

Lexicon (version 2)

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note: This is the second draft of the lexique. The coding of the pages is completed. Most of the changes have been done. We are writing the last piece of explanation for each concept. The alphabet has been entirely rebuild from scrap with more fault tolerance than the previous one.

Introduction

This document will present and explain the message in a simplify way. It is not intended to give an elaborated explication of the meaning of everything. This is left to another document, possibly a scientific article. Nevertheless, we will try to explained as much as possible the concept behind the message without entering too much in details.

We are in the process of correcting the message. Some errors were detected and we must change them. Also, more informations will be added in the process. So, what it is described in those pages should be considered "Message version 2.0". We had anticipated those changes a while ago. The timeframe of the whole project should not be modified, we will have a new version after Christmas.

Anatomy of a Page

The base of each page is first the frame. A one-pixel-thick frame is drawn at the border of the page. This is the first indication of the picture's shape. It is also a good way to have a structure in the bit-stream.

Once the bits are rearranged into a squared image. The viewer will see a series of symbols dispose in groups. But more important, he will notice 2 structures at the top. One at the left and one at the right. Those structures are the page number and section number in binary representation.

This page-section arrangement could help sorting through the message and group concepts together.

In the top-center of each page, we will find a single symbol. It is the section marker.

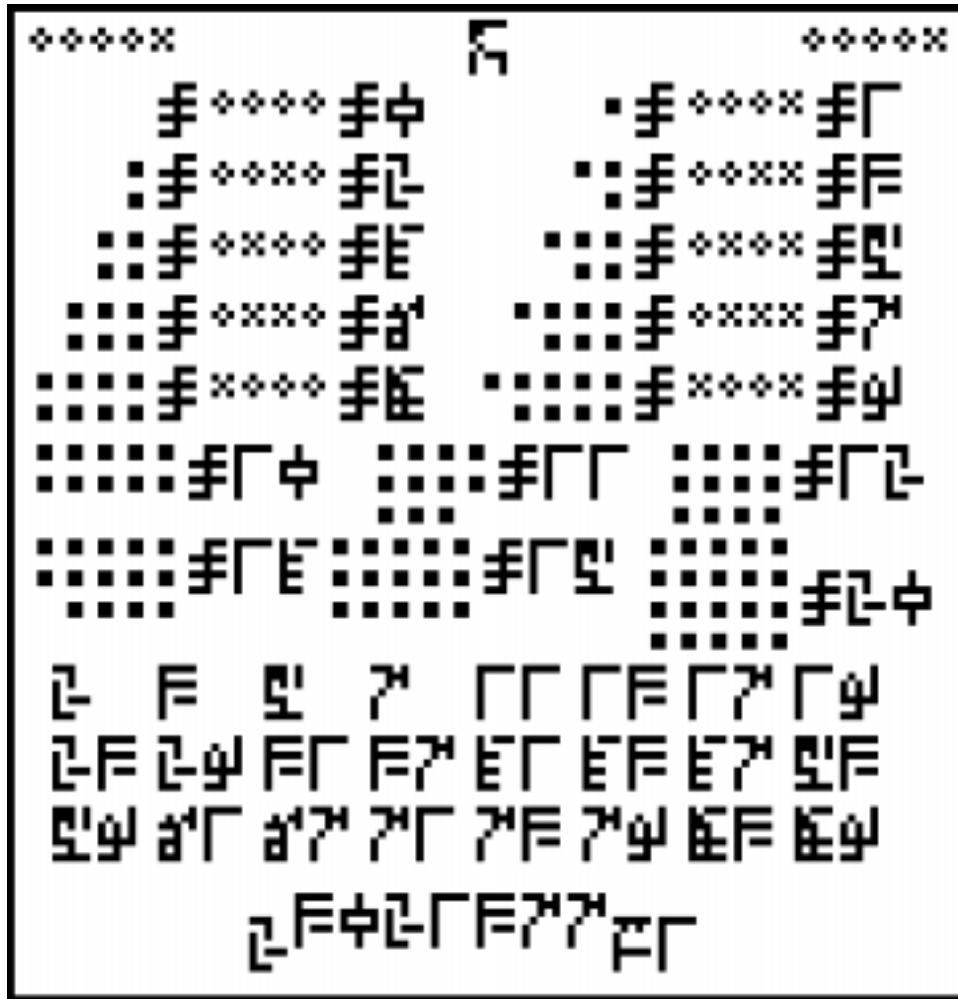
Each symbol is separated from the other by at least 2 pixels.

Most of the message will not be understand by common people. Some informations contains inside are very specialized. We have assumed it will be read by scientist, engineer and people from field of knowledge very close to mathematics, physic and biology.

The message it-self is written in a progressive way. One must start reading at page 1 and progress through all the pages to understand must its contain. The redundancy of the informations should help someone to read it with the first pages, but it will be harder.

A lot of informations are given by association and comparison. The Why we did it like that is outside the scope of this document. But again, another paper will be written soon on the subject.

1. Page on Numbers



This page is the first of the series. It defines the numbers as we used them.

The first part is a double equality between a group of dots, a binary representation and the symbol we will use. The binary number are a set of 0's and 1's that are represented as lozenges (0) and an X (1). This gives the maximum resistance to noise in a limited space.

At the bottom of the page, we find the primes (2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89). The last prime of the list is the biggest we find to this date:

$$2^{3,021,377} - 1$$

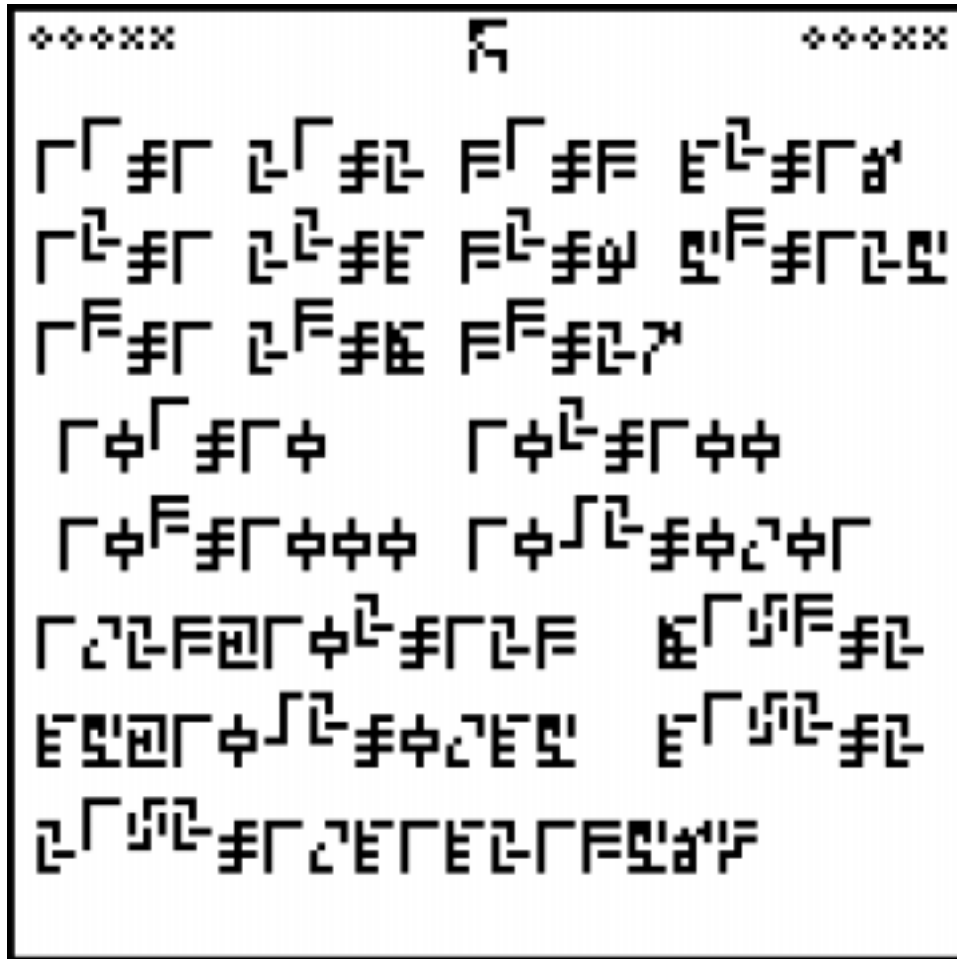
2. Page on Operations



With this page, we are concerned with the definition of mathematical operations such as the +, the -, the * and the ÷. The periodic notation (...) is also introduced using fractions.

1+1=2	1-1=0	1*1=1
1+2=3	1-2=-1	1*2=2
3+2=5	3-2=1	3*2=6
4+3=7	4-3=1	4*3=12
1+0=1	1-0=1	1*0=0
1/1=1		1/3=0.3333...
1/2=0.5		4/3=1.3333...
3/2=1.5		1/9=0.1111...
1/0=undetermine		2/3=0.6666...
0/1=1		1/11=0.0909...
0-1=-1		

