



## Science Magazine Podcast Transcript, 15 February 2013

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### **Promo**

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### **Music**

#### **Interviewer – Kerry Klein**

Kerry Klein here, and I’ve got online news editor David Grimm who’s here to give us a rundown of some of the recent stories from our daily news site. So Dave, in our first story, we’ve got some new clues about the origin of life.

#### **Interviewee – David Grimm**

Right, Kerry. Well, this story is about where do we all come from? How did life start? You know, there was some thinking awhile ago that maybe there was these molecules that assembled into DNA in early seas, and then this DNA somehow became encapsulated in cells and, sort of, things took off from there. But recently, scientists have thought that maybe it was RNA instead of DNA. RNA is sort of the cousin of DNA, and actually there are some organisms that actually have a genome just based on RNA. The thing with RNA, the advantages it has is that it’s more chemically reactive than DNA which means that if you’ve got a bunch of RNA or RNA precursors in the water, they are more likely to start bonding to each other than you would have with something similar to DNA. But the problem is, is that even in water, scientists have shown that the nucleotides – these, sort of, letters – the A, G, C, T for DNA, U for RNA. They found that these building blocks of RNA don’t spontaneously assemble. So it seemed to be a detraction for that hypothesis that these molecules are floating around – just, sort of, automatically formed RNA.

#### **Interviewer – Kerry Klein**

So what insight does this new study bring to that RNA theory?

#### **Interviewee – David Grimm**

Well, researchers think they have found a way that RNA could have assembled in early seas. They toyed with this idea of what they’re calling proto-RNA, and this is, sort of, a much simpler version of RNA. It involves just two chemicals. One is called cyanuric acid, or CA, and the other is triaminopyrimidine (if I’m saying that right, and I probably am not). We’ll call it TAP for short. And TAP comes from a family of compounds that are known as pyrimidines as do the RNA bases C and U, so it’s a real relative of what we see in RNA today. Previous research has shown that when CA and TAP were put in an organic solvent, groups of three CAs and three TAPs would spontaneously form these ring-like structures called rosettes, and these rosettes would then stack on each other forming long chains. And you can begin to see that when you have all these molecules starting to stack on each other, you start to get much more complex molecules, something

maybe resembling RNA. But when researchers put CA and TAP together in water, they tend to clump into large ribbons, and they quickly fall out of solutions meaning that they don't seem like good candidates for what the researchers were, sort of, considering proto-RNAs. So what the researchers did in the new study was they think they solved this problem. They gave TAP a short chemical tail which transformed it into a chemical they call TAPAS (makes me hungry just thinking about it). And they found that one change, the simple change, encourages it to assemble with CA and form rosettes in water. So it didn't have the problems that researchers had seen before. And what's more, these rosettes actually stacked on top of one another as you would, sort of, hope for these simple molecules forming much more complex molecules, and they form these long chains that actually, sort of, resemble genes, in a way, made up of as many 18,000 TAPAS and CA components. So you're really starting to see this assembly of things that begin to look like very early versions of genes just with these two fairly simple molecules.

**Interviewer – Kerry Klein**

So do we know if these molecules were even around billions of years ago?

**Interviewee – David Grimm**

We don't know that. And the other thing we don't know is even if these types of proto-RNAs could actually encode information, and that's really the important thing because DNA and RNA, that's the blueprint for our cells. So it's not just having the structure itself, it's having this structure that's able actually to encode instructions that would enable these very, very early cells to actually carry out activities. And until that's solved, we're really not going to know whether these CAs, these TAPAS, these sort of proto-RNA like molecules may have actually resembled some of the earliest forms of genetic information on the planet.

**Interviewer – Kerry Klein**

Right. And so now let's fast forward a couple billion years to when humans began to split into hunter-gatherers and farmers.

**Interviewee – David Grimm**

Well, Kerry, one of the most important things that happened in human history happened about 11,000 years ago, and this was the beginning of the Neolithic period. This is the period where a lot of human populations began settling down. They were transitioning from a hunter-gatherer lifestyle to really settling down as farmers. And this Neolithic revolution, as it's called, is when we started growing crops, domesticating plants and animals, really forming the first permanent villages which eventually became cities. So an incredibly important time in human history. What's interesting about this time is not all populations around the globe were doing this. There were still a lot of groups of humans that were still engaged in what was called a Mesolithic culture. They continued to hunt, fish, and gather, so they didn't really settle down. And the big question has been, well, if we have these two different sort of lifestyles going on, on the planet, what happened when these people met? What happened when the farmers met the hunter-gatherers?

**Interviewer – Kerry Klein**

Right. So how can we begin to even understand how that would've happened?

**Interviewee – David Grimm**

Well, researchers looked at the Balkans. And the Balkans offer a really rare glimpse of this tumultuous time when farmers began to arrive, but there were still hunter-gatherers on the scene. And they analyzed a lot of skeletons that were buried in a particular region there. The skeletons were dated from about 13,000 to about 7,500 years ago. And this spans a period from just before the Mesolithic to the early Neolithic. And the researchers focused specifically on isotopes of strontium-87 and strontium-86. And these isotopes really varied depending on the soils and the rocks and the environment. They get into the food, and what they give scientists is this lifelong signature of where a person grew up so researchers can actually tell where people came from just based on looking at these ratios of isotopes.

**Interviewer – Kerry Klein**

And this is in their teeth?

