Lincos with
Dr. Yvan Dutil

http://library.thinkquest.org/C003763/index.php?page=interview01

The Lincos encoded message was sent from the Evpatoria transmitter in the Ukraine. Courtesy Yvan Dutil

Most people see SETI (the Search for Extra-Terrestrial Intelligence) as a project for merely listening for signals from other stars, but Dr. Yvan Dutil and Stephane Dumas from the Defence Research Establishment Valcartier in Canada had other ideas in mind when they composed a message sent to the stars last year.

The message they sent was only the second serious attempt to actively signal civilizations around other stars; the first was in 1974 by the founder of the SETI Institute Frank Drake (also known for 'Drake's equation). Unlike's Drake's message, the message sent last year was written in the Lincos mathematical language.

Lincos was devised by Professor Hans Freudenthal in 1960, and it was aimed to be the most understandable language in existence - in other words, a language that would be very easy for aliens to decode. Each symbol in Lincos is defined by symbols that come before it, so that you don't have to know anything apart from pure mathematics to understand it.

Some of the components of the message included humanity's knowledge of basic physics, our location in the universe and the solar system, as well as some elementary biology.

Adrian Hon talked to Dr. Yvan Dutil in this interview.

Astrobiology: Why did you choose Hans Freudenthal's Lincos language to encode your message over any other method?

Dr. Dutil: Lincos is not exactly what we might call a language. It is more a logical method (I think the word Freudenthal used was "programme") to establish a common language based on mathematics.

Basically, you start by explaining the basic math:

```
o + o   =  oo    ( 1 + 1 = 2 )
oo + o  =  ooo   ( 2 + 1 = 3 )
o + oo  =  ooo
ooo - o =  oo
```

and so on...

And you build on these simple ideas to explain the more complex ones. However, Lincos has it own drawbacks. Since it is based on pure logic it become rapidly difficult to communicate some complex processes. For this reason many researchers find it impractical. Therefore, we preferred an hybrid method with the addition of schema and graphics to guide the reader. However, even this approach has its own drawbacks since graphical representations is can be somewhat culturally blinded.

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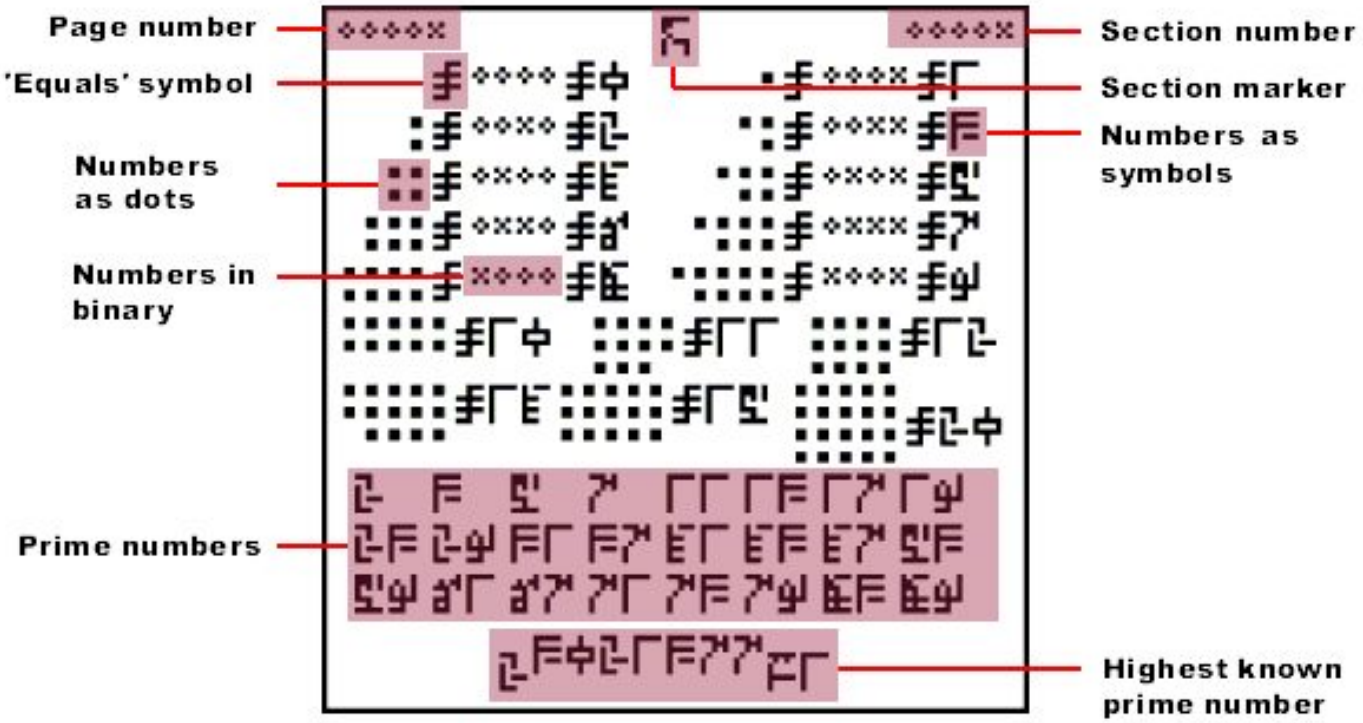