3. Page on Exponents

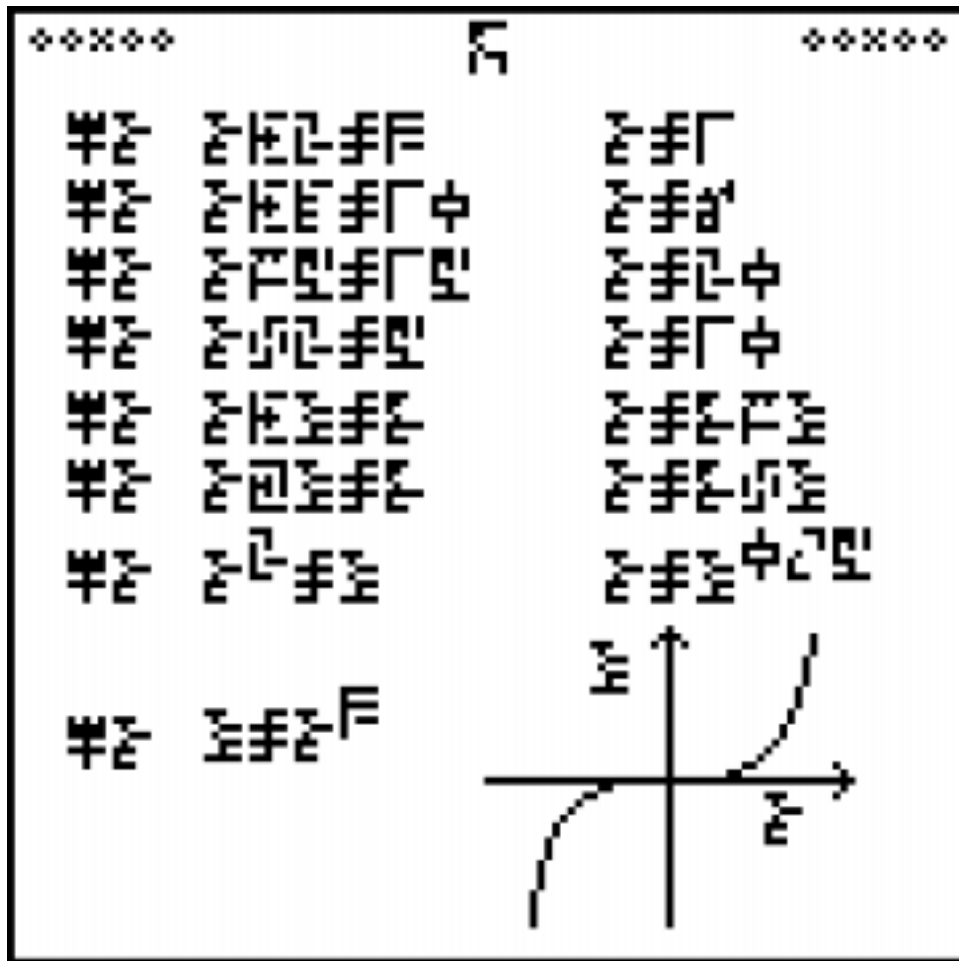


This page concentrates on demonstrating the power notation. Very useful for huge number that will come later. We are not using the “a^b” or “a*b” notation, but the more usual “a^b” notation. This prevents us to have to introduce the mathematical precedence of operations.

$1^1=1$	$2^1=2$	$3^1=3$	$4^2=16$
$1^2=1$	$2^2=4$	$3^2=9$	$5^3=125$
$1^3=1$	$2^3=8$	$3^3=27$	
$10^1=10$		$10^2=100$	
$10^3=1000$		$10^{-2}=0.01$	
$1.23 \cdot 10^2=123$		$8^{1/3}=2$	
$45 \cdot 10^{-2}=0.45$		$4^{1/2}=2$	

$$2^{1/2} = 1.4142356\dots$$

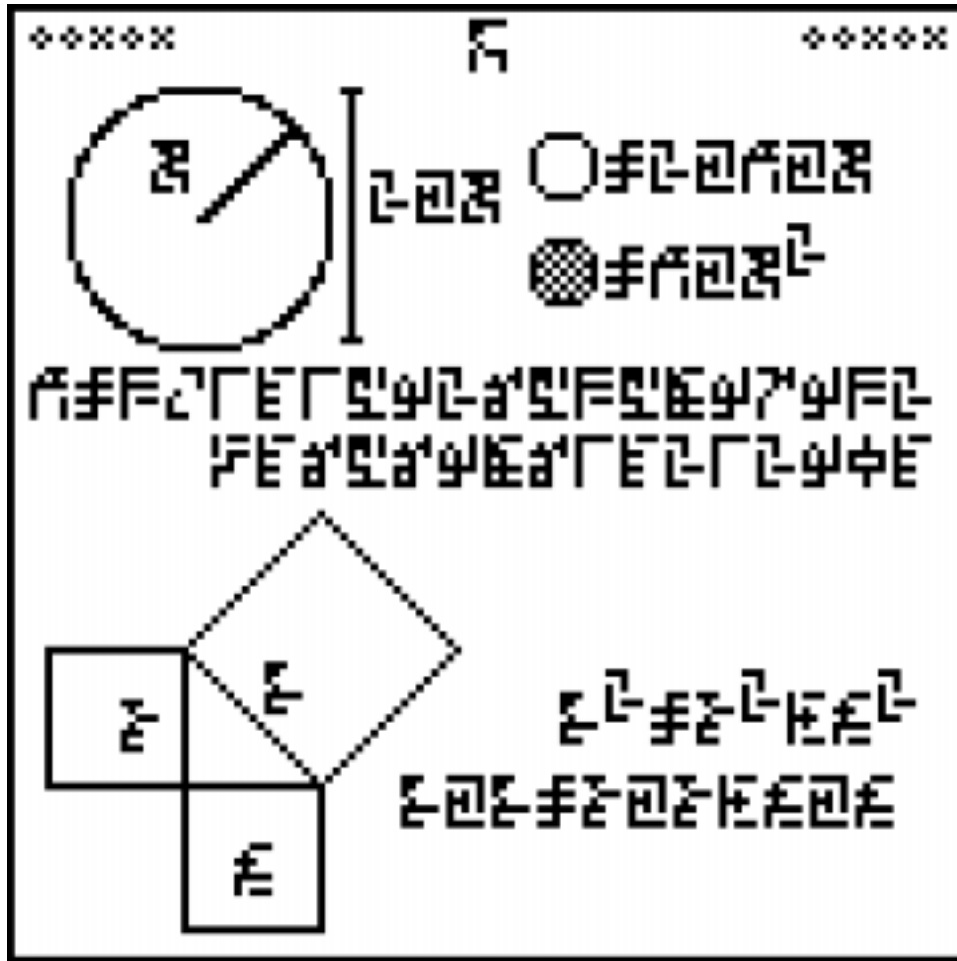
4. Page on Variables



The Page on Variables talks about the notion of equation, correspondence and interrogation. This will be use later to ask questions.

?a	$a + 2 = 3$	$a = 1$
?a	$a + 4 = 10$	$a = 6$
?a	$a - 5 = 15$	$a = 20$
?a	$a \div 2 = 5$	$a = 10$
?a	$a + b = c$	$a = c - b$
?a	$a * b = c$	$a = c \div b$
?a	$a^2 = b$	$a = b^{0.5}$
?a	$b = a^3$	

5. Page on Geometry



The geometry is quite useful to establish length and volume notions. Here, we talk about the circle and the relationship between its radius and the number PI. Which is given in the middle of the page. The first digits are given, followed by the equivalent of "...". The last digits represents the last 51,539,600,000th digits we found lately. The 15 digits ensure that it is not a purely random sequence of numbers.

$$\pi = 3.1415927...465698614212904$$

Below, the Pythagore's theorem is shown.

$$c^2 = a^2 + b^2$$

$$c * c = a * a + b * b$$

This reinforce the idea of exponent developed previously.

6. Page on the Elements



This page introduces some elements needed in the message to explained further notions of chemistry and physics.

The Hydrogen atom is displayed with the representation of the proton and the electron. The respective mass and charge of both are also written. The proton's mass is given in relation to the electron's. As we know, $\text{Mass}_{\text{proton}} = 1836 \times \text{Mass}_{\text{electron}}$.

Below it, the Helium is used to show the neutron.

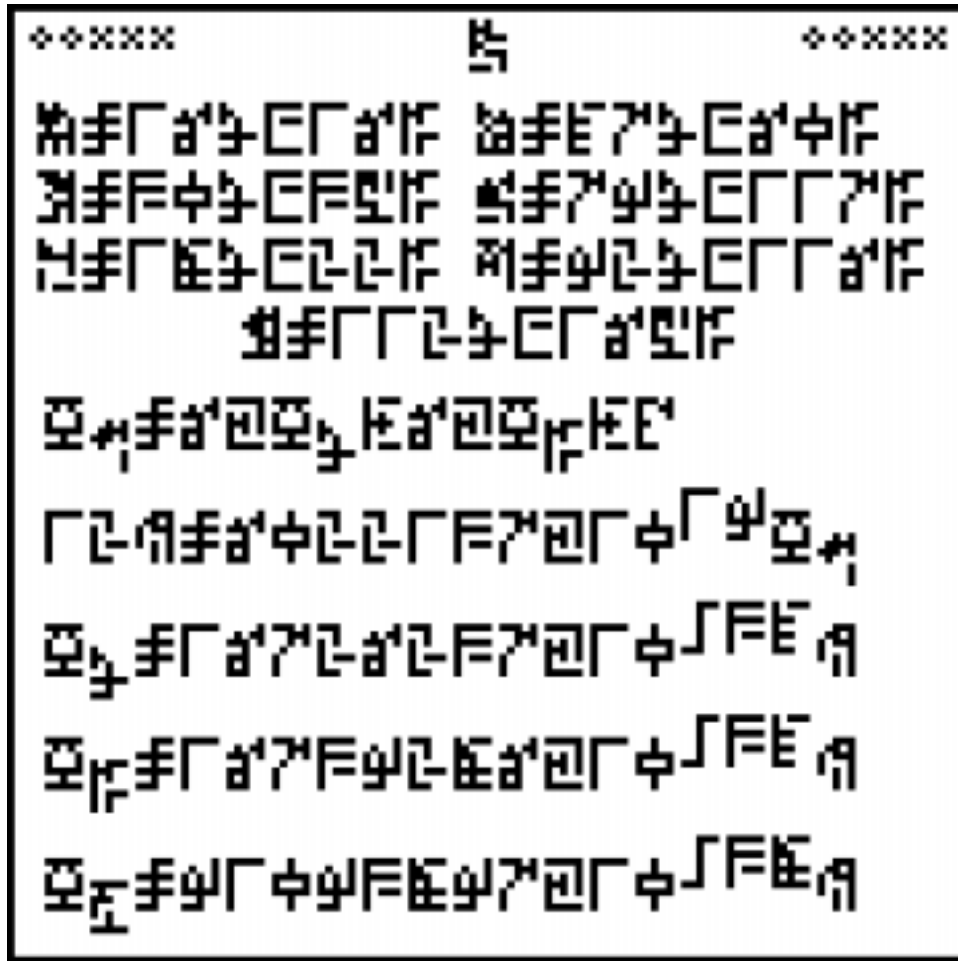
The representation of the atom of is the Bohr's one. 10 elements are enumerated in this page. They are introduces using the protons and neutrons contain in their nucleus. It is more precise to talk about UNION OF rather than ADDITION OF particules in that case.

$$\text{H} = 1\text{p} \cup 0\text{n}$$

$$\text{Al} = 13\text{p} \cup 14\text{n}$$

He = 2p ∪ 2n	Si = 14p ∪ 14n
C = 6p ∪ 6n	Fe = 26p ∪ 30n
N = 7p ∪ 7n	Na = 11p ∪ 12n
O = 8p ∪ 8n	Cl = 17p ∪ 18n

7. Page on the Mass



The notion of mass is further introduced in this page.

