin to query individuals within the network about job opportunities, or throw out questions, engage your network and ask for solutions to problems that you pose through the network.

Interviewer - Donisha Adams
You spoke about engaging people in your network, but what is the appropriate way to solicit information from a potential employer?

Interviewee - Clifford Mintz
One of the best ways to do that is to target various and sundry employers, or companies, or institutions that you're interested in, and then try to follow, or create, a relationship somehow between those institutions and yourself, either by directly asking for a person who works at a particular company for information about the company. What types of projects are going on in the company, if they're able to disclose those. Are they hiring? What types of persons or people are they hiring these days? Get a better understanding of the opportunities at companies and organizations where there are jobs that are available.

Interviewer - Donisha Adams
So, do you think that the use of social networking sites in this way will increase in popularity in the future?

Interviewee - Clifford Mintz
I personally believe that they will, mainly because it's a quick and immediate way to establish a professional relationship with another professional and establish a business relationship, or even if you get to know somebody on a business relation more on a personal relationship. And really, as we all know who have been in the job market, or on the job market and worked at various places, it's always about networking. And social media is really an extension of in-real-life networking, and for many people, particularly scientists, it takes the worry out of being close, so to speak, because a lot of scientists are not necessarily adept at networking in real life – going to meetings, gatherings, et cetera – and it takes a lot of the anxiety of having to make small talk out of the equation, which many scientists don't believe is necessary to look for a job.

Interviewer - Donisha Adams
Up until now, we spoke about the positives, but aren't there some negative things that people should watch out for when using these social networking sites?

Interviewee - Clifford Mintz
The thing to remember about social networking sites – like Facebook, LinkedIn, Twitter – is that once a comment, or a tweet, or something that you've written is posted to an internet site, or website, or anything on the internet, it's there forever. It may not be on page 1 of a Google search, but if somebody – for example, a prospective employer – is trying to get a better sense of who a job candidate is, probably these days, outside of a life science, I would say probably 75-85% of prospective employers do Google the names of candidates that they're interested in moving forward with. It's a little bit slower in the life sciences, but recently I've been speaking to companies like AstraZeneca and Merck, and they are beginning to Google individuals, not necessarily to find anything negative about people, just to get a better sense of the person and whether or not they would be a likely new hire, or a good hire, for the company or organization. So, you have to be very careful about what you say, what you tweet, what your wall status is in Facebook. And clearly, one should never criticize your current employer, one should never post inappropriate sexual, racial, religious, or pretty much any remarks that reflect that you are biased or prejudiced in any way, and not to even disclose your age or your relationships, your sexual preference, that kind of stuff. So, it's really important that, if you're a jobseeker, once you create these profiles, you maintain them as professionally as possible, and only post information that you think any prospective new employer would like to know, or you want them to know is probably more appropriate, about you.

Interviewer - Donisha Adams
Clifford Mintz, thanks for being with us.

Interviewee - Clifford Mintz
Okay, thank you very much, Donisha.

Host – Stewart Wills
Clifford Mintz spoke with Donisha Adams of *Science* Careers on the importance of social media for scientific job seekers. You can find his story on the topic at sciencecareers.sciencemag.org .

Music

Interviewer - Stewart Wills
Finally today, David Grimm, *Science*'s online new editor, is with us to bring us up to date on a couple of recent stories on our daily news site. Well David, first an answer to that age-old question, why is a frog like a glass of lemonade?

Interviewee - David Grimm

Well, scientists finally have the answer to that question. It turns out frogs are using something we like to call – and maybe we just made it up – lemonade physics. And the reason we're calling it that is – Stewart, I don't know if you've ever noticed, you probably have – that if you've got a cold glass of liquid – let's just say lemonade – in the fridge, and you take it out, and it's maybe a warm day, or it's warm inside your house, very quickly that glass begins to build up condensation on its surface. Well, it turns out this also happens with animals. And this story deals with the green tree frog, which lives in Australia's tropical savannas. And what is interesting that scientists noticed about the tree frog is the frog spends a lot of its time in these warm tree hollows, but it will often go outside, especially when it's very cold outside, and spend a long time out in the open air – and this open air is often very cold, and much colder than its tree hollow. And the question is, why is a frog doing that? It's much warmer in the tree hollow. If you're out there in the open air, you can get eaten. It's cold; you could freeze to death. And scientists wondered if frogs were using this trick of lemonade physics.

