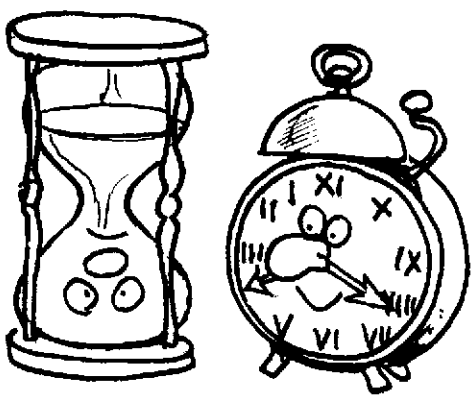
**Association Savoir sans Frontières**

# The Chronologicon

**Jean-Pierre Petit**

**Translated by John Murphy**



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**Jean-Pierre Petit** **Gilles d'Agostini**

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Jean-Pierre Petit intends to create numerous other works which will be accessible to a larger audience. Even illiterate people will be able to read them because the written parts will “speak” when the readers click on them. Thus it will be possible to use these works to support literacy schemes. Other albums will be "bilingual" in so far as it will be possible to switch from one language to another selected language with a mere click. Hence another tool made available to develop language skills.

Jean-Pierre Petit was born in 1937. He made his career in French research. He worked as a plasma physicist, he directed a computer science centre, he has created softwares, he has published hundreds of articles in scientific magazines, dealing with subjects ranging from fluid mechanics to theoretical cosmology. He has published about thirty books which have been translated in numerous languages.

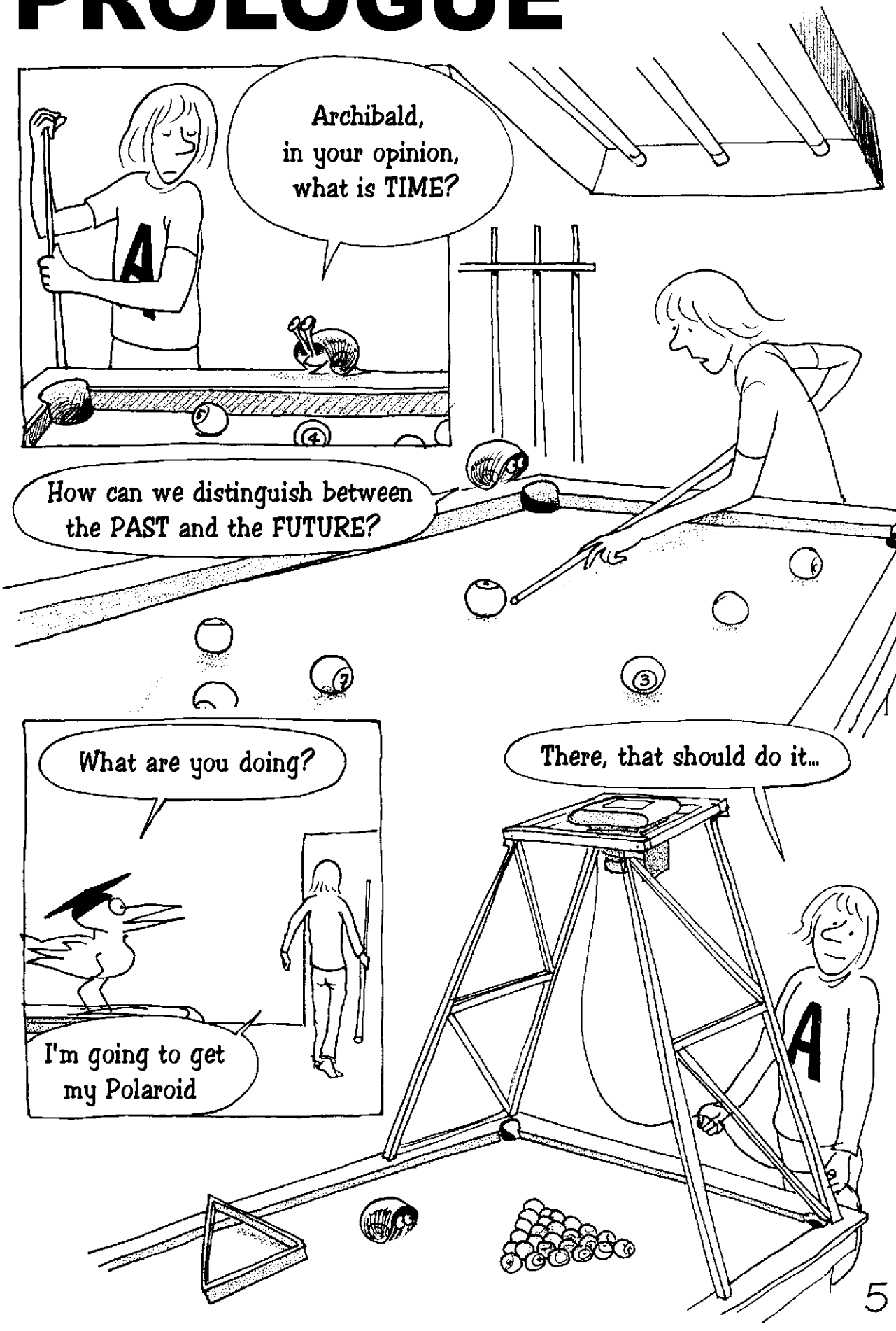
The association can be contacted on the following internet site:

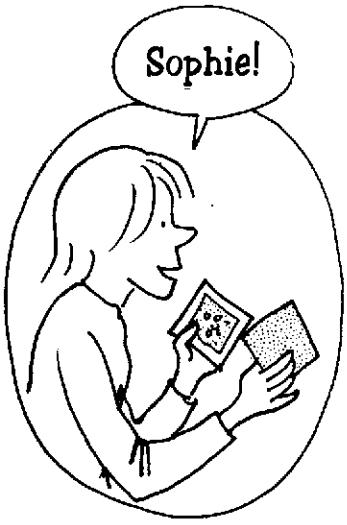
**http://savoir-sans-frontieres.com**

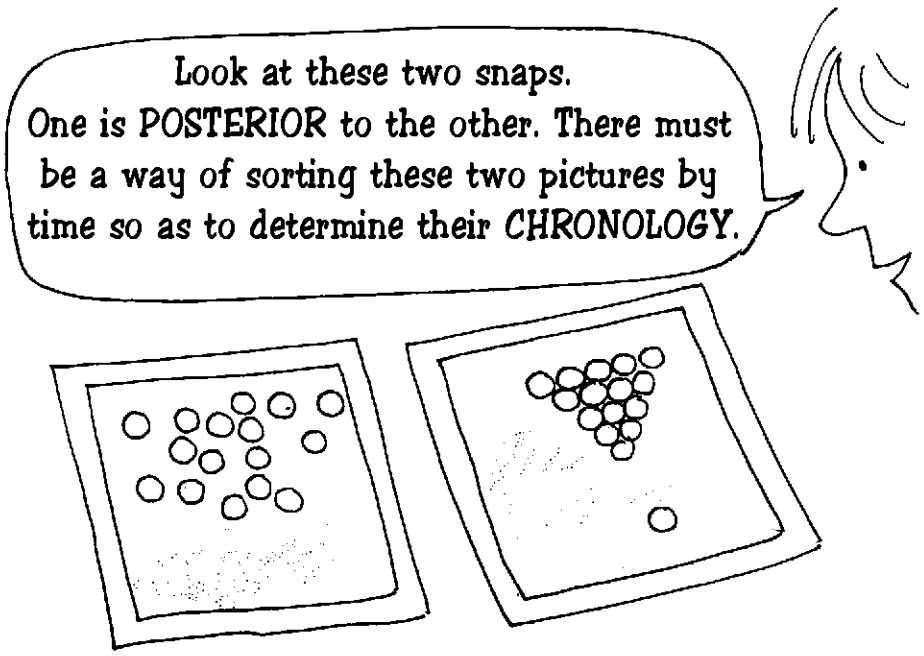
Lanturlu rime avec hurluberlu... Sûr ! Mais Kepler, Newton, Darwin, et même Einstein n'étaient-ils pas, eux aussi, un peu, des hurluberlus ? Si la science n'avançait que sur les sentiers battus, elle n'avancerait guère !

Jean-Claude Pecker

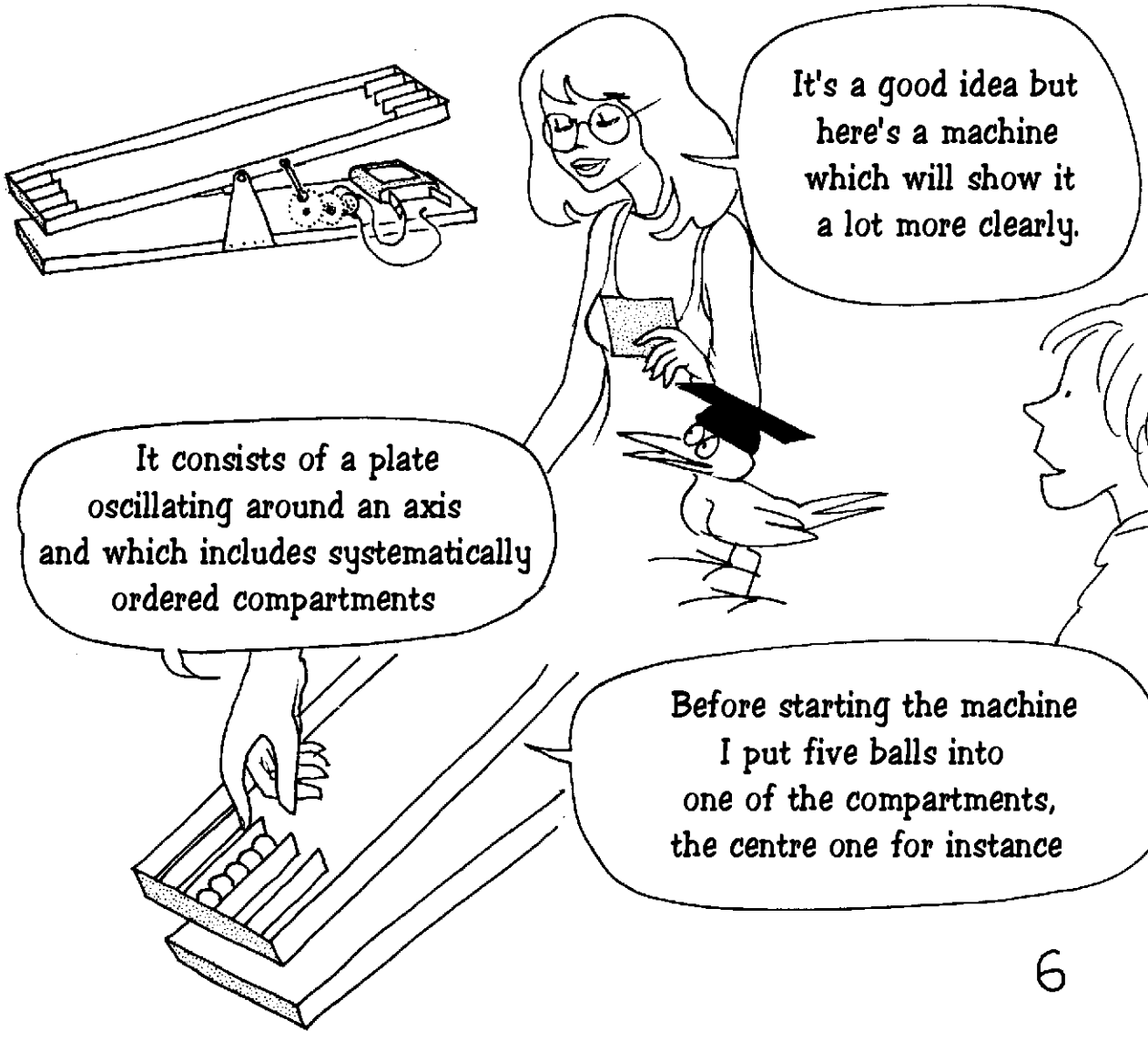
# PROLOGUE


Archibald, in your opinion, what is TIME?
How can we distinguish between the PAST and the FUTURE?
What are you doing?
I'm going to get my Polaroid
There, that should do it...



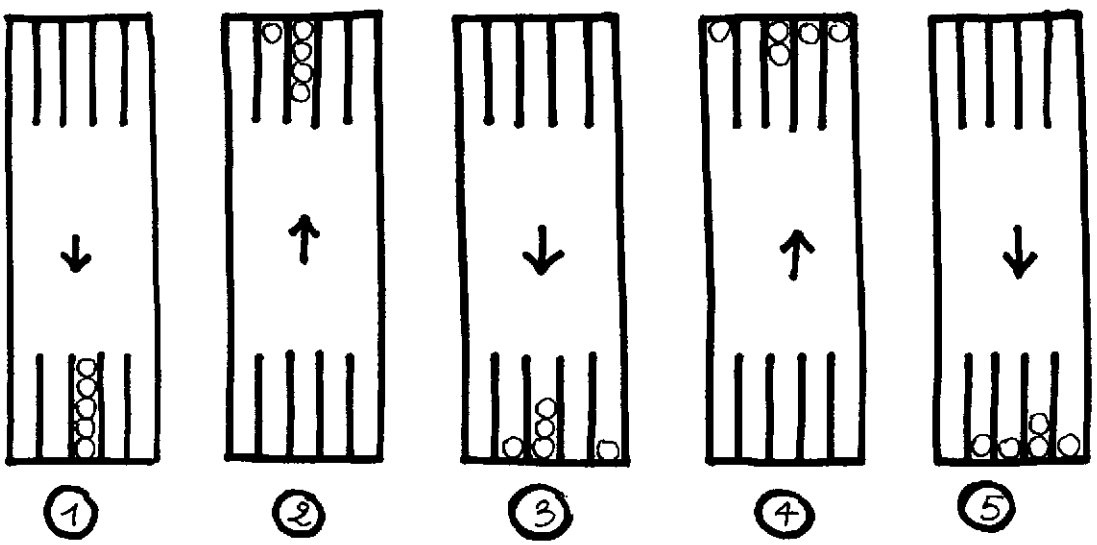

# PROBABILITY



Right, it's working. The plate, whose axis is perfectly horizontal, oscillates gently which makes the balls move from one edge to the other.

CLONK !

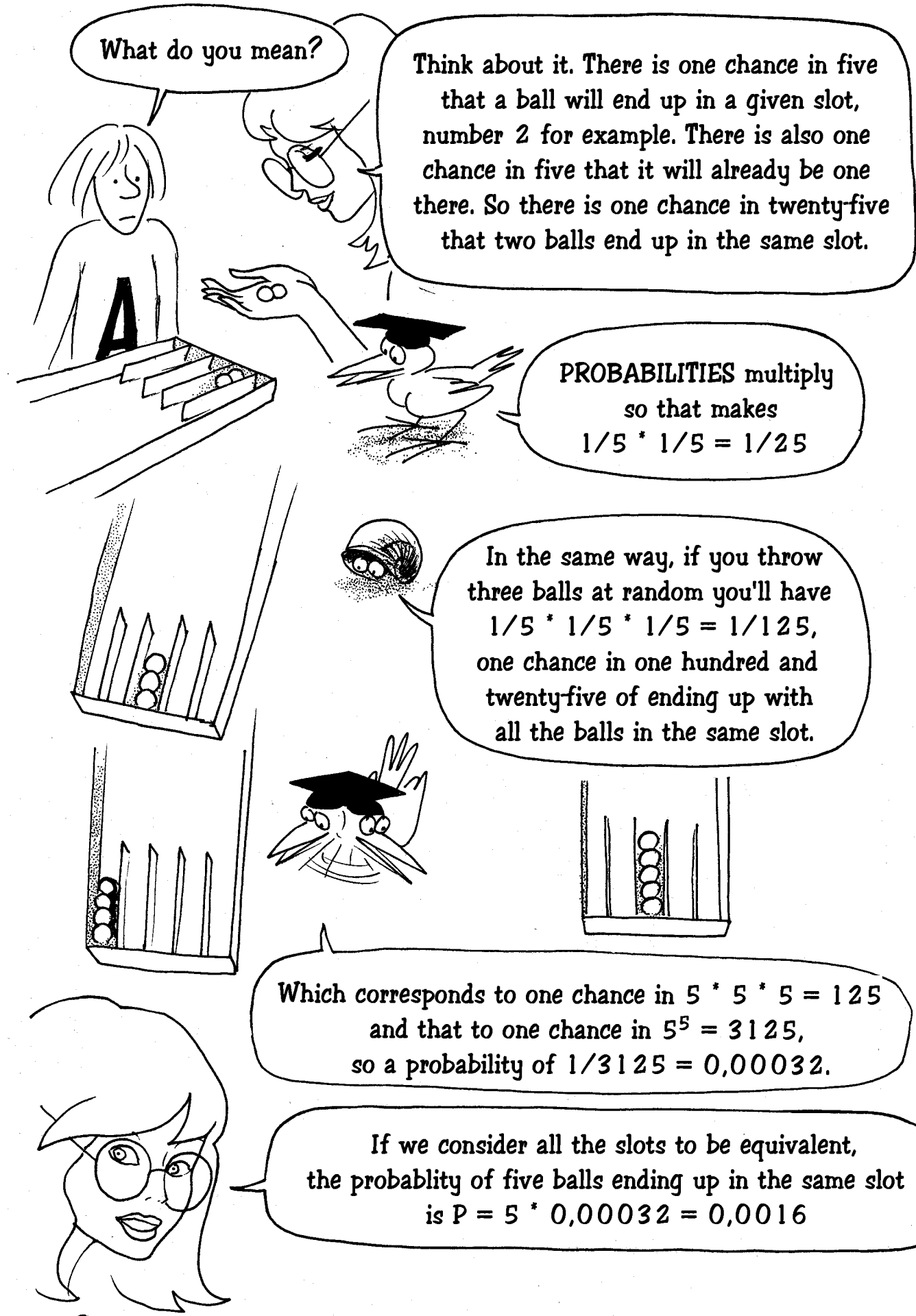
Look, the tiny irregularities in the machine and air turbulence makes it that the balls don't remain in the original compartment but have a tendancy to migrate towards the adjacent compartments



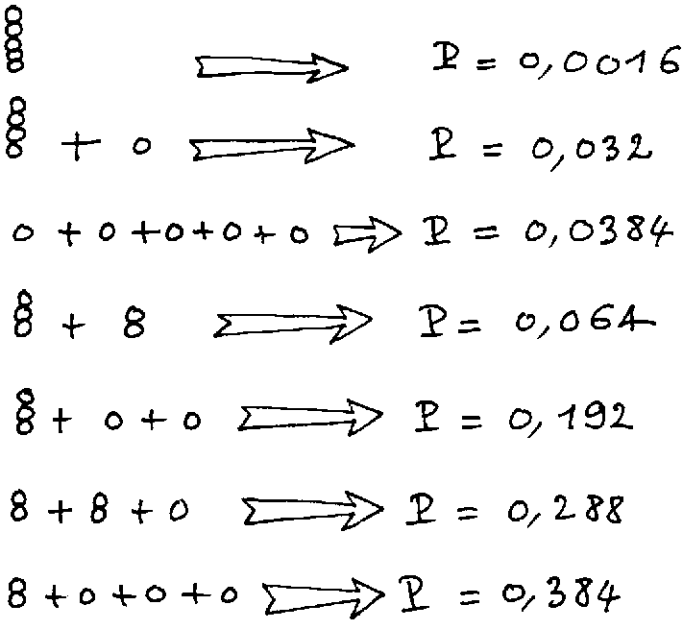

The balls go backwards and forwards but don't seem to want to end up in the same slot.

Because such a situation is too IMPROBABLE.

A


What do you mean?
Think about it. There is one chance in five that a ball will end up in a given slot, number 2 for example. There is also one chance in five that it will already be one there. So there is one chance in twenty-five that two balls end up in the same slot.
PROBABILITIES multiply so that makes 1/5 * 1/5 = 1/25
In the same way, if you throw three balls at random you'll have 1/5 * 1/5 * 1/5 = 1/125, one chance in one hundred and twenty-five of ending up with all the balls in the same slot.
Which corresponds to one chance in 5 * 5 * 5 = 125 and that to one chance in $5^5$ = 3125, so a probability of 1/3125 = 0,00032.
If we consider all the slots to be equivalent, the probablity of five balls ending up in the same slot is P = 5 * 0,00032 = 0,0016

If all the slots are considered to be the same then these are the probabilities attached to each configuration.

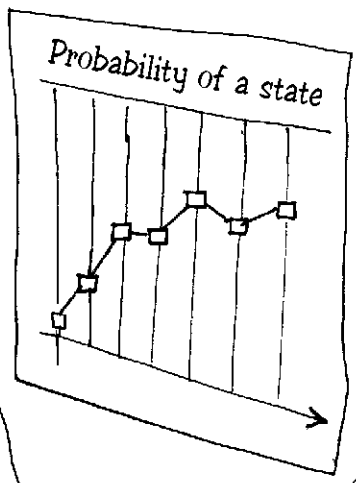



Odd: one ball in each slot is not the most probable?

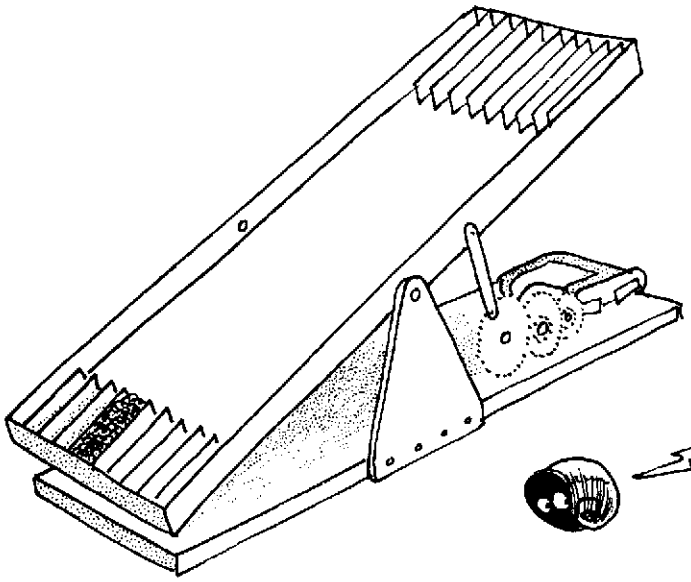
# SECOND PRINCIPLE

Let us note the probabilities of successive configurations according to our experience.

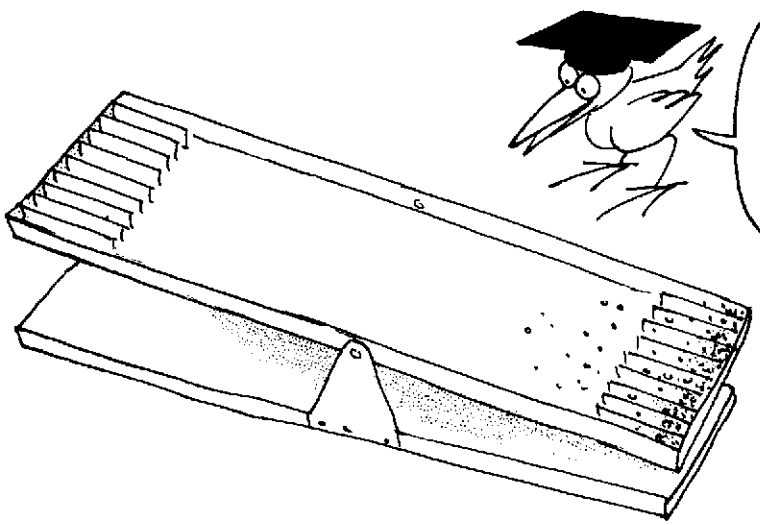
It's quite clear Sophie. The probability of a state increases rapidly followed by states with the highest probabilities.



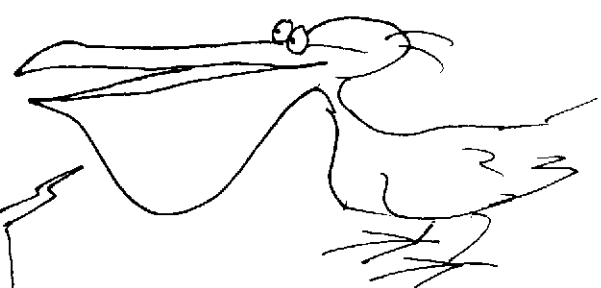

Try with 10 slots and 1000 balls



Archibald used gunshot.
The probability of finding the 1000 balls in the same slot is $(1/10)^{1000} * 10$, that is
P = 0,0000... ...0001
(998 zeros!).
Extremely low therefore.

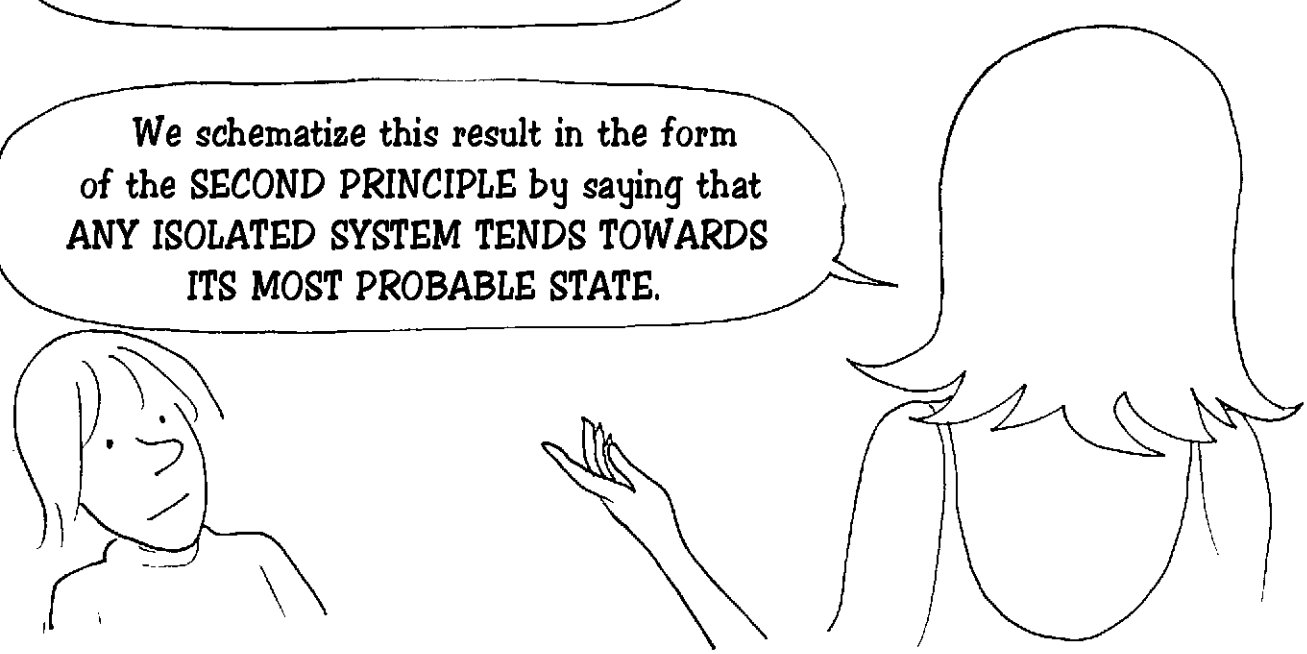


When the machine is started, the balls tend to be distributed practically equally in the different slots



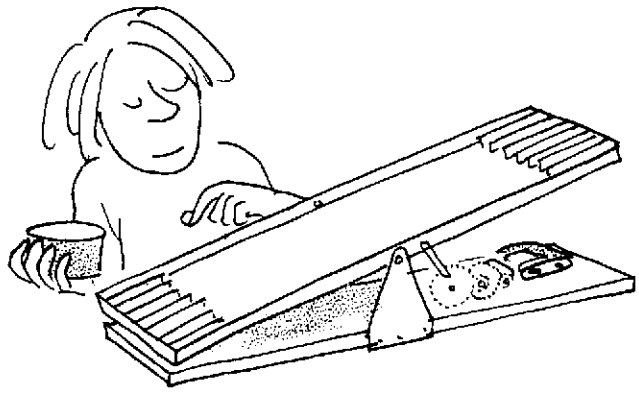
All observed states are therefore very close to an average state where all the slots will contain the same number of balls (*).

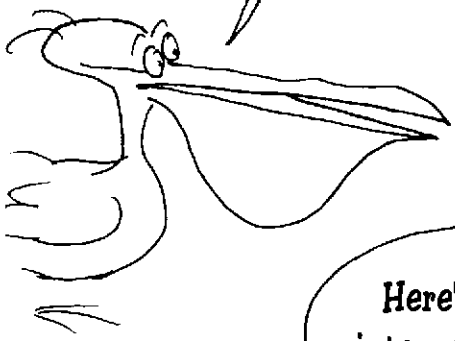
We schematize this result in the form of the SECOND PRINCIPLE by saying that ANY ISOLATED SYSTEM TENDS TOWARDS ITS MOST PROBABLE STATE.



(*) A system having this sort of statistical stability is called ERGODIC.

What is a non-isolated system?



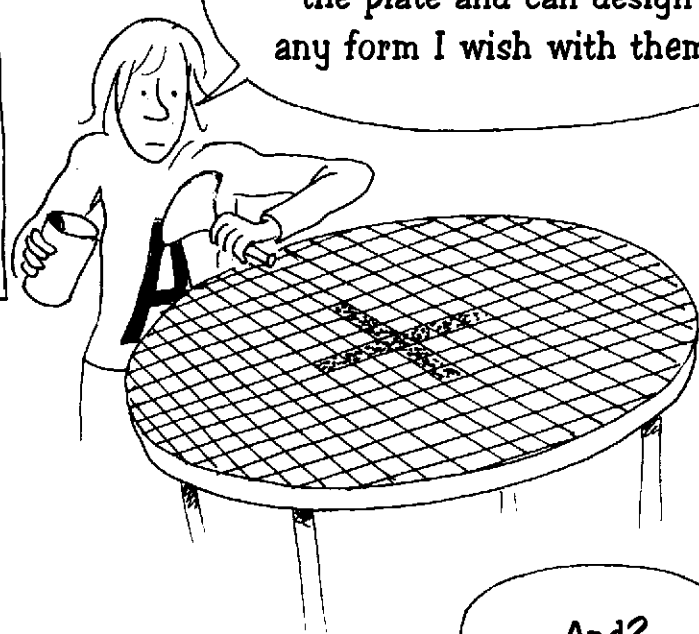


Here's one: when Archibald intervenes to arrange the balls.

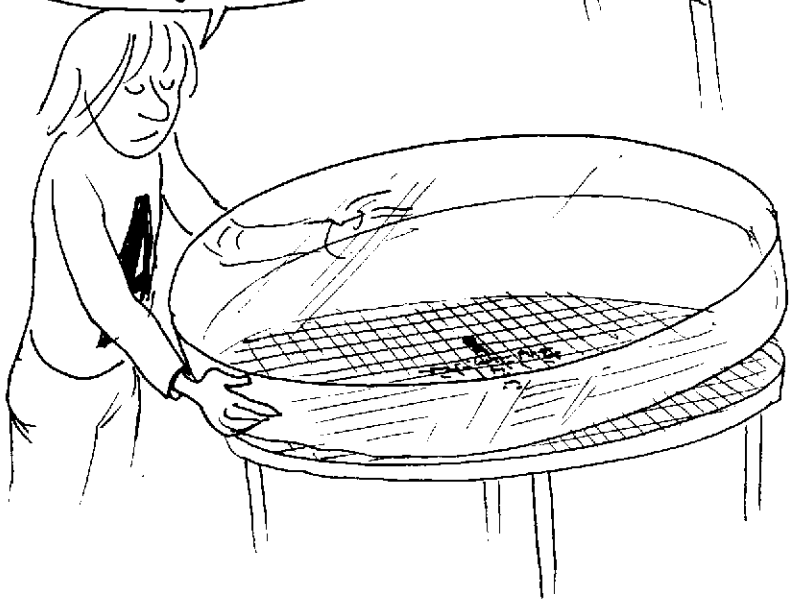
Unless he's a vegetarian that is.