The use of the Carbon-12 atom to introduce the Avogadro number (6.0221367×10^{23} atoms / mol) is also quite useful. Also the proton ($1.6726231 \times 10^{-27}$ kg), neutron ($1.6749286 \times 10^{-27}$ kg) and electron ($9.1093897 \times 10^{-31}$ kg) mass is given at the bottom using the symbol for gram. Therefore consolidating the whole notion of mass. We can now give the mass of other objects such as the Earth or the Sun. This will be done later.

In order to display the most digits, we have removed the “.” and readjusted to power of 10. Therefore, for the proton’s mass we have 16726231×10^{-34} kg.

5 others elements are introduced to complete our set. They will be needed for Temperature and Earth description.

S = 16p U 16n	Ag = 47p U 60n
Zn = 30p U 35n	Au = 79p U 117n
Ar = 18p U 22n	U = 92p U 116n
	E112 = 112p U 165n

Element 112, the latest OFFICIALLY found, shows how advanced in nuclear physics we are. At the time of writing this page, the element 114 was announced but without confirmation. No element 113 was announced, yet.

$$\text{Mass}_{\text{carbon}} = 6 * \text{Mass}_{\text{proton}} + 6 * \text{Mass}_{\text{neutron}} + \text{Energy}$$

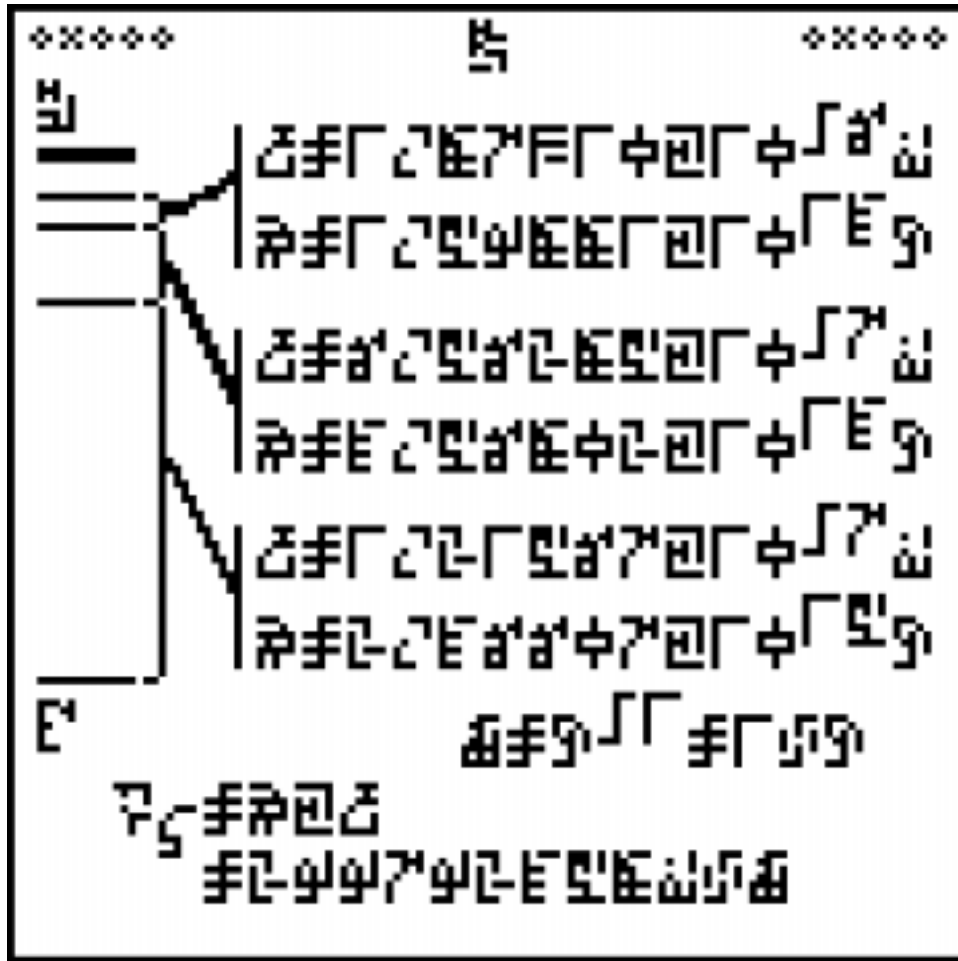
$$12 \text{ kg} = 6022137 \times 10^{19} * \text{Mass}_{\text{carbon}}$$

$$\text{Mass}_{\text{proton}} = 16726237 \times 10^{-34} \text{ kg}$$

$$\text{Mass}_{\text{neutron}} = 16739286 \times 10^{-34} \text{ kg}$$

$$\text{Mass}_{\text{electron}} = 91093897 \times 10^{-38} \text{ kg}$$

8. Page on the Hydrogen Atom



With this page, we start to push a little further the teaching of our knowledge. We introduce the Hydrogen's spectrum.

Hence, the notions of frequency, wavelength and time are now displayed.

At the bottom, we will find the speed of light given using the relation between the frequency and the wavelength.

You will notice to use of symbols after each number. This is for meter and one for Hertz.

$$\begin{aligned} \lambda &= 1.87310 \times 10^{-6} \text{ m} \\ f &= 1.59881 \times 10^{14} \text{ Hz} \end{aligned}$$

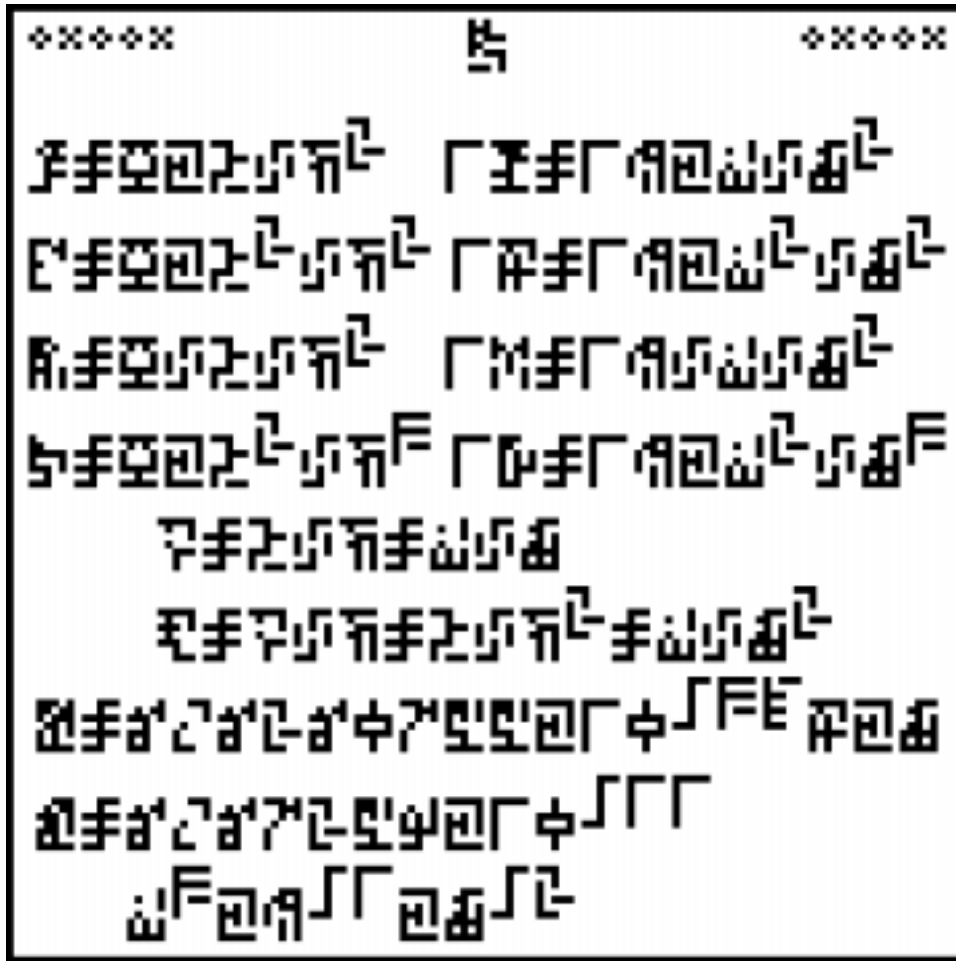
$$\begin{aligned} \lambda &= 6.56285 \times 10^{-7} \text{ m} \\ f &= 4.56802 \times 10^{14} \text{ Hz} \end{aligned}$$

$$\begin{aligned} \lambda &= 1.21567 \times 10^{-7} \text{ m} \\ f &= 2.46607 \times 10^{15} \text{ Hz} \end{aligned}$$

$$\text{second} = \text{Hz}^{-1} = 1/\text{Hz}$$

$$\text{speed}_{\text{photon}} = \text{frequency} * \text{wavelength} = 299792458 \text{ m/s}$$