Interviewer - Stewart Wills
Using lemonade physics for what, though?

Interviewer - David Grimm
Well, one thing I forgot to mention, Stewart, is that a lot of amphibians actually suck moisture through their skin, so if they've built up a lot of condensation on their skin, they can actually use that as an important source of liquid to drink. And so the question was, were these frogs actually building up condensation by going from these cold environments back to their warm environment of their tree hollows, and building up condensation on their skin, A? And B, were they actually drinking up this condensation? If both of these things were true, it would indicate that these frogs had hit upon a very ingenious strategy for drinking.

Interviewer - Stewart Wills
Okay, so how do we tell if these frogs are that ingenious?

Interviewee - David Grimm
Well, the researchers actually took some of these frogs back to the lab and chilled them. They either put them out in the night air, or they put them in ice baths – so they're trying to replicate these frogs sitting out for hours in the cold environment – and then they put them in a well-used tree hollow. And so the frogs were – just like they were in their natural environment – going from a very cold environment to a relatively warm environment. And lo and behold, when the researchers did this, they noticed that the frogs' skin started to glisten as if it had liquid on it, just like you would notice on that cold glass of lemonade. And not only that, but after about 15 minutes, the frogs had gained about 1% of their body mass, indicating that they had started to absorb something into their body that made them heavier – most likely culprit is this water that had built up on their skin.

Interviewer - Stewart Wills
So, they really were tapping this condensation from the air, basically, to drink it.

Interviewee - David Grimm
Exactly.

Interviewer - Stewart Wills
Is this something we see in other animals, as well?

Interviewee - David Grimm
This actually has been seen in tarantulas, geckos, and toads; at least this condensation has been seen, this behavior that leads to the condensation from going from cold environments to warm environments. What's different about this study is that the researchers actually showed that the frogs seemed to be drinking this water. So it's not just that they can build up the condensation, but they seem to be doing it for a reason. There's actually a lot of situations where these frogs would be in an environment where, say, there's a drought. Several times during the year, actually, in these tropical savannas, there's not a lot of water supply available, so this is sort of an ingenious strategy to get water when it's potentially not raining, or when you don't have access to water in a different way.

Interviewer - Stewart Wills
And, for something completely different, using brain waves to steer a robot. It sounds like we're getting close to what used to be science fiction there.

Interviewee - David Grimm
Right. Well Stewart, this second and last story is about trying to control robots with our minds. So this is actually not the first time this has been shown. Researchers have been working for a while to develop either implanted electrodes in people's brains, or actually just caps that would have electrodes on them that could just sort of be fitted over the head that people could use to either control a computer or control a robot. And the reason scientists are trying to develop this technology, other than it sounds pretty cool, is that there's actually a lot of people out there that are either severely handicapped – maybe they're paralyzed from the neck down – and they have no way to control things, and so this gives them an opportunity maybe to control an object – a prosthetic arm, or maybe even a robot that could help them pick up things – also for patients that are referred to as "locked in". These are people that, for all intents and purposes, really can't communicate at all with the outside world. If you saw the movie, or read the book, *The Diving Bell and the Butterfly*, people that basically can only, perhaps, even blink an eye. But they do have brain activity, and so researchers are looking for ways to convert that brain activity into physical motion, even if it's the motion of a robot. What this new study is about is trying to make the process easier. As the scientist in charge of the research of this study that we covered says, these devices that allow people to sort of control robots with their mind, they're very clunky, they're very hard to use. And he really wants to develop a device that would basically be as easy as driving a car on a highway – very intuitive. The problem is a lot of these robots, you need to do everything for them. You know, if you're trying to control a robot walking down the hall, you've got to make sure you're not bumping into walls, and you're not bumping into people, and the things that you and I

would sort of just do instinctively, these robots have to be told to do that. And so this new study's about trying to find ways to make these robots much more automatic, but at the same time, still allowing the user to exert enough control over the robot so they can make them do what they want them to do.