Isolated system ready to converge towards a state of maximum stability.

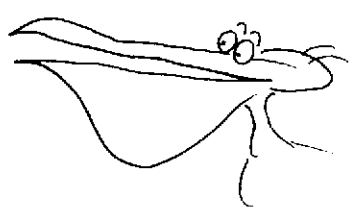
Look Sophie, I've improved the system. I've arranged the slots and the shot on the plate and can design any form I wish with them.

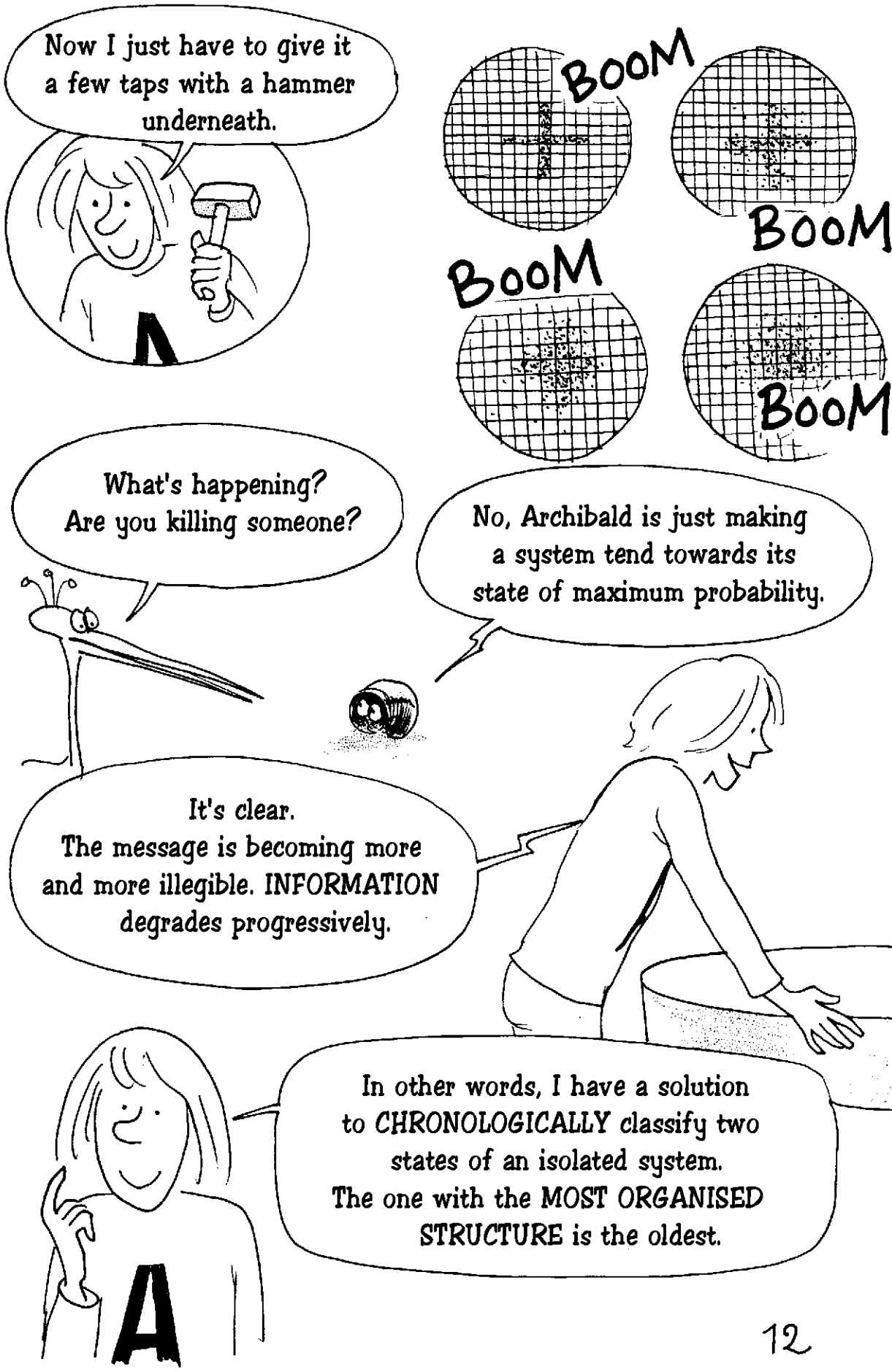


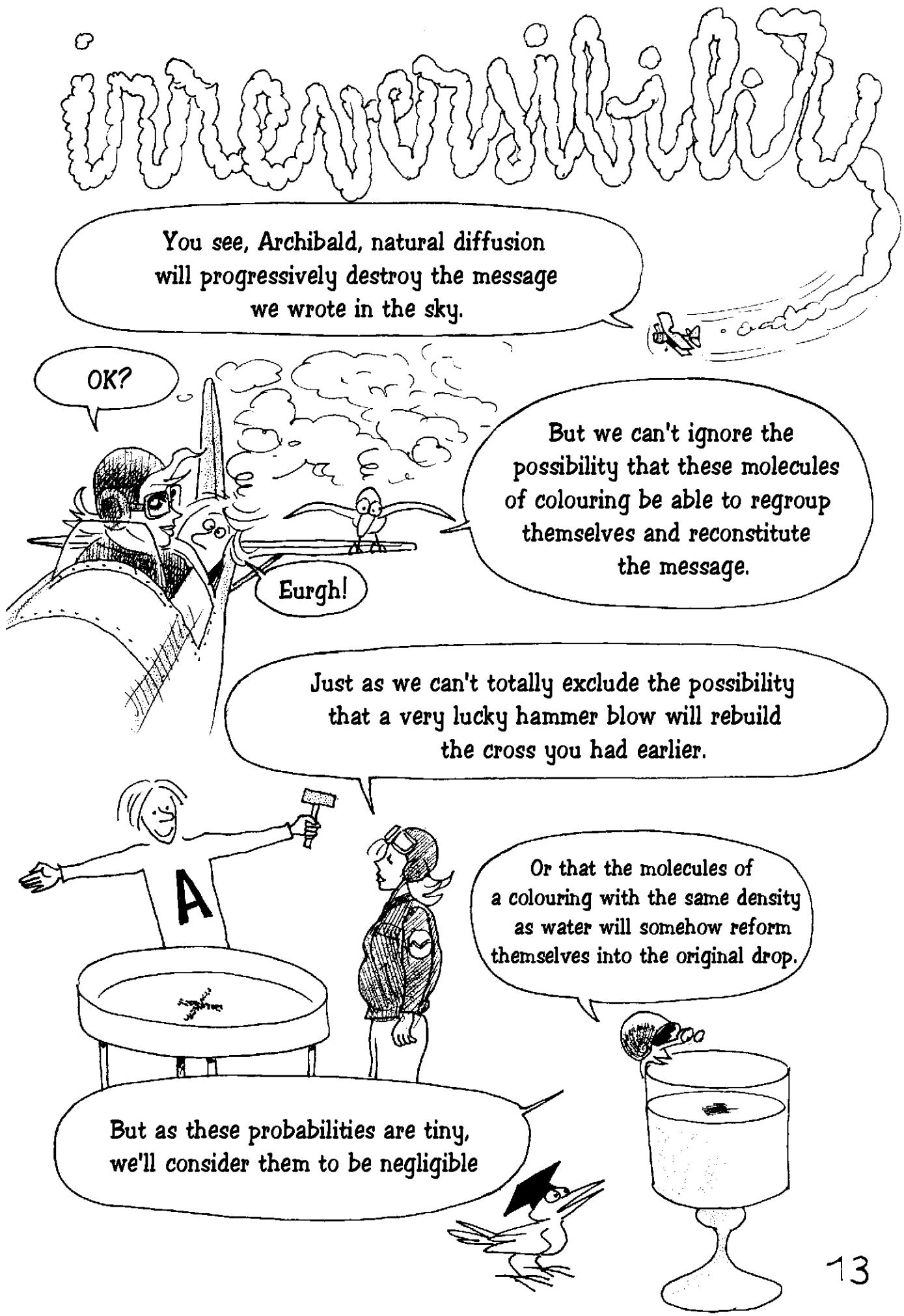
We cover everything with a transparent bell jar



And?

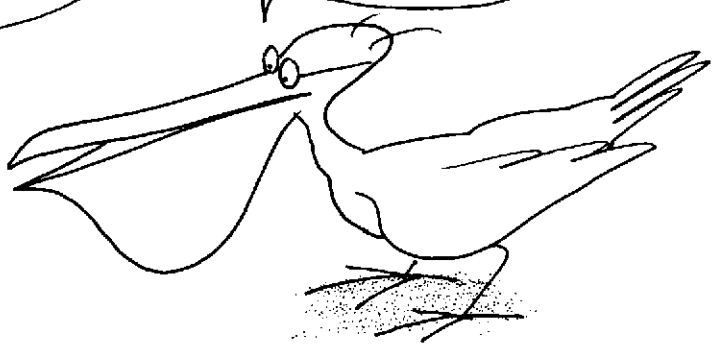



Now I just have to give it a few taps with a hammer underneath.
BOOM
BOOM
BOOM
BOOM
What's happening? Are you killing someone?
No, Archibald is just making a system tend towards its state of maximum probability.
It's clear. The message is becoming more and more illegible. INFORMATION degrades progressively.
In other words, I have a solution to CHRONOLOGICALLY classify two states of an isolated system. The one with the MOST ORGANISED STRUCTURE is the oldest.

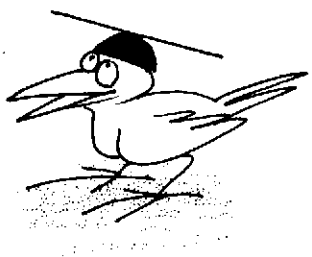

You see, Archibald, natural diffusion will progressively destroy the message we wrote in the sky.
OK?
Eurgh!
But we can't ignore the possibility that these molecules of colouring be able to regroup themselves and reconstitute the message.
Just as we can't totally exclude the possibility that a very lucky hammer blow will rebuild the cross you had earlier.
A
Or that the molecules of a colouring with the same density as water will somehow reform themselves into the original drop.
But as these probabilities are tiny, we'll consider them to be negligible

So the Universe is irremediably moving towards CHAOS. Vanilla ice-creams melt, mountains crumble.

In short IT'S ALL GOING WRONG.

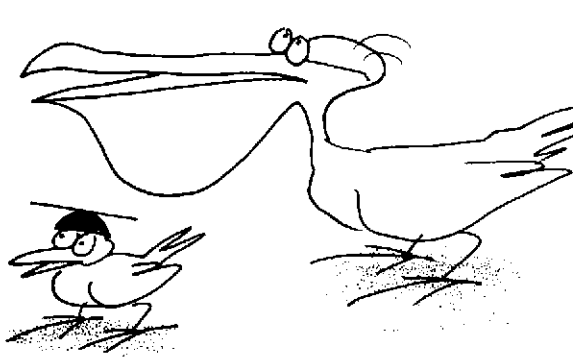


We generally associate this phenomenon with the irremediable growth of a quantity called ENTROPY (*).



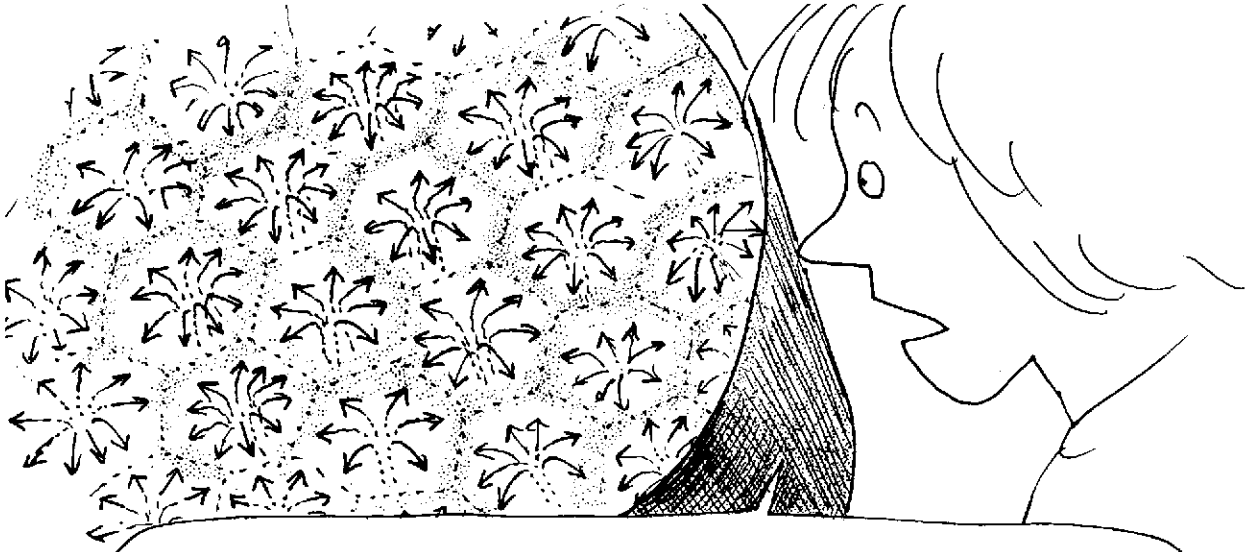
Well that's very upsetting. I think I'll make a cup of tea.


But it seems to give the answer. As ENTROPY can be MEASURED, we can classify a system's states CHRONOLOGICALLY.

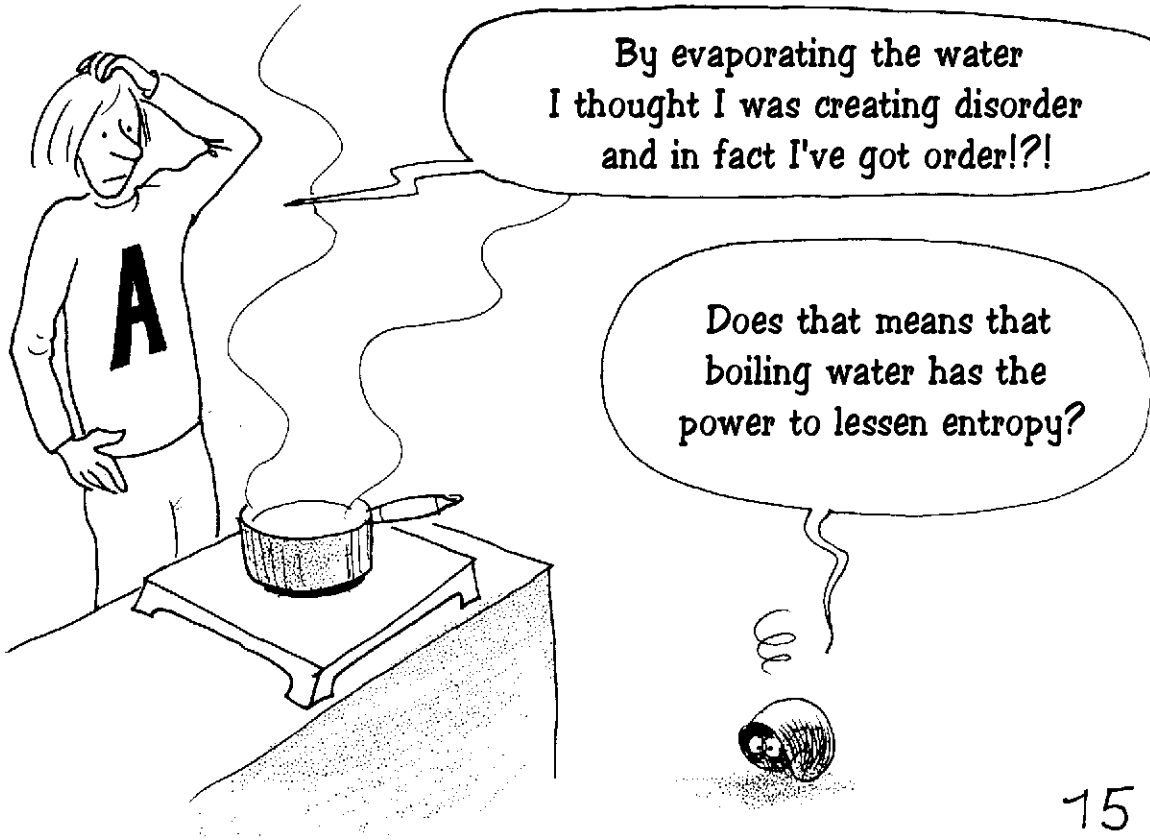


(*) If P is the probability of a state, entropy is S = P LogP, where Log means logarithm.

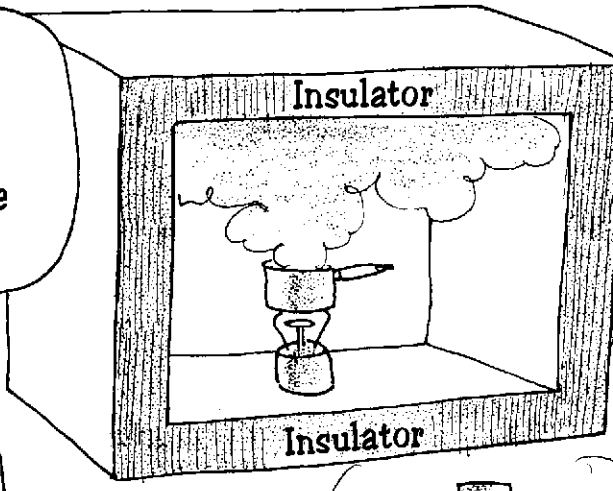
# DISSIPATING CELLS



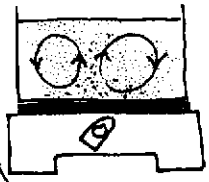
There's a thing! When I heat water a swirling hexagonal mesh system appears, there where there was nothing before, yet my hotplate gives a homogenous heat.

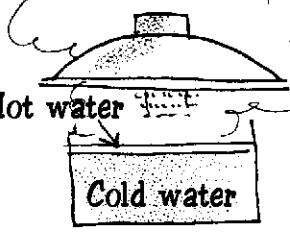


That simply means that this idea of ENTROPY only enters into it for THE WHOLE OF AN ISOLATED SYSTEM, that is to say the ensemble heater-saucepan-water-atmosphere.



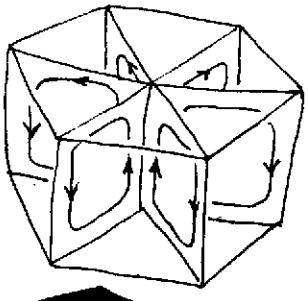

Convection






No convection

It's also perfectly possible to make all the water evaporate without any swirling, with no convective movement, by heating it with radiation from above, using a simple parabolic radiator (*)

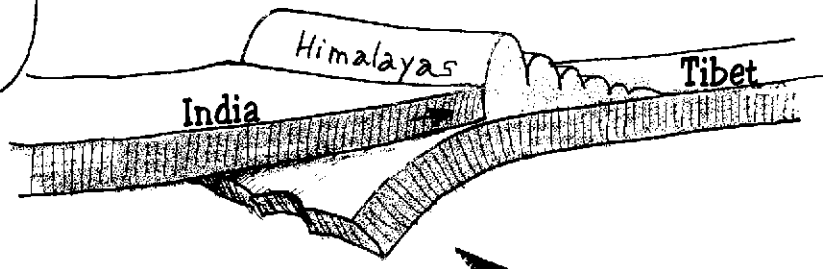


It isn't the return to AMORPHISM that characterises the increase in entropy of a system. The DISSIPATING CELLS, when they appear, cause an acceleration of evaporation, a global entropic increase.

Mountains crumble by themselves but the water carried there by clouds accelerates their erosion.

(*) See "If we flew?"

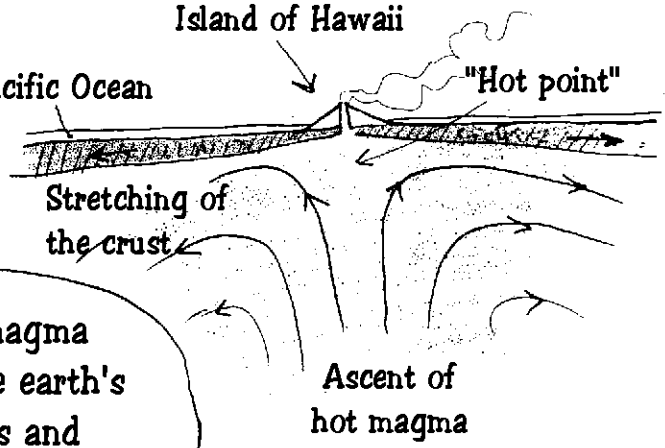
But aren't there also mountains on earth that are being formed, such as the HIMALAYAS?




Effectively yes, it is thought that the "Indian plate", by squashing Tibet, created the mountains.

All that is just a result of convective currents which animate the MAGMA and help it release the heat at its centre, which is maintained by the disintegration of primitive Uranium 235

You mean there are convective cells in the magma?



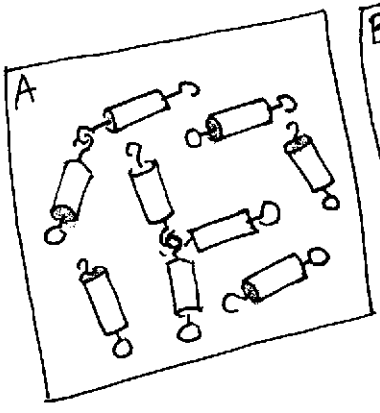

Of course, and the magma movements pull on the earth's crust which fractures and creates something like a Hawaian type volcanism.

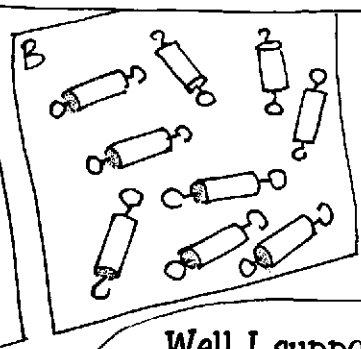



(*) See "A Thousand Billion Suns".

# MORPHOGENESIS

Archibald, these objects were in a box that we shook. Can you class the two orders of content chronologically?

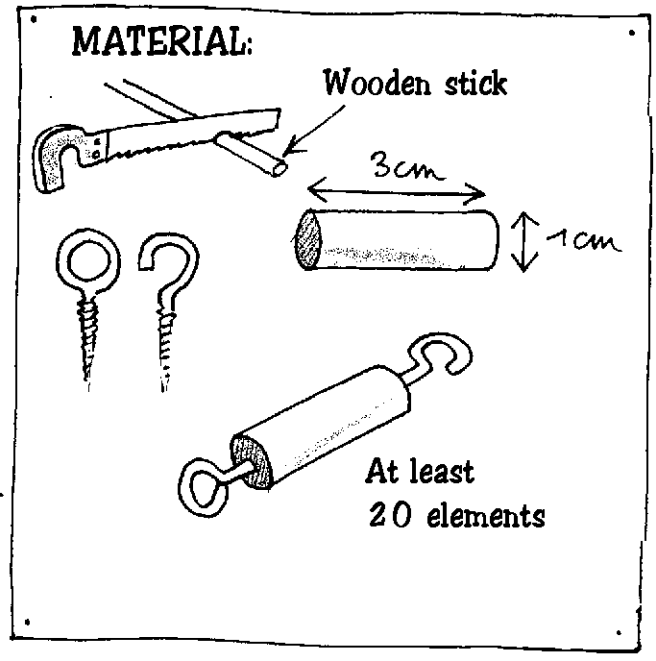


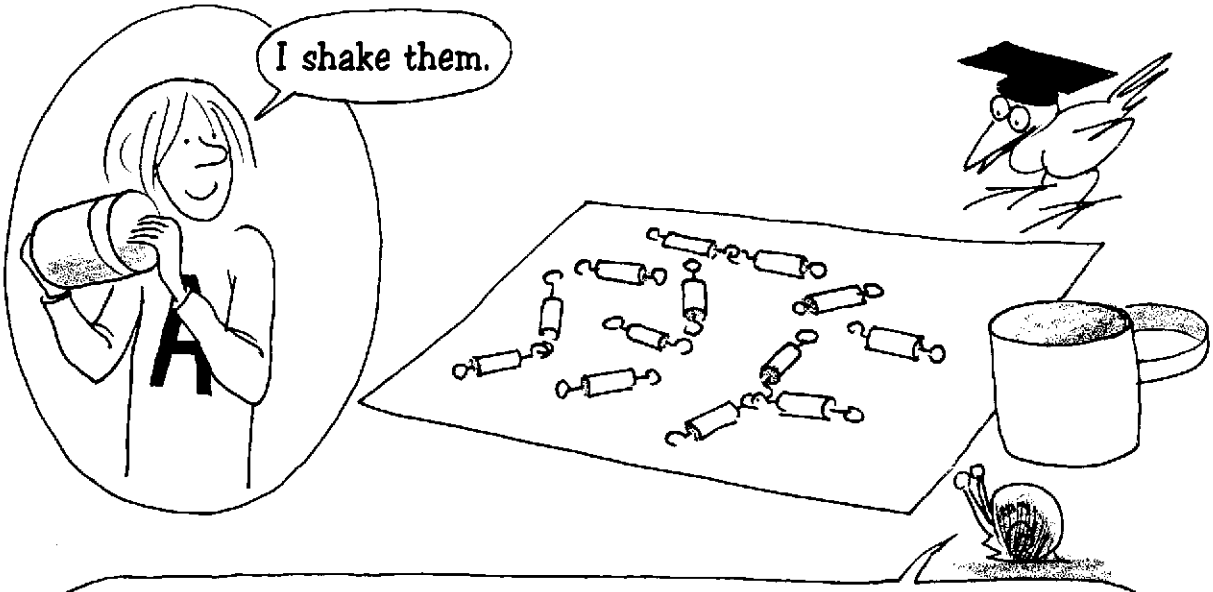




Well I suppose they are in order. When they were shaken the structures of two or three elements would have been dislocated.

What are you doing?

It seems I mucked it up again. The only solution is a return to experiment.

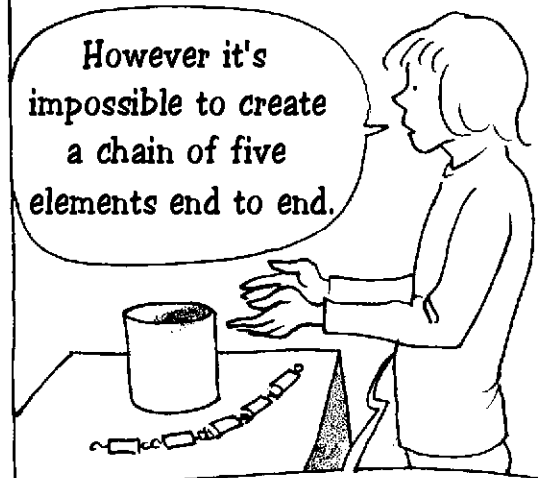





Well there's a thing! Despite several tries, Archibald always ends up with an assembly of two, or three elements

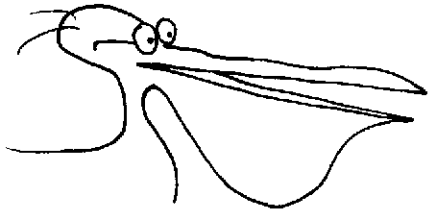
That simply means that for this particular system, it is the MOST PROBABLE configuration.

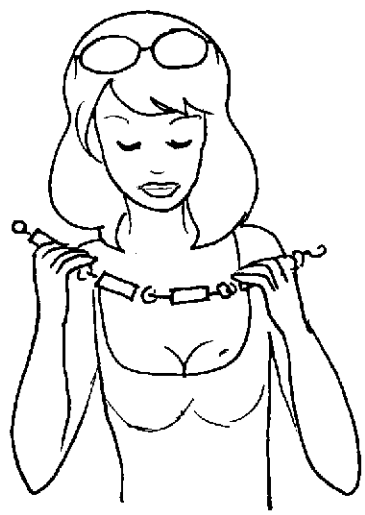
However it's impossible to create a chain of five elements end to end.



And if I introduce such a structure into the box, it disappears when I shake it!!!

If you can't synthesise this "mechanical polymer" it's simply because it's very improbable.



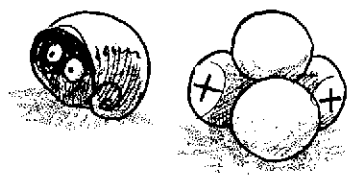


You know, Nature is made in such a way that when something, at a given instant, is HIGHLY PROBABLE it will inevitably happen

And I suppose that conversely, if something is very improbable it won't happen.

And when something has an extremely small chance of happening during the lifetime of the Universe, we can consider it IMPOSSIBLE.

The formation of helium at the moment of the BIG BANG was extremely probable. So it exists in the Universe!

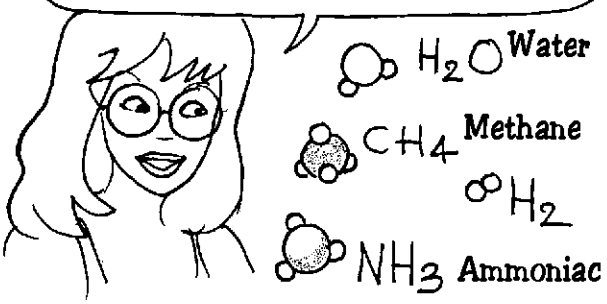


However, because of the extreme dilution in the galactic ether, we have calculated that the sun has just one chance in ten million of meeting another star during the next ten thousand million years.

We therefore consider this EVENT to be an IMPOSSIBILITY.

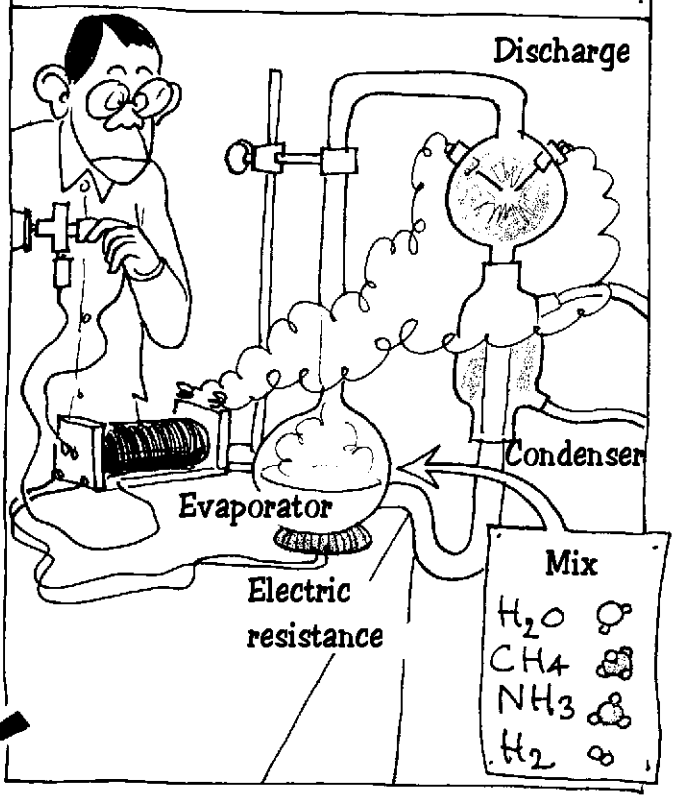
Understood...