First page of the Dutil-Dumas Lincos message (with key)

Note the presence of a black border around the entire 'page'. The black border was used by Dutil so that if bits of the message were corrupted in the transmission, any aliens listening would be able to reconstruct the message by lining up the page border so it would make a box - one of many redundancy measures instituted by Dutil to ensure clarity.

Astrobiology: What do you feel are the flaws of other attempts to send signals to other stars, such as the message sent by Frank Drake?

Dr. Dutil: The only other serious attempts was the transmission from Arecibo in 1974. Many companies claim to send interstellar messages but essentially they are no better than using cell phones or CB for this job. Even the 2000 edition of the Cosmic Call from Encounter 2001 using the Mir space station is worthless.

The main drawback of the Arecibo message is its lack of resistance to the noise. Even at the time of the transmission it was known for a long time since Carl Sagan as pointed this out in the sixties. Also, the message is much too short and do not contain any redundant information. Therefore, it is impossible for the reader to cross-check his deductions.

Finally, the target chosen was very bad. The globular cluster M13 is a very unlikely place to find planets and life.

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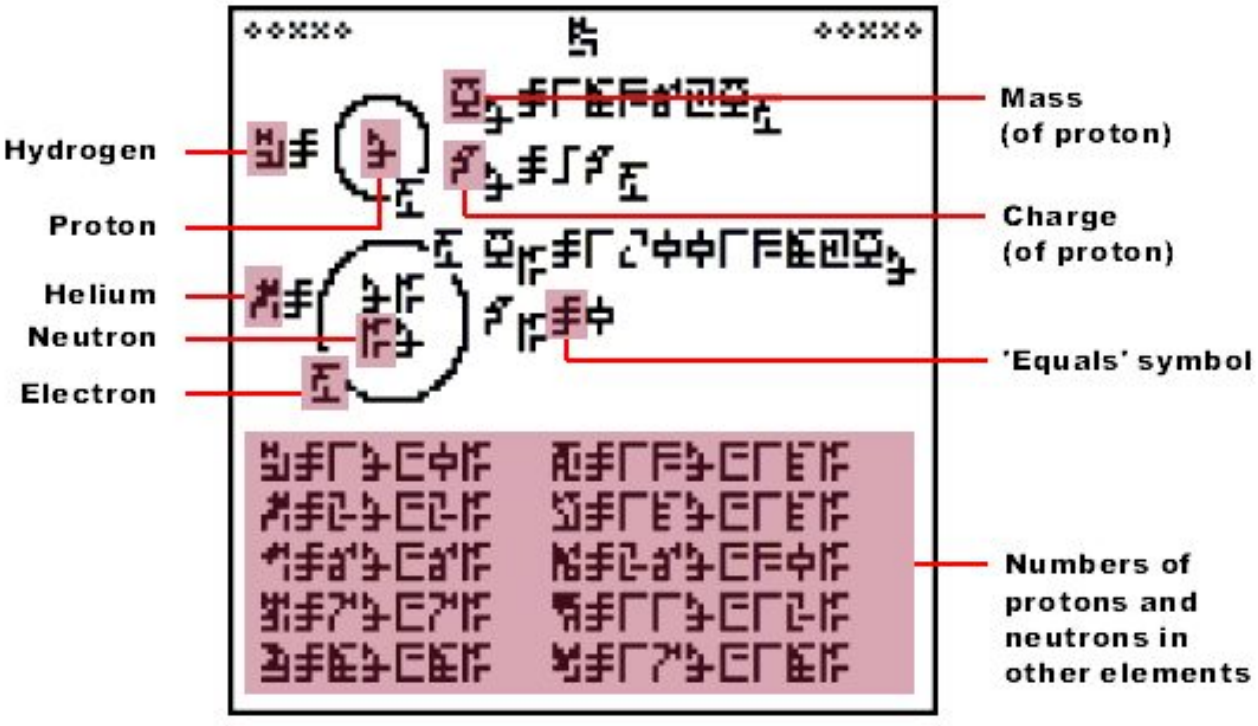
Astrobiology: For your message, you've used several universal points of reference to base measurements on, such as the hydrogen spectrum and the properties of atoms. How difficult do you think it will be for aliens to recognise them?

