***SCIENCE* - PODCAST –29 June 2007**

Music

Interviewer —Stewart Wills
Greetings, and welcome to the *Science* Podcast for June 29, 2007. I'm Stewart Wills, the online editor of *Science* Magazine. In today's show: Progress in synthetic biology; how humans have domesticated the world; and thoughts about the role of punishment in the evolution of human cooperation. All this, plus our usual roundup of other stories from *Science* and its online daily news site, *Science*NOW. So stick around.

Music

Interviewer —Stewart Wills
Synthetic biology — the creation of new species using computationally derived genomes — took a step closer to reality this week. In a paper published online this week by *Science*, Carole Lartigue, John Glass and colleagues at the J. Craig Venter Institute report the successful transplant of an entire genome from one microbial species to another. *Science* news writer Elizabeth Pennisi reports on the story in this week's issue. She is in the studio with us now. Liz, thanks for coming in.

Interviewee — Elizabeth Pennisi
Thanks for inviting me.

Interviewer —Stewart Wills
So, Liz what's this all about?

Interviewee — Elizabeth Pennisi
Well, for decades now researchers have been doing genetic engineering, where they put in pieces of genes or entire genes into bacteria. What these researchers did is insert an entire chromosome, an intact chromosome, which represents an entire genome from one species into another species of bacteria.

Interviewer —Stewart Wills
So how did they actually pull this off?

Interviewee — Elizabeth Pennisi
Well, they started off by modifying the genome they were transferring. First, they added a gene for antibiotic resistance; then they added another gene for an enzyme that causes any bacteria expressing the gene to turn blue. What this enabled them to do is see whether or not the transplant had taken. They then isolated the DNA, added that DNA to a tube of a closely related bacterium, and then waited to see what happened. After three days, they saw blue colonies, and they tested to see whether those colonies really had the new genome as opposed the original genome in them. And they did.

Interviewer —Stewart Wills

So, essentially this was — one bacterial species had become another bacterial species by the transfer of this genome.

Interviewee — Elizabeth Pennisi
Correct.

Interviewer —Stewart Wills
And what does all that mean going forward? That sounds pretty provocative.

Interviewee — Elizabeth Pennisi
So, one of the goals has been to create an organism that has what they call a minimum genome, in other words just enough genes to sustain life. And the idea is that once you have this minimal organism, you can then add the genes you want to add to sort of get the bacteria to make biofuels or pharmaceuticals or something like that. So, the first step, of course, is building the genome, and they are working on that, But the second step, which is related to this paper, is that once you have built this synthetic genome how do you get it into a bacteria? How do you get it to basically run an organism? So, what these researchers did is take an existing genome and demonstrate that you could put a naked genome into another species and have that genome take over that cell.

Interviewer —Stewart Wills
So, it gives a way that — if they come up with one of these minimal genomes, it's a way to practically test it, as it were, or insert it into an organism.

Interviewee — Elizabeth Pennisi
Exactly.

Interviewer —Stewart Wills
So, this seems — you know, given the connotations of artificial life, this seems certain to be controversial. Do you have any thoughts on the societal issues that this work raises?

Interviewee — Elizabeth Pennisi
Well, first of all, it's important to realize that this is an important step, but we are still a long way from artificial life. Basically, taking a genome of a really closely related species and putting it into its close kin is way different than taking an artificial genome and trying to put into a bacteria. So, that step has to be taken yet. Now, of course the researchers in the whole synthetic life field have been discussing these issues since the very beginning. And they are hoping to and planning on coming up with guidelines to keep these organisms from getting into the wrong hands and from sort of being unsafe.

Interviewer —Stewart Wills
So, it's kind of a stay-tuned situation.

Interviewee — Elizabeth Pennisi
Yes, it's very much a stay-tuned situation.

Interviewer —Stewart Wills
Liz, thanks for filling us in on this.

Interviewee — Elizabeth Pennisi
Well, thanks for inviting me.

Interviewer —Stewart Wills
Science news writer Elizabeth Pennisi reports on new research in synthetic biology in this week's issue. The paper by Carole Lartigue and colleagues appears this week on *Science* Express, the journal's publish-before-print website.