9. Page on Units



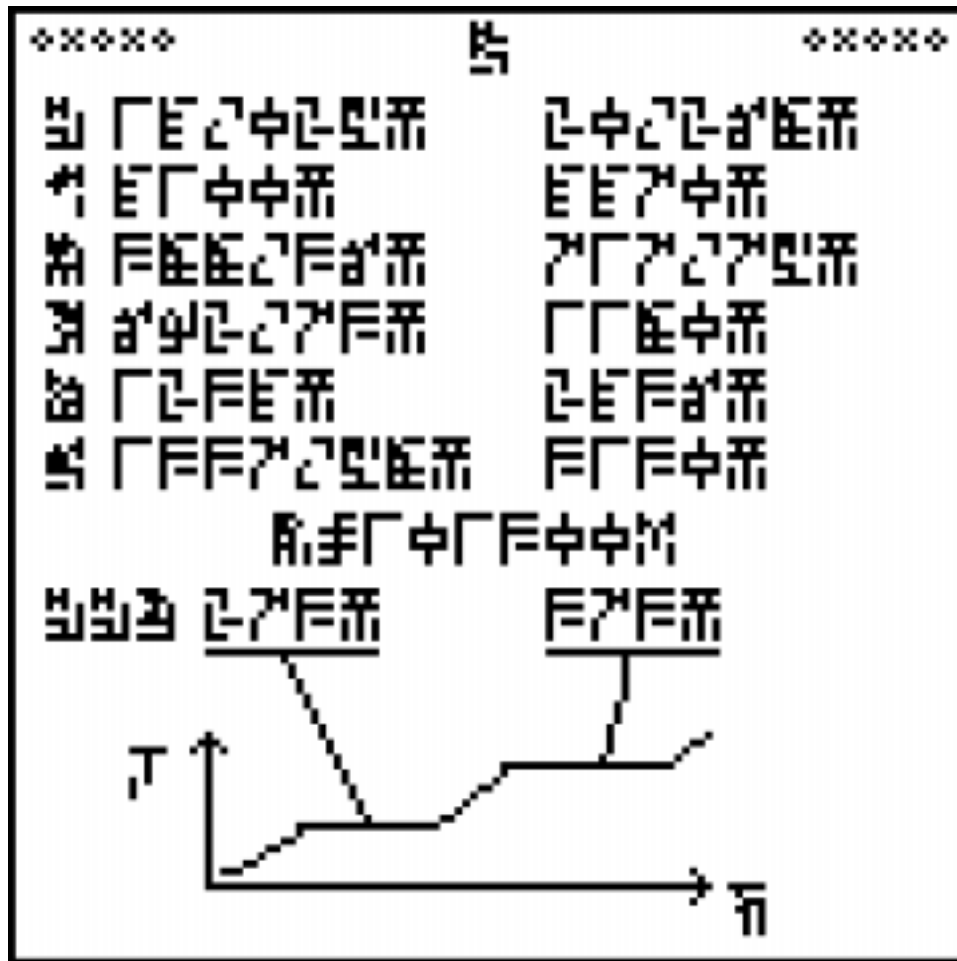
This page is concerned by the definition of measurement units. The last items on this page are the value of “h” and “G”.

Force = $M \times L \div T^2$	1 Newton = $1 \text{ kg} \times \text{m} \div \text{s}^2$
Energy = $M \times L^2 \div T^2$	1 Joule = $1 \text{ kg} \times \text{m}^2 \div \text{s}^2$
Pression = $M \div L \div T^2$	1 Pascal = $1 \text{ kg} \div \text{m} \div \text{s}^2$
Power = $M \times L^2 \div T^3$	1 Watt = $1 \text{ kg} \times \text{m}^2 \div \text{s}^3$
speed = $L \div T = \text{m} \div \text{s}$	
acceleration = speed $\div T = L \div T^2 = \text{m} \div \text{s}^2$	

$$h = 6.6260755 \times 10^{-34} \text{ J s}$$

$$G = 6.67259 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

10. Page on the Temperatures



We have to introduce also the temperature notion. We do that by using the boiling and melting temperature of some chemical elements from the periodic table.

At the bottom, there is a graphic of temperature vs. state, of the water. The temperature are given in kelvin. Therefore, for the water we will find the following values: 273 and 373.

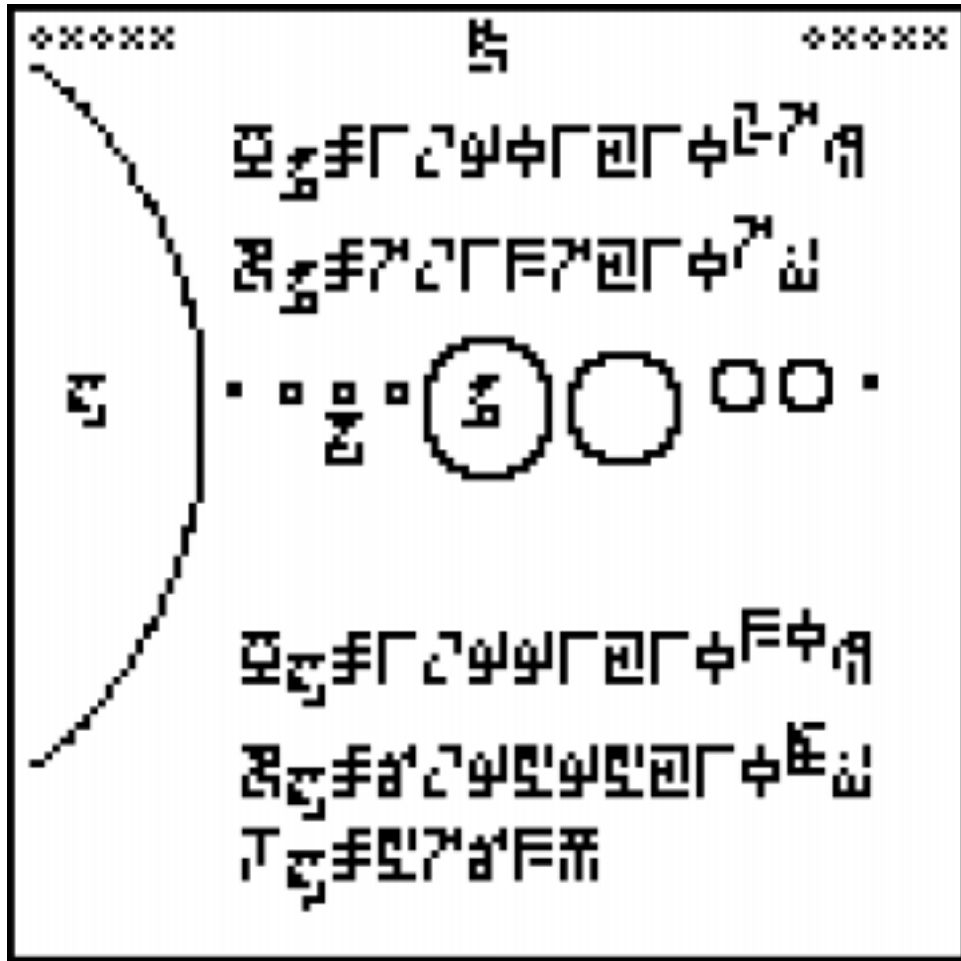
The line between the table and the graphic, simply explained that those temperature are for a pressure of 101.3 kPa.

H	14.025K	20.268K
C	4100K	4470K
S	388.36K	717.75K

Zn	692.73K	1180K
Ag	1234K	2436K
Au	1337.58K	3130K

Pression = 101300 pascal

11. Page on the Solar System



We will find here a representation of the solar system. Each planets are identified.

The values above and below, are the masses and radius of the Sun and the Jupiter. Since they are the objects mostly detailed from another star system. We are ourself starting to discover Jupiter-like planets around some stars.

This will help a further identification of the source of this message. The specs about the Sun (Size and Temperature) give the signature of our star. The data relative to Jupiter is very useful if they can detect large planets near stars.

$$\text{Mass}_{\text{Jupiter}} = 1.901 \times 10^{27} \text{ kg}$$

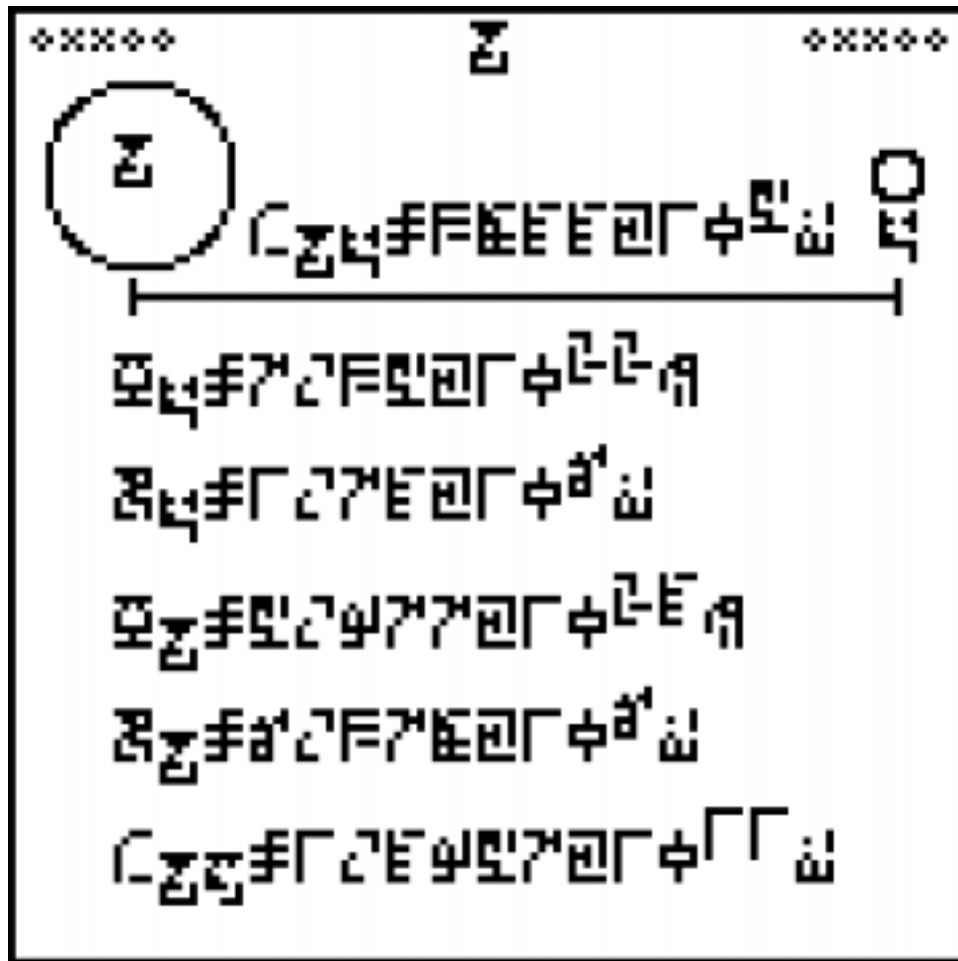
$$\text{Radius}_{\text{Jupiter}} = 7.137 \times 10^7 \text{ m}$$

$$\text{Mass}_{\text{Sun}} = 1.991 \times 10^{30} \text{ kg}$$

$$\text{Radius}_{\text{Sun}} = 6.9595 \times 10^8 \text{ m}$$

$$\text{Temperatur}_{\text{Sun}} = 5763 \text{ K}$$

12. Page on the Earth (part 1)



This page gives some informations about the Earth and the Moon.