Dr. Dutil: This is the weakest point of the whole method. Essentially, we could explain all the math without much problem. However, the most interesting things are not mathematical objects, but physical ones. Fortunately, math and physics are closely related but there is still a lot of possibility of failure. As I said before, the graphical representation of the hydrogen atom may vary from culture to culture.

However, once you understand correctly one part of the message the rest comes out relatively rapidly. In order to help the reader, we use some fundamental ratios. They are pure numbers and can be easily recognised (for example, the ratio of the mass of a proton over the mass of an electron).



Sixth page of the Dutil-Dumas Lincos message (with key)

To us, the image of an atom is easily identifiable because of the circular path of the orbiting electron around the nucleus - but will it be so recognisable to aliens? Dutil admits that this is the weakest point of message.

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Astrobiology: What do you feel is the problem of projects such as Encounter 2001? Surely since Earth has been broadcasting information for over one hundred years there isn't much that could make matters worse?

Dr. Dutil: Your goal is to be louder than the rest of the Earth (and in fact the Earth is not that loud). That's why you need a very powerful transmitter. There isn't much choice with regard to transmitters; there are only three that are suitable for the job now: Arecibo, Goldstone and Evpatoria.

If you use those transmitters, you speak for the Earth. And that's the base of the politico-diplomatico-ethical problem.

What should be said? How can we describe the humanity in a representative matter? Is that dangerous? For us, and for them?

How the message was sent

The Dutil-Dumas message was sent as part of the Cosmic Call venture by the Encounter 2001 organization in May 1999.

The Cosmic Call message consisted of two main parts. The first part was the Dutil-Dumas message, and the second part comprised thousands of personal messages from Encounter 2001 participants (who had to pay for this privilege).

This year, the Cosmic Call II message will be sent from the Mir space station. Cosmic Call I was sent from a transmitter in the Ukraine.

Astrobiology: Lincos is used to communicate scientific and mathematical information - if communication were established with another star, what problems do you foresee in trying to talk about other concepts such as human history, or even simple information like biology or behaviour?

Dr. Dutil: Rapidly you face what is call the "incommensurability" problem. Many concepts are not translatable in math (at least at this point of our understanding). How do you describe the concepts of good and evil? What about love, or pain?

Freudenthal suggested the usage of "play" to do so. It is probably the right approach. If enough bandwidth is available perhaps sending a film could do the job.

Astrobiology: How did you choose the stars you sent the message to?