Music

Interviewer —Stewart Wills
As the name implies, the "Agricultural Revolution" that began roughly 10,000 years ago has usually been thought of as a historically sudden, big bang event. But new archaeological fieldwork, genetic studies, and other investigations are starting to change our way of thinking about the rise of farming and plant domestication. *Science* contributing correspondent Michael Balter writes about this new work in a News Focus article in this week's *Science* — part of a collection of articles and reviews on plant domestication in the issue. Michael is on the line with me from Paris to talk about the story. Michael, welcome to the Podcast.

Interviewee — Michael Balter
It's good to be back, thanks.

Interviewer —Stewart Wills
Michael, maybe we could just start by reviewing the standard, you know, the kind of standard model of how agriculture got started.

Interviewee — Michael Balter
Well, the standard model has gone through different changes over the years. But for until about 10 years ago, basically it looked as though agriculture started first in the Old World — the so-called fertile crescent area that includes Israel, Iraq, Syria, Jordan, southeastern Turkey — about 10,000 years ago, and that it was a fairly abrupt process, in other words, it kind of blossoms very, very quickly, and that it also corresponded roughly with the beginning of the so-called Holocene geological epoch that began about 11,500 years ago. And according to this view, there were other centers of plant domestication and agriculture, too. Following fairly soon on would have been China, with crops such as rice, about 8000 years ago. But the New World, meaning North and South America — where we have things like squashes and maize or what we call corn, beans, and yams and things like that — there wasn't much evidence, even 10 years ago, that there had been domestication or very much agriculture any earlier than about 5000 years ago.

Interviewer —Stewart Wills

Okay, so basically a pretty Old World focused picture — agriculture starting in the Near East, and I guess starting fairly suddenly according to the, you know, the model that was prevalent up until around 10 years ago. But I guess it's starting to appear that in the Near East, at least, plants may actually have been domesticated much more gradually than that has been thought?

Interviewee — Michael Balter
That's absolutely right. What archaeologists and botanists are starting to realize now is that rather than just sort of an abrupt process, where plants became domesticated — and I should point out that domestication, we refer to what the botanists have called traditionally the domesticated syndrome, or the domestication syndrome, I should say, where you have certain traits such as the fact that the spikelets which carry the grains or the seeds stay on the stalk, say of a wheat or barley stalk, rather than fall off easily, so that they hang around until people actually harvest them and can replant them. These and other genetic changes such as a quicker seed germination time and so forth. All these physical signs and physiological signs of domestication occurred or appeared fairly abruptly. And one of the reasons that might have seemed that way is because until very recently we didn't have that kind of methodology that we do now to sort of detect domestication, and we also didn't have some of the archaeological methods that we have now. But with new archaeological methods, with sort of statistical methodologies, and with new genetic techniques that can help us to trace what genes have undergone selection for domestication, it's now clear that this was a process that went on over thousands of years. Although it appeared to have happened suddenly in the past, it really took thousands of years. And that it was a process that probably began when people started first *using* plants not even cultivating them, but *using* them. For example, a site in Israel that was excavated in the 90s showed that wild wheat and barley had been collected by people who were basically foragers as early as 23,000 years ago, but certainly they weren't farming or cultivating those plants. Later on, at some point — we don't know exactly how long ago, but certainly you know maybe as early as 13,000 years ago or even earlier than that — people began to cultivate wild plants. And that cultivation of wild plants went on for several thousand years before we had the fully domesticated phenotypes or physical morphology that, if you will, of the domesticated plants that we have today.

Interviewer —Stewart Wills
Okay, so some evidence that in the Near East we had a sort of a gradual process of domestication over thousands of years. What's happening in the New World while all this is going on?