Water vapour, methane, ammoniacand hydrogen are all simple molecules, very symmetrical and comparible with the assemblies we had earlier

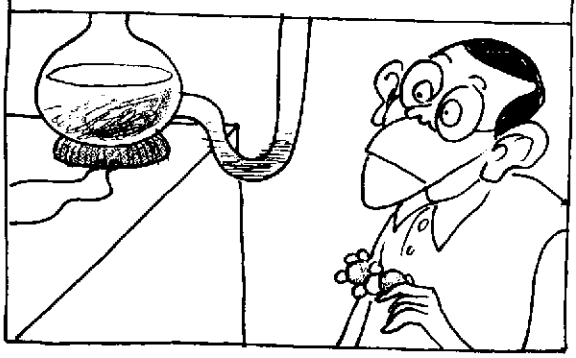



They were present therefore in the primitive atmosphere of our planet

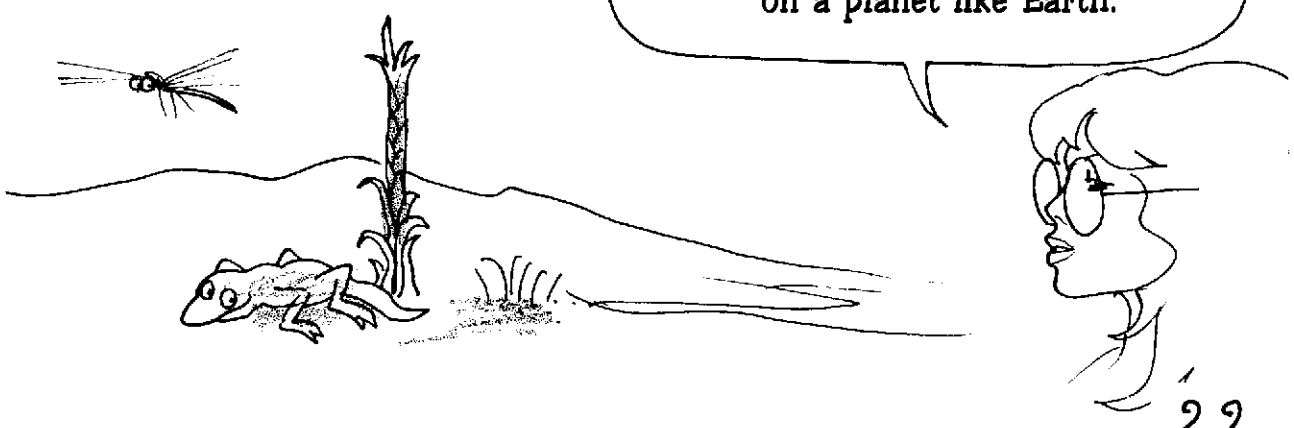
In 1950 a young student, Miller, decided to introduce these elements into a container and "shake" them by means of a simple electric discharge.




A week later the mix, colourless, had turned orange because of the presence of amino-acids, molecules made up of about 15 atoms.

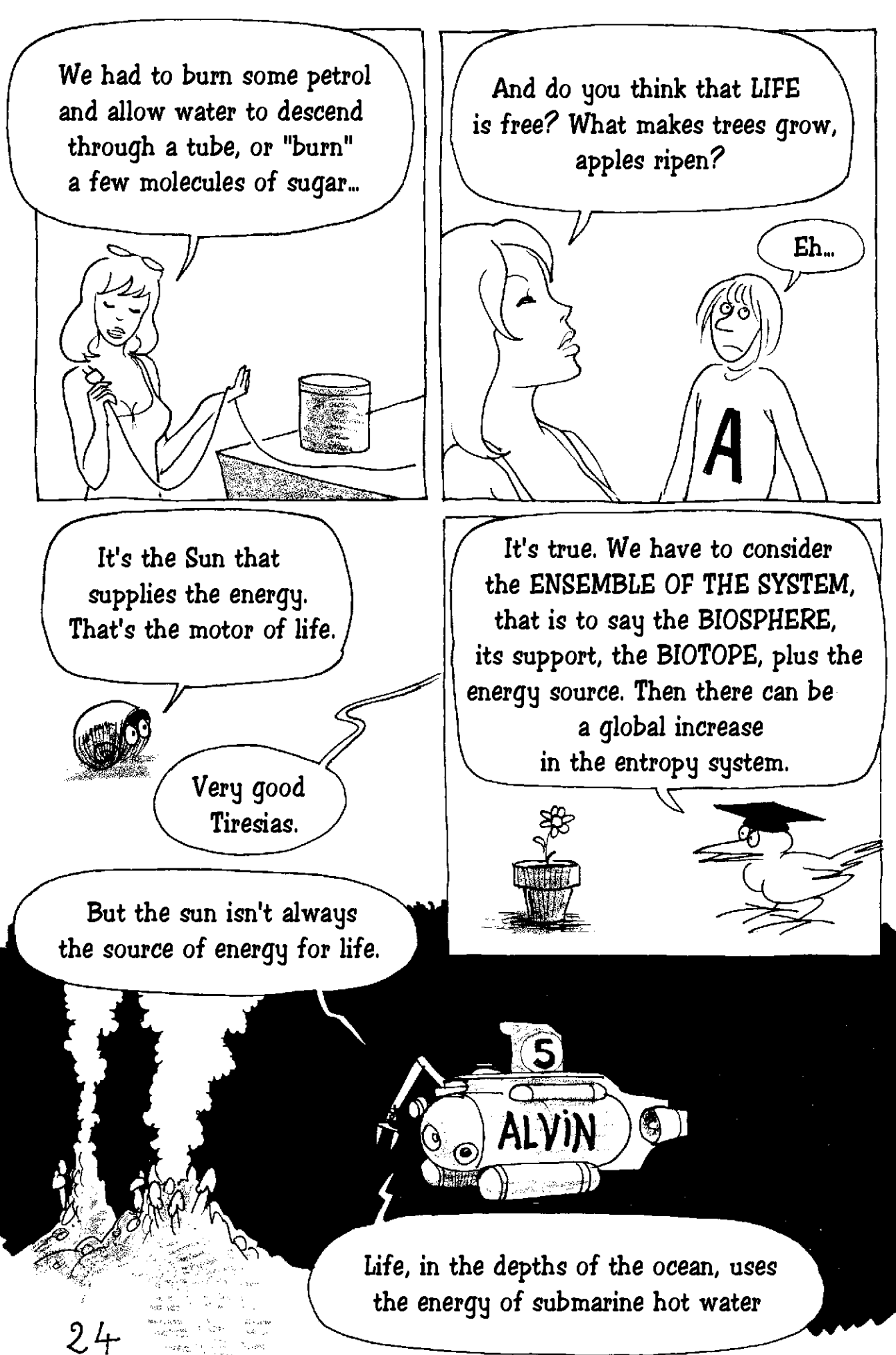


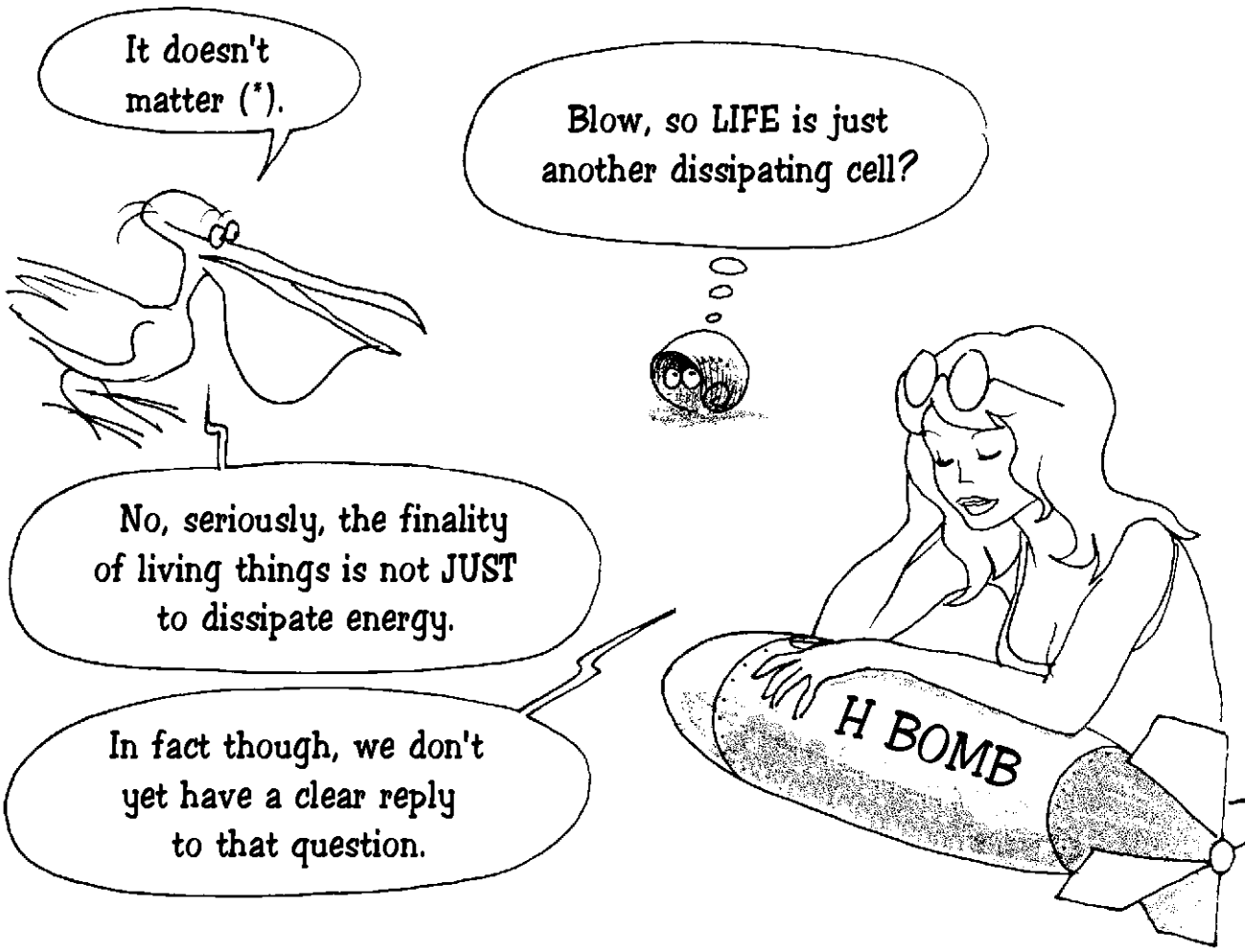
As in their turn these molecules are elements in the constitution of PROTEINS, we began to get used to the idea that LIFE must be not only a probable phenomenon but may even be INEVITABLE on a planet like Earth.



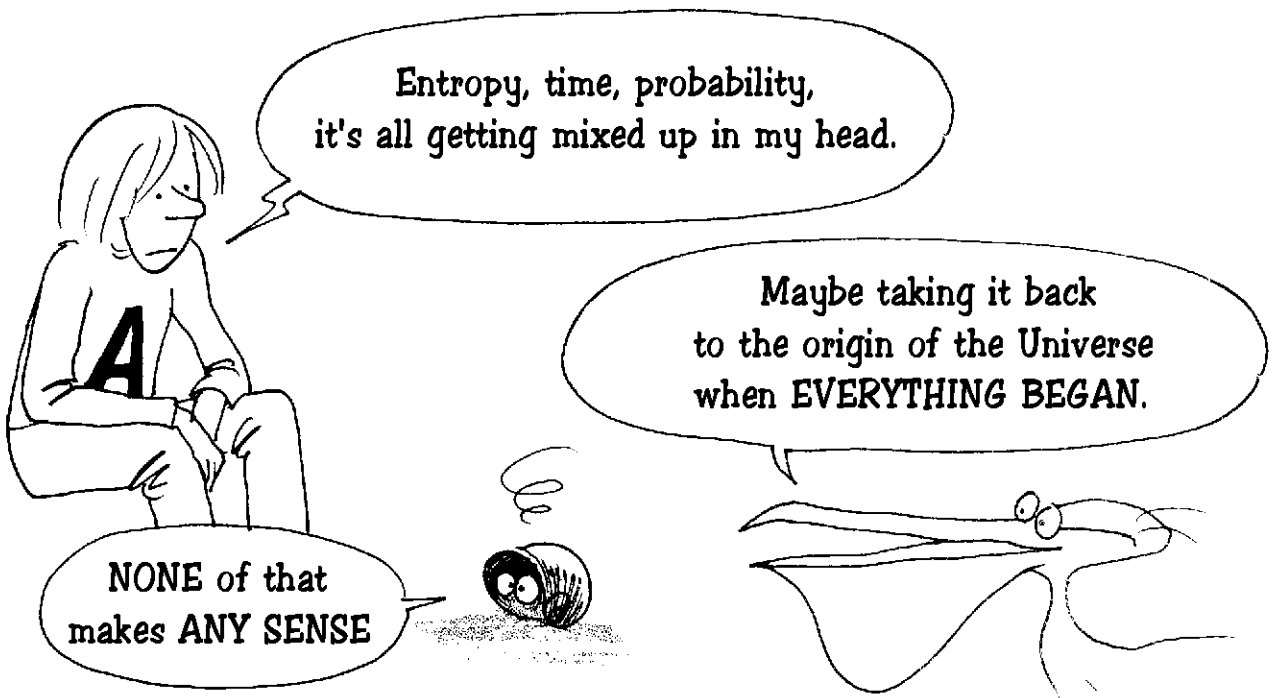
# NEGENTROPY?


Right, let's recapitulate. There are systems which simply tend towards DISORDER. Then there are those which secrete DISSIPATING STRUCTURES but which, at the end of the day, arrive at the same result.
A
And then there are systems that tend towards ORDER, which will reduce entropy. They are therefore NEGENTROPIC...
...like this game, or the game of LIFE
A
SNAP!
Apparently! And how did you produce the energy used to shake up the container, or create the spark needed to start molecular syntheses?
Like that?


We had to burn some petrol and allow water to descend through a tube, or "burn" a few molecules of sugar...
And do you think that LIFE is free? What makes trees grow, apples ripen?
Eh...
A
It's the Sun that supplies the energy. That's the motor of life.
Very good Tiresias.
It's true. We have to consider the ENSEMBLE OF THE SYSTEM, that is to say the BIOSPHERE, its support, the BIOTOPE, plus the energy source. Then there can be a global increase in the entropy system.
But the sun isn't always the source of energy for life.
5
ALVIN
Life, in the depths of the ocean, uses the energy of submarine hot water

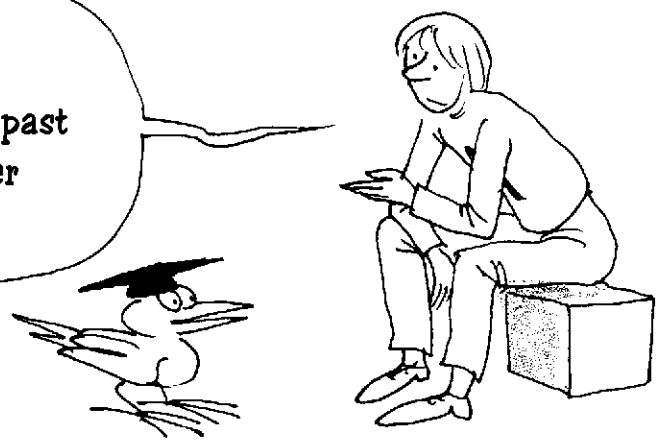



# ENTROPY




(*) This is all explained in the BIOLOGICON.

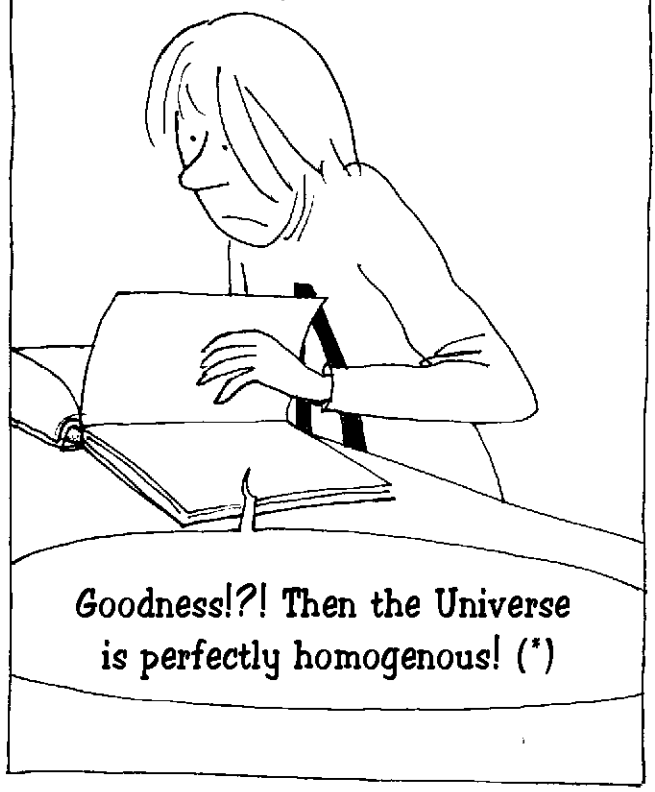
Life, planets, the stars, it's all too complicated! Wasn't there any time in the past when the Universe was easier to understand?




Let's look at the history of the Universe as written down by mankind.

Let's see... t = one hundred million years. That corrresponds to the birth of galaxies. No... it's still too complicated

Let's try t = 100,000 years



Goodness!?! Then the Universe is perfectly homogenous! (*)

(*) See "A Thousand Billion Suns".

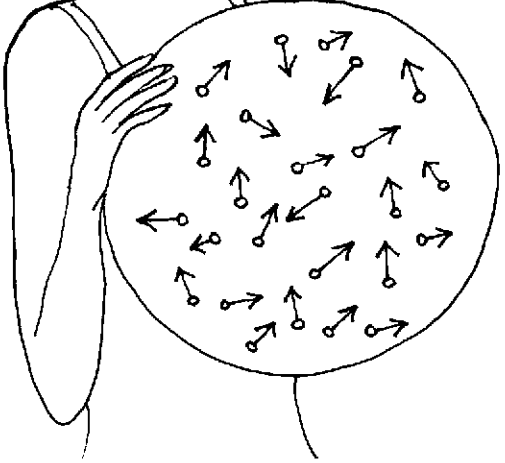
How can a perfectly homogenous Universe evolve, seeing as NOTHING happens?

Homogenous populations don't have history.

How can time pass when there isn't the slightest tendancy towards disorder, nowhere, given that this disorder is at its MAXIMUM!

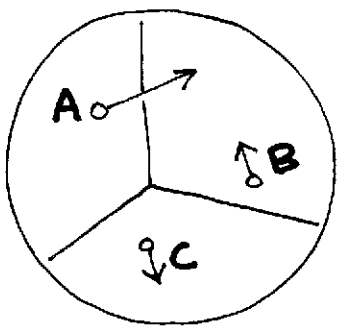
Wait, there is something happening in fact because the Universe is COOLING DOWN.

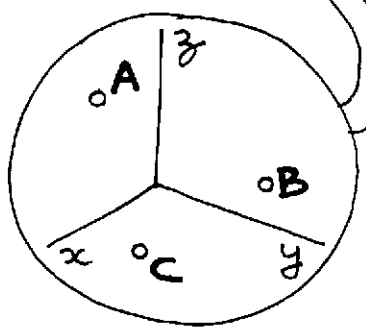
You need more than data on their positions to completely describe a system of particles at a given moment, you also need their velocities.



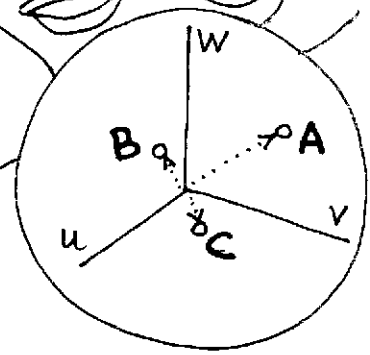
Yes, for VELOCITY is also INFORMATION.

Instead of using arrows we can represent particles in two spaces of three dimensions: POSITION SPACE and VELOCITY SPACE.



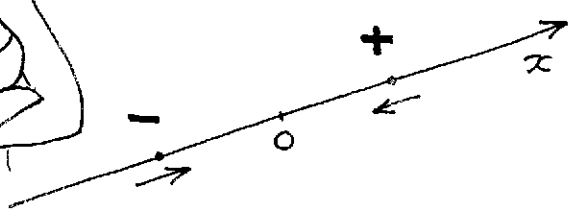

POSITION




VELOCITY

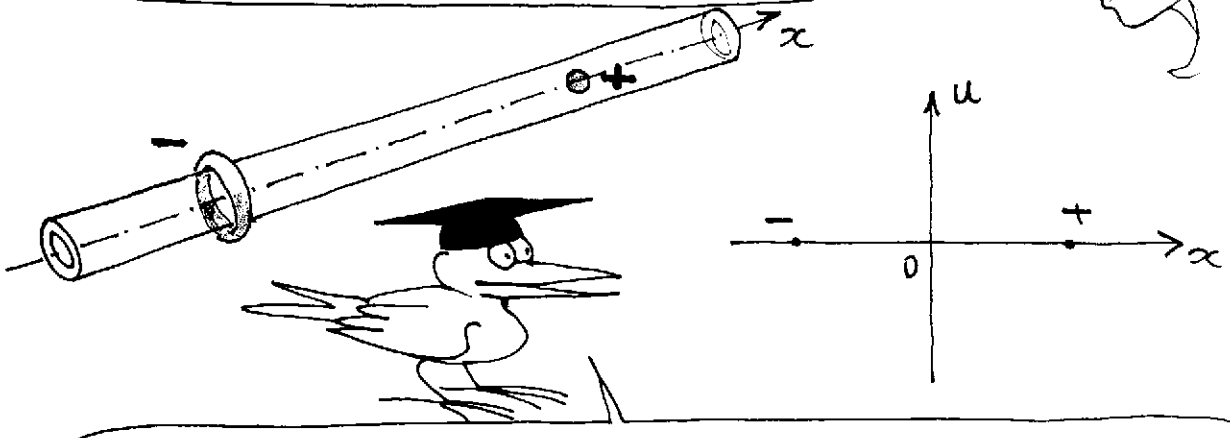
This complete description using six coordinates can be associated with a space of six dimensions called PHASE SPACE.

Let us simplify the situation to the extreme. Let's consider a universe with just one dimension in space (a simple line) where two punctual objects, supposed to represent particles with opposing charges, are mutually attracted.

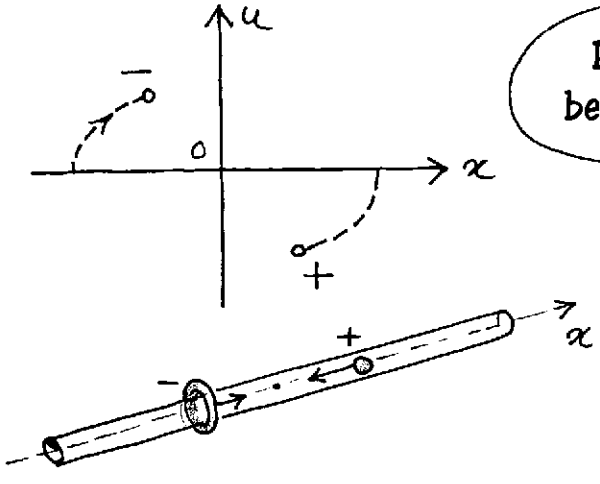



But how will they manage to meet each other?

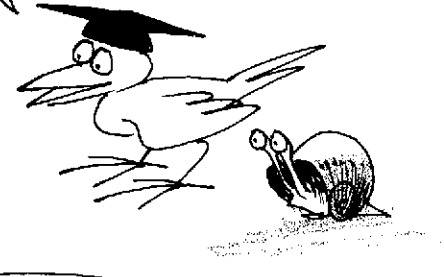
Good question! We just have to positively charge a small ball moving in a tube and negatively charge a ring, for which the tube will also serve as a guide.

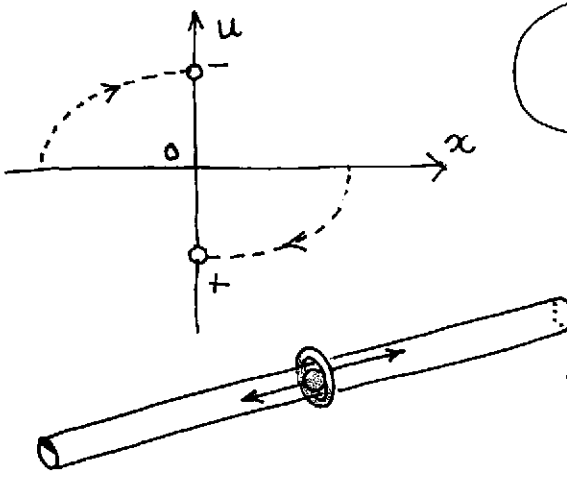



If we represent this system in a PHASE SPACE (x,u) where x is the coordinate of POSITION and u the coordinate VELOCITY, and with the particles given an initial speed of zero, we get the following schema.

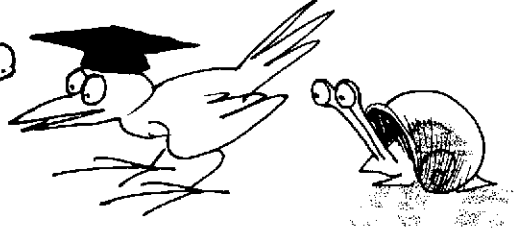


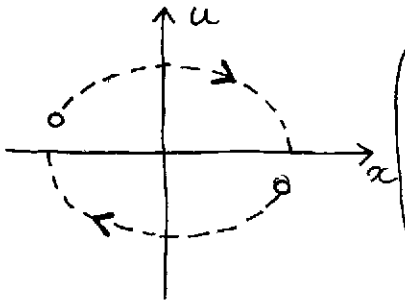

Particles which are attracted begin to fall towards each other.



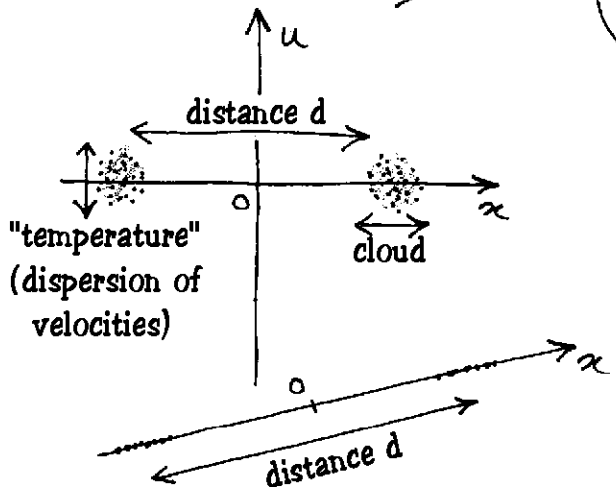



Here they meet at maximum speed.



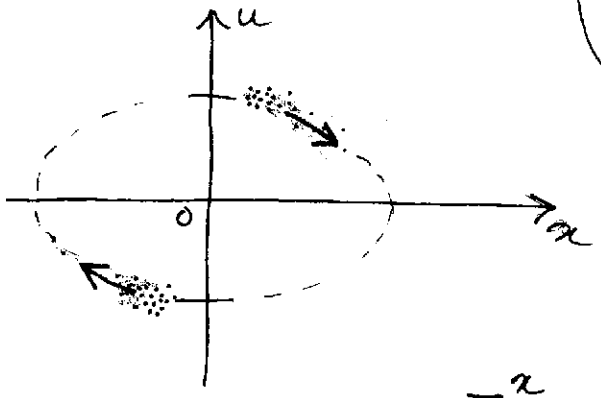


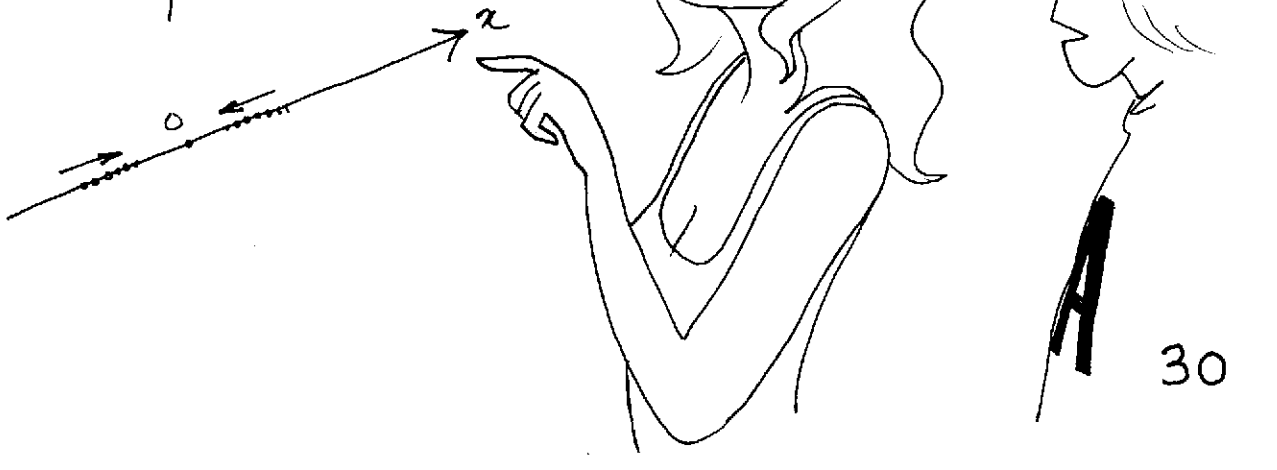

The to-and-fro movement, the oscillation of charges around their common centre of gravity, will give elliptical trajectories in the phase space.

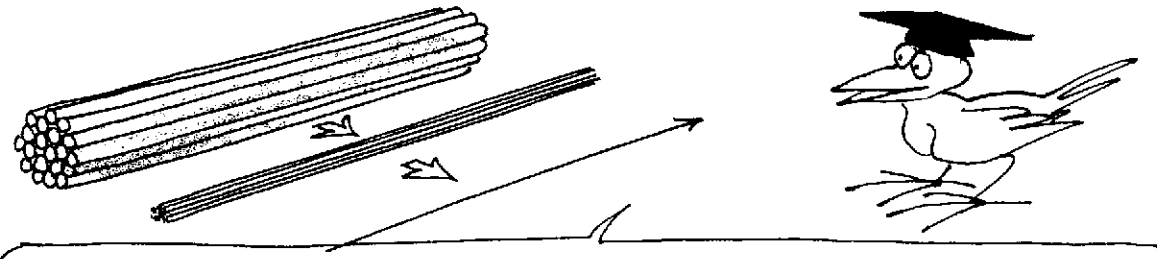



The schema describes two particle ensembles situated at a certain distance, with a globally zero speed (they are very close to the axis OX) but presenting random THERMIC AGITATION velocities.

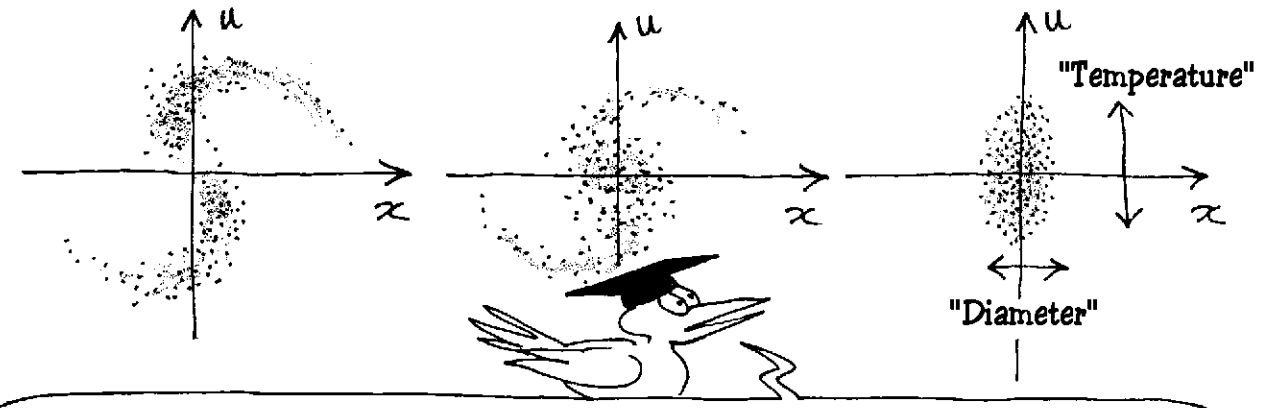
These ensembles will "fall" towards each other under the effect of mutual attraction.