It shows mass and radius of both, and distance between them.

The last line gives the distance between the Earth and the Sun.

$$\text{Distance}_{\text{Earth-Moon}} = 3844 \times 10^5 \text{ m}$$

$$\text{Mass}_{\text{Moon}} = 7.35 \times 10^{22} \text{ kg}$$

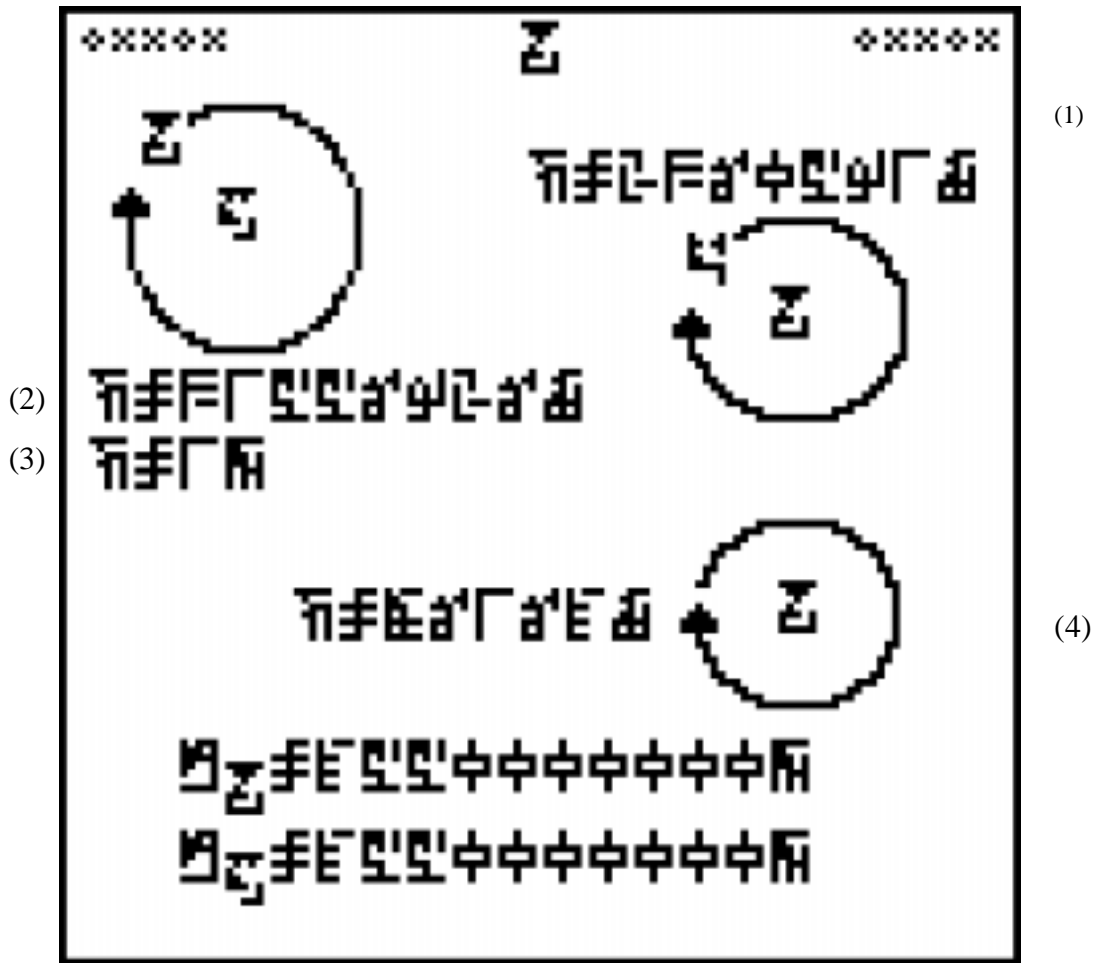
$$\text{Radius}_{\text{Moon}} = 1.74 \times 10^6 \text{ m}$$

$$\text{Mass}_{\text{Earth}} = 5.977 \times 10^{24} \text{ kg}$$

$$\text{Radius}_{\text{Earth}} = 6.378 \times 10^6 \text{ m}$$

$$\text{Distance}_{\text{Earth-Sun}} = 1.4957 \times 10^{11} \text{ m}$$

13. Page on the Earth (part 2)



This page gives further informations about the Earth.

We are talking about the length of the day and the year. We shows also how long it took for the Moon to do one orbit around the Earth.

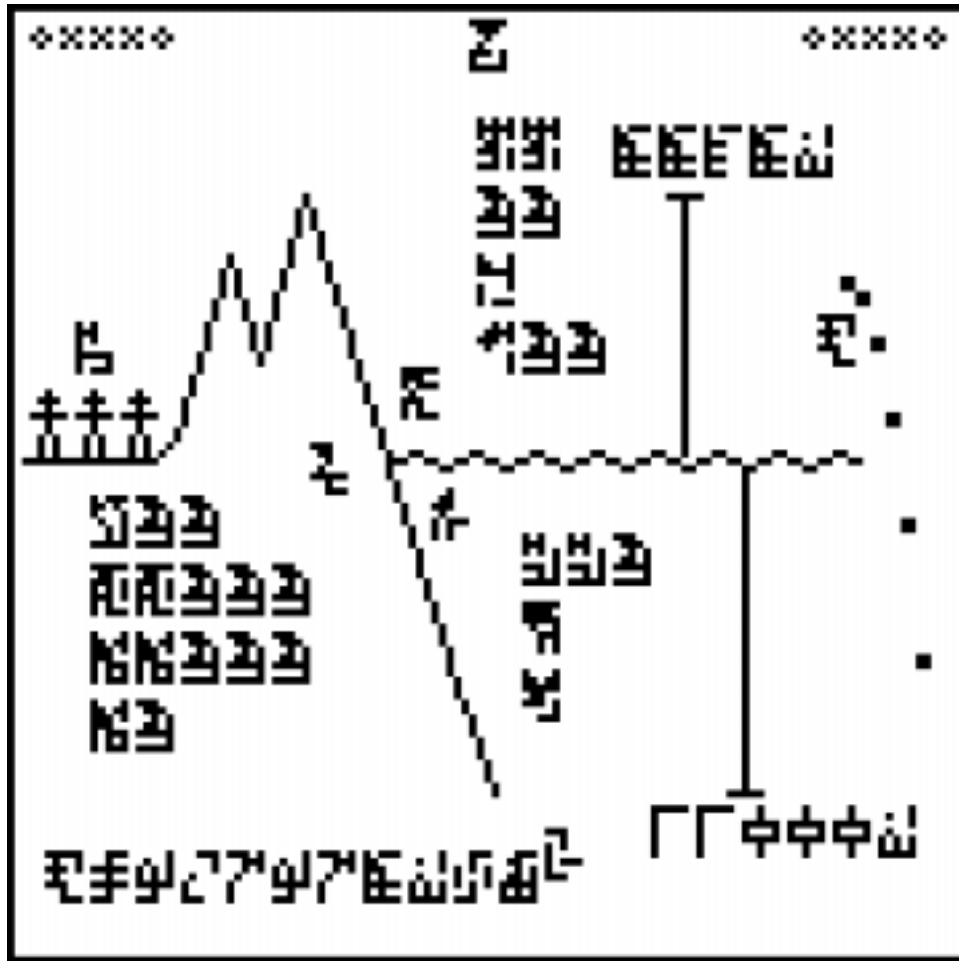
At the bottom, you will find informations on the age of the Earth, and the Sun.

This kind of information, couple with the masses, distance and radius increase the redundancy of the message. Everything is linked through equations very well know in physic.

- (1) time = 2360591 seconds
- (2) time = 31556926 seconds
- (3) time = 1 year
- (4) time = 86163 seconds

$\text{Age}_{\text{Earth}} = 4550000000 \text{ years}$
 $\text{Age}_{\text{Sun}} = 4550000000 \text{ years}$

14. Page on the Earth (part 3)



On this page, you will find some description of the Earth's biosphere: atmosphere, soil and water composition.