Interviewee — Michael Balter
Well, quite a different sort of process of discovery going on in the New World, but ending up in a convergence of the timeline in terms of this domestication. So, whereas until really just about 10 years ago it looked as though there were very few domesticated plants in the New World that were older than about 5000 years, new radiocarbon dating techniques and some other very cool techniques having to do with identifying plants that grow in the tropics by the microscopic grains of starch that they leave behind and by tiny

microscopic microfossils, called phytoliths, that they also leave behind in the archaeological record, in archaeological sediments or on stone tools; we are really beginning to push back some of those dates. So that now with the earliest dates for domestication of squashes is about 10,000 years ago. We have got evidence of maize going back at least 8000 years ago and the genetic evidence indicates that it's probably about 9000 years ago; even possibly peanuts about 8500 years ago. So, we are really pushing back those dates so that the earliest dates for agriculture in the New World — 10,000 years — pretty much now corresponds to the earliest dates in the Old World of about 10,000 years. So, we are really having kind of a convergence now.

Interviewer —Stewart Wills
And not just in those two areas. I mean one of the most interesting things that you bring up, at least to me, is how also there is growing sense that agriculture was rising at around the same time in a variety of other regions as well.

Interviewee — Michael Balter
Well, it's true. In our *Science* story, we provided the readers with a map of the world showing all the different places — the so-called as independent centers of domestication. And 50 years ago, there were only two: Old World, New World. Now, we have got about 10. Not all at the same time, although certainly a lot of the dates that we are looking at on this map are very early. And there is some surprises. In New Guinea, we got the first evidence for bananas and taro and yams about 7000 years ago. Taro is kind of a leafy plant that people eat there. Nobody thought until about four years ago really that New Guinea had been much of a center for domestication of anything, and now we have three very, very important crops that we find out were independently domesticated there.

Interviewer —Stewart Wills
So, why was all this happening at this time, Michael?

Interviewee — Michael Balter
Well, that's what archaeologists are really debating now. It does appear to correspond with the beginning of the Holocene and the end of the last ice age, but after that, why, you know, people decided to give up foraging and began farming is really still a bit of a mystery. Some people stress the climatic and environmental factors. Other archaeologists stress social factors, such as the rise of symbolism, or religion, or even kind of the internal dynamics of the increasingly sedentary societies that began to farm. We don't know the answer yet, and that is very much an area of active research.

Interviewer —Stewart Wills
Well, Michael, thanks for being with us today.

Interviewee — Michael Balter
Okay, you are very welcome.

Interviewer —Stewart Wills

Michael Balter writes about new views of the agricultural revolution in the June 29th issue of *Science*.

Music

Human domestication of natural species goes well beyond plants of course. Animals, landscapes and even entire ecosystems have been subject to human control. Over human history, these domestications of nature have generally been net positives to humankind. But as Peter Kareiva and three colleagues explain in a review article in this week's *Science*, humanity may finally have turned a corner, as the harmful impacts of domestication are starting to outweigh its human benefits. Dr. Kareiva joins us on the line from Seattle. Dr. Kareiva, welcome to the show.

Interviewee — Peter Kareiva
Well, good morning.

Interviewer —Stewart Wills
Well, let's start with some sense at the scale here if we could. You talk a bit in your review about the so called global footprint of humans. Could you describe that footprint for us?

Interviewee — Peter Kareiva
Sure, there are a couple ways of looking at it. One way is if you visit different places on the planet, what signs can you find of human influence. And those signs would take the form of invasive species, of roads, of logging, of maybe pollution — all sorts of different signs of impact. And when people have done that analysis, they basically find that virtually the entire planet has been impacted by humans — over 80%. And the only places that haven't are the hottest and coldest and most inhospitable places, places we can barely live in. And my guess is if we look there, we would still even find signs of our impact, certainly because of some pollution that is wide ranging and can't be contained. So, one way of looking at it is that you just can't go anywhere and find pristine nature, untamed or untouched by humans nature. And the range of our impact of course varies enormously, but the notion of pristine nature really is just a myth.

Interviewer —Stewart Wills
So, you know, as you suggest, we have almost domesticated the planet, if you will, and these domestications of nature presumably involve some tradeoffs of human goods versus problems for the natural world.