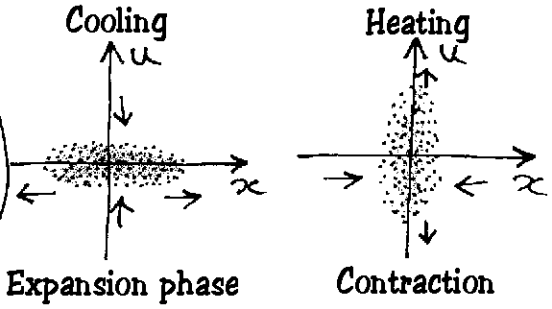


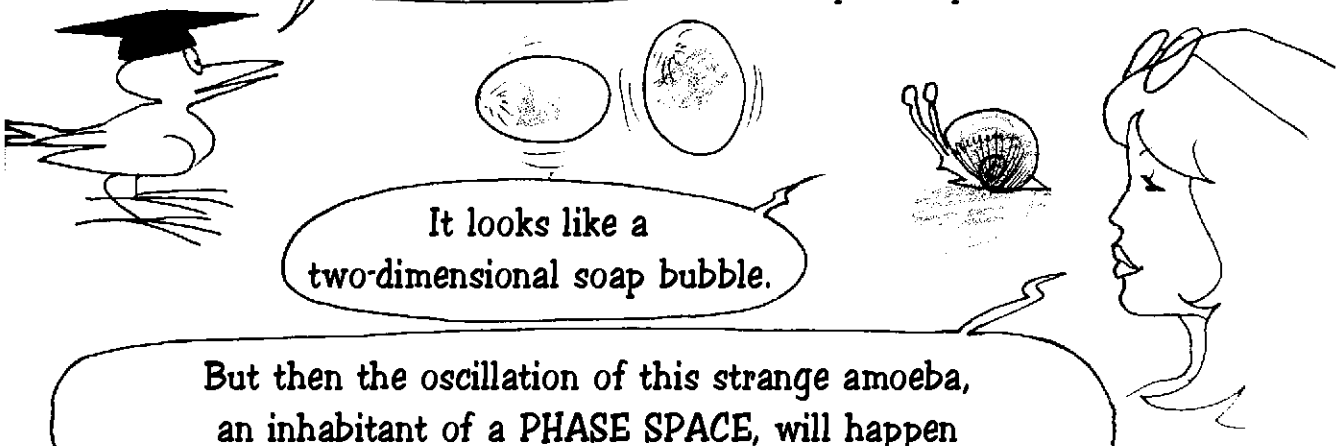
Technically we could allow particles to cross each other without telescoping into each other by putting them in extremely thin tubes.




The two clouds amalgamate into one, unique cloud.
The acquired KINETIC ENERGY is randomly redistributed and the result is "heating", a spreading according to the dimension velocity u. The surface occupied by all these particles will increase globally. But this surface IS, precisely, ENTROPY.

The system will oscillate, EXPANSION being synonymous with a reduction in speed (of thermic agitation), and of TEMPERATURE. The inverse process takes place during contraction



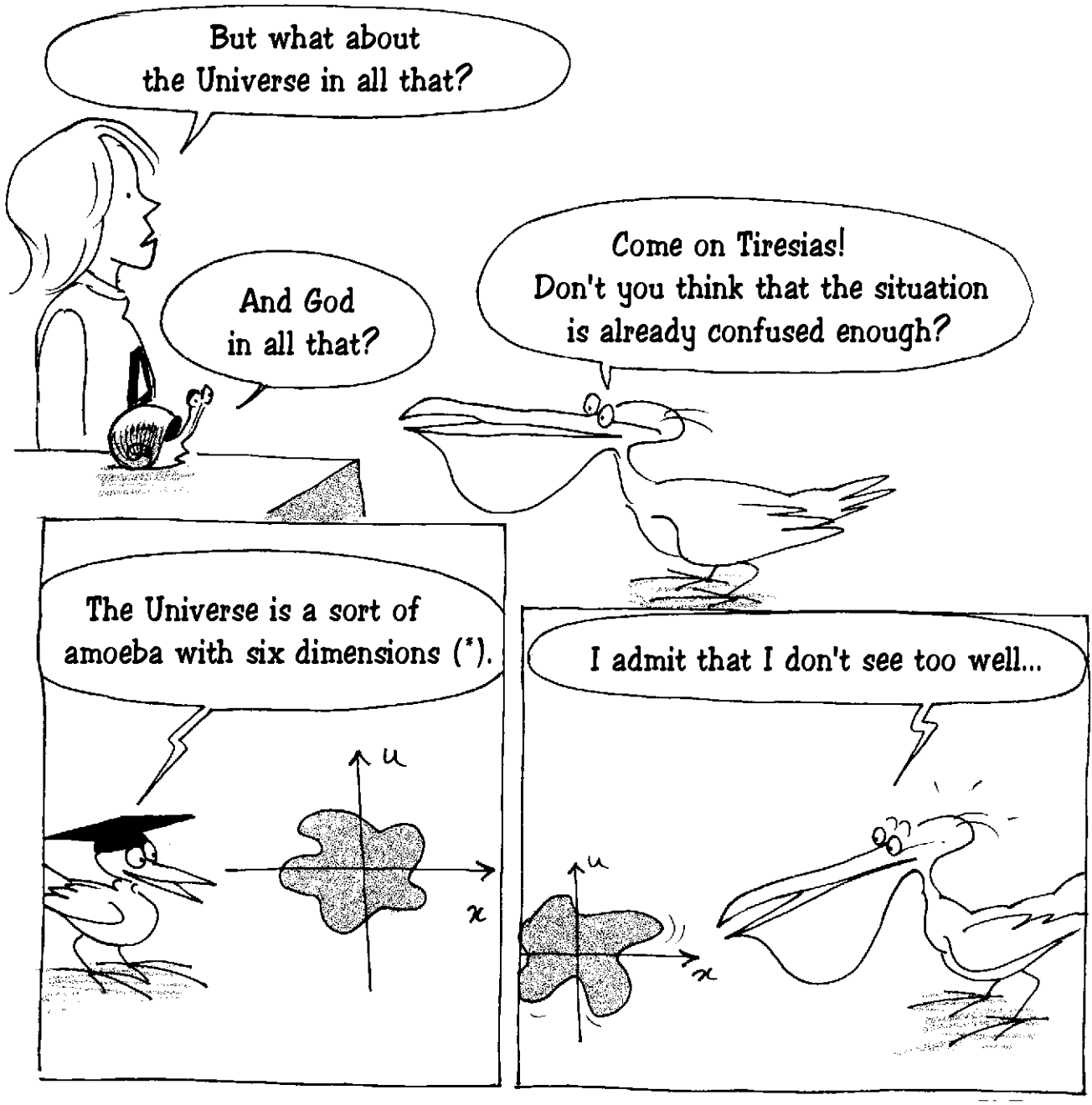
It looks like a two-dimensional soap bubble.

But then the oscillation of this strange amoeba, an inhabitant of a PHASE SPACE, will happen with a constant area, a CONSTANT ENTROPY (*)



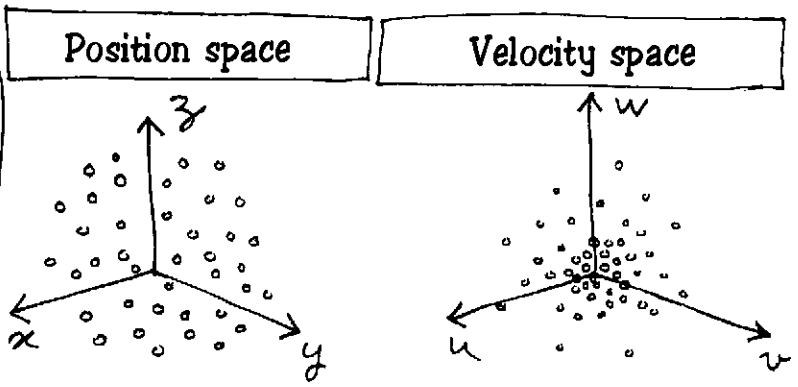
(*) In the chosen example particles do not meet.

# FIRST COSMOLOGICAL PARADOX

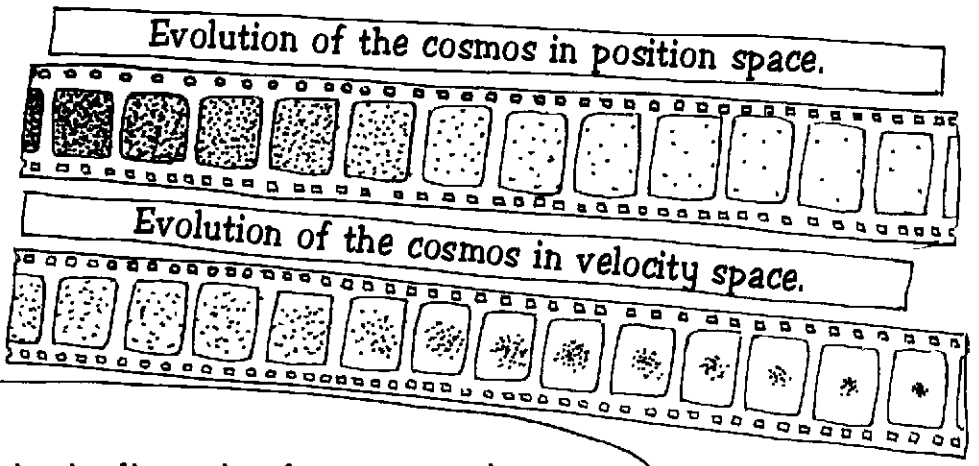



(*) See The Geometricon.

To represent this six dimensional PHASE SPACE (3 for position and 3 for velocity), you just have to 'unfold' it according to two three dimensional representations.




In POSITION SPACE the Universe is diluted and this dispersal is synonymous with DISORDER. Inversely, agitation speed diminishes. However in its representation in VELOCITY SPACE, the Universe condenses, which translates as a tendancy towards ORDER.

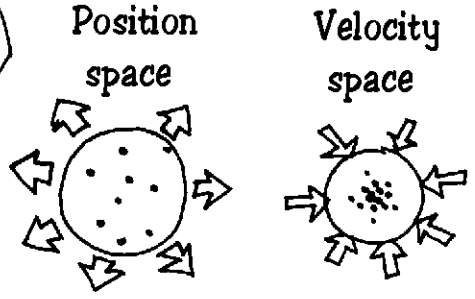



Globally, in this six dimensional representation the Universe's ORDER STRUCTURE remains invariant. ENTROPY, which is its HYPERVOLUME, or the product of its volume in position space by its volume in velocity space, does not vary (*)

In other words, in its six dimensional representation the cosmos is an incompressible fluid.

(*) LIOUVILLE's theorem, French mathematician (1802-1882).

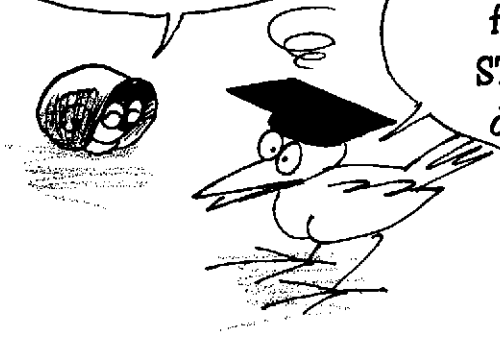
In other words, it dilates on the POSITION side but gets thinner on the VELOCITY side


But let's see, as the SECOND PRINCIPLE also states that ENTROPY INCREASES WITH TIME, how can there be an EVOLUTION FROM THE COSLIS TO CONSTANT ENTROPY?


In effect this paradox is one of the weaknesses of classic cosmological models.

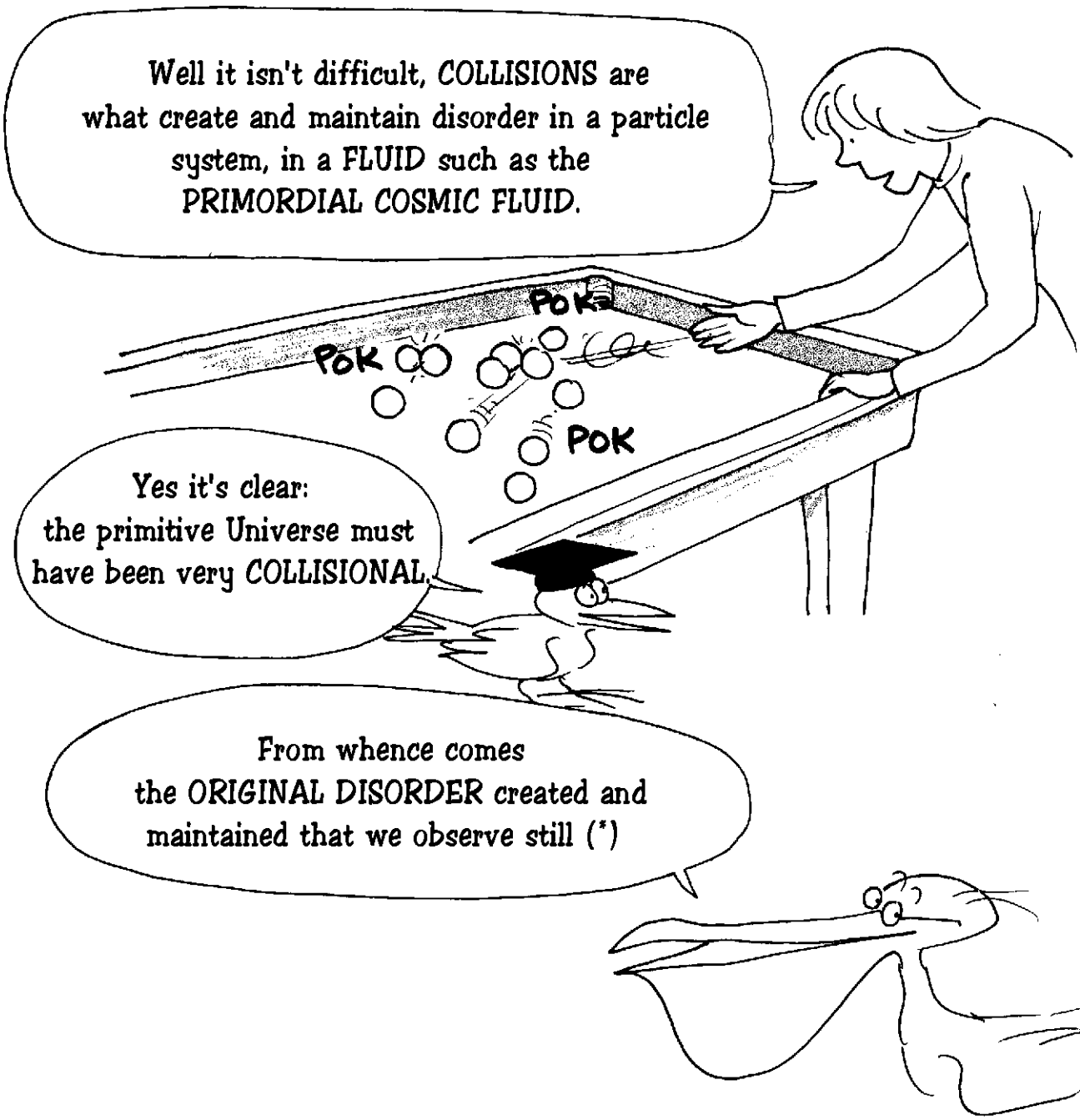
It's the cosmic summit, ha! ha!



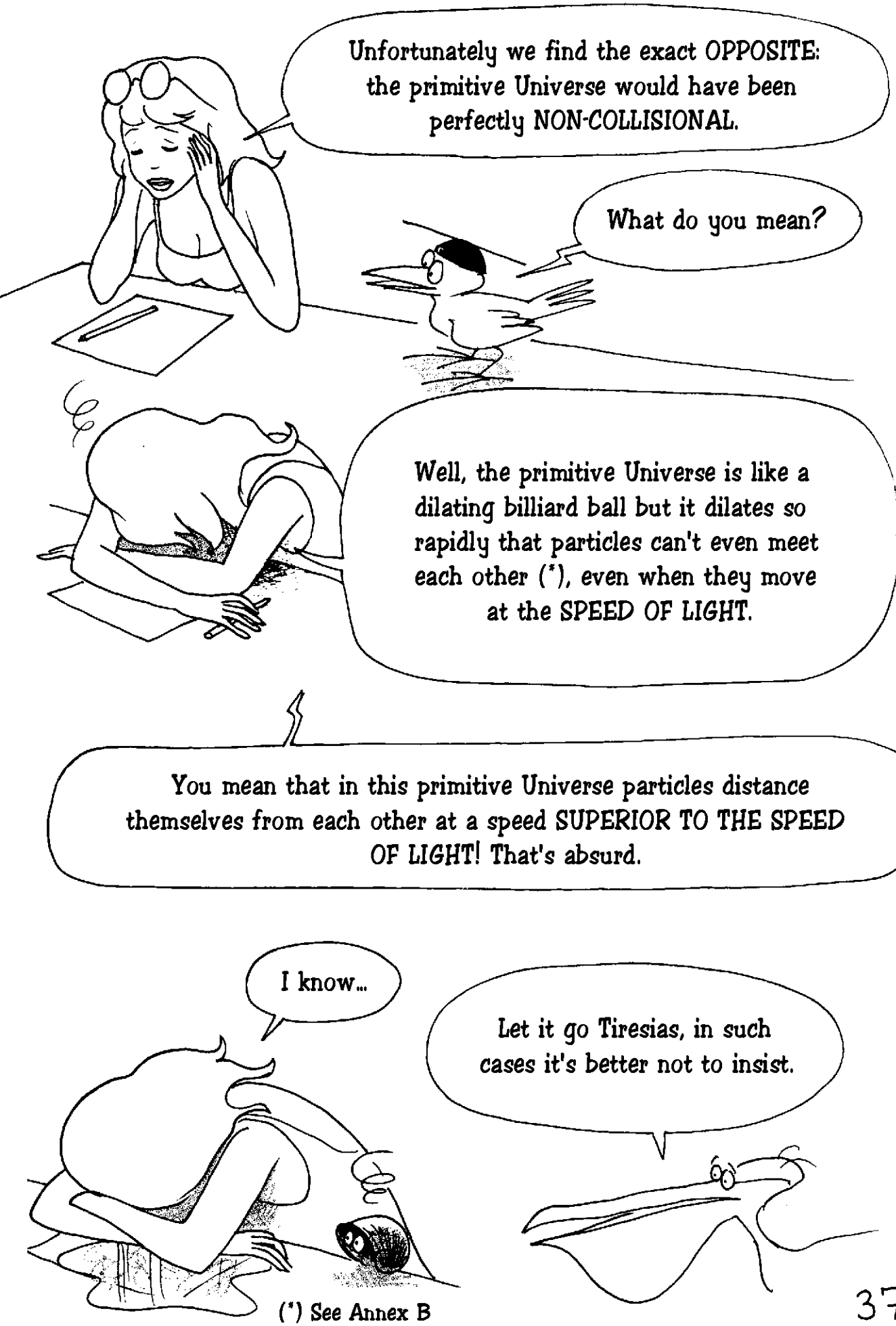
In short, just because a model is developed from very scholarly calculations, like the STANDARD COSMOLOGICAL MODEL, that doesn't mean it is automatically coherent.


But doesn't Science have a partial response to give, a bit of a theory? Anything in fact?
Alas the immense temporal plains covered by constant entropy is one of the weaknesses of our vision of the Universe.
So time advances and we don't know why. There's a thing!
And no-one mentioned it to me.
I wasn't aware of this paradox either. It's true that scientists don't shout it from the rooftoops.
All the same... it hurts.
As well as that, not only is this ENTROPY conserved with the passing of time, but it is also at MAXIMUM, DISORDER being at its highest point at the time of the BIG BANG.

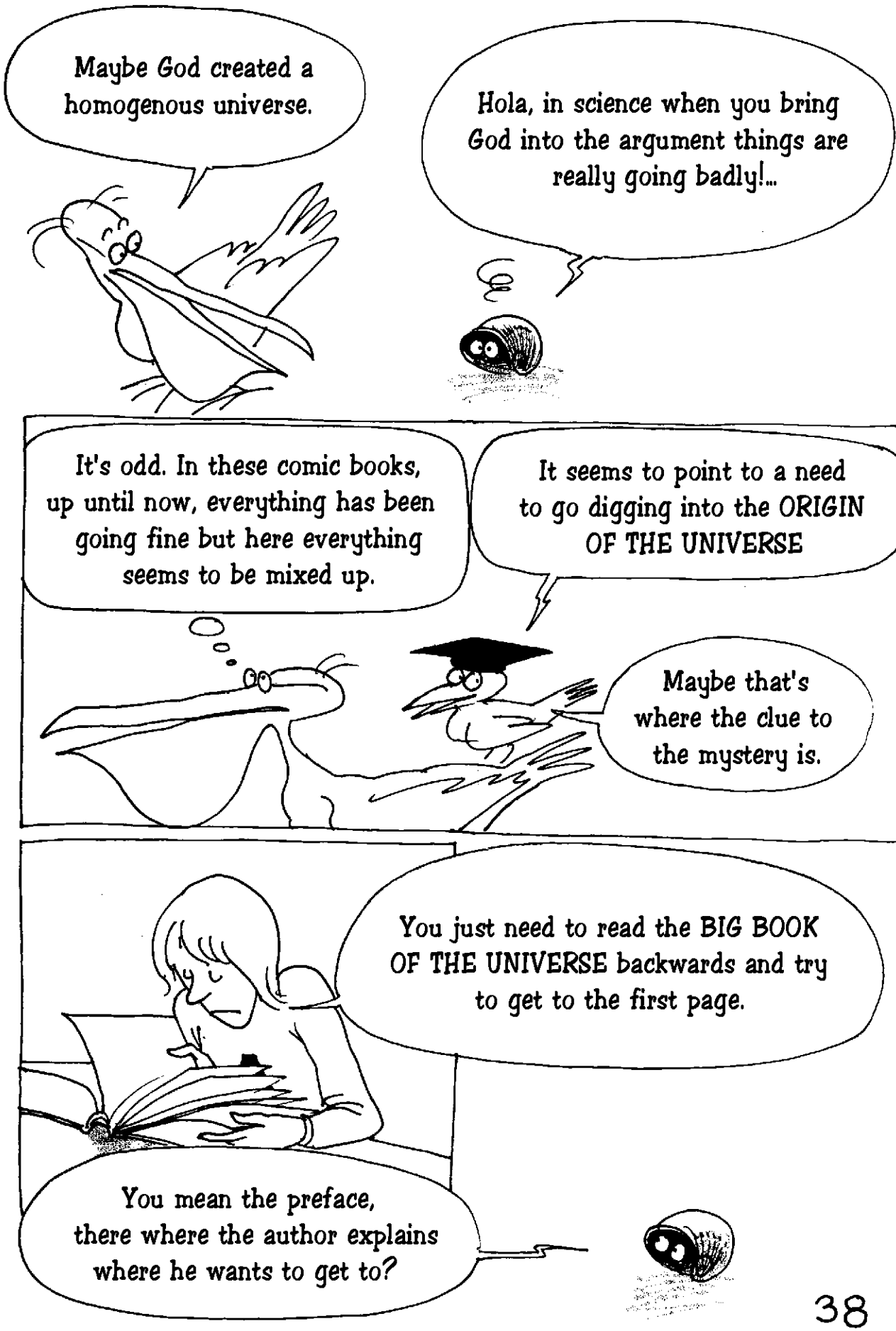
# SECOND COSMOLOGICAL PARADOX

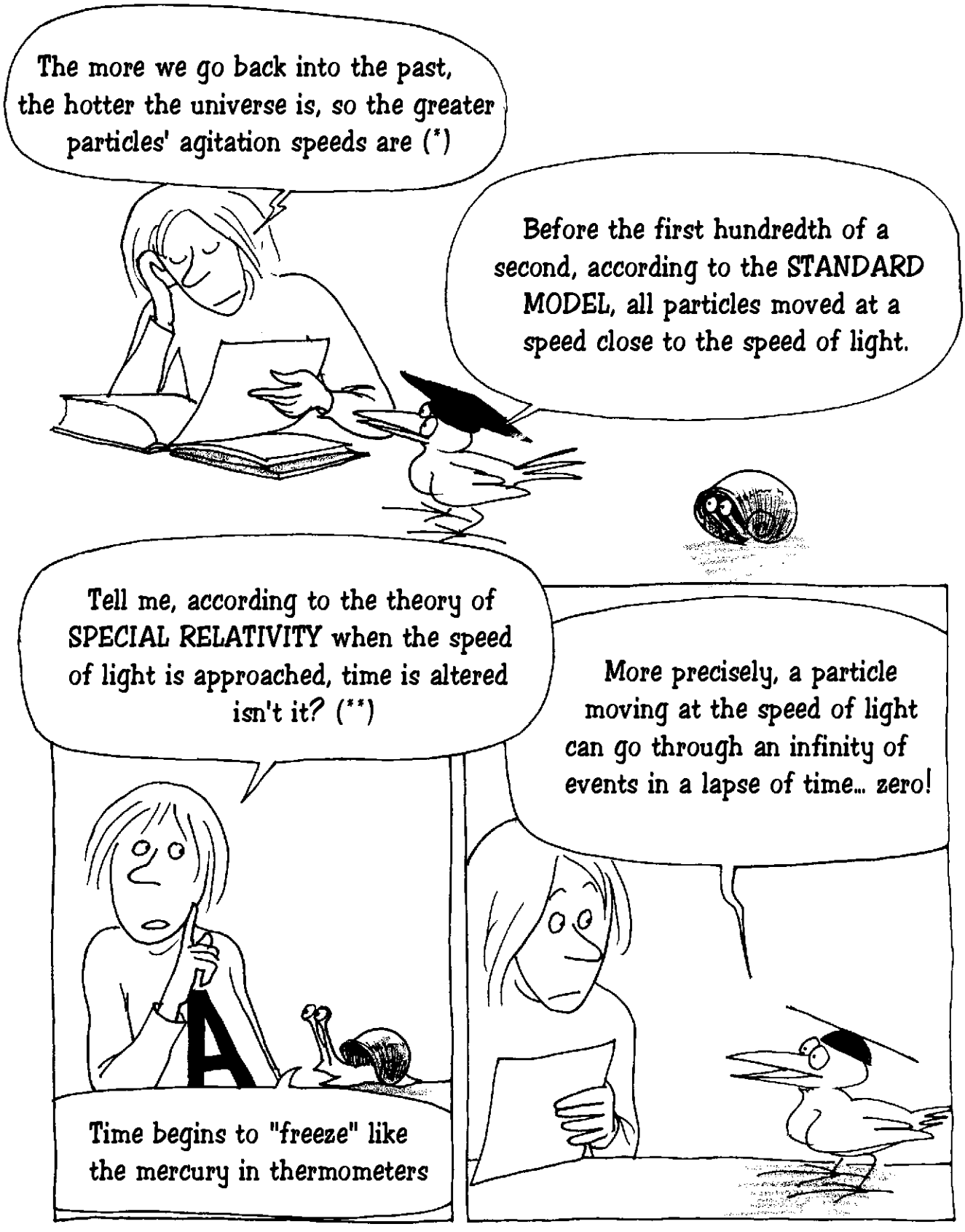



(*) In effect the Universe is extremely HOMOGENOUS in all directions of space.


Unfortunately we find the exact OPPOSITE: the primitive Universe would have been perfectly NON-COLLISIONAL.
What do you mean?
Well, the primitive Universe is like a dilating billiard ball but it dilates so rapidly that particles can't even meet each other (*), even when they move at the SPEED OF LIGHT.
You mean that in this primitive Universe particles distance themselves from each other at a speed SUPERIOR TO THE SPEED OF LIGHT! That's absurd.
I know...
Let it go Tiresias, in such cases it's better not to insist.

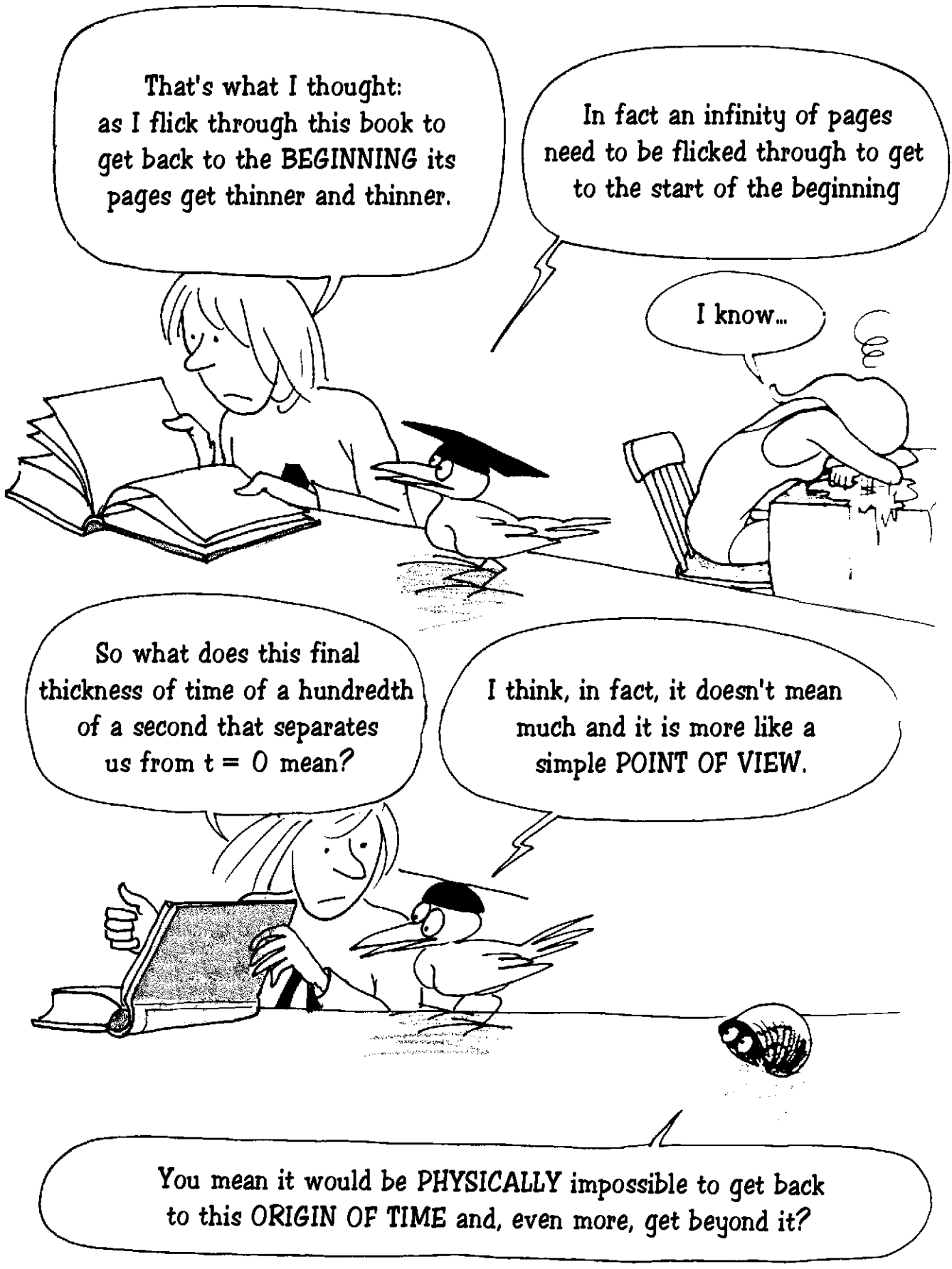
(*) See Annex B

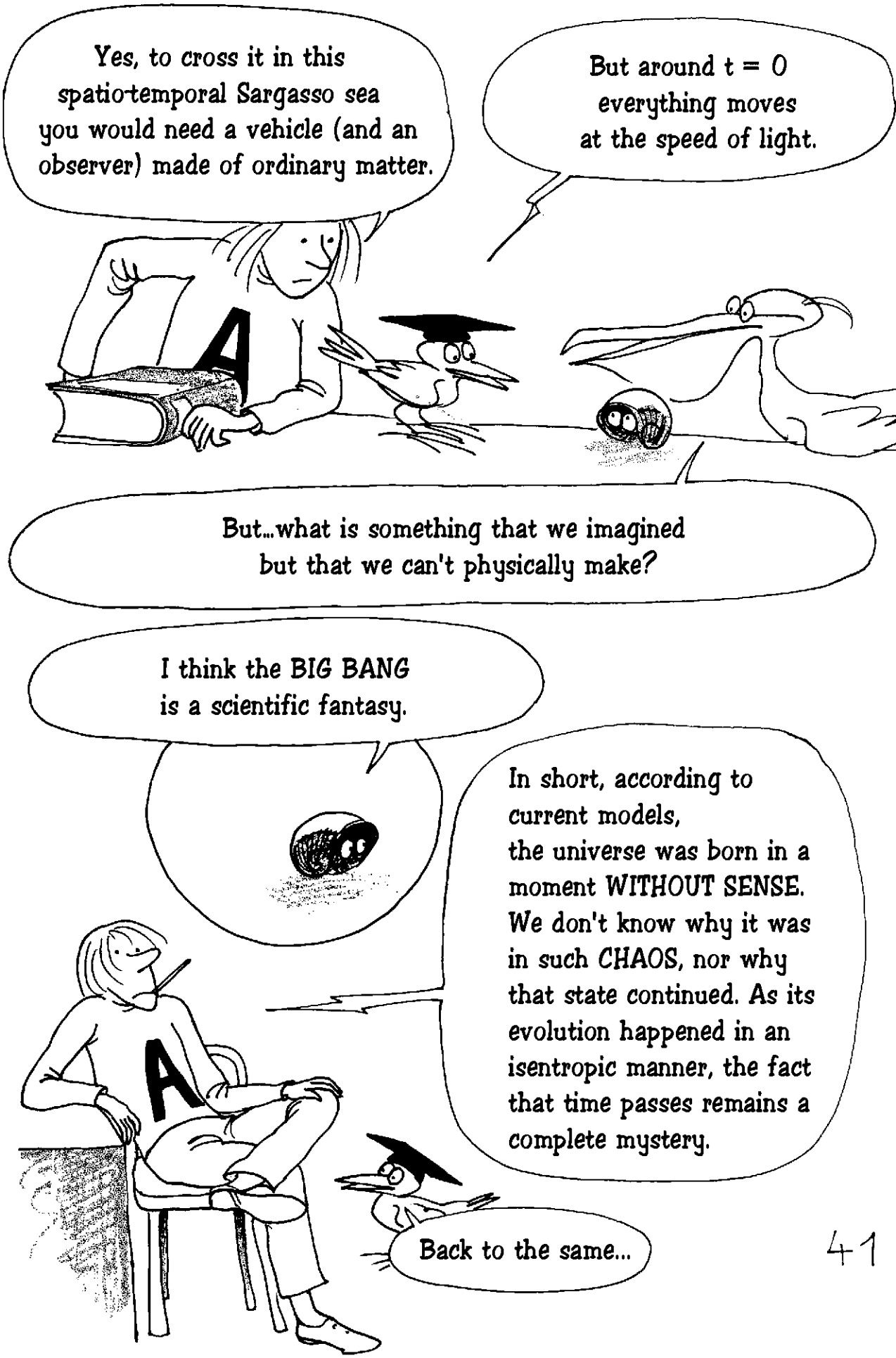

Maybe God created a homogenous universe.
Hola, in science when you bring God into the argument things are really going badly!...
It's odd. In these comic books, up until now, everything has been going fine but here everything seems to be mixed up.
It seems to point to a need to go digging into the ORIGIN OF THE UNIVERSE
Maybe that's where the clue to the mystery is.
You just need to read the BIG BOOK OF THE UNIVERSE backwards and try to get to the first page.
You mean the preface, there where the author explains where he wants to get to?