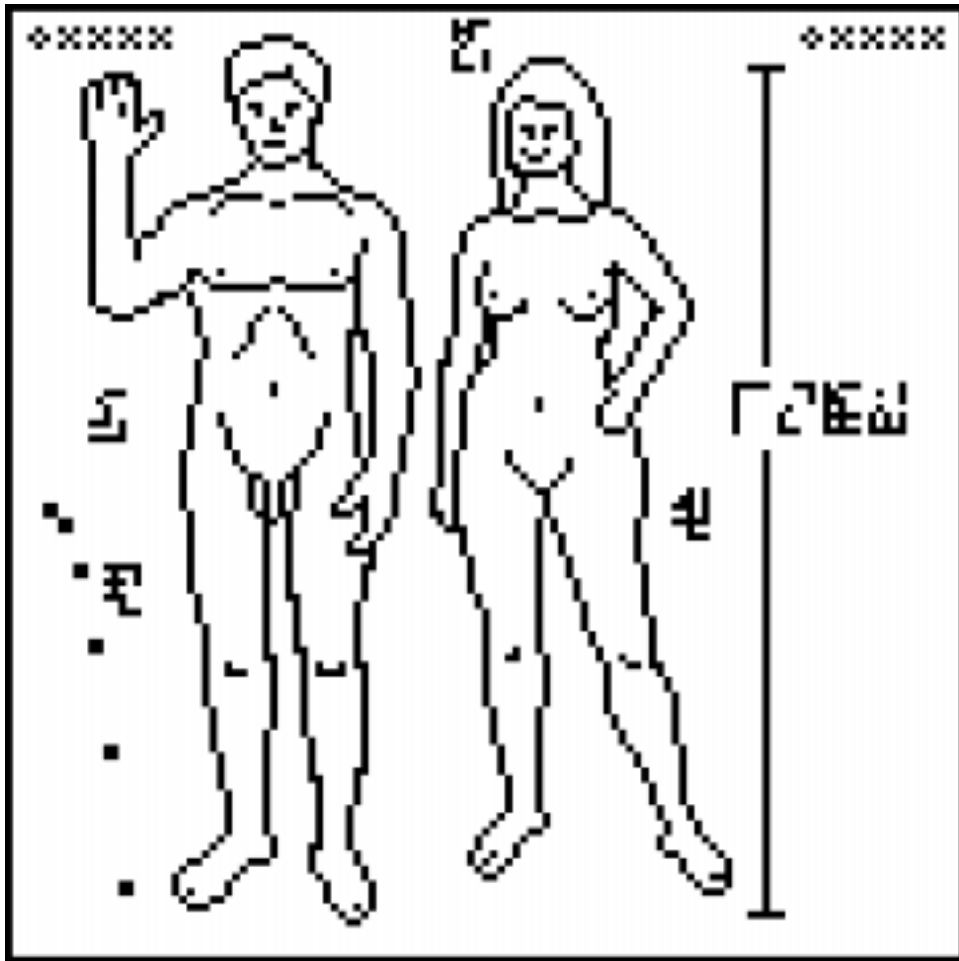
The last item indicate the value of the gravity at the surface.

Land	Sky	Ocean
SiOO	NN	HHO
AlAlOOO	OO	Na
FeFeOOO	Ar	Cl
FeO	COO	

Top of Land = 8848 m (Mt. Everest)
 Bottom of Ocean = 11000 m (Mariana's Trench)

$$\text{Acceleration} = 9.7978 \text{ m/s}^2$$

15. Page on Humans (part 1)



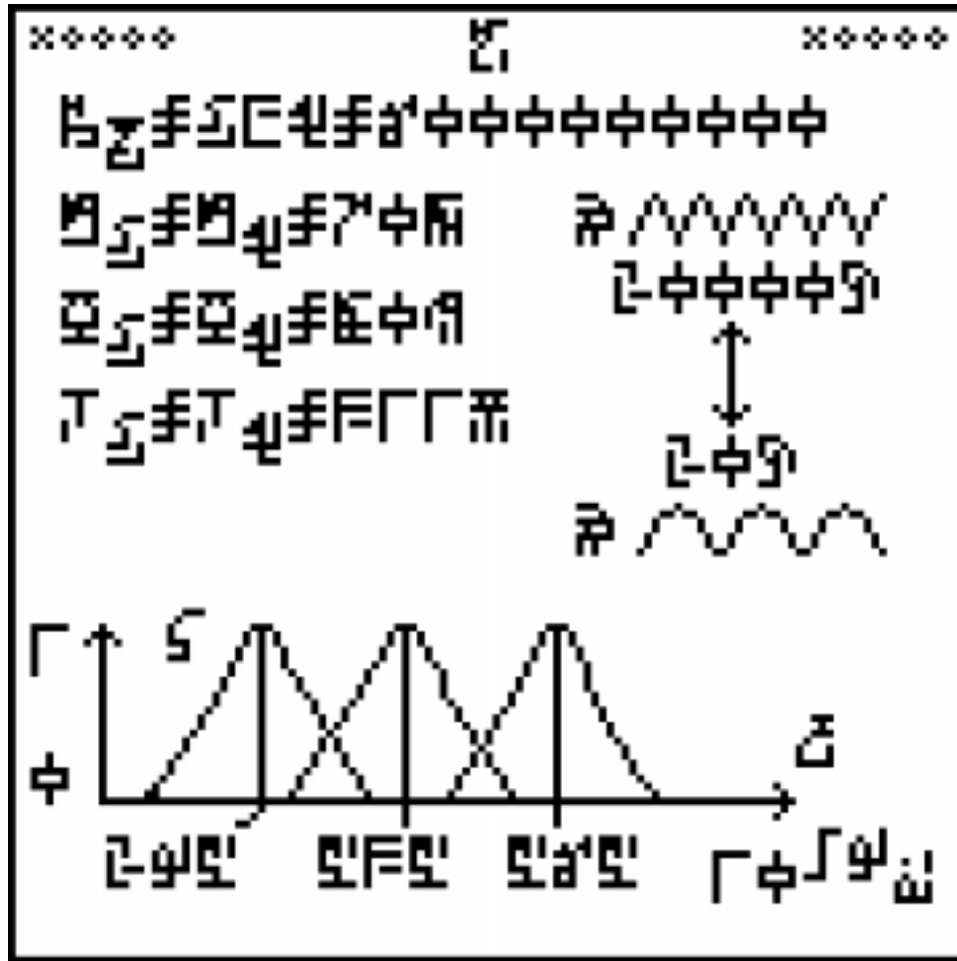
As we are going deeper and deeper in the message, you will find out that it close on the humans themselves, US.

Hence, this page display a schematic representation of a man and a woman. It gives a mean value of the height.

The dotted line at the left side, give a representation of Up and Down. It is ballistic trajectory, showing clearly where the gravity goes.

1.8 m of height

16. Page on Humans (part 2)



In the previous page, we have shown the exterior appearance of humans.

Now, we give some of their specification in relation to acoustic and visual sensors.

The group of symbols on the left, gives the age, mass and temperature of humans.

The group of symbol at the right, talk about acoustic in term of frequencies. It gives the range of our earring capabilities.

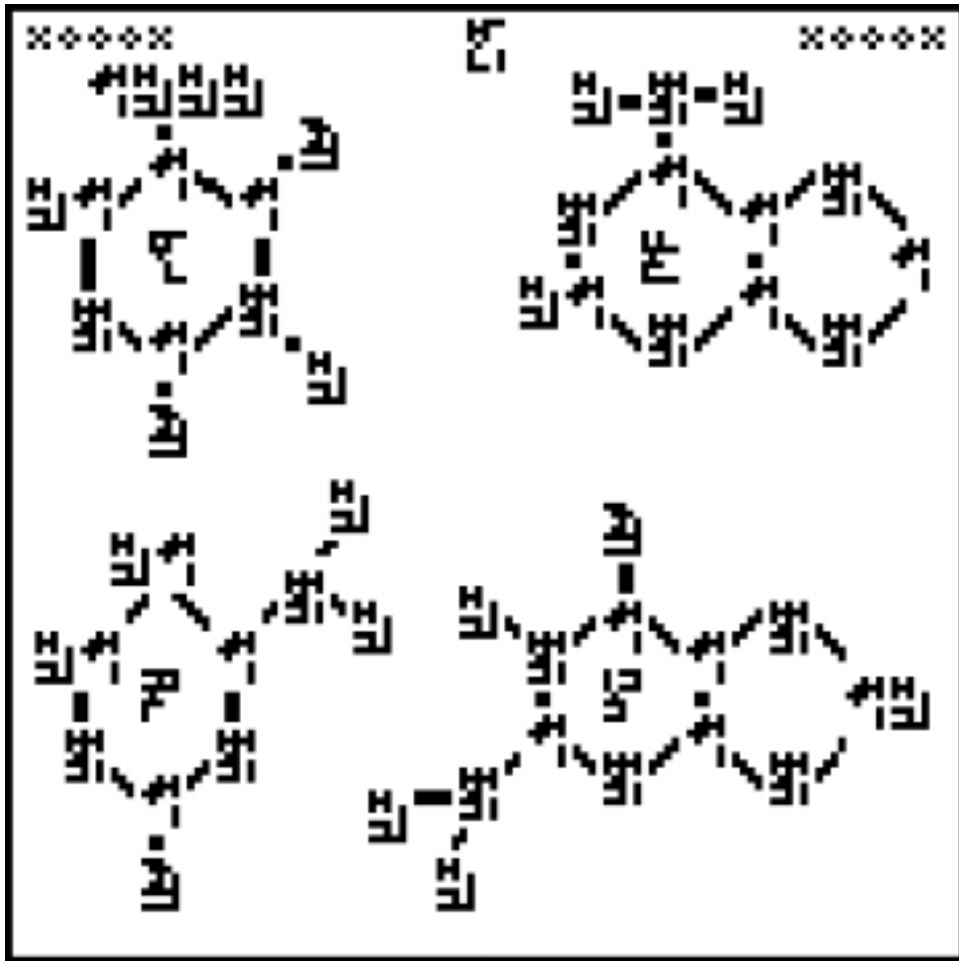
The graphic below shows our color range.