Interviewee — Peter Kareiva
Yeah, that's right. The reason I like to emphasize the tradeoff point of view is that sometimes when you hear environmentalists talk about environmental problems, they almost think it sounds like, Oh, how stupid the human race is, or Oh, how greedy and selfish the human race is. And they paint it in such a simplistic way. And really what has happened is, we've fed ourselves, we have sheltered ourselves, we have built cities, you know, which have culture and sometimes a high quality of life. We have done all these

things which are good for us, and in the process some parts of nature are harmed. And so it's not a matter of just massive ignorance, destroying the planet, you know — we can feed ourselves better than we ever have been able to feed ourselves. On the other hand, in the process of doing that, there is no doubt that other things that nature gives us — biodiversity, clean water, prolonged soil fertility, other things that nature gives us — are traded off. We suffer. We lose some of them. And as you mentioned in your introductory remarks, one of the points of our article is that the tradeoffs seem to be shifting, so that the net balance is that we may be losing more than we gain. And once you see that, you really want to start examining them from the point of view how we manage these tradeoffs, so that on net, it still turns out to be a good bargain for us.

Interviewer —Stewart Wills
So in a sense that we are coming to a point where the tradeoffs are actually harming these sort of goods to humankind that might come out of these domestications. It's not just a question of nature, as it were.

Interviewee — Peter Kareiva
Yeah, that's exactly right and that was the big finding of the Millennium Ecosystem Assessment. We are just coming to a point where the tradeoffs seemed to be taking a real downward turn.

Interviewer —Stewart Wills
You know, you mentioned cities a few moments ago, and you talk about them in your article as particularly intense areas of domestication, which I guess is not a way I have really looked at cities before.

Interviewee — Peter Kareiva
Well, I think cities are an important thing for conservationists and ecologist to pay attention to, and to recognize. Cities have nature and influence nature. You know, this year is the first year that the majority of people on the planet on live in cities. And people who live in cities really make decisions about how all of nature is domesticated, whether they realize it or not. One of my favorite stories is, you know, New York City — what was it, I think it was like in 1890 or roughly around there — a fellow brought into Central Park starlings because he wanted the Central Park to have every bird that was in Shakespeare's plays. And of course now starlings are a pest in all North America. There are over 200 million of them and we try to get rid of them. But it was this gentleman's, you know, urge to fashion Central Park in a certain way. And some cities and suburbs allow hunting in their vicinity, and other cities and suburbs don't allow hunting, and there are huge consequences of that for deer populations and for overbrowsing and everything. So, cities are where most of us live, and decisions made about cities impact all the world's tradeoffs and nature.

Interviewer —Stewart Wills
Well, you have also discussed another interesting element of this — national parks and nature reserves, which I guess are maybe not so natural after all.

Interviewee — Peter Kareiva
Yeah, and probably most people who visit national parks realize that, but sometimes it is lost that most natural parks require a lot of management. It's not a case where you take a piece of land or water if it's a marine protected area and you just set it aside and say, this is a park, we are not going to have buildings in it, or we are not going to have commercial activity and it goes forth. Whereas some of the most spectacular national parks, like Kruger Park in Africa, require huge management investments to maintain the wildlife that people come to watch. And similarly almost all parks are visited. They're parks because they're valued by humans, and they're visited by humans sometimes in extraordinary rates. So that many parks get millions of visitors a year. So you can't think of that national park being a pristine piece of nature.

Interviewer —Stewart Wills
Okay, so we have this situation, if I am understanding it, where pretty much all of nature has been domesticated to one extent or another, and the cost benefit tradeoffs of domestication, as you mentioned, are getting increasingly problematic. So, what do we do about all of this?

Interviewee — Peter Kareiva
Well, I think there are two things. One is, we frame the way we look at the world and conservation and environmentalism slightly differently. Often the way it's framed now is, we want to protect nature, and we want to maintain nature in some mythical historical condition of untainted or pristine nature. And I am saying, do not even think about it that way. We cannot protect nature from people. People are part of nature. They are in it. So, instead of that view, you should be looking towards, what is the future you want — not how can we keep nature like it was 500 years ago, but recognizing our impacts, what of the nature we want 100 years into the future. Too often, environmentalists and conservationists just live in the past. They want to keep things as it was, and that's just not possible. The second thing is more scientific. And as a scientist I think that what is interesting is to start assemble quantitative data and information about these tradeoffs. And we should start trying to systematically understand, is it true that every time we select for productivity, whether it's in a forest or a farmland, is it inevitable that then it becomes more vulnerable to disasters? I can't answer that question. And the answer to that question is important, because if it's not inevitable, then we should identify the situations where it isn't, and that's the direction in which we should go.