(*) The TEMPERATURE of a gas is nothing other than the measure of the average thermic energy agitation $1/2mV^2$. See "IF WE FLEW?".

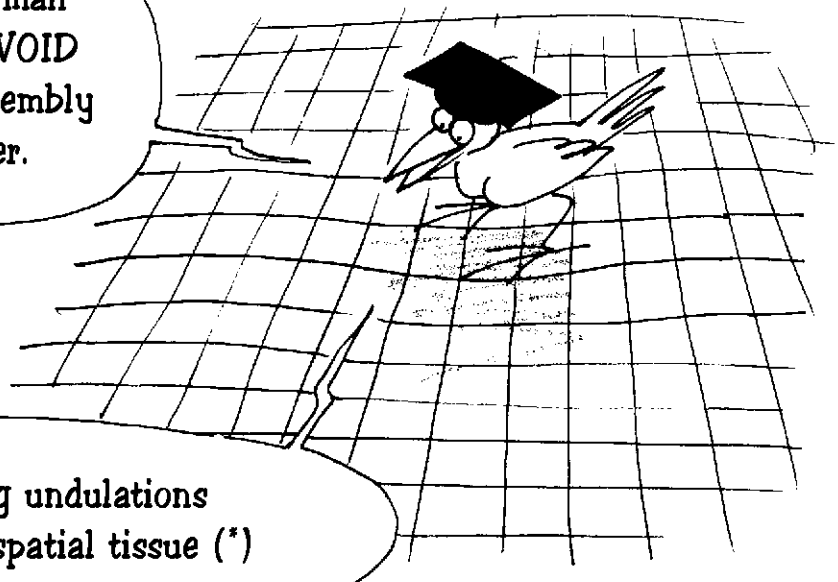
(**) See "Everything is relative".


That's what I thought:
as I flick through this book to get back to the BEGINNING its pages get thinner and thinner.
In fact an infinity of pages need to be flicked through to get to the start of the beginning
I know...
So what does this final thickness of time of a hundredth of a second that separates us from t = 0 mean?
I think, in fact, it doesn't mean much and it is more like a simple POINT OF VIEW.
You mean it would be PHYSICALLY impossible to get back to this ORIGIN OF TIME and, even more, get beyond it?


Yes, to cross it in this spatio-temporal Sargasso sea you would need a vehicle (and an observer) made of ordinary matter.
But around t = 0 everything moves at the speed of light.
But...what is something that we imagined but that we can't physically make?
I think the BIG BANG is a scientific fantasy.
In short, according to current models, the universe was born in a moment WITHOUT SENSE. We don't know why it was in such CHAOS, nor why that state continued. As its evolution happened in an isentropic manner, the fact that time passes remains a complete mystery.
Back to the same...

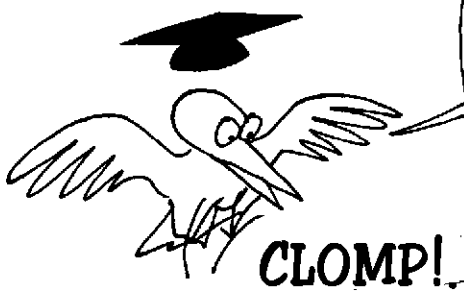
# THIRD COSMOLOGICAL PARADOX

According to the Englishman DIRAC what we call THE VOID is in fact a very tight assembly of matter and anti-matter.

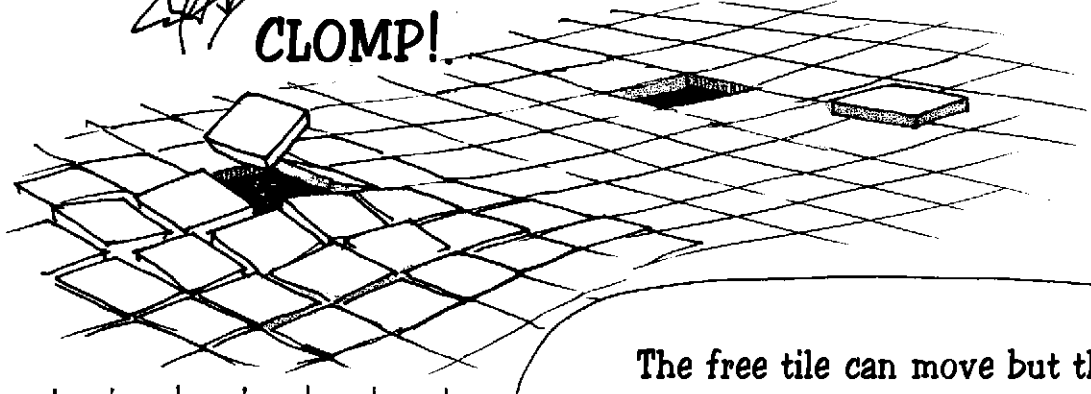


PHOTONS being undulations that agitate this spatial tissue (*)

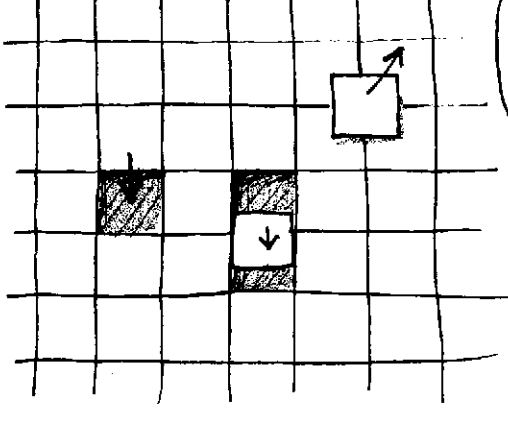
When two suffciently pronounced undulations meet, a tile comes unstuck. The freed tile becoming synonymous with matter and the void that it leaves with anti-matter



CLOMP!



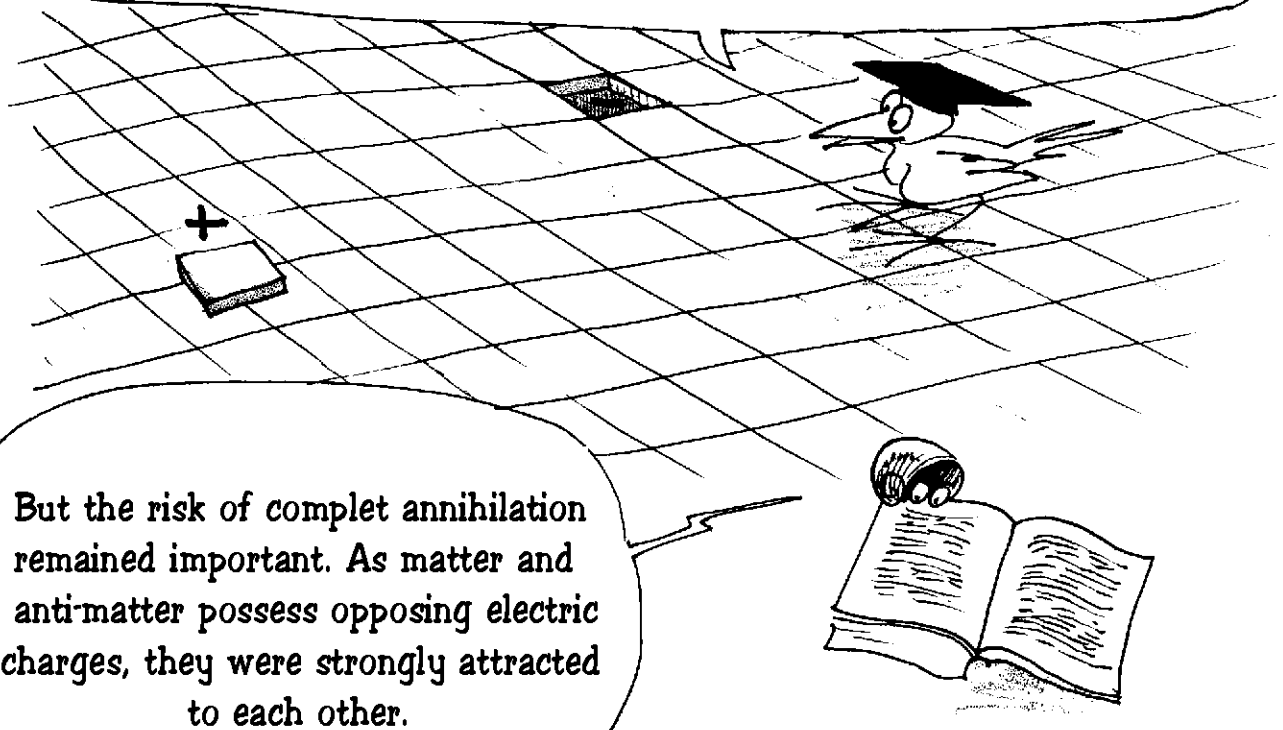
The free tile can move but the hole as well, because of the adjacent tiles, like in the game of MAGIC SQUARES.



(*) See BIG BANG.

At the instant of the BIG BANG the turbulence of the cosmic tissue (the temperature) was considerable. The tiles couldn't stay in place. They came unstuck and joined each other incessantly in a fantastic hubbub.

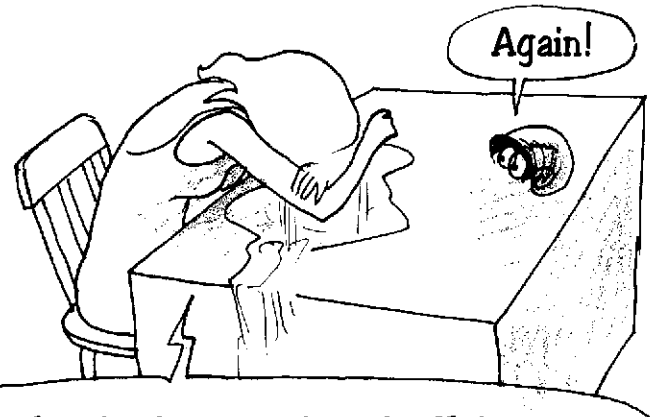
When the temperature had diminished enough (*) almost all the tiles returned to free places... except one in a hundred thousand and the folds that were agitating the cosmic tissue became so weak that they were then unable to loosen any more tiles.



But the risk of complet annihilation remained important. As matter and anti-matter possess opposing electric charges, they were strongly attracted to each other.

(*) After 1 3 seconds the temperature of the universe had dropped to three hundred thousand degrees.

Well it's quite simple. Sophie said earlier, the brutal phenomenon of expansion separated these two enemy sisters and stopped their mutual destruction.

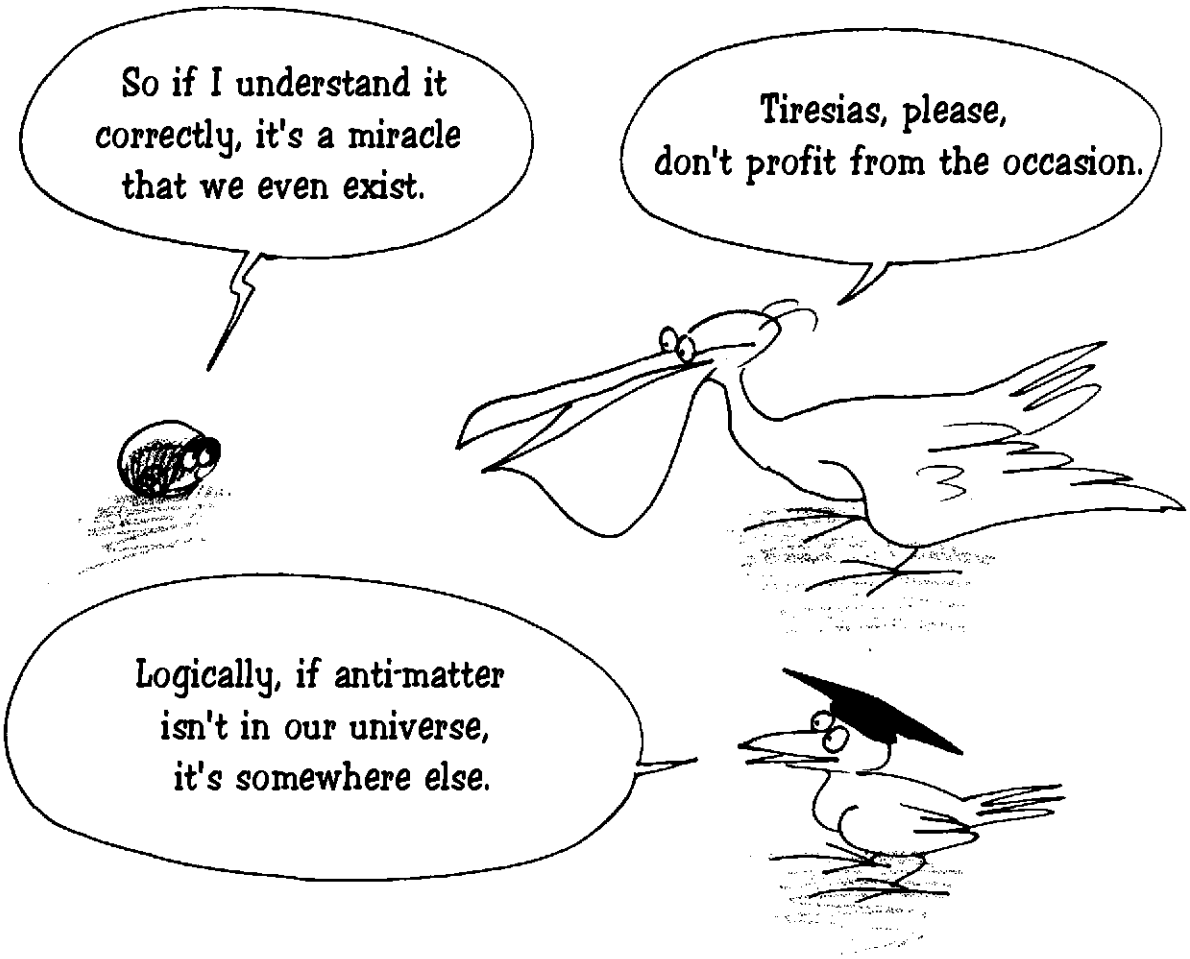




Yes, but in the meantime the Universe became collisional. If there were galaxies made of matter and others of anti-matter they would have met each other from time to time

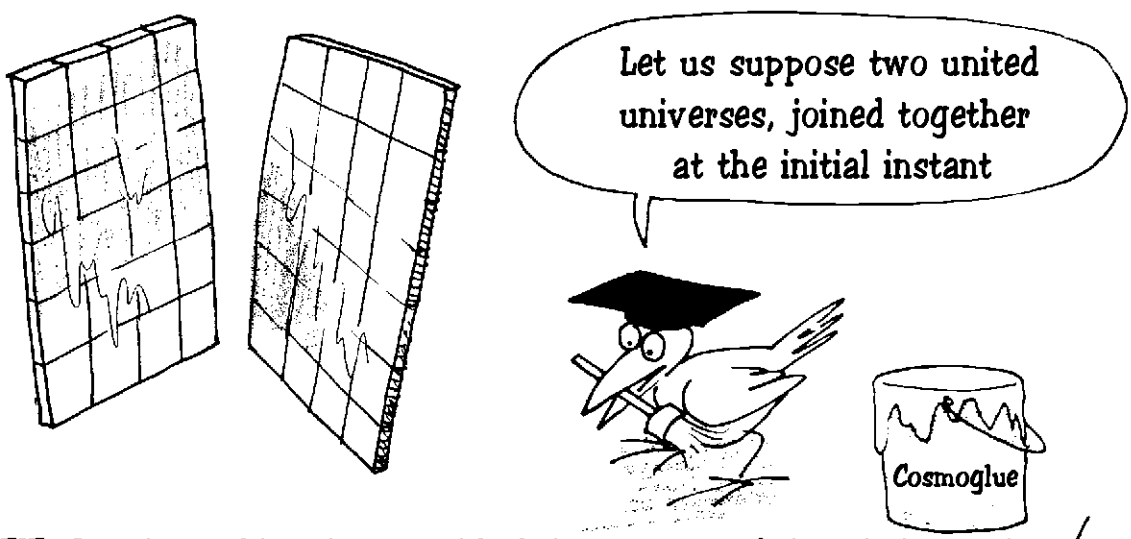
And that would make radio noise so loud that it could be heard from one end of the Universe to the other


But we do not detect this matter - anti-matter annihilation

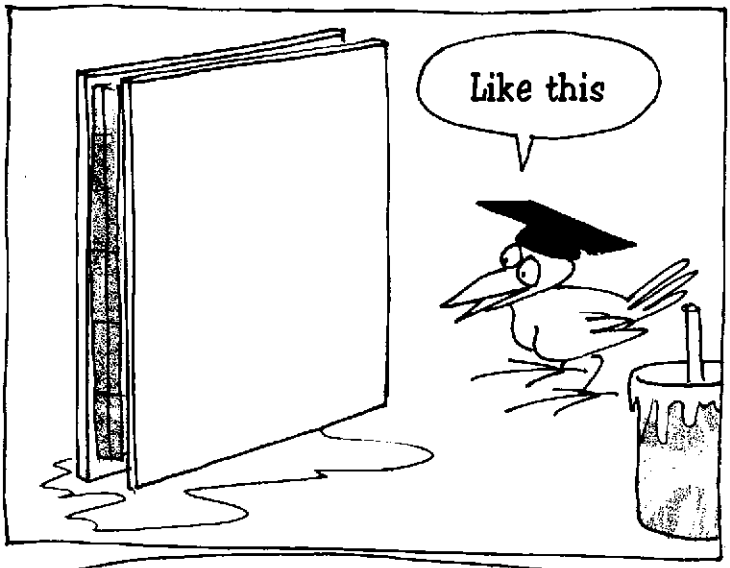
Worrying

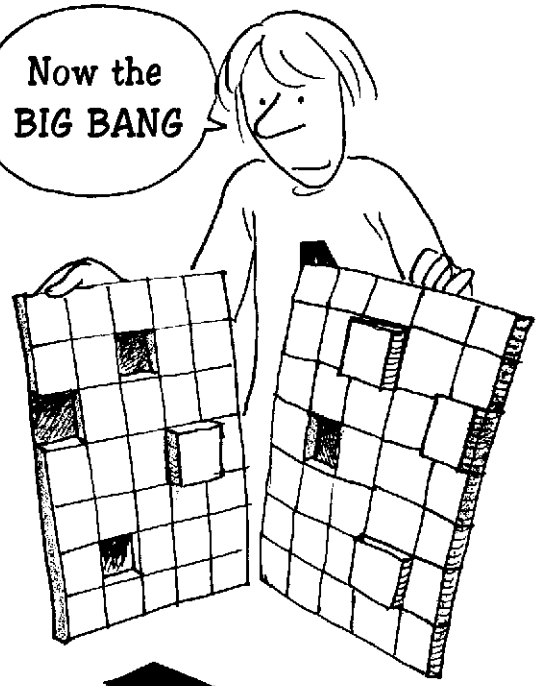



# THEORY OF A. SAKHAROV and J.P. PETIT (*)



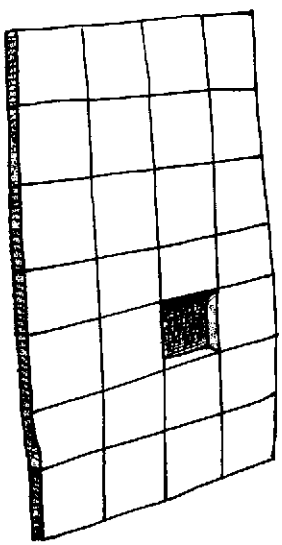

(*) J.P PETIT: Enantiomorphic universes with their own opposed times in interaction with their image in the mirror of time. Accounts of the Paris Academy of Science, volume 284 (23 May 1977) series A, page 1315 and volume 284 (6 June 1977), page 1413.



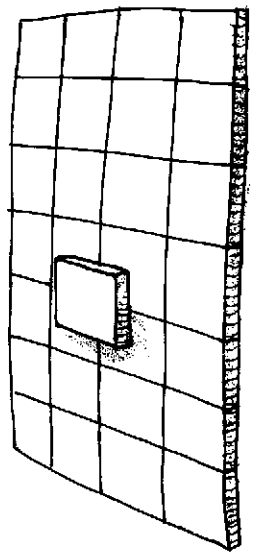




By separating these sheets it might be that on each paving certain tiles have been pulled off and others are extra-thick

In each of these universes the extra-thick tiles will lodge in the free areas. If the situation is perfectly symmetrical we'd find the intial flatness again.

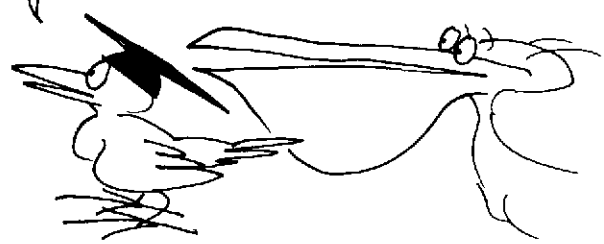


ANTI-UNIVERSE
(anti-matter)

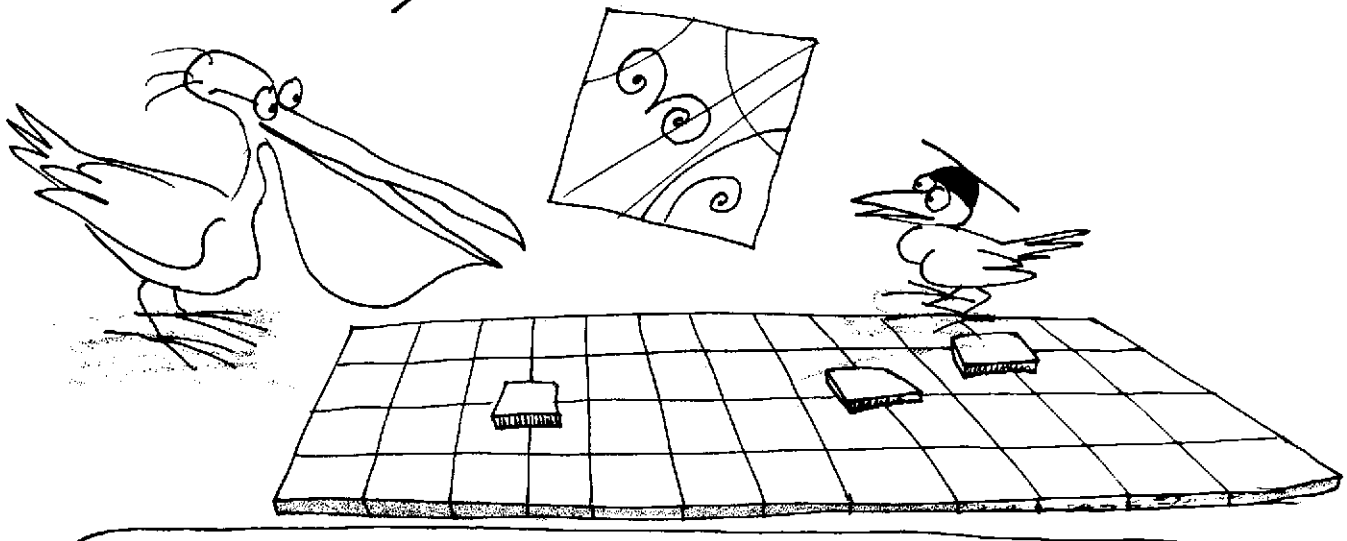


UNIVERSE
(matter)

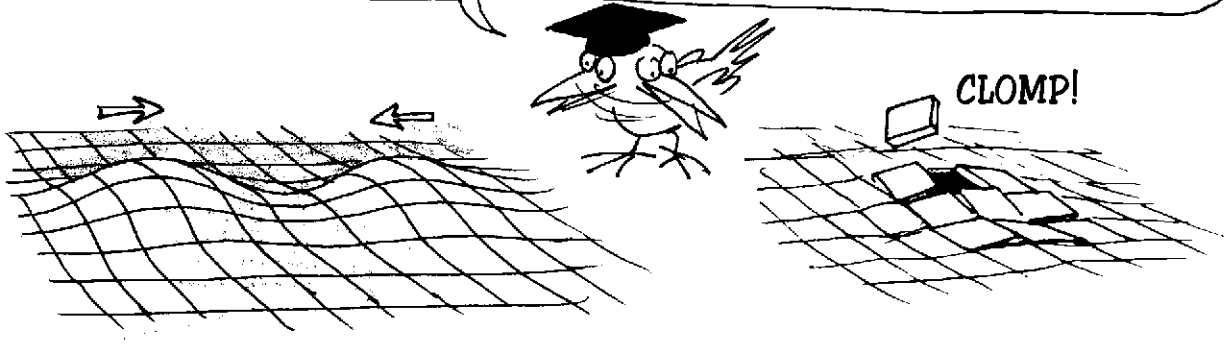
However, if a SYMMETRY BREAK occurs, there will be an excess of matter in one of these universes and an excess of anti-matter in the other, which could no longer annihilate each other.



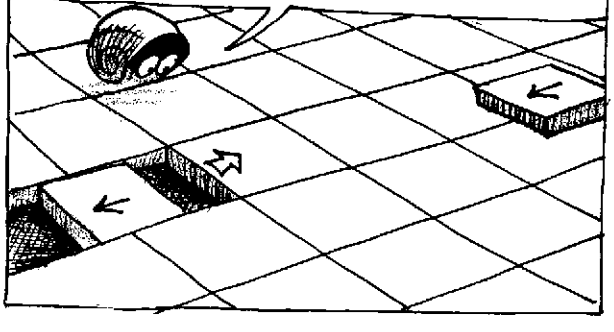
But...to what does the anti-matter discovered in cosmic rays, a little while after Dirac's discovery, correspond, or that that's created in laboratories?



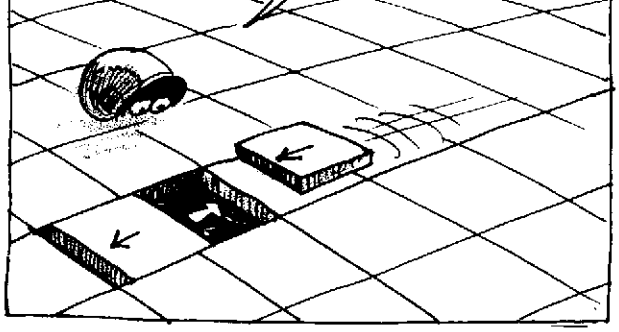
Down here there is nothing to stop us from creating strong energy concentrations in giant particle accelerators, to the point of detaching another tile, that is to say the creation of a matter-anti-matter PAIR.



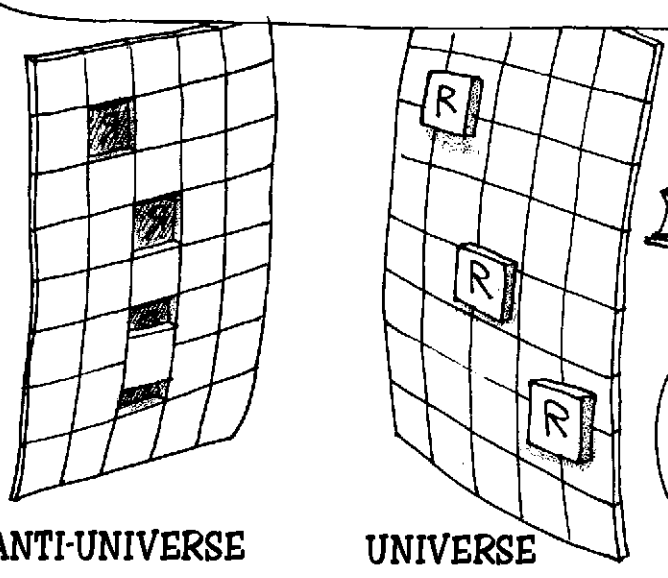

But if you don't take precautions to keep this anti-matter at a distance from matter



it will immediately annihilate itself.