$$\begin{aligned}
 \text{People}_{\text{Earth}} &= \text{Male} \cup \text{Female} = 6,000,000,000 \\
 \text{Age}_{\text{Male}} &= \text{Age}_{\text{Female}} = 70 \text{ years} \\
 \text{Mass}_{\text{Male}} &= \text{Mass}_{\text{Female}} = 80 \text{ kg} \\
 \text{Temperature}_{\text{Male}} &= \text{Temperature}_{\text{Female}} = 311\text{K}
 \end{aligned}$$

audition: 20Hz to 20000Hz

Visual: 295, 535 and 565 x10⁻⁹ m

17. Page on the DNA (part 1)

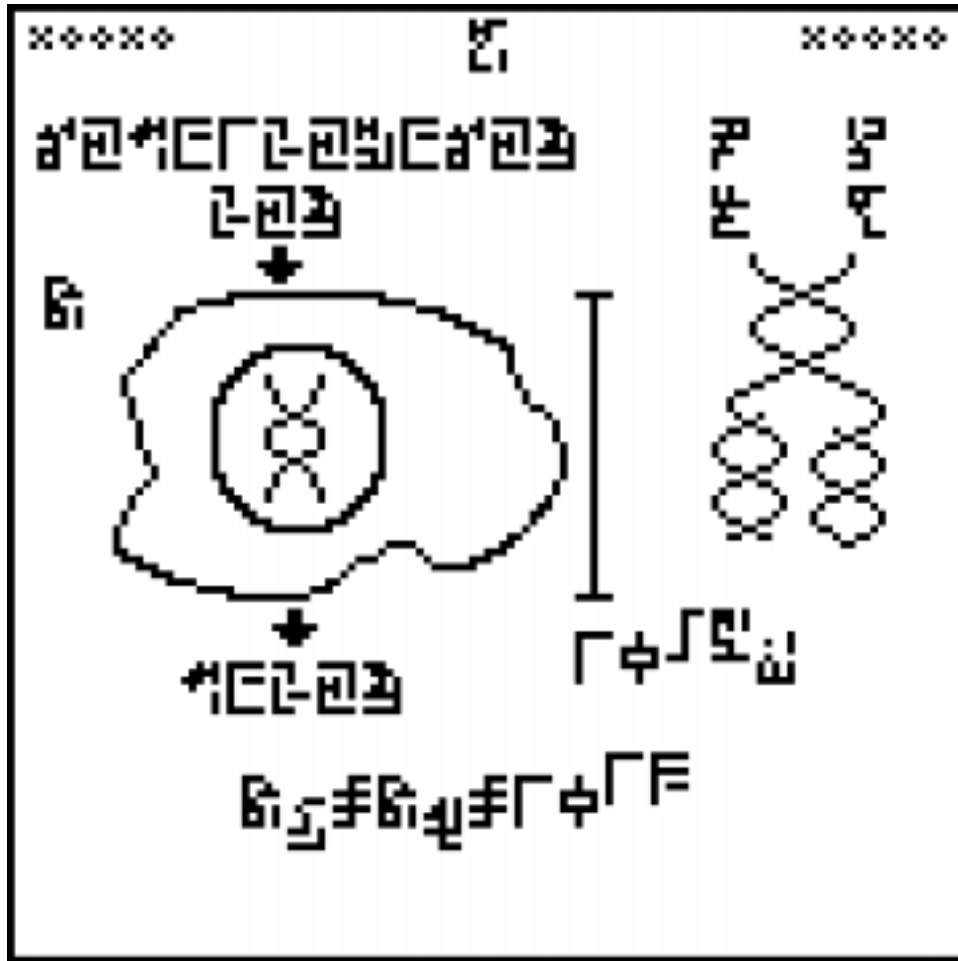


We have here the representation of the Nucleic Acids: This is the building blocks of human life on Earth. It constitutes the basic elements of DNA.

We show them using a standard chemical representation. It is not visualize on this picture, but the link between atoms can be a single line or a double one.

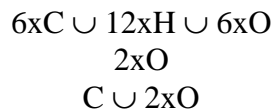
thymidine	adenosine
cytidine	guanosine

18. Page on the DNA (part 2)



This page shows a typical cell in our body. The nucleus encloses the DNA which is made of a combinations of amino acids.

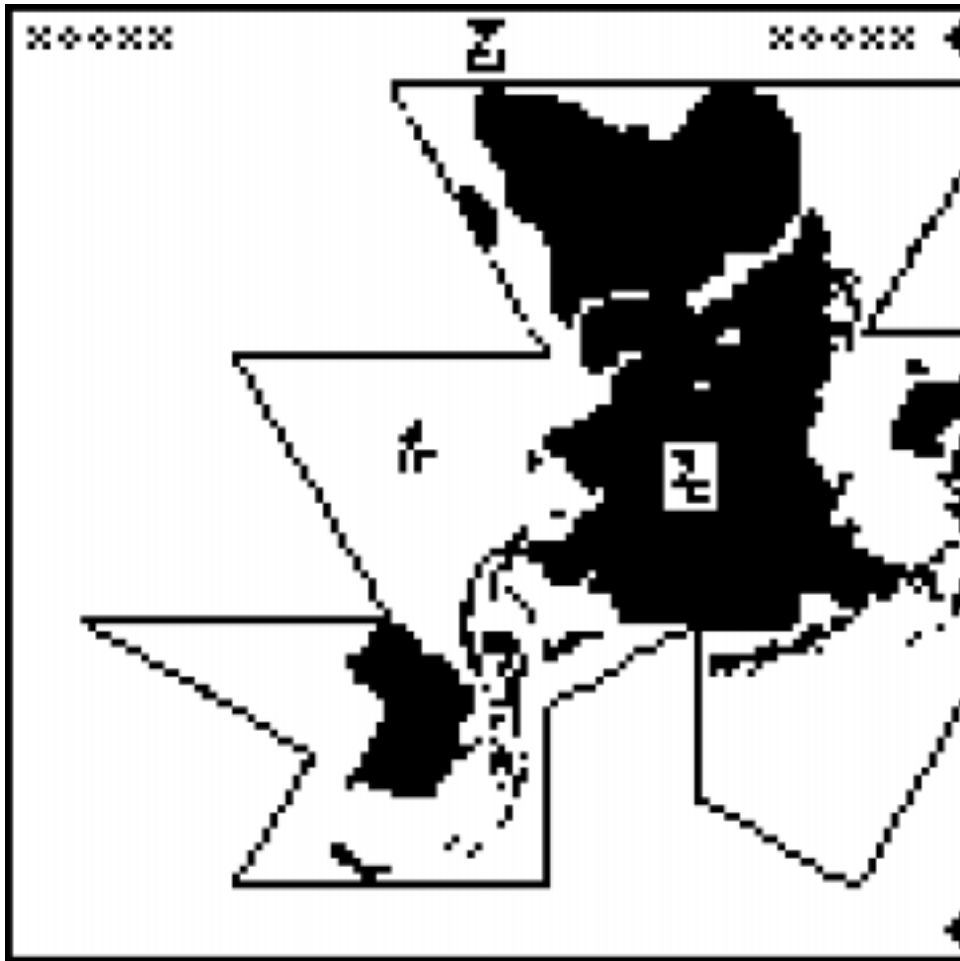
The characteristic drawing of the DNA is also displayed.



cell size = 10^{-5} m

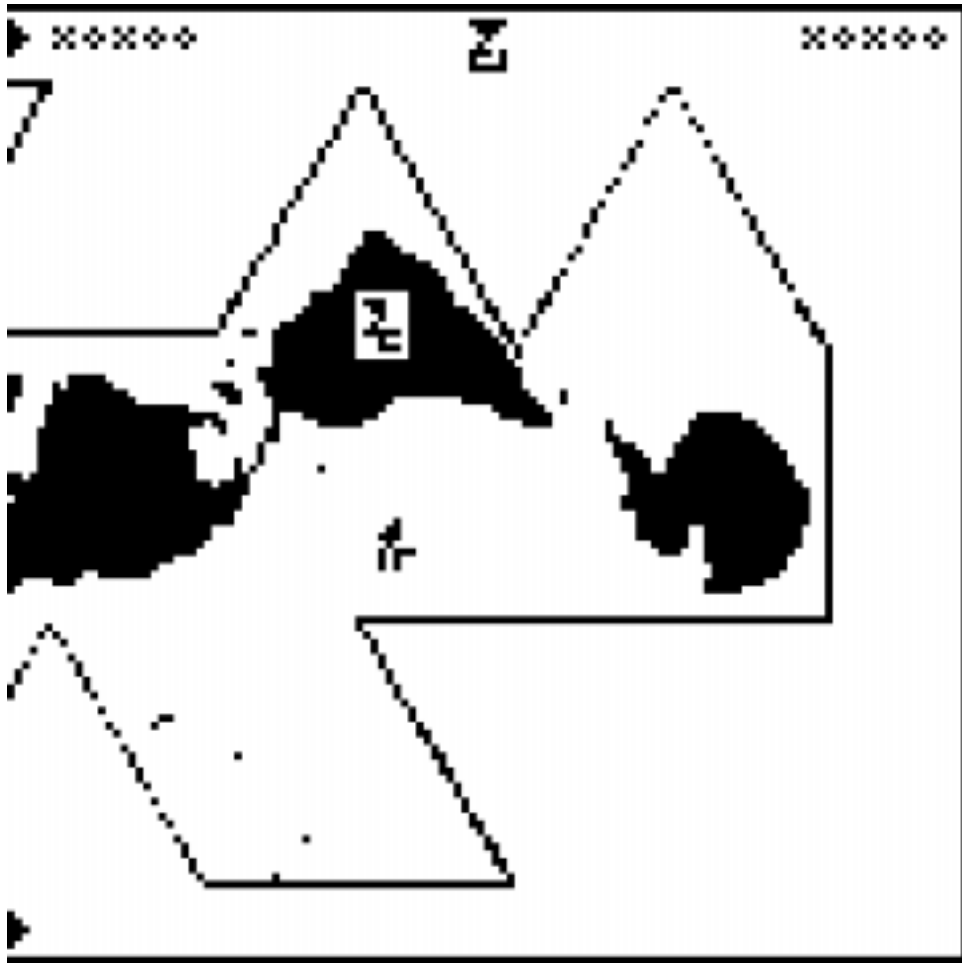
Cell_{Male} = Cell_{Female} = 10^{13} cells