Interviewer - Stewart Wills
Sounds like a tough problem. What did they do in this study?

Interviewee - David Grimm
Well in this study, they again used this cap that people wear, so they weren't implanting electrodes into people's brains. They put a cap on a couple of patients. And these patients, their lower bodies were paralyzed, and they had been bed-bound for six or seven years. And the question was, you know, clearly these people obviously still have brain activity; they're fine, except for the fact that they're bed-bound, but they haven't walked for a very long time, and so would they still have the brain activity that would be able to communicate to a robot, "I want you to walk in this direction or that direction," if they themselves hadn't been walking for a long time? And to test that, the researchers fitted these patients with caps. And they created this robot – or actually they adapted a robot that's called Robotino – and this is basically – you can see a picture of it on the site – but this is a robot, basically it looks like a platform on three wheels. And the researchers modified it by putting a laptop on that platform with a Skype connection – and Skype is basically a internet service that allows you to talk, and even video chat, with others remotely. And the advantage of putting the laptop on there is that the laptop sort of became the eyes and the ears of the person in the hospital bed, and then the laptop actually had a image of the person on its screen, so that anybody the robot interacted with would see an image of the patient in the hospital. And the researchers call this telepresence – the idea of being somewhere that you're actually not. This robot's giving the illusion of somebody – you know, it's kind of a crude illusion, but it's still giving the illusion of someone being somewhere that he or she is not, and being able to interact with other people. And the amazing thing that the researchers found is that after a little bit of training, these people in their hospital beds that hadn't walked for six or seven years were able to control robots, even robots that were a hundred kilometers away in a distant lab. The patients were able to navigate these robots through obstacle courses, avoid targets, and the robots were somewhat automated, so again, the person in the bed didn't have to think about every little wall, or bumping into people, the robot was kind of taking care of that itself, but the people could navigate the robot around an obstacle or move it into a position where they could have a conversation with somebody.

Interviewer - Stewart Wills
Well, I guess this opens up some real possibilities for the disabled.

Interviewee - David Grimm
It does, and even for people that are not disabled, there could be some interesting possibilities here. Just think about, you know, being able to, you know, even in a conference-type setting or what have you, being able to interact with individuals that are perhaps on the other side of the world, but giving more of a feeling that you're actually

there and actually being able to manipulate objects. You could even think potentially surgeries being performed remotely, you know, this idea that a doctor could potentially do a surgery from long distances away, and really give the impression that he or she is actually still in the room with the patient.

Interviewer - Stewart Wills
Okay, Dave, what other stories are you looking at for the news site?

Interviewee - David Grimm
Well, Stewart, for *Science*NOW, we've got a story about using antibodies to fight cancer. Researchers have been using antibodies for a long time to fight cancer, but this is a way of actually getting antibodies inside the cancer cell, which opens up a whole host of new potential drug targets. Also, a story about the physics of hearing. What is the complex physics that's going on in our ears when we hear a sound? For *Science*Insider, *Science*'s policy blog, we've got a story about the White House and environmental standards, what role the Obama administration is playing in the regulation of smog and other pollutants. Also a story about patent reform. And, finally, for *Science*Live, our weekly chat on the hottest topics in science, this week's *Science*Live is about the movie Contagion, which is this new thriller that's coming out about a viral contagion, and the effect it has on the world at large. We'll be talking to experts about whether such threats are actually real, and how accurately Hollywood portrays science. So be sure to check out all these stories on the site.

Interviewer - Stewart Wills
David Grimm is the online news editor of *Science*. You can check out the latest *Science* news, and the policy blog, *Science*Insider, at news.sciencemag.org, where you can also join a live chat, *Science*Live, on the hottest science topics every Thursday, this week at 2 p.m. U.S. Eastern time.

Music

Host – Stewart Wills
And that wraps up the September 9th, 2011, edition of the *Science* Podcast. If you have any comments or suggestions for the show, please write us at sciencepodcast@aaas.org. The show is a production of *Science* Magazine. Jeffrey Cook composed the music. I'm Stewart Wills. On behalf of *Science* Magazine and its publisher, AAAS, thanks for joining us.

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