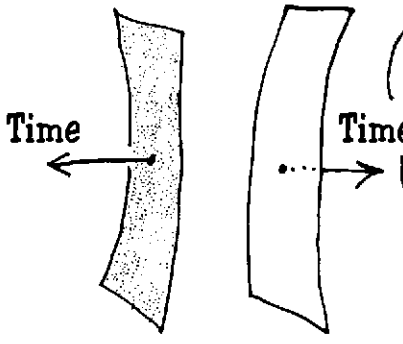
Andrei Sakharov used this twin vision to explain the apparent absence of anti-matter on our "side" of the Universe




ANTI-UNIVERSE

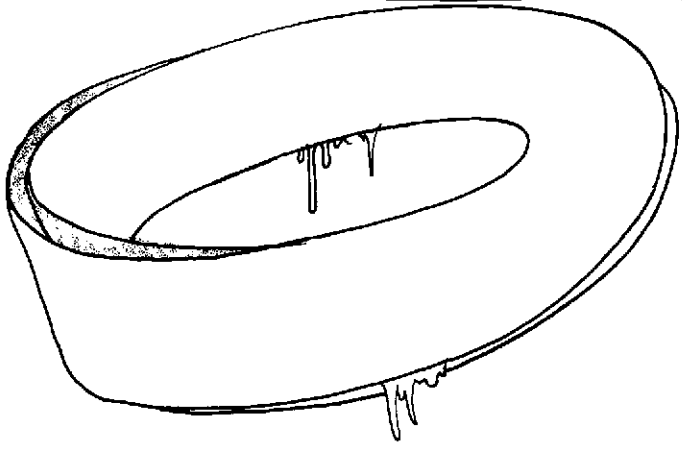
UNIVERSE

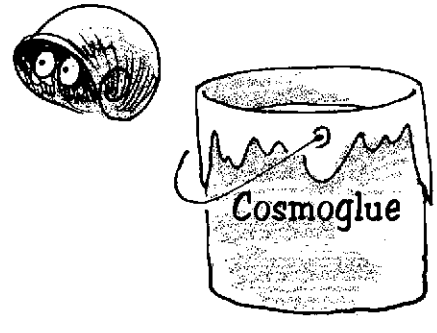
The two TWIN UNIVERSES present inverted PARITIES (broken RIGHT-LEFT symmetry)

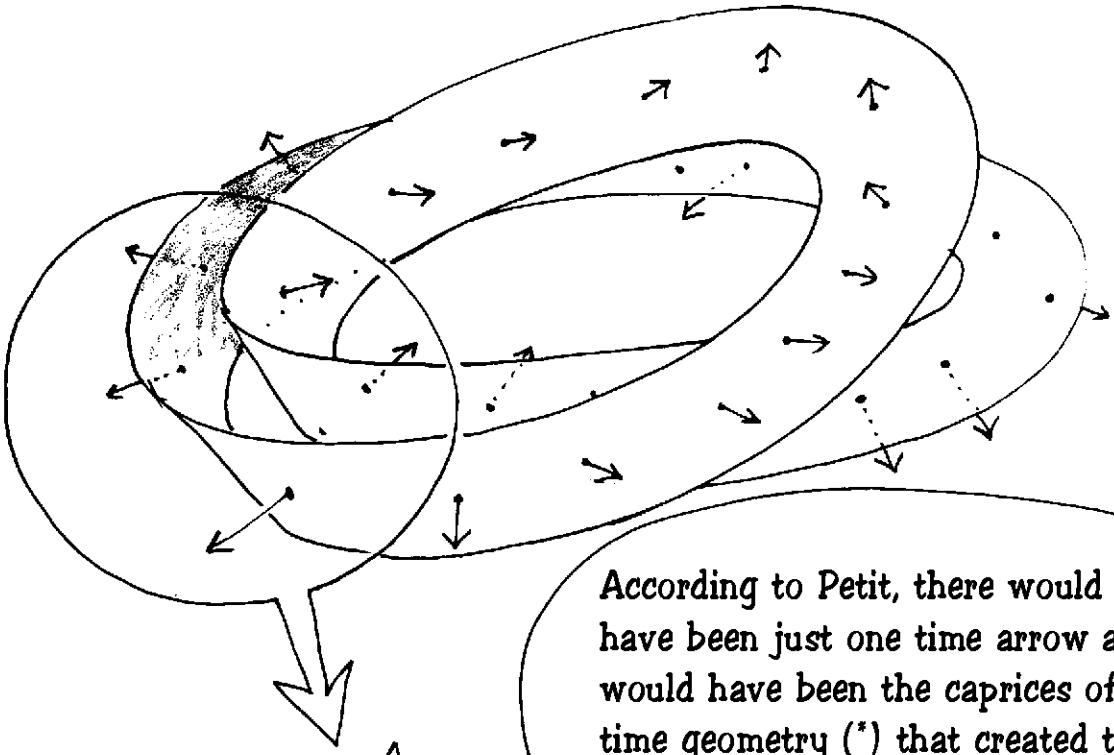



The TIME ARROWS will also be in opposition, the future of one universe being the past of the other.

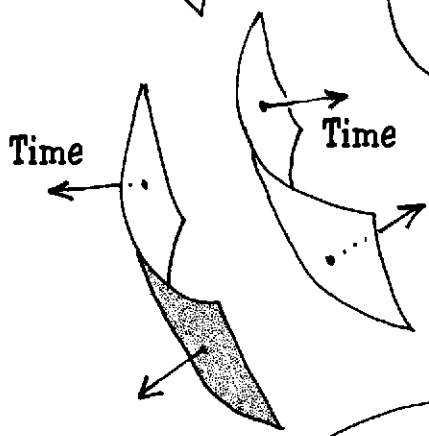
The same approach was effected independently by Jean-Pierre Petit in 1977, he believes that there was just one universe, initially attached to itself along a "three dimensional Moebius strip"



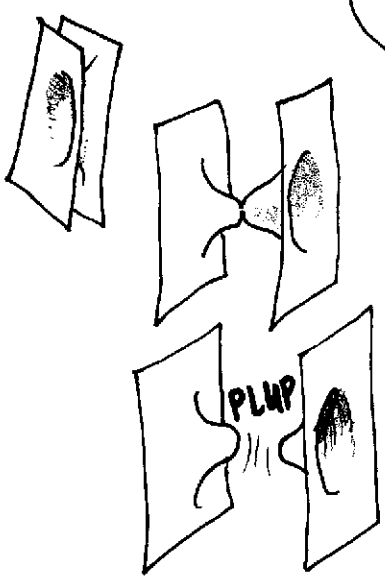




According to Petit, there would then have been just one time arrow and it would have been the caprices of space-time geometry (*) that created this TWIN STRUCTURE illusion

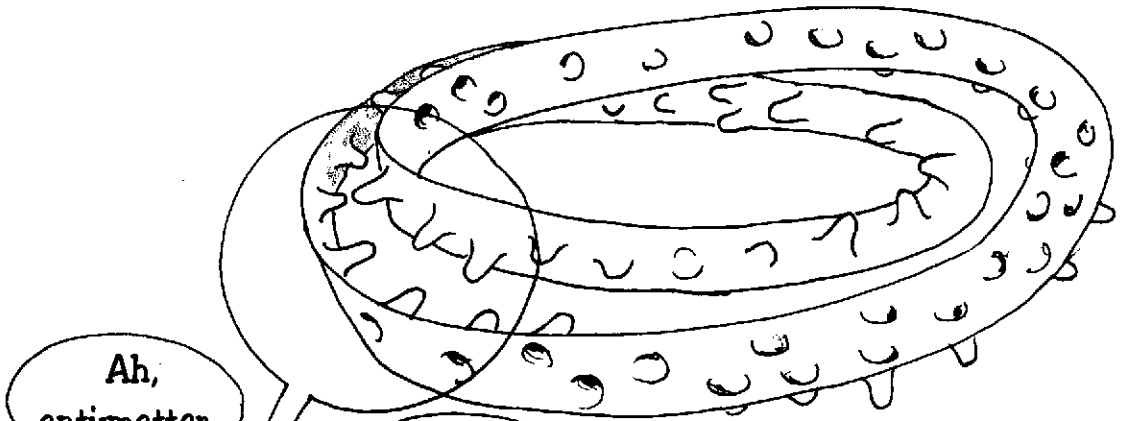



There would also have been just one sort of matter, anti-matter being, according to the term of Abbé Lemaître, "seen backwards"




These would have been residual curvature deformations

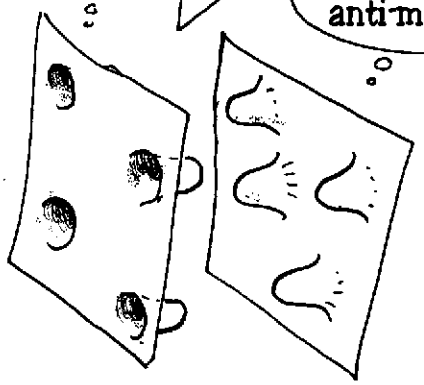
(*) See TOPO THE WORLD.



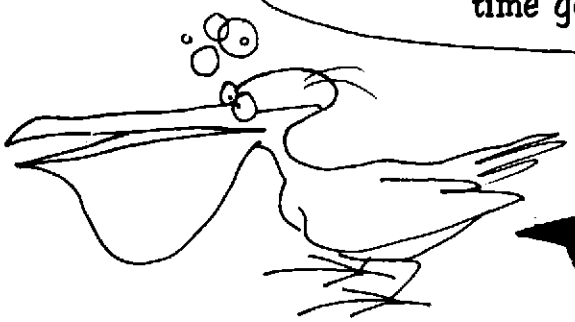
Ah, anti-matter

Ah, anti-matter

Geometric configuration with the appearance of a duality matter - anti-matter

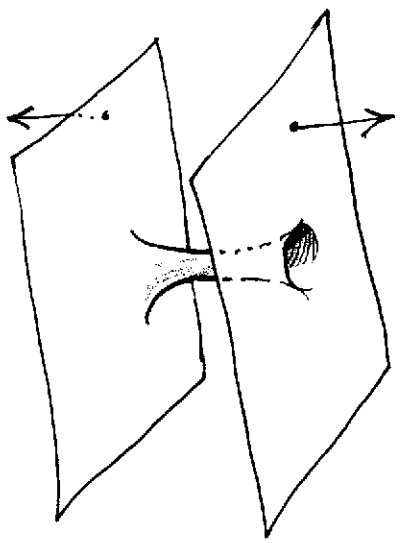


If I understand correctly, first it's impossible to go beyond the BIG BANG because then time freezes in chronometers and, in any case, on the other side time goes backwards



And Sophie, feeling better?

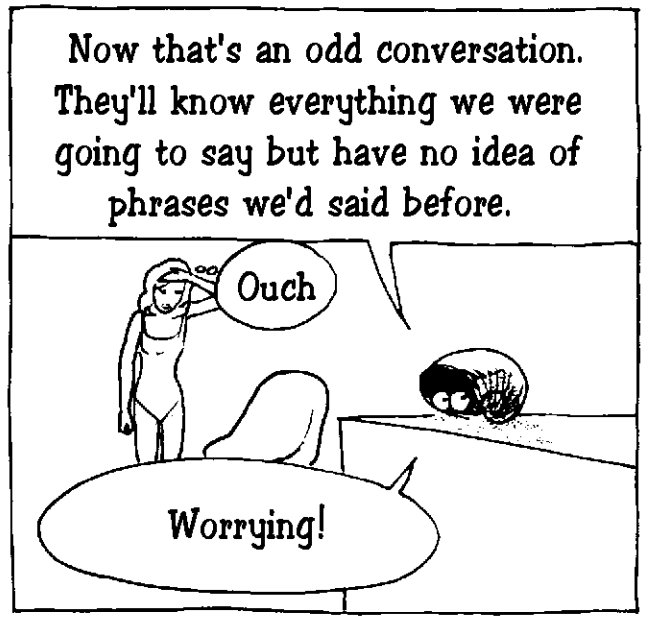
Yes

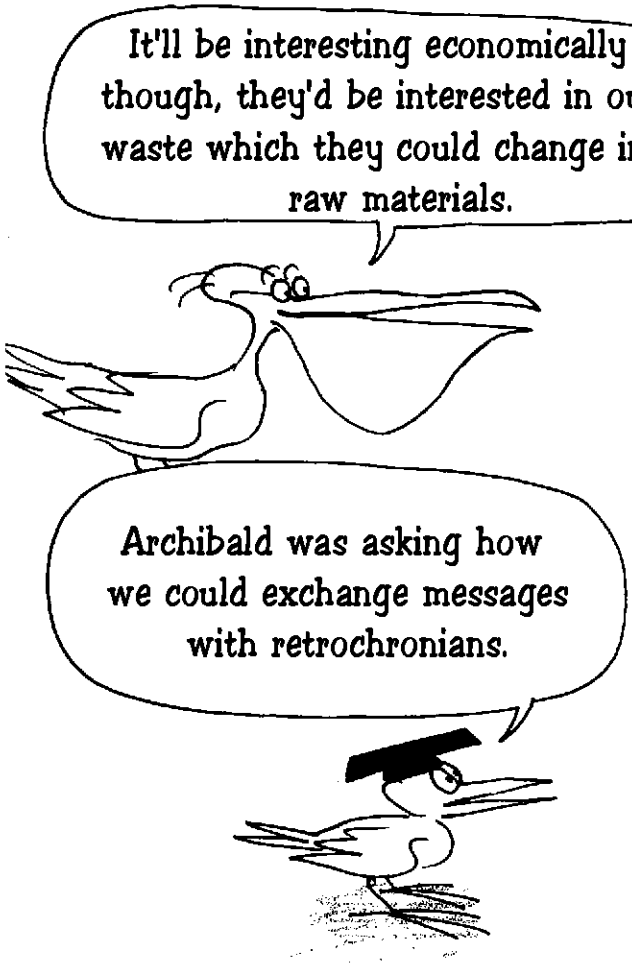


Could we pass through to the other side with the help of black holes and find ourselves among the RETROCHRONIANS?

Gosh!...

# DIACHRONIC AND RETROCHRONIC



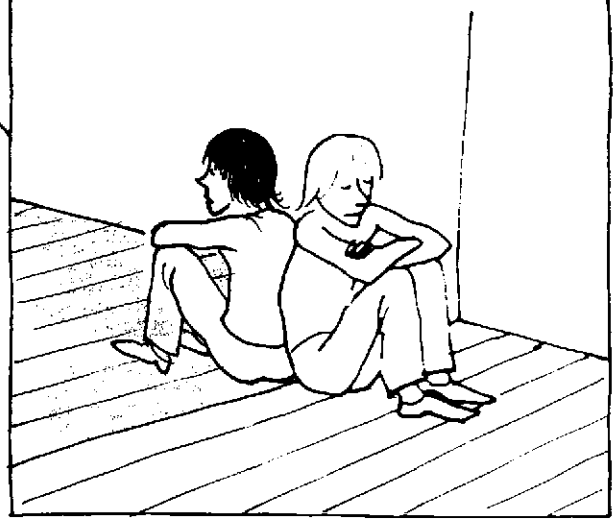
That seems difficult to me because if we sent them a message, when they received it, in their time, they would be sending it.
So with these people all dialogue would be impossible?
Or a person exists with whom we could never exchange information.
Who?
Yourself.
!!!
Try sending yourself a message through the mirror.
You won't learn much.
But...for the Universe?

You like stories.
I'll tell you one.

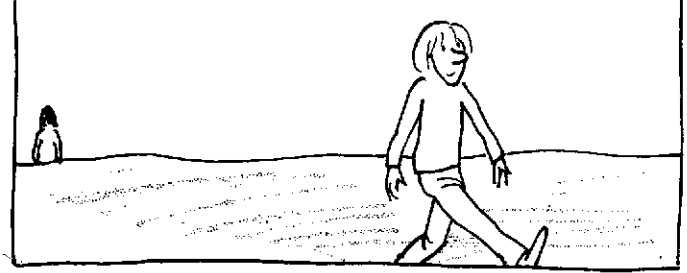
Yes please.

A

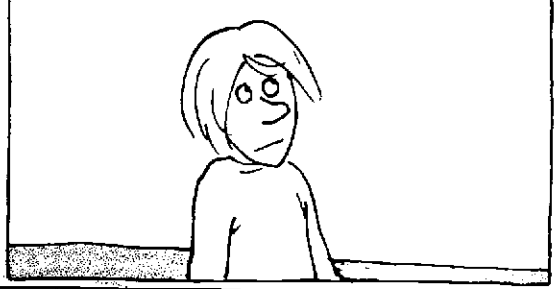
Once upon a time there were two young boys who spent their days pressed back to back, like bookends.



They lived in the same house and on the same landing. One day they went straight out from where they lived, the brown haired one to the west, the blond to the east.

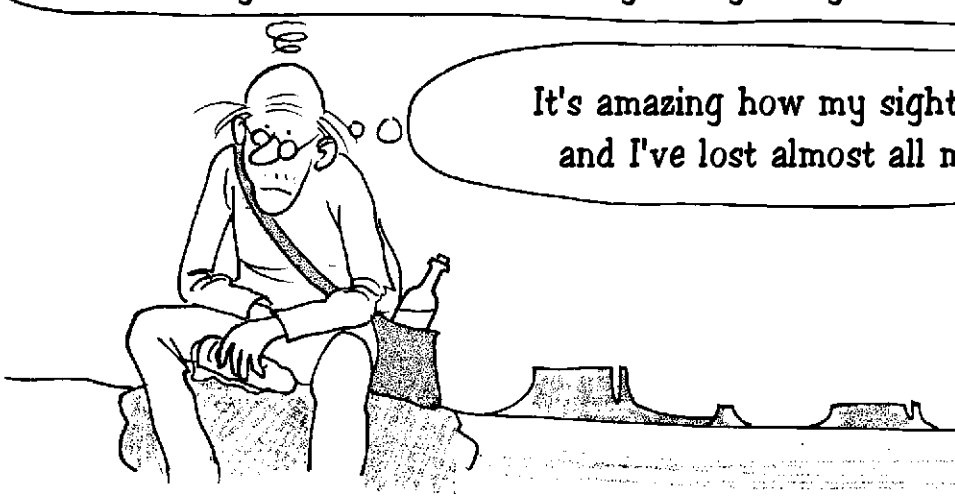


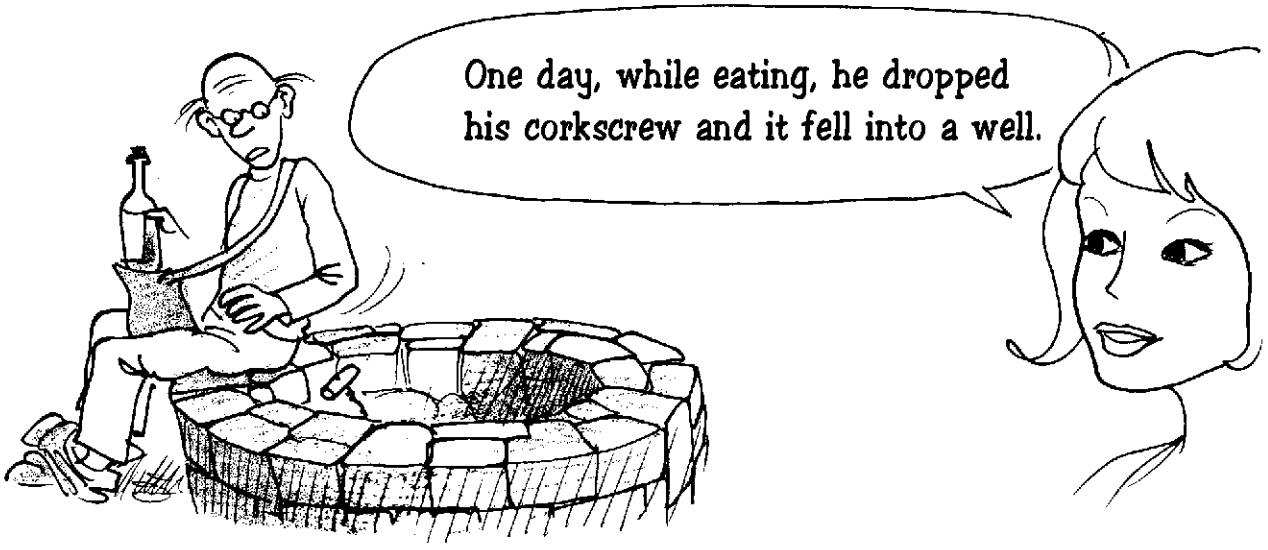
The blond said "if the world is round, by walking straight we should go right round and meet each other half way".



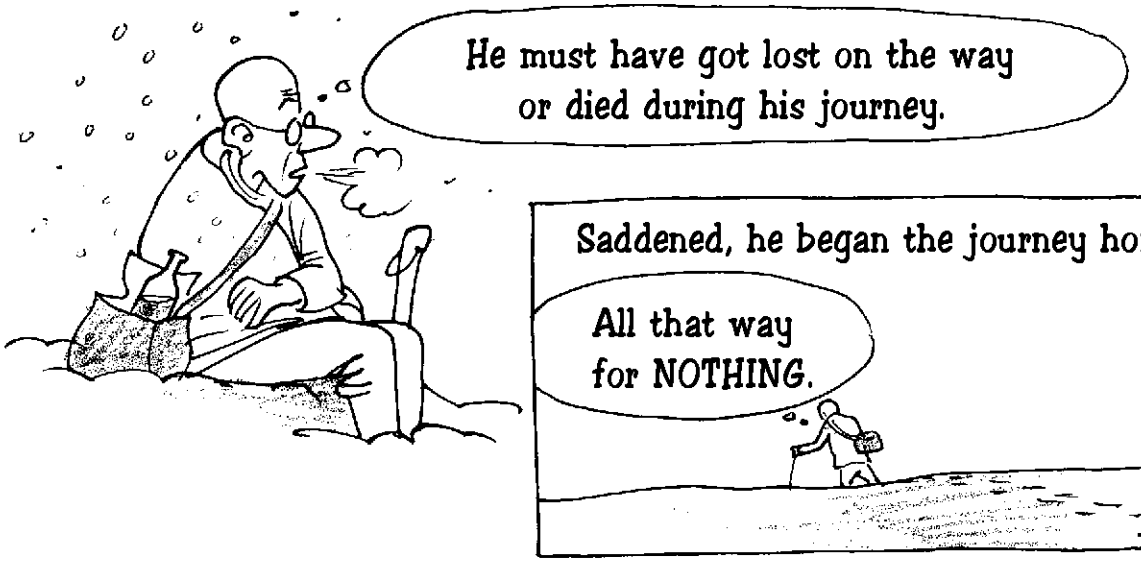
The journey was unimaginably long and the blond thought he wouldn't live long enough to get to the end.

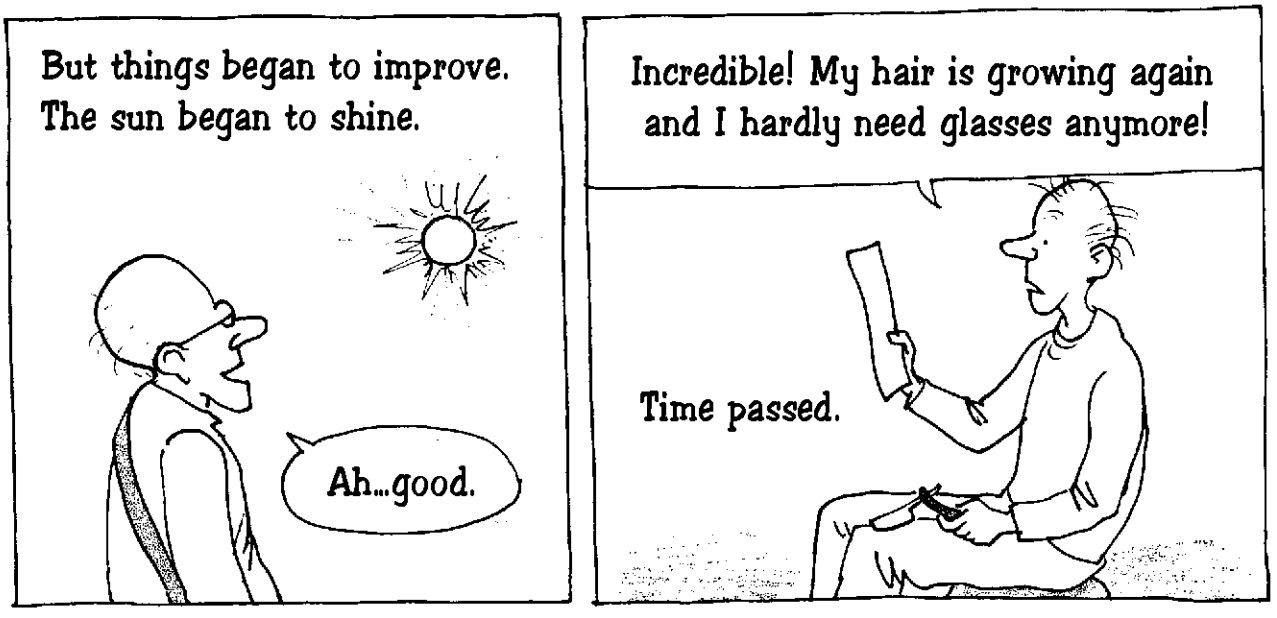
It's amazing how my sight is going and I've lost almost all my hair.






When he was halfway, at the other side of the world, it was very cold and he suffered because he had lost all his hair. He waited for his companion in vain.



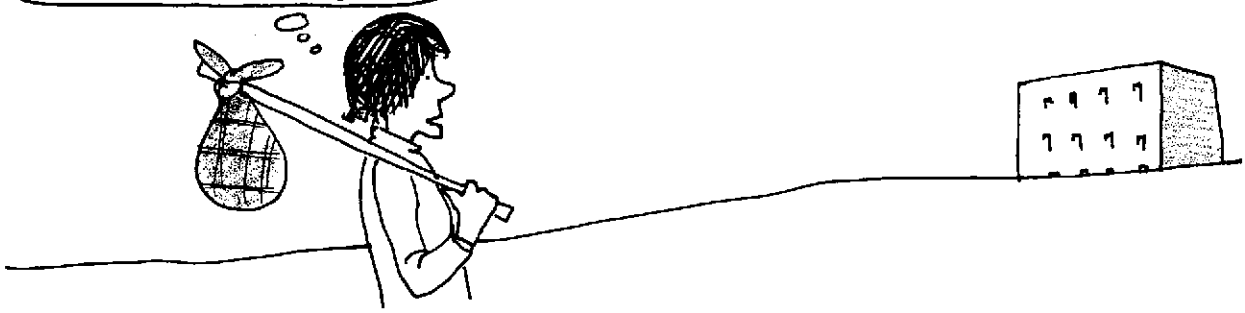



The loss of his corkscrew bothered him but one day while eating by the side of a well, a corkscrew popped out.

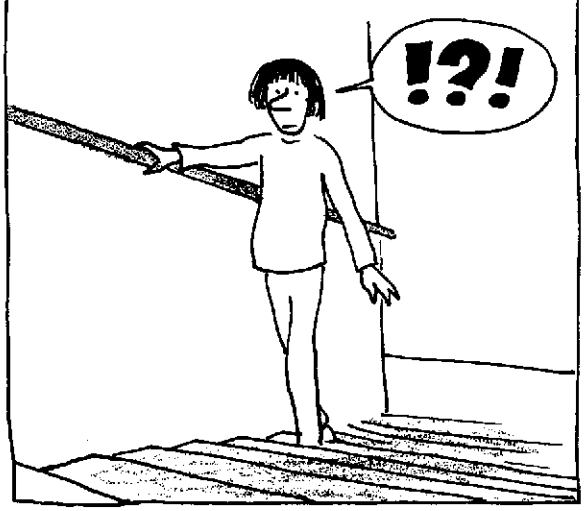
However, despite his efforts, he couldn't use it.


Finally, in the distance, he saw the building he had left so long ago.

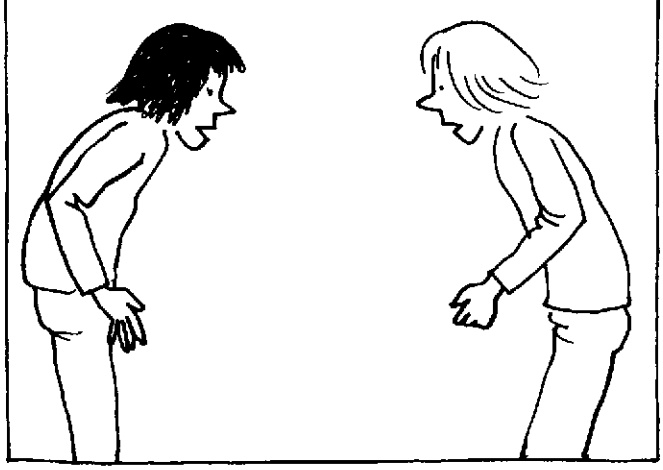
The circle was completed.



He climbed the stairs and came face to face...




...with a young, blond boy...




(*) See The Black Hole, page 61.

# TIME AND QUANTUM MECHANICS


(*) See Annex D.

That would mean that the present has a finite thickness.

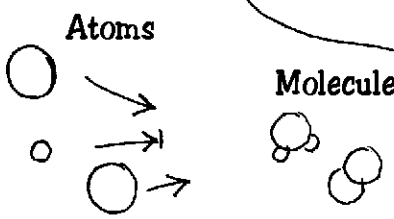
It also means that for quanticians the past stops at $10^{-43}$ sec. They are also unable to conceptually reach the time t = 0.

Really...

So what are we talking about exactly? If the Universe is a machine what are its main mechanisms?

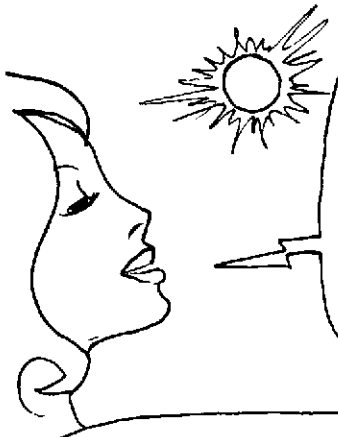
Schematically the known Universe is a mix of photons and particles of matter, in a ratio of a thousand million to one. Gravity creates assemblies of matter where FUSION continually converts matter into radiation. The products of these reactions are called "atoms" (*).

These products of NUCLEOSYNTHESIS can interreact, either spontaneously or by reabsorbing photons (PHOTOSYNTHESIS), producing assemblies called molecules. Atoms can also decompose by re-emitting photons (NUCLEAR FISSION).

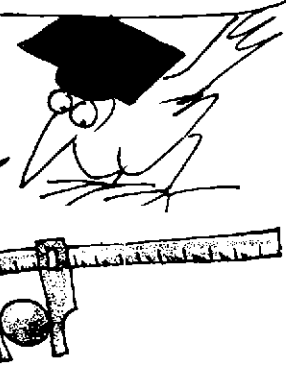




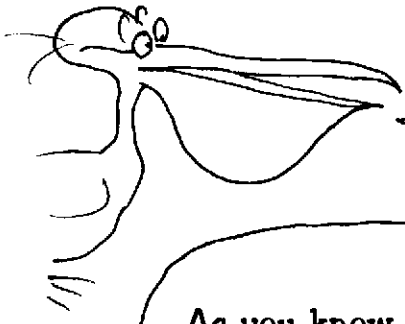
(*) See A Thousand Million Suns.



Matter and light are two manifestations of one and the same entity. ENERGY-MATTER and all these phenomena just translate as a slow reconversion of a part of matter in the form of photons.



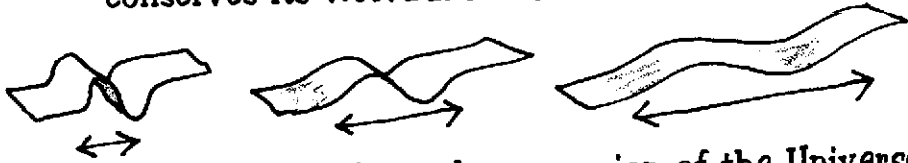
At the beginning of the century it was supposed that particles of matter kept an invariable size, that is to say that the energy-matter they contained was conserved with time.