Dr. Dutil: We first chose a region of the sky, then we chose the stars within that region. We chose to send the message near the galactic plane because that's where the most star stand, and so the message would reach the most planets. Also, we restricted ourselves to a small patch of the sky where the signal would travel without too much interaction with the interstellar medium. Essentially we sent the signal between two spiral arms. The region chosen sits in the middle of the summer triangle.

Then using the SETI Institute list of candidate stars we chose four nearby Sun SOSIES (single, old, high metallicity stars). We did not choose specifically stars with planets.

However, one of the star chosen was 16 Cyg A which forms a wide binary system with the star 16 Cyg B, which does has a planet.

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Astrobiology: But if an 'active SETI' programme were to be started, do you think that its transmissions should be targeted at stars known to have planets?

Dr. Dutil: There are planets and then there are planets. Most scientists think that the best places to find life are on Earth-like planets. This would mean small and wet worlds. At the moment, our detection techniques only allow us to detect Jupiter-sized planets which do not appear to be a good location for life unless there is a very large satellite (moon) orbiting around it around, a satellite large enough to keep an atmosphere and its own magnetosphere to shield the surface from the huge radiation fields surrounding the Jupiter-sized planet.

> *If active SETI isn't pursued, then you'd end up with everybody out there listening, but no-one speaking.*

Even worse, most of these giant planets we have found so far are very near their stars. Theoretically, this can be explained by planetary migration from the external part of the stellar system to the internal parts (i.e. planets moving towards the sun). This is very bad news for any Earth-like planets in the stellar system since this would mean that they would have been gravitationally slung out of their places as the giant Jupiter-sized planet was migrating toward its sun.

Interestingly, there is a small probability for an Earth-like planet to be captured by the giant in the process and turned into a moon of that giant. So it is not completely hopeless.

Still, for the moment, stars with planets do not appear to be especially good candidates for life. However, within 20 years, planet detection technology is likely to be improve to the point that we will be able to detect Earth-like worlds and even searching for traces of biological activity in the spectrum of their atmosphere. At that moment, this would strongly increase the odds of finding life. Nevertheless, you have to keep in mind that on Earth, oxygen would have been detectable for less than one billion years in its atmosphere out of its 4.6 billion year life.

Bearing in mind that a technological civilization on Earth capable of sending and receiving interstellar radio messages has only been around for about 100 years, the odds are smaller than one in ten million for the probability of finding a technological civilization on a planet which shows obvious signs of life. It's not going to be easy, even with the telescopes that can detect Earth-like worlds, but there's no doubt that they'll help enormously in the search.

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Astrobiology: Exactly what is 'active SETI' and why should we pursue it?

Dr. Dutil: Active SETI is the active search for extra-terrestrials. In 'classical' SETI you listen as hard as you can, in 'active' SETI you shout as loud as you can.

If we are serious about SETI then two methods should be pursued simultaneously, otherwise you'd end up with a situation where everyone is listening but nobody is speaking.

However, for many reasons, active SETI is tougher than classical SETI. By the way, to be honest active SETI is the true 'classical' SETI, since it was first proposed by the German scientist Gauss at the end of the 19th century.

Astrobiology: What are the sort of problems that face 'active SETI'?

Dr. Dutil: First, you need a powerful transmitter. Unlike passive SETI, these things need a LOT of maintenance and a dedicated installation. Therefore, they are quite expensive. Also, we have to write a clever message and you need to choose your target carefully. Overall, now I think the technics favour the passive SETI by a large factor.

Astrobiology: What is your interest in communicating with extra-terrestrial life? How did you get started on creating your message?

Dr. Dutil: Well, my interest for extra-terrestrial communication goes very far back. For example, I was working on the character encoding scheme back in college (more than 12 years ago). At that time, I was wondering what the character set of a civilisation which lived underwater or in microgravity would be like. In such situations, every characters must be different from all others and this would have to remain true, whatever the orientation of the characters. At that time, I wrote a computer program that would generate all the combinations.

For the Encounter 2001 project, we used a much more advanced version of these characters.