Interviewer —Stewart Wills
Dr. Kareiva, thanks very much for joining us today.

Interviewee — Peter Kareiva
Okay, great.

Interviewer —Stewart Wills
Peter Kareiva is the author, with three colleagues, of a review on human domestication of the natural world. The article appears in the June 29th issue of *Science*.

Music

Interviewer —Stewart Wills
And while we're on the subject of domestication: A new paper published online this week by *Science* finally solves the mystery of the origin of one of humanity's favorite domesticated species -- the housecat. Previously, it's been extremely difficult to tease out the domestic feline's origins, owing to its tangled history of hybridization and breed development. But now, a research team including Carlos Driscoll and Stephen O'Brien of the U.S. National Cancer Institute, David MacDonald of the University of Oxford, and ten colleagues has analyzed the nuclear and mitochondrial DNA of 979 domestic and wild cats. By studying the genetic markers within the genomes, the group found that the feline lineages that ultimately gave rise to the domestic cat originated more than 100,000 years ago in the Near East, and were derived from at least five founders across that region. Cats were subsequently domesticated in the region much later -- probably at the same time that agricultural villages were rising there, some nine to ten thousand years ago. The domestic cats then were spread worldwide as their human companions wandered and migrated.

Music

Interviewer —Stewart Wills
The evolution of human cooperation also implies the evolution of another institution — punishment, to discourage non-cooperative behavior. But how does punishment itself actually become established in human groups? In the June 29th issue of *Science*, Christoph Hauert, Karl Sigmund, and three colleagues propose an answer to that question, and thereby cast further light on the evolution of cooperative institutions. We are very pleased to have Dr. Sigmund on the line with us now from Vienna to talk with us about the new paper. Dr. Sigmund thanks for joining us.

Interviewee — Karl Sigmund
I will do it with pleasure, yes, thank you.

Interviewer —Stewart Wills
Dr. Sigmund, take us through the broad issue here. Why is the evolution of punishment such a perplexing topic?

Interviewee — Karl Sigmund
Well, essentially it is because punishment in general is a rather costly activity. It takes energy, it takes time, the other guy might retaliate and so on. And the temptation is not to pay at these costs, and to let other people punish the wrongdoers. So, you see that in most institutions — for instance in public transportations or tax offices and so — if somebody defects by not contributing the due share, then there is a lot of mechanisms for punishing such persons. But the interesting thing is that in stages where there is no such institution, where people are on their own, they are nevertheless frequently willing to punish each other. This is called peer punishment by some of my colleagues. And this is quite interesting. Why should you do it?

Interviewer —Stewart Wills
So, in a sense, the problem we have is, we have a costly activity here that seems to arise in these human institutions, and the question is, Why does it arise in the first place?

Interviewee — Karl Sigmund
How did it start, yes. You see, if you have reached a stage where everyone is punishing the dissidents who do not contribute and so on, this is a very stable situation. But at the beginning, before there was such a sanctioning institutional social system, it is more astonishing. If you are the first one willing to punish the wrongdoers, the defectors, you will have to punish left and right, and this is extremely costly.

Interviewer —Stewart Wills
And so, you have attempted to try and find a way out of this by modeling this process mathematically. Now, how does such a model of a process like this work?

Interviewee — Karl Sigmund
Well, basically, you model individuals and the society composed of individuals, and these individuals can take part in a public-good game. This is a joint effort where they have to contribute, and they get some thing in return. And, they also have the possibility of imposing fines on other players, on those who do not contribute. And, in addition, we assume that these players, these agents, are imitating each other. More precisely, they are imitating those who have a higher success, higher payoff. And we want to see how, in such a very elementary situation, punishing behavior can emerge.

Interviewer —Stewart Wills
But this isn't the first time that somebody has tried to model this situation. How does your model in particular differ from other models?