19. Page on the Land (part 1)



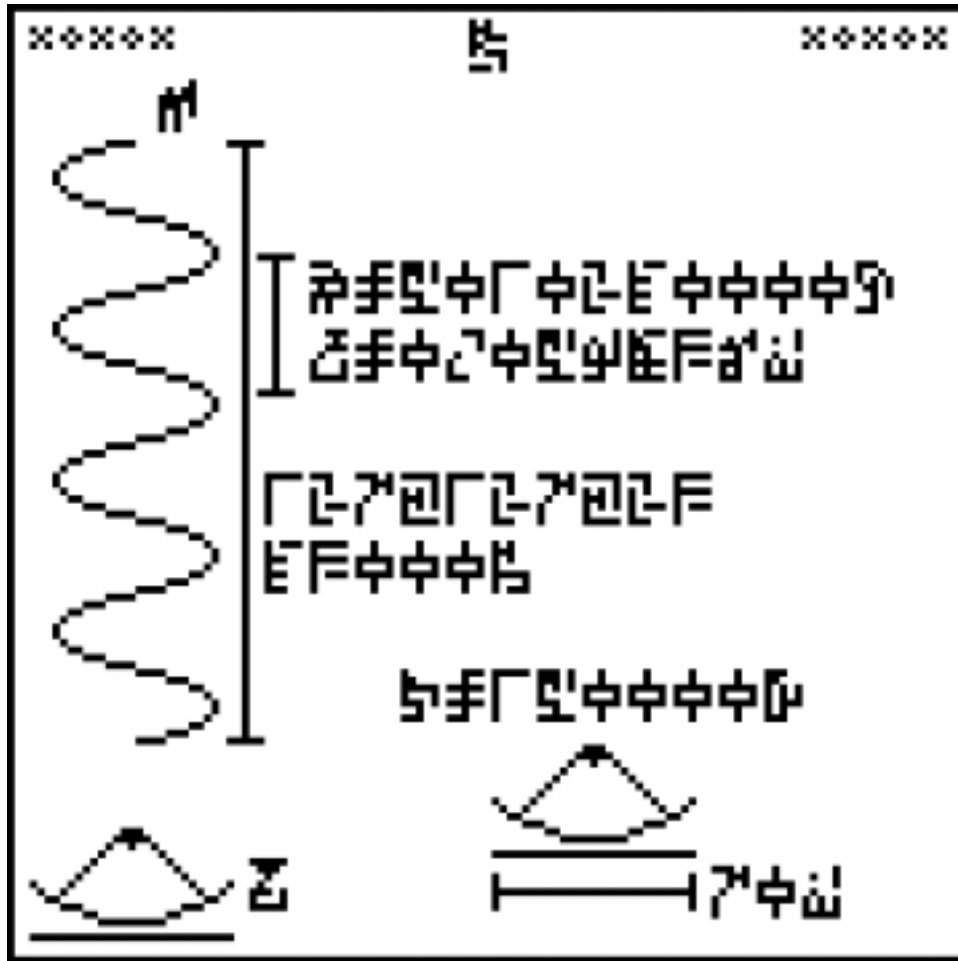
This page is the left part of a map representing the Earth oceans and continents.

20. Page on the Land (part 2)



This page is the right part of a map representing the Earth oceans and continents.

21. Page on the Radiotelescope



We are completing the message with information about the transmitter.

Frequency = 5,010,240,000 Hz

Wavelength = 0.059836 m

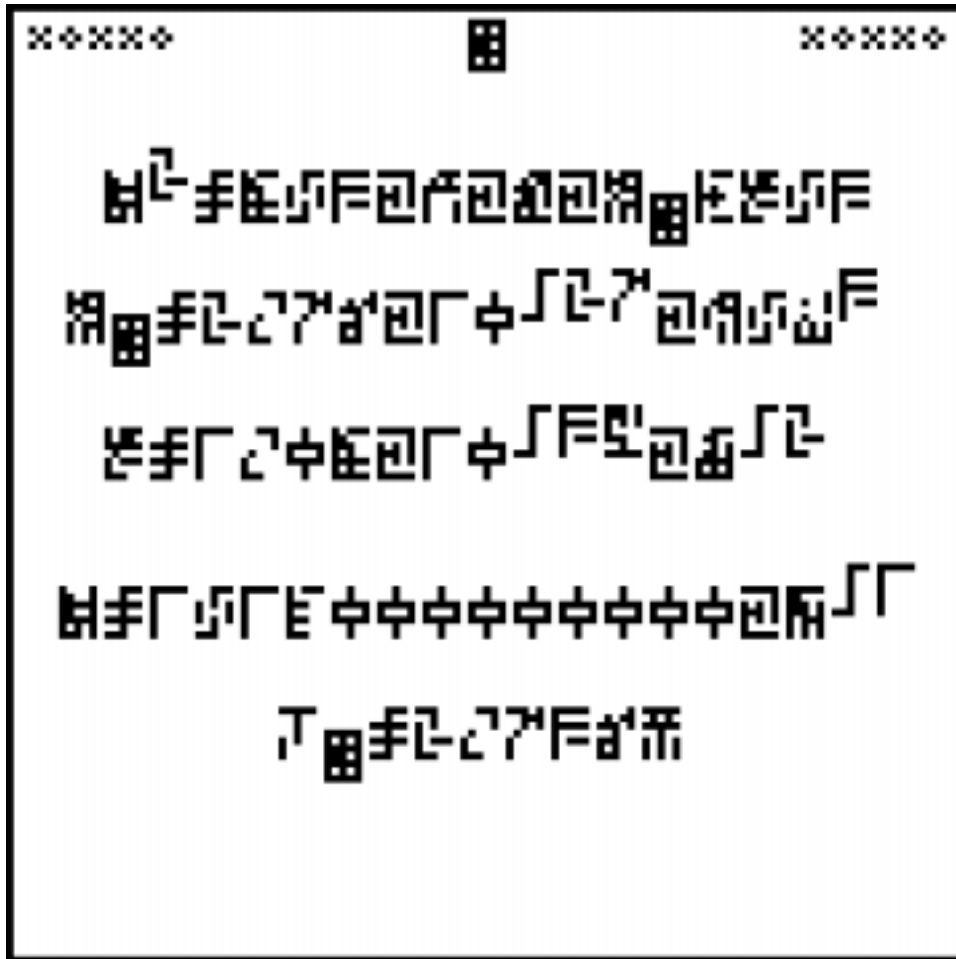
127x127x23

43,000 peoples

Power = 150,000 Watts

70 meters

22. Page on Cosmology



This page give some element of cosmology. This is a very elaborated subject. But we wanted to show our current status in that field of knowledge.

The first lines decribed General Relativity concepts.

The two lines at the bottom show our idea of the Univers's Age and it temperature. We estimate it to be around 14 billions years and its temperature to be around $T=2.736$ kelvins.

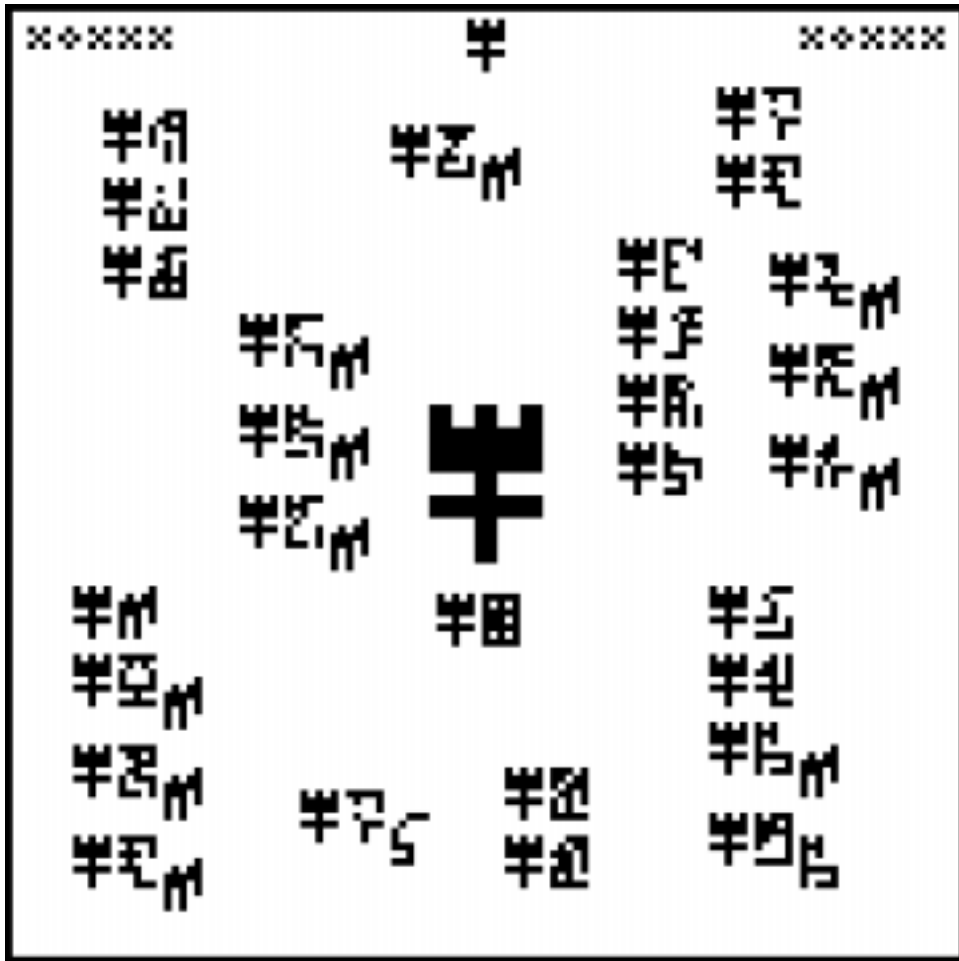
Again, this is very specialised stuff. We know not everybody will be able to decipher it, less understand it. Nervertheless, for those who can, it will reveiled a lot on us.

$$H^2 = \frac{8}{3}\pi G\rho + \frac{\Lambda}{3}$$

$$\rho = 2.76 \times 10^{-27} [kg \cdot m^{-3}]$$

$$\Lambda = 1.08 \times 10^{-35} [s^{-2}]$$

23. Page on Questions



The last page of the whole message.

During 22 pages, we taught how to read our message, we have given informations about our planet, about us.

Now we simply ask the receiver to answer back some questions. Basically, it is the same notions we have introduced in the message.

We ask them about their understanding of their world and about themselves.

The huge symbol at the center is the same used to introduce variables. It is the equivalent of the question mark.

? Mass

? Length

? Time

? Earth_{target} (Home_{target})

? Math_{target}

? Physic_{target}

? Biology_{target}

? Target

? Mass_{target}

? Radius_{target}

? Acceleration_{target}

? Speed

? Acceleration

? Energy

? Force

? Pression

? Power

? Land_{target}

? Sky_{target}

? Ocean_{target}

? Male

? Female

? People_{target}

? Age_{people}

? Univers

? Speed_{photon}

? h

? G