**Interviewee – David Grimm**

In their teeth, exactly. What the researchers found was they found a really significant change in the strontium profile right around the time that the first signs of the Neolithic culture show up in this area. And by, sort of, digging a little bit deeper, what they found was that there appeared to be a lot of non-local individuals appearing to come from far away, and the number of these immigrants really jumps over time. Before 8,200 years ago, for example, almost all of the burials at this specific site that they looked at were locals, but just a couple hundred years later, five of the 19 people they'd found buried in this area were non-locals. They had come from far away.

**Interviewer – Kerry Klein**

So what does, you know, immigration of these early humans tell us about their interactions?

**Interviewee – David Grimm**

Well, the researchers suspect that these non-locals represent Neolithic migrants, so farmers that were coming from far away and that they were mixing with local hunter-gatherers. And that suggests that the two groups lived side by side, especially since you're having these common burials of people that are coming from these different regions. So, you know, some people suspected that this may have been a very violent encounter. You know, the hunter-gatherers meeting the farmers – very different lifestyles, maybe very different cultures, maybe they didn't get along very well. But this suggests that they actually may have had a very peaceful co-existence.

**Interviewer – Kerry Klein**

But, of course, this is only one small sample set from one river in Europe.

**Interviewee – David Grimm**

Exactly. This was happening all over Europe and elsewhere in the world, and so we can't extrapolate just from this one study to say that it was peaceful everywhere it happened. But at least it looks like everybody was getting along in this particular area of Europe.

**Interviewer – Kerry Klein**

Alright. And in our third story, we learned something new about ants.

**Interviewee – David Grimm**

Right, Kerry. Well, scientists found out a few years ago that adult ants of some genuses are actually able to make noise. They have this specialized spike on their abdomen, and they can actually stroke it with their hind legs. It's kind of like dragging the teeth of a comb along the edge of a table. [audio clip] The question in this new study is do these noises actually serve a purpose? Are they a form of communication? And the reason that's unusual is because scientists have always thought of ants as communicating primarily using pheromones, which are these sort of chemicals they can pick up on. And pheromones have been thought to communicate a lot of stuff in ant societies – social status, maybe even where food is. So the question is, well, maybe they make noise, but why do they need to make noise if they are already communicating via pheromones?

**Interviewer – Kerry Klein**

So why do they?

**Interviewee – David Grimm**

Well, one of the interesting things that they found was it wasn't just the adult ants in one of these groups of ants that they looked at. This was a group from Northern Europe. And what they found was that even the mature pupae, which are, sort of, the stage right before adulthood, were able to make noise. And their noise sounded a little bit different from the adult noise. [audio] So you can see it's simpler. And what the researchers think is it is a way of, sort of, communicating, and they believe that when the adults use this noise, it's kind of an emergency signal. Maybe it's saying, "Help! Hey, I'm over here. Help me. This is your friend." You know, maybe there's a lot of complicated stuff happening in that noise, but with a mature pupae, you're basically maybe just getting something like, "Help." You know, it's a much more simple communication.

**Interviewer – Kerry Klein**

So how did scientists determine that this was really what these noises mean?

**Interviewee – David Grimm**

Well, the first thing they did was actually played back some of these sounds that the mature pupae made to adult ants. And adult ants responded by walking over to the speaker that was playing this noise and rubbing their antennae against it and starting to guard it, which suggests that they were interpreting this as maybe an SOS type signal. And the researchers actually even went a bit further. They removed this abdominal spike from the mature pupae, and they put them in a nest. And they disturbed the nest so that the other ants around would think there was an emergency, and normally what happens is

adult ants rescue their nest mates but when the mature pupae were unable to make sound because their spikes were removed, the adult ants completely ignored them. It was kind of like the mature pupae didn't even exist.

**Interviewer – Kerry Klein**

Wow. So why would they communicate with sounds rather than pheromones in this really important scenario?

**Interviewee – David Grimm**

Well, the researchers think it's because the mature pupae don't yet have the full array of adult pheromones, so they are not actually able to communicate as well as adult ants. You can, sort of, almost think of it as a baby just learning to speak, and maybe these ants can only say a few words in pheromones. So if an emergency arises, they need another way to signal that they are in trouble, and that's where these noises would come in.

**Interviewer – Kerry Klein**

Wow, how cool. Alright. So what else has been on the site this week, Dave?

**Interviewee – David Grimm**

Well, Kerry, for *ScienceNOW*, we've got a story about building earthquake shields for buildings. Another story about how mice can shed light on human evolution. For *ScienceInsider*, our policy blog, we've got an analysis of President Obama's State of the Union speech – what it means for science. Also, the future of science in a European union – what's going to be happening over there in the coming years. And as you know, Kerry, we're here in Boston. We're covering breaking news from the annual meeting of the AAAS. We're going to be having several stories on our website everyday along with podcasts and a new feature this year. We're going to be doing live video chat with some of the top scientists from the meeting. You can find all this on the site.

**Interviewer – Kerry Klein**

Great. Thanks, Dave.

**Interviewee – David Grimm**

Thanks, Kerry.

**Interviewer – Kerry Klein**

David Grimm is the online news editor of *Science*. You can check out all of our news at [news.sciencemag.org](http://news.sciencemag.org) including daily stories from *ScienceNOW* and science policy from *ScienceInsider*. And while you're there, be sure to check out *ScienceLive* – a live chat on the hottest science topics every Thursday at 3 p.m. U.S. Eastern time.