Interviewee — Karl Sigmund
Most of the attempts so far have assumed that selection operates via groups. So, in a group which is contributing a lot, in the group which is very pro-social, we would imagine that it has, in the long run, a higher probability of survival than a group where people do not punish and people do not contribute to the public good. But these group selection arguments are something that are always hotly debated. It seems that such an everyday behavior like punishing those peers who do not contribute should also be — one should also be able to explain this by individual selection.

Interviewer —Stewart Wills
And so, you have essentially set up a series of individual types if you will, that attempts to explain the emergence of this group behavior?

Interviewee — Karl Sigmund
Exactly. We have assumed, so to speak, the most complicated, the most difficult situation — where the players are anonymous; where they do not interact repeatedly, but just once; and where they are imitating those who have success, and not simply those who are in the

majority. And in that case, we managed to show that if players have the possibility not to participate in a joint enterprise, they are much more likely to evolve towards punishing the others and towards a stable society where everyone is contributing and everyone is ready to punish the exploiters, then if the players head obligatorily to participate in this enterprise.

Interviewer —Stewart Wills
So, in a sense, what has happened here is you have included an element of free will in the model and the ability to opt out of the entire behavior without, you know, necessarily being a free rider who is taking advantage of what other people are doing. That seems like a rather surprising result actually.

Interviewee — Karl Sigmund
Yes. It did surprise me a lot, actually, and in the beginning I didn't believe it. But, well, we convinced ourselves with several different methods that this was a real, robust result. So, other things being equal, a society where people are ready to enforce cooperation is more likely to merge among individuals who can choose *not* to participate in this joint effort, or so who can voluntarily, on their own, opt out of the whole enterprise. This makes it much more likely that the enterprise will succeed.

Interviewer —Stewart Wills
Dr. Sigmund, I guess that's a good segue into some of the larger issues here. I mean, you close your article with some interesting comments on how what you are describing relates to the whole notion of public goods and, you know, the so-called tragedy of the commons. These considerations are obviously becoming increasingly important as we come to grips with large scale sort of public-goods problems like climate change. I wonder if you could just comment briefly on some of those larger implications.

Interviewee — Karl Sigmund
Sure. Yes, well, actually climate change is a typical example of a type of public good or of a joint enterprise that we *have* to participate. This is something where we cannot opt out, and choose another planet to live or so on. And therefore, it might be that this is one of the reasons why it seems so awfully hard to come to a consensus on this problem. On the other hand, one should not forget that in the models we have considered, we have assumed that the players were more or less anonymous, whereas here in real life, nations and firms are of course not anonymous. They know each other. There is a lot of public debates of these issues. And it could very well be that what does not work via punishment could work through rewards.

Interviewer —Stewart Wills
Well, a fascinating topic Dr. Sigmund. Thanks very much for joining us today to tell us about it.

Interviewee — Karl Sigmund
Thank you.

Interviewer —Stewart Wills
Karl Sigmund is the author, with Christoph Hauert and three colleagues, of "Via Freedom to Coercion: The Emergence of Costly Punishment," a research report in the June 29th issue of *Science*.

Music

Interviewer —Stewart Wills
What will you be reading on the beach this summer? How about Robert Sawyer's medical thriller *Frameshift*? Or the real-life medical mystery *The Family That Couldn't Sleep*, by D. T. Max?' Or *A Guinea Pig's History of Biology*, which tells the story of the life sciences from the point of view of the plants and animals that have been some of that story's central players? These are just three of forty recommendations for summer reading, both fiction and nonfiction, from *Science*'s advisory board, reviewers, and editorial staff. The list appears in the Book Review section of the June 29 issue of *Science*. Check it out before you pack for that summer holiday.

Music

Interviewer —Stewart Wills
Finally today, Erik Stokstad, the managing editor of *Science*'s free daily news site *Science*NOW is in the studio with Tunisia Riley of AAAS for our usual roundup of other recent stories.

Interviewer — Tunisia Riley
Erik, it is good to see you this week. What interesting science topics do you have for us today?

Interviewee — Erik Stokstad
We are going to talk a little bit about chimps, and fossil wolves, and weather on faraway stars.

Interviewer — Tunisia Riley
Sounds pretty good! Let us hear about the chimps who may not be as selfish as we thought.