What is the magic link between an object's size and its energy?

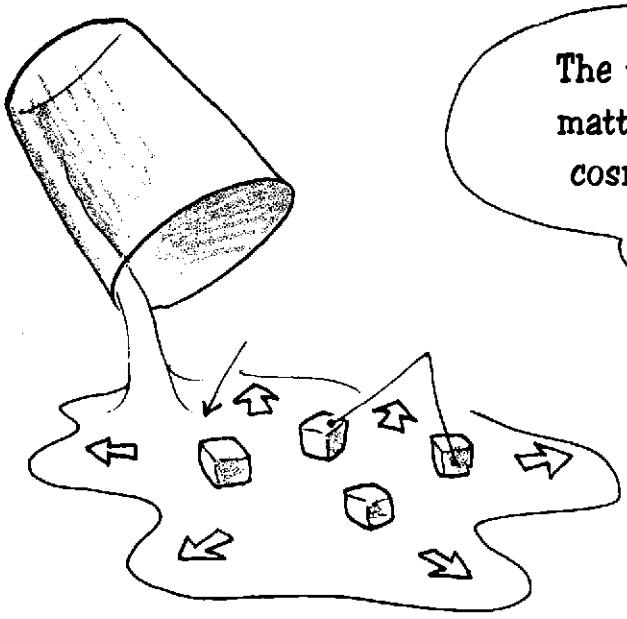
As you know in quantum mechanics all particles are considered to be undulations of space, to WAVE PACKETS. By definition if E is the quantity of energy-matter carried by a particle, the associated wavelength is $\lambda = hc/E$ (*)

The wave packet that a particle of MATTER represents conserves its WAVELENGTH over time.



A PHOTON follows the expansion of the Universe.

(*) h: Planck's constant
c: Speed of light



The two forms of ENERGY- MATTER, matter and photons, don't experience cosmic expansion in the same way.

Ah yes, matter is FROZEN energy - matter (*)

In short, the Universe is made up of grains of matter and photons with a lot of EMPTINESS around them.

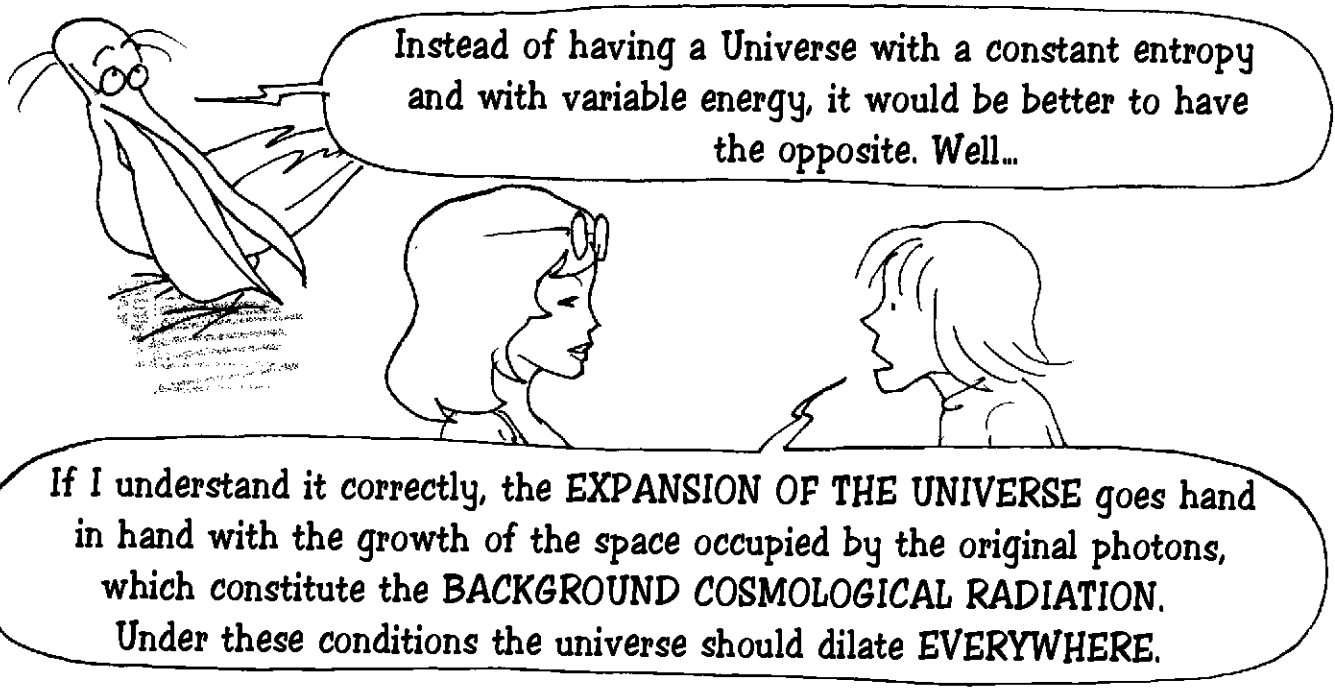
No, no Leon, EMPTINESS, the void, doesn't exist. In quantum mechanics the Universe is a surface that isn't "SMOOTH" anywhere. Certains folds are as if starched and represent matter. Other folds, photons, can stretch and that's what allows the Universe to expand.

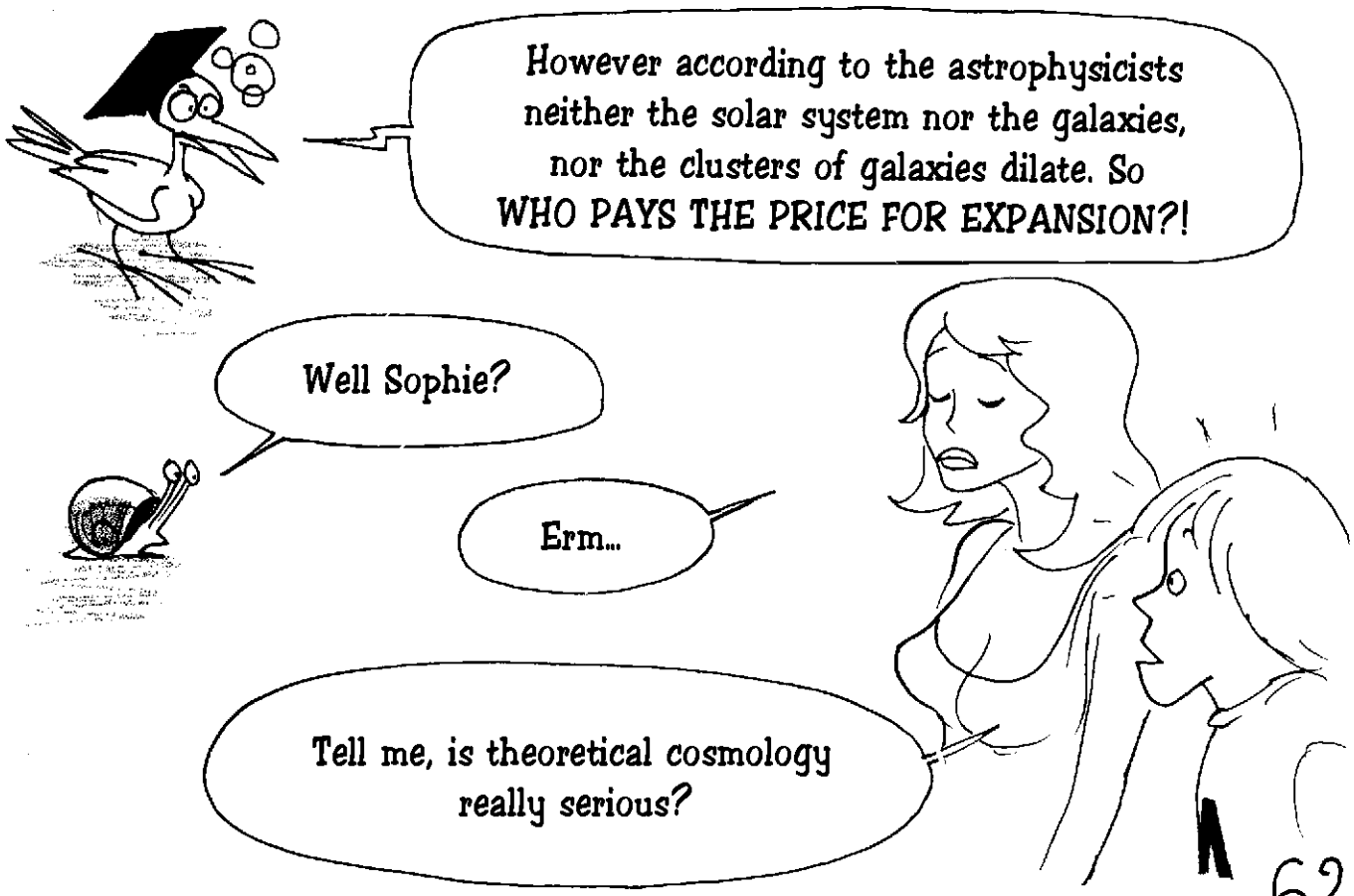
But... wait... If energy varies as the inverse of the wavelength, the spatial extension of a particle, then this photon distension translates as a CONTINUOUS LOSS OF ENERGY by the Universe.

And obviously no one gives a fig.

(*) See BIG BANG.

# COSMIC EXPANSION



After all, maybe the Universe is just the fruit of our IMAGINATION.

Come on, Tiresias, don't be silly. What do you do with EXPERIMENTAL FACTS, OBSERVATIONS?!? If we believe in cosmic expansion it's because of the RED SHIFT.

Look at these two spectra. One is produced by hydrogen heated to a high temperature, the other is of decomposed light sent by a distant galaxy and shows an important shift towards red. From this DATA we deduce the RECESSION SPEED. Where's the imagination in that?

How can you be sure that this red shift is due to the DOPPLER-FIZEAU effect?

What do you want it to be due to? That the light got tired?...

The cosmologist and philosopher MILNE, who refused the idea of the expansion of the Universe, gave a completely different signification for this photon frequency reduction .

A photon's energy is hv, where h is Planck's constant and v the frequency. MILNE said "Let us suppose that a photon's energy is conserved but that h increases proportionally to time. Then, at the reception of the message, we would measure a lower frequency v, without a DOPPLER effect, without expansion".

A STATIC universe! My friend that doesn't work. What do you do with fossil radiation, the trace of PRIMORDIAL EXPANSION?

OK, let's go back to an expanding universe, but expanding in relation to WHAT?

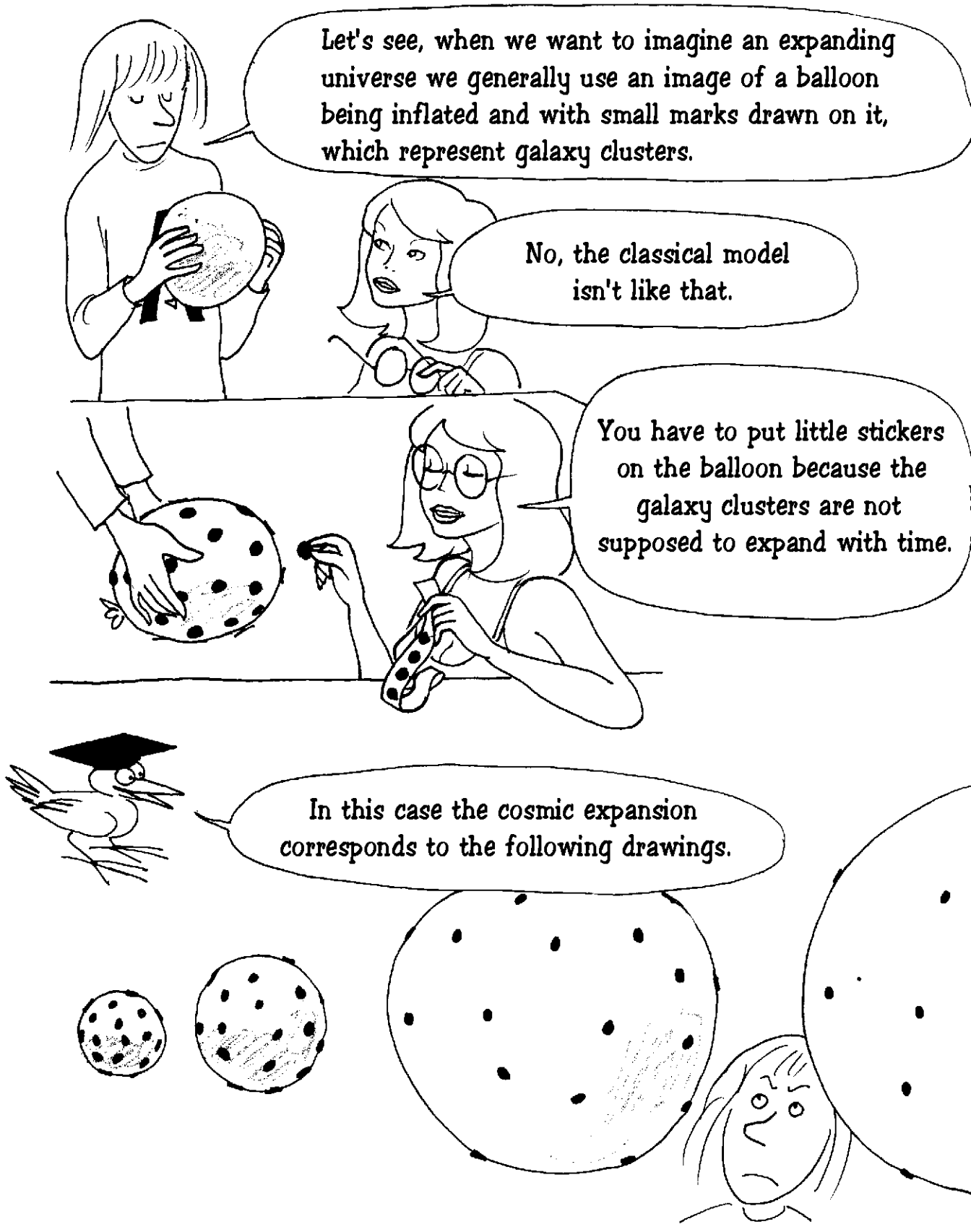
Is there a COSMOTOPE? (*)

A nonsense! The container and the content of the Universe are one and the same object. The only thing that counts is the measure of the shift

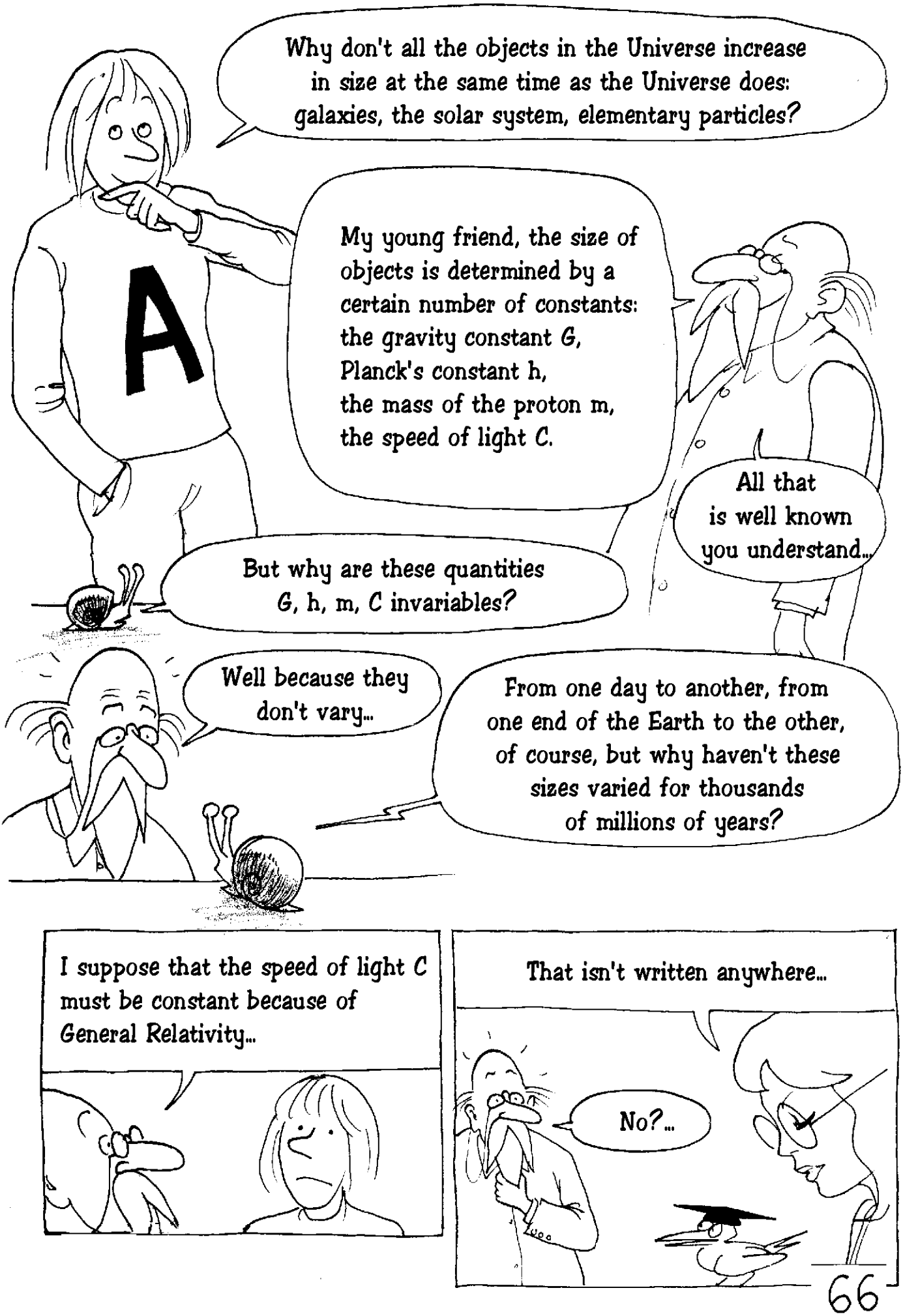
In any case we can't go and measure in-situ things that are millions of light years away. We have to build a SYSTEM OF REPRESENTATIONS that will account for observations in an acceptable way. In Science we never do anything other than to KEEP UP APPEARANCES.

(*) Literally: "the place where the universe is".

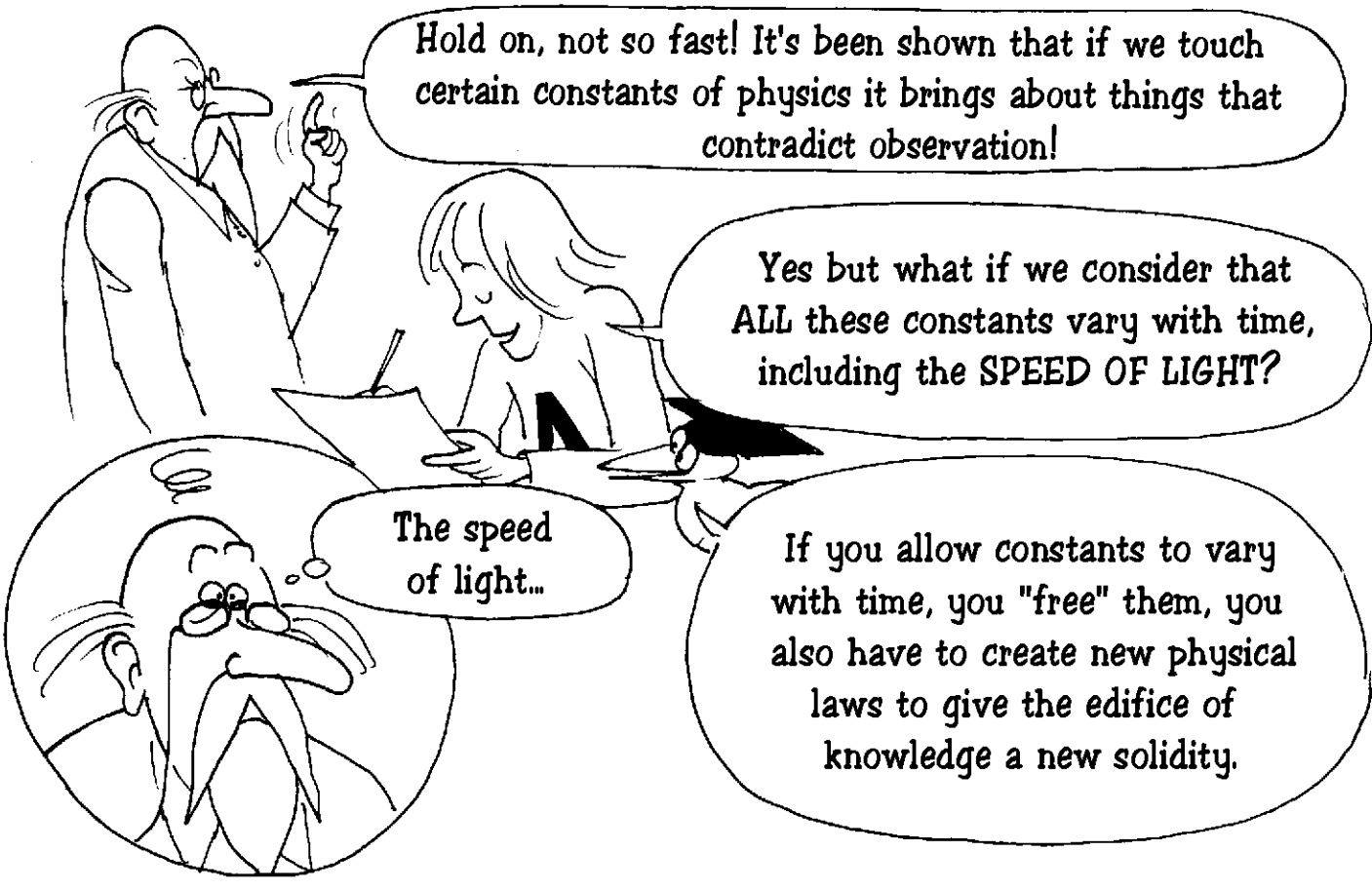
# YELLOW MODEL (*)



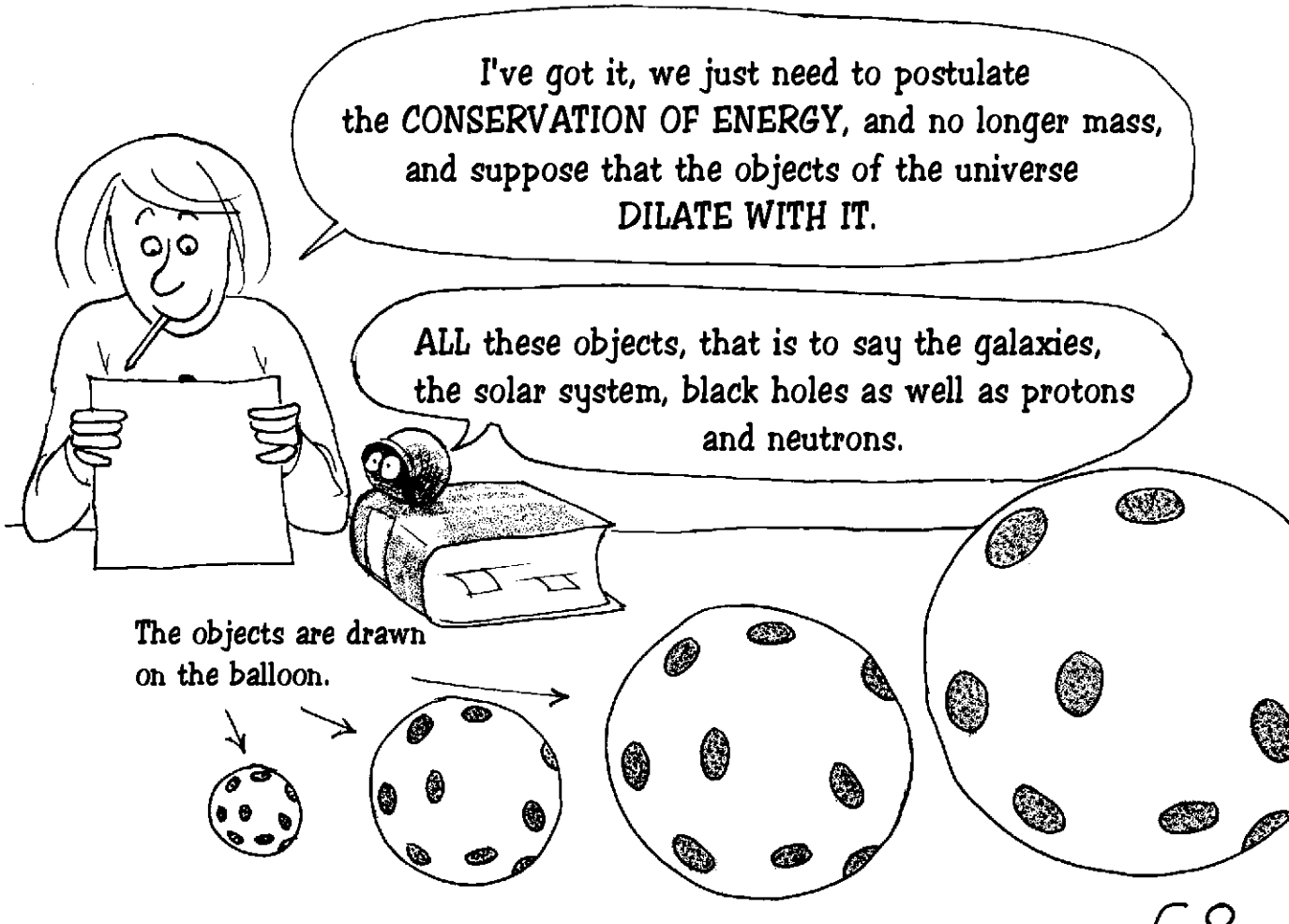

(*) "An interpretation of cosmological model with variable light velocity": JP Petit, Modern Physics letters A, Vol. 3, N° 16 (1988) Page 1527-1532.
"Cosmological model with variable light velocity, the interpretation of red shifts": JP Petit, Modern Physics letters A, Vol. 3, N° 18 (1988), page 1733-1744.

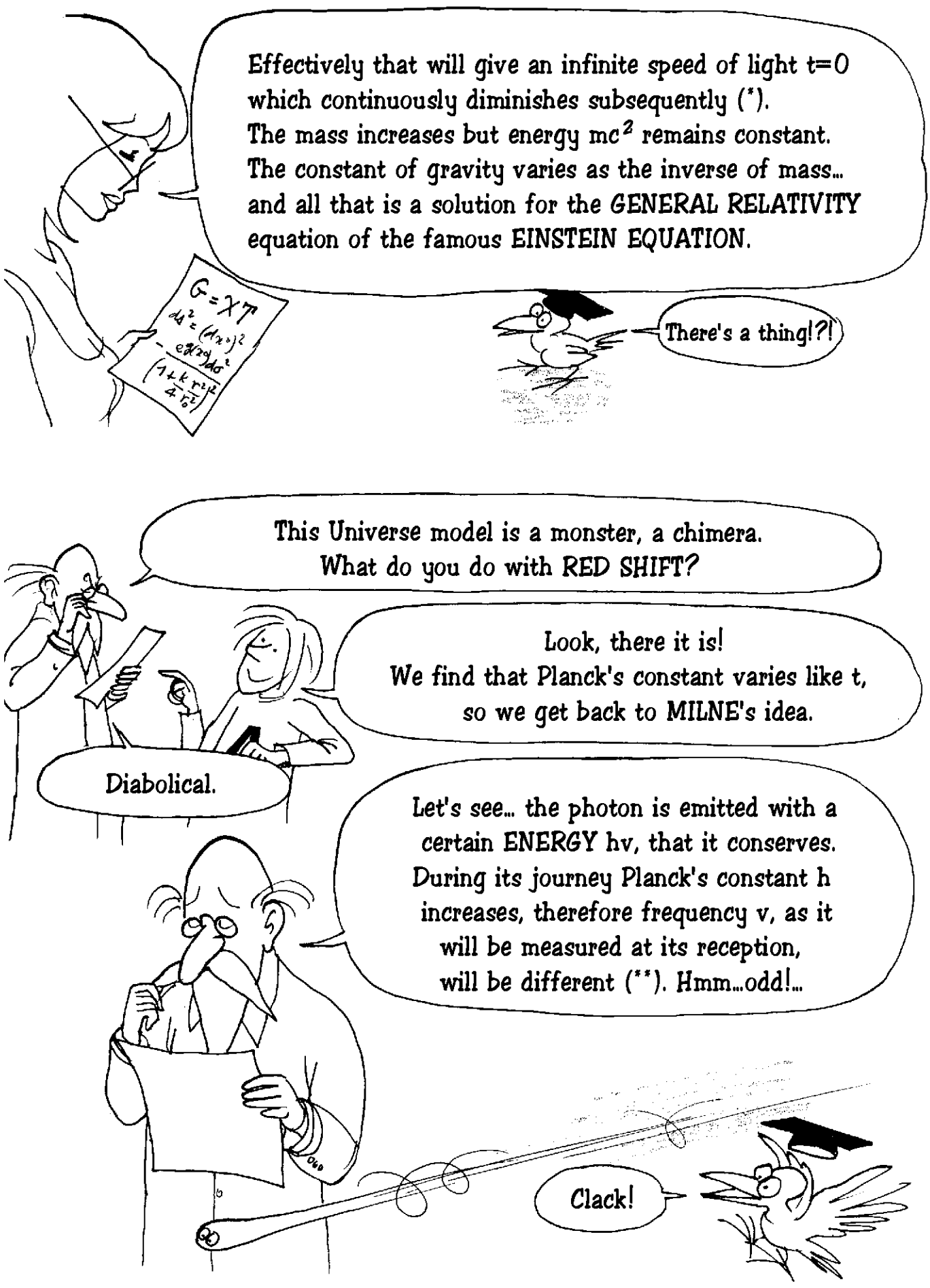

Why don't all the objects in the Universe increase in size at the same time as the Universe does: galaxies, the solar system, elementary particles?
A
My young friend, the size of objects is determined by a certain number of constants: the gravity constant G, Planck's constant h, the mass of the proton m, the speed of light C.
All that is well known you understand...
But why are these quantities G, h, m, C invariables?
Well because they don't vary...
From one day to another, from one end of the Earth to the other, of course, but why haven't these sizes varied for thousands of millions of years?
I suppose that the speed of light C must be constant because of General Relativity...
That isn't written anywhere...
No?...


(*) See 'Cosmic Story", page 26.