Interviewee — Erik Stokstad
Okay, well your image in your mind might be of chimps sitting in the forest picking nits off each other, which looks pretty happy and selfless. But even there, there is an expectation of payback. You pick my nits I will pick your nits, so to speak. So, it is not really altruism like humans do — with anonymous donations or charity, you do not expect anything back. So, this was an experiment trying to decide, figure out if there really is selfless behavior in chimps. What they did was, they had a chimp in a room and another one that could look through a window and see a piece of watermelon that looked really good. But it couldn't get to it because the door was locked. Now, imagine, in a third room, there is another chimp that can see what is going on, and it has the power to

unlock, by pulling a pin, unlock that door and let hungry chimp number one go after the watermelon. Does it do it?

Interviewer — Tunisia Riley
Let us see, does he?

Interviewee — Erik Stokstad
Well, 80% of the time it did so. And that chimp got nothing out of this.

Interviewer — Tunisia Riley
Interesting! So, why is this finding important?

Interviewee — Erik Stokstad
It raises some questions about when and where selfless behavior might happen in chimps. Now, one thing about this was, that chimp had no expectation of being able to get food. So, it could be that it is this idea of being able to get something or being hungry in the wild that really drives that selfish behavior.

Interviewer — Tunisia Riley
And next, the story about an ancient über-wolf found preserved in Alaska.

Interviewee — Erik Stokstad
All right, much as I like umlauts, let's call it a "hypercarnivore."

Interviewer — Tunisia Riley
Okay!

Interviewee — Erik Stokstad
This is a fossil they found in Alaska, in permafrost. It is about 12,000 years old. And the really interesting characteristics of this animal are that it had a short snout, a broad skull, and really big teeth. These are all features that suggest that the wolves were really good at bringing down big prey like mammoth or bison. Unfortunately, about 12,000 years ago, humans and climate change meant that those prey were no longer available so that the hypercarnivores went extinct.

Interviewer — Tunisia Riley
Does this mean anything for the modern wolves?

Interviewee — Erik Stokstad
Modern wolves are not descendants of those hypercarnivores, but the interesting thing is that those modern wolves pulled through that period. And the reason is thought to be that they were generalists. They were able to take down a range of prey. So, the big question for modern wolves is: are they generalist enough to be able to survive changes to habitat or future climate change?

Interviewer — Tunisia Riley

And finally, we move away from chimps and hypercarnivores, on to the weather on the stars. You got to tell me about this one.

Interviewee — Erik Stokstad
Okay, right. Good news for fans of the Weather Channel, but maybe not quite now. The reason people think there might be weather on stars — and they have suspected this might be the case for a century or more — is that if you look at stars that are all the same composition and about the same age, nevertheless you see some variations in their atmospheres. So, this team went and they looked at a star called alpha Andromedae, which is about 95 light years away.

Interviewer — Tunisia Riley
Well, how do you find weather on a star that far away?

Interviewee — Erik Stokstad
Well, you need a telescope that is good enough. And with advances in instrumentation they were able to resolve, look at the star for seven years and look at variations in the composition. What they found was that levels of mercury were changing. They were changing in a way that sure looked like it was clouds of mercury moving across the, moving through the atmosphere.

Interviewer — Tunisia Riley
Well Erik, thanks for dropping in and, as usual, sharing your interesting stories this week.

Interviewee — Erik Stokstad
Thanks Tunisia, it was great to be here.

Interviewer — Tunisia Riley
Erik Stokstad is the managing editor of *Science*NOW, the free online daily news service of *Science*. You can catch up with these and other stories on the site at www.sciencenow.sciencemag.org

Music

Interviewer — Stewart Wills
And that wraps up the June 29, 2007, *Science* Podcast. The show is a production of *Science* Magazine and of Triple-A-S, the Science Society, with additional financial support from the Golden Fund. The content is provided by the news and editorial staff of *Science*, and Jeffrey Cook composed the music for the show. I'm Stewart Wills, the online editor of *Science*. On behalf of the journal and its publisher, the American Association for the Advancement of Science, thanks for joining us.

Music