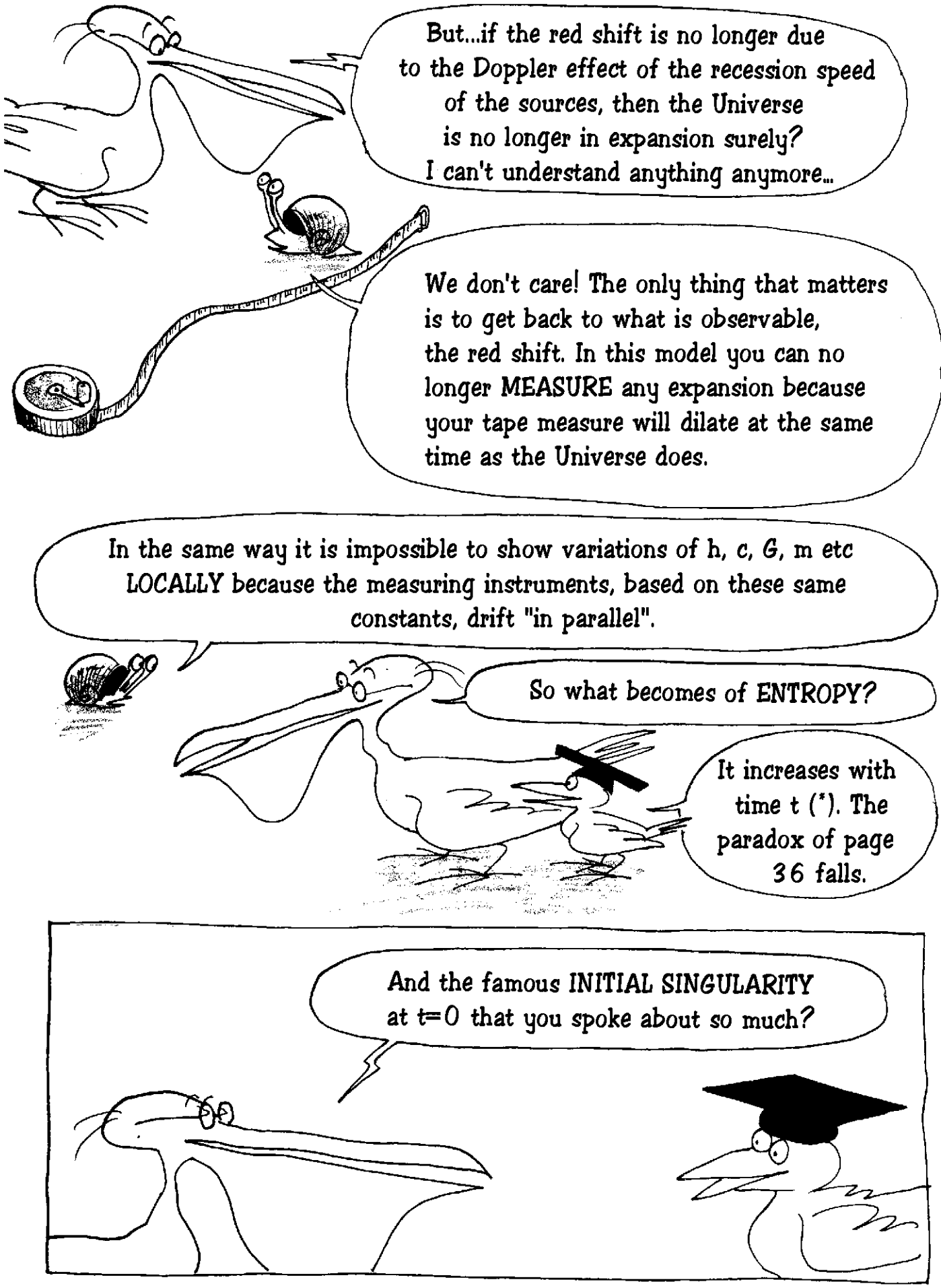

# SUPER-RELATIVITY






(*) In this model the speed of light C varies as $1/\sqrt[3]{t}$.

(**) The shift $\Delta v$ of frequency is proportional to the distance to the source. This brings us back to HUBBLE'S LAW.

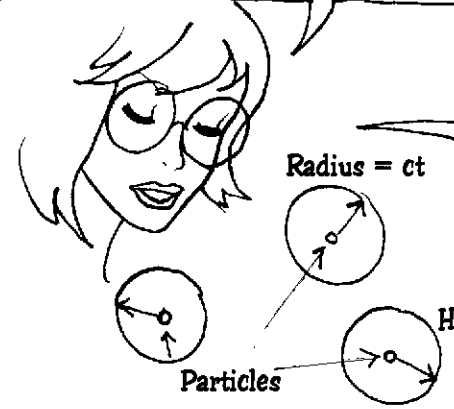



(*) In this model entropy S varies as Log t (Annex F).

If we swap the CHRONOLOGICAL VARIABLE t for ENTROPY S the singularity no longer exists, because then this so-called "INITIAL INSTANT" corresponds to $S = -\infty$ (*). The Question of the state of the Universe BEFORE the big bang becomes meaningless.

Which means that TIME will not be the right VARIABLE to describe the EVENTS but a sort of illusory mirage.

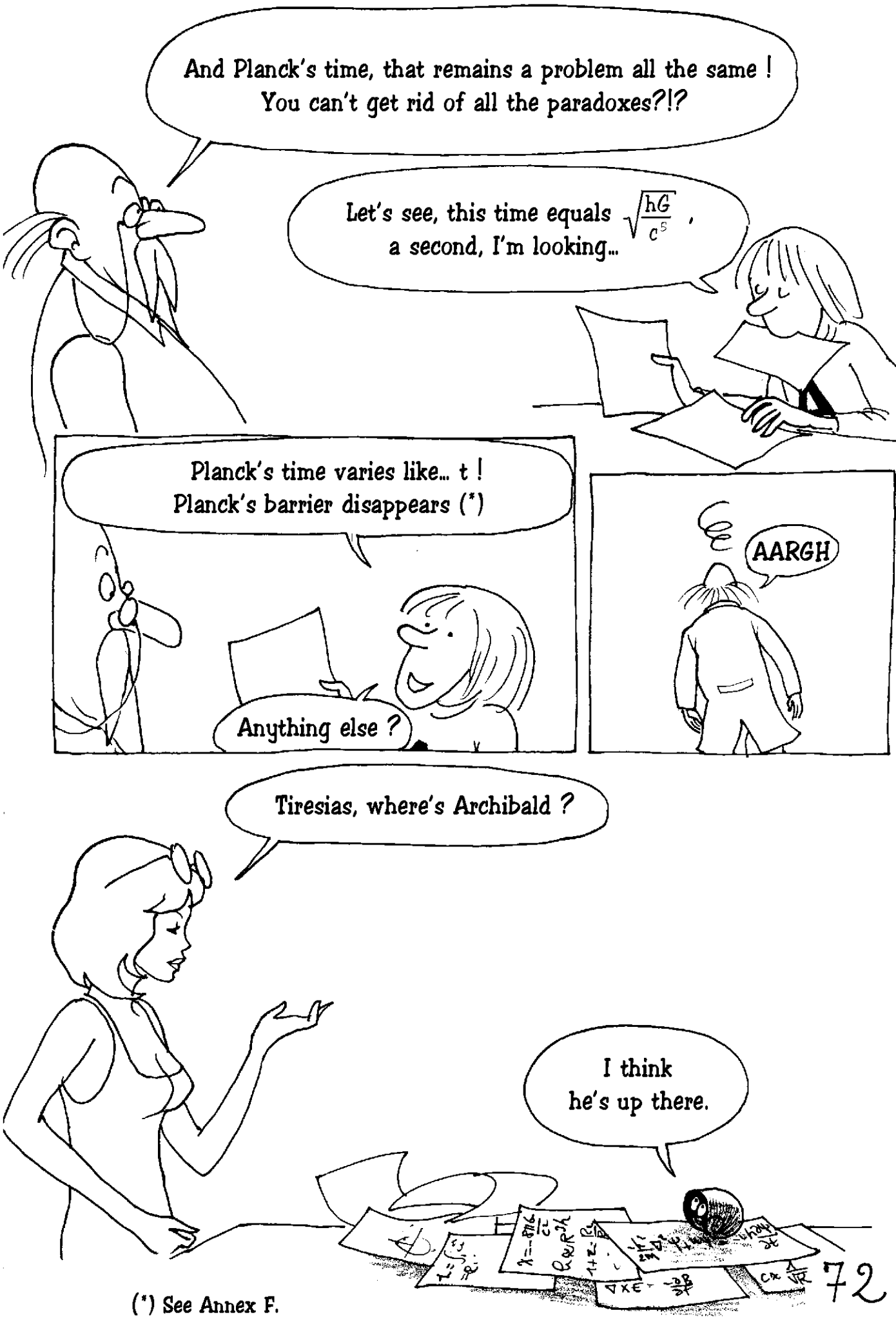
Well as we're attacking paradoxes...we saw on page 36 that no-one knows how to explain the apparent disorder and remarkable homogenity of the Universe because, when it was young, particles completely ignored each other.



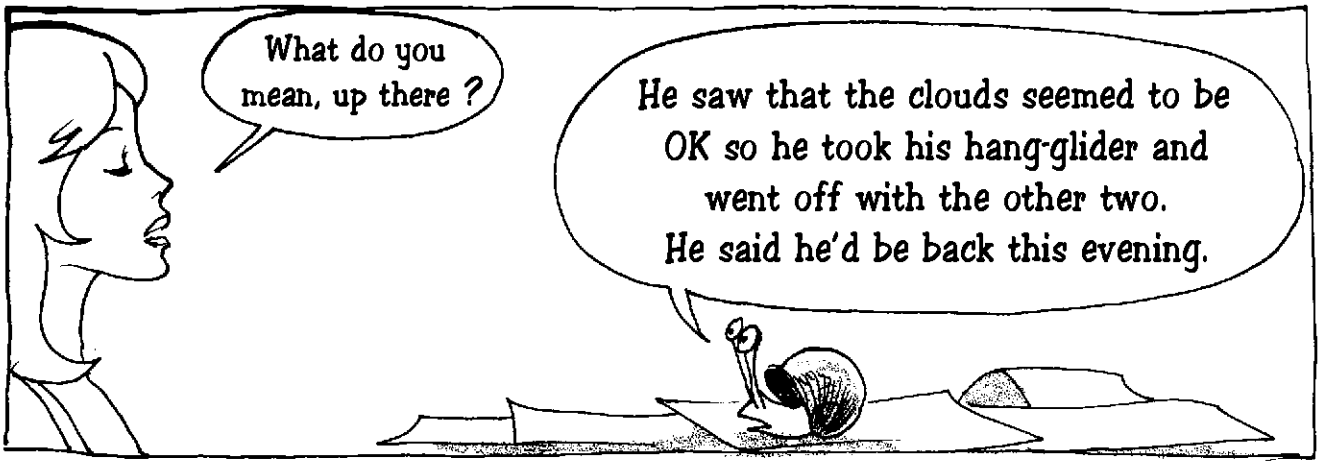

These particles emitted a luminous wave, at speed C and at time t = 0, but they distanced themselves so rapidly from each other that their "HORIZON SPHERES" did not interpenetrate. They are in a state of perfect AUTISM (*)

However, in SUPER RELATIVITY the horizon spheres interpenetrate during every epoch, they grow at the same speed as the Universe itself. Particles interact. DISORDER and HOMOGENITY are thus justified.

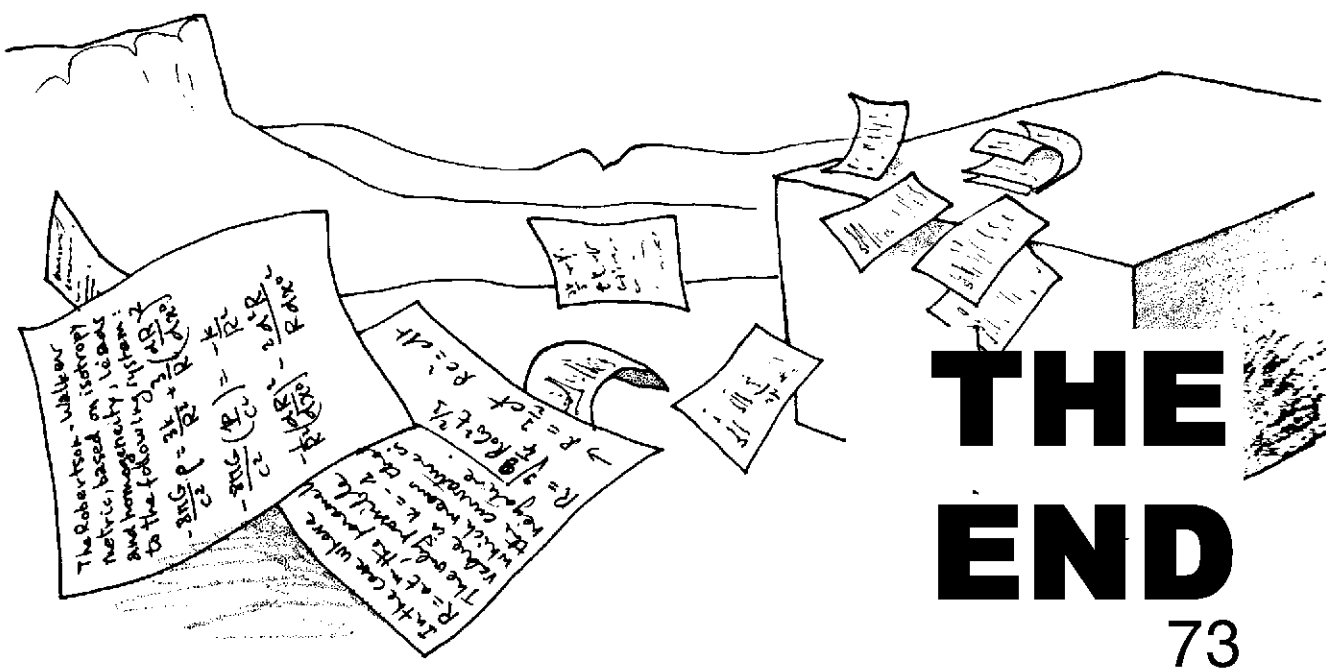
(*) Psychiatry : Total absence of communication with others.


And Planck's time, that remains a problem all the same ! You can't get rid of all the paradoxes?!?
Let's see, this time equals $\sqrt{\frac{hG}{c^5}}$ , a second, I'm looking...
Planck's time varies like... t ! Planck's barrier disappears (*)
Anything else ?
AARGH
Tiresias, where's Archibald ?
I think he's up there.

(*) See Annex F.

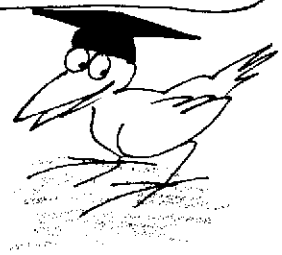

What do you mean, up there ?
He saw that the clouds seemed to be OK so he took his hang-glider and went off with the other two. He said he'd be back this evening.


One day I'll fly too, there's no reason why not...



# THE END

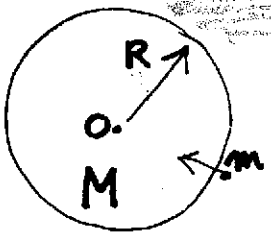
Modern science has the reputation of being built from dreadfully complicated equations that only a very limited number of "brain boxes" can understand.
But fundamental ideas are always very simple and can often be illustrated perfectly well with calculations similar to those of shopkeepers.



The following notes are examples of this.

# Annex A

Or how to capture the law of evolution of the Universe in three lines of calculation.




Let us assimilate the Universe to a homogenous lump of dust with a radius R and a mass M. Let us consider a grain of dust of mass m on its surface.

We can show that the force exerted on this mass is the same as that produced by all the mass M concentrated in the centre O, that is to say $F = -GMm/R^2$

Let's apply the $\vec{F} = m\vec{\gamma}$ of mechanics.

That gives : $-mR'' = GMm/R^2$ where : $R''R^2 + GM = 0$

In other words the famous FRIEDMAN EQUATION.

Let's build one of three solutions to this differential equation.

Let's give for the function R(t) the form $at^b$ , where a and b are two constants yet to be determined.

$R = at^b$ then $R' = abt^{b-1}$ then $R'' = ab(b-1)t^{b-2}$

We put it in the equation and get: $b(b-1)a^3t^{3b-2} + GM = 0$ which should "work" whatever t is.

The only solution : The exposant of t must be nil, so $b = 2/3$ which gives $a = \sqrt[3]{9GM/2}$ and $R = \sqrt[3]{9GM/2}\, t^{2/3}$

R(t) is the characterisitc length of this universe, which could be compared to either its radius of curvature or the average distance between two particles.

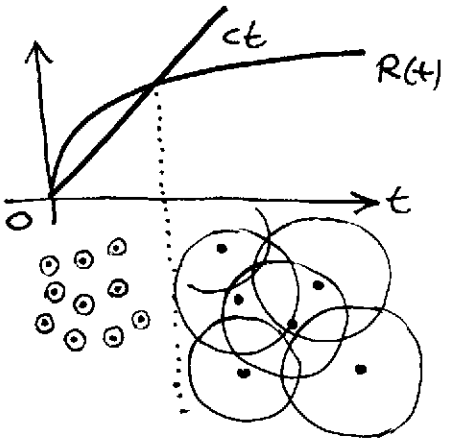
# Annex B

The autistic universe.

A glance at the curve R(t) shows that the expansion of the Universe began with an explosion, the speed of expansion gradually slowing from then on.

If we take R(t) as the average distance between two particles, ct represents the radius of the electromagnetic wave emitted at the instant t=0.

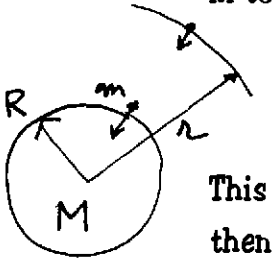
With a constant speed of light we see that the radius of this 'horizon sphere', or knowable sphere, will remain inferior to the average distance between particles for a certain time, and these particles will ignore each other totally during this period.




# Annex C

How to calculate the radius of a BLACK HOLE

Take a star with a radius R and a mass M with a mass m at its surface.
Let us suppose that this is a rocket. The energy that it can use cannot exceed $mc^2$, which represents its equivalent in energy.
Let's calculate the energy that must be expended to allow this mass m to escape the star's gravity.




The force is $F = -GMm/r^2$

The work is $-GMm/r^2\,dr$ where dr represents a small movement

The energy required is $E = -\int_R^\infty GMm/r^2\,dr = GMm/R$

This energy will exceed the maximum energy available if : $GMm/R > mc^2$
then $R < GM/c^2$ (Schwarzschild's Radius).

A more precise calculation, taking the reduction of mass into account, would give the exact value $R_s = 2GM/c^2$

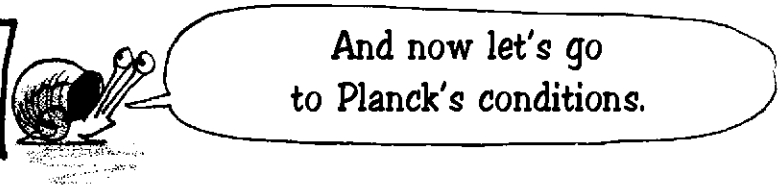
If a mass M is contained within its Schwarzchild Radius, no object will be able to leave it because the energy required is superior to $mc^2$.

The SCHWARZCHILD RADIUS of the Sun is 3.7 km.

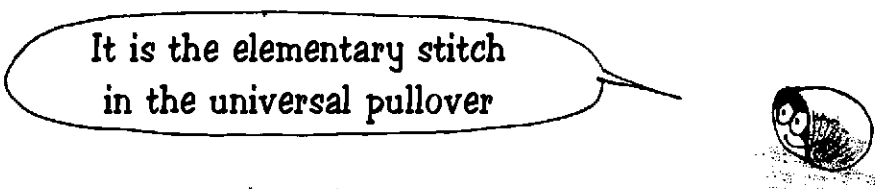
A photon has an energy hv.
It represents a quantity of matter equivalent to $m_\varphi = hv/c^2$
with which we can calculate its extraction energy : $-\int_R^{\infty} GMm_\varphi/r^2 dr = (GM/Rc^2)\ hv.$

The energy of a photon managing to leave the star is : $E' = hv(1 - GM/Rc^2) < hv$
Gravitational red shift phenomenon
If $R < GM/c^2$ , the star cannot emit light. It's a black hole.

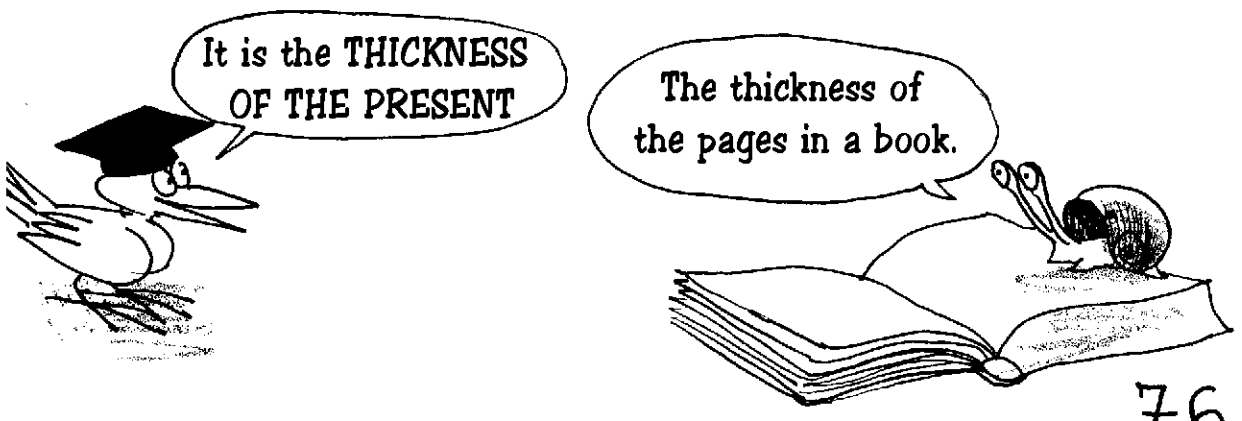
# Annex D




The spacial extension of a particle with mass m is given by the COMPTON length $\lambda_c = h/mc$.
Let us suppose that the particle is a black hole. Then this length $\lambda_c$ should be identical to the Schwarzchild radius, that is to say: $h/mc = Gm/c^2$ , which gives $m_p = \sqrt{hc/G}$, which equals $10^{-5}$ grams. No heavier particle can exist. Then its radius is
$h/mc = h/c\sqrt{G/hc}$ . That is $L_p = \sqrt{hG/c^3}$.
That's PLANCK'S LENGTH $1{,}610^{-33}$ cm. Nothing smaller can exist in the Universe



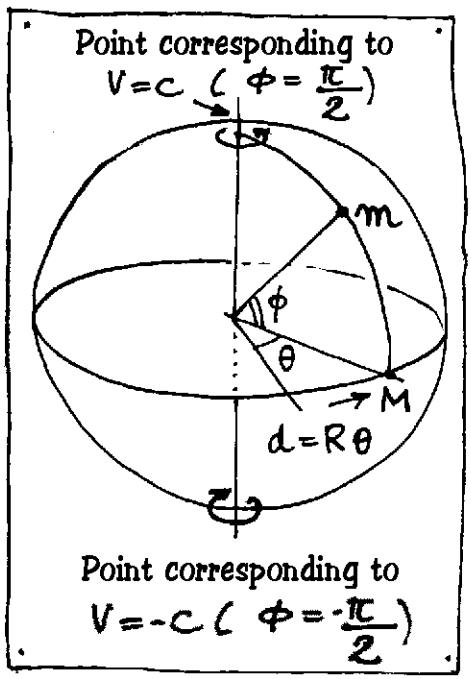

That is a photon with a wavelength of $\lambda = c/v$ . Its energy is $E = hc/\lambda$ and its equivalent mass $m_\varphi = E/c^2 = h/\lambda c$ . Its Schwarzchild radius is $R_S = Gm_\varphi/c^2 = Gh/\lambda c^3$ which is equal to its wavelength if $\lambda = \sqrt{Gh/c^3} = L_p$.
When a photon's wavelength is equal to its Schwarzchild radius it starts to go round and round like a dog trying to catch its tail and information can no longer circulate.
At that length we associate the time $t_p = L_p/c = 0{,}5410^{-43}$ seconds.



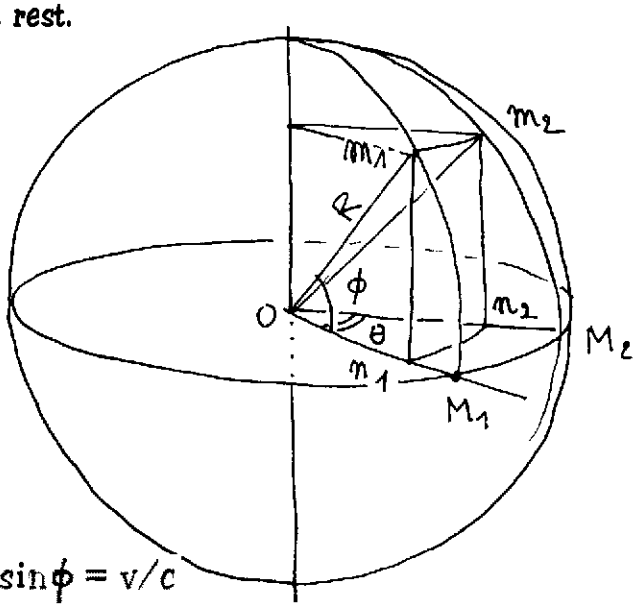
# ANNEX E

## THE RELATIVIST PHASE SPACE

It will be curved, both in its position and its speed. We will limit it to one position dimension and one speed dimension.
The position will be noted by the marker $\theta$ and the speed by the marker $\phi$.



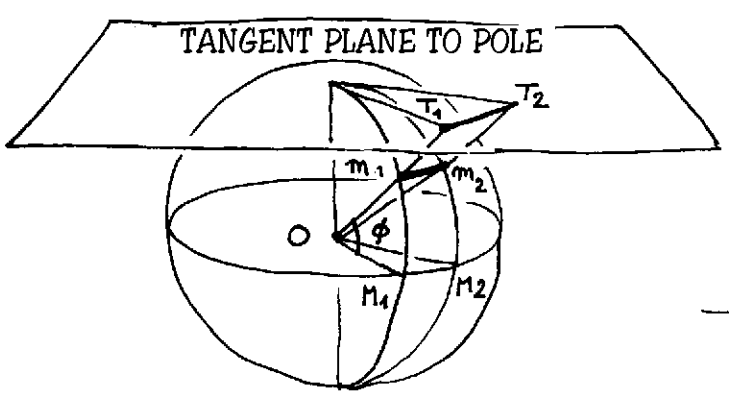

For an immobile observer the displacement of an object at speed V will be $d = R\theta$ and its speed will be linked to the angle $\phi$ by the relation $V = c \sin\phi$ .
For this observer the photons will encircle the poles following trajectories of zero length (See "Everything is relative").
That is $\widehat{M1M2} = R\theta$ in displacement, as seen by an observer at rest.



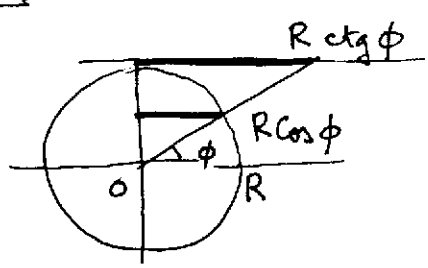

In the space phases the real displacement corresponds to the arc M1M2 which is projected in the equatorial plane according to the arc n1n2.
The segment $on_1 = R\,Cos\,\phi$
The arc $\widehat{n_1 n_2} = \overline{on_1}\,\theta$ as $\cos^2\phi + \sin^2\phi = 1$ and $\sin\phi = v/c$
We get:

$$\widehat{m_1 m_2} = \widehat{M_1 M_2}\sqrt{1 - v^2/c^2}$$

Which is none other than the famous LORENTZ CONTRACTION.
In the phase spaces time isn't a free variable. PROPER TIME is calculated.
It's proportional to the arc T1T2, projection of the arc m1m2 on the tangent plan at the pole.




$$t = \widehat{T_1 T_2}/c = (\theta R\,ctg\phi)/c$$



The speed V is the relation displacement/duration $\frac{\widehat{m_1 m_2}}{\widehat{T_1 T_2}} c$ then

$$V = c \frac{R \cos\phi \ \theta}{R \cot g \phi \ \theta} = c \sin\phi$$

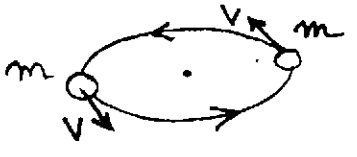
# ANNEX F

## SUPER-RELATIVITY

We "give their freedom" to all the "constants" of physics.
For example, G, the constant of gravity; h, the Planck constant; c, the speed of light, m the mass of the proton or neutron.
In the equation of general relativity, Einstein's constant $\chi = -8\pi G/c^2$ is an ABSOLUTE CONSTANT. Therefore $G \approx C$ ($\approx$ means "varies as")
We suppose that energy $mc^2$ is conserved through time, m being the particle's mass when at rest.

We suppose that the galaxies, the solar system, black holes, protons and neutrons "get bigger" at the same time as the Universe, whose perimeter is taken as equalling $2\pi R$
Let's write that the radius of a black hole (Schwarzchild's radius) increases as R and then $Gm/c^2 \approx R$, as $G/c^2 = cte$. then $\boxed{m \approx R}$.
As does $mc^2 = cte$

$Rc^2 = cte$ or $\boxed{c \approx \frac{1}{\sqrt{R}}}$ and $\boxed{G \approx \frac{1}{R}}$




Let us take two stars of the same mass orbiting around a centre of gravity according to a circular trajectory of radius r.
The centrifugal force is $mV^2/r$, and mutual gravitational attraction is $Gm^2/4r^2$
If r varies as R, then $Gm^2/R \approx mV^2/R$, from which $\boxed{V \approx 1/\sqrt{R}}$.
The relation $\beta = v/c$ is conserved with time, just as is energy $E = \frac{mc^2}{\sqrt{1 - v^2/c^2}}$

The spatial extension of the proton being given by its Compton length $h/mc \approx R$, we have:

$$\boxed{h \approx R^{3/2}}$$

The resolution of Einstein's equation, in supposing that the Universe is homogenous and isotropic (Roberts' or Walker's metric), leads to the differential equation :

$$\frac{2R''}{R} + \frac{R'^2}{R^2}(2+\beta^2) + \frac{kc^2}{R^2}(1+\beta^2) = 0$$

where $v = \beta c$ is the agitation speed of the galaxies in this "cosmological fluid".

In seeking a solution of the type $R = at^b$ we see that $\beta$ eliminates itself and that $k = -1$ gives a solution $\boxed{R \simeq t^{2/3}}$

k is the exponent of curvature

Therefore this universe has negative curvature (*)

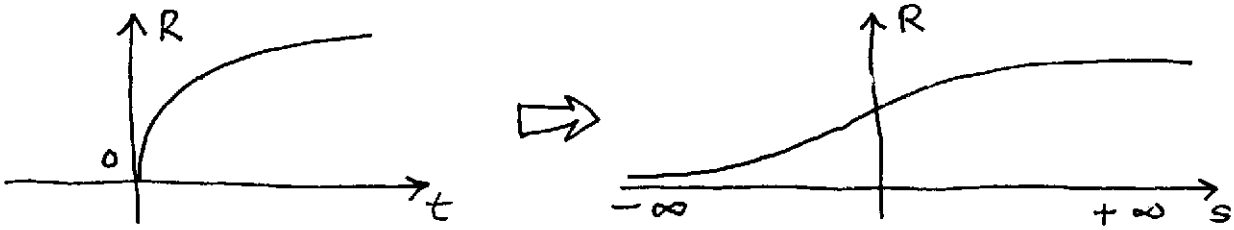
The cosmological horizon is defined by the integral $H = \int_0^t c(\tau)d\tau$

and we find $H \equiv R(t)$.

Therefore the homogenity of the universe is justified during every epoch

Entropy becomes $S \simeq \text{Log } t$

In a description where entropy replaces the variable time, the initial singularity quite simply disappears




All the equations of physics (Schrödinger, Maxwell, Boltzmann) are invariant by the transformations obtained.

We find that the RED SHIFT is proportional to the distance (Hubble's law).

Up to a few hundred million light years ago, the distances calculated for sources are almost identical to the distances of the classical model

It being supposed that the energy of photons hv is conserved (like all energies) as

$h \simeq t$ then $v \simeq 1/t$.

The red shift is no longer a consequence of the Doppler effect but proceeds from the secular drift of Planck's constant.

In 1988 Barthel and Millet ("Nature", vol.333, May 1988) showed that the further quasars were, the smaller they were. This fits in with the model where quasars "grow" with the Universe itself.

(*) See "The Geometricon" and "The Black Hole".


For the moment Archibald's model doesn't contradict any observed fact.
And it works rather better than the classical model for quasars.
And you Sophie, what do you think?
Archibald's model isn't complete. There are other constants linked to nuclear processes and we need to invent a way of making them vary in order to account for these phenomena, which are also part of cosmology.
Otherwise a contradiction will arise. And then, trouble!
He must be really worried...
You reckon?...